FRUIT TREE BIODIVERSITY, WISDOM, AND FACTORS AFFECTING CONSERVATION: A CASE STUDY OF FRUIT ORCHARDS IN SAMUTSONGKHRAM PROVINCE

DALIN PHUNBAMPHEN

A THESIS SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR
THE DEGREE OF MASTER OF SCIENCE
(TECHNOLOGY OF ENVIRONMENTAL MANAGEMENT)
FACULTY OF GRADUATE STUDIES
MAHIDOL UNIVERSITY
2011

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Miss Dalin Phunbamphen
Candidate

Lect. Kulvadee Kansuntisukmongkol,
Ph.D. (Ecology)
Major advisor

Asst. Prof. Piyakarn Teartisup,
Ph.D. (Forestry)
Co-advisor

Prof. Banchong Mahaisavariya,
M.D., Dip Thai Board of Orthopedics
Dean
Faculty of Graduate Studies
Mahidol University

Lect. Kanchana Nakhapakorn,
D.Tech. Sc. (Remote Sensing and
Geographic Information System)
Program Director
Master of Science Program in
Technology of Environmental Management
Faculty of Environment and Resource
Studies,
Mahidol University

Thesis
entitled

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for the degree of Master of Science (Technology of Environmental Management)
on
May 11, 2011

Miss Dalin Phunbamphen
Candidate

Asst. Prof. Somsak Sukwong, Ph.D.
Chair

Lect. Kulvadee Kansuntisukmongkol, Ph.D.
Member

Asst. Prof. Piyakarn Teartisup, Ph.D.
Member

Prof. Banchong Mahaisavariya, M.D., Dip Thai Board of Orthopedics
Dean
Faculty of Graduate Studies
Mahidol University

Asst. Prof. Sittipong Dilokwanich, Ph.D. (Human Geography)
Dean
Faculty of Environment and Resource Studies,
Mahidol University

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Dalin Phunbamphen

FRUIT TREE BIODIVERSITY, WISDOM, AND FACTORS AFFECTING CONSERVATION: A CASE STUDY OF FRUIT ORCHARDS IN SAMUT SONGKHRAM PROVINCE

DALIN PHUNBAMPHEN 4936851 ENTM/M

M.Sc. (TECHNOLOGY OF ENVIRONMENTAL MANAGEMENT)

THESIS ADVISORY COMMITTEE: KULVADEE KANSANTISUKMONGKOL, Ph.D., PIYAKARN TEARTISUP, Ph.D.

ABSTRACT

The aim of this thesis was to study the biodiversity of fruit trees in Samut Songkhram province, by surveying the number of species and varieties of fruit plants, and by studying the way of life and wisdom associated with growing fruit trees by the owners of the fruit orchards. Data were analyzed using Shannon-Wiener's Index, H, and Shannon-Wiener's Evenness Index, Eh, and conducting multiple regression to analyze the relationship between fruit tree biodiversity and household-level socio-economic factors, as well as attitudes of the orchard owners.

The study was conducted with a random sample of 390 households. A total of 33 families, 56 genera, 68 species and 282 varieties of fruit plants were found, of which is most were woody plants. More than 50 percent of the households have decided to grow coconut, followed by banana, mango, rose apple, jackfruit, pomelo and papaya. The average number of species of fruit trees grown by the owners of fruit orchards was 12.40 species and 16.96 varieties.

The factors significantly related to biodiversity of fruit trees ($p < .05$) included water zones, area of residency, educational levels, amount of savings, duration of time spent on managing orchards, orchard size, presence of promotional agencies, presence of younger generations, frequency of access to agricultural information, and owner attitudes. The attitudes included (1) attitudes towards growing fruit trees to earn more money, (2) attitudes towards growing fruit trees to conserve species and varieties of fruit trees, (3) attitudes towards better selection of varieties if taken by fruit orchard owners themselves, (4) attitudes towards local wisdom to be important to fruit orchard owners, (5) attitudes towards fruit orchard owning as an independent occupation, (6) attitudes towards professional pride in farming orchards, and (7) attitudes towards market price not affecting decision making to change species or varieties of fruit plants grown. These factors significantly accounted for 19%, 19%, 20% and 15% of the variation within the number of species, varieties, diversity and evenness of fruit plants that the orchard owners decided to grow in their own orchards.

The fruit orchard owners in the study area continue to maintain knowledge in orchard management by making ridges, using natural fertilizers, and employing other methods of how to take care of orchard farms by focusing on orchard owners themselves, consumers and the environment. The trend of modification among the main economic fruit species remains in the coconut, pomelo and lichee. This has been supported by governmental agencies. The local fruit which has not been economically important has dramatically declined in popularity, but has still gotten campaign support for planting from local scholars in the area. In addition, this refusal to change could be caused by a decrease in farming labor both inside and outside households, due to urbanization, industrialization, and tourism promotion in the area. To maintain the local ways of orchard farming in order to conserve biodiversity of fruit trees in the area, the residents and their descendents need to be aware of the value of their community and also their traditional occupations in Samut Songkhram province.

KEY WORDS: BIODIVERSITY / FRUIT / DIVERSITY INDEX

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ความหลากหลายทางชีวภาพของไม้ผล ภูมิปัญญา และปัจจัยที่มีผลต่อการเปลี่ยนแปลง: กรณีศึกษาสวนผลไม้จังหวัดสมุทรสงคราม
FRUIT TREE BIODIVERSITY, WISDOM, AND FACTORS AFFECTING CONSERVATION: A CASE STUDY OF FRUIT ORCHARDS IN SAMUT SONGKHRAM PROVINCE

ดาลิน พูนบำเพ็ญ 4936851 ENTM/M

วท.ม. (เทคโนโลยีการบริหารสิ่งแวดล้อม)

คณะกรรมการที่ปรึกษาวิทยานิพนธ์: กุลวดี แก่นสันติสุขมงคล, Ph.D., ปิยะกาญจน์ เทียธิทรัพย์, Ph.D.

บทคัดย่อ

วิทยานิพนธ์เล่มนี้มีวัตถุประสงค์ในการศึกษาความหลากหลายทางชีวภาพของไม้ผลในจังหวัดสมุทรสงคราม โดยสำรวจจำนวนสายพันธุ์ และจำนวนชนิดพันธุ์ของไม้ผล ศึกษาวิถีชีวิตและภูมิปัญญาการเพาะปลูกของชาวสวนผลไม้ วิเคราะห์ดัชนีความหลากหลาย (Shannon-Wiener's Index, H) และค่าความสม่ำเสมอของชนิดพันธุ์ (Shannon-Wiener's Evenness Index, Eh) และวิเคราะห์สมการถดถอยแบบพหุคูณ (Multiple Regression) ของความสัมพันธ์ของความหลากหลายทางชีวภาพของไม้ผลกับปัจจัยทางด้านเศรษฐกิจสังคมในระดับครัวเรือน และปัจจัยด้านทัศนคติที่เกี่ยวข้องจากเกษตรกร

จากการศึกษากลุ่มตัวอย่างเกษตรกรจำนวน 390 ครัวเรือน ไม้ผลที่พบมีจำนวนทั้งสิ้น 33 วงศ์ 56 สกุล 68 ชนิด และ 282 สายพันธุ์ ส่วนใหญ่อยู่ในกลุ่มพืชที่มีเนื้อไม้ (Woody plant) เกษตรกรมากกว่าร้อยละ 50 ของครัวเรือนทั้งหมดเลือกปลูกมะพร้าวมากที่สุด รองลงมาคือ กล้วย มะม่วง ชมพู่ ขนุน ส้มโอ และมะละกอ ส่วนจำนวนชนิดพันธุ์ และสายพันธุ์ไม้ผลที่เกษตรกรปลูกในครัวเรือนมีจำนวนเฉลี่ย 12.40 ชนิดพันธุ์ และ 16.96 สายพันธุ์

ปัจจัยที่มีความสัมพันธ์กับความหลากหลายทางชีวภาพของไม้ผลอย่างมีนัยสำคัญทางสถิติที่ระดับ 0.05 คือ เขตน้ำภูมิลำเนา ระดับการศึกษา เงินออม ระยะเวลาในการจัดการสวนผลไม้ ขนาดพื้นที่ หน่วยงานที่ส่งเสริม ผู้สืบทอด ความถี่ในการรับรู้ข้อมูลข่าวสารทางการเกษตร ด้านทัศนคติที่มีความสัมพันธ์ คือ 1) ทัศนคติเรื่องการปลูกไม้ผลเพราะรายได้ดี 2) ทัศนคติเรื่องปลูกไม้ผลเพื่อต้องการรักษาสายพันธุ์ และชนิดพันธุ์ของไม้ผลไว้ 3) ทัศนคติเรื่องการคัดเลือกสายพันธุ์จากเกษตรกรดีกว่านำมาจากที่อื่น 4) ทัศนคติเรื่องภูมิปัญญามีความสำคัญต่อเกษตรกร 5) ทัศนคติในเรื่องอาชีพทำสวนผลไม้เป็นอาชีพที่อิสระ 6) ทัศนคติเรื่องความภาคภูมิใจในอาชีพทำสวนผลไม้ และ 7) ทัศนคติเรื่องราคาตลาดไม่ทำให้เกษตรกรต้องปรับเปลี่ยนชนิดพันธุ์ไม้ผล ซึ่งปัจจัยดังกล่าวสามารถร่วมกันพยากรณ์จำนวนชนิดพันธุ์ จำนวนสายพันธุ์ ค่าความหลากหลาย และค่าความสม่ำเสมอของไม้ผลได้ร้อยละ 19, 19, 20 และ 15 ตามลำดับ

เกษตรกรในพื้นที่ศึกษายังคงรักษาภูมิปัญญาในการจัดการสวนแบบยกร่อง การให้ปุ๋ยตามธรรมชาติด้วยการโกยดิน และวิธีการดูแลอื่นๆ ที่ให้ความสำคัญต่อตนเอง ผู้บริโภค และสิ่งแวดล้อม แนวโน้มการปรับเปลี่ยนชนิดพันธุ์ไม้ผลหลักทางเศรษฐกิจยังคงอยู่ในกลุ่มของมะพร้าว ส้มโอ และลิ้นจี่ที่เป็นไม้ผลหลักในปัจจุบัน ซึ่งได้รับการสนับสนุนจากหน่วยงานของภาครัฐ ส่วนไม้ผลพื้นเมืองที่ไม่มีความสำคัญทางเศรษฐกิจนั้นมีแนวโน้มลดลง แต่ก็มีการรณรงค์การปลูกไม้ผลเหล่านี้ทดแทนจากปราชญ์ชาวบ้านซึ่งเป็นเกษตรกรในพื้นที่ หรือจากปัญหาแรงงานทั้งภายใน และภายนอกครัวเรือนที่ลดลงเนื่องจากลักษณะทางสังคมเมือง โรงงานอุตสาหกรรม และการท่องเที่ยวที่กระจายตัวเพิ่มขึ้นในปัจจุบัน มีการร่วมมือกันในการปลูกฝังให้เกษตรกร และลูกหลานรักถิ่นฐานบ้านเกิดรวมถึงอาชีพดั้งเดิม เพื่อให้สวน และภูมิปัญญาอยู่คู่กับจังหวัดสมุทรสงครามต่อไป

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CHAPTER I
INTRODUCTION

1.1 Significance and background of the study

Genetic diversity, species diversity and ecosystem diversity, which are considered as the principle elements of biodiversity, plays an important role in creating and balancing to soil, water, and global atmosphere. The emergence of such elements are all dependent on the cycle whose time is considered as the primary principle to mobilize the relationship among the organisms themselves who takes a different responsible taker upon the mechanical in adaptation and development to remain their life appropriately within their own residence in different levels of ecosystem. And also the human who is considered as one part of the cycle needs both direct and indirect fundamental basis to live his or her life. Due to the adaptation and the ability in rapid learning more than any other living thing, the increase of the population and the behavior of using the resources more excessively than to survive from both intentionally and unintentionally, nature of the crisis situation, increasing violence in the present Which is affected by the reduction of biodiversity.

The threat resulted from the human results in the changes to the environment that affect the loss of biodiversity. This can be seen from the loss rate which increases rapidly each year and is likely to rise in the future. The population growth has withdrawn other creatures, faster than the natural rate of up to 1,000 times (Department of Environmental Quality Promotion, 2009). Although many sciences have been evolved progressively, it cannot bring back the extinct plant. This can be the waves that affect chain of all ecosystems. Not only plant species in the forest, native plant species in agricultural areas is also facing the problem in the reduce number of plant species and then leads to the extinction of such plant. Due to the modification of the plant species, focusing on the final production in order to meet the needs of agriculturists, markets and consumers according to economic mechanism, these circumstances result in the contamination of chemical residues for increasing the

productivity of grown plant and the pesticide is a disturbing factor to the local plants. (Wisut Baimai, 1989, 1995; Somsak Sukwong, 1994; Sumontha Promboon and co., 1999)

The loss of biodiversity causes many countries including Thailand are aware of the disadvantages of this circumstance. The cooperation among the countries has been created from the relevant authorities and certified by the Convention on the biodiversity in terms of conservation management and coordination by means of the biodiversity, the establishment of legal, policy, strategies to support operations as well as the promotional campaign. The objective of this is to understand the importance and the conservation of unique native plant species in agriculture as well as the conventional wisdom that parallel to the agriculturists. (Yos Santasombat, 1999)

Fruit tree is another type of plant which is important by its taste and nutrients, resulting in its popularity. The fruit tree has been planted for both household consumption and economical purpose which also build the fame to Thailand. With a tropical climate, temperature and appropriate precipitation, the biodiversity of fruit tree is high and results in the shifting of fruit throughout the year. Songpol Somsri (2009) said the changes emerged causes the risk of extinction of typical fruit tree species in Thailand and the world. Therefore, the agriculturists are the important part of taking care of such fruit tree. If there is still no concern about this because the agriculturists believe that there is unworthy to do so, then the number of local varieties of fruit tree will decrease eventually and may be extinct in the near future.

Samut Songkhram is an area with terrain suitable for plantations of fruit in Thailand. The main fruit tree of this province is coconut, lychee and pomelo. With the wetlands with river and being called as "City of three river." is the area that belongs to salt water, brackish water and freshwater and possess up to 366 canals, benefiting to the culture of life and historic sites in the agriculture (Committee of documents and archival processing, 2001). Nowsday, most agriculturists lack the inherited age children who receive the education are likely to choose another career. Forwarding love and commitment in the orchard are decrease. Coupled with external factors in various aspects also affect the fruit tree species, and ecosystems of orchards; for example, the minimal amount of sugar coconut, a fruit tree that is famous in Samut Songkhram Province. According to the statistics of the Provincial Agriculture Office,

Samut Songkhram (2010) reported that the area planted sugar coconut in the year 2004 and year 2009 decreased from the year 2000 the percentage 57.47 and 79.23, which tends to decrease continuously in the future including the wisdom and ideas gained from the legendary ancestor is likely to decrease and lost as well

According to the importance as indicated, it allows the researcher to recognize the problems with interest in the study of biodiversity of fruit tree in Samut Songkhram Province. The survey has made with the varieties and species and ecosystems of fruit grown, intellectual life of the agriculturist including analysis of various factors involved in the species selection or abandon, the species in cultivation of the agriculturists in each area or ecosystems in order to benefit the conservation of species and varieties of fruit tree today.

1.2 Objectives

1. To study the varieties, species and ecosystems, agricultural varieties of fruits tree grown in the area of the study area

2. To study the life and intellectual cultivation of agriculturists, including patterns of plant selection and storage of fruit tree species in the study area

3. To analyze the factors affecting agriculturist household in the conservation of species and varieties of fruit tree

1.3 Research hypothesis

1. The male agriculturist posses the negative relationship with the diversity of the species of fruit tree.

2. The age of the agriculturist posses the negative relationship with the diversity of species and varieties of fruit tree.

3. The duration of time spent on living in the residence is positively correlated to the diversity of species and varieties of fruit tree.

4. The agriculturists who are possessed to the different original residences would possess the differences in the diversity of species and varieties of fruit tree.

5. The number of the members of the family showing the positive relationship with the diversity of the species of fruit tree.

6. The degree of the education of the agriculturist is positively correlated to the diversity of species and varieties of fruit tree.

7. The area of salty, brine and freshwater zone are correlated positively to the biodiversity of the varieties and species of fruit tree.

8. The size of individual fruit orchard is positively correlated to the diversity of species and varieties of fruit tree.

9. The number of manpower is positively correlated to the diversity of species and varieties of fruit tree.

10.Agriculture occupation is negatively correlated to the diversity of species and varieties of fruit tree.

11.The household income is positively correlated to the diversity of species and varieties of fruit tree.

12.Income from other occupations is negatively correlated to the diversity of species and varieties of fruit tree.

13.Household expenditure is negatively correlated to the diversity of species and varieties of fruit tree.

14.Savings are positively correlated to the diversity of species and varieties of fruit tree.

15.The duration of time agriculturists spend on managing the orchards are positively correlated to the diversity of species and varieties of fruit tree.

16.The agency that promotes agriculturists is positively correlated to the diversity of species and varieties of fruit tree.

17. The agriculturists possessing the descendant are correlated positively to the biodiversity of the varieties and species of fruit tree.

18.The frequency of information awareness of the agriculturists is correlated to the diversity of species and varieties of fruit tree.

19.The agriculturists have different attitudes which are related differently to species and varieties of fruit tree.

1.4 Research conceptual framework

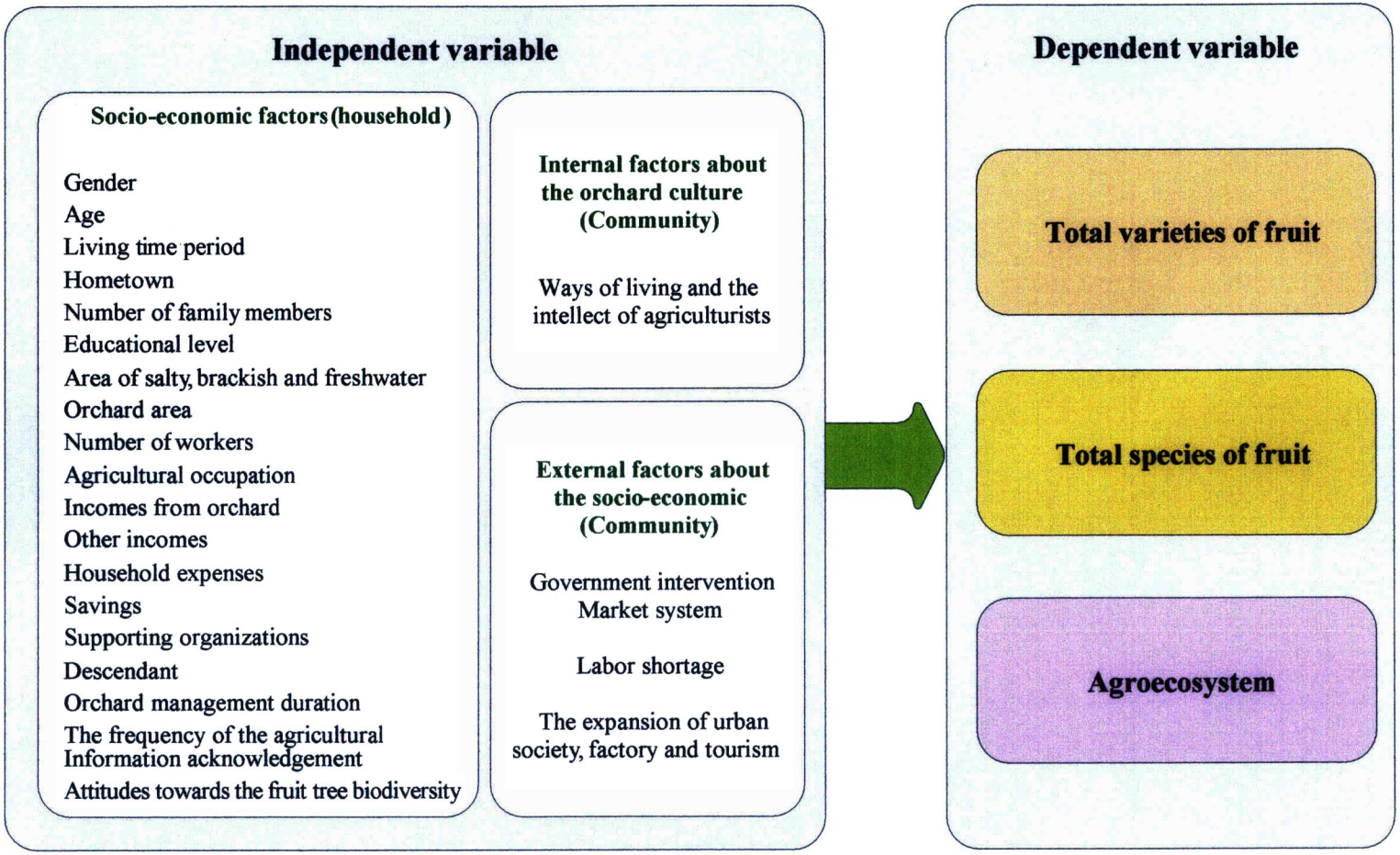


Figure 1.1 Research conceptual framework

1.5 Scope of research

1.5.1 Scope of the content

• The research was conducted to study the main issues related to biodiversity of the orchard. The study of fruit tree in this area will use the Morphological classification of the fruit to separate the different species.

• Study the ecosystem of fruit tree by the characteristics of the area which can be classified as:

1. By level of biodiversity means the division of the agricultural ecosystems that have a monoculture, multiculture and the production of the mixture of varieties and species of fruit tree

2. By ecosystem management by human means the characteristics of agriculture and management of the agriculturist to fit in the plant and landscape, such as a raised groove

3. By the landscape means the division made by the topography of the area, Samut Songkhram Province, such as freshwater, brackish water, saltwater zone

• The study of the characteristics of local culture associated with fruit growing methods divided into 4 levels of the study:

1. Food and drug
2. Production system and resource management
3. The customary beliefs, rituals and ways of operation
4. Way of thinking

• Study of the variables affecting the harvest or species abandon and fruit tree species per farming area or surrounded ecosystem

1.5.2 Scope of area and time

The research in accordance with the biodiversity of fruit tree was conducted in Samut Songkhram Province by considering the local people who are the agriculturist for a long term. Such area is comfortable with its geographical diversity, which is concluded with three different types of freshwater, brackish water and salty water zone. Here has gotten a large number of both natural canals and the canals that

local people dug up for agriculture and transportation. The local people focus on the wisdom that has long been inherited from the past for the appropriateness of the growing fruits tree, for the household consumption as well as for the growing of main fruits that are economically important to Samut Songkhram Province (Agriculture Office, Samut Songkhram Province, 2007)

The research study was conducted in the year of 2008 - 2011 by dividing the procedures of the step of the study according to the following table

Table 1.1 Duration of time in the research process

Procedure	Duration of time (Year/Month)															
	2008				2009				2010				2011			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
- Scope of issues	→															
- Literature review		→	→													
- Research design					→	→	→									
- Data collection from questionnaire									→							
- Preliminary analysis										→						
- Data collection from in-depth interviews And related information											→	→	→			
- Analysis of the total conclusion											→	→	→			
- Revised as appropriate	→	→	→	→	→	→	→	→	→	→	→	→	→	→		

1.5.3 Scope of the target population

The target subjects have been divided into 3 different types of group according to the researcher's criteria:

1. Fruit agriculturist
2. Agricultural specialist of the Office of Agriculture in subdistric
3. Local people involved in fruit agriculture

Within the society of the agriculturist there have many factors that are important to the indication of the production system pattern and preservation that possess mainly the household factors. Such factors include culture, life pattern and wisdom inherited from the ancestor which is still consistent with one another. Giving the value to the natural environment as a resource which is important to maintaining a

simple life and self-sufficiency appears as a management plan which is to deploy resources to manufacturing and supervising to meet production targets of the local. Changes are subject to change based on conditions and external factors such as economics, society, policy, political system, market system, labor system and attitude factors related to the biodiversity of fruit tree enhancement, causing of the increase or decrease of the biodiversity of the fruit tree by the promotions of various governmental institutions in terms of production technology, information or financing fund, which affect the manufacturing. This is an external intervention as well. From these factors, as a result of issues related to the diversity, variety and ecosystem fruit tree in the area of conducted area where still keeps conservation including potential changes in the future.

Table 1.2 The variables conducted in the study of fruit tree biodiversity

Dependent variable

Dependent variable	Unit of measurement	Scale of measurement
Diversity of fruit tree species	Species	Ratio
Diversity of fruit tree varieties	Varieties	Ratio
Diversity of fruit tree ecosystem	System	Ratio

Household socio-economic factors

Independent variable	Unit of measurement	Scale of measurement
Gender	(Female/Male)	Nominal
Age	Years	Ratio
Living time period	Years	Ratio
Hometown	(Inbound/Outbound)	Nominal
Number of family members	Person(s)	Ratio
Educational level	Year(s)	Ratio
Area of salty, brackish, and freshwater	(Salt/Brine/Fresh)	Nominal
Orchard area	Rai(s)	Ratio
Number of workers	Worker(s)	Ratio

Table 1.2 The variables conducted in the study of fruit tree biodiversity (cont.)

Household socio-economic factors

Independent variable	Unit of measurement	Scale of measurement
Agricultural occupation	(No/Yes)	Nominal
Incomes from orchard	Baht	Ratio
Other incomes	Baht	Ratio
Household expenses	Baht	Ratio
Savings	(No/Yes)	Nominal
Supporting organizations	(No/Yes)	Nominal
Descendant	(No/Yes)	Nominal
Orchard management duration	Year(s)	Ratio
The frequency of agricultural information acknowledgement	Frequency	Interval
Factors of attitudes towards fruit tree biodiversity	Scores of attitudes	Interval

1.6 Definition

Fruits have been defined as the production of breeding through sexual reproduction in which human, some fruits can be made as a dessert and the most such as never be made as a dish such as orange apple, banana, durian, and mango can have them uncooked. The research does not include the overlapped agriculture production between the vegetables and fruits such as tomato, lemon, etc.

Typical fruit implies the fruit trees in which has been planted for a long time and later been concluded as of both economical importance and non-economical important fruit types. With the ways of conservation of such fruits in the research, the agriculturists tend to not to plant the non-economical important ones, resulting in the continually decrease number of this type of local fruits.

Water zone and water system implies the area where assembly associates with salty, brine and fresh water, resulting from the support of up or low level of sea water relied on the influence of moon and season. The division has been made into salty water zone, brine water zone and freshwater zone.

Orchard means the area in which the fruit tree is grown and held as the conducted area of the research in the Samut Songkhram Province.

Fruit tree biodiversity represents a variety of species upon the diversity of ecosystems characterized by 1) the level of biodiversity 2) level of administration and management of human ecology 3) the topography in Samut Songkhram.

Agriculturist's community means community groups who hold the agriculture professionals alike, settle in the same local neighborhood and relate to each other by doing activities together in terms of ideologies, with the same generosity. "Community" as a case study includes the physical structure which is obviously seen such as a group of houses which possess the temple, being as the center of the community, schools and shops. Apparently, the temple can be considered as the center of the community, and the name of the temple is often called as the district community.

Life of the agriculturists means the scheme of life of the agriculturist in the agricultural community by geography based on society and culture in Samut Songkhram

Wisdom of the agriculturist means the local body of knowledge caused by the interaction between agriculturists and orchards in the style of learning to live together and solving the problems of life which are derived from the limitations of local resident in the area, ways of solving problems or the ways handling by this manner will be the accumulated knowledge and then transmitted to the descendants if method, knowledge or wisdom can respond to the conditions of their life and well-being of local people as well. (Kriangkrai Kietsiri, 2004)

1.7 Significance of the study

1. To acknowledge the number of species of fruit tree from the different ecosystems

2. To understand life forms and wisdoms inherited from ancestors to the agriculturist to grow fruit tree which possesses a combination of data or technologies that have been promoted by other institutions of the current scheme affecting to how the fruit tree grown in the area

3. To know both intrinsic and extrinsic variables related to the relationships in selection, conservation or abandon of species and variety in the ecological system of the fruit tree

CHAPTER II
LITERATURE REVIEW

Since the present research aims to study the fruit tree biodiversity in Samut Songkhram Province, it is therefore necessary to understand both overall diversity and specific diversity of fruit trees in aspects of meaning, significance, value, problems, and so on. This research also studies wisdom associated with the fruit tree biodiversity including relevant concepts and theories as detailed below:

2.1 Biodiversity

2.1.1 Meaning and types of biodiversity.

In an academic work, it is mentioned that biodiversity associates with various kinds of organism (species diversity); each kind of such organism has different genetic elements among species (genetic diversity), which leads to suitability to different habitats along a large number of diverse and complicated locations in the ecosystem (ecosystem diversity). Biodiversity possesses a great number of direct and indirect values to human-being. That is, both living and non-living things in numerous ecosystems, from small to large scale, are regarded dynamically-linked natural resources necessary to interdependence among human and any other organism to live together in a peace, balance, and sustainable manner (Wisut Baimai, 1995). Types of biodiversity are classified in three categories as follows:

2.1.1.1 Species diversity

Somsak Sukwong (1994) mentions that species diversity means such diversity of species prevailing in an area. The species diversity is classified: i.e., species richness which means the number of organisms per a particular area, and species evenness which means the proportion of organisms existing in such area. Accordingly, in the area of high biodiversity, various species of organism should

exist; each of which should be in a similar proportion. Whether the species diversity is high or not depends on appropriateness of location and landscape. For example, the number of species in an extremely cold area is much smaller than that of a warm zone or a tropical zone.

2.1.1.2 Genetic diversity

Genetic elements or genes are diversified among different kinds of organism. Moreover, the same kind of organisms may contain different genes among species. Such genetic diversity in organisms has resulted from evolutional adjustment and natural selection for so long time. The adjustment of such genetic-related elements associates with and corresponds to environments and habitats which dynamically change over time. This results in that an organism has gradually adapted itself for survival, avoidance of pests, and efficient resistivity to diseases. Such process is an essential base onto which various kinds of organism originate. The genetic diversity within population of species residing in various locations help enhance potentiality of such species to effectively and properly evolve for survival. For instances, wild plants or wild animals adapt themselves in accordance with their living conditions in different kinds of forest. Those plants possess varying good properties; thereby enabling propagation of such plant to improve varieties and enhance desired characteristics in next generations for those agricultural and economic plants: e.g., starches, vegetables, or fruits. Despite prevalence of various species, in some cases, agricultural selection and preservation is humanly performed so as to give rise only to a yield; thereby causing a decrease in genetic base of those agricultural plants and loss of genetic diversity.

2.1.1.3 Ecosystem diversity: ecosystem diversity is considered in three aspects (Somsak Sukwong, 1994) as follows:

1) Habitat diversity: each natural area consists of environmentally physical elements: i.e., air, soil, altitude, water, nutrients. For example, in the western forests of Thailand through which a primary waterway flows, many natural habitats are found: i.e., bodies of water, sandish lands, small branching waterways, forested swamps, banks of water, cliffs, caves, and several types of highland forest. Organisms originating and surviving in each of these areas well-adapt to its habitats and this results in different types of organism found; e.g., wild buffaloes

along a waterway, peacocks in a sandish land, mountain goats on a cliff, and bats inside a cave. Upon invaded by human activities, such habitats has been changed; for example, a large river is confined and become a huge lake after a dam has been constructed. This leads to a decrease of habitat diversity because organisms existing in such areas cannot adapt themselves to the dramatically changed environment. Some organisms live their own lives in many types of natural habitat. For example, a bison or a guar sometimes seeks for food either in a grassland, a sparse forest, or an evergreen forest, and their habitat varies depending on a season; a larva of insect initially lives in water and is therefore a major food source for fish, while in some stages of life cycle living on earth; some fish along a waterway sometimes eat wild fruits for their living, etc. Thus, forest destruction can be also considered demolition of food source for aquatic organisms. To maintain specific natural habitat diversity especially in a particular area so as to integrate such habitats as an adjacent one thereby increases the number of species.

2) Succession diversity: the process takes place once the ecosystem is developed into some extent, affected by some interference, or destroyed by various factors: e.g., storm, wildfire, and flood. This thereby influences the ecosystem in a particular area to be lost. The nature then generates ecological succession of new species to replace the prior ones depending on fundamental factors of areas in such ecosystem, which contribute to existence: e.g., food, moisture, and temperature. The incidence of social succession is called secondary succession. Once a forest destructs and develops into an empty area, some pioneer plants such as foxtail grass initially originate, and some other overgrown shrubs and soft woods such as "Krathum Nam" (*Mitragyna diversifolia*), "Por Hu Chang" (*Pterospermum acerifolium* Willd), bitter bush, large-leaved lantana, wild banana, and vine subsequently emerge. Besides, some animals emerge or migrate into a new land based on their suitability. This is resulted from growth and development into an abundant forest when the ecosystem of such area is not infested, endangered, or destroyed with respect to natural cycle. Among emerging species, they have to adapt themselves for survival along with developmental stages of the ecosystem. Accordingly, the changes arisen from continuous succession of organisms over time result to diversity of habitats so as

to form the chain of relationships in the social ecosystem; thereby leading to an overview of biodiversity.

3) Landscape diversity: morphologies of the earth crust in each area are different in their pattern: hill, valley, mountain, plain, plateau, etc. Each type of the earth crust is landform; while landscape is integration of landform into one total unit of a particular area. Living and non-living things in each landscape are consequently different depending on factors such as air, soil, altitude, and ground. In addition, many natural vegetations and animals are particularly unique to such region. Therefore, if an area consists of diverse landscapes or topographies, such area possesses high biodiversity. For instances, in the area consisting of mountain, river, swamp, mangrove forest, sea, plain, and plateau, there is higher diversity of species than that of single topography. For another example, in the area consisting of only a mangrove forest, some species residing on the mountain or in the waterfall is not found. This principle is important in blocking up some areas for conservation; such as in the Kao Sam Roi Yot National Park of Prachuap Khiri Khan Province, etc.

Thus, natural diversity on the earth consists of all abovementioned elements: diversity of species, genes, and ecosystems; wherein whether such ecological diversity is high or low is influenced by diversity of habitats, successions, and landscapes. It is necessary for us to study an associated link among factors in several aspects which naturally overlap or suppress one another. These also are ecological structures with different biodiversity depending on appropriateness of overall factors associated with such area as well as time which is an important factor to construct dynamics parallel to other factors in order to continue in a progressive or regressive manner by which human itself is also a part in such dynamic process of biodiversity.

2.1.2 Significance of biodiversity

2.1.2.1 Types of economic value of biodiversity

In economics, an economic value of biodiversity is human satisfaction on a particular biological resource. Such satisfaction results from consumption of resources or "use value" and non-consumption of resources or "non-use value" (Sumontha Promboon et. al., 1999) according to these following details:

- **Value from the use of resources of biodiversity:** the value of different consumption such as the use as food sources, pharmaceuticals, and construction materials. This includes the use for aesthetic benefits, and the use as an origin of rivers or streams. Such use value can be classified into 3 types:

1) Direct use value refers to the biological resources directly used by human or being fundamental factors necessary to living both for utilization and consumption: e.g., collecting forest products for use, hunting animals for food or sports, breeding plants or animals for sale, or utilizing resources for industrial benefits such as wood, processed wood, and household handicrafts, etc.

2) Indirect use value refers to the value arisen from co-existence of various species; wherein a type of species serves to support other species that human can directly utilize. For example, some birds and bats assist in pollen conjugation of the plants that human consumes. The ecosystem also gives indirect values to human because it is a habitat of plant varieties and animal varieties which human can directly utilize. In addition, integrity of biodiversity influences atmospheric balance on the earth and is a preventive shield from natural disasters.

Various types of biological resources are directly and indirectly useful to human. For example, human directly utilizes honey for consumption while bees are indirectly useful for assisting in conjugation of plant pollens; human directly uses an earthworm as a prey in fishing, while such earthworm and several kinds of invertebrate indirectly make loose soil, help improve soil quality, and assist in decomposition of humus and carcass so as to enhance wild plant growth. For another example, domestic forests are directly useful to human in wood utilization, forest product collection for use as herbs, genetic sources for plants, animal hunts for sports and food, recreation, and travelling. In a meanwhile, forests also provide indirect usefulness for human in being habitats of living things, serving to conserve soil and retain water, controlling flood, maintaining seasonal cycles, and reducing the amount of carbon dioxide in air, etc.

3) Option value refers to the value of biological resources where human still does not appreciate their benefits, or still does not apparently envision such benefits, and then preserves such resources until their benefits are more clearly seen in the future. It is evaluated that plants along an equator zone contain

chemicals capable of curing severe diseases such as AIDS and cancers. Accordingly, conservation of biodiversity in equator zones is necessary for further study.

- **Value from preservation of biodiversity:** the value of biodiversity which human still does not exploit. Such value is categorized in two types:

1) Bequest value refers to the value of diversity which human of current generation appreciates and makes use thereof. Thus, such resources are preserved in a complete manner so that the next generations also have an opportunity to utilize such biological resources for ensuring their survival and acquiring their happiness as same as those of this generation do.

2) Existence value It is regarded that existence is value of living thing originating as a part of society, with its own value, and capable of independently surviving in the world as human do.

Wisut Baimai (1992) mentions that biodiversity according to evolution of emerging organisms is important for learning and studying histories or mechanisms of each organism in each area. However, in context of economy and society, having no understanding and being unknowing of such aspects causes no ability to evaluate value of such things. In contrast, a thinking process of naturalist places importance on all emerging organisms based on a degree of utilization thereof. In addition, biodiversity is essentially important to living (Wisut Baimai, 1995). Four requisites: i.e., aliments, wearing apparels, dwellings, and pharmaceuticals, are all essential factors for human existence and yielded from biodiversity of the nature. Integrity of such biodiversity influences atmosphere of the earth and prevents natural disasters. The use of resources according to living results to understanding in its structures, realization that human is a part of the nature, and learning of relationships between origination and utilization of major resources in a corresponding, balance, and suitable manner. The study concerning the nature leads to development and integration of natural utilization into folk wisdom in a creative, collective, and successive manner from generation to generation. The study is also unique local knowledge and intellect, subsequently results to diversity of native cultures and traditions among folks, and then leads to diversity of ethnics in all areas of the earth.

2.2.2.1 Economic advantages of biodiversity

Sumontha Promboon et. al. (1999) divides economic advantages based on types of biodiversity as follows:

- **Economic advantages of species diversity:** human makes use of species directly from cultivated species and wild species. Economically, economic advantages of species are classified in two aspects:

1) Serviceability: utilization of species in research, education, travelling, and recreation, etc.

2) Merchandisibility: i.e., utilization of biological resources in consumption and raw materials for production. Those biological resources are derived from agriculture, forestry, and collection of wild products; examples of which are rattans, bamboos, dammars, rubbers, herbs, spices, crops, industrial and edible insects, scented wood, barks, tannin, natural colors, palm leaves, tea leaves, sedges, brooms, etc.

- **Economic advantages of genetic diversity:** the apparent advantages of genetic diversity are utilization as food sources, fiber sources, and drugs. Moreover, genes are used for enhancing plant varieties or animal varieties by introducing state-of-the-art biotechnology into modification and transfer of genetic elements to same species or different species. A study was established on chemical generation of plants for self-protection so as to be used as insect trappers or repellents, and the use thereof for insecticides, perfumes, and pharmaceuticals; wherein, at this present, active ingredients of such pharmaceuticals are chemical compounds derived from plants or synthesized from other mimic substances of such chemical compounds derived from plants.

- **Economic advantages of ecosystem diversity:** biodiversity in aspect of ecosystem diversity plays an important role in environmental support, social security, and human welfare. Economically, ecosystem diversity cannot be totally evaluated in cash, but the most apparent advantages of ecosystem are, for example, being tourist attractions, assisting in diet circulation, balancing seasonal changes, collecting food and retaining water, being habitats of various species, assisting in filtration of air and existing pollution, and contributing to optimal atmosphere on earth for survival of all organisms including human. Therefore,

cooperatively-functioning diverse ecosystems assist one another in order to create maximum benefits based on regional appropriateness.

However, Sumontha Promboon et. al. (1999) states that biodiversity is complicated and difficult to evaluate its systematic economic value in a comprehensive manner. For example, in case of evaluation on a price of plant variety in marketplace, it is often evaluated only from cost and consumer requirements excluding opportunity costs for fresh air yielded by such plant, carbon dioxide gas fixed by it, the amount of its transpiration which causes seasonal change, its shade and coolness as a shelter, its creation of food source for living things, its leaves and branches as a habitat and food source for microorganisms, its decomposition into fertilizer which returns to other plants, etc. In view of a capitalist, these physical and biological values are not included in a selling price of such plant. Consequently, the total economic value of biodiversity is still not the total environmental value.

A focus on biodiversity is important because, once a problem on biodiversity arises, it is a problem for everyone. Many problems arisen from changes on habitats in original ecosystem are caused by human activities from land exploitation, segmentation and downsizing of the ecosystem, and introduction of alien plants into the ecosystem causing climate changes. These factors cause impacts on ecosystem balance, and directly affect the poor and those who live in proximity of such ecosystem at first. That is because those local people have no opportunity and power in seeking for other substituted things. A way to maintain biodiversity is to integrate sustainable utilization of biodiversity into other relevant sections as necessary as possible, and to foster people to acknowledge this significance in order to motivate conservation (Office of Environmental Policy and Planning, 2006).

2.1.3 Factors influencing conservation of biodiversity

Somsak Sukwong (1994: 63) mentions about factors influencing conservation of biodiversity that there are many factors reduce the biodiversity as abovementioned. If a type of diversity decreases, it also decreases another type of diversity; for example, if genetic diversity decreases, it also causes species diversity to decrease in turn.

2.1.3.1 Over-hunting, over-acquisition, or over-deforestation is factors causing decrease in biodiversity. The minimum number of population has to survive in order to be existent; wherein many factors determine the optimal minimum size of population: e.g., genetic diversity, birth rate, death rate, migration, environmental variance, and probability of natural disasters or human threats.

2.1.3.2 Downsizing or segregation of natural habitat into small parts or areas, or destruction of natural habitats causes decrease in habitat diversity. For example, not building of a dam only causes a forest along a bank of waterway to be destroyed, but building of a reservoir of several kilometers long also separates a land into segments. Therefore, natural habitat should be of large size enough for the population of organisms to be viable.

2.1.3.3 Use of chemicals, e.g., insecticide, pesticide, not only directly damages organisms but this also destroys ground covers. That is, absence of such ground covers causes more erosion to the ground and also demolishes insects assisting in conjugation plant pollens.

2.1.3.4 Immigration of alien organisms, either plants or animals, causes decrease in genetic diversity and species diversity. Such impact is severe in an insular topography; for example, introduction of dogs, cats, mice, goats, and sheep can cause extinction of some birds, introduction of alien plants causes domestic birds, insects, and mammals to have no habitats, growing a single type of industrial crop cause decrease in the number of original organisms, etc.

2.1.3.5 Environmental pollutions, e.g. use of Dichloro Diphenyl Trichloroethane or DDT, not only demolish microorganisms in soils and kill insects, but these also affect other organisms along a food chain such as birds.

Moreover, changes on the earth temperature predicted of 1-3 degrees Celsius higher in the next century will be able to increase a sea level by 1-2 meters, cause some islands to sink, alter some conservation zones, and thereby affect biodiversity.

2.1.4 Issues and threats of biodiversity in Thailand

Based on assessment of natural and environmental resources of Thailand, it is found that abundance of such resources, which originally used to be a strength of

Thailand, is now affected by development plans focusing on exploitation of resources mainly for satisfying economic growth; thereby causing the use of resources without any limitations considered. Besides, it is also affected by expansion of economic sector and relocation of industrial production base which causes high pollution. Liberalization of trade and investment as well as consumption behaviors with respect to materialism result to increase in the amount of pollution and waste, affect the environment, and lead to problematic natural and environmental situations. Forest areas have been ruined by 67 million rais during 40 years. Nowadays, the forest areas remain only 33 percent of country land; less than countries in Asia, and lower than the standard of at least 40 percent which is considered a level where ecologic balance can be maintained. Continuous loss of forest areas causes high incidences of serious flood, drought, and natural disasters, deterioration of soil resources, and decrease in soil abundance; while requirements for agricultural areas increase. This thereby causes higher use of chemicals; leading to issues concerning chemical residues. Furthermore, plenty of marine and coastal resources are also decreasing, a birth rate of aquatic animals decreases by 3 times, mangrove forests decrease from 2 million rais to only 1.5 million rais, coral sources decrease by 50 percent, and 30 percent of seagrasses become deteriorated. As a result, resources of biodiversity are rapidly destroyed mainly by human activities affecting habitats of various organisms and influence ecological changes. This thereby increases the number of almost extinct organisms. A list of nearly extinct items contains 684 species of plants and animals (Somchai Ratanachuesakul, 2008)

Upon literature review on biodiversity in overview, the researcher realizes that biodiversity is dynamic and linked among 3 components (species diversity, genetic diversity, and ecosystem diversity) which are the most important concepts for understanding a current state of changes into agricultural ecosystem diversity. That is because an agricultural ecosystem is similar to a natural ecosystem in that both are composed of those associated dynamic elements of genes, species, and ecosystem. Besides, the agricultural ecosystem is outstanding in conservation and selection of varieties for agriculturists; which is a feature that natural ecosystem does not provide. Agriculturists in the past have experienced in solving problems and understood the

nature of selection. They then have developed such knowledge for so long time in growing plants so as to obtain enough yields for living in a society.

2.2 Biodiversity and agricultural ecosystem

2.2.1 Meaning, current situations, and classification of agricultural ecosystem

Agriculture is a fundamental occupation for Thai people because natural ecosystems of Thailand are appropriate. Several aspects of biodiversity are therefore significant for agricultural systems; together with complicated living in relations with cultivation system, social system, and natural ecosystem. Agricultural areas in Thailand consist of diverse ecosystems supported by fundamental natural resources of the country. These elements of biodiversity ecologically function as necessary for existence of human-beings. Biodiversity generates production bases and processes of important roles and functions in agricultural system. High species diversities of plants, animals, and microorganisms are necessary for subsistence of production and sustainability of cultivated plants, livestock, and aquatic animals. Food stability in the future depends on control and support of agricultural biodiversity and various existing roles in agricultural areas. Issues arisen from adjustment of agricultural land into city or results of urbanization causing changes in some elements, methods, and structures of agricultural areas lead to loss of organisms, both plants and animals, from chemical uses. Losses of genetic diversity within or among species of plants or animals utilized in cultivation onto agricultural areas generally have some associations with one another. It is thus important to properly understand and recognize conservation methods under production systems in a long term (Program for Biodiversity Research and Training, 2007).

Roles of biodiversity in agricultural ecosystem of Thailand are classified based on types of utilization or wāys of human living; i.e., the use as income source, food source, appliances, pharmaceuticals, aesthetic value, and source of useful insects, as well as source of social and cultural value. An area of agricultural biodiversity, beside a land for growing plants and feeding animals, also covers a water source for

utilization, an area in which natural or cultivated plants grow, and a less utilized area, such as earthen dyke, ridge, and roadside. According to program for biodiversity research and training, ecological characteristics of agricultural areas in Thailand are classified into 5 types based on different levels of biodiversity in agricultural area, physical variation, and management: i.e., (1) water ecosystem, (2) earthen dyke including roadside, trees, and groves, (3) residential area, (4) planting area, and (5) empty area.

Chanuan Rattanawaraha (2009) defines agricultural ecosystem as "*A system where plants, animals, fishery, and forestry are generated by human in natural environments so as to obtain basic requisites for survival, exchange, and trade. Elements of the system consist of both living things: i.e., humans, animals; and plants, and non-living things: i.e., soil, water, air, and sun, which were natural environments. The system includes factors of direct and indirect influences: i.e., technology, economy, society, tradition, and politics. All of these things have interactions with one another; thereby creating an agricultural ecosystem*"

Based on area size, agricultural ecosystems are classified from smaller areas; i.e., household agricultural area, to larger areas in the size of village, subdistrict, district, province, region, country, country group, and world; wherein each level has both direct and indirect relationships with one another in physical, biological, economic, social, and political manners. Capability in communication technology is a significant factor influencing trade, politics, and international economy; which in turn causes agricultural production system in every level of agricultural ecosystems from the smallest to the biggest ones to affect one another. For example, crop prices at some countries would influence those at other countries. Such influence causes the production system to depend on higher yields for obtaining worthwhile profits from investment. This would be a continuous effect to production system to which any one of technologies would be implemented so as to increase yields in each procedure; in order to respond to market and investment condition with yield quantities. This cycle naturally affects more to detailed elements of agricultural ecosystem in aspect of useful animal and plant in farm, field, and plantation; which in turn affects back to human in aspect of long-term food instability and unsustainable ecosystem.

The biodiversity division, office of natural resources and environmental policy and planning (2005) not only gives a slightly different detail of agricultural ecosystem but also another dimension of idea: i.e., "*Agricultural ecosystem is an ecosystem comprising of living communities and non-living surrounding factors; wherein various organisms live together and possess their variations depending on such surrounding factors. To perform farming, whether technological or traditional one, can cause interactions among associated elements which can negatively affect agriculture and biodiversity.*" A structure of agricultural ecosystem is not complicated nor highly diverse. However, the agricultural ecosystem dynamically changes due to farmer's activities causing nutrition loss from the cultivated area unless fertilizer is added for soil abundance. As a result, the system is subsequently lost, and no agricultural ecosystem is self-sustainable. Agricultural ecosystems in Thailand can be categorized as follows:

1. Mobile plantation system: located along a high mountain. Agriculturalists dynamically migrate from/to their cultivated areas. Currently, the total areas are approximately 25 million rais.

2. Rain-fed agricultural system: based merely on rainwater. Rainwater variation causes the system to change. Currently, the total areas cover major agricultural areas of the country; i.e., approximately 112 million rais.

3. Irrigation-based agricultural system: a system developed to obtain efficient yields. Total areas are approximately 36 million rais.

All three agricultural ecosystems possess biodiversities in aspect of plants, animals, and microorganisms. Plants in agricultural ecosystem are farm plants, vegetables, and garden plants, which are genetically modified and utilized in limited varieties; thereby causing reduced biodiversity. Animals include domestic animals, wild animals, aquatic animals, terrestrial animals, coastal animals, soil faunas, and pest-controlling animals. Microorganisms in soil are, for example, fungi, etc. Agricultural microorganisms used for producing biological fertilizers and controlling pests are; e.g., green molds, etc.

2.2.2 Adaptation of natural ecology principle onto production in agricultural ecosystem

Adjustment of agricultural ecosystem to depend on nature requires natural knowledge in a manner that it depends on, relies on, and interact with each other according to real natural forest. Regarding agricultural system management in which multi-diversities support and regulate one another, Chanuan Rattanawaraha (2009) provides its details as follows:

1) Advantages of diversification: diversification of living things in agricultural ecosystem so as to be similar to natural ecosystems provides these following advantages:

1.1 Prevention against pest breakout: based on several researches, single plant cultivation greatly causes breakout of pests and this issue cannot be avoided. Use of chemicals gives an opportunity for the pests to spread out more. Diversity in terms of plants and animals in the ecosystem leads to achieve species diversity and such sufficient amount of natural enemies that it promotes biological prevention against pests. Accordingly, several kinds of plant have to be cultivated in the system. Different stages and characteristics of plant are habitats and food sources for such natural pest insect enemies to increase in their species and quantities in an appropriate and continuous manner. Therefore, adjustment of ecological conditions to possess appropriate complexity would be an efficient tool in prevention against pests as well as causing stability and sustainability.

1.2 Soil enhancement: diversity leads to mutualism in plant community. Agriculturalists can choose farming major industrial crops, as desired, together with other industrial crops such as pea ground-covering peas or shade-based plants; e.g., cocoa, coffee, or tea. As well as in fruit tree plantation, various plants which are harmonious with one another can be grown together; examples of which are longkong, mangosteen, rambutan, herb, and ground-covering pea. Such integrated plantation results in high yields, continuous income, and enhanced soil due to organic matters and nitrogen fixation by ground-covering peas. Not only peas are cultivated for covering the ground, but some weeds can also be grown for such purpose; thereby enhancing soil moisture, decomposing into organic fertilizer for primary plants,

adhering soil onto the land for prevention against topsoil collapse, as well as being a habitat of animals contributing to elimination of pest insects.

1.3 Income stabilization and environmental sustainability: the diversity in which both plants and animals are appropriately involved in accordance with natural principles has mutual interaction. Agriculturalists should understand natural cycles so that they can utilize such diversity, equalize agricultural ecosystem to its balance, and increase yields. These cycles drive valuable resources in the system, reduce costs, and increase agriculturalist income.

1.4 Creation of shades: within agriculture of same diversity as in nature are shades and sustainability. That is, any agriculturalist growing perennial fruits in an adequate proportion to requirement contributes to being more shady and moist in the area. In overall of the country, if every farm and field of agriculturalists is grown of more perennial plants, there will be more green lands in Thailand.

1.5 Life quality improvement: diversity helps agriculturalists have improved quality of life because the harvested yields are adequate to initial household consumption and mutual diversity leads to higher yields for trade. Accordingly, agriculturalists always have regular income throughout the year, and they are never affected by market price decrease of agricultural yield because of other substituted yield; enabling security for agriculturalists.

2) Advantages of natural selection: at present, although many varieties of plant, animal, fish, etc., are substantially improved, some problems regarding the improved varieties still occur upon their cultivation in a farm or field of agriculturalists with varying environments in each locality. Besides varying yields in both quantity and quality, those chosen varieties are often susceptible to diseases, insects, and other enemies in each cultivated location. Therefore, if agriculturalists in each locality re-select the chosen varieties to grow in their own field or farm according to the principle of natural selection, they will found that their varieties are varying after such reselection in each locality. This thereby results in suitability and tolerability to environments, diseases, and pests. Upon this method of variety selection, Thai agriculturalists have been performing such selection for long time until they obtain the varieties which are suitable to their topography, tolerable to diseases and insects, as well as economical in variety costs. However, agriculturalists in the

past had selected some varieties since ancient times until they obtained those of plant and animal of good quality, quantity, and characteristics for each locality. It is unfortunate that such varieties are neglected at this present time.

3) Utilization of interaction principle in ecosystem: according to natural principle, every unit of organisms living in any ecosystem cannot live alone without interaction with any other one in the same ecosystem. Such interaction may be in the form of direct interaction, indirect interaction, symbiosis, antagonist, and food chain; all of which interact with one another. As same as agricultural ecosystem, organisms that human cultivates and breeds for growing into consumable yields or for trade have interaction with one another in the same ecosystem. In this regard, it must be understood that organisms collectively include those cultivated by human along with others already living in nature; such as soil microorganisms, weeds, pest insects, natural pest insect enemies, etc. These organisms inevitably interact with such plants and animals cultivated by human for the resulting yields. Therefore, in any agricultural ecosystem, human has to study and understand natural environments in which organisms are cultivated to grow. Humans often exploit nature for their own benefits; thereby drastically causing direct and indirect impacts to human and they are hard to solve. For example, use of chemical insecticide causes population of pest insect enemies to decrease, and thereby gives an opportunity to pest insects, both previously existing and newly existing, to dramatically increase. As a result, agriculturalists need to take actions from using more chemical insecticides to subsequently altering to new types of chemical. Consequently, these finally lead to adverse effects to human of both users and consumers. Accordingly, it is considered that living together in a diverse and secure manner can be promoted and supported to one another. The diversity interactions are divided in 2 types as detailed below:

3.1 Symbiotic interaction

- Plant-plant interaction: for example, beans help nitrogen fixation to other plant species; perennial plants provide shade and habitat to natural pest insect enemies, etc.
- Symbiotic interaction among plants, animals, and fisheries: for example, plant remains become food for fish; perennial plants are wind shields for animals; herbs are medicaments for animals, etc.

3.2 Antagonistic interaction

- Plant-plant competitive interaction: for example, eucalyptus trees scramble for water and nutrients from farm plants and rice grown together; thereby causing yield decrease, etc.
- Antagonistic interaction among plants, animals, and fisheries: for example, raising too many animals results in decrease of natural and cultivated plants; animal droppings result in water pollution, result to epidemics, and lead to other results, etc.

According to literature review regarding biodiversity and agricultural ecosystem, this leads to understanding of natural characteristics within agricultural ecosystem, overview of past situations, and consideration of drawbacks due to changes of traditional methods and patterns of management so as to only respond to requirement of market system for producing a huge amount of yields; e.g., growing single plants in large area, or raising such many animals that the number of which is much farther than natural balance. The particular diversity being emphasized at this present is an agricultural ecosystem wherein, besides there are not only complicated correlation within system, symbiosis for mutual benefits wherein agriculturalists are administrators in every procedure, and emphasis on variety selection in order to be appropriate to area conditions as performed by such agriculturalists themselves, it is also necessary to link their relations and go back to study ancient wisdom for cultivation details in an agricultural ecosystem within their own area so as to understand management reasons, for example, in variety selection; or else, study from the rest literatures in the field of cultivation management according to topography with recognition of successive natural changes, as well as integrate technologies into suitable implementation for the sake of long-term benefit and security.

2.3 Fruit tree biodiversity and issues

Fruits have been relevant to Thai people of every age so far and now become economic importance from community to country level. This importance enables fruits to make a large amount of revenues to the country. In addition, fruit

requirement is more and more desirable as function of the number of population which continuously increases. Thailand, from its northern to southern, contains different landscapes, soil, water, and air, which are suitable to production of various kinds of fruit. Such production varies depending on seasons and area conditions; thereby enabling to have various kinds of fruit launched to the market throughout the year. Furthermore, some fruit trees can be available all year long.

Somsak Sukwong (1994: 62) states that Thailand is a source of world important fruits; e.g. jackfruits (*Artocarpus heterophyllus* Lam.), Champedak (A. integer), some wild jackfruits of total 45 species in the far east; oranges (Citrus) having the same amount of species; durians (*Durio zibethinus* L.) having 5 original species, i.e., Thurian don, Thurian Nok, and wild durians; wild rose apples (Eugenia aquaea) Malay rose apples (*Eugenia malaccensis*); and various kinds of black plum having edible fruits of almost 50 species, black plums in Melesia regions of 700 species; mangosteens (*Garcinia mangostana*); gamboges (G. atrovirdis);cowa (G. cowa) of up to 23 species while in this genus having approximately 200 species in total; Langsat (*Lansium domesticum*); mangoes (*Mangifera indica*); ambatjang mangoes (M. foetida) having 16 species in this genus while total 23 species in this region, some of which produce edible fruits; wild bananas of various species; rambutans (*Nephelium lappa* ceum); Kho Laen (N. hypoleucum) short-haired rambutan (N. mutabile) having its relatives of 20 species in forests; Zalacca (*Salacca rumphii*); Sala (S. edulis); Lumphi (S. Conferta) having 12 species, etc. Accordingly, Thailand is considered a gene pool of numerous important fruits. The author additionally states that Thailand has lost almost all large lowland forests because the lowlands have been changed into cultivated areas and located under reservoir generated by construction of large dams, which has currently been increased over time. The last large lowland forest was located under the Rajjaprapha Dam. Nowadays, no one finds wild durians nor wild mangosteens because these two types of fruit naturally originate in the forest along the valley and the flooded lowland in rainy season. Unfortunately, such land has been totally changed into cultivated areas and it is considered unfortunate that diversity of those two fruits is completely lost despite previous prevalence in wild environments. Songpol Somsri (2008) states that there are a number of local fruit trees on risk of current extinction; e.g., Maphud; garcinias;

some varieties of mangosteen; Langsat; custard apples; Look Khui; Look Pruad; rambutan familes such as Kho Laen or hairless rambutan; Silaman like lychees; neck oranges; king orange; gamboges; acid limes; original durian species which are especially ancestors of currently popular durian varieties such as Thong Suk which is an ancestor of Kanyao, Kampan which is an ancestor of Monthong Nokyib; pandanus; and hennas which is being extinct from Thailand.

2.3.1 Important fruit trees in Samut Songkhram Province

Upon the literature review on major agricultural data of 2008, it was found that Samut Songkhram Agricultural Office (2009) had collected data of major economically important crops: i.e., coconut palm, coconut fruit, and young coconuts, which were primary grown in the province; and other minor crops: i.e., lychees, pomelos, mangoes, and cultivated banana; all of which are detailed as follows:

Table 2.1 Major economic crops in 2009 of Samut Songkhram

Item	Coconut palm	Coconut fruit	Young coconut	Lychee	Mango	Pomelo	Banana
Mueang (rai)	7,790	1,5437	1,734	20	87	984	1,411
Amphawa (rai)	42,23	20,298	534	4,234	70	7,820	660
Bang Khonthi (rai)	2,772	17,525	2,783	5,131	508	6,210	1,153
Cultivated area (rai)	14,785	53,260	5,051	9,385	665	15,014	3,224
Average yield (kg/rai)	800	1,250	1,600	20	600	1,200	3,000
Price (Baht/kg)	19	4.81	5	100	15	17	2.70
Yield value (million Baht)	224.73	320.23	40.41	18.77	5.99	306.29	26.11

Source: Important agricultural data of 2008 (Agriculture Office, Samut Songkhram Province, 2010)

Apart from the economically important crops of 2008 as abovementioned, Samut Songkhram Agricultural Office also collected those data of longans, Manila tamarinds, papayas, marian plums, monkey apples, guavas, rose apples, and conserved

fruits like king oranges, grapes, fiddle coconuts, and other native fruits. These fruits are supported by both Samut Songkhram domestic markets and Damnoen Saduak Market in Ratchaburi. In case a plenty of seasonal fruits are yielded, the Agricultural office would distribute them to its neighboring provinces so that they in turn pass the yields through Nakhon Ratchasima, Sing Buri, Chai Nat, Ang Thong, Nakhon Sawan, Phichit, Sukhothai, and Nakhon Pathom, or even central markets at Bangkok; or contact appropriate export companies based on types of prevailing fruits (Agriculture office, Samut Songkhram Province, 2010)

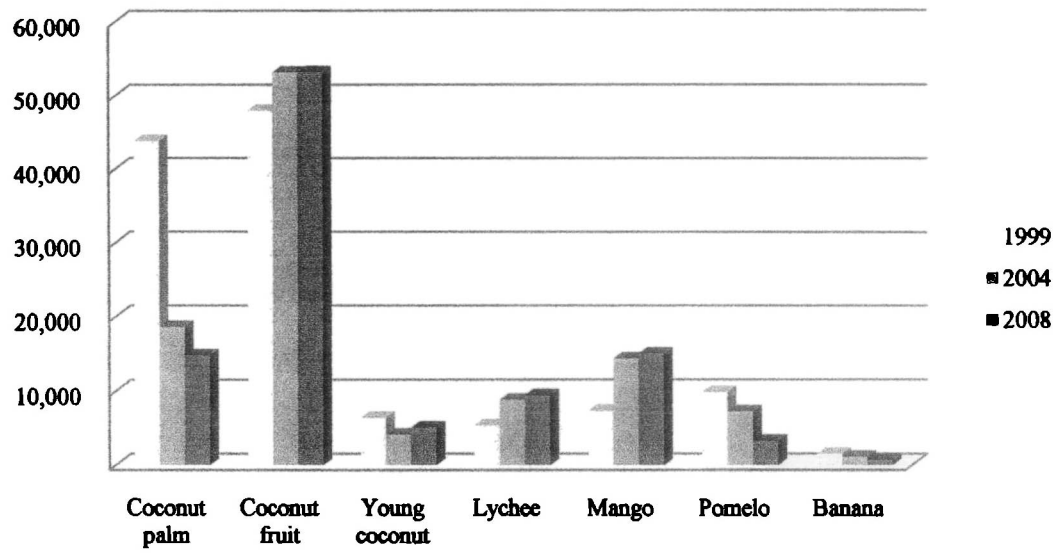


Figure 2.1 Cultivated areas of economic fruits in Samut Songkhram during 1999, 2004 and 2008

Source: Important agricultural data (Samut Songkhram Agricultural Office, 2009)

According to statistical reports of economic fruit tree cultivated areas in Samut Songkhram, it was found that cultivated areas of crop coconuts, lychees, and pomelos had been maintained and likely to increase. The cultivated areas of young coconuts had slightly decreased from 1999, but then slightly increased in 2008. However, those areas of coconut palm, cultivated bananas, and mangoes were likely to decrease; especially the coconut palm for which their cultivated areas dramatically decreased from the year 1999 of 46,947 rais, and the year 2008 of only 14,785 rais,

respectively. This indicated that the coconut palm cultivated areas drastically decreased by 68.5% of the number in 1999, and the number would be likely to continuously decrease in the future. (Group Strategic Development, Samut Songkhram Province, 2007)

2.3.2 Fruit plantation in agricultural areas

Thailand and global countries acknowledge biodiversity in aspects of importance and benefits as can be seen in increasing promotion on native fruit tree conservation. Agriculturalists turn to grow conserved plants and study more on fruit tree diversity in Samut Songkhram. Despite quite a short period of harvesting season as well as other factors causing high competition at this present, they do not directly influence agriculturalists because of plantation management in major areas. Overall nature of cultivation has been in a mixed manner since ancient times; wherein fruit trees have been grown based on factors in aspects of landscape, soil, water, and weather. In addition, other factors on market system gradually increasing over time are matters in plant selection for cultivation as well. Agriculturalists select fruit tree varieties according to suitability to cultivation areas within the province. For example, they choose to grow, e.g., coconuts, lychees, and pomelos, which are regarded major economic fruit trees. They also grow other secondarily important or beneficial fruit trees or plants: e.g., king oranges which were regarded as outstanding fruit trees as Khao Yai pomelos, and lychees which were regarded famous native fruit trees of Samut Songkhram. "King oranges" are actually regarded produces of Bang Khonthi and Amphawa Districts because soil condition in Bang Khonthi District is of loose clay originated from stream puffing sediments from the north to deposit the area, and totally fresh water condition thereof causes abundant organic substances. Therefore, the king oranges grown in this area are of high quality, and they are never yielded like this in any other area than these two districts in Samut Songkhram. However, agriculturalists usually grow king oranges only as in-between garden plants because these plants produce yields once a year and need more attentions on supplementary fertilizers and diseases/pests than pomelos producing yields more than four times a year. Besides, king orange cultivation require high costs in labors; thereby causing king orange not prevailing nowadays. The abovementioned examples are all factors

influencing administration of agriculturalist and associated agencies. Provided that no conservation is in action, these overall factors can cause native fruit trees of Samut Songkhram to be lost in an unfortunate manner. (Sarawut Srithananun, 2009)

According to literature review on fruit biodiversity in Samut Songkhram, it is recognized about various local fruit tree species, nature of partially combined fruit tree cultivation, and importance of fruits not only as economically important plants but also for biodiversity to Samut Songkhram of Thailand, and further to the world. Matters concerning cultivation are all important to farmer's decision, so cultivation of each species and variety of fruit trees for household consumption, domestic distribution, or international export in a substantial number depends on various factors appropriate to area and time. This results in that other less popular species or varieties of fruits are only grown as secondary in-between plants; otherwise they are not to be grown in any farm at all. These issues also depend on other biological, social, political, and cultural factors changing over time; thereby reducing the number of species and varieties of local fruits in a continuous manner. This is important to any relevant personnel and researchers in that they have to place importance on and pay attention to conservation of native fruit trees which are in a small number or on risk of extinction from the province; in order that such fruit trees become valuable properties for the next generation.

2.4 International agreements and domestic laws for biodiversity management

2.4.1 Convention on biological diversity

Due to current impacts from overall biodiversity, the Faculty of Environment and Resource Studies, Mahidol University (2007) prepared, collected, and provided details of convention on biodiversity which are international environmental agreements intended to stipulate the governments of all countries to be strict to environmental disciplines. Although having considerable needs to develop their economies, the countries shall not fail to conserve their natural resources. The

convention describes matters concerning objectives, major principles, domestic laws, strategic frameworks, operational plans on conservation and utilization, performance of plant species conservation, and operations in Thailand.

2.4.1.1 Objectives of convention on biological diversity consist of 3 elements as follows:

1) To conserve biodiversity,

2) To utilize biodiversity in a sustainable manner, and

3) To share advantages derived from use of genetic resources in an equitable and fair manner

2.4.1.2 Important principles of convention on biological diversity:

1) Acknowledge the sovereign rights over biological resources; wherein a member state has its own sovereignty to utilize its natural resources in accordance with environmental policies and responsibilities of one state without causing any damage to the environment of other states.

2) Promote protection of local wisdom; wherein a member state should pay respect to, promote conservation of, and perform preservation for knowledge, innovation, and practices of local and native communities; especially for knowledge and local wisdom concerning conservation and utilization of biodiversity in a sustainable manner.

3) Promote access to and utilization from biological resources under the principles of "consent with prior notification" and "fair apportionment of benefits" so as to open an opportunity to access and utilize the resources in a sustainable and fair manner to the proprietary state of such resources.

4) Promote access to and transfer of technologies between developed and developing countries.

5) Protect intellectual property by prescribing that access to and transfer of technologies must substantially and efficiently comply with such intellectual property protection.

6) Prescribe monitoring mechanisms for biodiversity and management of biological technology, as well as organization and control of risks arisen from use and release of genetically modified organism to the environment.

7) Prescribe financial mechanisms for assisting developing countries in conservation of biodiversity based on spirit of the convention.

The convention on biodiversity is therefore the first international convention covering conservation of genes, species, and ecosystems; wherein the contents of which are frameworks for the member states to prepare their own appropriate domestic policies, measures, and operational plans in biodiversity conservation.

2.4.1.3 Applicable domestic laws

To operate in accordance with obligations to the convention on biodiversity associated to this research, international legislative measures on the environment are important tools for respective countries in order to protect and conserve the environment of their own countries. The measures are in form of those for ecosystem protection and species protection; both of which have to be operated in parallel. The applicable laws are listed below:

- Constitution of the Kingdom of Thailand B.E. 2540
- Forestry Act B.E. 2484; and its updates B.E. 2532
- National parks Act B.E. 2504
- National forest Act B.E. 2507
- Plant quarantine Act B.E.2507, and Plant quarantine Act (No. 2) B.E. 2517
- Plant varieties Act B.E. 2518
- Export and import of goods Act B.E. 2522
- Science and technology development Act B.E. 2534
- Patent Act B.E. 2522; and its updates B.E. 2535
- Improvement and conservation of national environmental quality Act B.E. 2535
- Forest plantation Act B.E. 2535
- Plant protection Act B.E. 2542
- Protection and promotion of traditional Thai medicine Act B.E. 2542

2.4.2.4 Conservation of plant varieties

Operations performed by associated agencies in conservation of plant varieties: i.e., Department of national park, Department of forestry, Department of agriculture, Academic department under ministry of education, and other agencies, according to the policies, measures, and plans on sustainable conservation and utilization of biodiversity B.E. 2541-2545 consist of these follows:

1) Biodiversity exploration: i.e., exploration of biodiversity in preserved areas, study of plant varieties, exploration of species status both inside and outside preserved areas, and exploration of status and distribution of species

2) Conservation inside natural habitat: i.e., conservation of forest ecosystem, forestation and forest recovery, additional declaration and prepared declaration of preserved areas, and preparation of model schemes on preserved areas. As a result of such conservation, at least 10% of respective ecological areas are efficiently conserved; approximately 50% of global areas particularly significant in plant diversity are secured in protection; at least 30% of production areas are managed in accordance with the principles of plant diversity conservation; and 60% of global threatened species are conserved in their natural habitats.

3) Conservation outside natural habitat: i.e., establishment of plant genetic bank, collection of wild vegetations in botanical gardens and arboreta, and accumulation of microorganism species for the sake of agricultural, industrial, and environmental purposes. Accordingly, 60% of endangered species are preserved in accessible botanic museums or herbaria, especially in their original countries; while 10% of such plant varieties are included in rehabilitation and recovery programs.

4) Conservation of agricultural plants and local wisdom: 70% of genetic diversity on crops and other economically and socially important species are conserved. Related traditional knowledge and local wisdom are also conserved. Besides, a sustainable agricultural system and agro forestry are encouraged in buffer areas located around the protected areas. This also includes recovery and conservation of cultural forests.

5) Conservation promotion in humans and sustainable utilization:

- Education and making of public awareness by preparing supplementary books, developing learning activities about biodiversity for student of

different levels, arranging activities and exhibition for knowledge dissemination, and holding meetings, seminars, trainings in related matters.

- Biotechnological researches and transfers: i.e., operating biotechnological projects for development of plant varieties and yields, and transferring technologies for development on countryside and agriculturalists.
- Collection and propagation of information about biodiversity: i.e., development of biodiversity database, biodiversity networking, and Clearing-house mechanism (CHM) in the form of websites and documents.

The cooperation in preparing these plans is a guide for national, regional, and global operations. Objectives of this cooperation are to inhibit loss rate of biological resources, to secure conservation stability, to maintain biodiversity for sustainable development, to change ways of resource utilization, and to distribute equitable and fair benefits. In practices, there are both short-term and long-term operations according to important principles specified in the convention.

2.4.1.5 Strategies, measures, and operational plans

Therefore, the policies, measures, and plans on sustainable conservation and utilization of biodiversity B.E. 2007-2011 prescribe operational directions for domestic conservation and utilization of domestic biodiversity in compliant with frameworks according to schematic plans in the convention so that biodiversity management of the country is in the same way to other countries and corresponding to the national economic and social development plan No. 10 which drives developmental strategies based on biodiversity, solves problems relevant to current situations, and stabilizes resource and environmental bases into practice. Objectives of the plan are for ecosystem stability and balance by species and genetic conservation with awareness in significance of local wisdom in respective areas which cannot be separated but influence overviews of tropical biodiversity conservation by efficient domestic management. Essences of each strategy are detailed below. (Biodiversity division, 2009)

Strategy 1 Protection of biodiversity elements

- Conserve important ecosystems and promote sustainable utilization thereof
- Enhance preserved area systems

- Conserve agricultural ecosystems to reduce diversity loss of plant varieties, microorganisms, insects, fleas, natural enemies, and livestock
- Protect and rehabilitate local animal and plant species which are rare or almost extinct, and also threatened native species
- Operate in accordance with global strategies in plant variety conservation

Strategy 2 Promotion on sustainable utilization of biodiversity

- Promote potential development of biological resources for commercial utilization
- Motivate sustainable conservation and utilization of biodiversity
- Develop forests for economic enhancement and renewable energy
- Protect and maintain traditionally successive knowledge associated with conservation and utilization
- Facilitate in access and apportion of biological resources in an equitable and fair manner

Strategy 3 Reduction of threats

- Reduce loss in ecosystems and natural habitats as consequence of developmental projects
- Control and lessen impacts to biodiversity by tourism
- Alleviate impacts from climate changes on biodiversity
- Control threatening by invasive alien species
- Regulate impacts to biodiversity from use of modern biotechnology

Strategy 4 Encouragement of researches, trainings, education, and awareness in biodiversity

- Prepare national policies, guidelines, and research plans for biodiversity

- Provide research funds, training funds, and supporting funds for private developmental agencies, local educational institutions, and communities for researches and campaigns in awareness and knowledge publicity on biodiversity
- Employ both intracurricular and extracurricular systems in promotion of education and knowledge provision on biodiversity within/out of classes
- Establish allied cooperative network among private developmental agencies, private economic sectors, and communities in arrangement of continuous activities for education, consciousness, and participation on sustainable conservation and utilization of biodiversity
- Focus primarily on biodiversity exploration
- Operate in accordance with Global taxonomy initiative (GTI)

Strategy 5 Enhancement of Thailand in operations according to international agreements on biodiversity

- Appoint organizational commission on biodiversity for monitoring operations in accordance with the national commission
- Promote integration among associated conventions on biodiversity
- Establish clearing-house mechanism (CHM) and maintain information network on biodiversity
- Establish and maintain information center on biosafety
- Promote technological transfer and technological cooperation

2.4.1.6 Operations in Thailand

Thailand endorsed the convention on biodiversity during the United Nations conference on environment and development on June 12, 1992 at Rio de Janeiro, Brazil. The convention on biodiversity subcommittee was established under the national environment board for considering objectives and obligations of the convention accompanied with major domestic laws and roles of various agencies in conservation and utilization of national biological resources. The office of natural resources and environmental policy and planning, ministry of natural resources and

environment (the former office of environmental policy and planning, ministry of science, technology, and environment) as a secretary of the convention on biodiversity subcommittee and the central cooperative agency for operations under the convention approved the subcommittee according to the convention on biodiversity under the policies and measures thereof. The office serves to monitor and track biodiversity status, analyze and research the problems and obstacles arisen from the conservation, employ the guidelines, policies, and measures, prepare the biodiversity database, evaluate and lessen the impacts causing damages to biodiversity, cooperate in provincial management of biodiversity, as well as arrange central and local trainings for education and awareness on biodiversity.

According to the review of the convention on biological diversity, the researchers found that biodiversity management of fruit tree species and varieties were important and useful for operations in accordance with all of five strategies focusing on conservation of agricultural ecosystem so as to lessen loss of diversity on species and varieties of beneficial organisms to agriculture as well as fruit tree plantation contributing to sustainable utilization of biodiversity.

2.4.2 International treaty on plant genetic resources for food and agriculture (ITPGR)

According to the study of the Faculty of Environment and Resource Studies, Mahidol University (2007), it is detailed about the given major principle that plant genetic resources are "common inheritances of mankind" which shall not be owned or retained by anyone. Plant genetic resources include forests, native plants, natural plants, and improved plants derived from modern genetic technology; causing many developed countries to reject endorsement in this practice because they consider that genetically modified plants are regarded intellectual properties but not "common inheritances of mankind". This permission to access to plant genetic resources is only limited to the objectives for scientific study, improvement on plant varieties, and conservation of plant genetics, and based on the principle of "mutually agreed requirements" detailed as follows:

2.4.2.1 Principles and essences

The treaty is intended to sustainably conserve and utilize plant genetic resources for food and agriculture, as well as to equitably and fairly share benefits derived from the use of such resources in accordance with the Convention on biodiversity for sustainable agriculture and food stability. Major principles of the treaty are listed below:

1) Acknowledgement of sovereign rights over plant genetic resources

2) Acknowledgement of agriculturalist right: emphasizing importance and role of native communities, local communities, and agriculturalists in conservation and development of plant genetic resources. In addition, there is still no interpretation in a manner that agriculturalist rights are prohibited in harvest, utilization, exchange, and sale of seeds and propagated portions derived from agriculture, depending on applicable laws of the member states and appropriateness. In case of Thailand, according to the plant protection Act B.E. 2542, an agriculturalist has his own right to reserve a propagated portion of plant for cultivation in the next year.

3) Conditions in access to plant genetic resources: from an idea that access to plant genetics for development and improvement of plant varieties are important factors influencing and resulting sustainability of agricultural sector, the "Multilateral system of access and benefit-sharing of genetic resources" is therefore established by covering two sources of plants: 1) plant genetic resources where the member states mutually agree to the list specified in the treaty consisting of 64 items in total: 35 items of food plants and 29 items of animal feed plants, and 2) plant genetic resources located out of habitats. The access conditions are prescribed as listed below:

- Access shall be provided solely for the purpose of utilization and conservation for research, breeding, and training for food and agriculture, provided that such purpose does not include chemical, pharmaceutical and/or other non-food/feed industrial uses.
- A fee charged shall not exceed the minimal cost involved.
- Recipients of the access right shall not claim any intellectual property or other rights that limit the facilitated access to the plant genetic

resources for food and agriculture, or their genetic parts or components, in the form received from the multilateral system.

- Access to plant genetic resources for food and agriculture protected by intellectual and other property rights shall be consistent with relevant international agreements, and with relevant national laws.

4) Intellectual property protection: plant genetic resources or their genetic parts or components in the form received from the multilateral system shall be prohibited to claim any intellectual property or other rights that limit the facilitated access to the plant genetic resources.

5) Benefit sharing: information exchange, access to and transfer of technology, capacity building, sharing of the benefits arising from commercialization, and *in situ* and *ex situ* genetic resource management.

2.4.2.2 Obligations of member states of the multilateral treaty

The obligations of the member states are: conservation, exploration, collection, differentiation, evaluation, and documentation about plant genetic resources for food and agriculture (Article 5); sustainable utilization of plant genetic resources (Article 6); international cooperation (Article 7); and technical support (Article 8); wherein the multilateral treaty prescribe the member states to perform measures, as appropriate and depending on applicable domestic laws thereof, in these following matters:

1) Protection of local wisdom relevant to plant genetic resources

2) Right of sharing the benefits arisen from use of plant genetic resources

3) Right of decision in national conservation and utilization of plant genetic resources

2.4.2.3 Operations of Thailand according to the obligations

Thailand endorsed the international treaty on plant genetic resources for food and agriculture on November 4, 2002 (no ratification); whereby the ministry of agriculture and cooperatives served as a main cooperative agency to carefully consider benefits and impacts on participation as a member of the

multilateral treaty, perform the participation of all relevant entities for consideration of advantages and disadvantages, and consider legal readiness as well as educate the public to prepare readiness prior to submission for cabinet and parliament procedures.

1) Resulting successes and benefits In the future, if Thailand participates in the multilateral treaty, the issue concerning limited enforcement of applicable Thai laws only within the Kingdom will be solved. As a consequence, the resulting benefit is that it opens an opportunity for Thailand to access and utilize 64 items of plant genetic resources listed in the multilateral system where said resources are located in other countries or collected in plant genetic banks within the member states of the multilateral treaty. This is thereby beneficial to development and improvement on plant varieties, development on agricultural sector, and food stability of Thailand. In addition, it is advantageous for *ex situ* plant genetic resource management; especially in the plant genetic banks. This is considered an issue for the countries originating said plant genetic resources because, although a number of resources are stored in foreign genetic banks, there are no transparent criteria for management therefore. Furthermore, the participation according to the Multilateral treaty opens another opportunity for Thailand to negotiate on provision of any criteria applied.

2) Issues, obstacles, and limitations Several unclear information and understanding in the multilateral treaty: e.g., in plant genetics, whether sovereign rights over those plant genetic resources belong to the state where the gene bank is located or the state where said plant genetic resources originate. There are few researches relevant to the treaty; especially in the analysis of possible positive and negative impacts on development, and in the study of legal readiness of relevant domestic laws and measures. According to the review of the International treaty on plant genetic resources for food and agriculture, the researcher found that the study of biodiversity management in fruit species/varieties and the study of local wisdom in conservation for fruit variety selection helped agriculturalists have appropriate plant varieties in accordance with their cultivated areas and the principles of local wisdom related to plant genetic resources and conservation thereof. The access for the purpose to study plant genetics was beneficial and important, but complicated in the stakeholder-related benefits hidden from such sharing of the plant

genetic resources for food and agriculture. These were considered hard to decide in ratification, so tracking and monitoring thereabout was necessary for actual sustainable benefits to Thailand in the future.

2.5 Local wisdom

2.5.1 Nature of local wisdom

Wisdom is local knowledge arisen from interaction between humans and surrounding nature in a mutually learning manner for dependent living and from various ways of survival solution based on limited choices of local people. The methods of solution or management are accumulated and succeeded to the next generation if such method, knowledge, or wisdom still well responds to lives and living conditions of local people (Kriangkrai Kirtsiri, 2004). In overview, these result in cultural landscape. Management of cultural landscape relates to the management to that society in aspects of topography, climate, nature, construction, and living of people in the ecological nature. The cultural landscape appears in existent and successive ways of life, and creates traditions, beliefs, arts, and aesthetics depending on the taste of work piece or group. All together have originated common practices in order to maintain elements for living from generation to generation until they became the culture of respective localities. Upon continuous development until innovative technology enters into the communities, the living then changes and this in turn changes the way of life along with ecosystems of the communities. It is not possible to live totally in traditional ways of life, so changes have occurred over generation. The past generation has their own traditional ways of life; while the new generation depends on appliances and new way of living. As a consequence, the management needed is to prevent against sudden and complete changes, but contribute to gradual changes (Office of the national culture commission, 2006: 18).

Yos Santasombat (1999: 58) mentions about relevant details that local wisdom is knowledge developed from physical contexts and cultures in interaction with the ecosystem of such locality. The composite knowledge therefore reflects unique and different wisdom depending on each locality. Local wisdom developed on

successive ways of living is therefore based on the relationship between communities and nature where humans still learn and adapt themselves to modern requirements of and the changing economic, social, and political contexts. Consequently, local wisdom also adapts itself to the era, so do other parts of culture. Besides, Yos Santasombat (1999: 58) gives further details that, among ethnic groups, the local wisdom having been accumulated, succeeded, and developed for so long is a body of knowledge similar to scientific knowledge, but the local wisdom is originated from empirical studies, subjected to experiments, and processed in concrete procedures of selection, improvement, and development of systematic thinking in actual ways of living within the locality. The local wisdom and the scientific concept are significantly different in two points:

Point 1: local wisdom is unique to a particular locality, area, and ecosystem. The body of knowledge is generated from interaction and dependence among humans, animals, plants, natural energy, beliefs, spirits, waterways, and topographic areas especially where relative habitats of human are located. Accordingly, the local wisdom is resulted from express understanding in the relationship among organisms that originate, exist, decease, and collapse within the set of ecosystems. In-depth understanding leads to capability in sustainable management, adjustment, utilization, and development of resources in the ecosystem; while scientific knowledge, although it is more universal, cannot be used for managing and solving resource problems within all local ecosystems.

Point 2: specificity of local wisdom is closely associated with social aspects and community rights. From the view of local wisdom, every set of ecosystem is made up based on a social relationship network among people, families, communities, and other organisms living together within the set of ecosystem. As such, the ways of thinking is presented in the form of stories and folktales mentioning the relationships between humans and other organisms mutually associated by lineage, marriage, or any other relationship. Accordingly, the ecosystem structure in local wisdom is that generated by organization via negotiation and mutualism among spirits (angels, the dead), humans (living people), animals, plants, soil, water, and other natural energy linking via kindred relationship, mutualism and negotiation, and ideas mainly focusing on human-natural and human-human societies.

Traditional resource management seems to be proprietary based on internal relationship within community rather than on the title document. The management emphasizes on resource utilization rather than tenure; that is, although receiving utilization right, one must consider about the community. Such right is therefore different from decisive right over assets according to the west thought because some resources are common to the community. Under the common assets of the community, the community is both utilizer and manager, and regarded a social institution established based on approved and successive criteria. The right is characterized by its complexity; that is, upon a resource, there is overlapping right. For example, although one farmland is individually owned, the community has its right to use this land. The farmland owner is an owner of cultivated rice, but naturally generated animals in his field; e.g., shrimps, crabs, and shells, can be caught by the community members (Somchai Ratanachuesakul, 2006).

2.5.2 Elements of local wisdom

The analysis of ecosystem with social relation network influences ideas on usage and management right in the ecosystem of particular locality. Moral-based ideas are also associated to the management right on ecosystem. The usage right refers to a common right over public resources of the community; wherein only the community members can access or utilize said resources. A concept of the right focuses on utilization of resources for public rather than private purposes. In the meantime, community can exercise its own right to prescribe regulations based mainly on social fairness. Knowledge obtained from these ideas is transferred to people acknowledged by the society; examples of which are descendents within a family or lineage, people in a community, or disciples well-trained and proved capable of taking responsibility and power of such knowledge with humility. Yos Santasombat (1999) analyzes that local wisdom consists of four levels of knowledge:

Level 1 Food and drugs: local wisdom of this level is fundamental knowledge; wherein females in community or locality play important roles on this level. Food and drugs are important to daily life, and knowledge of which is usually transferred from mother to her child or from important person such as herbal

specialists, conjurors, ritual leaders, etc. These people know well about local herbs in aspects of properties, usages, or treatment techniques thereof.

Level 2 Production system and resource management: this technique is more complicated than wisdom on food and drug. The technique assists in overall production system management within locality in aspects of selection, consideration, storage, generation, utilization, and conservation, as well as development into social relationship pattern and cooperation in production management and public resource administration.

Level 3 Ritual beliefs, ceremonies, and traditions: from common use of resources, regulations are established for organization and as common criteria of the community. The local regulations avail in the forms of beliefs, rites, and ceremonies; whereby they are prescribed based on morality so that local people have humility and realization in favor or value of resources and sacred items or ancestors. This therefore generates lineage relations and natural-based connection.

Level 4 Ways of thinking: this includes refinement of ideas arisen from resource management in aspects of food and drugs; resource management in production system; or rites, ceremonies, and ways of practice proved over time to refine and inherit from generation to generation in form of appropriate practicing methods or ideas to living and natural resource conservation in parallel to the guideline largely acknowledged by majority in the locality.

2.5.3 Current issues in local wisdom

Yos Santasombat (1999) mentions that there is rapid change nowadays. Local wisdom is impacted to lose its originality due to major aspects:

- Government intervention: extending its roles and scopes to cover country areas, ideas on establishing security and controlling commercial production, and educational promotion on current curriculum to community influencing decrease of dialect learning or intercommunication between the new and the old generation; which causes difficulty in original knowledge and wisdom transfer to the next generation. Furthermore, western values adopted by the new generation lead to negligence of local wisdom due to the ideas in that traditional simple ways of life and the uneducated are old-fashioned. These factors destroy important ways of thinking and wisdom in locality.

- Exogenous invasion: in a manner that woods are franchised by exotic people or capitalists. This causes body of knowledge or resources to be lost: for example, forests are damaged; herbs in gardens, plantations, and fields are lost. Also, adaptation into commercial cultivation according to more extensive market mechanism is important to cause changes in production system, resource management, and local ways of thinking. Accordingly, cultivation of diverse plants is substituted with that of single plants in large area for the commercial purpose according to increasing and decreasing market prices. Furthermore, dramatic uses of chemical fertilizers and insecticides influence ground soil collapse; leading to loss of unique varieties of local plants.

From literature review on local wisdom, the researcher understands importance of diverse local wisdom according to ways of life of local people and various elements within areas where such society holds them as bases for living; wherein social factors influences wisdom in each generation to change, exist, or lose depending on priority, difficulty of practices, ideas, and age of values. Especially, expansion of rapidly advanced technologies in social and economic purposes, which emphasizes externality rather than utilizes surroundings and conserves them in accordance with ancient ways of life. The wisdom is subject to long-term succession: e.g., basic knowledge on food and drugs where herbs are used for treatment via proved methods from generation to generation and ideas integrating morality in reasoning into living. Lack of succession due to the factors causes loss of culture, wisdom, unique solutions, human-living history, and valuable areas.

2.6 Relevant concepts and theories

2.6.1 *In situ* conservation

In situ conservation: Ampol Senanarong (1990) provides details that *in situ* conservation is a way to maintain plant and animal genetics in a wild or their original environment; while *ex situ* conservation is genetic preservation of wild or raised plants and animals in forestry plantations, botanical gardens, or plant vegetation, in a manner of seeds in seed storage room or in laboratory by any ways of storage). Both *in situ* conservation and *ex situ* conservation are humanly intended to utilize necessary genetic material in an efficient manner. The *in situ* conservation not only preserves those genetics in their original manner, but also provides an opportunity for evolution to continue in a concurrent manner with environmental changes: e.g. the number of diseases, and climate in agricultural ecosystem. Therefore, the *in situ* conservation is the best way to maintain plant varieties as well as wisdom in local cultivation.

In situ forest genetic resources conservation Wichien Sumantakan (2008) mentions that *in situ* forest genetic resources conservation is usually performed in forestry because it is only defense and prevention against human actions toward plant varieties, so as to maintain forestry ecosystem for other agricultural plants that are difficult to conserve in a wild environment. The growth and development of human causes some plants; e.g., wild rice, to be rarely available in nature and difficult to preserve in a wild environment. Furthermore, there is more suitable way of rice variety conservation in progress. It is also found that some perennial crops probably conserved along with other plants: e.g., wild mangos, prevail in general mixed forests and still exist in its wild variety. Thus, those agricultural crops may be included in the forestry operations as well.

The idea on *in situ* forest genetic resources conservation does not mean that, once the border is restricted, the conserved area in nature is left as is without any operation. In this regard, the main objective of such conservation is to conserve wild strain of a particular plant which, in fact, is dynamic -- changes over time. Accordingly, its genetic characteristics changes according to the stage of succession. The plant varieties preserved in a wild environment without any operation are subsequently changed over time. The conservation in this way requires some

management in order to conserve desired genetic composition. Another required management in the *in situ* forest genetic resources conservation is carefulness in that cultivation of same species from other sources beside the conserved plants can cause breeding such that the conserved species can be changed. Therefore, it is highly recommended not to grow the same species of plant from another source in proximity of the conserved plantation.

In Thailand, examples of the *in situ* forest genetic resources conservation are national parks, botanical gardens, wild animal protection areas, and no-hunting areas, where various plant varieties exist and there are regulations not to perform any action in those areas. The forests contain some useful wild and perennial plants such as wild mangoes, wild lychees, wild baccaureas, and wild santols. In addition, some herbs exist in a mixed up manner with other plants; thereby being considered good plantations for the *in situ* forest genetic resources conservation. However, based on the management principles, it may not be considered the correct plantations for the *in situ* forest genetic resources conservation.

2.6.2 On-farm conservation

In the past, Thai agriculture were changed into monoculture with expectation that the cultivation of single variety of plants or animals by using fertilizers and chemicals adopted from external sources would result in increasing yields. Such monoculture or cultivation of less species and varieties impacted overall ecosystems. The resulting yields were good in initial cultivation because the cultivation area was still abundant. However, once the overall natural system deteriorated; i.e., soil, water, and air ran out or degenerated, the yields in the year after became less and less. In addition to the less yields, diseases and insects also destroyed the plants and this caused big problems. For example, in 1990, spreading-out plant hoppers caused destruction of rice cultivation areas in 29 provinces. Another example was in 1994 where the root rot disease caused by Phytophthora spp. and found in durians from many regions of the country led the agriculturalist into a trouble from budgeting for solutions thereto (Foundation for Sustainable Agriculture of Thailand, 2009).

2.1.2.6 Sustainable agriculture

From those major problems, academics and agriculturalists were awakened to adjust and address the problems on monoculture. They turned to study the cultivation histories based on regions, resurrect importance of local plants associated to folk wisdom or local wisdom, and maintain biodiversity to be more important for its direct and long-term advantages toward household agriculturalists. This principle refers to plant cultivation in a manner of sustainable agriculture emphasizing biodiversity preservation. BIOTHAI (2009) indicates its principles and advantages below:

1) Principle of cultivation in sustainable agriculture The guideline for generating biodiversity in agricultural areas is based on cultivation of plants and animals according to their differences in nature. Plants serve to synthesize food from soil minerals and sunlight; while animals serve to consume plants in the form of food and decompose them into fertilizers. However, in the area where they cannot raise animals, agriculturalists should increase types of cultivated plants by selecting symbiotic plants for integrated agriculture in order to prevent competition between species. These factors should be considered: i.e., root system, sunlight consumption, water consumption, and growth cycle; all of which should be appropriate. As a result, diverse plants help maintain ground surface and become a source of natural fertilizers. It is also useful to raise animals; for example, raising goats in natural rubber or various fruit plantations are as good as raising cows in coconut plantations, because these kinds of animal help get rid of weeds and self-enhance natural fertilizers. For another example, raising bees in fruit plantations can be performed in almost all types of fruit tree and this makes by-products from more pollination caused by bees. The guideline also focuses on ancient agriculture such as Suan Som Rom (integrated plantation) in the South, and Suan Yok Rong (leveled plantation) in the central; all of which are simulation of natural ecosystem wisely implemented into agriculture. In addition, exchange of plant varieties among families, communities, and regions by utilizing those plant varieties for diversity and becoming a part of genetic and cultural inheritances.

2) Benefits of cultivation in sustainable agriculture

- **Enhancement of soil abundance:** deep roots of plant serve to digest bottom minerals for utilization; while small plants have superficial roots. Cultivation of beans along with other plants adds fertilizers into soil. In addition, raising animals together with plant cultivation results in more abundance because animal feces help enhance soil quality.
- **Breakout reduction of diseases, pests, and weeds:** once various plants are grown, insects involved in the system manage themselves and this decrease disease breakout because food sources are not contiguous. Cultivation of ground-covering plants such as beans helps prevent grasses not to cover the plantation and preserve soil quality.
- **Retention of moisture in soil and air:** plants of multiple levels reduce evaporation, generate moisture, and provide shades for primary seedlings in agricultural areas.
- **Diverse food sources:** cultivation of multiple plants and animals leads to household stability without dependence on external economy. In addition to safe food from chemicals, agriculturalists obtain various advantages from those cultivated by themselves.
- **Yield and income distribution:** market price fluctuation causes no or little impacts on agriculturalists because they grow several kinds of plant for support.
- **Higher production efficiency:** from several researches, integrated cultivation provides higher yields than monoculture.
- **Base for development of plant/animal varieties for the future:** since some beneficial plant varieties and species to agriculture cannot be generally grown; or some original varieties of plant are native to areas and communities from the past, preservation and conservation is not only necessary for the agriculturalist themselves but also provides benefits to the country and overall humanity.

In conservation on agricultural areas by comparing plants preserved in gene banks with those varieties conserved on the agricultural ecosystem, it is found

that, in the conservation on agricultural areas for which agriculturalists prescribe and manage, dynamic plants over time due to biodiversity are continuously managed and developed in variety selection based on plant responses to pressures of surrounding agricultural ecosystems. The conservation of agricultural areas is important in the role of agriculturalists. That is, apart from natural selection of plant varieties, agriculturalists themselves also take part in manage and select those varieties wherein the agricultural management is based on factors motivating the agriculturalists to decide in preservation of those species and varieties.

Agriculturalists should cultivate more species of plant at the same time so that it influences basic requirements of their living because monoculture is not able to satisfy those requirements. In addition, cultural factors like paying attention to agricultural diversity in aspect of cooking and respective local cultures are associated in economic choices explaining risks and imperfection of the marketing system for yields from data and resources in cultivation, production cost, and yield attributes.

2.6.2.2 Implications for local conservation of genetic resource: in the study, it is found that new species are not more advantageous than the original ones in aspect of average yields and incomes. The cultivation of new varieties causes agricultural areas to lack one who preserves, breeds, generates, and improves local varieties of plant. Therefore, agriculturalists can choose to work with plant varieties and their natural development process on their own agricultural areas of the ecosystem for the sake of their benefits and efficiencies that are necessary for their locality, with proviso that they have to understand, for example, to provide exemplary agricultural areas for households in aspects of varieties, agriculture, environment, and historical data of required nutrients. These good bases lead to further development of plant varieties in an improved and effective manner.

Strategies on *in situ* conservation of original plant varieties should be clearly considered based on relevant processes in the form of their cultivation as major, minor, or optional plants. Major plant varieties improved by local agriculturalists provide benefits in preservation of their original varieties and cause no loss of originality. The cultivated areas of major plants must be easy for tracking and predicting possibilities in changes of local species. Manageable methods must be provided in case of important threatened species. For the plants agriculturalists grow

to enhance the major or minor plants, promotional plans should be provided so as to be more advantageous. Besides, local exchange of seeds reduces low quality problems of plant varieties.

Techniques created and acknowledged of wisdom should be implemented to maintain knowledge, agricultural wisdom, and local genetic diversity not to be lost in a villager level. Or else, agriculturalists should have opportunities to absorb ideas or values of local plant cultivation, that is called they are "Landraces custodians." Landraces refer to plant or animal varieties developed in their genetics using improved method transferred from ancient wisdom without modern technical fields involved. However, in some situations, the environment is restricted: for example, infected areas and insect breakouts influence plant evolution; causing Landraces in danger and thereby requiring such locality to have knowledge in *ex situ* conservation for these Landraces, and maintaining the existing agricultural knowledge and wisdom. Furthermore, conservation facilitates in providing host areas for other varieties to grow (Faculty of Agriculture, Chiang Mai University, 2008).

2.6.3 Attitude

Attitude is one of important ideas in social psychology and research communication. According to the study of Preapattra Kiewcha-Um (2009), the term "attitude" is derived from its Latin root of "Aptus" which means "incline." Each of academics gives different meaning of attitude based on their opinions below:

Sakthai Surakitbaworn (2002: 138 as cited in Preapattra Kiewcha-Um, 2009) mentions that attitude is mental readiness associated to thinking, feeling, and tendency of personal behaviors toward individuals, objects, and situations in an either particular way. The mental readiness has to exist in a moderately long manner.

Soitrakun (Tiwayanont) Atthamana (1998: 64 as cited in Preapattra Kiewcha-Um, 2009) gives the meaning that attitude is combination among personal thoughts, beliefs, opinions, knowledge, and feeling toward a particular thing, person, or situation that is expressed in an evaluable manner; thereby probably allowing either acceptance or denial. In addition, these feelings tend to cause one of the behaviors.

Phong Horadan (1997: 42 as cited in Preapattra Kiewcha-Um, 2009) provides the meaning that attitude is a worker's feeling, reaction, opinion, and

behavior toward his colleagues, administrators, people groups, organizations, or other environments by expressing his feeling or reaction for acceptance or denial.

Hornby, A S. (2001: 62 as cited in Preapattra Kiewcha-Um, 2009) defines that attitude is the way you think or feel toward a particular thing or person and the way you behave toward a particular person by expressing how you think or feel.

Gibson (2000: 102 as cited in Preapattra Kiewcha-Um, 2009) interprets that attitude is the way to determine behaviors in the form of positive or negative feeling. It is a mental state ready to influence one's response to other peoples, objects, or situations, wherein the attitude can be learned or managed by experience.

Schermerhorn (2000: 75 as cited in Preapattra Kiewcha-Um, 2009) states that attitude is the way a person places an idea or a feeling in a positive or negative manner toward a particular person or object in his environment. The attitude can be learned or interpreted from what someone informally says or formally explores or expresses to respond to the other one's behaviors.

According to the above meanings, it may be mentioned that attitude refers to combinative processed feeling, thought, belief, or knowledge influencing one's possible expression. Personal behaviors are responsive interaction by evaluating one's own like or dislike, or positive or negative thought, toward a particular person, object, and situation in that one's own surroundings; wherein the attitude can be learned or managed by one's own experiences, and recognized or interpreted from what one informally says or formally explores or expresses to respond to the other one's behaviors.

6.2.3.1 Nature of attitude: the ways to mention overall characteristics of attitude for better understanding (Sakthai, 2002: 138 as cited in Preapattra Kiewcha-Um, 2009). The good characteristics of attitude are listed as follows:

1) Attitude is knowable.

2) Attitude is moderately permanent.

3) Attitude is self-evaluated: indicating good–bad, like–dislike, etc.

4) Attitude enables its owner to respond to the destination of such attitude.

5) Attitude reflects relation of person-person, person-thing, and person situation. That is to say attitude has its own destination.

Subin Yoorarat (2007) mentions about characteristics of attitude in that it is important for studying human behaviors. In addition, many psychologists or attitude theorists, who have studied and understood significant characteristics of attitude: i.e. Doob, 1947; Chein, 1948; Hovland et al., 1953; Sherif and Sherif, 1956; Shaw and Wright, 1956; Krech et al., 1962; McDavid and Harari, 1969; (as cited in Jirawat Wongsawatdiwat, 1995), collect its important features as follows:

1) Attitude comes from individual learning or experience accumulation; not native by birth.

2) Attitude has evaluative nature and results from evaluation of thoughts or beliefs that a person has about things, other people, or events mediated to his/her responses.

3) Attitude has quality and intensity; both of which indicate differences of attitude that the individuals have toward various things.

4) Attitude is permanent because it is produced by accumulated experiences and proficient learning.

Nevertheless, while attitude is persistent, it is not necessary that a person has to have such attitude for his/her whole life long. Nuansiri Paorohit (1984) mentions that human attitude is dynamically changeable. For example, one used to have bad attitude toward the other one probably change such attitude in a positive way upon having interaction with each other.

1) Attitude has its own destination such as humans, objects, things, places, events, etc.

2) Attitude has relation nature to express the relationship between a person to objects, things, other peoples, or events.

6.2.3.3 Elements of attitude: from literature review on elements of attitude, there are three ideas as follows: (Theeraphorn, 1985: 162–163 as cited in Preapattra Kiewcha-Um, 2009)

1) Attitude consists of three components: This idea specifies that attitude has three components:

1.1 Cognitive component: consists of beliefs, knowledge, thoughts, and opinions based on faiths, imagines, and memories. It means a thinking process focusing on reasoning and logics. The important elements of knowledge and understanding are evaluation beliefs or self-evaluated beliefs. These beliefs are expressed by like/dislike impression that one feels toward a particular thing or person.

1.2 Affective component: means like-dislike feelings, good–bad gestures, or either one of or both positive/negative feelings toward a target; all of which derived from parents, teachers, or companions.

1.3 Behavioral component: means trends or intention that a person is ready to act toward a particular target in a manner where this intention may be measured or evaluated based on consideration of behavioral components concerning the attitude.

2) Attitude consists of two components: This idea specifies that attitude has two components:

2.1 Cognitive component

2.2 Affective component

3) Attitude consists of one component: This idea indicates that attitude has only one component: i.e., like/dislike emotion toward a particular thing.

Katz (Loudon and Della Bitta, 1993: 425, as cited in Preapattra Kiewcha-Um, 2009) mentions about four major components of attitude:

4) Four major components of attitude

4.1 Adjustment function: attitude assists in adaptation toward satisfaction and rewarding while avoids undesirable, unpleasant, or disadvantageous things. That is, attitude is a way to make the best advantages or avoid the least disadvantages for one own. This helps individual adaptation to surroundings so that such individual has satisfaction in that, once one has had an experience with a particular thing and would find such experience again, that one then develops his/her response in a way as desired.

4.2 Ego–defensive function: attitude assists in protection of ego or self-image against conflicts within one's mind and expresses such

thing in a form of self-protection mechanism so as to protect oneself by creating self-respect, avoiding unpleasant things, or generating the attitude to save one's face.

4.3 Value expressive function: while self-protection attitude is generated in order to protect one's self image or to disguise one's actual attitude, such attitude serves to express values and actual characters in a way to let other people know the values of oneself. This is an expression of attitude in a way to create satisfaction to one expressing such attitude because it is an expression of basic value that one is satisfied.

4.4 Knowledge function: human needs association with surrounding objects; thus has to acquire stability, meaning, and understanding regarding those things. Attitude is used for evaluation and understanding of those things so as to be a standard in comparison or a scope to easily understanding the world and the environment because human, once perceiving one thing, collects such experience in parts and, upon discovering new thing, uses the existing experiences as a reference for what should be perceived or what should be avoided. Attitude helps human understand surrounding environments in a manner that such human can interpret or assess the surroundings.

6.2.3.4 Types of attitude: expression in attitude can be categorized in three types (Daranee, 1999: 43 as cited in Preapattra Kiewcha-Um, 2009):

1) Positive attitude: a feeling toward the environment in a positive, acceptable, and pleasant way. For example, a student has good attitude toward advertisement because such subject allows anyone to have freedom in thinking.

2) Negative attitude: an expression or feeling toward the environment in an unpleasant, bad, unacceptable, and disagreeing manner. For example, Nid does not like one who keeps a pet because she thinks that it is mistreat.

3) Non-expressive attitude or indifferent attitude: neutral attitude may be due to lack of knowledge and understanding in a particular subject. Otherwise, this may be because one does not have prior attitude or tends to have no knowledge on such subject. For example, one has neutral attitude to microwave oven because that one has no knowledge about advantages and disadvantages thereof.

Expression of attitude is caused by formation of accumulated attitude as thoughts and feeling until they can be expressed in the form of behaviors according to the attitude toward a particular thing.

6.2.3.5 Formation of attitude

Each type of attitude originates and changes due to several factors. In fact, those factors originating such attitude are not prioritized because importance of each of those factors depends on reference in forming of such attitude and on how a particular person is related to different objects or ideas. In this regard, Newsom and Carrell (as cited in Preapattra Kiewcha-Um, 2009) mention about the factors of attitude origination and explain that attitude originates from these main components as follows:

1) Individual background or historical setting: individual biographical characteristics: i.e., birth place; growth place; and economic, social, and political status, preach individual personality and lead to formation of attitude for particular people.

2) Social environment: human interaction: e.g., information exposure, grouping, group norms, personal circumstances, and experiences.

3) Personality process: as well as predispositions are basic processes in creation of individual attitude.

2.7 Associated research

Wandee Payab (2004: 82), in a study of factors influencing fruit plantation farming in Surat Thani Province, found that farmers in Surat Thani were of middle age and educated in primary/secondary level. That is to say, the majority of farmers graduated in bachelor degree still did not pay attention in fruit plantation farming. Therefore, the government should provide supports such as cultivation method for high amount of yields, marketing opportunities, agricultural promotion, training in fruit plantation farming for interested people, or assistance in case fruit price increases.

Pra Manote Potchanasiri (Bun Manit.) (2004), in a study of factors affecting the change in the livelihood of the farmers who produced coconut palm: a case study of the farmers in Mueang Mai Subdistrict, Amphawa District, Samut

Songkhram, found that the factors influencing changes in way of life of those farmers were: 1) development policy in education where the government required more juveniles to be educated in compulsory level; 2) lack of production labors for coconut palm, 3) origination of industries turning people into new occupations, 4) convenient communication and transportation causing modern fruit planting farmers to have urban-based value. However, since governmental officials and local leaders still recognized importance of coconut farming and coconut palm production because this was original occupation and unique to the population of Amphawa District, they then encouraged those people by methods such as making good sense of agriculturalists to love their occupation, financial support, provision of good coconut varieties for agriculturalists, issuance of quality assurance certificate of sugar produced by plantation farmers for consumer confidence, and supporting on agriculturalist grouping. Regarding problems and obstacles in occupation promotion for those farmers who produced coconut palm, it was found that there were problems in their values to encourage their descendents to get higher education to avoid being a farmer because they realized that this occupation was troubled, farmer assembly, lack of household labors, contaminated coconut palm, production yield marketing of coconut palm, and destruction of coconut trees by pest insects.

Suwannee Pornpanarom (2005: 72-73) mentioned about wisdom attributes of farmers in Suphan Buri by studying literatures during 1967-1976 in Uthong zone at the time of floating rice variety which was a rice variety capable of adjusting its height according to water level. This allowed the rice not to be sunk or rotten, which were unique characteristics of this variety of rice. However, since start-up of irrigation project, farmers could only grow rice for more than once a year. Importantly, this helped farmer be able to grow rice of Kor Khor variety developed by a foreign country. This was considered a start point in importing foreign rice varieties to grow, develop for optimization, and prevail throughout Thailand. However, since the Kor Khor variety could not be grown in flooded areas, farmers needed to pay for land adjustment, fertilizers, and chemicals so that a higher amount of yields were produced to supply markets. In addition, since farmers were more likely to use seeds developed by organizations than maintain original rice seeds, there was no affirmation who still kept this variety and grew original varieties.

Pongsa Chunam, Somkiat Tansakun, and Chakrit Punsawaskitti (2001), according to the research on a management, production, marketing and conservation of indigenous wild vegetables: a case study of Ban Bokfire Indigenous wild vegetables gathering group, Paksong Subdistrict, Phato District, Chumphon Province, found that the whole population in the village were directly involved in indigenous wild vegetables because they were resorts of values and advantages of diversity and multi-dimensional complication of each other. One aspect of management was paying respect to nature where humans used opportunities and wisdom in exploitation there from for their self-sufficient survival, security, sustainability, and generosity to everything. The accumulated wisdom and knowledge was transferred from generation to generation in a grateful manner, and resulted in preservation of indigenous wild vegetables which were food and herbs indicated by local wisdom that they were medicaments according to Thai cultural knowledge. This reflected knowledge and understanding of sustainability of the forests surrounding the community and realization in values of several wild vegetables by making them grown in their land and breeding them so as to increase indigenous wild vegetables of Ban Bokfire. This management led to diversity and well increased future yields of the community.

Chanin Wasinondh, Surapin Khaokhan, and Yipsy Chanpengpen (2008), in the study of marketing information of lower basin Songkhram River at district level market: a case study of Akat Amnuai District market in Sakon Nakhon Province and Si Songkhram District market in Nakhon Phanom Province, found that resources in Songkhram River Basin dramatically decreased; thereby influencing high decrease of plant and animal biodiversity. Consequently, it turned back to a big focus on ancient wisdom because in the past time, if there had been a campaign to allow the involved parties in Songkhram River Basin to focus on local wisdom for conservation and recovery of resources therein, sustainable increase and existence of those resources could be continued. However, according to the study of consumer behaviors, it was found that the majority of consumers was in the middle age and lived their life as villagers, which influenced the future needs of resources in Songkhram River Basin. Especially, local vegetables were less consumed because there were no new consumers in succession. The consumers of new generation turned to consume more vegetables according to modernity instead. Therefore, to maintain the market for local

vegetables of Songkhram River Basin in the future would need a campaign for value realization in consumption of natural and uncontaminated local vegetables so as to further maintain future sustainability of local vegetable consumption.

Tawin Thongsin (2000: 86-87 cited in Patcharawadee Kamrod, 2007), in a study of coconut palm farmers: a case study of coconut palm farmers in Bang Khae Subdistrict, Amphawa District, Samut Songkhram, found that the factors affecting occupation change of professional coconut palm farmers were internal factors: i.e., lack of labors for assistance and succession, boredom, and dangerous risks from occupation; and external factors: i.e., neighbor persuasion to change their occupation, lack of determined governmental supports, low price of coconut palm, and market intervention by impure sugar.

From literature review of associated researches on fruit cultivation and production of farmers in localities, the researcher found that both internal factors and external factors affect the conservation. For external factors, the researcher focused on requirement system affecting market price, and public or private sectors encouraging accessible channels to support agriculturalists. For internal factors, in addition to topographical suitability for fruit cultivation, potentiality of agriculturalists itself was important to self-management of plantation based on multi-dimensional views, ideas, or standpoints influencing agriculturalist capability in refinement of information from easily accessible external system. Further to these factors, the researcher also found that the researches in these aspects had not enough significance to support the conservation of plant varieties on agricultural lands.

2.8 Associated variables in research

1) Gender of agriculturist

According to the study of knowledge and practice on coastal natural resources and environmental conservation of grade 9 students in Trang Province by Thidarat Thananan (2009), the research mentioned about the relationship between basic factors and knowledge on conservation of coastal natural resources and environments in that gender was significantly related to knowledge on coastal natural resource conservation at the statistical level of 1.

Supornchai Mangmeesit (1992), in a study of people participation in the non-governmental organization community forests management project: a case study of the project initiated by the CBIRD in Ban Phai District, Khon Kaen Province, found that gender was a factor significantly affecting participation of the villagers in community forest management at the statistical level of 0.05.

2) Age of agriculturist

Age is important in learning and practices adopted from surrounding people and environments. According to the study of Beaver and Parted (Cited in Pitsamai Wibulswasdi, 1985: 262), it was found that increase of age resulted in more social communication, reasoning, and social learning depending on circumstances. In the study of the Participation in River conservation: a case study of Tha Chin River, Nakhon Chai Si District, Nakhon Pathom Province led by Warat Yantassanakit (2005), it was found that age of the sample was positively related to the participation in conservation of Tha Chin River in aspects of decision making and practices/operations.

3) Education level of agriculturist

In a conservation-based research of Hmong, ways of life, and uses of ways of life, and uses of natural resources, Chiang Mai Province of Wutthichat Sriphaphlern (2002) by studying conservation behaviors of natural resources, it was found that education level was positively related to conservation behaviors of soil and forests. Otherwise, in the research on participation of prawn farmers in mangrove forest conservation in Surat Thani Province, Thailand of Pratak Intarakanneod (1996), one of the factors significantly related to participation in mangrove forest conservation activities was education level.

Ben Ja Somprakob (2005), in the evaluation of plant conservation project, rajamagala institute of technology: a case study of village 5 and village 6 areas, Phluang Subdistrict, Khao Khitchakut District, Chanthaburi Province by studying the relationship between evaluation of plant conservation project with personal information, found that education level was significantly related at the statistical level of 0.05.

4) Number of family members

Surayud Limtrakul (2001) found that the factors influencing people participation in forest conservation of Ban Huay Saphan community forest in a statistically significant manner were the number of family members and the number of cultivated lands.

Somnuk Chaiyatham (1999), in the research of forest resource conservation of Karen in Chiang Mai Province, found that the Karen hill tribe had knowledge and understanding in cultivation of plants capable of preventing ground collapse, enhancing ground surface, and maintaining water sources. In hypothesis testing, the number of family members was related to forest resource conservation.

5) Living time period

Surayud Limtrakul (2001) found that Living time period in the village and utilization of community forests were factors influencing people participation in forest resource conservation of Ban Huay Saphan community forest in a statistically significant manner.

6) Hometown

Domicile is one of the societies refining humans to be same or different. According to Supatra Supap (1987), it was mentioned that hometown was related to beliefs, reactions, traditions, and criteria of particular groups or societies, in a manner that the behavioral relationship corresponded to a particular group of different patterns, cultures, and ways of life.

Chaiyaporn Wichawut et. al. (1988) studied ethics in the current Thai society and found that domicile regions of respondents significantly affected social behaviors and ethics at the statistical level of 0.05. That is to say, the sample whose hometown was in the central region had the highest level of behaviors and ethics.

7) Orchard area

Supornchai Mangmeesit (1992), in a study of people participation in the non-governmental organization community forests management project: a case study of the project initiated by the CBIRD in Ban Phai District, Khon Kaen Province, found that the size of possessed lands was a factor affecting villager participation in community forest management. In the study, it was found that the variable was

significantly related to the villager participation in community forest management at the statistical level of 0.05.

Somnuk Chaiyatham (1999), in the research of forest resource conservation of Karen in Chiang Mai Province, found that the Karen hill tribe had knowledge and understanding in cultivation of plants capable of preventing ground collapse, enhancing ground surface, and maintaining water sources. In hypothesis testing, the number of possessed lands was related to forest resource conservation.

8) Number of workers

Warotai Kosolpisitkul (2007) mentioned in the article about debts of agriculturalists in the Thai country that the average age of sample agriculturalists was of 51 years which was considered moderately high, and their descendents did not work in the agricultural sector. This indicated that, in the future, the number of agricultural labors would decrease, and this would affect agricultural policies of the country.

Somnuk Chaiyatham (1999), in the research of forest resource conservation of Karen in Chiang Mai Province, found that the Karen hill tribe had knowledge and understanding in cultivation of plants capable of preventing ground collapse, enhancing ground surface, and maintaining water sources. In hypothesis testing, the number of agricultural labors was related to forest resource conservation.

9) Occupation

According to the study of knowledge and practice on coastal natural resources and environmental conservation of grade 9 students in Trang Province by Thidarat Thananan (2009), the research mentioned about the relationship between basic factors and knowledge on conservation of coastal natural resources and environments in that occupation of the parents was significantly related to knowledge on coastal natural resource conservation at the statistical level of 1.

Suwannee Kongthong (1993), in the study of people participation in the conservation of the community mangrove forest in Sikao District, Trang Province, concluded that the factor dominantly related to people participation in mangrove forest conservation of local community was occupation.

10) Income

Income is one of the factors necessary for living, and it is a determinant of opportunities in utilization of resources and acquisition of services. Therefore, income affects different alternatives of practices as seen in the research on knowledge and practice on coastal natural resources and environmental conservation of grade 9 students in Trang Province of Thidarat Thananan (2009). The research mentioned about the relationship between basic factors and knowledge on conservation of coastal natural resources and environments in that total income of family was significantly related to knowledge on conservation of coastal natural resources and environments at the statistical level of 1 from statistical analysis in the research of Kasem Chattakul (1990), it was found that proprietary right of land, agricultural asset, and income was related to acceptance of modern techniques in soil and water conservation.

11) Information exposure

From the research on factors influencing herbicide-using behavior in para rubber orchard: a case study of Phatthalung Province, Thailand made by Paibun Chaikaet (1995: 146), it was found that training on the use of herbicides and other pesticides significantly affected different behaviors to use herbicides in para rubber orchards at the statistical level of 0.05. That is, the trained farmers used the herbicides for para rubber orchards in a more accurate manner than those not trained. Pongsak Chat Techa (1997), in the research of people participation in forest resources conservation at Mae Tho National Park, Hot District, Chiang Mai Province, found the relationship between independent factors and participation in forest resources conservation. It was found that exposure to forest information was related to the villager participation in forest resources conservation. Also from a comparative study of information reception, knowledge, attitude and participation in forest and watershed rehabilitation between Lisu Hill tribal Ban Huai Nam Dang, Ban Huai Nam Ru Doi Sam Mun with lowland people Ban Mae Lao in Mae Tang District, Chiang Mai Province, made by Charupat Thawarorit (2001), it was found that information exposure was related to knowledge on rehabilitation of forests and water sources. From the research on media exposure, knowledge, awareness, attitude, and participation in environment conservation of people in Bangpoo Industrial Estate, Samut Prakan Province, made by Pinyaporn Penpinan (2001), it was found that

information exposure on environmental conservation positively was related to knowledge and realization in environmental conservation; and that information exposure on environmental conservation was positively related to participation in environmental conservation.

12) Attitude

Gordon W. Allport (Cited in Pitsamai Wibulswasdi, 1985: 81) mentions that attitude is a mental state making people always ready for responding to the environment. This nature is caused by experience and being an orientation that each individual responds to related things and events. In addition, Oscamp (cited in Thawin Tarapot, 1989: 47) mentions about significance of attitude which can be concluded that attitude is a cause of behavior that one acts to other people or things. Psychologically, attitude is preparation of interesting focus points in aspect of viewpoints, which are natural phenomena and behaviors.

From the research on media exposure, knowledge, awareness, attitude, and participation in environment conservation of people in Bangpoo industrial estate, Samut Prakan Province, made by Pinyaporn Penpinan (2001), it was found that attitude toward environmental conservation was positively related to participation in the environmental conservation.

Tawin Thongsin (2000: 86-87 cited in Patcharawadee Kamrod, 2007), in a study of coconut palm farmers: a case study of coconut palm farmers in Bangkhae Subdistrict, Amphawa District, Samut Songkhram, found that the factors affecting occupation change of professional coconut palm farmers were internal factors: i.e., lack of labors for assistance and succession, boredom, and dangerous risks from occupation; and external factors: i.e., neighbor persuasion to change their occupation, lack of determined governmental supports, low price of coconut palm, and market intervention by impure sugar.

It is concluded that associated factors in researches according to the aspects of fruit tree biodiversity, wisdom, and factors affecting conservation are economic and social factors in a household level such as gender, ages, living time period, hometown, number of family members, educational level, orchard area, number of workers, occupations, incomes from orchard, other incomes, expenses, and orchard management duration, frequency in information exposure, and other related

attitudes. Internal factors in agricultural community are ways of life and wisdom of farmers; while external factors in economic and social aspects of the community are governmental intervention, market system, labor, urban expansion, industry, tourism, as well as attitude factors concerning fruit tree biodiversity.

CHAPTER III
METHODOLOGY

The research study focused on the preservation of fruit tree species, varieties, and ecosystem which were still well retained by the local framer of orchards in Samut Songkhram. Although, most of people are interested in the loss of biodiversity of various plants which leads to the increase of plant preservation, previous relevant researches revealed that both internal and external factors still affected fruit tree species and varieties chosen for preservation or neglecting.

The research study on the issue of fruit tree biodiversity in Samut Songkhram was conducted by using the mixed method between qualitative and quantitative study. Its objectives and conceptual framework emphasized the diversity of fruit tree species, varieties and ecosystem. It was also the study on growing pattern, selection, preservation of local fruit tree species, ways of living, and local wisdom of agriculturist. Moreover, it analyzed the factors at household level, factors of attitudes, including the external factors affecting plant selection, species abandonment, fruit tree varieties in each ecosystem, including the overview of fruit tree biodiversity. The main components of the research methodology in the research are shown as follows:

3.1 Study areas

In this research study, the study areas were in Samut Songkhram. Its outstanding and appropriate characteristics of this province were the diversity. The administrative division of Samut Songkhram is divided into 3 districts and 36 subdistricts (284 villages) (Agriculture Office, Samut Songkhram Province, 2009) as appearing in the map below.

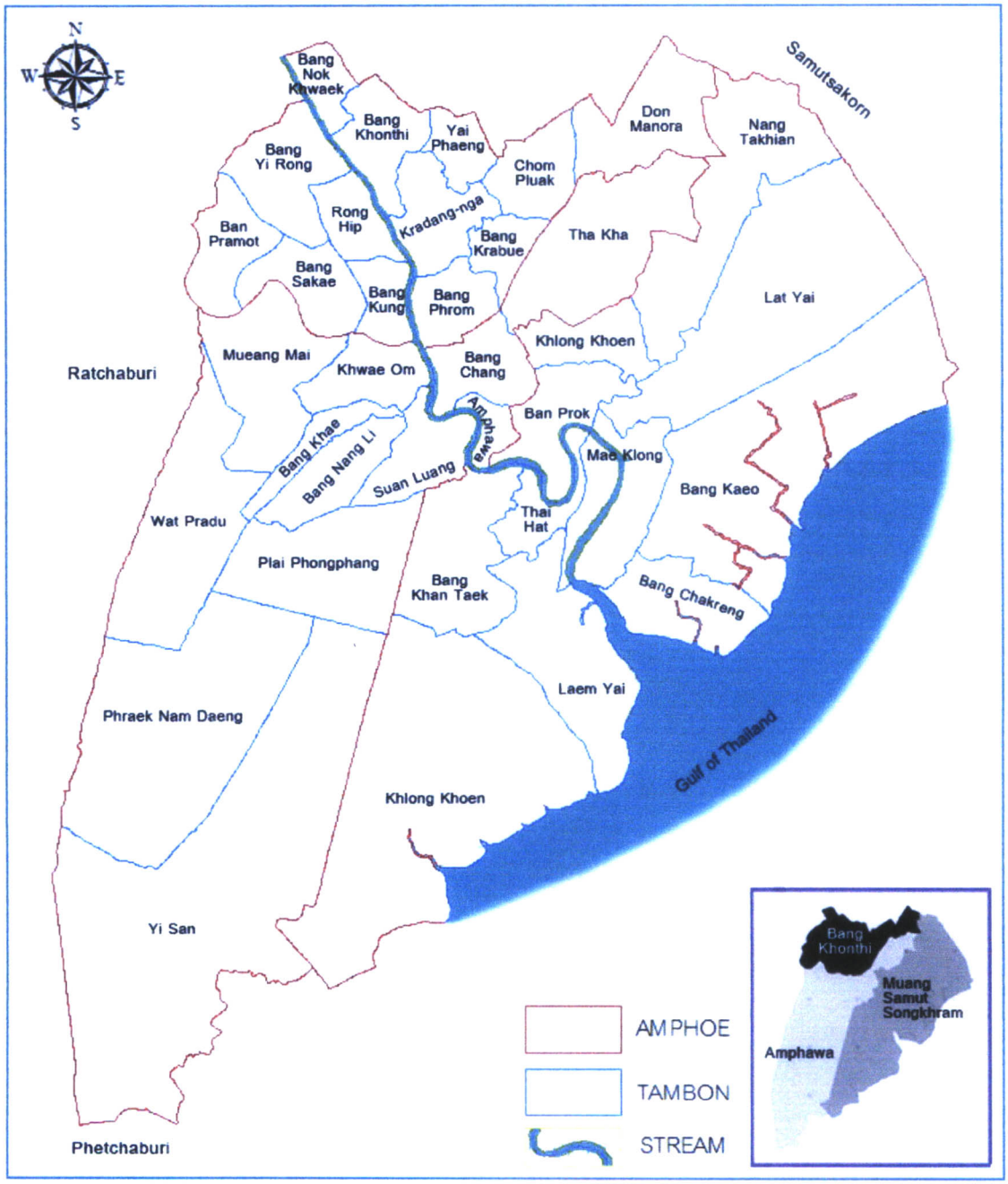


Figure 3.1 Map of Samut Songkhram

Source: Google Map of Thailand, 2009

3.2 Methods

Table 3.1 Research methods

Research method	Research methodology	Expected results
Problem identification	1. Primary and secondary data	Understanding the problem of the loss of biodiversity
Problem identification	2 Literature review, study the relevant concept and relationship to the research	Theories for fruit tree biodiversity preservation of agriculturists
Research design	3. Study the conceptual framework for fruit tree diversity	Conceptual framework for the study of fruit tree biodiversity
Selection of the areas to be studied	4. Primary and secondary data	The appropriate areas to be studied (Samut Songkhram)
Data collection	5. Questionnaires on fruit tree species, varieties and ecosystem 6. Interview 7. Observation with and without participation within the group of fruit tree growers and relevant people 8. In-depth interview with relevant local people	The data on fruit tree diversity, factors affecting fruit tree diversity at household level and in-depth interview at district level including the overview of fruit tree diversity at province level
Data analysis	9. The relationship analysis of the factors important to the fruit tree biodiversity	Relationship, significance, factors affecting the local fruit tree diversity
Conclusion	10. Conclusion of data analysis and data collection	Conclusion of the relationship of factors affecting the diversity of the fruit trees in the study area

3.3 Quantitative data

The quantitative data according to the main objectives of the study were (1) to study the varieties, species, and ecosystems agricultural of fruit trees grown in the study area and (3) to analyze the factors affecting agriculturist household in the conservation of fruit tree biodiversity, factors regarding socioeconomic at household level as well as the factors about the attitudes towards the fruit tree biodiversity.

3.3.1 Target population

3.3.1.1 Sample size

In the study of fruit tree diversity, the researcher then selected the agriculturists from 15,252 households in Samut Songkhram with Taro Yamane method and 95% of reliability.

$$n = \frac{N}{1 + Ne^2}$$

n stands for sample size of agriculturists

N stands for number of the target population (15,252 households)

e stands for error probability (0.05)

$$n = \frac{15252}{1 + [15252(0.05)^2]}$$

$$n = 390$$

From the sampling in Samut Songkhram, the agriculturists from 390 households were selected.

3.3.1.2 Sampling

By considering the sample of the agriculturists from 390 households, the researcher used the following sampling method.

1) Multi-stage sampling: the population was divided into many stages according to the subdivision. The sampling was conducted from the district level until the household level (three-stage sampling). The subjects from 390 households, 31 villages, 9 subdistricts and 3 districts were selected from 15,252 households, 284 villages, 36 subdistricts, and 3 districts.

2) Data on map and the land use: the sampling was mainly conducted with the consideration of the land use. The researcher utilized the data of land use from the map of RTSD Royal Thai Survey Department (2000) and Land Development Department (2009) in selecting the areas to be studied at district and subdistrict levels, and used the economic fruit tree database in 2008 of Agriculture Office, Samut Songkhram Province (2009) in selecting the subjects.

3) Proportional division of the number of agriculturists in each stage from subdistricts until villages, the details of which are shown as follows:

$$n_i = (N_I/N)\ n$$

n_i	stands for	Sample size in each stage
N_I	stands for	Number of population in each stage
n	stands for	Sample size of agriculturists (390 households)
N	stands for	Number of agriculturists to be studied (15,252 households)

By sampling, the samples in the area at district level were chosen as shown in table 3.2 comparing the number of the population in Samut Songkhram.

Table 3.2 Number of sample of orchard households at district level

Districts	Number of population			Sample size		
	Number of districts	Number of villages	Number of households	Number of districts	Number of villages	Number of households
1 Mueang	11	87	4,522	3	9	116
2. Amphawa	12	101	5,872	3	9	150
3. Bang Khonthi	13	96	4,858	3	13	124
Total	**36**	**284**	**15,252**	**9**	**31**	**390**

Source: The important agriculturist data in the year of 2008 (Agriculture Office, Samut Songkhram Province, 2009)

Simple random sampling was conducted by randomly sampling the households at village level based on the sample size divided for the interview with the agriculturists.

3.3.2 Research tools

The qualitative data collection was conducted by collecting the data from 390 households of agriculturists in Samut Songkhram to study the factors related to the literature and also to study regarding the economy, society, attitudes towards physical characteristics relevant to growing fruit trees at household level. The variables used in this research are shown below.

Table 3.3 Variables used in the study of fruit tree biodiversity

Dependent variable

Dependent variable	Unit of measurement	Scale of measurement
Diversity of fruit tree species	Species	Ratio
Diversity of fruit tree varieties	Varieties	Ratio
Diversity of fruit tree ecosystem	System	Ratio

Household socio-economic factors

Independent variable	Unit of measurement	Scale of measurement
Gender	(Female/Male)	Nominal
Age	Years	Ratio
Living time period	Years	Ratio
Hometown	(Inbound/Outbound)	Nominal
Number of family members	Person(s)	Ratio
Educational level	Year(s)	Ratio
Area of salty, brackish, and freshwater	(Salt/Brine/Fresh)	Nominal
Orchard area	Rai(s)	Ratio
Number of workers	Worker(s)	Ratio
Agricultural occupation	(No/Yes)	Nominal
Incomes from orchard	Baht	Ratio
Other incomes	Baht	Ratio
Household expenses	Baht	Ratio
Savings	(No/Yes)	Nominal
Supporting organizations	(No/Yes)	Nominal
Descendant	(No/Yes)	Nominal
Orchard management duration	Year(s)	Ratio
The frequency of agricultural information acknowledgement	Frequency	Interval
Factors of attitudes towards fruit tree biodiversity	Scores of attitudes	Interval

3.3.2.1 Questionnaires on the diversity of fruit tree species, varieties, and ecosystem. The data was gathered from the sample households on the species, varieties and ecosystem of fruit trees grown or preserved in the studied areas. The ecosystem can be classified as follows:

1) Classified by biodiversity: monoculture plantation, multi-species plantation, and mixed species and varieties plantations

2) Classified by ecosystem management: growing patterns, orchard management to suit the plants and geography such as orchard with groove lifted

3) Classified by geographical characteristics and lands owned by agriculturist.

Principally, the fruit tree species and varieties were identified by the local names. After that, they would be presented with scientific names by using references.

3.3.2.2 The questionnaires about the factors and attitudes towards the fruit tree species and varieties as well as the factors relevant to the preservation of the fruit tree diversity in Samut Songkhram

Table 3.4 The questionnaires about the factors and attitudes towards the fruit tree species and varieties

Part 1 Personal data and particular information of each households

Objective	Variables	Question type
Number (3) To analyze the factors affecting agriculturist household in the conservation of species and varieties of fruit tree	- Gender - Age - Living time period - Hometown - Number of family members - Educational level - Area of salty, brackish, and freshwater - Orchard area - Number of workers - Agricultural occupation - Incomes from orchard - Other incomes - Household expenses - Savings - Supporting organizations - Descendant - Orchard management duration	Personal data and particular information of each household mainly referred to the variables in the research.

Part 2 Data on channels and the frequency of acknowledgement the information on agriculture and fruit tree biodiversity

Objective	Variable	Question type
Number (3) To analyze the factors affecting agriculturist household in the conservation of species and varieties of fruit tree	- The frequency of agricultural information acknowledgement	- Frequency of each channel for the agricultural information acknowledgement

Part 3 Data on the attitudes towards the local fruit tree biodiversity

Objective	Variable	Question type
Number (3) To analyze the factors affecting agriculturist household in the conservation of species and varieties of fruit tree	- Factors of attitudes towards fruit tree biodiversity	- Attitudes towards the local fruit tree biodiversity - Physical characteristics of the areas - Local fruit tree species - Abandonment of fruit tree varieties Ways of living and intellect External factors affecting growing fruit trees

Part 4 Data about fruit tree species and varieties

Objectives	Variables	Question Type
Number (1) To study the varieties, species and ecosystems, agricultural varieties of fruits tree grown in the area of the study area	- Fruit tree varieties - Fruit tree species	- Fruit tree species at household level - Fruit tree varieties at household level

3.3.3 Measurement and research tool quality testing

The research tools were questionnaires using both primary and secondary data of the study. Content validity were tested by the specialist (adviser) proof reading, advising in editing so that the content was suitable, clear and right to the point of the research. Then, the questionnaires were used to collect the data (Pre-test) in the selected areas - Samut Songkhram - and the samplings were conducted in the following aspects:

1) Multi-Stage sampling was conducted from the district level until the village level

2) The data of map and land usage

3) Simple random sampling was conducted to select the sample from households in each village chosen by multi-stage sampling

Table 3.5 Number of households to test the quality of the research

Districts	Sample size for tool test		
	Subdistricts	Village No.	Number of households
1. Mueang	Khlong Khoen	6	10
2. Amphawa	Suan Luang	9	10
3. Bang Khonthi	Kradang-nga	10	10

Source: The important agriculturist data in the year of 2008 (Agriculture Office, Samut Songkhram Province, 2009)

After the sample responded to the questionnaires to test the quality of research tool, the researcher then modified the questionnaires which mainly based on the attitudes as follows.

3.3.3.1 The quality of attitude measurement

1) To find the discrimination power in this study, the research used the measurement of the attitude towards orchard containing 5 levels: strongly agree, agree, neutral, disagree, and strongly disagree. After the agriculturists provided the attitudes to each study issue, the research gathered the scores and then ranked them into order which could divide the respondents into 2 groups: 1) Upper group and 2) Lower group. Then, the research used 25% of the highest score and the lowest score of each group to find the average score and the variances of each questionnaire item. Then, the average score and the variances were used to calculate discrimination power with the following formula. (Puangrat Taweerat, 1995: 132 as cited in Patcharawadee Kamrod, 2007; Sin Panpinitch, 2004: 198 as cited in Warunyupa Tongklom, 2007)

$$t = \frac{\bar{x}_h - \bar{x}_l}{\sqrt{\frac{s_h^2}{n_h} + \frac{s_l^2}{n_l}}}$$

t stands for value of discrimination power

$\bar{x}_h$ stands for average score of upper group

$\bar{x}_l$ stands for average score of lower group

s_h^2 stands for variances of upper group

s_l^2 stands for variances of lower group

n_h stands for number of samples in upper group

n_l stands for number of samples in lower group

According to the criteria of the discrimination power type t, the discrimination power must be greater than or equal to 1.75 and contain 36 items of the attitude measurement: 22 items for positive questionnaire and 14 for the negative ones. After finding the discrimination power, 6 items not passing the criteria (item no. 2, 19, 20, 21, 33, 34 and 36). Hence, there were 19 remaining positive items and 10 negative items or 29 items altogether (Appendix).

2) To test the reliability, the researcher used Cronbuch method which was α coefficient presented below (Puangrat Taweerat, 1995 as cited in Patcharawadee Kamrod, 2007)

$$\alpha = \frac{N}{N-1}\left(1 - \frac{\sum s_i^2}{s_t^2}\right)$$

α stands for Reliability coefficient of measurement tool

$\sum s_i^2$ stands for Total variance of score of each item

s_t^2 stands for Variance of the scores from every item

N stands for Number of items or lists used for measurement

In the item to measure the attitudes, the 'reliability measure' value is greater than 0.7 (Patcharawadee Kamrod, 2007). After the efficiency analysis of the attitude measurement, the reliability equals to 0.85 (Appendix).

3.3.3.2 The measurement of attitudes towards fruit tree biodiversity

The measurement of attitudes was conducted by using the questionnaires with Likert scale containing 5 scales: strongly agree, agree, neutral, disagree, and strongly disagree (Sin Panpinit, 2004: 152-153 as cited in Warunyupa Tongklom, 2007). The measurement of the attitudes towards the fruit tree biodiversity was divided into 3 levels: positive, neutral and negative attitudes. There were 19 items to assess the positive attitude with high score each but 10 items for negative attitude with low score each. Then, the researcher averaged the score for each item and interpreted the average scores. The interpretation used the same criteria as the scoring (Boonchom Srisa-ad, 1992 as cited in Patcharawadee Kamrod, 2007).

Table 3.6 Level of attitude measurement, scoring, and agreement

Types	Attitude level and scoring				
	level 1	level 2	level 3	level 4	level 5
	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Favorable statement	5	4	3	2	1
Unfavorable statement	1	2	3	4	5
	Average score of each agreement level				
Level of agreement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Score of agreement	4.51 – 5.00	3.51 – 4.50	2.51 – 3.50	1.51 – 2.50	1.00 – 1.50
Level of agreement	Positive attitude		Neutral attitude	Negative attitude	
score of agreement	3.51 – 5.00		2.51 – 3.50	1.00 – 2.50	

3.3.4 Data analysis

3.3.3.1 The arrangement of the data on fruit tree species and varieties

1) Descriptive approach analysis was conducted by using the program called SPSS (statistical package for social science) and Microsoft office excel to alter the data into percentage, mean and standard deviation. The analyzed data was then used to analyze the factors affecting fruit tree species, varieties and ecosystem.

2) Fruit tree biodiversity

- The diversity index of Shannon-Wiener (Shannon-Wiener's Index, H), Ludwig and Reynolds (1998)

$$H = - Sum (P_i) (\log P_i)$$

- The species consistency value of Shannon-Wiener (Shannon-Wiener's Evenness Index, E_h)

$$E_h = H / \ln S$$

$$\text{With } P_i = \frac{\text{Number of plants at initial number of organism at n}}{\text{Total number of plants}}$$

S = Species Richness (Total species in the areas)

E_h ranged from 0 to 1 (The largest score was 1 meaning that there was equal number of plants and tree or even dispersion)

3.3.3.2 The analysis the factors affecting fruit tree species and varieties

The research used the program SPSS and Microsoft office excel to analyze the quantitative data aimed to study the relationship among significant factors.

1) Descriptive approach analysis: the researcher used percentage, average score, standard deviation and ranking method with weighting.

2) Multiple regression analysis was conducted to assess the relationship among the factors of household socio-economy and the factors of attitudes affecting the diversity of species and varieties of local fruit trees.

3.4 Qualitative data

The qualitative data according to the objective number (2) to study the life and local wisdom cultivation of agriculturist, including patterns of plant selection and storage of fruit tree species in the study area. The relevant factors were the internal factors about the orchard culture and the external factors about the socio-economy of that community.

3.4.1 Target population

For the variety of qualitative data, the qualitative selection of the target sample from the population was conducted by using the following methods.

3.4.1.1 Purposive sampling: The target population of this sampling was those who related to fruit trees, i.e. district agricultural extension offices, community leaders, agriculturists, local people with the network of agriculturists or relevant network. To obtain the data according to the study objectives, the criteria in the sampling was established.

1) **Criteria in selecting agriculturists**

   Having more than 30 years of orchard experience

   Living during the construction of Srinakarind Dam in the year

   Being knowledgeable about fruit tree

   Being familiar with the areas and the change regarding fruit trees

   Growing many species and varieties of fruit trees or growing fruit trees in the rare or preserved areas

   Being knowledgeable about ways of living and intellect of orchards

2) **Criteria in selecting district agricultural extension offices**

   Working in the areas for a long period

   Being knowledgeable about the history of the local fruit trees

   Being knowledgeable about plans and policies promoting growing fruit trees

   Having relationship with fruit tree growers

   Understanding the current areas influenced by the downtown

3.4.2 Data collection

3.4.2.1 Literature study

Documents and books containing the data about local culture, e.g. the history of the local areas having the relationship with orchard

Relevant researches about the fruit tree growing in Samut Songkhram

Statistical data of Samut Songkhram, documents and the data from the website of the relevant organizations

3.4.2.2 The observation with and without participation

The observation without participation was conducted when the researchers only observed the data in the normal situation. The researcher did not participate in any activities of villagers'; the observation with participation was conducted when the researcher formally introduced herself, informed the villagers about the data collection and participated some activities of the villagers to collect the significant data according to the objectives of the research as follows:

- The dispersion of fruit tree
- Characteristics of orchard management (e.g. groove lifting and maintenance)
- Growing pattern (monoculture or mixed species plantation)
- Orchard methods (e.g. applying technology)
- The types of local fruit trees and fruit trees surrounding the living places
- Community relationship (e.g. kinship relation)
- Support from the organizations outside the community (government and other sectors)

3.4.2.3 In-depth interview between the researcher and key informants

- The land of the orchard in the past (as far as the informant could remember) up until now
- Selecting the fruit tree species and varieties to grow
- Growing plan and maintenance

- Endangered fruit trees and fruit trees needed to be protected
- Ways of living of farmers in the present and in the future
- Intellect about the fruit tree such as selection, consideration, preservation, ruling (belief, ritual, moral) depending on the relationship of relatives and thinking for living as well as occupation, and transferring to the people in the next generation both at household and community level.
- Production price affecting fruit tree selection of orchard and the domestic and oversea market
- Labor shortage and following agricultural profession of the next generation
- Policies and the result of promoting the agriculturists in manufacturing, knowledge, and technologies
- The results of the external factors, e.g. culture in urban cities, dam construction, the participation of government sectors, problems affecting fruit tree diversity and some measures
- Other internal and external factors affecting the change in local fruit tree species and varieties

These questions were the main points of the interview. They varied according to the local fruit tree species, studied areas and informants. The researchers might add some questions up to the situations during the interview.

3.4.3 Data analysis

The researcher was to analyze the current situations of the overall fruit tree biodiversity in the country and the studied areas – Samut Songkhram – and also analyze the variables being relevant factors including the conceptual framework. The criteria for the analysis consisted of the following.

3.4.3.1 Content analysis

The researcher analyzed the data from the literature review which resembled academic journals in the issues of biodiversity, agricultural ecosystems, fruit tree biodiversity, problem issues, subcontract concerning

biodiversity, local wisdom, agricultural preservation, relevant researches for overall understanding and the ability in identifying the factors affecting fruit tree biodiversity in the present as well as in the future.

3.4.3.2 Inductive analysis

This part was to analyze the key issues from the field work to study the area for growing fruit trees, growing plans, maintenance, local wisdom, orchard management, preservation, abandonment from the past until the present, government intervention, the results after supported by the government and private organizations, the changes resulted from urban expansion, the change of policies promoting the orchard management about preparing for the external factors, labor shortage, and the market system from the in-depth interview with district agricultural extension offices, agriculturists, as well as relevant people including the overall area analysis from the observation with and without participation in the studied areas in Samut Songkhram.

3.4.3.3 Mind mapping

The mind mapping connecting thought and data relationship of each study point from the literature review and field work

CHAPTER IV
SAMUT SONGKHRAM'S LOCAL ORCHARD COMMUNITY

In this research talks about general details of Samut Songkhram Province which are very important for information analysis along the purpose of researching diversity of fruit tree, knowledge and basic factor effected of change.

4.1 General information of Samut Songkhram

Samut Songkhram is a small province which has less area in Thailand about 416.707 square kilometers or 260,441.87 rais. The province located in the middle region of Thailand on west side near gulf of Thailand (Committee of Documents and Archival Processing).

In the north, Samut Songkhram is located near Ratchaburi and Sumut Sakorn Province, on south near Gulf of Thailand and on the east side is located near Samut Sakorn and west side near Petchaburi and Ratchaburi. It is not far from Bangkok, capital of Thailand, as we can see from the map of Samut Songkhram. The province is between Samut Sakhon and Bangkok and can travel by car using the road 35 Thonburi – Pakthor which will take one hour about 65 kilometer.

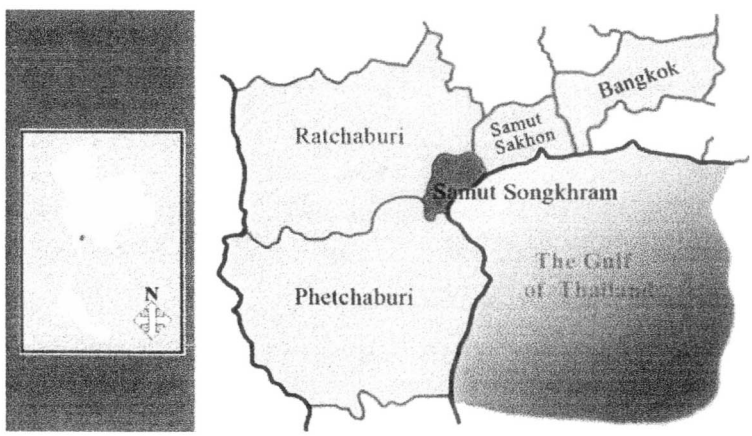


Figure 4.1 Map of area adjacent to Samut Songkhram Province

Source: Department of Mineral Resources, 2004



Figure 4.2 Map of Samut Songkhram

Source: Google, Thailand map, 2009

Government location

The government of Samut Songkhram divided in 3 districts 36 tambons and 284 villages

1) Mueang Samut Songkhram District has 169.057 square kilometer from 40.57 percentage of whole area

2) Amphawa District has 170,164 square kilometer from 40.84 percentage of whole province

3) Bang Khonthi District has 77,486 square kilometer from 18.59 percentage of whole province

Table 4.1 The boundary of Samut Songkhram

District / Subdistrict	Government authority			Local government			
	Tambon	Village	Household	Municipality		District administration organization	
				Mueang	Tambon	Medium	Small
Mueang	11	87	23,602	1	-	2	8
Amphawa	12	96	14,262	-	2	-	11
Bang Khonthi	13	101	9,352	-	2	-	9
Total	**36**	**284**	**56,216**	**1**	**4**	**2**	**28**

Source: Department of Provincial Administration Reference Group Strategic Development, Samut Songkhram Province, 2009

Local administration

1) One provincial administration is Samut Songkhram Provincial Administration
2) Five municipalities

- Mueang Samut Songkhram District is Samut Songkhram Municipality
- Amphawa District is Amphawa Municipality and Mueang Mai Municipality
- Bang Khonthi District is Bang Nok Kwaek Municipality and Kradang-nga Municipality

3) Local administration 30 place

- Samut Songkhram, District 10 local administrations
- Amphawa District, 11 local administrations
- Bang Khonthi District, 9 local admnistrations

Population

In the year of 2008, Samut Songkhram has population 194,054 people. By among of men population are lower than women population. Male populations are 93,331 people and women populations are 100,723 people in total of 48 and 52 percentages from 76 provinces in Thailand. Among of population of Samut Songkhram is the 75th of Thailand and Ranong Province is the lowest population and highest is Bangkok as following details on Table 4.2

Table 4.2 Total population and households in Samut Songkhram in year 2008

Rank	Province	Total population and households			
		Male	Female	Total	House
	Total 76 provinces	31,255,869	32,133,861	63,389,730	20,608,269
1.	Bangkok	2,722,313	2,988,570	5,710,883	2,263,680
75.	**Samut Songkhram**	**93,331**	**100,723**	**194,054**	**56,216**
76.	Ranong	95,313	87,416	182,729	67,835

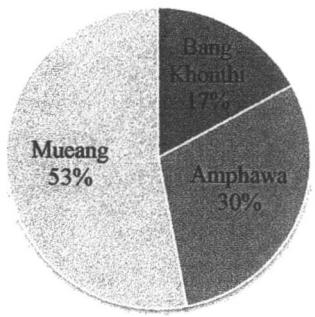
Source: The Bureau of Central Registration, Department of Provincial Administration, 2008

The district which has highest population is Mueang District in percentage of 53. The second is Amphawa District and Bang Khonthi District in the percentage of 30 and 17 accordingly. The table 4.3 shows among of population in 10 years trend to be changed by social which is population will be decreased but housing will be increasing.

Table 4.3 Population and households separated by gender and district in year 2008

District	Total of population classified by gender and district			
	Male	Female	Total	Household
Mueang Samut Songkhram District	35,676	37,856	73,532	22,927
Mueang Municipality	14,151	15,876	30,027	9,675
Total of Mueang District	**49,827**	**53,732**	**(53%) 103,559**	**(58%) 32,602**
Amphawa District	23,981	25,400	49,381	11,925
Mueang Mai Municipality	1,058	1,115	2,173	666
Amphawa Municipality	2,659	2,948	5,607	1,671
Total of Amphawa District	**27,698**	**29,463**	**(30%) 57,161**	**(25%) 14,262**
Bang Khonthi District	13,855	15,243	29,098	7,923
Bang Nok Kwaek Municipality	872	1,051	1,923	694
Kradang- nga Municipality	1,079	1,234	2,313	735
Total of Bang Khonthi District	**15,806**	**17,528**	**(17%) 33,334**	**(17%) 9,352**
Total all	**(48%) 93,331**	**(52%) 100,723**	**194,054**	**56,216**

Source: The Bureau of Central Administration Department of Provincial Administration, 2008



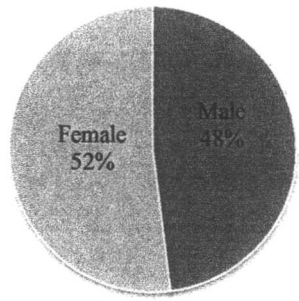


Figure 4.3 population classified by district **Figure 4.4 population classified by gender**

Source: The Bureau of Central Administration Department of Provincial Administration, 2008

Occupation and economic

According to geography in every province is suitable for agriculture. Most population about 70 percent does farming. Especially in Amphawa District which has greatest agriculture area. Secondly, Bang Khonthi District and following by Mueang Samut Songkhram District. The most important agricultural resources are coconut, lichee, pomelo and rice. There are also has inland fisheries, brackish fisheries and saltwater fisheries. Most manufacturing is a small industry about foods such as fish sauce industry, fish processing industry, agricultural product processing industry and so forth.

The highest among of industry is Mueang District about 208 factories following by Amphawa District about 35 industry and Bang Khonthi about 24 industries which total among of manufacturing in Samut Songkhram are 267 factories.

Economic condition in overall of Samut Songkhram expands slightly and fishery is a production sector in agricultural. It is the highest income of people in the city following by farming and processing foods

Land ownership and valuable of agricultural

Table 4.4 The summary of land use in Samut Songkhram in year 2009

Type of land use	Area (rai)	Percentage
Fruit trees	**113,430**	**43.55**
Aquaculture place	75,595	29.02
Local community and building	27,802	10.69
Other	16,381	6.28
Forest area	15,614	5.99
Water area	8,296	3.19
Field	2,265	0.87
Garden plants	1,059	0.41
Total	**260,442**	**100.00**

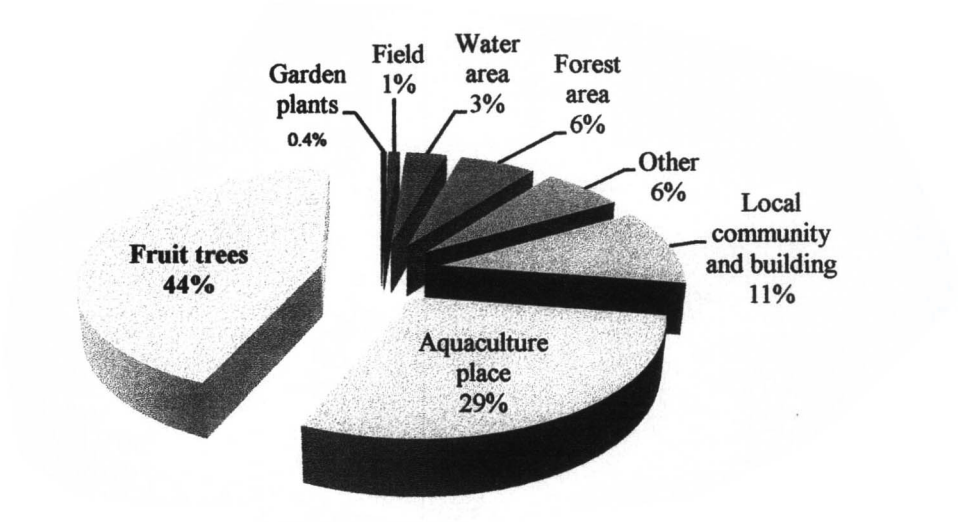


Figure 4.5 A ratio of land use in Samut Songkhram in year 2009

Source: Office of Soil Survey and Land Use Planning, 2010

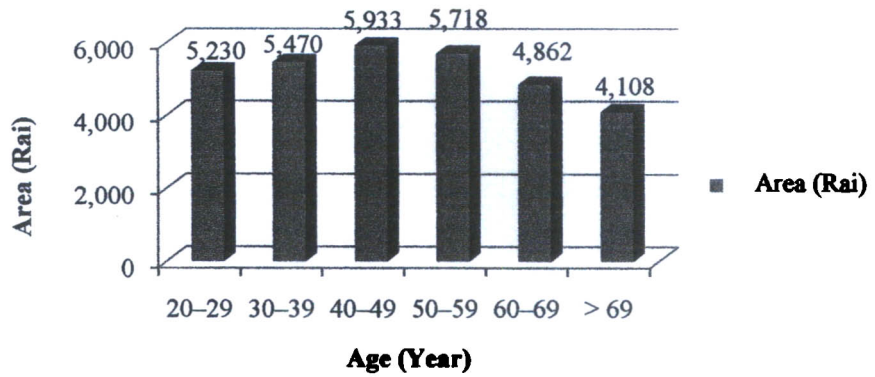


Figure 4.6 Category of land use for agriculture in year 2009 divided by ages of agriculturists

Source: Statistical Office, Samut Songkhram Province, 2004

Table 4.5 Agricultural land holding divided by title deeds in year 2005

District	Land holding divided by title deeds (rai)				
	Total	Title deed /Nor.Sor.5/ Nor.Sor.3/ Nor.Sor.3Kor.	Sor.Por.Kor.4-01/ Nor.Kor./Sor.Tor.Kor./ Kor. Sor. Nor	Nor. Sor.2/ Sor. Kor.1	No titld deed
Mueang	(25%) 15,468	15,340	111	16	1
Amphawa	(41%) 25,688	25,651	26	-	11
Bang khonthi	(34%) 21,600	21,586	8	-	6
Total	**62,756**	**62,577**	**145**	**16**	18

Source: Statistical Office, Samut Songkhram Province, 2005

Culture tradition and activities

Kao Yai pomelo festival, There is a belief that pomelo is a sacred fruit in Chinese beliefs. Chinese-Thai people are favor to pay respect to god or ancestor. The festival held in 2 periods firstly before Chinese's New Year and Ghost Festival during February to August. The purpose is to promote Kao Yai pomelo to be recognized widely and also will be another way to sale pomelo direct to consumer.

Lichee festival fist held in year 1967. At the first time the festival was arrange for local agriculturist make good relationship in the local community. The festival is well known and presently, the festival will be arranging when lichee blooms during early April to May at Amphawa District.

The art of making alto fiddle at Phaya-sor Village, the fiddle is a Thai traditional instrument for central region. Ban Phaya-sor isa village of making fiddle which takes art of Thai instrument mixed with beauty curving by using coconut. The extra curving has many pattern such as Fairy Tale character, flowers pattern, short name and constegation design.

Loy Krathong festival by banana leaf's Mae Klong is the custom that using material from banana trees to make floating Krathong. People will buy incense stick and dip in dammer oil. After that sun bathing them which will take 2- 3 days. After that, they will bring banana tree and cut it into a piece then take incense stick on banana trunk and wait until the full moon day, Loy Krathong day, People will bring Krathong on the boat and float them on the river. The light of Krathong shades beautifully along the river.

The main festival of Samut Songkhram. Mostly, people will bring fruits which are popular in city to participate and expand their product by completing competition ex. Celebration of His Majesty Buddha Loetla Nabhalai, Kao Yi San festival Amphawa District. Tawanron Don Hoiloard and Tuna festival and another festival in the cities.



Figure 4.7 Cultural tradition and fruit activities

Source: Samut Songkhram Provincial Office of Tourism and Sport, 2008 and researcher, 2009

Development strategy

The strategies of development guide of Samut Songkhram during 2010 - 2013 is the focus of attention as potential areas, resources in the area and also

including the local people in order to preserve the knowledge about the way of life, cultural and intellectual which is shown the basic features of this province and bring to the economy term. As it can be clearly seen by the vision of promoting Samut Songkhram which has been supported and developed as these following:

"*City of seafood and the center of the river shrimp, fruit safe from toxins, leisure and tourism hub of river conservation, national canal, people love the land of origin, safe the environmental and the great culture.*"

From the vision of the supporting development term in "Organic fruits" The process is focused on safety and the health of consumers directly and also study on the outer level to make it clearly understand, improve and adjust to make the business survive in the recent situation and economic growth. Using of organic material to promote agricultural production just to show the standards of the quality management practices and it is good for the agricultural crops GAP: Good agricultural practice as a bridge between the manufactures standards also the cleanliness and safety with revenue for the manufacturer and type. This is including the importance of the canals as well as participating in cultural heritage restoration sector and the development of tourism. This is a significant advantage in terms of economy of the province and the way to develop the conservation to sustainability.

4.2 Background of orchard in Samut Songkharm

Table 4.6 Summary of history of the orchards in Samut Songkharm

Year	Incident.
Census 2170 to 2320.	Ayutthaya appears orchard in Bang Chang.
Census 2352 to 2367.	Reign 2, appeared a " *Suan Nai Bangkok* " and " *Suan Nok Bang Chang*".
Act 2409.	Reign 4, digging of canals large and small period
Act 2448.	Starting of the railway line in the Mae Klong
Act 2507.	Mae Klong Yai irrigation project
Act 2512.	Growth of industry along the Mae Klong River.
Act 2516.	Create a Road Thonburi - Pak Tho.
Act 2520.	Srinakarind Dam was built and the problems affecting the marine orchard.
Act 2523.	Starting the marine protection project.

Table 4.6 Summary of history of the orchards in Samut Songkharm (cont.)

Act 2524.	Tha Thung Na Dam.
Act 2525.	Agriculturists have modified coconut trees planted pomelo and lychee.
Act 2528.	Dam Vajiralongkorn (Khao Laem Dam).
Act 2532.	Mae Klong Dam.
Year 2536 -2540	Gay and Linda wind storm destroyed the southern part of Thailand
Act 2540.	The condition marine affecting the pomelo and lychee.
Act 2541.	Promotion of agricultural tourism.
Act 2542.	How to change the government.
Act 2543.	Established in Ratchaburi electricity generating company.
Act 2546.	Problem squirrels destroyed crops
Census 2552 to 2553.	Global warming lead to reduced yields and uncertainty

Year 2170 - Year 2320 reign of King Prasat Thong, Ayutthaya. Third City was a town of Mae Klong, up to the town of Ratchaburi and next to the Town of Mae Klong River this area known as Bang Chang began to emerge the orchard. The plenty of vegetables and fruit trees especially mango, coconut and pepper, so that there was the market called Bang Chang Market. It was for exchanging the products among the agriculturists. At the Present Bang Chang is in the area of Amphawa, Samut Songkhram.

Census 2310 of Ayudhya the city lost to Myanmar State and the country was left because people migrated to escape the war. People finally expanded the area from east of the Mae Klong River where a small canal line and they started to live and it turned to be a community since then.

Year 2352 - Year 2367 the Reign 2 period was a peaceful time. Economic changed from monopoly economy to free trade. Most of the area next to the Mae Klong River area was a garden trees and fruit trees. It is well known as a out park as a garden, orchard west of the city of Thonburi. Sujit Wongtep, 2539: 110 reference from Aaporn Chansomwong, which in the early Rattanakosin period. Rivers routes have been developed because it is the main route of transportation within the city and taxation.

In the year 2409, the Reign 4 period started to dig "Damnoen Saduak" canal, linking the Tha Chin River and Mae Klong River which was made more convenient way of transportation for people. The canal began to dig from Pratunam Bang Yang on Tha Chin River side, Ban Phaeo District. Samut Sakhon Province. It

was as a route to connect the east side of Pasri Jareon Canal which is link from Tha Chin River to Bangkok. The river has flown out of the Chao Phraya River, that makes the city such as Samut Sakhon, Samut Songkhram, Ratchaburi west to Bangkok and Nakhon Chaisi travel easier. Furthermore, there were separate smaller canal to another 200 canals which it has become a commercial district for agricultural crops shopping and the key factors of the production. Also, these could make the trade routes of the western provinces to Bangkok or any other city.

In the year 2448, started to create the Mae Klong Railway line. It represents the beginning of the mainland transportation of the Mae Klong. This made more channel of the logistic, some seafood products and the fruits into the center of the city. This channel connected with the railway Pakceoongsan – Tha Chin Line (Samut Sakhon) (Sujit Wongtade, 1996: 127-128 as cited in Aaporn Chansomwong, 1998). Moreover, it has been continued to develop around Mae Klong area, Samut Songkhram in the term of trade, service as well as the government administration. As the mainland transportation routes has been develop since then, it played an important role among the cities by using the way of the river as a major way and gradually reduced to use the canal.

Since the year 2500 onwards the development of transportation is more advanced. It has been build more and there was a road Bang Phae – Damnoen Saduak which connected to Petchkasem road and it made Samut Sakhon Province has been develop because it is near the center of cultivation and the market in Damnoen Saduak District, Ratchaburi Province. The local people in the Mae Klong area still using the river as a major way which is connect to Damnoen Saduak road and the of the Mueang District, Samut Songkhram.

The year 2507, made the Mae Klong Yai irrigation project. This was to manage water resources in the Mae Klong River expand to the farmland. This was as a part of the context of the nation development. Since the first national economic development plan, the agricultural sectors were being encouraged to change in the way of production by increasing the production cycle "Tien" Park (Herbaceous plantation) that was grown under optimized for next season, flood changed to "Height" to grow vegetables in flood period.

The year 2508, the transportation from Damnoen Saduak can be connected to Samut Songkhram with the land route number 305 Bang Phae - Samut Songkhram.

The year 2512, the growth of the industry has been expanded from the capital city into along both banks of the Mae Klong. That made the water problems later and it was affect vegetable fruit tree crops which located in the coast rivers as well as the reduction in the diversity of species, some species of fish has been extinct.

The year 2516, school road has been created – Pak Tor has made the Mae Klong connected to a city which it link to Bangkok and also the south and the west. Some road separate and show the different area which was the upper part of the road was the salt farm and next was the coconut trees and vegetables in the order. The lower area of Mae Klong River and a seacoast was the salt farm and the sea fisheries (Chanthini Lerdjindasap, 1991 as cited in Aaporn Chansomwong, 1998).

The year 2520, Srinakarind Dam was built as a second dam on the Mae Klong River from the city of Kanchanaburi and water storage dam has been kept the water for three years and it also collected some water from the drought season so that the water become less salty. The high-salt conditions problem caused the orchard and coconut trees. (Surachit Shirawet, 2008) as well as fruit tree that could not tolerate to the salt, such as durian, mangosteen and other fruit tree so that some kind of fruit tree has lost itself in this period.

The year 2523, starting of the saltwater prevent project, Samut Songkhram. The road building, the blocking road from the sea and the canal gates were about 191 gates, which is a problem on the circulation of the lost water, trapped water immersion causes water pollution and these caused flooding during September – April. This problem played a big impact to the agriculturists and fishermen from three divided zones. Nowadays, there are many gates left open because of the people drain waste water out (Surachit Shirawet, 2008). Recently, this project has been improved the water-gate and the water solution.

The year 2524, Tha Thung Na is completed.

The year 2525 agriculturists have changed from planting coconut to pomelo and lychee. The year 2528, Vajiralongkorn Dam. (Khao Laem Dam).The dam brought lots of the benefits in terms of flood mitigation, the field of irrigation and agriculture, tourism and fisheries including the keep the good water Quality in the Mae

Klong protect the salt sea and water pollution in the summer. There is also the waste water from factories along both sides of the Mae Klong and the water release from the dam during the summer which has been improve the water quality and drive it for the electricity power.(Electricity Generating Authority of Thailand, 2009)

The year 2532 Dam Mae Klong, Tha Muang District, Kanchanaburi

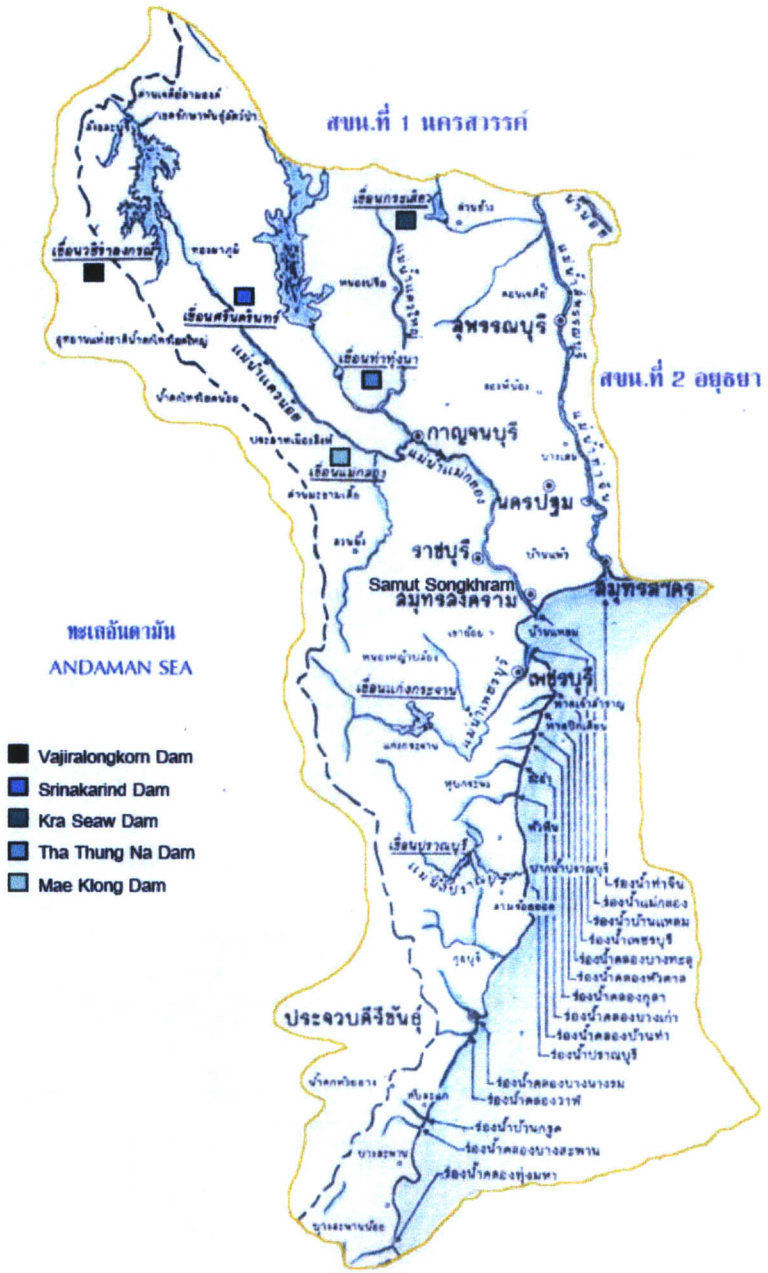


Figure 4.8 Location maps of rivers and dams

Source: Harbor Department, 2006

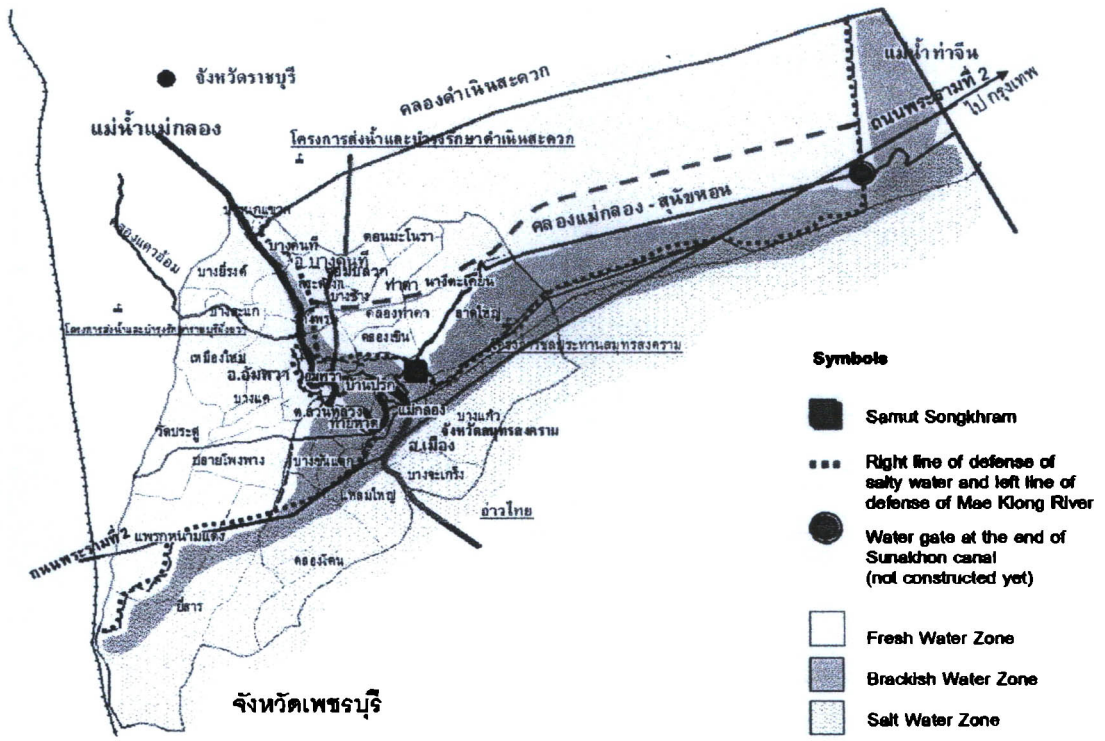


Figure 4.9 Map of boundaries of freshwater, brackish and salt water

Source: Irrigation Project in Samut Songkhram, 2006

Although the dam has various advantage in irrigation in both the west and the east of the Mae Klong River but it caused a change in the ecosystem of the channel and the way of life in the communities. They use the benefit of the ecosystem and three sort of water; natural saltwater freshwater and the water which is up to the influence of the moon and the season typically flooded each year one time was approximately 1 month. These help to damage and decrease the problem of the disease such as the bodies of insect larvae that live in soil, termites as pests of the coconut and fruit tree. Thus, these include the perfection of the soil as well as the integrity of the sediment by the river. However, when the dam and sluice was created it effect to the ecosystem and the natural water and the water flow could not be as usual and also there was Lack of brackish water in ecosystems and the water pollution.

Building Vajiralongkorn Dam and the others made the downstream area did not receive fresh water from upstream to decrease the flood salt away as it happen. Combining with the drought in the year 2519-2522, though it has been build the Thonburi- Paktor Road for a saltwater barrier wall but it could not resolve the problem

moreover it affect the orchard, coconut trees from the state marine areas which was the great change in the Mae Klong River.

During the year 2536 - 2537 metropolitan waterworks authority has divided the water from the dam down Vajiralongkorn (Currently, known as the Mae Klong Dam) to send the canal water supply in Bangkok. There was argument about the amount of water and an agreement to reserve enough water to decrease the salt water pressure. The water diversion project completed in 2544 and sent to the water supply authority.

Act 2536 and the year 2540 nine storm events. Gay and Linda storm blow to the south. It caused flooding in the province and affect pomelo and other fruit trees have been damaged. Later, it became one of the main points that this made a distribution of the fruit trees and this became the major of main economic such as the pomelo.

The year 2540 marine affect drive with some conditions. It was a problem with some crops that could not tolerate the salt such as durian, lychee, orange peel, some apple, mango, etc., but this was not a serious cause in the year 2520.

There was no flood for long time and the landscape from building the dam gate or the other infrastructure that changed the way of the water flow. Although there were flooding period but did not take as a long as the past and made a serious problem for the agriculturist. Water from the dam, there was only water that flows down without fertilizer or organic material that was beneficial to the plant as the former. Agriculturists have turned to rely on chemical which affects directly to the orchard. This forced the agriculturists to use the chemical pesticides such an herbicide. Using the herbicide could be residual and effect to the famer's health, environment and the consumers. In term of the famer's life, it was gradually change from that they had been prepared for the next flood season as usual. Furthermore, the way of life, the way to build the house and the idea to use their life due to the inconvenience life while they face to the flood season in daily life rather than to the famer's benefit as in the past. In the term of the marine issue which the dam could not release the water to help the saltwater problem due to the water quantity in the dam. The lack of water in the dam caused the water needed so that the agriculturist decided to close the pipe to protect their orchard such as lychee to solve the problem.

The year 2541 Department of Agriculture promoted the agricultural tourism starting from a tour study about sugar production made from the coconut in Mueang District. Later, it has been launched at Amphawa District and Bang Khonthi District by improve the landscape to facilitate for travelling. After that the Municipality and the President of Amphawa began to promote the tourism in Amphawa such as the floating market and the other for making such an opportunity for people to come to travel in Samut Songkhram.

The year 2542 modify the work instruction, the promoting agriculture policy in the Provincial agriculturist office and also accepted the opinion from the agriculturists. This could bring to adjust the administration, for instant the suppuration for an efficient individual in the community to provide the knowledge and teach the agriculture technology for people to distribute the balance of knowledge and wisdom from the old generation. The objective was to let the agriculturist not to use the unsafe chemicals to plant and reduce production costs.

The year 2543 was established the electricity company in Ratchaburi province.

The year 2546 squirrels' problem destroyed the crops in the orchard and it became more serious to the agriculturists.

Year 2552 - 2553, most agriculturists are feeling the variability of weather conditions because it really affected flower plant and uncertainty in productivity. Some agriculturists who live in the Bang Khonthi District feel the heat from Ratchaburi electric power plant and affecting fruit tree especially Lychee, which should be in cold temperatures and lower than 20 degrees Celsius during approximately 10 days to flowering. Due to this problem the famer could not gain the product or because of the cold weather which made less quality which is called. Lychee hermaphroditic pollen is the loss or damage before pollen. Lychee hermaphroditic effects are small slightly astringent taste. The groups of people who make a syrup lychee to sell face this problem as they could not get a good price. It also due to the rainfall during the flowering season and the lychee fall to harvest period. Moreover, the agriculturist did not take enough water to plant as to make it a good test conversely lychee growth but the shell could not be expanded.

4.3 Mae Klong River, the major river of Samut Songkhram

Samut Songkhram Province has a main river which is flow though is Mae Klong River. It passes though Bang Khonthi District, Amphawa and went out at the Pak Mae Klong area, Gulf of Thailand, Mueang District, Samut Songkhram. there are many large and small canals that have been separated from the Mae Klong River and the canal up to 366 aircraft amounting to 1947 Lam Kra Dong (Group Strategic Development, Samut Songkhram Province, 2007) by these numbers it distributing as a net to cover the entire province moreover it can be clearly seen that the agricultural sector has benefited from the river either.

As the landscape of Samut Songkharm which is fertile and suitable for settlement and as it based on physical characteristics of the site where the river flows through and to remove sediment from the upper to the sediment in the flood season which is moving up and down under the influence of the moon. The clearly seasonal wind as we can see the occupation of the people which are influenced by fresh water they had orchard and garden. While people who live in the center area have been influenced by brackish water they had coconut plantations and plant the fruit tree in the summer and had the rice field. The south area which is close to the beach, Mae Klong people do the farming, shrimp farming, mangrove forests (Rot Chintamat, 2003).

The expansion of housing to the canal area increased from the existing river and irrigation to help them to live. The fishing and create a network of Transportation brought connection between the area and the outside region. In the past, the south of Mae Klong River was an important route for the Thai army during the war time in case to prepare the war and prevent the Thon Buri and Bangkok which were the major economic, social and political from the war between Thailand and Myanmar.

The lower Mae Klong River Basin play an very important role because it is shown the way of life support to the historical, social, cultural and economic communities. Related to the relationship among the group of people such as in the term of trade which could be seen that they had the market to exchange and sell the product among the community. This has been shown the way of economic among different area and ecosystem.

Range of Ayudhya lost to Myanmar period, a herd of people from neighboring countries like Laos, Cambodia, and Mon enter into the inner cities because local people are scattered away. The country needs to fight the Burmese people. Since the reign of King Rama I down to the lower Mae Klong River Basin is the area of distribution of various ethnic groups to come and settle in the area (Srisak Valliphodom, 2536 b: 50-53 as cited in Aaporn Chansomwong, 1998).

Mon is a large group of people to settle in Ban Pong District and Photharam District, Ratchaburi Province. They live in the area of Mae Klong River, the lower part and it can notice from the temple which is located nearby river. Hong pillar is the only a symbol of the Mon temple. For Lao Yuan, LAO Poun Lao Song, Lao Krang and Khmer live in several places. The Chinese came from settlements in cities long time ago.

Late to the early Ayutthaya period, Chinese people often take up residence in Siam especially the seaside of the Gulf of Siam. At the mouth of the river near the big rivers, such as Bangkok and the Tha Chin River, Bangpakong, Mae Klong River (Chanvit Kasetsriri, a translator, 1986: 80-81 as cited in Arporn Chansomwong, 1998) make this area a better basic economic than the general villagers with the way of sufficient economy. The Chinese are playing an integral role in the agricultural trade. Besides being a manufacturer, then it is also a middleman to purchase products from local agriculturists to agriculturists sold in key markets outside the community or a small trader who buy from the other place to sell in the community. It shows that some characteristics of capitalism formed happen since the early of Rattanakosin period. (Suparat Lerdpanichakul, Ph.D., 1994: 88-89 as cited Aaporn Chansomwong, 1998).

In other regions, subsistent economy is villager's way of life of. But for Chinese, they produced agricultural products for sell. Apart from being the producer, they were the middleman who buys the products from producers in local area to sells in bigger market outside the village or to sells to retailers who buy product to sell in the village. This indicates some characteristics of capitalism which had founded since the Era of the early Ratanokosin. (Suparat Lernpanichkul, 1994: 88-89 as cited in Aaporn Chansomwong, 1998)

In the period of King Rama the IV, Phasi Charoen canal was dig from Thon Buri to Tha Chin River. Damnoen Saduak canal was also dug from Tha Chin

River to Mae Klong River for transporting sugar cane, sugar, and other economic goods. This causes the expansion of community; the Chinese group from Tha Chin River moved to settle down around the riverside of Damnoen Saduak and Mae Klong in Ratchaburi Province to Samut Songkhram Province. Most of them earn their living as fruit tree agriculturist, agriculturist and making palm sugar. (Srisak Walliphodom, 1993: 55 as cited in Aaporn Chansomwong, 1998). There is a story about the migration of agriculturists between river basins, such as, the story of orange agriculturist at Bang Mod area. They are Thai who have Chinese ancestor. They moved from Bang Chang and Damnoen Saduak to find cultivated area in Bang Mod. After planting orange tree was succeeded in this area, it was become their career. (Sujit Wongtes, 1996: 274 as cited in Aaporn Chansomwong, 1998)

Mae Klong River is important basic factor of living and also causes social changes. A conflict about water requirement increased rapidly among many groups of people. Dam building, water gate building, and water diversion project from Mae Klong for water production for Bangkok was especially criticized in terms of unsuitable resource management between urban and rural area, (Project of Ecological Recovery, 1993: 6-23 as cited in Aaporn Chansomwong, 1998) including water pollution in Mae Klong River and shoal canal which stem from careless. Comparing with others rivers that flow toward gulf of Thai, according to the report of Pollution control department,(Office of Natural Resources and Environmental Policy and Planning, 1997: 116-117 as cited in Aaporn Chansomwong, 1998) Mae Klong was indicated that the water quality is above standard, but, bioindicator is much below standard. The average of total coliform bacteria is over standard because of domestic wastewater.

In 2004, there was a report about the situation of surface water quality. Mae Klong is one in a group of better water quality comparing with a year of 2003: water quality changing from below standard in 2003 to be standard in 2004. This is because of contaminated of total coliform bacteria is lower than in 2003.

According to the report of Regional Environment Office 8 (in 2009), if commensurate from gazette of Pollution control department, surface water quality and Mae Klong water quality from 12 stations was found below standard in 6 stations which is 50%. The main problems of water quality index are the quantity of total

coliform bacteria (TCB) and fecal coliform bateria (FCB). However, compare with 2007 and 2008, water quality tend to be better: the average of water quality standard all year is higher in ratio. The measurement of 4 stations in Samut Songkhram indicates standard water quality. The problem of quantity of total coliform bacteria (TCB) and fecal coliform bateria (FCB) was not found. Environmental outlook in 2009 reported by Ministry of Natural Resources and Environment (2009) shows that natural water resources, such as, river, canal, ditch in Bangkok, Samut Sakhon, and Samut Songkrham were encroached and careless. Water situation report by Water Resource System Research Unit (2009) shows the normal of water quantity for agricultural usage in most of area in Samut Songkhram. There is only some subdistrict in Amphawa District that has high water quantity.

In 2009, in Mae Klong Subdistric, groups campaigned for cleaning up and using grease trap in the areas that have restaurants, tourist attractions, temples, and schools. Provincial governor attended in these issues by visiting home stays and resorts to consult with owners about problems and campaign for domestic waste water management. There is "Rak Mae Klong" group in Amphawa Subdistrict. In Mueang Mai Subdistric, the groups of subdistrict headman and village headman assemble for developing community. They interchangeably dig the canal to clean up. They are many groups do some activities to conserve Mae Klong River. In Mueang District, they use boat to clean up the canal and river. All in all, the conservation tends to increase in the future.



Figure 4.10 Livelihood in Mae Klong River

4.4 Way of life and local wisdom

4.4.1 Wisdom of production system and resource management

The Committee of Documents and Archival Processing (2004: 27) described that Mae Klong is the original name of province. There are other names and evidence of settling down appears in article "Thongtin Samut Songkhram" which means local Samut Songkhram" by Associate Professor Srisak Walliophodom as mention below.

"*In the past, people knew Amphawa in the name of Bang Chang. They knew it as much as Bangkok because both are agriculturist's zone. There are some diminutives to call these places such as "Suan Nai Bangkok, Suan Nok Bang Chang" which means Bangkok, the inside orchard and Bang Chang, the outside orchard. The names are from the location of the places, the similarities of their geographical environment and the acclimation which is growing three crops. Bangkok and Bang Chang geographical environment are similar in terms of their origin of the places. The location are on devious waterways piling up and run to the sea; alluvium. People also used upland to settle down, use water from river for agricultural in cultivated land, use canal for transportation and for consumption. But Bangkok is more important city. The recorded document shows the period of development. For Ban Chang, although there was no recorded document, it is supported by archaeological evidence. Mae Klong River and Chao Phraya River is the main path to contact with foreign countries. Break-bulk carrier sails from estuary to inside seaport. Both Mae Klong and Chao Phraya Rivers have their own seaport. Chao Phraya has Ayutthaya and Bangkok. Mae Klong has Khu Bua and Ratchaburi. Khubua and Ratchaburi are older and have more history than Ayutthaya and Bangkok. But, Bang Chang is not younger than Bangkok. Bang Chang and Bangkok may arise at the same period which is after 20th of Buddhist era*".

The geographical features and archaeological evidences show that not only the settlement and gardening in Amphawa are from the suitable upland location, it also has many waterways join which causes the occurrence of communities and causes Mae Klong River routes to sea routes. Aom which is an important waterway is the old Mae Klong River. The old Mae Klong River is if travelling from the Mae Klong

estuary through Mueang District in Samut Songkhram bending up the river curves around the west side of Baan Klong Phee Lok and then flowing to Amphawa District. From here there are a river and two canals coverage overlapping each other. The northern part is the river that flows out of Baan Bang Krabue straight through Baan Klongtrong, Bann Klongkoke, and Wat Chula Manee canal. Another canal is a canal dug by man which is named Klong Pra Cha Chom Chuen. It was dug starting at Ban Dok Chan through Ban Pha Won, Ban Plai Phongphang, Ban Suan Luang and run to the south of Mae Klong River. The northern Mae Klong diverges to two tributaries. The first one, which is the big waterway of Mae Klong, runs to the north through Bang Khonthi District. Another is called Lam Maenam Aom which flow to the northwest through Ban Bang Kung, Bang Sa Khea, Baan Klong Sue, Baan Rong Wee, Wat Pleng District. Then it runs to the north through Baan Koh Morn, Baan Tha Thad, Koh Sarn Phra, Vieng Tun, Baan Sri Petch, and join the straight Mae Klong River at Mueang Ratchaburi District.

"Bangkok, the inside orchard" "Bang Chang, the outside orchard"

"The inside orchard" means the orchard along Chao Phraya River starting at Mueang Nonthaburi, Bangkok, down to Mueang Phra Pradang (in Samut Prakan). In the year 127 of Ratanakosin Era (1905), there are areas for gardening around 30,000 beds (Pladisai Sittithanyakit, n.d.: 74 as cited in the Committee of Documents and Archival Processing, 2001). But, at the present time, Suan Bang Yai and Ban Kruay are in serious situation because of the urban growth and the expansion.

"The outside orchard" means the orchard next to the inside orchard. They appear in the western burgs along Tha Chin River and Mae Klong River. The famous fruit are Mango of Bang Chang, Watermelon of Nakhonchaisri etc. (Khaisang Sukhawattana, 1979: 173 as cited in the Committee of Documents and Archival Processing, 2001). The outside orchard locates in Amphawa District and vicinages which are still be cultivated lands nowadays. Their way of live and culture of people here which derived from people in Ayutthaya period can be seen in communities around Aom River and Mae Klong Riverside's communities as mention follow.

The old communities around Aom River appear starting at Mae Klong's tributary through Ban Lad Koh, Ban Bang Khung and Wat Pleng District. The antiquity can be seen from debris of old temples along the river and from the small and

big canals which were dug from the main route of Mae Klong River, especially in the south of river that has dug canals in every 400 meters.

Communities along Mae Klong River which start at Amphawa to Bang Noy canal in Bang Khonthi District are location that crowded with agriculturist's communities. Most of the crucial places such as Yai temple locate in the east of river. Apart from having communities placed elderly along the river, the communities have expanded to canals that are dug from the main route of northern and eastern Mae Klong River. They also appear until Bang Noy canal around Ban Bang Kra Bue.

Gardening, by selling the output from their own garden, has been developed to be a principal occupation of people in this area. In the past, each kind of fruit tree is famous as their planted location (Bang), for example, Mango of Bang Chang. Because each "Bang" has their particular landforms and each landform also suitable for particular kind of fruit tree to grow. Because, gardening is a career of old Thai people since Sukhothai era, orchard is so significance for Thai history.

The obvious benefit of gardening in this area are yielding agricultural products for local people, being cool and pleasant areas, and giving beautiful landscapes. It is also community herbaria of communities which benefits in terms of being a natural history classes for agriculturist's descendant (Martin, 1995: 230 as cited in Committee of Documents and Archival Processing, 2001) and for people who are interested in gardening occupation.

Intellect, a local knowledge, has developed by collecting and then passing knowledge and experiences of villagers in ancient time to the people in present time. Intellect was created from natural potential. It benefits living and reconcile with nature and folkways. As Mae klong is called Mueang Sam Nam (City of three rivers), it can be categorized into 3 forms of land.

1) **Fresh water area** in Bang Khonthi District
2) **Brackish water area** in Amphawa District and the north of Mueang District
3) **Salt water area** in the middle and in the south of Mueang District

In salt water area in the middle and in the south of Mueang District, ancestors of Mae Klong local people well understood state of nature and geography. So, they could adjust and reconcile with nature and could live happily. Garden plots

such as Lam Kra Dong, Praek, and Lam Rang were dug like a network throughout the province for orchard, flat gardening (herbaceous plants such as banana tree and sugar cane), coconut growing for fruit, and palm sugar tree. Moreover, wisdom of people in coconut selection to get plentiful sugar, big top coconut trunk, and big and strong leaves are releasing sea water into beds when flood tide and letting the beds dry when ebb tide. Ancients realized that palm sugar tree best grow up in brackish water and require effective and concordant water circulation system. Therefore, in their perspective, nature is a dependent system. Non-toxic agricultural requires flood water cycle, sedimentary mineral, nutrient, natural fertilizer from forest river in Kanchanaburi in immerse flood season: August-October. Immerse water control life circle of ant, termite, and insect, therefore, orchards in estuary lands and around Mae Klong River receive new sediment for recovering soil and get nutrient for all year. Furthermore, nearly died trees would rehabilitate. Agriculturists restore the soil quality by shoveling alluvium from new immerse flood that pile up the old ground. In this period, fruit tree receive natural fertilizer and pest would also be control (Committee of Documents and Archival Processing, 2001).

Orchard arrangement

In order to arrange bed for planting, agriculturists mutually depend on each other. For example, waterways or irrigation ditches should be connected, road between each orchard should be narrow enough to lean small bridges in order for walking to other orchards. Dredged soil from irrigation ditches must be shared in the same proportions by measuring from the middle of ditch. They may alternate to do this by the year. In each bed, the possibilities to gentrify the ground depend on their forms and suitability or convenience to work. In other words, orchard arrangement is lay out management. Moreover, past generation of land title deed of Samut Songkhram show the position of plantation areas (Committee of Documents and Archival Processing, 2001: 129).

Aporn Chansomwong (1998: 17) studied significance characteristics of agricultural system around basin and found that agriculturists normally dig the ditches crossly in order to level up the ground to prevent flood. The ditches were dug parallel each other. Scuppers were made in orchards. The entrance of ditches would be closed if there is too much water flow inside the ditches. Earthen dykes were made around the

orchard in order to prevent flood. An orchard with ditches and an earthen dyke around it would be called "*Suan Nueng Khanad*" which means one orchard. Digging the ditches and earthen dyke's management are intellect in irrigation system and water management which are suitable for landform and geography for plantation. Chao Phraya and Mae Klong River basin are areas for plantation with ditches. In the past, orchards were categorized into two forms which are "*Inside orchard*" and "*Outside orchard*". For orchard management, in rainy season to winter which is the period for fresh water, agriculturists would grow rice in the ditches in orchards. Agriculturists would space around 8 meters behind the ditches in order that rice plant, which grew under the coconut three, receive some sunlight for photosynthesis. But, if they plant only coconut tree, they would space around 6 meters which is the nowadays style of garden with no rice plantation. In orchard arrangement nowadays, agriculturists, like their ancestors, still give precedence to irrigation system by digging the ditches and earthen dyke management. Although, there is dam to prevent long term flood, digging ditches are used to keep and manage rainwater. Digging the ditches is a kind of irrigation system to control water quantity, prevent flood, and prevent salt water flow into the orchard. It is a route to release old water, receive new water, and prevent dankness. Clay, the landform of this area, can causes dank orchard and bring about root rot and foot rot. The capacities to adjust water system depend on the differences in depth and size of ditches. Agriculturists can also used water from canal in the orchard for watering fruit tree easier. Mr. Somsong Saengtawan, agriculturist and savant in natural agriculture mention as below.

"*Because the underground soil is clay, ancients dug the ditches to provide the good scuppers. 30 years ago, if there was heavy rain and current from the north, this area would flood for 1 month in every year. However, the water goes down rapidly because we have a lot of effective scuppers. Because of these scuppers, our fruit trees aren't died. Moreover, water would not still and scuppers can also keep rainwater to prevent flooding. This is what we try to preserve. We won't pile up the land even the project of Local administration that wants to build the road. On the contrary, we work together to dredge the canal every year*"

Mostly, agriculturists will grow one main tree type in the same row and insert accessory plant between the main plants. Agriculturists will classify the types of

plant from the period of time in yielding profit such as daily, monthly, and yearly. They also categorize type of fruit as their implement areas considering the suitability to grow each fruit together. For example, if agriculturists grow pomelo tree and lychee tree, they will not grow coconut tree, because coconut tree's root take too wide space. When growing lychee, agriculturists will clear its leaves under the tree or sweep off leaves and leave it at the middle of the trees in order to avoid humidity, for clarity of its stub, and stimulates efflorescence. Currently, some of agriculturists adjust irrigation style by covering ground with soil, make bigger garden plot or adjust by covering the canal between the plot with soil or organic matter in order to get one bigger plot and get natural fertilizer. It gives large area for plantation and let tree root expand wider as manage by agriculturists. Another ways is mixed intercropping. Agriculturists will interchangeably give priority to the fruit tree that yield more output. For instance, if jackfruit gives more produce, it is the main fruit and others will be the inferior fruits. This can be changed depends on season. According to the personal communication about orchard management with Mr. Somporn Khetkaew, agriculturist and savant in making "Saaw": Thai musical instrument making from coconut shell, he reveals that

"*I plant what I want to eat and I do what I want to do. In my perspective, if we buy not much, money will still with us. What do we get are experience, competency and success. What do I left is saving. Before 1957, we bought our product, but, if we did not buy, we would exchange to get other products that we don't have or lack of. Like our ancient, they changed agricultural products with rice and seafood. In 1969, we still interchanged our products. People use money instead, but, we preferred exchanging because it brings about relationship, preference, and friendship.*"

Agriculturists normally grow the plant uncomplicatedly. They plant as labor force they have. In growing main fruit trees, trees would be planted in suitable distances considering the width of their bush. Growing inferior fruit trees, agriculturists will examine space between the main fruit trees. They may plant inferior fruit trees aside the plot by considering the capabilities in receiving water and sunlight or abilities to adjust in order to get photosynthesis. Agriculturists will plant inserted or inferior fruit trees while the main fruit trees are small such as banana tree and papaya tree.

In late morning and early afternoon, although trunk of these kinds of fruit is not high, its leave is wide enough to be shade for small trees. Other perennial plants such as cassod tree and coral tree need appropriate period management. For instance, when agriculturists just finished planting lychee trees, they may plant some kinds of tree like tangerine trees for shading and for getting their produces as well. When lychee trunks get higher, their bushes would be shade for tangerine trees. However, agriculturists must trim their bushes for air ventilated. Beside, agriculturists will grow the plant thickly in order to camouflage their produce.

To maintain fruit tree or plant, agriculturists use the concept of interdependency. Applying fertilizer one kind of tree will benefit other kinds of tree and specie. Agriculturists use an amount of money to plant many kinds of tree, get various kinds of fruit and can sell all of them together. Therefore, agriculturists are able to live and can rely on themselves. Agriculturists, who have grown single pomelo tree, found the problem when they run out of produces. They need to wait until the new generation will yield new outputs. Learning from their own experience make them understand and start to use mixed intercropping.

This conform to Sudha, M and F Kruijssen (2007) study. They mention that mango specie maintenance by using mixed intercropping is effective strategy to get profit in different period of harvest and diminish the risk in getting too small amount of produce from some kinds of fruit tree. Local media and external media can promote mixed intercropping: wisdom of ancients. The inspections allow agriculturists to study orchard organization structure, select what they can apply to use and suitable for their areas.

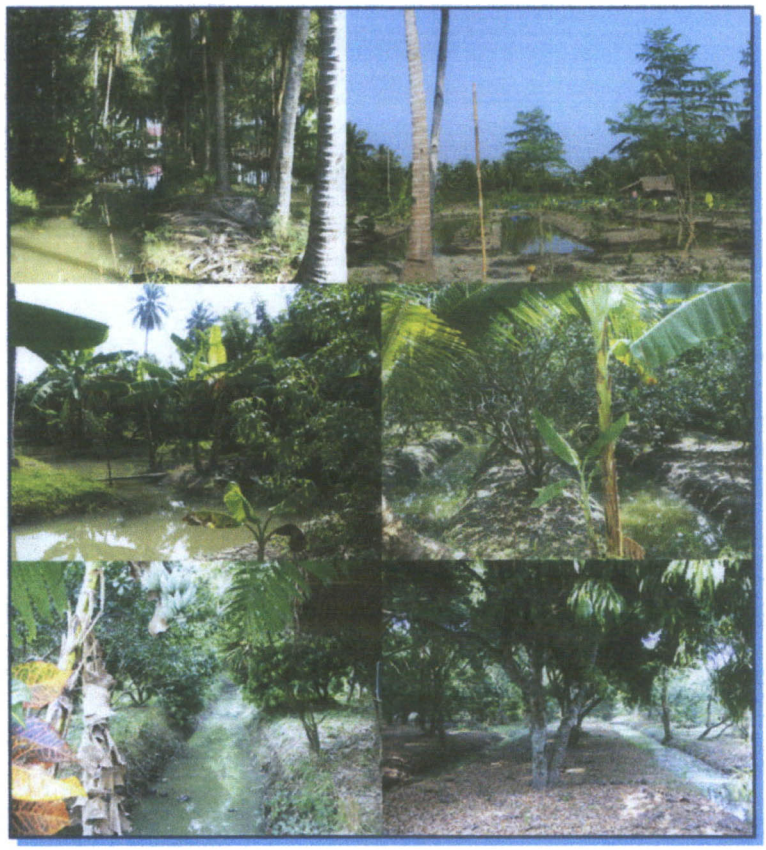


Figure 4.11 Orchard management of agriculturists in Samut Songkhram
Source: Researcher, 2010

Forms of agriculturist's way life

Forms of agriculturist's way life are different depending on seasonal plantation. Agriculturists who have not much area will specify the period of working tentatively. In 1 month, agriculturists don't set fixed plan of working. They prioritize the work to do. The most important work will be done firstly following with others. They plan what to do day by day. As they don't hire outside workers and want to save their energy, they proceed work gradually. However, for some hard works such as scooping up the soil and eliminating parasite plant all over the orchard, they will hire laborers who are not the family members to help. However, people they employ will be the local people.

The pomelo needs to be maintained when the outputs are harvested. The pamelo tree will be maintained by cutting down the parasite plant which is a crucial weed of the pamelo. To get rid of the weed, the organic fertilizer is applied and

sprayed to the pomelo and we need to water once in 3 days if there is no rain. When the pomelo blooms, the agriculturists will spray an herb to sack the insects those damage a pomelo's capitulum. Moreover, the outputs need to be harvested cautiously by avoiding a fruit crashing or contusion for maintaining the fruits from easily being rotten. The agriculturists will consider harvesting only the fruits which are already mellow and it is supposed to harvest in the harvesting season due to nowadays the agriculturists will harvest hurriedly when the price of pomelo increases and the hasty harvesting will diminish the quality of pomelo, be discreditable and losing the market share.

The lychee farming normally concentrates in bloom period which starting on November until the fruition period which consumes 120 days. Typical agriculturists will prepare a fertilizer for spaying to lychees. The lychee tree will not be watered during the bloom period but the lychee trees will be sprayed the fertilizer for protection worms and insects those will damage the calyx and sprayed the hormone. The agriculturist will allow bees to swarm the flower when they bloom out. The agriculturists interpret that the bee will help the lychee for pollination and they will gain the income from selling honey. However, the orchardists notices that the natural local bee or called "the honeybee" which has a small size and there is a sensibility to swarm the carpel more than a mellifera those has a duty to collect the nectar by ignoring the lychee flower which there is a small size and fragile hence the lychee flower will fall down while the mellifera collects nectar for the whole day.

In case of coconut, the typical agriculturists who plant the coconut for harvesting will be treated by the natural way or called "angel feeds (an ancient believes that an angel controls the climate)". The coconut will be harvested at 45-day by self harvesting or hiring local labors, the way to compute the wage is by counting the coconut tree harvested or the coconut harvested. The land will be mowed and the ground will be ladled in each year, it is the way for naturally fertilization. For the coconut sugar tree, the agriculturists will pay special attention to maintain more than other types of coconut by using a 16-16-16 fertilizer and 13-13-21 fertilizer for increasing a sweetness and providing more quality of sugar when the sugar is boiled. Furthermore, some of aromatic coconut gardens where there is a plenty of land will be fertilized to increase the quality and quantity of coconuts and be worthy to invest.

During 1 month, the aromatic coconuts can be harvested twice times that providing more than 10,000 of coconut per time, for example, the aromatic coconuts cover more than 10-20 rais in Don Manora Subdistrict.

For the other kinds of fruit, the agriculturists will not much maintain it. The additional fruits which planted will be fertilized or if the fruit is currently in the good condition, the agriculturists will normally use the natural way to maintain the orchard. Every month, the agriculturists will have a meeting for exchanging and receiving news from a sub district's specialist and it is a good chance to exchange opinions among the agriculturists in the particular area or forming a meeting by the type of fruit. Moreover, the agriculturist who is a merchant will take their own output to sell in that particular area. As shown on below at the left side, the agriculturists in Bang Khonthi District is bringing their own products to sell at Tha kha floating market which the merchants will row boat to this particular floating market around 04.00 a.m. silently due to they are too courteous the local people and the rowing is a crucial way to exercise in the morning, after that the motor will be used to drive the boat instead of rowing in the return trip.



Figure 4.12 The way of life of fruit agriculturists

Source: Researcher, 2010

Plant propagations and maintenances

Long time ago, the agriculturist used to plant by seeding but nowadays, the majority of agriculturist is interested in layering for plant propagation. The different plant propagations have both advantages and disadvantages. The cultivation by seeding is more sustainable than layering but there is a high possibility for mutation while the layering would give the perfect output as required but the harvesting period would be shorter than the cultivation by seeding. The agriculturists are interviewed and the results showed that some agriculturists maintain their fruits to be perfectly strong for building its own immunity and allowing the fruits to be annoyed by insects sometimes.

For the fertilization, the agriculturists approbate that the organic fertilizer and the compost appropriate for their agriculture. The agriculturist will pay specially attentions to every single plant that has been planted. The plants would be analyzed separately for the maintenance management due to the nature and the perfection of each plant are different but the chemical fertilizer is slightly used in nowadays. From the interview, the agriculturists thought that if comparison to human, the human needs different types of food for living and the fruits need it as well hence the fertilization way needs to be changed for serving needs of plant and suitable for each fruit which the agriculturist is maintaining.



Figure 4.13 The composting area and liquid organic fertilizers of agriculturists
Source: Researcher, 2010

In term of output, the outputs from agriculturists which is planted by natural dependence system. The output will not vary to amount of labor and the

agriculturists need to manage times by themselves, the problems will be solved and considered from the source of problem. For example the pomelo which there is a low quality, the agriculturists need to consider to the particular physical of any pomelo such as the excess output, the bad condition of soil that there is a high rate of the pomelo production which there is a low quality and the agriculturists need to solve the problem from the particular physical evidences by cutting down some of the output from the pomelo tree or adjusting the chemical formula of the organic fertilizer to suit to the nature of pomelo but the pomelo will be damaged if the organic fertilizer used is in an excess the optimum limit.

Slush tillage

Before the slush ladles from the canal, the water in canal will be dried and the slush will be concreted to be convenient for ladling the slush out and the water quality will not turn to be wastewater. It is an advantage for the fruit because of the fruit can take a rest and the root will not be rotten. If the land is usually flooded and the quantity of soil will increase related to the quantity of water flows. The quantity of soil will be increased if the water in the canal keeps flowing but in the area where the water is quite serene will has not much slush to be ladled. For the labor, the agriculturists will employ the local labor for ladling the slush by doing the wage negotiation with the orchard owner first. The slush ladling is the main expense of the orchardist in the province, the wage calculated is different in each orchards depending on each area, the quantity of slush ladled hence the wage will be high if there is a numerous of slush in the canal but if the agriculturist ladles the slush frequently and there is not much a quantity of slush and the wage will be diminished. Almost agriculturists will ladle the slush once a year but long time ago before building any dam, the water flowing will carry a slush together including the organic matter those flowed from Kanchanaburi Province to be precipitated at Samut Songkhram Province but the almost sediments currently locate on above the dam hence there is not much sediments in the water which discharges to the orchard nowadays.



Figure 4.14 The slush ladled in the coconut orchards, Bang Khonthi District

Source: Researcher, 2010

Charcoal making and the vinegar from the charcoal making process

To make a charcoal and the vinegar from the plant's components from orchard of agriculturists such as a limb, a trunk, a fallen fruit which has an imperfect condition only, those components will be made to be charcoal and the vinegar that is from the fume's condensation of charcoal making process. The product as interpreted on above can be mainly used to crop dust insects in pomelo and lychee orchard. For the charcoal that we received at the end of process can be used to absorb the bad smelling in household or selling the charcoal for earning an extra income for agriculturists.



Figure 4.15 Charcoal making and the vinegar from the charcoal making process
Source: Researcher, 2010

Fertilizer from the salt farming (Khi-Dad-Na-Gluer)

The fertilizer from the salt farming is from the dark brown seaweed which grew in the ridge during the salt farming break or the break in rainy season. The fertilizer from the salt farming can absorb the water very well when that particular fertilizer is soaked into the water. Using of the fertilizer from the salt farming produces a sweet and mellow taste fruits. The agriculturists who used the fertilizer from the salt farming inhabit in the freshwater area i.e. Amphawa District, Bang Khonthi District. The agriculturist interprets that the table salt was used for orchard farming before using the fertilizer from

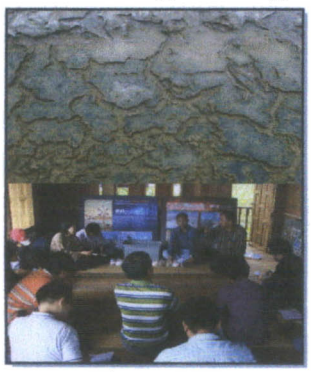


Figure 4.16
Pane of dried algae and moss
Source: Kanuengrat Kummanee, 2010

salt farming. The table salt using as a fertilizer will provide soft skin pomelo because of the pomelos which harvest in different time will provide the different taste as well, with the suitable volume of the fertilizer of the salt farming used for maintaining the pomelo. Some agriculturists mix the fertilizer from salt farming with muck and chaff to make compost. The fertilizer will be applied to the fruit which has a good condition due to the fruits with good condition will not produce fruits, hence those pomelo needs to be applied the particular fertilizer to break the growth rate and stimulate the fructification. The particular fertilizer from salt farming is not important in the salina area where there is plentifully same type of nutrient as that particular fertilizer from the salt farming provides. The agriculturist takes soil in Bangkhan Taek Subdistrict area to analyze, the results show that the soil brought have a high volume of calcium, phosphorus and potassium more than 10 times of the standard level. Nowadays, the learning center for salt pan farming has been formed in order to educate people on the useless algae in salt pan (Khi-Dad-Na-Gluer). This project has been launched by the learning institute of folk wisdom called "Mahavijchalai" in Samutprakharn. Those who are interested in salt pan farming can exchange their knowledge, pursue the research area of salt pan farming. With this learning centr, it would create benefits for people who live in the area. (Kanungrat Kammanee, 2010)

Pomelo peels burning for insect expulsion

Currently, smoking out is still be used in present farming. During the time that pomelo flowers are fertile, agriculturists will put pomelo peel in the sun until it gets half dry. Then, smoke it out in an opened area. Dispersion of smoke will give the best result of insect expulsion.

Herbs fermentation for insect expulsion

Agriculturists will bring herbs such as lemongrass, neem, golden shower, bitter bush, Hang Rai Deang, and ferment them with molasses for 3 months. Sometimes curry paste is also used to strengthen the herbs fermentation according to sustainable agriculture which makes use of nature-made ingredients.

Insect prevention; grass mowing

Basically, agriculturists usually prune the trees in order to have some open area. During the time of blooming, agriculturists will also cut the grass to let its tip

grows. The growing grass will entrap the insects to come and eat it. In this case, the insects wouldn't destroy the flowers and the fruits on top of the tree.

It brought to the understanding that agriculturists must maintain high spirit of working hard since the use of pesticide only works on insects emulsion not elimination. Within a short period of time, agriculturists will be distracted by the insects again. As a result, the agriculturists must bear in mind that the multiple uses of pesticide requires the understanding of retaining the nature and surrounding environment at the same time.

To keep and increase the farming-friendly insects, the natural fertilizer and organic pesticide should be used. There are some kinds of insect called "predaceous insects" that help the agriculturists get rid of the harmful insects which destroy the planting areas. The examples of these creatures are frog, tree frog, and toad. They eat small insects on tip of the grass which is cut down by the agriculturists when the trees start blooming. Moreover, Dragonfly, bird, and spider are the helping hand of pomelo flowers. In addition, agriculturists use the light to attract the insects during the night. These insects will enjoy the light for awhile before falling down to the below bowl which has fish in it. The fish will eat up the falling ones. Another way is to control the insect cycle from its natural recovering.

According to the interview of Mr.Chusak Deesawas - Professional Agricultural Officer who has been a agriculturist for a long period of time explained about other folk wisdoms that,

"*In the past, agriculturists put the wet sticky rice at the root of the trees. It resulted in a better taste of the fruits. I had learned this trick from the award winning farm. Another way is that, agriculturists were using pig blood fermentation for watering the plant to increase the amount of fruits. However, the pork factory is no longer exists and the geographical area has been changed at present. They have switched the idea from using pig blood to the use of fish and molasses fermentation instead. Before the use of this fermentation, the use of fish alone was stink and smelly. People also use their own faeces to fertilize their crops. It did grow well. These are all the folk wisdom. Moreover, palm spathe*[1] *was used as a watering*

[1] Khone-Gab-Bai or Dry Spathe which fall of from the coconut tree or palm tree can be created as a scoop for watering the plants or make it as a spoon for picking up food from the pan or mortar.

tool. Agriculturists put spathe into the water, so that it absorbed the water and soften itself a little bit before folded into watering tool. Some make it as a fan in hot weather. There are many benefits we could find here. Many useful stuff. Leaf sheaf of banana tree was made into a cover. Palm was made into the basket called "Kra-sher[2]*" and "Nian". Lime or Calcium Hydroxide from shell helped adjusting acid sulphate in soil. Besides, there is a recent research which shows that smoked orange water was the local idea originated from Yee-san Subdistrict. It has just been discovered, not that it happened long time ago. The useless algae or (Khi-Dad-Na-Gluer) has also been conducted as a research to look for nutrients, its usage, as well as the local herb - Boraphet"*

Fruit wrapping

Fruit wrapping has its aim of insects protecting and maintaining the smooth skin of the fruits. In the past, coconut leaves or lime bags were used as a wrap. Nowadays agriculturists tend to use the materials that can easily be found within their household.

Fruit preservation

Agriculturists put special care for harvesting the fruits. When cut the fruits, agriculturists softly place them on ground. The fruits must not be toss since they may get bruise and easily rotten. The fully ripen lychee must be harvest within 1 month. Otherwise, insects would destroy the stem of fruits. Lychee may fall off and wouldn't be able to make a sale. Moreover pomelo should be harvested exactly on its season as it may affect the preservation and qualities of pomelo which include pulp and taste.

The ideas of folk wisdom, including believes and rules of farming have been passed along from generation to generation. For example, when it is close to blossoming period, there will be the worship for fruitful production of the farm. Agriculturists are making merit in terms of thanking god for giving such a plentiful agriculture. In addition, the first set of fruit will be selected and give to the monk as a tradition of making merit because agriculturists believe that this will bring a luck to them. The agriculturists have faith in doing such thing since they have been

[2] Krasher or Nian is a kind of basketry in which made of thin bamboo stripes. It is normally used for unmilled rice, other utensils as well as fruits.

experiencing with the outcome of doing so. Lastly, they are satisfied with their sufficient agriculture and agro forestry. Siang Inprasert, the director of organic pomelo team showed the believe of folk wisdom that

"It is recommended not to water the pomelo trees during the blooming period as water will make the flowers fall off. It turned out to be the truth. When agriculturists watered the trees, it shook off the flowers and started to put forth leaves. The previous generations would keep only some amount of water for pomelo to put forth leaves. When it started to bloom, a little amount of water would be slightly given. Then 1 week before harvesting, pomelo wouldn't be watered at all. At this time pomelo would transpirate water itself in order to intensify the taste."

Processed food production

The idea of processed product is crucial. Many of agriculturists bring their fruits to turn into other products and finally it becomes their career for living, for example; making dessert, various kinds of fruits preservation, or even forming a production group. The groups are created to increase the production lines. Miss Chaweewan Huttagam - the head and representative of the woman agriculturists group for agricultural development brought up many fruits and transform them into many different kinds of products such as orange peel, plum flavored orange peel, pickle orange peel, dried fruits. The other groups may produce the products made of banana such as crispy banana, banana roll, etc. And banana leaves can be very useful for food wrapping. Coconut parts are also processed into coconut jelly, basketry, and hat. These wisdoms are really important to the agriculturists.



Figure 4.17 Processed food from fruits

Source: Researcher, 2010



Figure 4.18 Local products from fruits

Source: Researcher, 2010

Sugar production

Sugar production is considered very important for the agriculturists in the area. It begins with the selection of the coconut trees which can produce the sugar. Then they started to pull the coconut palm's spanix when the blossoms are still bud or in the period of changing from yellow bud to fully mature green flower. The reason of pulling down the spanix because when it is cut the sugar will directly drop into the container. The pulling of coconut palm's spanix must be done when the spanix has just sprung. The selection shouldn't be made on the spanix that is too soft or too hard. Tie the rope at the end of the spanix to the lower coconut leave so that spanix could bend down. The process must be done every day until sugar drops. Cut the spanix until one third of its length and hang the plastic container for the drops of sugar.



Figure 4.19 Palm sugar production

Source: Soranapong Buaroay, 2006

When the coconut flowers are fully mature, the spanix will be dried and cracked. Agriculturists will pull out this part of coconut tree which will results in the dispersion of pollens. Use the rope and tied the pollen stems together. In term of cutting the palm, if that tree produces a lot of sugar, small cut will last longer and can be cut until it gets to the root of spanix. However, if the palm is not giving as much sugar, a deeper cut is needed. In the morning, agriculturists slip their hand on the cut for some sugar to be left on hand. Then they use that hand to rub and squeeze spanix of coconut tree. They would only do this in the morning. The result is that it would give more sugar to come out.

To prevent the coconut warm of eating spanix, agriculturists will rip off the pollen when it started to change to green. The bud is white and then change to yellow and to green respectively. The bud inside will be cut by the knife directly through the flower stalk or the baby coconut fruit. Because though the coconut is alive, it wouldn't give any sugar. Later, when spanix started to dry, pull the new one. 2-3 spanix of the same coconut tree can be cut simultaneously. Maximum of 4 can be reached for a good coconut tree, but only few are found.

The ladder or so called Pha-Ong and the bamboo used for the making of Pha-Ong need to be in a good condition. The length of Pha-Ong from the base could be 14 meters long. Each block should have a suitable gap to make a hole in order to put in a bar (Pha-Ong or Salak) for making steps. Pha-Ong is made of fad wood which grown in wetland. The wood is viscous and durable. In the past Pha-Ong could last for 4-5 years. To lean Pha-Ong on coconut tree, If the tree is 8 meters long, the Pha-Ong used must be 10 meters. Pha-Ong length must exceed the top part of coconut stalk for about 2 meters to make it more stable while climbing up and down. The longest Pha-Ong that has been used has the length of 14 meters.

There are many sizes of sugar container according to the amount of sugar the trees given. Therefore the size must suit with the tree. The container is made of bamboo. When making bamboo container, bamboo skin will be peeled. The reason for peeling is to prevent the dry skin of bamboo. If it gets too dry, the container will simply cracked or broken. On the other hand, if the bamboo is peeled, the temperature in the container will be cool. The sugar will not easily be rotten and have less

bubble. However, nowadays the trend of using naturally made-sugar container has been changed to the use of plastic container rather than bamboo.

Before getting sugar, small pieces of Pha-yom sticks or Kiam sticks or Ta-Kien sticks are put into sugar container in order to prevent sugar from getting rancid because the container is normally hung on the tree for several hours. Those kinds of wood will also make it easier while simmering sugar as it tends to stick together while stirring. Agriculturists will calm up coconut tree in the morning because the tree give more sugar during that time. In the evening, the hanging container will be replaced by the new one and the filled one will be brought down. In general, there will not be sugar collection during summer. If there is no break for sugar collecting, there will be less coconut palm's spadix. However, the technique of collecting sugar by turn can be used in order to have the sugar for the whole year.

Sugar simmering will start when agriculturist sieve sugar through cheesecloth in a huge strainer. The pan is able to contain the amount of 3 sugar buckets. When finish simmering, 10 kilos of dry sugar will be made. When the sugar is not boiling, the agriculturist use strainer to take away the bubbles. And when it is boiling, cover is used to prevent the overflow of sugar. Finally, sugar will be condensed. When sugar turns sticky or changes the color, agriculturists will move around the pan so that it wouldn't burn the sugar. Wait until there is no bubble then put the pan down on the car tyre. Then use the iron stick to stir sugar so that it would cool down. Then knot the sugar and put in the bucket or make a palm sugar cake.

Coconut fiddle

In fact, coconut fiddle has been existed since Middle Ayuttaya Period. But it was proved in the end of Ayuttaya era during King PraChaoSue period. The most important fiddle in Thai history is called "Soh Sai Fa Fad" in King Rama II period. It has been preserved as folk wisdom of fiddle making. Soh is a stringed musical instrument. Soh which made of coconut shell has been carved into several styles such as thai characteristics, flowers, abbreviation names, or zodiac. This carving varies upon the size and color of coconut shell which due to the age of the coconut tree. However, Soh is quite difficult to be found nowadays. Samut Songkhram is the only province in Thailand that grows fiddle coconut. "Ban Phayasor" - the center of

making Soh is located at Moo 5 Bang Phrom Subdistrict, Bang Khonthi District. (Committee of Documents and Archival Processing, 2001: 129)

According to the information provided by Mr. Somporn Ketkeaw - the agriculturist and experts in making Alto fiddle and treble fiddle mentioned that under the current situations fiddle coconuts have been attacked by coconut leaf beetles like most of the coconut trees. If it has not been supported in plant propagation: tissue culture, or other kinds of propagation, it has high percentage of extinction. Natural fertilization or non-caring of the agriculturists may result in the transformation with other kinds of coconut. An expert also gives the additional information that the agriculturists are not educated or use the new scientific method which still remains the traditional ways of farming like in the previous generation did. They follow the way of flexibility, if there is no longer fiddle coconut, then no need to do anything. If it still naturally exists, then we maintain and keep on preserving by listening to Thai musical instrument. There is less popularity in Thai musical instruments nowadays. And there are other ways in choosing to listen to music from electrical media. So fiddle is less important in everyday world. Business on fiddle is also decrease. Therefore Phayasor is considered as a main center of musical instrument and Thai culture preservation of the country.



Figure 4.20 Fiddle conservation

Source: Researcher, 2010

Housing of coconut agriculturists

According to the study of local architecture of coconut agriculturists: The relations of life, environment, and architecture, the case study of Bann Mob-Lad and Bann Klong-Dan Tambon Lam-Yai Samut Songkhram, (Natcha Sakulngam, Yossaporn Punnawattana, Wongsakorn Udomphot and Itsarachai, 2010) found that "House" of coconut agriculturists clearly reflects the system of the relationship between life, career, and environment. It shows the figure of extended family. As we can see how the house has been developed, fixed, and enlarged in order to support the increasing number of family members. Each house has the sugar simmer place along with the coconut growing area. People normally set up their house on aside of the canal which they use boat as the main transportation mode. The house is built as a traditional Thai style house which lift up the platform and has the open-air basement. In this case, the house will be safe from the tide up and down each day as well as preventing the residents from flash flood. This idea shows that the villager well live with the nature and have understood the surrounding environment. In the past, the construction materials used for building up the house and sugar shimmer shed were the materials that could easily be found within the area or the neighbors. The main structures were made of bamboo, mangrove, and genuine wood. Partition was made of genuine wood and palm leaves. The roof top was made of the binding palm leaves. The sugar shimmer shed was also made of the natural materials that could be found in the nearby area.

Nowadays, the housing has been change since road becomes the major mode of transportation. Coconut agriculturist houses now tend to be close to the street. Construction materials also change to industrialized materials. These kinds of materials are also use in fixing the house as well as building up the new one. The house poles have been changed to concrete pole. Cement and bricks or plywood are used for wall and partition. Roof is built by corrugated iron or carved tiles. However, there is one thing that remains the same, the sugar simmer place. There is still sugar simmer shed together with the house and there is less change of constructional materials for this place.

According to the study, it indicates that palm leaves roof top is able to stand the sugar steam better than the corrugated iron and cheaper than using the carved

tiles. Moreover, the materials used for binding the palm leaves which are rattans and bamboo stripes are more durable than steel wire. However, there are some people that use plastic rope. Normally sugar simmer shed constructional materials will be changed more often than the house because of the dirt from sugar steam and its oldness. Though frequent changes are needed, the use of palm leaves is considered the most efficient in terms of endurance and cost.

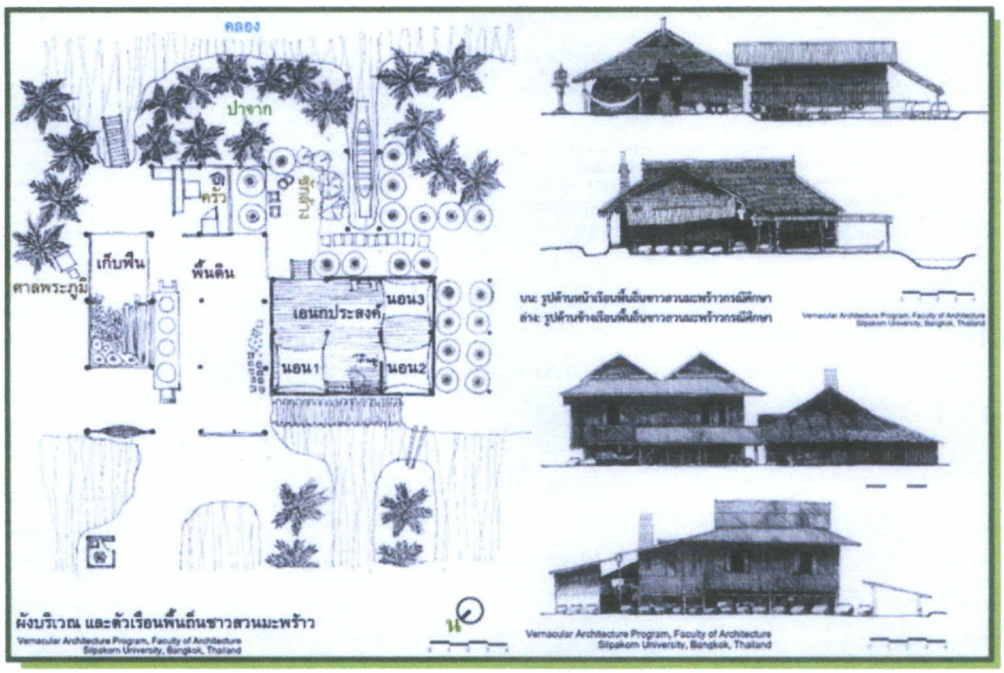


Figure 4.21 Area plan and house of coconut agriculturists

Source: Natcha Sakulngam, Yossaporn Punnawattana, Wongsakorn Udomphot and Itsarachai, 2009



Figure 4.22 Examples of houses agriculturists at present

Source: Researcher, 2010

Most houses still remain Thai traditional style housing. Therefore, the type of the house being seen is a higher platform house. However, the house has been adapted to fully usage of downstairs since there was no flood for over 10 years, which is the benefit from having the dam. The life style of villagers which include the style of house seems to be changed gradually. Besides, there is less sugar simmer shed since most agriculturists are no longer make the sugar themselves but send the fresh sugar to the factory instead.

4.4.2 Agriculturist's perspective toward folk wisdom.

According to the study, it has been found that agriculturists' point of view toward the local ideas think that they were significant. The previous agriculturists spent the rest of their lives in the farm which piled up all of the knowledge, experiments, and pass it along generations. So that it is necessary for the current agriculturists to keep on discovering and developing the local wisdom by continue expanding the knowledge and apply it with their own farming. At that point, the agriculturists will truly understand the concepts and see the significance of the local intelligence. The preservation concepts remind the agriculturists of the understanding of nature, including water, soil, as well as knowing the fruits by noticing the root, trunk, stem, leaves. If the plants are growing well, there is not necessary to give them any fertilizer. Too much fertilizing might create a problem of non-balancing later on. Some of the agriculturists are not really get into the concept of keeping the way the nature is. So it affects on the output of the plants. Depending on this theory, agriculturists in the area try to call for the traditional way of living, since there are many kinds of indigenous knowledge and each of them are outstanding in its own way. There could be some similarity of local wisdom between provinces. However, the usage of delivering each method would be different according to the area of living, for instance, farming, fishery, bakery, etc. This knowledge is worth to be learned and exchanging. The agriculturists are now encouraged to continue developing the knowledge in a way of transforming, improving to suit the area of living and environment. In addition, they should view all the elements holistically. For example, the experiment of the comparison of plant cycle in different periods of time whether

when plant can adjust itself and mature. During that time fertilizer might not be useful.

However, besides the precious wisdom which had been sent over by the ancestors or the direct experiences of the agriculturists, keeping up- to-date with the newest information should also be focused. This new information can be obtained through media such as television, internet, and demonstration from other farms. In addition, noticing and keep on learning continuously will also expand the knowledge of the agriculturists. Learning from other farms will give benefits on exchanging the knowledge. On the other hand, in terms of usage, the concept of organic agriculture is kept in mind. Each agriculturist would implement the gained knowledge into their own farm. They adapt and adjust until it suit with their farm. For example, vetiver grass for prevention of eroding soil surface. When it grows longer, the agriculturists will get rid of it later on. Besides, grass help maintaining humidity on the soil surface during summer time. This is the advantages that derived from the improvement and integration of the current agriculturist local ideas.

4.4.3 Knowledge and local intelligence education for the next generation.

The fundamental of knowledge that ancestors intent to pass along to the next generation are to keep the local fruits as well as local wisdom, Environmental conservation, and maintain their land of living. Each individual in household family can be a part of getting things started. This way they can be an illustration for any other families within the community. Knowledge learning will be focusing on the importance of disease and insects. Natural materials selection for insects prevention, for example fungus will be killed by fruit peel that taste bitter such as betel nut, mangosteen. Lemongrass is used for mosquito protection. Other kinds of insect will be away from the herbs that have a strong smell and taste bitter like boraphet and bitter bush. Herbs fermentation is also very useful. The fruit planting should be considered according to the geographical area of planting. Recently, the areas of growing fruits tend to reduce and also the decreasing number of agriculturists. With these reasons, it finally may vanish the farming. Therefore, the elders had been taught to put good reminders on younger agriculturists.

Mr. Adisak Chuangyam – agriculturist, expert, and the director of local expert network in Bang Nang Li Subdistrict, Amphawa District give an example to motivate other agriculturists to love and maintain their land.

"Eventhough we have sold the land and earn the money, year after year you will finally run out of money. And when you sell the land, it won't come back to you. However, those ancestors who have done their best for us, they could still maintain their land. Despite they had little amount of money, they still choose to protect the land, not to sell it. "

The instruction, both practically and theoretically, will work well only if the learners are motivated and interested. Said Mr. Arun Deeprasert, the agriculturist.

"Most agriculturists will rely on the information from the experts who have high reputation and they will only ask the famous one. When I asked, they would say they have had learned that before. When they answered it that way, it means that they don't want to know anymore. They already know. Then we move on to another topic. It appeared that the first orange tree gave low-weight yields, and then he decided to cut the rest of all. It shows that agriculturist must be calm and be patient and good at problem solving because it takes time to fight against the obstacles and wait for the products in order to have the best quality and sell it. For community instruction, I will only teach when someone asks. Then I give out my suggestion. I would like to teach those who are interested, having faith, and believe. These people will open up their mind. If I just directly tell them, they only have their own opinion, things will be in contrast"

Even though the agriculturists want to transfer their knowledge to the next generation, the needs to continue farming depend on workforce. Because the new generation ceases the willingness to do farming after their parents, it became the gap between generations. And when the previous generation passed away, the knowledge and wisdom are no longer exist.

4.4.4 The relationship of farming within community

The agriculturists have agreed that when compare to the past, the relationship of those agriculturists who live in the same community tend to be lower because of the higher cost of living which result in less sharing between

neighbors. Luckily, some good relationship can still be seen. Mr. Chusak Deesawas, professional agricultural officer, stated that "Mae Klong is the area in which when it turns dark, all the people will go to bed. In this case, we are not talking about the youngster since there are less and less nowadays. It's natural for agriculturists. There are plenty of temples in the society. Helping each other is still the traditional way of living for Thais. Food delivery or making merit at the temple can still be seen."

From his statement, it shows the relationship which lessen but still remained in the society of Samut Songkhram. Temple is the center and people are still helping each other. The strong relationship of current agriculturists originates from the group of people gathering together. The groups are classified into the groups of agricultural careers or the types of economical fruits which brings the agriculturists together. These people are having activities together such as talking in round table, having seminar, giving instruction on technologies, making of fertilizer, fruit consumption management, the exchange of knowledge, problem consultant, helping hands within the groups or the cooperation in any other areas which concern the way of living. These create a better relationship for the agriculturists within community. The agriculturist may bring the knowledge from group discussion into practices in order to reduce the investment cost. And it becomes very important for those agriculturists working together. Mr. Siang Inprasert, the director of organic pomelo and voluntary agriculturist of Bang Khan Taek Subdistrict stated about the group that "*We have agriculturists training and seminar every month which emphasize on teamwork and cooperation with the community. If there is anyone having a problem about the production or any other issues, we can talk and trying to figure out the problem together. If there is anyone who runs out of fertilizer supply, we offer them the fund by buying the fertilizer so that they can run their farm and when they can make a sale on their products, then they can return the money to the group. We also setup the welfare to create the benefits and maintain relationship for the members. We make a suggestion on the process of making fertilizer and let them practice on their own. Besides, we teach them how to make the herbs for insects expulsion, how to do compost so that they could reduce the expenses. We also eagerly support those who intend to know more about farming to keep exploring.*"

Nowadays, there are a couple of pomelo groups in Bang Khan Taek. Altogether there are about 30 members and they are sponsored by the agricultural officers of Bang Khan Taek which is very important for the relationship within the community. Mr.Adisak Chuangyam, the director of expertise network in Samut Songkhram and the voluntary agriculturist of Bang Nang Li indicated "*We are trying to group together with the agriculturists who work in the same field and having the same ideal. We are discussing and sharing the knowledge together. For example, we have the fertilizer group which trying to make the fertilizer for our own use. We share the knowledge so that we know what to prepare and what to do, then we make it into practices.*"

4.4.5 Agriculturists in the past, present, and future

In the past, agriculturists were more related to the nature. Their main job was making the palm sugar together with growing various kinds of fruits. Soil was abundant so there was no need for huge amount of fertilizer. When there was the flood, water would get into the channels which also brought about some nutrients for fertilize the plants. Even though the production was not as many, the trees constantly give the fruits according to the season of each kind. Agriculturists also made their farm cleared without any grass, in order to prevent any disease. Weeds would be brought to make fertilizer or burn away. Agricultural officer believed that the burning would cease the breakout of plant and insects disease. The farm was in limited area and the problem of global warming was not as severe as it is in present, so the farming was mostly about the plant preservation and sustainable farming.

Even the production was low but the plants were well taken care by the use of fertilizer and suitable pruning. For example, pomelo can be alive up to 20-30 years, coconut for 40-50 years or even the living 200 years old lychee tree is still produce lychee fruit. However the quantity of the fruit will decrease according to the age. On the other hand, the lack of treating the plants or over-fertilization may shorten the plant lives and make the unqualified production. In the past, there was no rush in producing the fruits. Therefore, agriculturists got low income each day. However, the expense was also low. Since the previous style of farming did not contain only fruit

growing but it was the mixture of other kinds of agriculture as well. Therefore farming was the crucial source for human living at that time.

Later, when the world has changed in several aspects such as development or the world has turned into materialism world. Consequently, agriculturists rely on business and commerce from selling the same kind of fruits which using chemical to generate more outputs for the increasing demand. It seems that most of the agriculturists do not realize on the negative effects of the continuous or excess use of chemical that may follow afterward. Besides the plants, harmful result also occurs on agriculturists' health and the poisonous substances still remain in the area which impacts the surrounding environment. Farming should have been done over time which means that the owner of the farm should increase more workforces in order to meet the supply of the market. Miss Sataporn Tawankhun, Village Headman Assistant of Bang Phrom Subdistrict, Bang Khonthi District, Agricultural Center Committee and Wood Vinegar Expert mentioned that

"*When the time changes, money takes a crucial role. Government has supported farming especially on pomelo and lychee. Exporting of these products becomes greater. Then people started to chop down the trees. And the whole groups of agriculturists turned into growing lychee. In the past, lychee created a lot of profits. So agriculturists were using chemical to increase the amount of fruits. 20-30 years ago, the weather was perfect. It was quite cool. Lychee flowers were blooming. Agriculturists were eagerly prepared to warp the newspaper around the lychee fruit bunch. It's not necessary to see the fruit, only the flowers we can make sure that we would get the fruit 100% sure. And it continued with large amount of outputs every year. However, it remained for only 5-6 years. At that time lychee was very famous. When there was a temple fair at Bang Prom Temple, a lot of people came for a visit. Because lychee gave agriculturists money, they turned their farm into lychee farm. Not so long, it started to change again. There were a lot of coconuts back then. To my understanding, Coconut well absorbs the humidity in the air. If we cut it off, we would see that it soaked in lots of water. Therefore the weather was cool. Not extremely hot like nowadays. The temperature was fine. On the other hand, lychee is not the tree that absorbs a large amount of water. It doesn't maintain any humidity. But people still choose to grow them anyway. Moreover, there is a*

construction of power plants. The heat is dispersed. Now it affects lychee. When the agriculturists see lychee getting blooming, they are not sure whether they will receive a good outcomes like they used to. Sometimes there is even none. The last 4-5 years was even worse, except if we were lucky enough. It depended on the weather. If there was no heat flow from power plant, then we got lucky. But sometimes it was getting too cold. There was no perfect weather like it used to be. When we were doing coconut farm, there was no falling down. Only fall from the top. Growing coconut is a very good career. It generates a lot of income and we are like a freelance. Nowadays, the number of people who are doing this job is quite low. However, it seems like the number tends to increase."

The reasons have been given by the agriculturists about the changes that it is a result of human and the mistake on the support of growing one type of fruit which generate high income but it doesn't support the family like mix agriculture. With various types of agriculture, family will have food supply throughout the whole year and they will naturally grow without forcing them by using chemical. Nowadays, ripe coconut is sold at 20 baht/fruit which had never happened before in the past. Since there was a spread of a disease caused by Bombardier beetles or so called coconut leaves beetles, it directly affects coconut farm. In the area of Amphawa, there was also a spread of this disease but less than what happened in the south. When Bombardier beetle attacked, it started to suck the water and nutrient from the sap which lessen the products. The problem of cutting down the trees for land business also occurs in the area of Samut Songkhram. Agriculturists decided to get rid of lychee because they are no longer earning from doing so. It takes time for the agriculturist to change from lychee to coconut since they will need to spend time on growing and more time until the tree produces a bunch of coconuts. Nowadays, farm owner hires agriculturists to climb up the tree in order to get sugar palm once a day. This sugar will not be processed but directly send it fresh to the factory. This changes the life of the agriculturists. In the past, they needed to find fire wood, make a simmer oven, etc. During that time the elder generation could save a lot of money than our generation who need to spend a lot to cover the expenses on farms.

When the agriculturists and government understand the current situations, the instruction on chemical usage is given to the agriculturists. The government

recommended on the use of traditional method which our grandparents or great grandparents used to do. It is the way of moving backward which should be done. The suggestions focus on sustainable and sufficient agriculture. Agriculturists will need to depend on their own as much as they possibly could. Both government and the experts in the area are trying to help on the reduction of chemical usage or restricted to the certain amount, emphasize on multi-agriculture and cover cropping since there is more heat affected by the problem of global warming. Cover cropping will also reduce the problem of rinsing soil surface during rainy season. The main objective is to restore the nature by using main fruits of the province. The changing into non-chemical substances is not the main issue. There are a lot of market targets that need our supply. Therefore, the trend seems to be that the current agriculturists still persist in recovering and maintaining the nature and carry on an occupation of being agriculturist.

According to the lower amount of fruits in the area as well as temperature fluctuation, it forces some of the agriculturists to find another part-time job for earning more money and lessen their expenses such as doing homestay business, fruit transforming. Current agriculturist are quite old of age, therefore it results in low workforce, capital and higher expenses. The new generation is not really interested in becoming a agriculturist like their previous generation because of low income and salary is not regularly received like working for factory or company. Parents do not recommend their children to do farming as they are afraid of tiresome. Some of the agriculturists choose to sell their land and migrate to capital city of Bangkok because they want their children to gain higher education. Therefore, the farming areas are less as well as the number of agriculturists. These are the effects from selling the land. In addition, the land maybe transform into housing, resort, accommodation. Besides, the impacts of tourism industry cause the price of the land to dramatically increases. The leader of each farming groups realize and concern about these problems. The campaign has been set up for the agriculturists to perceive the importance of their hometown and to maintain the folk wisdom which is a crucial part toward the local career preservation. It also includes the multi-fruit farming in Samut Songkhram.

In term of management, agriculturists agreed that the current colleagues or the agriculturists are interested in the different methods such as the improvement, the

maintenance by fertilizer, the technology involved like sprinkler. In the past, agriculturists needed coconut spanix as a scoop to water the plants. The spraying fertilizer for fruits by using electrical devices also interests the agriculturists. The machine that helps the old agriculturists is also useful as a helping tool. These are all the continuous ideas originated from the local wisdom.

4.5 The support from governmental organizations and other organizations

4.5.1 Management support and fruit farming folk wisdom.

To promote folk wisdom of fruits agriculturist, Office of Agriculture Samut Songkhram is giving a support by emphasizing local people to participate in district activities. It begins with growing major economical fruits such as coconut, pomelo, and lychee. Discussion, Advising, Exchanging knowledge and promoting are being explicitly encouraged in the year 2010. One way to maintain local wisdom is to have local experienced agriculturists who are successful in farming or experts who are knowledgeable from different districts to gather for a conference. So that they will have a good basis of management, problem solving, processed food of banana, cucumber tree, garcinia, lychee, coconut, and other related issues on fruits. Seminar and Trainings are provided for the local agriculturists since most of the agriculturists do not own the massive size of the farm and living in sufficient and sustainable economy. Government has supported in terms of knowledge and technology which doesn't cost the amount of investment and easily be understood. The government also provides budget, instruments, academic materials, research approval, and knowledge extension like Technology center budget, learning center within the area for different districts of the province to come and use.



Figure 4.23 Local wisdom campaigns from governmental units

Source: Researcher, 2010

Not only the learning center provided but also the activities house of community. Sometimes it turns into agricultural clinic and the mobile agricultural office in which it goes into the areas or the districts that are holding the activities. For example, pomelo competition, lychee competition, pomelo and lychee exhibition which show the steps on growing these fruits and show the way how to cultivate for those who are interested. The activity at King Rama II Park which brought several kinds of fruits as well as another activity set up by other organizations. For example, The Chaipattana Foundation held Amphawa Project – Chaipattana Nurak which encourages and maintains Thai traditions. People ways of living were reflected by simulation method, community exhibition, farming demonstration for learning, and other activities. The objective was to attract local people as well as other tourists in order to make them learn traditional ways of living. The party was held at King Rama II Park where most of the time the activities has been set up here. The place itself is a place for keeping and maintaining the provincial culture, including the local fruits which getting close to extinction.



Figure 4.24 Amphawa Chaipattana Nurak Project and King Rama II Park

Source: Researcher, 2010

4.5.2 Marketing and pricing support

The government has supported in coordination and product pricing by coordinating through enterprise registration of the fruit farming groups. The office of commercial is acting as the coordinator in products sale both within and outside the province. Most of the markets are the domestic market in Bangkok area. It is also exported to neighboring country like Laos. Booth exhibition in the hall or huge markets such as Marketing Organization for Agriculturists (Au-Tor-Kor Market), Siam Paragon, Siam Square, Thai Market are also the target markets. However the consideration for having booth exhibition depends on the output of products in each year. For example, the survey of lychee products must be conducted since the time lychee flowers start blooming. If there is not adequate output, the province would cease the exhibition in that year. On the other hand, pomelo always gives the fruits throughout the year but the amount may vary from year to year. In this case the fair can be held every year in order to publicize the local fruits. Pomelo fair has been arranged twice a year. And each time the office of agriculture will set up the price for sale. In case that pomelo fruits exceed market demand, the office of agriculture will take control in fruit distribution to other units. However, prior to this process, government and the agriculturists will first discuss about the amount of outputs before proceed to the next steps.

There is also the support for some changes in order to make the fruits become chemical-free. The government has introduced the suitable form of farming call "Good Agricultural Practice" (GAP). Agriculturists will be able to gain a better price in the market. GAP will also suit the market as the consumers now more aware on products selection. Moreover, the recommendation on growing a short kind of coconut has been given. Even though there is the distinction in the amount of sugar given by the tree, it reduces the risk of agriculturists when they climb up the high coconut trees every day. There is another recommendation suggesting that when the existing coconut trees get higher, the new set of coconut trees can be grown at the same time. The strategy of growing new coconut trees is to make it compatible with the tall ones. Using this tactic, the agriculturist will be able to make the coconut fruits from the tall tree for sale as well as its tip and trunk, and collecting the sugar from newly grown trees. However, to use this method, the large size of land is

needed. Overall, the experts try to persuade the agriculturists to go back to traditional career which give various products including, sugar, coconuts, banana, etc. This multi agricultural farm suits with the geographical area and the size of farm which the agriculturists own and they can manage their own.

Major floating markets - Amphawa floating market, Bang Noi, Bang Nok Khwaek, Tha Kha are also being supported. Homestay living, resorts, as well as agricultural tourism give a good opportunity on local fruits distribution to the tourists in the area. Somehow it has helped on publicity of local fruits and the fruit products are constantly sold. Therefore there is no left over fruits in the stock and the agriculturists are satisfied with the price.



Figure 4.25 Pricing and marketing support for agriculturists

Source: Researcher, 2010

4.5.3 The distinction between previous and present policy

The previous policy of the government was processed by top-down system, formal organization. The orders come from the management level to the officers and directly to villagers or agriculturists. However some policy may be useful while some are not. After bureaucratic reformation, the government is now listening to more voices of the agriculturists which create the intimacy between them. It is more likely to be a visit, a chit-chat talk, giving new information, passing on the news, teaching, etc. In the year 1999, Agricultural Technology Center was founded. The policies, mission were changed. The objectives were obviously presented. The agriculturists were encouraged to expand their land of farming. But soon after, it

changes to emphasize on the qualities of the products, no more use of chemical substances and forcing agriculturists to use natural fertilizer in order to prevent and get rid of diseases and insects.

In term of policy, most officers agree with the present policy as it focuses on the importance of environment, agriculturists and consumers' health. Therefore, the future policy would have only minor changes in small aspects. The main concern will still be as same as the current one. The focusing policies are chemical-free fruits, natural conservation, local intelligence, traditional farming which include maintaining the types of fruits, increasing its qualities, and supporting on multi-farming for substitute the existing farm. However, the officers start to concern about the future of agriculturists in the next generation. In the future, there will not be a consistently evaluation on coordination. There might be less parties of agriculturists because no one to continue. However, the plan was created by the committee of the group that agriculturists should be able to run and manage the farm by themselves as well as responsible for advising the important factors the next generation.

4.5.4 Problems and difficulties

According to experiences of the officers in the office of agriculture Samut Songkhram, they have been pointed out the following problems

- The main issue that affects the work of officers is insufficient budget for equipments support and experiment. It also lacks of the researches budget which would help the agriculturists expand their knowledge in different aspects. They would respect the supporting from organization.

- Some of the agriculturists do not see the necessity in applying the knowledge into their own farm. And the land owner leave the land deserted which cause the disease and bring in the unwanted insects to the nearby farms.

- Variety of agriculturists is also an issue. The agriculturists who do multi-farming are normally middle class people. These people are having different principal job and temporary job. Because of the differences in occupations, it is difficult to get them group together. Most of the agriculturists are seniors, therefore high motivation is needed. For example a field trip at Suan Luang. The leader of the

group used field trip to motivate the members. The result was satisfied. The agriculturists brought back some knowledge and use it with their own farm.

- Product pricing is fluctuated and cannot be fixed to the stable rate in central market. It impacts the reputation of the supporting organization. According to the expert, the case of agriculturists that changed the kind of fruits for their farm was supported by the government on seedling, fertilizer, and maintenance. On the other hand, when the product supply exceeds the demand of market, the price tends to be low. But for those agriculturists who do not follow the recommendation of the governmental organization will get the different result. Changing the type of fruits also takes a longer time until the agriculturists can get the outputs. It shows that the support is meaningless. This will also reduce the reputation of the experts. From the mistakes learned, the expert chose to give support on growing the fruits that suit with geographical area and not fluctuated with market pricing.

- The problem of chemical from the agriculturists who rent the land for farming. When the land is not owned by the agriculturists, rental cost is considered as investment. Therefore agriculturists will need to grow the fruits as many as they could without any concern in their mind about the effects that may occur. The products from this kind of farm will have nice shape and skin which impacts naturally grown farming. Its beauty actually resulted from chemical usage. The danger may occur to both agriculturists and consumers and the accumulated amount of chemical might affect the area as well.

4.5.5 The reserved plan for tourism and urban society.

One way to prepare for the effects occurred by tourism in Amphawa is to set up the group for planning. This group would manage tidiness, landscape, homestay renovation, homestay network set up - according to the definition of Tourism Authority of Thailand (TAT) and the sample of agricultural tourism. For example tourism center by Ajarn Somsong Sangtawan. The objective of tourism is to bring agriculture into tourism industry by creating the mixture of site visiting, product sale, and processed products which the area is close to floating market. Or the plan suggested by Mr. Prapas Bunyindee, provincial governor which emphasize on the sustaining of their own land, to love and care their hometown and maintain being local

agriculturists. The areas have been clearly separated to the preserved area by using the green color, which means clear of factory. This issue is a continuous policy from Mr. Witan Suvarntat, the previous governor who maintained the perfect environment of Samut Songkhram.

4.5.6 Agriculturists' view toward government support.

According to the agriculturists' perspectives who have been supported by the governmental units to use biological fertilizer, herbs for insect expulsion, reducing chemical substances for example squirrel tails purchasing from agriculturists under the project of squirrel prevention. Moreover, the suggestion to get rid of coconut leaves beetles which bring agriculturists a better health and reduce investment cost by helping each other. From participating with the community and focusing on sufficient economics, the agriculturists now understand the importance of government role. For example, budget providing for learning center construction or technology training which is the center for community activities. The supports are given by various organizations but the main supports are from Ministry of Agriculture and Cooperatives, officers of the office of agriculture, Land Development Department, etc. These organizations mainly take care of related academic materials and educating people as well as providing the budget which is not really high.

From the agriculturists' perception, they agree that these are beneficial and useful for them. However, some of the issues cannot fully support their needs. These are the instructions which do not give the satisfied outcomes since it doesn't provide any experiment. The inconsistent evaluation is also a problem. Therefore, the agriculturists follow their own experiences and knowledge on tools and types of fruits. And most of the time, it turns out to be self serving. For example, at the end of 2010 to the beginning of 2011 some of the agriculturists are not giving fertilizer to lychee during the time of blooming as has been instructed by the officers. Last year, agriculturists use to follow the instruction given by the government and there was the weather factor that affected lychee, therefore it didn't give fruits as expected. And the agriculturists lost a lot of money without earning anything. Also the seedling that has been given, some are lack of the qualities which doesn't meet agriculturist expectation and the needs of the market. And it takes times to prove. As well as the problem of

delayed Good Agricultural Practice: GAP Certification. In fact most of the problems concern with the different geographical area of the farm along with the supports, received seedlings and distinctive point of views.

CHAPTER V
RESEARCH RESULTS OF FRUIT TREE BIODIVERSITY

This chapter explains the study results in variety and species of fruit tree, including agricultural ecosystem of fruits, which is a part of research objectives relating to fruit biodiversity. It is the result of survey in sampling group of agriculturists growing fruit orchards. The total 390 families were selected from 31 villages in 9 subdistricts of 3 districts in Samut Songkhram Province. The survey and data collection were performed during January to August, 2010.

5.1 The fruit tree biodiversity in Samut Songkhram

From the study of general information in this area, it found that the variety of fruit according to the characteristics of the area of Samut Songkhram can currently be identified by the following issues. (Group Strategic Development, Samut Songkhram Province Patcharawadee, 2550)

5.1.1 Geographical features and agricultural management

5.1.1.1 Terrain feature

General terrain feature is plain with Mae Klong River flowing into in central area from north to south, through Bang Khonthi, Amphawa District and into the Gulf of Thailand, at river mount in Mueang Samut Songkhram District. The whole area is covered with the natural and artificial waterways connecting as canal network. More than 366 canals and 1,947 ditches facilitating the transportation and vocational agriculture are well-known as "the last Venice of the East in Siam". These waterways can assist in draining water between the upper and coastal areas. The tides occur along the length of 23 kilometer coastline in Samut Songkhram on each day.

5.1.1.2 Climate characteristic

From the map, it illustrates that Samut Songkhram Province is adjacent to the Gulf of Thailand so it is directly influenced by the south-west monsoon from the Gulf of Thailand and the South China Sea. It generates average to heavy rain falls in rainy season during July – October. According to adjacent area to the sea, it has the moisture causing not to cold weather in winter during November – February and not to hot weather in summer during February – April. The annual average temperature is 28.1 degree Celsius.

5.1.1.3 The feature of soil

The soil of Samut Songkhram generated from the the deposition of marine sediments and brackish water sediment and when broadly analyzing according to the topographical features and marine influence, the division can be made as lists below:

1) Active tidal flat is the coastal area and the midst of Mae Klong River as the sampling field of this study. Such area possesses the huge influence of tide. The general characteristics of the soil here is clay-like or viscous also can be found the organic ruin underneath. Drainage ability is bad to very bad. The ability to transmit water is low. Strong acids and alkaline of soil reaction is presented. Moderate to very high salt content in soil is found (4-16 milimole), natural soil fertility is high. Soil contains Tha Chin soil, Samutprakan salty soil and Samut Songkhram soil. The basic capacity of soil is not suitable for growing crops due to the flooding always occurring and coupled with the lack of fresh water. The Samut Songkhram soil may be able to plant the salt-tolerant crops such as coconut and pine. The other soils are used to make salt felid, mangrove reforestation and brackish aquaculture.

2) Former tidal flat is an area next to the sea can be flooded. The area has been the influence of the sea since the past but enormously less affected nowadays. The influence of sea water is often less. Some areas of sea water have not been influenced at all. The general characteristics of the soil are clay-like. The shells can be found underneath the soil. The drainage ability is bad to very bad. The ability to transmit water is low. Chemical condition of the soil varies from acidic to alkaline. The natural soil fertility is low to moderate. Amount of salt in soils with low to moderate (0-4 milimole). This area consists of Samutprakan soil, Bangkok soil,

Bangkok soil (low), Thonburi soil and Damneonsaduak soil. In general, the performance of soil cultivation is good. However, plants may be damaged by the intrusion of salt water in the hot season and the shortage of fresh water.

The most area of Samut Songkhram is coastal plain with the slop towards the sea. It affects the tidal current flowing into Mae Klong River and waterways. As a result, the water in Samut Songkhram can be classified into 3 conditions: salt water, brackish water and fresh water.

Currently, the areas are divided by the water conditions changed from the consequence of dam construction and floods protection project as the figure 4.9 and 5.1. It demonstrates the change in the water conditions zoning after launching floods protection project. The freshwater zone has increasingly expanded into Amphawa District, instead of limited in Bang Khonthi only while the brackish water and saltwater zones have decreased. The seasonal changes in water currently have the effects on the tides characteristics, saltwater intrusion, the rain falls as the natural seasons. However, there are also optimal organizations in releasing, storing and controlling water in the dam, including managing water gates and ridges to suit the areas. It still enhances this kind of ecosystem in managing ridges to suit the fruit types, the features of agricultural areas, the volume and characteristics of fresh and salt waters. As a result, the water drainage in the orchards can be designed and modified to suit to the whole ecosystem.

5.1.2 The level of biodiversity

5.1.2.1 The Economic fruit varieties

Considering the land use in Samut Songkhram, agricultural occupation covers the area of 101,384 rais or 44% of the total area. The important fruits that generate the main source of revenue are coconut, coconut palm, young coconut, pomelo, lychee, cultivated banana, and mango. There are hardly differences in the area of fruit plantation in each district. Amphawa District has the most area of fruit plantation, for 37.32% of total area. Then, Bang Khonthi has the area of 35.59% and Mueang District has the area of 27.09% respectively.

According to the above plantation area, coconut is most grown at the area of 53,260 rais, or equivalent to 52.53%. Secondly, two kinds of fruit,

pomelo and coconut, are grown at the same coverage area of 15,014 and 14,785 rais, equivalent to 14.81% and 14.58% respectively. Then, lychee is grown at the area of 9,385 rais, young coconut at 5,051 rais, cultivated banana at 3,224 rais, and mango at 665 rais. They are equivalent to 9.26%, 4.95%, 3.18% and 0.66% respectively.

Table 5.1 Number of plantation areas for main economic fruits in 2008, Samut Songkhram

District	Main economic fruit (rai)							
	Coconut fruit	Pomelo	Coconut Palm	Lychee	Young coconut	Banana	Mango	Total
Mueang	15,437	984	7,790	20	1,734	1,411	87	(27.09) **27,463**
Amphawa	20,298	7,820	4,223	4,234	534	660	70	(37.32) **37,839**
Bang khonthi	17,525	6,210	2,772	5,131	2,783	1,153	508	(35.59) **36,082**
Plantation area	**(52.53) 53,260**	**(14.81) 15,014**	**(14.58) 14,785**	**(9.26) 9,385**	**(4.98) 5,051**	**(3.18) 3,224**	**(0.66) 665**	**(100) 101,384**

Source: Agriculture Office, Samut Songkhram Province, 2010

1. Graph illustrating the total fruit plantation areas in Samut Songkhram

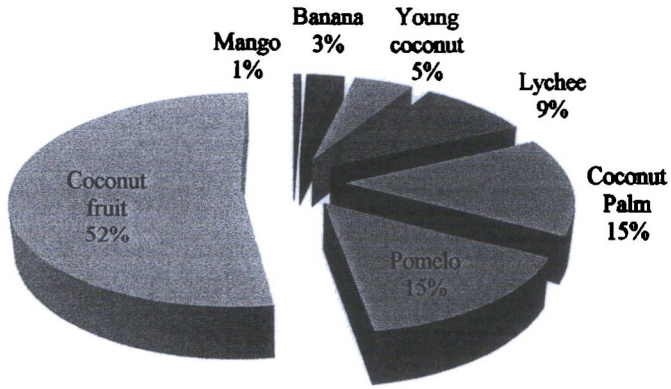
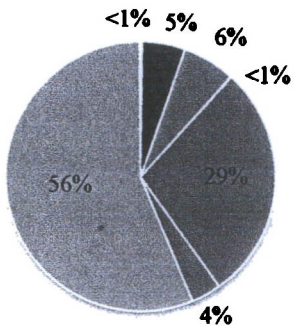
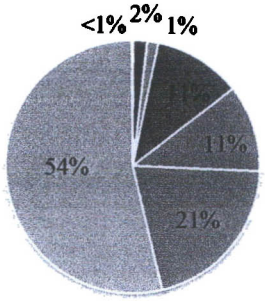


Figure 5.1 Graph illustrating the plantation areas of economic fruits 2009

2. Graph illustrating the fruit plantation areas in Mueang District, Samut Songkhram



3. Graph illustrating the fruit plantation areas in Amphawa District



4. Graph illustrating the fruit plantation areas in Bang Khonthi District

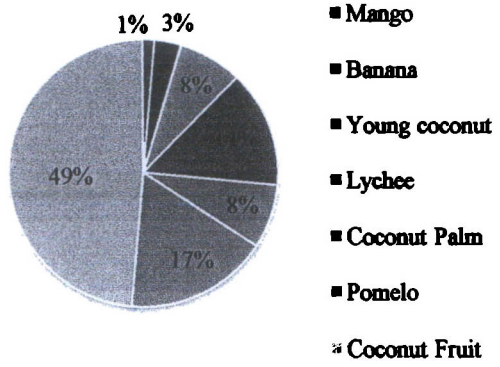


Figure 5.1 Graph illustrating the plantation areas of economic fruits 2009 (cont.)
Source: Agriculture Office, Samut Songkhram Province, 2010

Considering the proportion of areas in each district from figure 5.1 – 5.3, it was found that the economic fruit plantation has suitably distributed to the proper terrain involving the classification of water zones as follows:

5.1.2.1 The ecosystem classification of main fruit varieties and influence of saltwater intrusion

The main fruit varieties in saltwater zone

Due to the adjacent area to the sea in Samut Songkhram, the water zones are divided into different areas. The saltwater zone, mostly in Mueang District and some lower districts in Amphawa where are nearby the sea, is directly affected by the saltwater intrusion. As a result, it causes the least plantation areas in this zone because of the proportion of aquaculture and salt farming. In Mueang

District, The plantation areas nearby the sea and most affected by the salinity of saltwater are the following subdistrict; Klong Khen, Lad Yai, Mueang Samut Sonkhram Municipality, Bang Kaew, Bang Cha Greng, Mae Klong, and Laem Yai. For Prak Nham Daeng and Yee Sarn Subdistrict of Amphawa District, the coconut fruit and coconut palm can be mainly grown in this zone because of their salinity tolerance. The young coconut, cultivated banana and Manila tamarind are grown in less proportion.

The main fruit varieties in brackish water zone

The majority of brackish water zone is in the upper areas of Mueang District and most of Amphawa District in Central part of Samut Songkhram. The saltwater can reach the areas of this zone seasonally, but not as much as the areas of saltwater zone. These areas are in the central part of Mueang District as the following subdistricts; Thai Hat, Bang Khan Taek, Ban Prok and in some subdistricts of Amphawa District as; Tha Ka, Bang Chang, Kwae Om, Amphawa, Suan Luang, HMueang Mai, Wat Pradoo, Bang Nang Lee, and Plai Phongphang. The fruit varieties that the agriculturists have increasingly grown in this part are pomelo and lychee. Also, the cultivated banana is mainly grown in some subdistricts. Inferior to coconut, pomelo can secondly tolerate salinity. It can give a good yield if the plantation is at the appropriate level of salinity.

The main fruit varieties in fresh water zone

The fresh water zone is in the whole area of Bang Khonthi District. Currently, the saltwater sometimes intrudes this area during high saltwater intrusion with heavy rainfall. It increases the water volume but the saltwater intrusion does not last long. As a result, it does not affect to fruit plantation at the moment. The main fruit grown in this area is coconut fruit which covers the most area, equivalent to 49%. Comparing to coconut plantation to Amphawa and Mueang District, it is less than those two districts. The areas of coconut fruit plantations are equivalent to 54% in Amphawa and 56% in Mueang Districts. However, for the plantation area, Bang Khonthi District claims the second inferior from Amphawa District. For the other fruit varieties, Bang Khonthi District has the most area ratio of main fruit plantation in Sumut Songkhram. From the data collection of fruit varieties of Agriculture Office,

Samut Songkhram Province (2009), Bang Khonthi can grow 6 – 10 main fruit varieties in each subdistrict. It is different from the brackish water and saltwater zone. 1 – 4 main fruit varieties can be grown in the brackish water zone while only 1 – 2 main fruit varieties can be grown in the saltwater zone. Besides the fruit varieties grown in Bangkontee; coconut fruit, coconut palm, young coconut, banana, pomelo, and lychee, there are also guava, mango, tangerine, rose apple, papaya, plum mango, and longan. As a result, the coconut plantation decreases because the area must be distributed to the other fruit varieties.

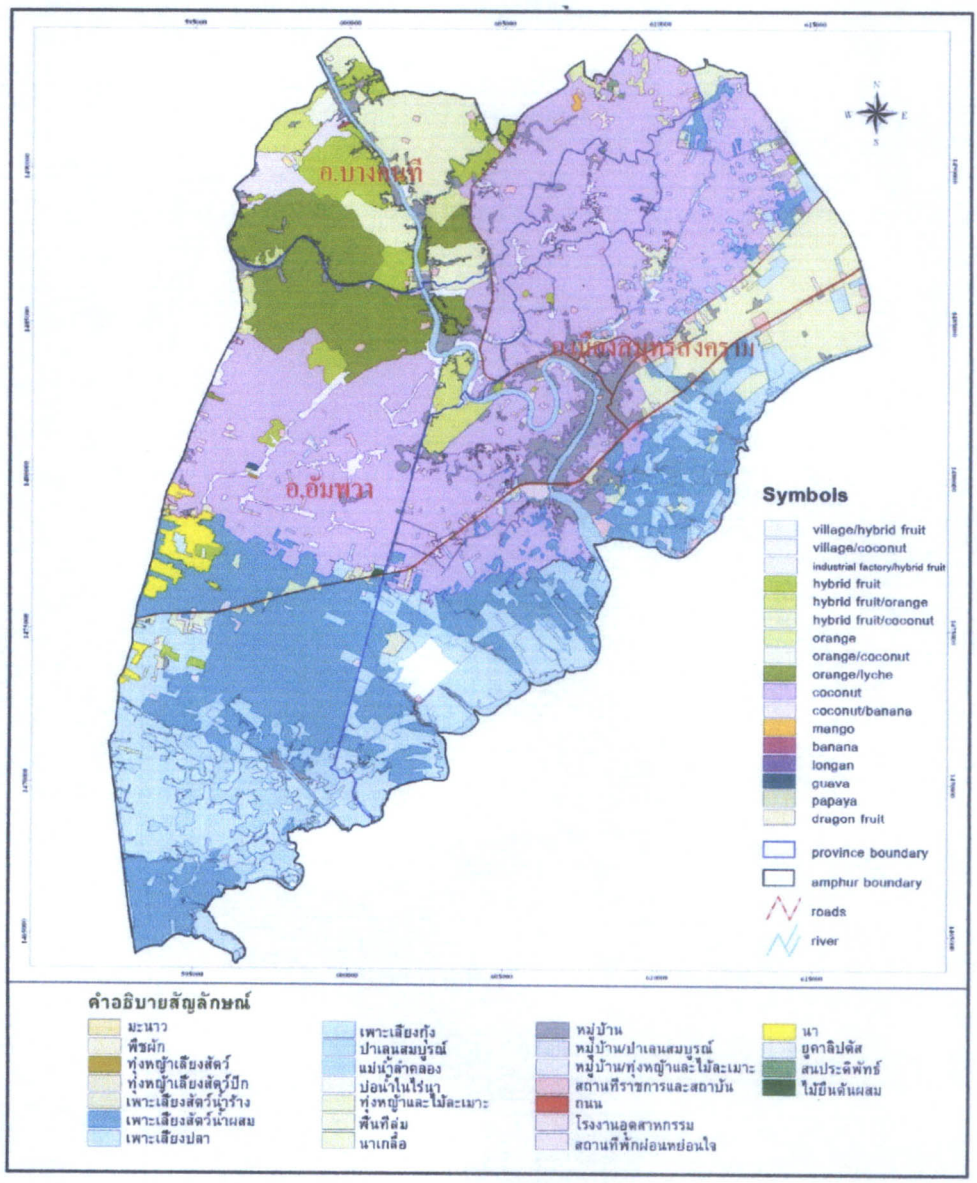


Figure 5.2 Map of land use in Samut Songkhram 2006

Source: Office of Soil Survey and Land Use Planning 1, 2009

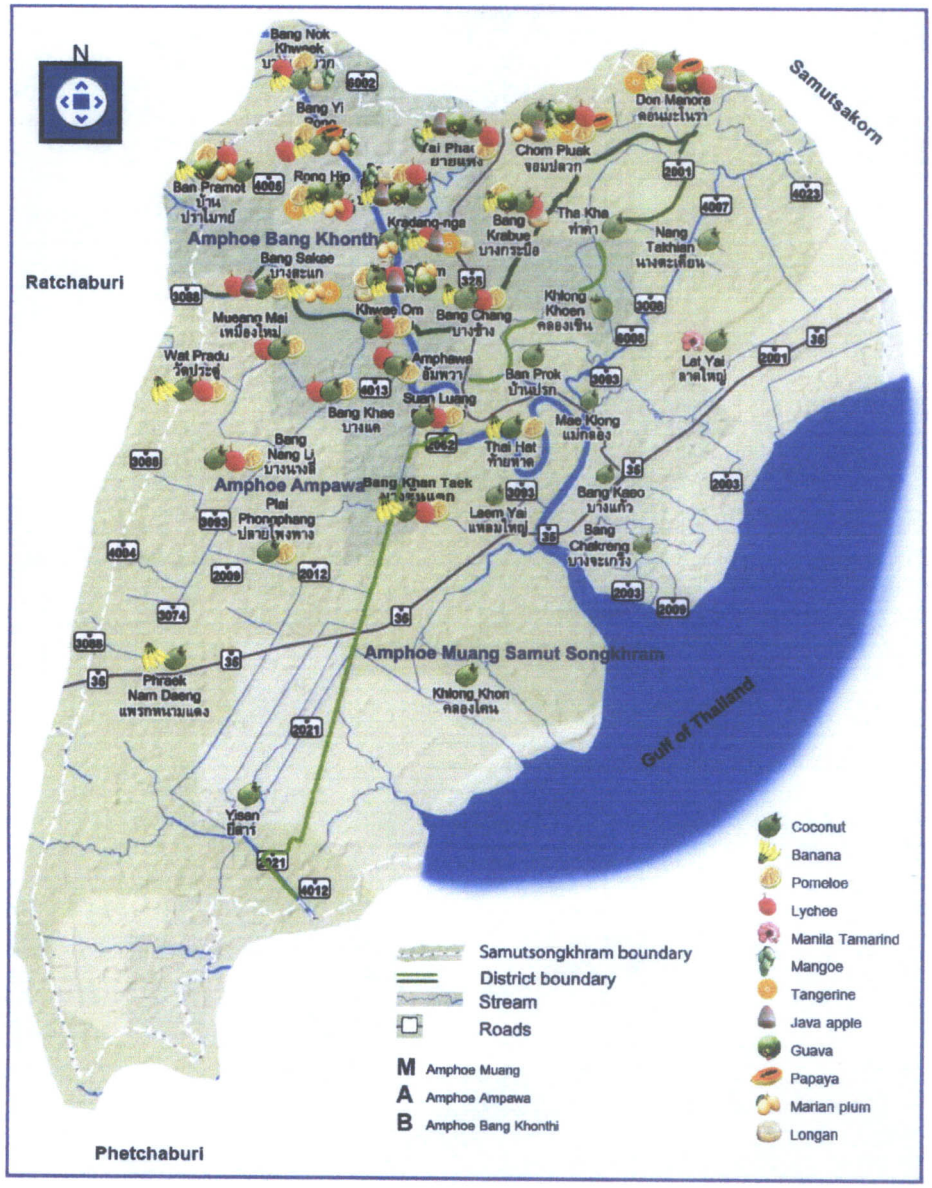


Figure 5.3 Map of main fruit plantations in subdistrict, reported by Agriculture Office, Samut Songkhram Province (2009)

Source: Google Thailand Map, 2009; The summary report of fruit plantation from the situation of crop production 2009 (Agriculture Office, Samut Songkhram Province, 2010) data superimposed by researcher

5.1.2.3 Ecosystem in the study area

From the random sampling for objective study, the subdistricts within administrative area of Samut Songkhram were selected as follows:

Mueang District	Amphawa District	Bang Khonthi District
• Mae Klong Municiple	• Plai Phongphang Subdistrict	• Don Manora Subdistrict
• Ban Prok Subdistrict	• Bang Chang Subdistrict	• Bang Yi Rong Subdistrict
• Bang Khan Taek Subdistrict	• Amphawa Municiple	• Ban Pramot Subdistrict

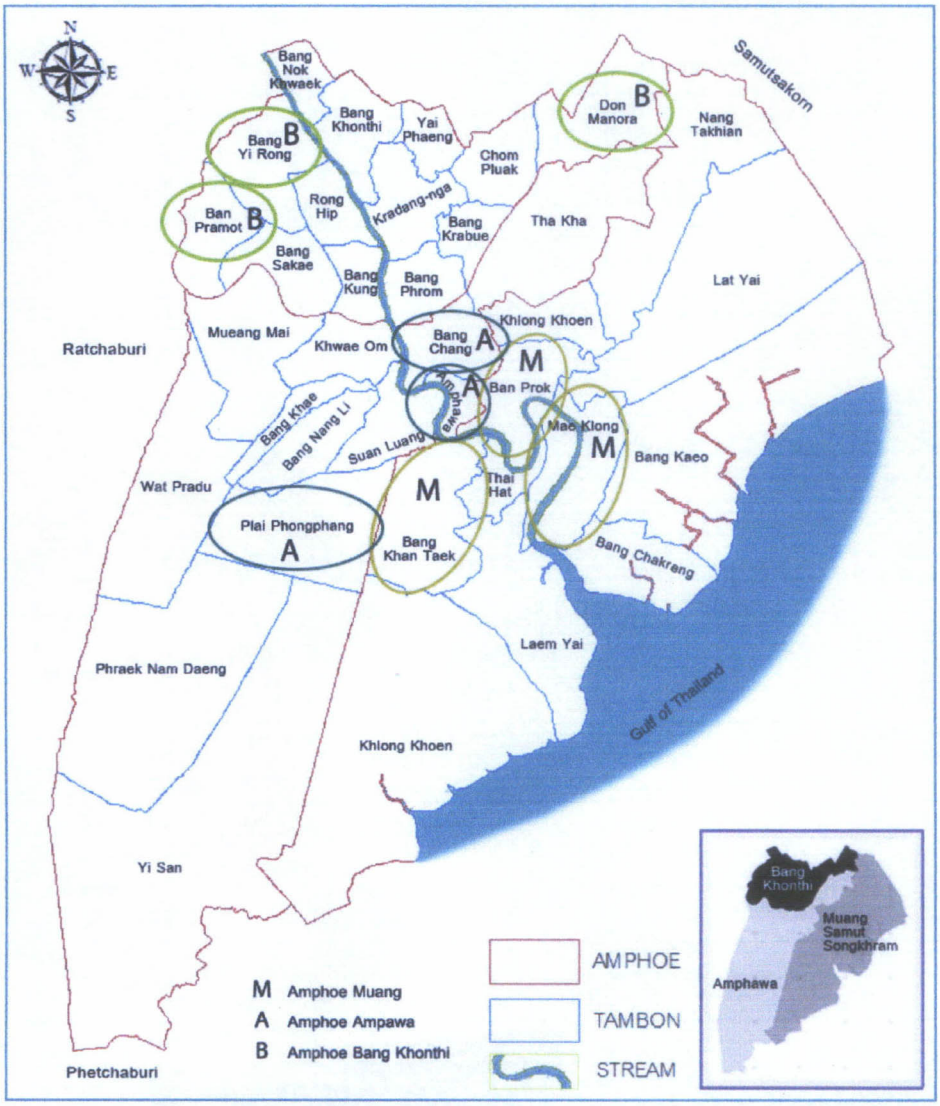


Figure 5.4 The map of the study areas of fruit tree biodiversity in Samut Songkhram

Source: Google Thailand Map, 2009 and data superimposed by researcher

Classified by water zones

- **Saltwater zone:** the subdistrict affected by saltwater most is Mae Klong in Mueang District.

- **Brackish water zone:** Ban Prok and Bang Khan Taek Subdistrict in Mueang District and Plai Phongphang, Amphawa, and Bang Chang Subdistrict in Amphawa District.
- **Freshwater zone:** The zones that saltwater cannot reach are Ban Pramot, Bang Yi Rong, and Don Manora Subdistrict in Bang Khonthi District.

Classified by the size of dominated area for fruit plantation

From the study, it is found that the size of area can be divided by ecosystems of fruit plantation. As the samples of 390 families in Samut Songkhram, the agriculturists have the average area of 6.82 rais.

After dividing the agriculturists' lands into administrative districts, the least area dominated by agriculturist is in Mueang District with the average area of 4.28 rais and the most is in Bang Khonthi with the average area of 9.23 rais. For Amphawa District, it has the average area of 6.8 rais, which is close to the total average area of Samut Songkhram. Though the average areas of district level are adjusted, the ascending order of average area is still the same as; Mueang, Amphawa and Bang Khonthi District respectively. Mae Klong Subdistrict has the least average area of 3.24 rais. Ban Prok subdistrict has the average area of 4.32 rais. Bang Khan Taek subdistrict has the average area of 4.72 rais. Plai Phongphang subdistrict has the average area of 6.26 rais. Amphawa subdistrict has the average area of 7.50 rais. Bang Chang subdistrict has the average area of 7.63 rais. Ban Pramot subdistrict has the average area of 7.54 rais. Don Manora subdistrict has the average area of 8.82 rais and Bang Yi Rong has the most average area of 10.11 rais.

Classified by the biodiversity and species' evenness of fruits

According to Shannon-Wiener's Index of Diversity, H and Evenness Index, E_h (Shannon-Wiener, 1988), the plant diversity index and the evenness index of fruit species in Samut Songkhram are equal to 1.6 and 0.13 respectively. The areas that are divided by administrative district system and by the water zones can be described as follows.

The plant diversity index and the evenness index in the household level

In the household level, the average index of the plant diversity and the evenness are equal to 1.49 and 0.21. The fruit tree biodiversity index is

between 0.85 – 2.15. The household that has the range of diversity index less than 1.5 is equivalent to 52.05% and more than 1.5 is equivalent to 47.95%. The evenness index is between 0.1 – 0.31. The household that has the range of evenness index less than 0.2 is equivalent to 28.46 and more than 0.2 is equivalent to 71.54.

Table 5.2 The species, subspecies, diversity index and evenness index of fruit tree in households

Type of data	Characteristics of data	Household (n = 390)	Percentage
The diversity index of fruit			
	Less than 1.5	203	52.05
	More than 1.5	187	47.95
	$\overline{X}$ = 1.49 S.D. = 0.24		
	Min = 0.85 Max = 2.15		
The evenness index of fruit			
	Less than 0.2	111	28.46
	More than 0.2	179	71.54
	$\overline{X}$ = 0.21 S.D. = 0.033		
	Min = 0.1 Max = 0.31		

The diversity index, the evenness index and the fruit in district level and water zones

- **Mueang District:** From the study of the fruit plantations in Mueang District, there are 28 families, 50 genera, 61 species and 186 varieties. The fruit species found most are in the RUTACEAE family, which has 6 species; tangerine (*Citrus reticulata* Blanco), pomelo (*Citrus maxima* (Burm.) Merr.), leech lime (*Citrus hystrix* DC.), karanda (*Citrus limon* (L.) Burn. f.), bael (*Aegle marmelos* (L.) Corr. Serr.), and limonia (*Limonia acidissima* L.). The fruit tree biodiversity index of Mueang District is 1.73 and the evenness index is 0.17.

- **Amphawa District:** From the study of the fruit plantations in Amphawa District, there are 29 families, 48 genera, 57 species and 207 varieties. The fruit species found most are in the PALMAE and SAPINDACEAE family, which have 5 species. For PALMAE family, there are coconut (*Cocos nucifera* L.), mangrove palm (*Nypa fruticans* Wurmb.), palmyra (*Borassus flabellifera*), dates (*Phoenix dactylifera*, L.), salak (*Zalacca edulis*). For SAPINDACEAE family, there are luna nut (*Lepisanthes fruticosa* (Roxb.) Leenh.), longan (*Dimocarpus longan* Lour. subsp. longan var. longan), lychee (*Litchi chinensis* Sonn.), rambutan (*Nephelium*

lappaceum L.) and Mahuat (*Lepisanthes rubiginosa* (Roxb.) Leenh.). The fruit tree biodiversity index of Amphawa District is 1.64 and the evenness index is 0.15.

- **Bang Khonthi District (freshwater zone):** From the study of the fruit plantations in Bang Khonthi District, there are 28 families, 49 genera, 60 species and 206 varieties. The fruit species found most are in the RUTACEAE family, which have 6 species; tangerine (*Citrus reticulata* Blanco), pomelo (*Citrus maxima* (Burm.) Merr.), leech lime (*Citrus hystrix* DC.), karanda (*Citrus limon* (L.) Burn. f.), bael (*Aegle marmelos* (L.) Corr. Serr.), and limonia (*Limonia acidissima* L.). The fruit tree biodiversity index of Bang Khonthi District is 1.43 and the evenness index is 0.13.
- **Brackish water zone:** The areas in the brackish water zone consist of Ban Prok and Bang Khan Taek Subdistrict in Mueang District, and Plai Phongphang, Amphawa, and Bang Chang Subdistrict in Amphawa District. There are 31 families, 53 genera, 66 species and 246 varieties. The fruit species found most are in the RUTACEAE family, which have 6 species; tangerine (*Citrus reticulata* Blanco), pomelo (*Citrus maxima* (Burm.) Merr.), leech lime (*Citrus hystrix* DC.), karanda (*Citrus limon* (L.) Burn. f.), bael (*Aegle marmelos* (L.) Corr. Serr.), and limonia (*Limonia acidissima* L.). The fruit tree biodiversity index of the brackish water zone is 1.69 and the evenness index is 0.15.
- **Saltwater zone:** The area of the saltwater zone is in Mae Klong Subdistrict. There are 18 families, 30 genera, 24 species and 43 varieties. The fruit species found most are in the MYRTACEAE family, which have 3 species; guava (*Psidium guajava* L.), rose apple (*Eugenia Javanica*), and jambolan plum (*Syzygium cumini* (L.) Skeels). The fruit tree biodiversity index of the saltwater zone is 1.1 and the evenness index is 0.15.

Table 5.3 The information of fruit tree biodiversity in district level and water zones

District	Number of Family	Number of Genera	Number of Species	Number of Variety	Fruit Biodiversity index	Evenness index
Samut Songkhram	33	56	68	282	1.6	0.13
Mueang	28	50	61	186	1.73	0.17
Amphawa	29	48	57	207	1.64	0.15
Bang Khonthi (freshwater zone)	29	49	60	206	1.43	0.13
(Bang Khonthi)						
Freahwater zone	29	49	60	206	1.43	0.13
Brackish water zone	31	53	66	246	1.69	0.15
Saltwater zone	18	30	24	43	1.1	0.15

5.1.3 The pictures of fruit plantations in Samut Songkhram

According to the survey studying main objectives, the photographs of fruit plantations were taken as the details in the map illustrating the main plantation areas in Samut Songkhram as follows.



Figure 5.5 The map illustrating the positions of plantation areas in Samut Songkhram

Source: Google Map of Thailand, 2009 data superimposed by researcher

Picture of position 1 The plantation areas in Laem Yai and Thai Hat Subdistrict



Picture of position 2 The plantation areas in Phraek Nam Daeng Subdistrict



Figure 5.6 The plantation areas in saltwater zone

Picture of position 1-2 In general fruit plantations, coconut is mainly grown as single economic fruit or supplemented with banana because of saltwater zone ecosystem

Picture of position 3 The plantation areas in Bang Khan Taek Subdistrict



Picture of position 4 The plantation areas in Plai Phongphang Subdistrict



Picture of position 3-4 The plantations are more dense. Not only coconut but pomelo and lychee are also the main economic fruits. In addition of growing other supplement fruits, the agriculturist considers the additional plantation from the suitability of the areas which is not the same pattern as being grown in freshwater zone.

Picture of position 5 The plantation areas in Bang Nang Li and Bang Khae Subdistrict



Picture of position 6 The plantation areas in Suan Luang and Khwae Om Subdistrict



Picture of position 7 The plantation areas in Ban Prok and Amphawa Subdistrict



Picture of position 8 The plantation areas in Tha Ka and Bang Chang Subdistrict



Figure 5.7 The plantation areas in brackish water zone

Picture of position 5-8 The plantation areas are in the brackish water zone. Coconut, pomelo and lychee are the main economic fruits but the proportion of lychee plantation is more significant. The majority of agriculturists also emphasize growing supplement fruits in the plantation by considering the suitability of the areas.

Picture of position 9 The plantation areas in Bang Phrom, Kradang-Nga and Bang Khonthi Subdistrict



Picture of position 10 The plantation areas in Don Manora Subdistrict



Picture of position 11 The plantation areas in Bang Sakae, Bang Kung, Ban Pramot, Bang Yi Rong, and Rong Hip Subdistrict



Figure 5.8 The plantation areas in freshwater zone

Source: Researcher, 2010

Picture of position 9-11 The plantation areas are in the freshwater zone which has more economic fruits than the others, such as coconut, pomelo, lychee, cultivated banana and mango. For the feature of plantation, it utilizes more areas than those of saltwater and brackish water zone. As a result, the plantation of main fruits can be clearly seen while growing supplement fruits are clearly less, as seen in the picture of position 10 (the plantation areas in Don Manora Subdistrict).

5.2 Varieties and species of fruit trees in Samut Songkhram

From the study, it found that the fruits, consisting of 33 families, 56 genera, 68 species and 282 varieties in which the agriculturists mainly plant for sale and also for household consumption in their dominated areas. The majority of them are woody plant, approximately to 62 species or 91.2% and herbaceous plant or non-woody plant, approximately to 6 species or 8.8%. The fruit species found most are 6 species in RUTACEAE family; tangerine (*Citrus reticulata* Blanco), pomelo (*Citrus maxima* (Burm.) Merr.), leech lime (*Citrus hystrix* DC.), karanda (*Citrus limon* (L.) Burn.f.), bael *(Aegle marmelos* (L.) Corr. Serr.) and limonia (*Limonia acidissima* L.). Secondly, there are 5 species in PALMAE family; coconut (*Cocos nucifera* L.), mangrove palm (*Nypa fruticans* Wurmb.), palmyra (*Borassus flabellifera*), dates (*Phoenix dactylifera* L.), salak (*Zalacca edulis*) and 5 species in SAPINDACEAE family; luna nut (*Lepisanthes fruticosa* (Roxb.) Leenh.), longan (*Dimocarpus longan* Lour. subsp. longan var. longan), lychee (*Litchi chinensis* Sonn.), rambutan (*Nephelium lappaceum* L.), and mahuat (*Lepisanthes rubiginosa* (Roxb.) Leenh.) and the species of other families as informed in figure 5.9

Considering the in family level, the distribution of PALMAE family has the most at 61,260 trees. The majority are coconut (*Cocos nucifera* L.) which is fruit the agriculturists grow most, equivalent to 40.24%. The second is MUSACEAE family or cultivated banana, which agriculturists grow as the main or supplement fruits in most of all plantations. There are 55,932 trees, equivalent to 36.74%. The third is MYRTACEAE family with 9,404 trees, equivalent to 6.18%. The fruits in this family are guava (*Psidium guajava* L.), rose apple (*Eugenia Javanica*), and jambolan plum (*Syzygium cumini* (L.) Skeels). The majority of these trees are grown in Bang Khonthi District, which grows guava mainly. The fourth is RUTACEAE family or fruits in varieties of tangerine and pomelo, at the number of 8,053 trees, equivalent to 5.29%. From the study, the fruits in these varieties do not have much difference in distribution of district level. The fifth is SAPINDACEAE family or fruits in varieties of luna nut (*Lepisanthes fruticosa* (Roxb.) Leenh.), longan (*Dimocarpus longan* Lour. subsp. longan var. longan), lychee (*Litchi chinensis* Sonn.), rambutan (*Nephelium lappaceum* L.), and mahuat (*Lepisanthes rubiginosa* (Roxb.) Leenh.). There are 3,904 trees, equivalent to 2.56%. The majority is lychee, the main economic fruit. The sixth is

ANACARDIACEAE family, at the number of 3,380 trees and equivalent to 2.22%. They are in the varieties of olive (*Spondias cytherea* Sonn.), plum mango (*Bouea macrophylla* Griffith), and mango (*Manaifera indica* L.) which agriculturists choose as supplement fruits with various varieties. The seventh is CARICACEAE family or papaya (*Carica papaya* L.), at the number of 3,013 trees, equivalent to 1.98%. The majority is grown in Bang Khonthi District. For the other families, they are informed in order as figure 5.9.

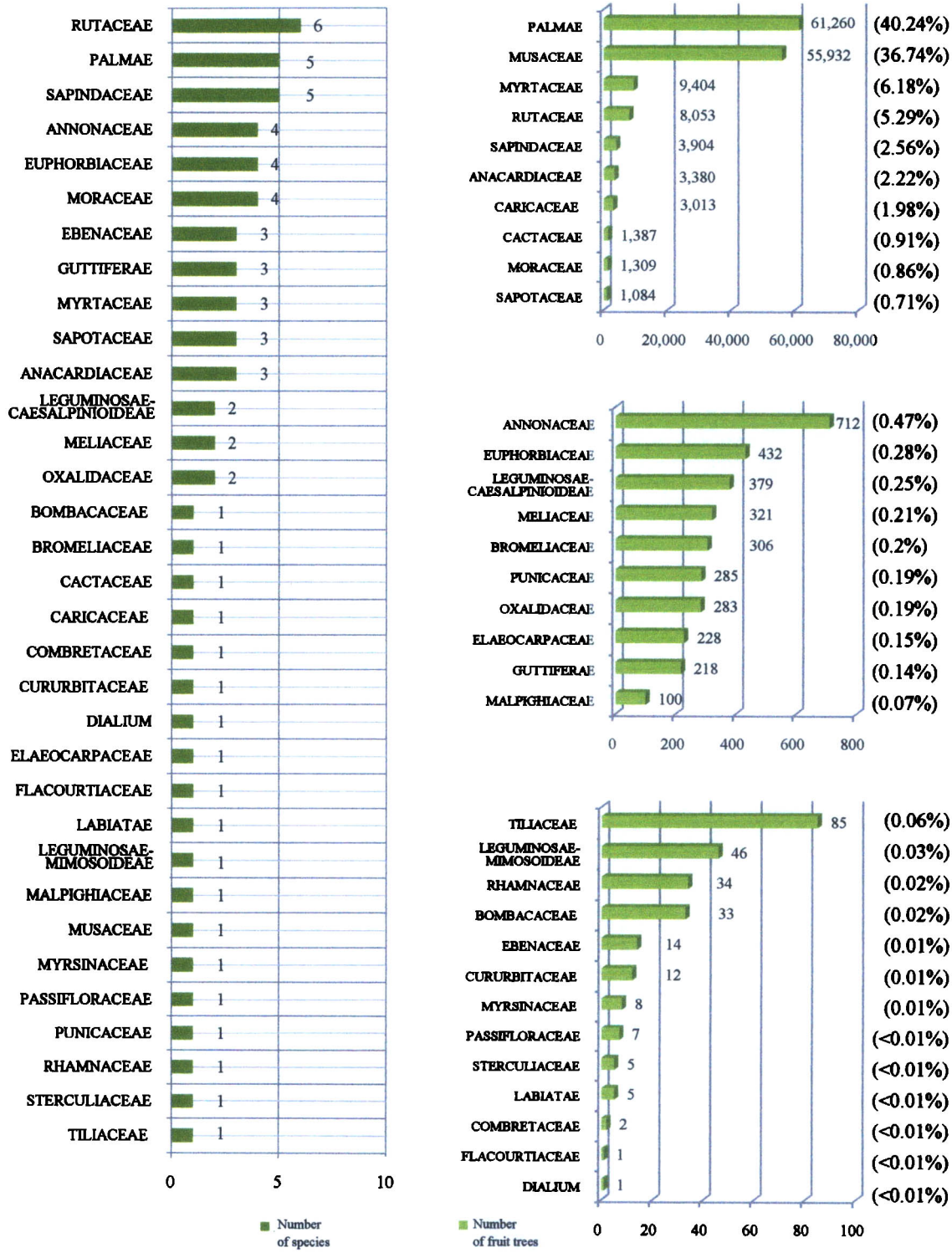


Figure 5.9 The number of fruit species and the number of trees in each family

Table 5.4 Species and varieties of fruit tree

No.	Family	Scientific name	Species	Varieties	Local name	Characteristics
1	ANACARDIACEAE	*Spondias cytherea* Sonn.	Ma Kok	*Farang	Jew's Plum, Otatheite Apple	woody plant
2	ANACARDIACEAE	*Bouea macrophylla* Griffith.	Ma Prang	*Hwan	Marian Plum	woody plant
3				*Hwan Khai Kai		
4				*Yong Chid		
5				Toon Klao		
6	ANACARDIACEAE	*Mangifera indica* L.	Ma Mueang	Khieo Sawoi	Mango	woody plant
7				*Khieo Yai		
8				*Khieo Khaiga		
9				Pa		
10				Nam Dokmai		
11				Nam Dokmai Sitong		
12				Nam Dokmai Man		
13				Nam Dokmai No.4		
14				*Og Rong		
15				Og Rong Tong		
16				Og Rong Yai		
17				*Og Rong Khao		
18				*Og Rong Hom		
19				Og Rong Pigun Thong		
20				Og Rong Kati		
21				*Hmoo		
22				*Sam Rudoo		
23				*Khieo		
24				*Kamdaeng		
25				*Kaew laum Rang		
26				*Kaew Klang Dong		
27				*Apple Lai thong		
28				*Apple (Talab Nark)		
29				*Salaya		
30				Chao Kuntip		
31				Fah Lan		
32				Chok Anan		
33				*Hnang Klang Wan		
34				*Hua Chang		
35				*Rad		
36				*Hnong Saeng		
37				Bun Bandarn		
38				Man Khunsri		
39				Man Prasae		
40				Man Duan Kao		
41				R2E2		
42				Maha Chanok		
43				*Kampan		
44				Khao Niyom		
45				Kho Chang		

Table 5.4 Species and varieties of fruit tree (cont.)

No.	Family	Scientific name	Species	Varieties	Local name	Characteristics
46	ANACARDIACEAE	*Mangifera indica* L.	Ma Mueang	Mae Look Dog		woody plant
47				*Thong Dam		
48				*Thong Ek		
49				*Tawai		
50				Fah Tor Kheio		
51				*Pimsen		
52				*Pimsen Man		
53				Pikul Tong		
54				*Pram		
55				Paya Yok Tab		
56				*Tab Ped		
57				*Kalamae		
58				Man Hmoo		
59				Man Kom		
60	ANNONACEAE	*Annona reticulata* L.	Noi Nong	*Local	Custard apple	woody plant
61	ANNONACEAE	*Annona squamosa* L.	Noi Nha	*Nua	Sugar apple	woody plant
62				*Hnang		
63				Petch Park Chong		
64				Luang		
65	ANNONACEAE	*Annona muricata* L.	Durian Kaeg	*Local	Sour Sop	woody plant
66	ANNONACEAE	*Ranwenhoffia siamensis* Scheff.	Nom Maew	*Local	Nom-Maew	woody plant
67	BOMBACACEAE	*Durio zibethinus* L.	Tu Rien	Pong Manee	Durian	woody plant
68				Hmon Thong		
69				Chanee		
70				Kan Yao		
71	BROMELIACEAE	*Ananas comosus* Merr.	Sapparod	Pattawia	Pineapple	non-woody plant
72				Suan Pueng		
73				Sai Nam Pueng		
74				*Khao		
75				Daeng		
76	CACTACEAE	*Hylocereus undatus* (Haw) Britt. & Rose.	Kaew Mangorn	Luang	Dragon Fruit	non-woody plant
77				Chompoo		
78	CARICACEAE	*Carica papaya* L.	Malagor	*Local	Papaya	non-woody plant
79				Kaeg Nuan		
80				*Kaeg Dam		
81				Hawaii		
82				Holland		
83				Kan Yao		
84				*Gogo		
85				*Thai Loog Yao		
86				Sai Nam Pueng		
87	COMBRETACEAE	*Terminalia chebula* Retz. var. chebula	Samor Thai	*Local	Myrabolan Wood	woody plant
88	CURURBITACEAE	*Citrullus vulgaris* Schard.	Taeng Mo	Jintarah	Watermelon	non-woody plant

Table 5.4 Species and varieties of fruit tree (cont.)

No.	Family	Scientific name	Species	Varieties	Local name	Characteristics
89	DIALIUM	*Dialium Cochinchinense* Pierre.	Hyee	Local	Velvet Tamarind	woody plant
90	EBENACEAE	*Diospyros rhodcalyx.*	Tagona	*Local	Ebony	woody plant
91	EBENACEAE	*Diospyros malabarica* Kostel.	Ma Plub	*Local	Bo Tree	woody plant
92	EBENACEAE	*Diospyros decandra* Lour.	Jan	*Local	Chingal	woody plant
93	ELAEOCARPACEAE	*Elaeocarpus hygrophilus* Kurz.	Makok Nam	*Local	Ma kok nam	woody plant
94	EUPHORBIACEAE	*Baccaurea ramiflora* Lour.	Ma Fai	*Local	Rambeh Bambi	woody plant
95				Sutep		
96	EUPHORBIACEAE	*Phyllanthus acidus* Skeels.	Ma Yom	*Priew	Star Gooseberry	woody plant
97				Hwan		
98	EUPHORBIACEAE	*Phyllanthus emblica* L.	Makham Pom	*Local	Indian gooseberry	woody plant
99	EUPHORBIACEAE	*Antidesma ghaesembilla* Gaertn.	Mao	*Khai Pla	-	woody plant
100	FLACOURTIACEAE	*Flacourtia indica* (burm.F.) Merr.	Ta Khob Pa		Governor's Plum	woody plant
101	GUTTIFERAE	*Garcinia schomburgkiana* Pierre.	Ma Dan	*Local	Garcinia	woody plant
102	GUTTIFERAE	*Garcinia vilersiana* Pierre.	Ma Pood	*Local	Garcinia	woody plant
103	GUTTIFERAE	*Garcinia mangostana* L.	Mang Kud	*Local	Mangosteen	woody plant
104	LABIATAE	*Vitex glabrata* R.Br.	Khai Nao	*Local	-	woody plant
105	LEGUMINOSAE-CAESALPINIOIDEAE	*Tamarindus indica* L.	Makham	*Priew	Tamarind	woody plant
106				*Hwan	Sweet tamarind	
107	LEGUMINOSAE-CAESALPINIOIDEAE	*Cynometra cauliflora* L.	Amphawa	*Local	Nam-man	woody plant
108	LEGUMINOSAE-MIMOSOIDEAE	*Pithecellobium dulce* (Roxb.) Benth.	Makham Taid	*Local	Guaymochil	woody plant
109				Man		
110	MALPIGHIACEAE	*Malpighia glabra* L.	Cherry	*Thai	Barbados Cherry	woody plant
111				*Small		
112				Australia		
113				Malay		
114	MELIACEAE	*Sandoricum koetjape* (Burm.f.) Merr.	Kraton	*Local	Sentul, Santol,	woody plant
115				*Pui Fai		
116				Era		
117				* Tab Tim Kao		
118				Tab Tim Mai		
119				Tab Tim Tong		
120				*Nim nuan		
121				Thong Kammayee		
122				Kun Sawai		
123				Loog Pasom		
124	MELIACEAE	*Aglaia dookkoo* Griff.	Longkong	*Tanyongmus	Longkong	woody plant
125	MORACEAE	*Artocarpus heterophyllus* Lam.	Kha Nhun	*Jampa	Jack Fruit Tree	woody plant

Table 5.4 Species and varieties of fruit tree (cont.)

No.	Family	Scientific name	Species	Varieties	Local name	Characteristics
126	MORACEAE	*Artocarpus heterophyllus* Lam.	Kha Nhun	Paisan Taksin		woody plant
127				Lueng Bangtoi		
128				*Local Nang		
129				*Local Sapodilla		
130				Si thong		
131				Si Banjong		
132				Tong Prasert		
133				Tong Sud Jai		
134				Toon Klao		
135				Mae Noi Tawai		
136				Luang Malay		
137				Daeng Suriya		
138				Hrian Baht		
139	MORACEAE	*Artocarpus integer* (Thunb.) Merr.	Champada	*Local	Champedak	woody plant
140	MORACEAE	*Artocarpus altilis* Forsberg.	Sakae	*Kao Hnieo	Bread Fruit Tree	woody plant
141	MORACEAE	*Morus alba* L.	Mon		Mulberry Tree	woody plant
	MUSACEAE	*Musa sapientum* L.	*Kluai*		Banana, Plantain	non-woody plant
142		*Musa (AA group) "Kluai Khai"*		Kai	Pisang Mas	
143				Kai India		
144		*Musa (AA group) "Kluai Leb Mu Nang"*		Leb Mu Nang		
145		*Musa (AA group) "Kluai Nam Thai"*		*Nam		
146		*Musa (AAA group) "Kluai Hom thong"*		*Hom thong	Gros Michel	
147		Musa (AAA group "Kluai Hom Khieo"		*Hom Khieo	Pisang Masak Hijau	
148		Musa (AA group) "Kluai Hom Jan"		*Hom Jan		
149		*Musa (AAA group) "Kluai Nak"*		*Nak	Red banana	
150		*Musa (AAB group) "Kluai Chang"*		Nga Chang	Plantain	
151		Musa (ABB group) *"Kluai Nam Wa"*		*Nam Wa Khao		
152		*Musa (ABB group) "Kluai Nam Wa Naun"*		*Nam Wa Naun		
153		*Musa (ABB group) "Kluai Nam Wa Khieo"*		*Nam Wa Khieo		
154		*Musa (ABB group) "Kluai Nam Wa"*		*Nam Wa Luang	Pisang Awak	
155		*Musa (ABB group) "Kluai Nam Wa Dam"*		Nam Wa Dam		
156		*Musa (ABB group) "Kluai Hak Mulk"*		*Hak Muk	Silver Bluggoe	
157	MUSACEAE	*Musa (ABBB group) "Kluai Teparod"*		Teparod	Banana	non-woody plant
158		*Musa balbisiana* Colla		*Tanee		
159	MYRSINACEAE	*Ardisia polycephala* Wall.	Pilang Gasa	*Local	-	woody plant
160	MYRTACEAE	*Psidium guajava* L.	Farang	Local	Guava	woody plant
161				*Kee Nok		
162				*Kee Nok Loog Yai		
163				Seedless		
164				Pan Sithong		
165				Kim Ju		

Table 5.4 Species and varieties of fruit tree (cont.)

No.	Family	Scientific name	Species	Varieties	Local name	Characteristics
166	MYRTACEAE	*Psidium guajava* L.	Farang	Klom Salee	Guava	woody plant
167				Toon Klao		
168				*Vietnam		
	MYRTACEAE	*Eugenia Javanica*	Chompoo		Java apple	woody plant
169		*Syzygium anacardiifolium* (Craib) Chantar. & J.Parn.		*Klom		
170		*Syzygium jambos (L.)* Alston		*Nam Dok Mai		
171				*Nam		
172		*Syzygium malaccense* (L.) Merr. & L.M. Perry		*Ma Miew	Pomerac, Malay Apple	
173				*Ma Miew Khao		
174				*Sa Raek		
175		*Syzygium samarangense* (Blume) Merr. & L.M.Perry var. samarangense		*Kam Mam		
176				*Nak		
177				*Khao		
178				*Kheio		
179				Tab Tim jan		
180				Petch		
181				Petch Sai Roong		
182				Petch Nam Hnueng		
183				Petch Sam Pran		
184				*Khaeg Dam		
185				*Daeng		
186				Thong Sam Si		
187				Sai Namphueng		
188				Toon Klao		
189				Sithong		
190	MYRTACEAE	*Syzygium cumini* (L.) Skeels	Loog Wa	Loog Lek	Jambolan Plum, Java Plum	woody plant
191				*Loog Yai		
192	OXALIDACEAE	*Averrhoa bilimbi* L.	Ta Ling Ping	*Local	Bilimbi, Cucumber Tree	woody plant
193	OXALIDACEAE	*Averrhoa carambola* L.	Mafuang	*Hwan	Carambola	woody plant
194				*Loog Yai		
195				Priew Loog Yai		
196				Priew Loog Lek		
197	PALMAE	*Cocos nucifera* L.	Ma Proaw	*Nam Hom	Coconut	woody plant
198				*Puang		
199				Nam Hom Naun Chawee		
200				*Nam Hwan		
201				*Keang (Phol Yai)		
202				*Hmoo Si Hmo		
203				*Hmoo Si Kheio		
204				*Hmoo Si Luang		
205				*Hmoo Si Hnoo		
206				*Puang Roi		
207				*Saw		

Table 5.4 Species and varieties of fruit tree (cont.)

No.	Family	Scientific name	Species	Varieties	Local name	Characteristics
208	PALMAE	*Cocos nucifera* L.	Ma Proaw	*Fai	Coconut	woody plant
209				*Na Li Gey		
210				*Khee Tub Plaug Hwan		
211				*Kati		
212				*Loog Yai Kati		
213				*Loog Daeng Kam Hna		
214				*Sai Bua Loog Yai		
215	PALMAE	*Cocos nucifera* L. var. spicata K.C.Jacob.		*Ma Praw		
216	PALMAE	*Nypa fruticans* Wurmb.	Jak	*Local	Mangrove palm	woody plant
217	PALMAE	*Borassus flabelliferar*	Tan	*Local	Palmyra, palm	woody plant
218	PALMAE	*Phoenix dactylifera* L.	Intapalam	*Local	Dates	woody plant
219	PALMAE	*Zalacca edulis*	Sala	*Local	salak pulm	woody plant
220	PASSIFLORACEAE	*Passiflora laurifolia* L.	Saowarot	*Local	Passion Fruit	non-woody plant
221	PUNICACEAE	*Punica granatum* L. var. granatum	Tab Tim	*Local	Pomegranate	woody plant
222				Daeng		
223				Seedless		
224	RHAMNACEAE	*Zizyphus mauritiana* Lamk	Putsa	*Local	Common jujube	woody plant
225				Look Yai		
226	RUTACEAE	*Citrus reticulata* Blanco	Som	*Kheio Hwan	Orange	woody plant
227				Kheio Hwan Luang		
228				Sai Nam Phueng		
229				Pan		
230				Shogun		
231				Jeen		
232		*Citrus sinensis* (L.) Osbeck		Cheng		
233		*Citrus sinensis* (L.) Osbeck		*Kliang (Ga)		
234		*Citrus nobilis* Lour.		*Kaew		
235		*Citrus aurantium* L.		*Sa		
236		*Fortunella japonica* (Thunb.)Swingle		Jeed		
237	RUTACEAE	*Citrus maxima* (Burm.) Merr.	Som O	*Khao Yai	Pomelo, Shaddock	woody plant
238				*Khao Puang		
239				*Tong Dee		
240				*Khao Nam Phueng		
241				Khao Taeng Kwa		
242				Sai Nam Phueng		
243	RUTACEAE	*Citrus hystrix* DC.	Ma Grood	*Hwan	Leech lime	woody plant
244	RUTACEAE	*Citrus limon* (L.) Burm.f.	Manaw Ho	*Local	Karanda	woody plant
245	RUTACEAE	*Aegle marmelos* (L.) Corr. Serr.	Ma Toom	*Local	Bael	woody plant
246	RUTACEAE	*Limonia acidissima* L.	Maquid	*Local	Elephant's Apple	woody plant
247	SAPINDACEAE	*Lepisanthes fruticosa* (Roxb.) Leenh.	Cham Ma Liang	*Deang	Luna nut	woody plant
248				*Khao		
249	SAPINDACEAE	*Dimocarpus longan* Lour. subsp. longan var. longan	Lam Yai	*Local	Longang	woody plant

Table 5.4 Species and varieties of fruit tree (cont.)

No.	Family	Scientific name	Species	Varieties	Local name	Characteristics
250	SAPINDACEAE	*Dimocarpus longan* Lour. subsp. longan var. longan	Lam Yai	Luang Lam Jiag		woody plant
251				Kom		
252				Petch Sakorn		
253				Puang Thong		
254				Edor		
255				Khan Thong		
256				*Kra Log		
257				Ping Pong		
258				Daeng Yho		
259	SAPINDACEAE	*Litchi chinensis* Sonn.	Lin Chee	*Haew	Lychee	woody plant
260				*Kom Hom Lam Jiag		
261				*Kra Log Bai Or		
262				*Kra Log Bai Thao		
263				*Sa Raek Thong		
264				*Thai Yai		
265				*Sam Pao Kaew		
266				*Krob Kaew		
267				*Jeen Daeng		
268	SAPINDACEAE	*Nephelium lappaceum* L.	Ngao	*Rong Rian	Rambutan	woody plant
269				*Chom Poo		
270	SAPINDACEAE	*Lepisanthes rubiginosa* (Roxb.) Leenh.	Ma Huat	*Local	-	woody plant
271	SAPOTACEAE	*Manilkara achras* Fosberg.	La Mut	*Krasuoi	Spodilla	woody plant
272		*Manilkara kauki* (L.) Dubard.		*Sida		
273				*Thai		
274				Malay		
275				*Khai Han		
276				*Ma Kok		
277				Nom Sao		
278				Kra Suay Malay		
279	SAPOTACEAE	*Synsepalum dulcificum* Daniell.	Mahat Sachan		Miracle fruit	woody plant
280	SAPOTACEAE	*Chrysophyllum cainito.*	Apple Pa	Kheio	Star Apple	woody plant
281	STERCULIACEAE	*Sterculia monosperma* Vent.	Kao Lad Thai		Noble bottle tree	woody plant
282	TILIACEAE	*Muntingia calabura* L.	Ta Khob Ban	*Local	Jam tree	woody plant

*Local fruit in the area

5.2.1 The number of agriculturists who select fruit to grow

According to the study of total sampling of 390 households, it is found that the most selected fruit to grow is coconut (*Cocos nucifera* L.), equivalent to 96.67% of total households. The second most selected fruits grown, more than 50% of total households, are banana (*Musa sapient* L.), mango (*Mangifera indica* L.), rose apple

(*Eugenia Javanica*), jackfruit (*Artocarpus heterophyllus* Lam.), pomelo (*Citrus maxima* (Burm.) Merr.), and papaya (*Carica papaya* L.), equivalent to 90.67%, 82.31%, 69.74%, 68.97%, 60.51%, and 56.67% respectively.

The most selected fruit varieties that agriculturists grow are; high coconut (Kaeng Pol Yai), Kheio Sawoey mango, Ma Miaw rose apple, Local Hnang jackfruit, Khao Yai pomelo, and Kaeg Dam papaya. For the least selected fruit varieties that agriculturist grow are; Pa mango, Nam Dok Mai Sithong mango, Og Rong Yai mango, Og Rong Khao mango, Og Rong Hom mango, Og Rong Kati mango, Kaew Klang Dong mango, Man Prasae mango, Kho Chang mango, Fah Tor Kheio mango, Pinsen Man mango, Tab Ped mango, Man Hmoo mango, Man Kom mango, Klom rose apple, Ma Miaw Khao rose apple, Petch Nam Hnueng rose apple, Petch Sam Pran rose apple, Thong Sam Si rose apple, Si Thong rose apple, Thong Sudjai jackfruit, Mae Noi Tawai jackfruit, Daeng Suriya jackfruit, Hrian Baht jackfruit, Khao Puang pomelo, and Kan Yao papaya.

The selected fruit varieties at the range of 41% - 50% of total households are gooseberry (*Phyllanthus acidus* Skeels.), lychee (*Litchi chinensis* Sonn.), luna nut (*Lepisanthes fruticosa* (Roxb.) Leenh.), and pomegranate (*Punica granatum* L. var. granatum), equivalent to 48.72%, 45.64%, 44.62%, and 41.03% of total households respectively.

The most selected fruit varieties are Priew gooseberry, Kom Hom Lam Jiag lychee, Daeng luna nut (Dam), and Local pomegranate. The least selected fruit varieties are Hwan gooseberry, Haew lychee, Krob Kaew lychee, Jee Daeng lychee, Khao lanu nut, Local pomegranate and Seedless pomegranate.

The selected fruit at the range of 31% - 40% of total households are guava (*Psidium guajava* L.), sugar apple (*Annona squamosa* L.), dragon fruit (*Hylocereus undatus* (Haw) Britt. & Rose.), santol (*Sandoricum koetjape* (Burm.f.) Merr.), tamarind (*Tamarindus indica* L.), and plum mango (*Bouea macrophylla* Griffith.), equivalent to 39.23%, 38.46%, 36.15%, 35.13%, 34.36% and 31.28% of total households respectively.

The most selected fruit varieties are Khi Nok guava, Hnang sugar apple, White dragon fruit, Pui Fai santol, Local sour tamarind, and plum mango. The least selected fruit varieties are Khi Nok Loog Yai guava, yellow sugar apple, pink dragon

fruit, Tab Tim Kao santol, Tab Tim Mai santol, Tab Tim Thong santol, Thong Kama Yhi santol, Khun Sawai santol, Loog Pasom santol, sweet tamarind, and Toon Klao plum mango.

The selected fruit at the range of 31% - 40% of total households are tangerine (*Citrus reticulata* Blanco.), breadfruit (*Artocarpus altilis* Forsberg.), water oive (*Elaeocarpus hygrophilus* Kurz.) and bilimbi (*Averrhoa bilimbi* L.), equivalent to 25.64%, 22.82%, 21.54%, and 21.03% of total households respectively.

The most selected fruit varieties are tangerine, Khao Hneio breadfruit, Local water olive, and Local bilimbi. The least selected fruit varieties are Kleang tangerine, Yellow tangerine, and Pan tangerine.

The selected fruit at the range of 11% - 20% of total households are star fruit (*Averrhoa carambola* L.), sapodilla (*Manilkara achras* Fosberg.), mangrove palm (*Nypa fruticans* Wurmb.), longan (*Dimocarpus longan* Lour. subsp. longan var. Longan), cherry (*Malpighia glabra* L.), garcinia (*Garcinia schomburgkiana* Pierre.), and nam nam (*Cynometra cauliflora* L.)

The most selected fruit varieties are sweet star fruit, Sida sapodilla, Local mangrove palm, Petch Sakorn longan, Thai cherry, Local garcinia, and Local nam nam. The least selected fruit varieties are Loog Yai sour star fruit, Nom Sao sapodilla, Lam Jiag yellow longan, Puang Thong longan, Khan Thong longan, Australia cherry, and Malay cherry.

The selected fruit at the range of less than 10% of total households are jam tree (*Muntingia calabura* L.), mahuat (*Lepisanthes rubiginosa* (Roxb.) Leenh.), pineapple (*Ananas comosus* Merr.), olive (*Spondias cytherea* Sonn.), mangosteen (*Garcinia mangostana* L.), long kong (*Aglaia dookkoo* Griff.), jujube (*Zizyphus mauritiana* Lamk), Manila tamarind (*Pithecellobium dulce* (Roxb.) Benth.), custard apple (*Annona reticulata* L.), limonia (*Limonia acidissima* L.), mulberry (*Morus alba* L.), jambolan plum (*Syzygium cumini* (L.) Skeels.), blackcurrant (*Antidesma ghaesembilla* Gaertn), garcinia (*Garcinia vilersiana* Pierre.), durian (*Durio zibethinus* L.), rambutan (*Nephelium lappaceum* L.), nom maew (*Rauwenhoffia siamensis* Scheff.), durain kaeg (*Annona muricata* L.), bael (*Aegle marmelos* (L.)Corr. Serr.), rambeh bambi (*Baccaurea ramiflora* Lour), karanda (*Citrus limon* (L.) Burm.f.), Indian gooseberry (*Phyllanthus emblica* L.), miracle fruit (*Synsepalum dulcificum*

Daniell.), chingal (*Diospyros decandra* Lour.), leech lime (*Citrus hystrix* DC.), Ebony (*Diospyros rhodcalyx*.), Champedak (*Artocarpus integer* (Thunb.) Merr.), salak palm (*Zalacca edulis*), passion fruit (*Passiflora laurifolia* L.), noble bottle tree (*Sterculia monosperma* Vent.), smooth chaste tree (*Vitex glabrata* R.Br.), pilang kasa (*Ardisia polycephala* Wall.), myrabolan wood (*Terminalia chebula* Retz. var. chebula), watermelon (*Citrullus vulgaris* Schard.), plamyra (*Borassus flabelliferar*), dates (*Phoenix dactylifera* L.), star apple (*Chrysophyllum cainito*), velvet tamarind (*Dialium Cochinchinense* Pierre.), bo tree (*Diospyros malabarica* Kostel.), and governer's plum (*Flacourtia indica* (burm.F.) Merr.) as defined in table 5.5.

Table 5.5 Fruit tree species and varieties grown by agriculturists

Scientific name	Species	Varieties	Households (n=390)	Percentage
Cocos nucifera L.	Coconut	Kaeng Phol Yai	377	96.67
Musa sapientum L.	Banana	Local	352	90.26
Mangifera indica L.	Mango	Kheio Sawaey	321	82.31
Eugenia Javanica	Malay Apple	Ma Miew	272	69.74
Artocarpus heterophyllus Lam.	Jackfruit	Nhang Local	269	68.97
Citrus maxima (Burm.) Merr.	Pomelo	Khao Yai	236	60.51
Carica papaya L.	Papaya	Kaeg Dam	221	56.67
Phyllanthus acidus Skeels.	Star Gooseberry	Priew	190	48.72
Litchi chinensis Sonn.	Lychee	Kom Hom Lam Jiag	178	45.64
Lepisanthes fruticosa (Roxb.) Leenh.	Luna Nut	Daeng	174	44.62
Punica granatum L. var. granatum	Pomegranate	Local	160	41.03
Psidium guajava L.	Guava	Local	153	39.23
Annona squamosa L.	Sugar Apple	Hnang	150	38.46
Hylocereus undatus (Haw) Britt. & Rose.	Dragon Fruit	Khao	141	36.15
Sandoricum koetjape (Burm.f.) Merr.	Santol	Pui Fai	137	35.13
Tamarindus indica L.	Tamarind	Local	134	34.36
Bouea macrophylla Griffith.	Marian Plum	Yong Chit	122	31.28
Citrus reticulata Blanco	Orange	Kheio Hwan	100	25.64
Artocarpus altilis Forsberg.	Breadfruit	Khao Hneio	89	22.82
Elaeocarpus hygrophilus Kurz	Olive	Nam	84	21.54
Averrhoa bilimbi L.	Bilimbi	Local	82	21.03
Averrhoa carambola L.	Carambola	Hwan	78	20
Manilkara achras Fosberg	Sapodilla	Sida	78	20
Nypa fruticans Wurmb.	Mangrove palm	Local	70	17.95
Dimocarpus longan Lour. subsp. longan var. longan	Longan	Petch Sakorn	70	17.95
Malpighia glabra L.	Cherry	Thai	62	15.9
Garcinia schomburgkiana Pierre.	Garcinia	Local	52	13.33
Cynometra cauliflora L.	Nam Nam	Local	47	12.05
Muntingia calabura L.	Jam tree	Ban	35	8.97
Lepisanthes rubiginosa (Roxb.) Leenh.	Mahuat	Local	33	8.46
Ananas comosus Merr.	Pineapple	Pattawia	30	7.69
Spondias cytherea Sonn.	Jew's Plum	Farang	24	6.15
Garcinia mangostana L.	Mangosteen	Local	23	5.9
Aglaia dookkoo Griff.	Longkong	Tan Hyong	23	5.9
Zizyphus mauritiana Lamk	Jujube	Local	23	5.9
Pithecellobium dulce (Roxb.) Benth.	Manila Tamarind	Local	22	5.64
Annona reticulata L.	Custard Apple	Local	20	5.13

Table 5.5 Fruit tree species and varieties grown by agriculturists (cont.)

Scientific Name	Species	Varieties	Households (n=390)	Percentage
Limonia acidissima L.	Limonia	Local	20	5.13
Morus alba L.	Mulberry	Local	17	4.36
Syzygium cumini (L.) Skeels.	Jambolan Plum	Loog Lek	17	4.36
Antidesma ghaesembilla Gaertn	Blackcurrant	Khai Pla	15	3.85
Garcinia vilersiana Pierre.	Garcinia	Local	15	3.85
Durio zibethinus L.	Durian	Mhon Thong	12	3.08
Nephelium lappaceum L.	Rambutan	Rong Rian	11	2.82
Rauwenhoffia siamensis Scheff.	Nom Maew	Local	10	2.56
Annona muricata L.	Sour Sop	Local	9	2.31
Aegle marmelos (L.) Corr. Serr.	Bael	Local	9	2.31
Baccaurea ramiflora Lour	Rambeh Bambi	Local	8	2.05
Citrus limon (L.) Burm.f.	Karanda	Local	7	1.79
Phyllanthus emblica L.	Indian Gooseberry	Local	6	1.54
Synsepalum dulcificum Daniell.	Miracle	Local	6	1.54
Diospyros decandra Lour.	Gold Apple	Local	5	1.28
Citrus hystrix DC.	Leech Lime	Hwan	5	1.28
Diospyros rhodcalyx.	Ebony	Local	4	1.03
Artocarpus integer (Thunb.) Merr.	Champedak	Local	4	1.03
Zalacca edulis	Salak palm	Local	4	1.03
Passiflora laurifolia L.	Passion Fruit	Local	4	1.03
Sterculia monosperma Vent.	Noble Bottle Tree	Local	4	1.03
Vitex glabrata R.Br.	Smooth chaste tree	Local	3	0.77
Ardisia polycephala Wall.	Pilang Gasa	Local	3	0.77
Terminalia chebula Retz. var. chebula	Myrabolan	Local	2	0.51
Citrullus vulgaris Schard.	Watermelon	Jintarah	2	0.51
Borassus flabelliferar	Palmyra	Local	2	0.51
Phoenix dactylifera L.	Dates	Local	2	0.51
Chrysophyllum cainito	Star Apple	Kheio	2	0.51
Dialium Cochinchinense Pierre.	Velvet Tamarind	Local	1	0.26
Diospyros malabarica Kostel.	Bo Tree	Local	1	0.26
Flacourtia indica (burm.F.) Merr.	Governor's Plum	Pa	1	0.26

5.2.2 The number of fruits selected to grow by agriculturist

According to the study in 390 households of agriculturists, it is found that the number of fruit species and varieties grown in dominated areas are in the range of 1 – 39 species and 1 – 61 varieties. The agriculturists grow fruits at average of

12.40 species and 16.96 species. For the most cultivated species, there are 11 – 20 species, equivalent to 47.69% of total households. Secondly, there are 1 – 10 species, equivalent to 41.28% of total households. Thirdly, there are 21 – 30 species and 31 – 40 species, equivalent to 10.26% and 0.77% of total households as defined in table 5.5.

For the most cultivated varieties, there are 11 – 20 varieties, equivalent to 40.77%. Next, they are in the range of 1 – 10 varieties, 21 – 30 varieties, 31 – 40 varieties, and more than 40 varieties, equivalent to 27.95%, 21.54%, 6.92% and 2.82% respectively. As defined in table 5.6, the varieties which the agriculturists grow most are mango, 54 varieties in total.

Table 5.6 The number of fruit tree species in plantations of agriculturists

Type of data	Characteristics of data	The number of Household (n = 390)	Percentage
Fruit Species			
	1 – 10 species	161	41.3
	11 – 20 species	186	47.7
	21 – 30 species	40	10.3
	31 – 40 species	3	0.8
	$\bar{x}$ = 12.40 S.D. = 6.47		
	Min = 1 Max = 39		
Fruit Varieties			
	1 – 10 varieties	109	27.9
	11 – 20 varieties	159	40.8
	21 – 30 varieties	84	21.5
	31 – 40 varieties	27	6.9
	More than 40 varieties	11	2.8
	$\bar{x}$ = 16.96 S.D. = 10.13		
	Min = 1 Max = 61		

From the total of 282 fruit varieties in study area, the data collected from local agriculturists who have local fruit varieties in their dominated areas demonstrates that there are 159 varieties of local fruits, 123 varieties of alien or new fruits. As defined in table 5.7 and 5.8, they illustrate the existence of various local fruit varieties. And the below table illustrates the existence of various alien or new fruit varieties in the order of the number of agriculturist households which select to grow and keep the mentioned fruit varieties.

Table 5.7 The selection of native fruit tree species for plantation

Species	Varieties	House-holds	Species	Varieties	House-hold	Species	Varieties	House-holds
Coconut	Kaeng Phol Yai	310	Jam Tree	Ban	35	Banana	Nam Wa Nuai	12
Banana	Nam Wa Khao	283	Guava	Khi Nok	33	Sapodilla	Thai	12
Coconut	Nam Hom	251	Rose Apple	Sa Raek	33	Mango	Kaew Laum Rang	11
Pomelo	Khao Yai	231	Mahuat	Local	33	Nom Maew	Local	10
Rose Apple	Ma Meio	199	Coconut	Nam Hwan	31	Rambutan	Rong Rian	10
Jackfruit	Local Hnang	198	Rose Apple	Nam Dok Mai	30	Sapodilla	Khai Han	10
Star Gooseberry	Priew	188	Mango	Hnang Klang Wan	27	Sour Sop	Local	9
Lychee	Kom Hom Lam Jiag	177	Jackfruit	Lamud Local	27	Rose Apple	Nak	9
Luna Nut	Daeng	167	Mango	Thong Dam	26	Bael	Local	9
Pomegranate	Local	158	Pomelo	Thong Dee	25	Sapodilla	Local	9
Mango	Og Rong	151	Olive	Farang	24	Papaya	Thai Loog Ya	8
Papaya	Kaeg Dam	125	Mangosteen	Local	23	Jambolan Plum	Loog Yai	8
Dragon Fruit	Khao	122	Tamarind	Hwan	23	Longan	Ka Lok	8
Tamarind	Priew	122	Longkong	Tan Hyong Mas	23	Sapodilla	Ma Kok	8
Banana	Hom Thong	104	Guava	Local	22	Mango	Salaya	7
Banana	Hak Muk	100	Rose Apple	Kam Hmam	22	Banana	Nam	7
Breadfruit	Khao Hneio	89	Orange	Cheng	22	Banana	Tanee	7
Santol	Pui Fai	87	Marian Plum	Hwan Khai Kai	21	Rose Apple	Kheio	7
Marian Plum	Yong Chit	84	Manila Tamarind	Local	21	Mango	Hua Chang	6
Olive	Nam	84	Custard Apple	Local	20	Mango	Hnong Saeng	6
Sugar Apple	Hnang	82	Elephant's Apple	Local	20	Indian Gooseberry	Local	6
Bilimbi	Local	82	Mango	Pram	19	Carambola	Loog Yai	6
Sugar Apple	Nua	78	Cherry	Lek	19	Coconut	Puang Roi	6
Banana	Nam Wa Kheio	74	Orange	Kaew	19	Mango	Apple (Talab Nak)	5
Mangrove Palm		70	Longan	Local	19	Chingal	Local	5
Carambola	Hwan	67	Jujube	Local	17	Guava	Vietnam	5
Orange	Kheio Hwan	67	Sapodilla	Sida	17	Coconut	Hmoo Si Khei	5
Mango	Kaew	64	Mango	Rad	16	Coconut	Puang	5
Papaya	Local	56	Banana	Nak	16	Coconut	Fai	5
Garcinia	Local	52	Blackcurrant	Khai Pla	15	Coconut	Na Li Gey	5
Marian Plum	Hwan	48	Garcinia	Local	15	Leech Lime	Hwan	5
Rose Apple	Kaeg Dam	48	Luna Nut	Khao	15	Lynchee	Sam Pao Kaev	5
Nam Nam	Local	47	Lynchee	Kalok Bai Or	14	Mango	Kheio Yai	4
Cherry	Thai	45	Jackfruit	Jampa	13	Mango	Pimsen	4
Santol	Local	37	RoseApple	Daeng	13	Mango	Kalamae	4
Coconut	Hmoo Si Hmo	37	Mango	Sam Rudoo	12	Papaya	Coco	4

Table 5.7 The selection of native fruit tree species for plantation (cont.)

Species	Varieties	House-holds	Species	Varieties	House hold	Species	Varieties	House-holds
Ebony	Local	4	Mango	Kheio Khai Ka	2	Bo Tree	Local	1
Santol	Tab Tim Kao	4	Mango	Hmoo	2	Rambeh Bambi	Local	1
Champedak	Local	4	Mango	Kaem Daeng	2	Banana	Hom Jan	1
Banana	Nam Wa Luang	4	Myrabolan	Local	2	Guava	Khi Nok Loog Yai	1
Rose Apple	Nam	4	Santol	Nim Nuan	2	Rose Apple	Klom	1
Rose Apple	Khao	4	Banana	Hom Kheio	2	Rose Apple	Ma Miew Khz	1
Salak Palm	Local	4	Coconut	Loog Yai Kati	2	Coconut	Khi Tub Pluak Hwan	1
Orange	Sa	4	Palmyra	Local	2	Coconut	Kati	1
Mango	Apple Lai Thong	3	Dates	Local	2	Coconut	Loog Daeng Kam Hna	1
Mango	Kam Pan	3	Lychee	Kalog Bai Thao	2	Coconut	Sai Bua Loog Yai	1
Smooth chaste tree	Local	3	Lychee	Saraek Thong	2	Coconut	Ma Preaw	1
Pilang Kasa	Local	3	Mango	Thong Ek	2	Pomelo	Khao Puang	1
Coconut	Hmoo Si Luang	3	Mango	Og Rong Khao	1	Lychee	Haew	1
Coconut	Hmoo Si Hnoo	3	Mango	Og Rong Hom	1	Lychee	Krob Kaew	1
Coconut	Saw	3	Mango	Kaew Klang Dong	1	Lychee	Jeen Daeng	1
Orange	Kliang	3	Mango	Tawai	1	Rambutan	Chompoo	1
Pomelo	Khao Nam Phueng	3	Mango	Pimsen Man	1			
Lychee	Thai Yai	3	Mango	Tab Ped	1			

Table 5.8 The selection of non-native fruit tree species for plantation

Species	Varieties	House-holds	Species	Varieties	House holds	Species	Varieties	House-holds
Mango	Kheio Sawoey	152	Longan	Petch Sakorn	25	Sugar Apple	Petch Pak Chong	8
Mango	Nam Dok Mai	122	Banana	Leb Mue Nang	24	Jujube	Loog Yai (Apple)	7
Rose Apple	Tab Tim Jan	95	Jackfruit	Thong Prasert	22	Karanda	Local	7
Banana	Khai	63	Sapodilla	Kra Suay Malay	22	Mango	Mae Loog Dok	7
Mango	Fah Lan	60	Rose Apple	Toon Klao	21	Pomelo	Sai Nam Phueng	7
Mango	Chok Anan	52	Mulberry	Local	17	Rambeh Bambi	Suthep	7
Mango	Man Khun Sri	43	Jackfruit	Si Banjong	13	Rose Apple	Sai Nam Phueng	7
Rose Apple	Petch	39	Longan	Edor	12	Carambola	Priew Loog Lek	6
Dragon Fruit	Daeng	35	Papaya	Kaeg Nuan	12	Durian	Kan Yao	6
Jackfruit	Luang Bang Toey	33	Santol	Era	12	Mango	Nam Dok Mai Man	6
Guava	Kim Joo	32	Rose Apple	Petch Sai Rung	11	Miracle	Local	6
Guava	Klom Salee	27	Jambolan Plum	Loog Lek	10	Orange	Jeed	6
Papaya	Holland	27	Papaya	Hawaii	10	Mango	Nam Dok Mai No.4	5
Pineapple	Pattawia	27	Durian	Hmon Thong	9	Mango	Og Rong Thong	5
Guava	Pan Si Thong	26	Orange	Chokun	8	Mango	Chao Khun Tip	5

Table 5.8 The selection of non-native fruit tree species for plantation (cont.)

Species	Varieties	House-holds	Species	Varieties	House-holds	Species	Varieties	House-holds
Orange	Jeen	5	Papaya	Sai Nam Phueng	2	Mango	Paya Yok Tab	1
Sapodilla	Malay	5	Pineapple	Suan Phueng	2	Mango	Man Hmoo	1
Jackfruit	Pisarn Taksin	4	Pomelo	Khao Taeng Kwa	2	Mango	Pa	1
Noble Bottle Tree	Local	4	Star Apple	Kheio	2	Manila Tamarind	Man	1
Orange	Sai Namphueng	4	Watermelon	Jintarah	2	Marian Plum	Toon Klao	1
Passion Fruit	Local	4	Banana	Khai India	1	Mango	Nam Dok Mai Si Thong	1
Mango	R2E2	3	Banana	Nam Wa Dam	1	Orange	Kheio Hwan Luang	1
Carambola	Priew Loog Yai	3	Banana	Tipparod	1	Papaya	Kan Yao	1
Durian	Chanee	3	Cherry	Astralia	1	Pineapple	Sai Nam Phueng	1
Longan	Daeng Yo	3	Cherry	Malay	1	Pomegranate	Daeng	1
Mango	Maha Chanok	3	Coconut	Nam Hom Nuan Chawee	1	Pomegranate	Seedless	1
Mango	Og Rong Pikul Thong	3	Dragon Fruit	Chompoo	1	Rose Apple	Petch Nam Hnueng	1
Star Gooseberry	Hwan	3	Durian	Puang Manee	1	Rose Apple	Petch Sam Pran	1
Banana	Nga Chang	2	Governor's Plum	Pa	1	Rose Apple	Thong Sam Si	1
Dragon Fruit	Luang	2	Jackfruit	Thong Sud Jai	1	Rose Apple	Si Thong	1
Guava	Toon Klao	2	Jackfruit	Mae Noi Tawai	1	Santol	Tab Tim Mai	1
Jackfruit	Si Thong	2	Jackfruit	Daeng Suriya	1	Santol	Tab Tim Thong	1
Jackfruit	Toon Klao	2	Jackfruit	Hrian Baht	1	Santol	Thong Kamayee	1
Jackfruit	Luang Malay	2	Longan	Luang Lam Jiag	1	Santol	Khun Sawai	1
Longan	Kom	2	Longan	Puang Thong	1	Santol	Loog Pasom	1
Longan	Pingpong	2	Longan	Khan Thong	1	Sapodilla	Nom Sao	1
Mango	Bun Bandan	2	Mango	Og Rong Yai	1	Sugar Apple	Luang	1
Mango	Man Duan Kao	2	Mango	Og Rong Kati	1	Velvet Tamarind	Local	1
Mango	Khao Niyom	2	Mango	Man Prasae	1			
Mango	Pikul Thong	2	Mango	Kho Chang	1			
Orange	Pan	2	Mango	Fah Tor Kheio	1			

5.2.3 The fruit production in one year period

The production period of major and supplement fruit caltivated from plantation can be presented as in table 5.9.

Table 5.9 The fruit production in Samut Songkhram

Fruit Species	Calendar Year (May - December)								Next Calendar Year (January - April)			
	5	6	7	8	9	10	11	12	1	2	3	4
Santol												
Banana												
Noble Bottle Tree												
Dragon fruit												
Jackfruit												
Smooth Chaste Tree												
Rambutan												
Chingal												
Mangrove Palm												
Champedak												
Rose Apple												
Luna Nut												
Cherry												
Ebony												
Governor's plum												
Jam Tree												
Bilimbi												
Palmyra												
Watermelon												
Pomegranate												
Durian												
Sour Sop												
Nom Maew												
Sugar Apple												
Custard Apple												
Guava												
Pilang Kasa												
Jujube												
Miracle												
Leech Lime												
Water Olive												
Olive												
Elephant's Apple												
Tamarind												
Sweet Tamarind												
Manila Tamarind												
Coconut												
Bo Tree												
Garcinia (Ma Pood)												
Carambola												
Rambeh Bambi												
Mango												
Star Gooseberry												

Table 5.9 The fruit production in Samut Songkhram (cont.)

Fruit Species	Calendar Year (May - December)								Next Calendar Year (January - April)			
	5	6	7	8	9	10	11	12	1	2	3	4
Papaya												
Mahuat												
Mangosteen												
Blackcurrant												
Longkong												
Sapodilla												
Longan												
Lychee												
Jambolan Plum												
Orange												
Myrabolan												
Pomelo												
Salak												
Pineapple												
Breadfruit												
Passion Fruit												
Mulberry												
Velvet Tamarind												
Nam Nam												
Dates												
Star Apple												
		Seasonal period					Off-season period					

5.3 The promotion of governmental agencies in fruit varieties and species

It is found from the study that, when mentioning about local fruit in the area, the most of agriculturists will firstly think of major fruits, such as lychee, coconut, and pomelo. For the varieties of lychee which agriculturists have known are Kom Lam Jiag, Thai, Jeen, Kalog, Sam Pao Kaew, Saraek Thong. Since it is an important fruit of the province for longer than 100 years, lychee was brought from China as being told by generation by generation. It was grown in plantations of freshwater zone, and brackish zone upto saltwater zone, such as upper Mueang District. For pomelo grown in the province, it is Khao Yai pomelo which has been grown for a long time. In the past, it was grown at home for a hundred years. There are several varieties of pomelo grown in the province, such as Khao Thong Dee, Khao Puang, Khao Pan, and Khao Yai. Especially, Khao Yai is the original variety which is

the most popular. For tangerines varieties, there are Kheio Hwan and Som Kaew. For coconut, the variety that agriculturists emphasize to grow in the province for a long time and exists only in this province, is Saw coconut. And the other local fruits that agriculturists mention about are nam-nam, jububе, sapodilla, mango, longan, rambeh bambi, jackfruit, etc.

For the extinction trend of local fruit varieties, the original fruit varieties are currently kept on growing. For the fruits decreasingly grown, the agriculturists mention that the extinction of some fruit varieties might occur if there is no conservation due to lack of tree appreciation. For instance, Nam Dok Mai rose apple, which is original fruit, is gradually decreased.

Since the agriculturists in Samut Songkhram have a long experience and inherit fruit plantation from their ancestors, it makes them understand the suitability in their own area. Choosak Disawas, an expert of agricultural extension in Amphawa District said that:

"*I think that the local agriculturists are good at fruit varieties because they can know by themselves. For example of fruit variety search of Kom Ta Peng, grandpa Peng is the one who has a good variety of Kom lives in Kwae Om. People are very fond of this variety so it becomes the name of 'Kom Ta Peng'. It is a good variety of Kom. This is a natural way of variety selection and we don't need to inform them.*"

For the trend for modification of economic fruit varieties and species, the agriculturists still keep on adapting in the major varieties and species they currently grow. The agriculturists accept that the current major fruit varieties are very good and suitable for the terrain conditions. As a result, the agricultural extention and promotion of government agencies is focused on searching free-disease varieties, such as root rot and foot rot. Or it is focused on the agricultural extention in biological prevention, such as using Mycorrhiza to prevent fungal diceases or using phosphate solution, biophoska, to decompose Phosphorus and Potusium in the soil for plant use. For the basis of various promotions, it encourages the agriculturists to reduce their production cost and to follow the framework of safe food production due to provincial strategic plans. Ther are not only selecting and implementing of good varieties from both local and neighbouring areas for alternatives, but also assisting in plantation productivity by growing trial. For example, Nam Hom Ton Tia coconut, it can give a quick yield and

be more conveniently harvested. The promotion of distributing Thai varieties lychee, of which strong pollen can assist in pollination with Kom Hom Lam Jiag lychee. It increases lychee fruit yield. For the lost species during saltwater intrusion period, the agriculturists are encouraged to grow it back in Bang Khonthi District.

For the local fruits, there is still no basis of strategic plan to promote because there is no potentiality to develop them as economic fruits. Therefore, the conservation is limitedly promoted in a group of agricultural extension experts or officers relevant to major fruit promotion in district area. They can understand the situation and work in the area for a long time. Some are local people who have their own plantation so it makes them understand the provincial basis. Apart from major training in regular conference, the additional promotions are launched for agriculturists' understandings and for conservation by supplementely planting local fruits. Or they are compensately grown in the area due to the number of fruit varieties and species have decreased. The representatives of provincial agricultural academician mention about local fruits, such as Thong Ek mango and Og Rong Hom mango, which have good smell when being ripe, and go well with sticky rice. Nam Dok Mai rose apple has a unique scent. Sa La Pao rose apple is similar to Nam Dok Mai rose apple, but it is bigger and sweet. Sa Reak Khao and Sak Kabue rose apples are similar to Sa Reak rose apple, but their sizes are longer. Their fruits are white and sour. Besides these, there are Ma Miew Khao rose apple, bilimbi, banana, carambola, garcinia, White luna nut, and ebony. Sour sop, of which texture is similar to sugar apple, has soft spikes and sour taste. Jug orange is similar to Kaew orange, but Jug orange with calyx attachment is sweeter than Kaew orange. Sa orange or Ma Grud orange is similar to Kheio Hwan orange, but its peel has special aromatic can enhance food smell. Puang Roi coconut is smaller than the majority of other coconuts. Pluek Hwan or Khi Thub coconut has the same feature as general coconuts, but its peel is soft and easy to be peeled off. The agriculturists will eat it during coconut shell formation and no coconut meat yet. The whole coconut fruit can be eaten. Mapreaw has the same stem as coconut, but its fruits are like palmyra. Fai coconut is different from general coconuts because the young coconut meat, attached to its calyx, is pink. Saw coconut has an extraordinary coconut shell from general coconuts, etc.

Apart from the conservation of plantation areas, the promotion on plant propagating for distriburion of major fruit varieties, extraordinary local fruit varieties, and rare fruit varieties, are also the other alternatives to improve fruit value and to assist to conserve the localvarieties and species. The community is ready for governmental promotion in the project of major and local fruits propagation. The partial budget is supported to agriculturists for propagation project and building outlets for local people and tourists. As mentioned by Mr.Sakda Arunrungrot, an agricultural officer, he said that:

"*We have requested for budget to preserve the indigenous and rare fruit species as in group to reproduce species for distribution in Chom Pluak Subdistrict, Bang Khonthi District. After providing materials for agriculturists, they will reproduce grafting from their plantations and sell them at the outlets assigned by the committees. We will gather both general major and rare fruits of the province to sell and keep some parts for community administration in the future.*"



Hom Banana, Theparod Banana, Khai Banana, Nam Wa Banana, and Hak Muk Banana



Pui Fai Santol



Dragon fruit

Figure 5.10 Examples of fruits in Sumut Songkhram



Jackfruit



Smooth chaste tree



Tab Tim Jan Rose apple



Toon Klao Rose apple



Nam Dok Mai Rose apple



Ma Meio Rose apple



Sa Reak Rose apple



Dam and Khao Luna nut



Thai Cherry



Local Pomegranate



Durian

Figure 5.10 Examples of fruits in Sumut Songkhram (cont.)


Custard apple


Khi Nok Guava


Salee Guava


Apple Jujube


Miracle


Leech lime


Garcinia (Ma Dan)


Elephant's apple

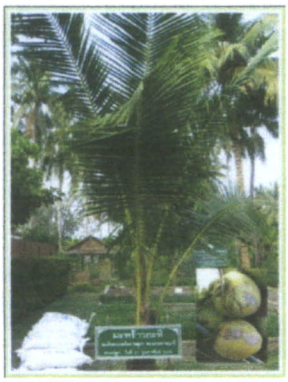

Manila tamarind

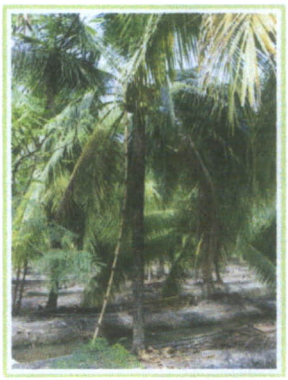

Olive


Hwan Marian plum


Saw Coconut

Figure 5.10 Examples of fruits in Sumut Songkhram (cont.)


Kati Coconut


Tan Ton Tia Coconut


Pluek Hwan Coconut


Puang Roi Coconut


Fai Coconut


Ma Preaw


Garcinia
(Ma Pood)


Sweet Marian plum


R2E2 Mango


Nam Dok Mai Man
Mango


Papaya


Mangosteen

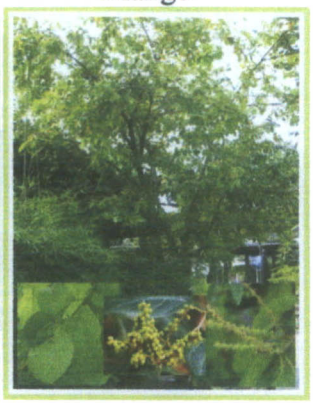

Khai Pla Blackcurrant

Figure 5.10 Examples of fruits in Sumut Songkhram (cont.)



Ton Hyong Mas
Longkong



Sapodilla



Sida Sapodilla



Kom Hom Lam Jiag Lychee



Kaew Orange



Jeed Orange



Cheng Orange



Khao Yai Pomelo



Khao Hneio Breadfruit



Mulberry



Nam-nam

Figure 5.10 Examples of fruits in Sumut Songkhram (cont.)

CHAPTER VI
FACTORS AFFECTING FRUIT TREE BIODIVERSITY

This chapter is the study of all 19 quantitative factors in the hypothesis and qualitative factors related to the number of species, varieties, diversity index and the evenness of fruit including issues that are important to orchard of the local agriculturists. The data was collected by the questionnaire, interview with the agriculturists and the officers as well as studying relevant contexts in the past, present and the future.

6.1 Factors that the orchard owners concern in choosing fruits to grow

Samut Songkhram is bordered by the sea, sea water floods in Mueang District during high tide and intruded the river in the region. However, the salt becomes diluted in Amphawa and Bang Khonthi Districts. The fruits which are mainly grown in this salt water region are coconuts and various fruits can be grown in less salty areas. Amphawa and Bang Khonthi Districts certainly have varieties of fruits. In selecting fruit varieties, the agriculturists usually grow the varieties they used to grow well. Otherwise, after they grow many varieties of fruits, they then select the best later. This leads to the interview with Mr. Aroon Deeprasert regarding the problems and solutions as follows.

"*In this orchard, there are many species of fruits. Not many trees of each kind are grown since the problems of growing cannot be solved and some varieties are grown only for study about the problems. For instance, growing too many pomelos, the pomelos then will not produce rich flesh but sour and bitter flesh instead because of fertilization deficieney. Moreover, plants need different amount of soil, water, sunlight and air to grow. The fruits to be sold to the markets are Holland papayas, king oranges and lychees. If we don't have lychees, we still have many types for the wholesale*"

In the past, there were not many sugar palms, coconuts, and other species of fruits. The coconut trees grown in this region were tall and gave rather big fruits. But when the price of coconut sugar decreased to compared with other species of fruits as well as the fact that older agriculturists could not climb up to pick them, some fruit growers then changed the fruits to be grown in their orchards such as pomelos, mangoes, jack fruits. Landraces are mainly concerned in selecting the varieties, e.g. pomelos (Khao Yai species), lychees (Khom Hom Lam Chiak species), cultivated bananas, tall species of coconuts, since all of them can grow well in the region and resistant to diseases and pests. The varieties that provide many fruits with rich and flavored flesh are tolerate to diseases. The fruit growers said if they are grown in other region they will produce more fruits but with poorer flavors than in Samut Songkhram. For example, lychees will give more fruit if grown in other regions due to the appropriate temperature but their flesh will be different, that is, juicy flesh. The grower also added that this is because of the different type of soil. Also, this can happens when we grow the fruit plants from other regions in ours.

The plating can be defined by the species of fruits in the orchard, i.e. the sugar palm trees producing a lot of sugar, the clusters then are left for producing fruits which will be grown for sale later. According to agriculturists in the past, there were not many species of young plants. Villagers would give the productive varieties or figs to only close friends or neighbors. Later on when numerous plants of excellent varieties were grown for selling, agriculturists then layer them for sale for their incomes. Lychees can normally be grown by layering only. The branches should be cut at a 45 degree angle and should not be stems. The cuttings can control the shape of lychee canopy, but the straight stem will grow straight up quickly and the canopy shape will not be what agriculturists want.

For other species of fruits, agriculturists will select the varieties based on the geography and weather condition. Growing various types of plants can improve soil quality, weather condition and help prevent surface soil erosion The plants are typically grown are bananas, papayas and other ephemeral plants since these species of plants use less space of soil to grow. The fruits are all safety and can be villagers' major incomes when the main trees have not produced their fruits. For perennials such as tamarinds and mangoes, they can not only provide the fruits to the growers, but they

also provide shade for the agriculturists' orchards. Lastly, the agriculturists will choose to grow rare varieties.

Pertaining to the species of fruits, it is expected that agriculturists will change them but still based on the main types nowadays. The tendency is that agriculturists will probably grow more original sugar palms or they may grow the shorter varieties of sugar palm trees. This is because of the markets need natural and non-toxic palm sugar, the price is increasing, that sugar palms continuously produce fruits, and they are easy to grow unlike others types, and it can be processed to various products such as coconut gel and many species of desserts. Moreover, many tourists have come to visit this province while fruits can also be sold to other markets; pomelos and lychees do not produce fruits consistently according to the weather condition. Mixed cropping system has increased since the influence of tourism that make flowering plants come to play a role in orchards of some parts of the province.

6.1.1 Factors affecting agriculturists in growing a variety of fruits.

Regarding factors affecting agriculturists in growing a variety of fruits, an agricultural extension officer pointed out that water zone is one of the factors is the area. For example, in areas with salt water main fruits that can be grown are only coconuts while in the brackish water - freshwater zone, such as Amphawa and Bang Khonthi District, a variety of fruits can be grown withless diverse in the present. A specialist of the district added that main plants in the orchard were grown for consumption and other advantages in households. Villages then grow various species and varieties so that they were adequate for their living. As there were not many varieties of plants developed in the past, agriculturists nowadays expect more incomes rather than consumption for their living. Neglecting the dying fruit plants and the plant succession can lessen the local species and lead to the extinction.

According to an in-depth-interview with agriculturists regarding the factors related to growing a variety of fruits, specialists emphasized current incomes as well as daily incomes. Apart from sugar palms, bananas, young coconuts, lychees, and pomelos, agriculturists can sell sugar every day. Young coconuts can be collected within every 45 days. Pomelos produce fruits throughout the year with higher amount of fruits especially in the beginning and in the middle of the year while lychees bear

fruits in the beginning of the year. Productions in orchards like sugar can be the cost and can reduce the expense of households. However, the factors that agriculturists do not grow a variety of fruits are the fact that modified crops take longer to grow and the change cannot be significantly changed. In the past, pomelos and lychees were not that popular. When their price has increased, more of them are grown by fruit growers. This can lead to the decrease in price later on. That lychee trees bear fruits throughout the year has changed due to the climate variability. Agriculturists believe that Monocultural plantation provide them more revenue which is enough for their living until the next year.

6.1.2 Factors of marketing and carrying capacity

Marketing is an important factor significantly affecting growing fruits. From the expanding fruit market trends, government has promoted the fruit exporting to neighboring countries such as Laos and China. For instance, government exported 700 kilograms of pomelos during the Asian Games and lychees to Taiwan. However, nowadays the fruit production is insufficient for selling due to the changing climate. Fruits from most orchards which are not very large are usually sold within the region and nearby provinces. Selling fruits through merchants has decreased while that fruit sellers come and purchase the fruits directly from the orchards to sell the fruits at markets in Bangkok, Mahachai market, kiosks and restaurants is still be as usual. Additionally, due to the tourism, agriculturists can sell their products directly to the tourists. This idea can change village to be markets which differ from large orchards with high production capacity. 8-15-year-old pomelo trees which are ready for bearing fruits will be sold to agencies who will distribute the products to overseas. Some orchards in Bang Khonthi District are as wide as 20-30 rais.

For the price, agriculturists who sell their fruits in the region normally sell in reasonable price since they sell only for their living and help among agriculturists and sellers. Their kiosks are for selling products to local people and tourists. Fruit sellers who come to purchase fruits will but small number of fruits but they will come quite often. At Mahachai Market, the demand is greater for the cost-effective transportation. If agriculturists cannot harvest in time, the buyers will help them.

Another problem in marketing is from fruits sellers who buy fruits from other regions and sell fruits in cheap price. This affects the production distribution of the agriculturists in the province. Agriculturists realize sellers' points that they will gain more profits by doing this. This is another reason that agriculturists cannot sell fruits in more expensive price in order to help both fruit sellers and agriculturists themselves. Another problem is about assuming local fruits, by pretending the products from other regions to be local fruits or vice versa, for instance, local pomeloes were assumed pomelos (Sai Nam Peung species). Pomelos growers said that both varieties of pomelos are rather similar. They differ in when to harvest. Harvested when they are ripped, the pomelos provide better flavors than an unripe harvest. However, an over-ripe harvest, pomelo flesh then turns rough. So, they should be harvested earlier and harvesting period becomes one of the relevant factors despite the same varieties. Normally, ripped pomelos are collected during March and May when they give the best and delicious flavor. But from November to February, pomelos flesh will turn sour. Agriculturists cannot wait until they are ripped as their flesh will be rough, not delicious. This also depends on caring and fertilizing. Therefore, providing knowledge to consumers regarding fruits are also significant, i.e. growing and harvesting fruits cannot be compared to the manufacturing products in factories; that lychee tree which were grown naturally provide beautiful lychees with rich flesh and small seeds involved many factors in growing; and the name assuming has been solved with the collaboration between fruit growers and government agencies auditing fruits in the responsible areas.

The price of coconuts and sugar nowadays has increased because the produce in other regions have been destroyed by leaf beetles as well as flooding disaster leading coconut trees to die. Nevertheless, those in Samut Songkhram are affected slightly. With the collaboration among agriculturists and government agencies, the price of coconuts has been increased from 4-5 baht up to 20 baht each from the end of the year 2009 until now. Most of the markets demanding coconuts are Mahachai market, coconut milk factories. Some products made of coconuts are sold at agriculturists' houses to compare the proportion of the dispersion in the province and other provinces.

For lychees, fruits sellers will come to buy them at the village by themselves just like they do with pomelos for the dispersion of production in the area and the areas nearby. They sometimes hire container truck to keep all the lychees in orchard and their workers will harvest the fruits in order to sell them domestically and abroad such as Taiwan. But due to the inconsistency of lychees, the lychee growers encounter problems, which are to say, they lack incomes and the price is not exact. In present days, merchants usually purchase the whole blooming lychee blossoms which will be bred with those from other region like Chanthaburi Province.

Agricultural Technician suggested pertaining to problems of price and marketing that if the price is consistent agriculturists will produce good-quality fruits but if not the agriculturists then lack the capital in growing better ones.

6.1.3 Factors related to workers in agriculturists

The shortage of labors both in and out of the household has been one of the major problems for decades. Villagers began to leave gardening for working other kinds of jobs. Those who did not own any orchard came to work in factories. Agriculturists pointed out that working in orchards, workers did not have chances to meet other people. So, this may cause bore to particularly adolescents and people at working age. The serious shortage of labors in agricultural sectors tends to occur within 5 years. These days there are only fewer agriculturists working hard and seriously in orchard. Some agriculturists alter the word 'cultivating' to 'harvesting'. An agriculturist added that it was not worth paying workers including other expenses. The wages nowadays has increased while the working time decreases. Fruit growers have to do all cultivating themselves even though they will obtain less produce and less revenue. Concerning foreign workers, most of them are fishers. In harvest season of, for example, lychees, exporting companies will come with many of their foreign workers to quickly harvest lychees in orchards so that the fruits are in good condition. This might affect the local labors in the future.

Nowadays agriculturists do not have many children. Most of their children are supported by their agriculturist parents and work in uptown. Their parents are orchard owners and they can afford paying for their children's better education. Working in urban society has changed their lifestyles and ways of thinking. The

opportunity that they will return home and do cultivating at their working age then lessens. Although, there are still some return to do cultivating because of tiresome in their working life, social environment, retirement, and thoughts concerning the importance of nature and orchard lifestyle. Some might concern about the higher price of the orchard produce in the future. This last probability is another motivation for people in new generation to return their hometown and doing orchard.

6.1.4 Factors from outside, society and tourism

Tourists have been flooding to Samut Songkhram nowadays as this province is not far from Bangkok and it has been promoted by Department of Agriculture Extension, Samut Songkhram Provincial Agricultural Extension, District Agricultural Office. Additionally, the strength of Samut Songkhram is that this province has considerably changed from the past. Department of Agriculture Extension has also promoted the floating markets in many places. Tourism is beneficial to dispersing the products of all agriculturists. For example, organic pomelo orchards belonging to Ajarn Somsong Saengtawan, presenting villager intellect to tourists like making sugar palm cakes, fruit processing and so on. The development in many aspects of orchard and the implemented promotion has increase the number of tourists who are satisfied with the atmosphere, environment, fruits and products with reasonable price. The facilities such as transportation are also improved. Still, there are some disadvantages of this development which is agreed by agriculturists and the specialists of the province. The mentioned bad sides are the environmental problems such as garbage. Residents' lifestyles have currently promoted tourism. This cause riverbank erosion, less orchard areas left due to building more accommodation, and migration of people residing outside the municipality according to Mr. Prachim Niamsuwan. Agricultural Extension Office in Amphawa District stated that,

"*Without the understanding of the local area, after buying some lands from the local land owners, กนนอnhas modify that piece of land with, for example, land reclamation or constructing fence which can cause flooding later on. This obstructs the water flow in the agriculturists with lifted grooves since the lands of agriculturists were originally allocated by pole hammered into the lands covered with Bermuda grass. Doing this way enable watering system flows easily. But when the land owner*

has changed and wealthy outsiders had the fence built, the water cannot flow easily. The lack of water can cause the problems to the coconut trees and others that need much water in the future."

Some agriculturists thought that these effects are still acceptable and not that terrible, since they were not too influenced by external factors. They think they should solve the problems that can be solved or if they cannot really solve, it will be better to reduce it. Another group of agriculturists contemplated that due to more population, the lands for agriculture has turned to be housing estate and the dispersion of the population has involved in several activities, e.g. releasing detergent into the river causing water pollution as well as damaging orchards. This can cause tree to bear fewer fruits and finally lessen the number of orchards. The dangerous situation should be extremely concerned by both local and outsiders.

6.2 The relationship between household socio-economic factors and fruit tree biodiversity

The study of the related factors affecting fruit tree biodiversity (number of species, varieties, diversity index, and evenness) in Samut Songkhram, used Multiple Regression Analysis at statistical significance level of 0.05. Household socio-economic factors were variables consist of gender, age, living period, hometown, number of family members, educational level, area of salty, brackish and freshwater, orchard area, number of workers, agricultural occupation, incomes from orchard, other incomes, household expenses, savings, orchard management duration, supporting organizations, descendant, the frequency of agricultural information acknowledgement, and factors of attitudes towards fruit tree biodiversity.

6.2.1 Information about socioeconomic characteristics and attitude towards fruit tree biodiversity

The analysis of the information about socio-economic characteristics and the attitude as mentioned are divided into 3 parts as follows:

1) Demographic and socio-economic information of households

2) Channels and the frequency of acknowledgement of agriculturists about the information regarding agriculture and fruit tree biodiversity

3) Attitude towards local fruit tree biodiversity

The data collection for these three parts were conducted by interview the sample of 390 households in Samut Songkhram; 150 households from Amphawa District, 124 households from Bang Khonthi District and 116 households from Mueang District or 38.5, 31.8 and 29.7 percent respectively.

Part 1: Demographic and socio-economic information of households

Factors involved in this part consist of agriculturists' gender, age, living period, hometown, number of family members, educational level, orchard area, number of workers, career, incomes from orchard produce, other incomes, household expenses, and time period for orchard management.

The agriculturists from 390 households were asked to respond to the questionnaires and the results revealed that the number of male and female was similar. The average age of agriculturists was 58.8 years old. Most of local people and 50% of agriculturists had lived in the areas for more than 50 years. Each household had 4 members averagely. Most of the sample graduated Prathomsuksa 1 – 4. The area of orchards covered approximately 7 rais. There were 4 workers altogether including the interviewee. Around 76.9% mainly works as agriculturists. Lastly, more than 50% of agriculturists took 0-20 years for orchard management. Incomes from the orchards were less than 50,000 baht per year. Up to 50% of agriculturists had less than 100,000 baht of expenses for orchards a year and around 50% of agriculturists were responsible for less than 100,000 baht of household expenses a year. Lastly, approximately 79% of agriculturists had positive thinking of positive visions for fruit biodiversity which will be shown below.

Gender

Female slightly outnumbered male agriculturists around 2.6%; 190 were male (48.7%) and 200 were female (51.3%).

Age

The age of all the interviewees ranged from 23 – 90 years old. The average age was 58.79. In age classification, 118 agriculturists were in the range of 51 – 60 years old (30.3%, the greatest group) followed by the second group of 103

agriculturists in the range 61 – 70 years old (26.4%. This showed that the population in the first group had more than half of all sample (56.7%). For those who fell in the range 41 – 50 years old had 68 people, 61 people were in the range 71-80 years old, 24 people were 31 – 40 years old, 11 people were 81 – 90 years old, and the smallest group of 5 people (17.4%, 15.6%, 6.2%, 2.8% and 1.3% respectively)

Living period

The average time period that agriculturists had lived in Samut Songkhrame in the range 1 – 90 years was 53.18 years. Next is the average time period that most agriculturists had lived here was in the 41 – 60 years and they were from 172 households (44.1%), followed by the range of 61 – 80 years there were 131 households. In the range of 21 – 40 years there were 58 households and 20 households had lived for 1 – 20 years (33.5%, 14.8%, 5.1% and the smallest group of nine 81-year-old agriculturists or 2.3% respectively)

Hometown

Mostly, agriculturists of 315 households (80.8%) lived in Samut Songkhram while 23 households (5.9%) had moved from other provinces. 18 households had moved from other districts or subdistricts within the province and only 16 households moved from other villages in the same district which was 4.6% and 4.1% in that order)

Number of family members

Number of family members of each household was in the range of 1-11 people. The average number was 4.06. 170 households (43.59%) had 3 – 4 members (the greatest group). 88 and 85 households (22.5% and 21.7%) had 5 – 6 members and 1 – 2 member(s). 35 households (8.9) had 7 – 8 members and the smallest group includes 12 households (3%) had more than 9 members.

Educational level

There were also the agriculturists who lack of education until those graduating Bachelor's degree. Most of them (187 people or 47.95%) finished Prathomsuksa 1-4. 87 people of all subjects (22.31) finished Prathomsuksa 5 – 7. Therefore, there were 274 people (70.6%) who finished primary schools. For secondary level, there were 89 people altogether which can be divided as follows: 49 people or 12.56% finished Matthayomsuksa 4 – 6 and 40 people (10.26%) finished

Matthayomsuksa 1 – 3 or the same educational level. 19 people (4.87%) graduated Bachelor's degree and only 8 people or 2.05% did not enter school.

Orchard areas

Agriculturists had their own orchards or leased orchards covering the area of from 0.04 to 41 rais. The average area was 6.82 rais. Most of them (218 households or 55.9%) had less than 5 rais of orchards. Next, 69 households processed 5 – 9 rais of orchards while 60 households had 10 – 14 rais. 27 households had 15 – 19 rais, 8 households had 20 – 24 rais, but only 4 households had up to 30 rais. These equals to 17.69%, 15.38%, 6.92%, 2.0% and 1.03% respectively.

Number of workers

There were around 1-16 workers in each orchards counting family members and employed workers, the average number of which was 3.63. 1-4 workers were hired by most agriculturists from 278 households or 71.3%, followed by 5 – 8 workers who were hired by each of 93 households. 15 households had 9 – 12 workers and 4 households employed 13 – 16 workers. (23.8%, 3.8% and 1.0% respectively)

Career

Interviewees' careers can be classified into two main types: main and minor occupations. The details are shown below.

Main occupations: Most of interviewees or 300 people (76.9%) worked as agriculturists. 39 people were employees, 38 people were sellers or ran their own business, 10 people were retired government officials, and only 3 people were company workers. (10.0%, 9.7%, 2.5% and 0.8% respectively)

Minor occupations: 164 people from all of the 390 interviewees had another job, 93 of whom (23.8%) worked as agriculturists, 40 of whom were sellers and ran business, 22 of whom were employees, while 7 of whom were government officials or the retired ones and only 2 worked as company workers. (10.3%, 5.6%, 1.8% and 0.5%)

Incomes from orchard per year

Most of the agriculturists or 307 households (78.7%) gained less than 50,000 baht as their incomes from selling fruits, 58 households received around 50,000 – 100,000 baht, 17 households earned 100,001 – 150,000 baht, 5 households

obtained 150,001 – 200,000 baht, and lastly, only 3 households earned more than 200,001 baht. These can be counted 14.9%, 4.4%, 1.3% and 0.5% correspondingly).

Other incomes per year

Most of the interviewees or 329 households (84.3%) earned less than 50,000 baht from other incomes besides that of orchard. 36 households gained 50,000 – 100,000 baht, 11 households gained 100,001 – 150,000 baht. Other incomes of 4 interviewees fell into three ranges which were 150,001 – 200,000 baht, 200,001 – 250,000 baht and more than 300,001 baht. Finally, the other two interviewees obtained 250,001 – 300,000 baht (9.2%, 2.8%, 1.0% and 0.5% respectively)

Expenses which can be divided into two types – household expenses and orchard expenses – to be shown in more details.

Orchard expenses: Most agriculturists from 194 households had less than 5,000 baht of expenses (49.7%). There were 66 households whose expenses were 5,000 – 10,000 baht; 50 households had 10,001 – 15,000 baht of expenses, 35 households paid 30,001 baht per year, 26 households paid 15,001 – 20,000 baht, 13 households paid 20,001 – 25,000 baht while 6 households had 25,001 – 30,000 baht of expenses. (16.9%, 12.8%, 9.0%, 6.7%, 3.3% and 1.5% respectively)

Household expenses: Most agriculturists or 329 households had less than 100,000 baht of household expenses (85%). 40 households paid 100,001 – 150,000 baht, 12 households paid 150,001 – 200,000 baht of household expenses. The two following ranges of 200,001 – 250,000 baht and more than 300,001 baht belonged to 4 households each while only one person paid 25,001 – 30,000 baht of household expenses (10.3%, 3.1%, 1.0% and 0.3% respectively)

Orchard management duration

Duration of orchard management by agriculturists themselves fell into the range from 0 – 70 years. Most of them (113 households or 29%) took less than 11 years to manage their orchard, 91 households took 11 – 20 years, 76 households took 21 – 30 years, 50 households took 31 – 40 years, 41 households took 41 - 50 years, 14 households took 51 – 60 years while 5 households took up to 61 – 70 years (23.3%, 19.5%, 12.8%, 10.5%, 3.6% and 1.35 respectively)

Table 6.1 Data used to analyze the study results

Factors	Data characteristics	Numbers (n = 390)	Percentage
Area (District)	Mueang	116	29.7
	Amphawa	150	38.5
	Bang Khonthi	124	31.8
Gender	Male	190	48.7
	Female	200	51.3
Age	21 – 30 years old	5	1.3
	31 – 40 years old	24	6.2
	41 – 50 years old	68	17.4
	51 – 60 years old	118	30.3
	61 – 70 years old	103	26.4
	71 – 80 years old	61	15.6
	81 – 90 years old	11	2.8
	$\bar{x}$ = 58.79 S.D. = 12.17		
	Min = 23 Max = 90		
Living period	1 – 20 years	20	5.13
	21 – 40 years	58	14.87
	41 – 60 years	172	44.10
	61 – 80 years	131	33.59
	More than 81 years	9	2.31
	$\bar{x}$ = 53.18 S.D. = 16.837		
	Min = 1 Max = 90		
Hometown	From birth	315	80.8
	Moving from another village	16	4.1
	Moving from another subdistrict	18	4.6
	Moving from another district	18	4.6
	Moving from another province	23	5.9
Number of members	1 – 2 person(s)	85	21.79
	3 – 4 people	170	43.59
	5 – 6 people	88	22.56
	7 – 8 people	35	8.97
	More than 9 people	12	3.08
	$\bar{x}$ = 4.06 S.D. = 2.001		
	Min = 1 Max = 11		
Educational level	Lack of education	8	2.05
	Prathomsuksa 1 – 4	187	47.95
	Prathomsuksa 5 – 7	87	22.31
	Matthayomsuksa 1 – 3 or the same educational level	40	10.26
	Matthayomsuksa 4 – 6 or the same educational level	49	12.56
	Bachelor's Degree	19	4.87
	$\bar{x}$ = 6.59 S.D. = 3.82		
	Min = 0 Max = 17		
Orchard areas	Less than 5 rais	218	55.90
	5 – 9 rais	69	17.69
	10 – 14 rais	60	15.38
	15 – 19 rais	27	6.92
	20 – 24 rais	8	2.05
	25 – 29 rais	4	1.03
	More than 30 rais	4	1.03
	$\bar{x}$ = 6.82 S.D. = 5.98 Min = 0.04 Max = 41		

Table 6.1 Data used to analyze the study results (cont.)

Factors	Data characteristics	Numbers (n = 390)	Percentage
Workers in orchards	1 – 4 workers	278	71.3
	5 – 8 workers	93	23.8
	9 – 12 workers	15	3.8
	13 – 16 workers	4	1.0
	$\bar{x}$ = 3.63 S.D. = 2.51		
	Min = 1 Max = 16		
Main occupations	agriculturists	300	76.9
	Employees	39	10.0
	Sellers or business owners	38	9.7
	(Retired) government officials	10	2.5
	Company workers	3	0.8
Minor occupations (n = 164)	agriculturists	93	23.8
	Employees	22	5.6
	Sellers or business owners	40	10.3
	(Retired) government officials	7	1.8
	Company workers	2	0.5
Incomes from orchard per Year	Less than 50,000 baht	307	78.7
	50,000 – 100,000 baht	58	14.9
	100001 – 150,000 baht	17	4.4
	150,001 – 200,000 baht	5	1.3
	More than 200,001 baht	3	0.5
Other incomes per year	Less than 50,000 baht	329	84.3
	50,000 – 100,000 baht	36	9.2
	100,001 – 150,000 baht	11	2.8
	150,001 – 200,000 baht	4	1.0
	200,001 – 250,000 baht	4	1.0
	250,001 – 300,000 baht	2	0.5
	More than 300,001 baht	4	1.0
Orchards expenses per year	Less than 5,000 baht	194	49.7
	5,000 – 10,000 baht	66	16.9
	10,001 – 15,000 baht	50	12.8
	15,001 – 20,000 baht	26	6.7
	20,001 – 25,000 baht	13	3.3
	25,001 – 30,000 baht	6	1.5
	More than 30,001 baht	35	9.0
Household expense per year	Less than 50,000 baht	165	42.3
	50,000 – 100,000 baht	164	42.1
	100,001 – 150,000 baht	40	10.3
	150,001 – 200,000 baht	12	3.1
	200,001 – 250,000 baht	4	1.0
	250,001 – 300,000 baht	1	0.3
	More than 300,000 baht	4	1.0
Orchard management duration	Less than 11 years	113	29.0
	11 – 20 years	91	23.3
	21 – 30 years	76	19.5
	31 – 40 years	50	12.8
	41 – 50 years	41	10.5
	51 – 60 years	14	3.6
	61 – 70 years	5	1.3

Table 6.1 Data used to analyze the study results (cont.)

Factors	Data characteristics	Numbers (n = 390)	Percentage
Orchard management duration	$\bar{x}$ = 24.03 S.D. = 16.38 Min = 0 Max = 70		
Attitudes towards the fruit tree biodiversity	Positive attitudes	308	79.0
	Neutral attitudes	81	20.8
	Negative attitudes	1	0.3

Part 2: Channels for agriculturists to acknowledge information

The agriculturists from 390 households were involved in the analysis of channels for agriculturists to acknowledge information. This analysis was conducted by assessing the total weight of each frequency level. Most of the agriculturists were interested in news and they choose televisions as their channel for the knowledge, followed by their neighbors, relatives, and children (82% and 79.6% respectively), from government officials, radio, printed media on agriculture, visiting exhibition and workshop in another district which can be converted into the following percentage 57.4%, 54.7%, 54.5%, 54.3% and 46.8%. The channel they had not received any information regarding agriculture was through schools and private sectors. Finally, agriculturists rarely use the Internet as one of their information channels (29.7%, 29.1% and 28.1% respectively as appeared in the table 6.2 showing the frequency in approaching each channel.

Televisions: Information acknowledgement can be classified and arranged from the most frequency to the least. 223 households frequently watch TV for agricultural information (57.18%), 78, 64 and 25 households sometimes, seldom, and never watch TV for the information which equals to 20%, 16.41% and 6.41% respectively.

Neighbors, relatives, and children: 212 households received the knowledge through these channels the most (54.36%), while 86, 49 and 43 households sometimes, never, and rarely use these channels (22.05%, 12.56% and 11.03% respectively).

Government officials: Arranged by frequency, 126 agriculturists (32.31%) never received any information on agriculture and gardening through this channel, 103, 81 and 80 households seldom, sometimes, and nearly never use this channel (26.41%, 20.77% and 20.51% respectively).

Radios: agriculturists from 145 households (34.62% or the greatest group) never obtain the information on agriculture via radio, 106, 78 and 61 households seldom, often, and nearly never choose radio as their information channel (27.18%, 20% and 15.64% respectively).

Printed media such as newspapers, leaflets, books on agriculture, and etc.: Arranged by frequency, 135 agriculturists or 34.62% never received the information about the agriculture through printed media while 115, 75 and 65 households seldom, sometimes and nearly never gain the knowledge from this channel (29.49%, 19.22% and 16.67% respectively).

Visiting exhibitions and workshops in another community: Arranged by frequency, 128 agriculturists or 32.82% never received the information from visiting exhibitions or joining workshops in another subdistrict. Similarly, 122, 86 and 54 households seldom, sometimes and nearly never received the information from this channel (31.28%, 22.05% and 13.85% respectively).

Public address system tower: Arranged by frequency, 203 agriculturists or 52.05 % (the greatest group) never received the information from public address system tower, and 76, 70 and 41 households seldom, at times and nearly never received the information from this channel (19.49%, 17.95% and 10.51% respectively).

Schools: Arranged by frequency, 339 agriculturists or 86.92% (the greatest group) never received the information from schools. In the same way, 32, 16 and 3 households seldom, at times and nearly never received the information from this channel (8.21%, 4.1% and 0.77% respectively).

Private sectors: Arranged by frequency, 343 agriculturists or 87.95% never obtained the information from any private organizations. Correspondingly, 34, 10 and 3 households seldom, at times and nearly never received the information from this channel (8.72%, 2.56% and 0.77% respectively).

Internet: Arranged by frequency, 360 agriculturists or 92.31% never use the Internet as their channel in receiving information about agriculture. Agriculturists from 17, 8 and 5 households seldom, sometimes and nearly never use this channel (4.36%, 2.05% and 1.28% respectively).

Table 6.2 Agriculture information channels

Channels	Frequency of receiving information				Scores	
	often (4)	sometimes (3)	seldom (2)	never (1)	score	Percentage
Televisions	**223** (**57.18**)	78 (20)	64 (16.41)	25 (6.41)	1,279	82.0
Neighbors/Relatives/Children	**212** (**54.36**)	86 (22.05)	43 (11.03)	49 (12.56)	1,241	79.6
Government officials in and outside the district	80 (20.51)	81 (20.77)	103 (26.41)	**126** (**32.31**)	895	57.4
Radio	78 (20)	61 (15.64)	106 (27.18)	**145** (**37.18**)	852	54.7
Printed media on agriculture	65 (16.67)	75 (19.22)	115 (29.49)	**135** (**34.62**)	850	54.5
Visiting exhibitions participating workshop in another district	54 (13.85)	86 (22.05)	122 (31.28)	**128** (**32.82**)	846	54.3
Public address system tower	41 (10.51)	70 (17.95)	76 (19.49)	**203** (**52.05**)	729	46.8
Schools	3 (0.77)	16 (4.1)	32 (8.21)	**339** (**86.92**)	463	29.7
Private sectors	3 (0.77)	10 (2.56)	34 (8.72)	**343** (**87.95**)	453	29.1
Internet	5 (1.28)	8 (2.05)	17 (4.36)	**360** (**92.31**)	438	28.1

Part 3: Data about the attitudes towards the fruits tree biodiversity

In this study, 390 agriculturists were asked to complete the questionnaires with discriminant validity and reliability. This questionnaire can be divided into 6 parts consisting of 29 questions about attitudes: 19 questions measuring positive attitudes and 10 questions measuring negative attitudes. The agriculturists from 308 households or 79% in Samut Songkhram showed positive attitudes towards fruit biodiversity, 81 households or 20.8% had neutral attitudes, and only one households or 0.3% of all the interviewees had negative attitudes. Most of them had high level of positive attitudes and low level of negative attitudes as shown in the table 6.3 below.

1) The followings were 3 items measuring positive attitudes towards all characteristics of the study areas in Samut Songkhram.

1. The soil in Samut Songkhram is suitable for growing fruits: 179 agriculturists (the biggest group) agreed, 144 people of all subjects were neutral, 35 people strongly agreed, 26 people disagreed, and 6 people strongly disagree (45.9%, 36.92%, 8.97%, 6.67% and 1.54% respectively).

2. The temperature and weather is appropriate to grow fruits: 173 agriculturists agreed, 140 people of all subjects were neutral, 45 people disagreed, 28 people strongly agreed, and 4 people strongly disagree (44.36%, 35.9%, 11.54%, 7.18% and 1.03% respectively).

3. The soil in Samut Songkhram is fertilized: the majority or 173 agriculturists agreed, 150 people of all subjects remained neutral, 38 people disagreed, 27 people strongly agreed, and 2 people strongly disagree (44.36%, 38.46%, 9.74%, 6.92% and 0.51% respectively).

2) For local fruits, there were 3 items used to assess positive attitudes.

4. Local fruits are more resistant to diseases and pests than modified fruits. 251 agriculturists agreed, 96 people were neutral, 21 people disagreed, 20 people strongly agreed, and 2 people strongly disagree (64.36%, 24.62%, 5.38%, 5.13% and 0.51% respectively).

5. They benefit ecosystem and other natural systems: 274 people agreed, 80 people remained neutral, 24 people strongly agreed, 12 people disagreed, and on one strongly disagree (70.28%, 20.51%, 6.15% and 3.08% respectively).

6. They had economic value: 270 people agreed, 95 people were neutral, 19 people strongly agreed, 6 people disagreed, and on one strongly disagree (69.23%, 24.36%, 4.87% and 1.54% respectively).

3) Conservation of fruit tree varieties or the reason why the agriculturists continuing growing fruits. This consisted of 9 items in order to measure positive attitudes.

7. Agriculturists follow their ancestors in growing: 272 people agreed, 60 people were neutral, 45 people strongly agreed, 12 people disagreed, and only one strongly disagree (69.74%, 15.38%, 11.54%, 3.08% and 0.26% respectively).

8. Growing fruits can give agriculturists good incomes: most of respondents or 199 people were neutral, 146 people agreed, 32 people disagreed, 10 people strongly agreed, and 3 people strongly disagree (51.03%, 37.44%, 8.21%, 2.56% and 0.77% respectively).

9. Current selling price of fruits is reasonable: most of them or 166 people agreed, 157 people were neutral, 56 people disagreed, 6 people strongly disagreed, and 5 people strongly agree (42.56%, 40.26%, 14.36%, 1.54% and 1.28% respectively).

10. Working as agriculturists is independent: nearly everyone or 301 people agreed, 42 people were neutral, 5 people disagreed, no one strongly disagreed (77.18%, 10.77% and 1.28% respectively).

11. Agriculturists would like to remain the varieties and species of fruit trees: most of them or 295 people agreed, 70 people remained neutral, 16 people strongly agree, 7 respondents disagreed, and 2 of them strongly disagreed (75.64%, 17.95%, 4.1%, 1.79% and 0.51% respectively).

12. Current grown fruit tree species and varieties are considered already good: most of respondents or 294 people agreed, 70 people neither agreed nor disagreed, 24 people strongly agree, and there was only one respondent for the level of disagree as well as strongly disagree (75.38%, 17.38%, 6.15% and 0.26% respectively).

13. The species chosen by agriculturists are considered better than those from other places: 263 respondents agreed, 75 people neither agreed nor disagreed, 34 people agree, and 17 respondents disagreed, and 1 person strongly disagree (67.44%, 19.23%, 8.72%, 4.36% and 0.26 % respectively)

14. Working as agriculturists in orchards is secured: 243 respondents agreed, 100 people were neutral, 25 people agreed, 20 respondents disagreed, and 2 people strongly disagree (62.31%, 25.64%, 6.41%, 5.13% and 0.51% respectively).

15. Agriculturists are proud of their profession: 261 respondents agreed, 65 people had neutral attitudes, 54 people strongly agreed, 8 respondents disagreed, and 2 people strongly disagree (66.92%, 16.67%, 13.85%, 2.05% and 0.51% respectively).

4) Fruit abandon or the reason agriculturists tend to quit growing fruits contained 9 items to assess negative attitudes.

16. Agriculturists earn little income: most of the respondents or 201 people disagreed, 95 respondents neither agreed nor disagreed, 29 people disagreed, 60 people agreed while 5 people strongly agreed (51.54%, 24.36%, 15.38%, 7.44% and 1.28% respectively).

17. Fruit trees give little produce: 175 questionnaire respondents disagreed, 123 people had neutral opinions, 67 people agreed, 20 people strongly disagreed, but 5 people strongly agreed (44.87%, 31.54%, 17.18%, 5.13% and 1.28% respectively).

18. Water system and quality are poor. 201 questionnaire respondents disagreed, 111 people were neutral, 45 people agreed, 24 people strongly disagreed, but 9 people strongly agreed (51.54%, 28.46%, 11.54%, 6.15% and 2.31% respectively).

19. The weather condition is inappropriate: 202 respondents disagreed, 119 people were neutral, 40 people agreed, 24 people strongly disagreed, and 5 people strongly agreed (51.79%, 30.51%, 10.26%, 6.15% and 1.28% respectively).

20. The soil is not fertilized: 207 respondents disagreed, 116 people were neutral, 37 people agreed, 23 people strongly disagreed, and 7 people strongly agreed (53.08%, 29.74%, 9.49%, 5.9% and 1.79% respectively).

21. Agriculturists want to change their career: 233 respondents disagreed, 73 people strongly disagreed, 64 people neither agreed nor disagreed, 16 people agreed, and 4 people strongly agreed (59.74%, 18.72%, 16.41%, 4.1% and 1.03% respectively).

22. Agriculturists get older and cannot do all gardening: 135 respondents disagreed, 129 people neither agreed nor disagreed, 88 people agreed, 23 people strongly agreed, and 15 people strongly disagreed (34.62%, 33.08%, 22.56%, 5.9% and 3.85% respectively).

23. Labor shortage: 174 respondents disagreed, 125 people neither agreed nor disagreed, 65 people agreed, 21 people strongly agreed, and 5 people strongly disagreed (44.62%, 32.05%, 16.67%, 5.38% and 1.28% respectively).

24. Gardening is dangerous: 187 respondents disagreed, 98 people were neutral, 52 people agreed, 49 people strongly disagreed, and 4 people strongly agreed (47.95%, 25.13%, 13.33%, 12.56% and 1.03% respectively).

5) Lifestyle and wisdom that relevant to orchard contained 4 items to assess agriculturists' positive attitudes.

25. Wisdom is important to agriculturists: 263 respondents agreed, 76 people were neutral, 44 people strongly agreed, 7 people disagreed, and on one strongly disagreed (67.44%, 19.49%, 11.28% and 1.79% respectively).

26. Growing fruit trees influences the agriculturists' ways of living: 283 respondents agreed, 61 people were neutral, 38 people strongly agreed, 7 people disagreed, and only one respondent strongly disagreed (72.56%, 15.64%, 9.74%, 1.79% and 0.26% respectively).

27. Significant wisdom comes from orchard: 271 respondents agreed, 85 people were neutral, 22 people strongly agreed, 10 people disagreed, and only 2 respondents strongly disagreed (69.49%, 21.79%, 5.64%, 2.56% and 0.51% respectively).

28. People in the community had best preserve local wisdom: 263 respondents agreed, 64 people strongly agreed, 54 people were neutral, 8 people disagreed, and only one respondent strongly disagreed (67.44%, 16.41%, 13.85%, 2.05% and 0.26% respectively).

6) External factors affecting fruits growing included only 1 item to measure the degree of negative attitude.

29. Market prices force agriculturists to change the species and varieties of fruit trees: 155 respondents disagreed, 122 people agreed, 93 people were neutral, 11 people strongly disagreed, and 9 people strongly agreed (39.74%, 31.28%, 23.85%, 2.82% and 2.31% respectively).

Table 6.3 Attitudes towards fruit tree biodiversity

	Attitude	Degree of agreement				
		Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1. The characteristics of the study areas (Samut Songkhram Province)						
1.	The soil is suitable for growing fruits.	6 (1.54)	26 (6.67)	144 (36.92)	179 (45.9)	35 (8.97)
2.	The temperature is appropriate to gardening.	4 (1.03)	45 (11.54)	140 (35.9)	173 (44.36)	28 (7.18)
3.	The soil is fertile and productive.	2 (0.51)	38 (9.74)	150 (38.46)	173 (44.36)	27 (6.92)
2. Native fruits						
4.	They are more resistant to diseases and pests than those modified.	2 (0.51)	21 (5.38)	96 (24.62)	251 (64.36)	20 (5.13)
5.	They benefit the ecosystem and other natural systems.	-	12 (3.08)	80 (20.51)	274 (70.26)	24 (6.15)
6.	Native fruits tree have economic value.	-	6 (1.54)	95 (24.36)	270 (69.23)	19 (4.87)
3. Fruit variety preservation and the agriculturists' reasons of keeping on gardening						
7.	Agriculturists follow their ancestors in growing	1 (0.26)	12 (3.08)	60 (15.38)	272 (69.74)	45 (11.54)
8.	Good incomes	3 (0.77)	32 (8.21)	199 (51.03)	146 (37.44)	10 (2.56)
9.	Selling price is reasonable.	6 (1.54)	56 (14.36)	157 (40.26)	166 (42.56)	5 (1.28)
10.	Working as agriculturists is independent.	-	5 (1.28)	42 (10.77)	301 (77.18)	42 (10.77)
11.	Agriculturists need to preserve fruit tree species and varieties.	2 (0.51)	7 (1.79)	70 (17.95)	295 (75.64)	16 (4.1)
12.	The currently grown species and varieties of fruit trees are already productive.	1 (0.26)	1 (0.26)	70 (17.95)	294 (75.38)	24 (6.15)
13.	The species chosen by agriculturists are better than those from other places.	1 (0.26)	17 (4.36)	75 (19.23)	263 (67.44)	34 (8.72)
14.	Working as agriculturists in orchards is secured	2 (0.51)	20 (5.13)	100 (25.64)	243 (62.31)	25 (6.41)
15.	Fruit abandon or the reason agriculturists tend to quit growing fruits	2 (0.51)	8 (2.05)	65 (16.67)	261 (66.92)	54 (13.85)
4. Fruit abandon or the reason agriculturists tend to quit growing fruits						
16.	Agriculturists earn little income from growing fruits.	29 (7.44)	201 (51.54)	95 (24.36)	60 (15.38)	5 (1.28)
17.	Fruit trees give little produce.	20 (5.13)	175 (44.87)	123 (31.54)	67 (17.18)	5 (1.28)
18.	Water system and quality are poor.	24 (6.15)	201 (51.54)	111 (28.46)	45 (11.54)	9 (2.31)
19.	Air quality is poor.	24 (6.15)	202 (51.79)	119 (30.51)	40 (10.26)	5 (1.28)
20.	The soil is not fertile.	23 (5.9)	207 (53.08)	116 (29.74)	37 (9.49)	7 (1.79)
21.	Agriculturists desire to change their career.	73 (18.72)	233 (59.74)	64 (16.41)	16 (4.1)	4 (1.03)
22.	Agriculturists get older and cannot do all gardening.	15 (3.85)	135 (34.62)	129 (33.08)	88 (22.56)	23 (5.9)

Table 6.3 Attitudes towards fruit tree biodiversity (cont.)

	Attitude	Degree of Agreement				
		Strongly disagree	Disagree	Neutral	Agree	Strongly agree
23.	Labor shortage	21 (5.38)	174 (44.62)	125 (32.05)	65 (16.67)	5 (1.28)
24.	Gardening is dangerous	49 (12.56)	187 (47.95)	98 (25.13)	52 (13.33)	4 (1.03)
5. Lifestyle and wisdom relevant to orchard						
25.	Wisdom is important to agriculturists.	-	7 (1.79)	76 (19.49)	263 (67.44)	44 (11.28)
26.	Growing fruit trees play a major role in agriculturists' ways of living.	1 (0.26)	7 (1.79)	61 (15.64)	283 (72.56)	38 (9.74)
27.	Significant wisdom comes from orchard.	2 (0.51)	10 (2.56)	85 (21.79)	271 (69.49)	22 (5.64)
28.	People in the community had best preserve the local wisdom.	1 (0.26)	8 (2.05)	54 (13.85)	263 (67.44)	64 (16.41)
6. External factors affecting growing fruits						
29.	Market prices force agriculturists to change the species and varieties of fruit trees	11 (2.82)	155 (39.74)	93 (23.85)	122 (31.28)	9 (2.31)

6.2.2 Factors related to the fruit tree biodiversity

The results of multiple regression analysis are presented in the table showing the relations among number of fruit species, number of varieties, the value of diversity, and the value of fruit evenness. They are presented as a model of the relationship among independent variables significantly affecting dependent variables as follows.

Number of Species

Number of Species = -4.9 + 2.07(Brackish water zone) + 3.89(Hometown) + 0.26(Educational level) + 1.36(Savings) + 0.06(Orchard management duration) + 2.26(Supporting organizations) - 3.61(Attitude: Agriculturists earn good income) + 6.13(Attitude: Fruit tree species and varieties preservation) + 3.4(Attitude: Chosen species by agriculturists are better than those from other places) + 1.6(Attitude: Market prices do not force agriculturists to change fruit species)

Table 6.4 Coefficient of multiple regression of fruit tree species and varieties

Independent variable	Coefficient of multiple regression			
	Number of species		Number of varieties	
	b (S.E.)	β	b (S.E.)	β
Water zone (Brackish water)	** 2.07(0.64)	0.15	* 2.18(1.01)	0.1
Hometown (the countries)	** 3.89(1.28)	0.14	** 5.73(2.002)	0.13
Educational level (years)	** 0.26(0.08)	0.16	*** 0.5(0.13)	0.19
Savings (yes/no)	* 1.36(0.62)	0.1	* 2.06(0.98)	0.1
Orchard duration for management (years)	** 0.06(0.02)	0.16	** 0.09(0.03)	0.15
Supporting organizations (yes/no)	*** 2.26(0.62)	0.18	*** 3.69(0.97)	0.18
Attitudes				
Agriculturists earn good income.	*** -3.61(1.07)	-0.16	** -4.98(1.68)	-0.14
Fruit tree species and varieties preservation	** 6.13(2.03)	0.14	** 10.23(3.19)	0.15
The species chosen by agriculturists are better than those from other places.	* 3.4(1.44)	0.11	* 5.18(2.27)	0.11
Wisdom is important to agriculturists.			* 7.8(3.55)	0.1
Market prices do not force agriculturists to change fruit tree species to grow.	* 1.61(0.64)	0.12	* 2.01(1.01)	0.09
(Constant)	-4.9		-18.41	
SE_{est}	5.89		9.23	
N	390		390	
R^2	0.19		0.19	

*p <0.05, **p <0.01, ***p <0.001

The multiple regression analysis revealed that the factors related to the number of fruit species in the orchard are brackish water zone, hometown, educational level, savings, orchard management duration, supporting organization, attitudes towards the notion that gardening can provide good incomes, growing fruits is aimed to preserve their fruit tree species and varieties, chosen species by agriculturists are better than those from other places, and market prices do not force agriculturists to change fruit tree species. These factors can be used to estimate the number of fruit tree species as 19 % at the 0.05 significance level and 5.89 residual standard error (SE_{est}).

According to the regression coefficient of determinants, orchard management duration could best estimate the number of fruit tree species (Standardized beta is 0.18), followed by supporting organizations, educational level and time period for management (Standardized beta is 0.16). Next were water zone, hometown, attitudes towards the notions that growing fruits is aimed to preserve their species and varieties, market prices do not force agriculturists to change fruit species, chosen species by agriculturists are better than those from other places, and savings

(Standardized beta is 0.15, 0.14, 0.12, 0.11 and 0.1 respectively). Based on the equation, factors affecting the number of fruit species were the positive and negative factors corresponding with the study hypothesis as follows.

1) Water zones had different relationship with the diversity of fruit species. According to the equation, the agriculturists who own the orchards in brackish water zone had 2.07 more species than those in brackish and fresh water zones.

2) Agriculturists who had different hometown also had different relationship with the diversity of fruit species. According to the equation, the agriculturists who moved from another province had 3.89 more species than those whose hometowns were in the province.

3) Agriculturists' educational levels had positive relationship with the diversity of fruit species. According to the equation, every 1 year of the agriculturists' educational levels affected 0.26 more species.

4) Savings had positive relationship with the diversity of fruit species. According to the equation, the households with savings possessed 1.36 more species than those who did not.

5) The duration of orchard management had positive relationship with the diversity of fruit species. According to the equation, 1 more year of orchard management duration affected 0.06 more species.

6) The supporting organizations had positive relationship with the diversity of fruit species. According to the equation, households supported by promoting organizations would have 2.26 more species.

7) Agriculturists who had different attitudes towards the diversity of fruit tree species also had different relationship with the diversity of fruit tree species. According to the equation, the details pertaining to attitudes are shown below.

- The households with positive attitudes towards good incomes from orchard possessed 3.61 fewer species.
- The households with positive attitudes towards the aim to preserve the fruit species and varieties had 6.13 more species.
- The households with positive attitudes towards the notion that chosen fruit species were better than those brought from another places had 3.4 more species.

- The households with positive attitudes towards the notion that agriculturists do not have to change fruit tree species because of market price had 1.6 more species.

Number of varieties

Number of varieties = (-18.41) + 2.18(Brackish water zone) + 5.73(Hometown) + 0.5(Educational level) + 2.06(Savings) + 0.09(Duration of orchard management) + 3.69(Supporting organizations) - 0.24(Information acknowledgement) - 4.98(Attitude: Agriculturists earn good income) + 10.23(Attitude: Growing fruits is aimed to preserve fruit varieties and species) + 5.18(Attitude: Chosen species are better than those from other places) + 7.8(Attitude: Wisdom is important to agriculturists) + 2.01(Attitude: Market prices do not force agriculturists to change the fruit tree species)

The multiple regression analysis revealed that factors affecting the relationship with fruit varieties were water zone, hometown, educational level, savings, the duration of orchard management, supporting organization, attitudes towards good income from orchard, growing fruits to preserve fruit species, that choosing species is better than bringing the new ones from other places, that intellect is important to agriculturists, and that market price do not force to change the fruit species. These factors can estimate 19% of fruit species in households at the 0.05 significance level and 9.23 residual standard error (SE_{est}).

According to the regression coefficient of determinants, educational level could best estimate the number of fruit varieties (Standardized beta is 0.19), followed by supporting organization, the duration of orchard management, attitudes towards growing fruits to preserve fruit species, attitudes towards good income from orchard, up-country hometown, that choosing species is better than bringing the new ones from other places, water zone, savings, attitudes towards that intellect is important to agriculturists, and that market price do not force to change the fruit species (Standardized beta is 0.18, 0.15, 0.14, 0.13, 0.11, 0.1 and 0.09 respectively). Based on

the equation, factors affecting the number of fruit varieties were the positive and negative factors corresponding with the study hypothesis as follows.

1) Water zones had different relationship with the diversity of fruit varieties. According to the equation, the agriculturists who own the orchards in brackish water zone had 2.18 more varieties than those in brackish and fresh water zones.

2) Agriculturists who had different hometown also had different relationship with the diversity of fruit varieties. According to the equation, the agriculturists who moved from another province had 5.73 more varieties than those whose hometowns were in the province.

3) Agriculturists' educational levels had positive relationship with the fruit tree varieties. According to the equation, every 1 year of the agriculturists' educational levels affected 0.5 more varieties.

4) Savings had positive relationship with the diversity of fruit varieties. According to the equation, the households with savings possessed 2.06 more varieties than those who did not.

5) The duration of orchard management had positive relationship with the diversity of fruit varieties. According to the equation, 1 more year of orchard management duration affected 0.09 more varieties.

6) The supporting organizations had positive relationship with the diversity of fruit varieties. According to the equation, households supported by promoting organizations would have 3.69 more varieties.

7) Agriculturists who had different attitudes towards the diversity of fruit varieties also had different relationship with the diversity of fruit varieties. According to the equation, the details pertaining to attitudes are shown below.

- The households with positive attitudes towards good incomes from orchard had 4.98 fewer varieties.
- The households with positive attitudes towards the aim to preserve the fruit species and varieties possessed up to 10.23 more varieties.
- The households with positive attitudes towards the notion that chosen fruit species were better than those brought from another places possessed 5.18 more varieties.

- The households with positive attitudes towards the notion that intellect was important to agriculturists had 7.8 more varieties.

- The households with positive attitudes towards the notion that agriculturists do not have to change fruit species because of market price had 2.01 more varieties.

Table 6.5 Coefficient of multiple regression of fruit tree diversity and evenness

	Coefficient of multiple regression			
	The value of fruit tree diversity (H)		The value of fruit evenness (E_h)	
Independent variable	**b (S.E.)**	**B**	**b (S.E.)**	**β**
Water zone (Fresh water)			** 0.01(0.004)	0.14
Water zone (Salt water)	* -0.15(0.07)	-0.1		
Savings (yes/no)	*** 0.08(0.02)	0.16	** 0.01(0.003)	0.14
Orchard management duration (year)	* 0.002(0.001)	0.12	** 0.003(0.0001)	0.14
Area (rai)	*** 0.01(0.002)	0.2		
Supporting organization (yes/no)	** 0.07(0.02)	0.15	** 0.01(0.004)	0.14
Successor (yes/no)	* -0.05(0.02)	-0.1	* -0.01(0.003)	-0.11
Information acknowledgement (score)	* -0.01(0.003)	-0.13	** -0.001(0.0004)	-0.15
Attitude				
Working as agriculturists is independent.	** 0.25(0.1)	0.12	* 0.03(0.01)	0.1
Intellect is important to agriculturists.	* 0.22(0.09)	0.12	* 0.03(0.01)	0.1
Market prices do not force the agriculturists to change fruit tree species.	* 0.06(0.02)	0.12	* 0.01(0.004)	0.13
(Constant)	0.93		0.16	
SE_{est}	0.22		0.03	
N	390		390	
R^2	0.2		0.15	

*p <0.05, **p <0.01, ***p <0.001

The value of fruit tree biodiversity

Fruit tree biodiversity = 0.93 – 0.15(Water zone) + 0.08(Savings) + 0.002 (Orchard management duration) + 0.01(Area) + 0.07(Supporting organization) - 0.05(Successor) - 0.01(Information acknowledgement) + 0.25(Attitude: Working as agriculturists is independent) + 0.22(Attitude: Wisdom is important to agriculturists) + 0.06(Attitude: Market prices do not force the agriculturists to change fruit species)

The multiple regression analysis revealed that factors affecting the relationship with the value of fruit tree biodiversity were water zone, savings, the duration of orchard management, area, supporting organization, successor, the frequency of agricultural information acknowledgement, attitudes towards the notion that working as agriculturists is independent, that intellect is important to agriculturists, and that market prices do not force the agriculturists to change fruit species. These factors can all estimate 20% of fruit tree biodiversity in households at the 0.05 significance level and 9.23 residual standard error (SE_{est})

According to the regression coefficient of determinants, the width of the area could best estimate the index value of fruit tree biodiversity (Standardized beta is 0.2), followed by savings, supporting organization, agricultural information acknowledgement, the duration of orchard management, attitudes towards the notion that working as agriculturists is independent, that intellect is important to agriculturists, and that market prices do not force the agriculturists to change fruit species, water zone, area, and successor. (Standardized beta is 0.16, 0.15, 0.13, 0.12 and 0.1respectively). Based on the equation, factors affecting the fruit tree biodiversity were the positive and negative factors corresponding with the study hypothesis as follows.

1) Water zones had different relationship with the diversity of fruit species and varieties. According to the equation, the households in salt water zone had 0.15 less fruit tree biodiversity value than those in fresh and brackish water zones.

2) Savings had positive relationship with the diversity of fruit species and varieties. According to the equation, the households with savings had 0.08 more fruit tree biodiversity value than those without savings.

3) Agriculturist management duration had positive relationship with the diversity of fruit species and varieties. According to the equation, every 1 more year of the orchard management duration affected 0.002 fruit tree biodiversity value.

4) The areas of agriculturists had positive relationship with the diversity of fruit species and varieties. According to the equation, every 1 more rai of area affected 0.01 diversity value.

5) Supporting organizations had positive relationship with the diversity of fruit species and varieties. According to the equation, the households supported by promoting organizations had 0.01 more diversity value than those who were not.

6) Successors had positive relationship with the fruit tree species and varieties. According to the equation, the agriculturists who had successors for gardening had 0.05 less diversity value.

7) The frequency of agricultural information acknowledgement of agriculturists had positive relationship with the diversity of fruit species and varieties. The equation disclosed that information acknowledgement had negative relationship, every 1 more level of information acknowledgement of the households affected 0.01 less diversity value.

8) Agriculturists with different attitudes would reflect different relationship towards the diversity of fruit species and varieties. According to the equation, the details regarding attitudes are shown below.

- The households with the positive attitudes towards the notion that growing fruits was independent possessed 0.25 more diversity value.
- The households with the positive attitudes towards the notion that intellect was important to agriculturists possessed 0.22 more diversity value.
- The households with the positive attitudes towards the notion that market prices did not force agriculturists to change the fruit species had 0.06 more diversity value.

The value of fruit evenness

Value of fruit evenness = 0.15 + 0.01(Fresh water zone) + 0.01(Savings) + 0.003(Orchard management duration) + 0.01(Supporting organization) – 0.01(Successor) – 0.001 (Information acknowledgement) + 0.03(Attitude – Growing fruits is independent) + 0.03(Attitude – Agriculturists are proud of their career) + 0.01(Attitude – Market prices do not force agriculturists to change the fruit tree biodiversity)

The multiple regression analysis revealed that factors relevant to the value of fruit evenness were water zone, savings, the duration of orchard management, the area of the orchard, supporting organization, successor, the frequency of agricultural information acknowledgement, attitudes towards the notion that working as agriculturists is independent, that intellect is important to agriculturists, and that the agriculturists were proud of their career. These factors can all estimate 15% of fruit evenness in households at the 0.05 significance level and 0.03 residual standard error (SE_{est}).

According to the regression coefficient of determinants, the frequency of agricultural information acknowledgement could best estimate the value of fruit evenness (Standardized beta is 0.15), followed by water zones, savings, the duration of orchard management, supporting organizations, attitudes towards the notion that market prices do not force the agriculturists to change fruit species, successor, attitudes towards that growing fruits is independent, and that working as agriculturists is secured (Standardized beta is 0.14, 0.13, 0.11 and 0.1 respectively). Based on the equation, factors affecting the fruit evenness were the positive and negative factors corresponding with the study hypothesis as follows.

1) Water zones had different relationship with the fruit evenness. According to the equation, the households in salt water zone had 0.01 more value of fruit evenness than those in fresh and brackish water zones.

2) Savings had positive relationship with the fruit evenness. According to the equation, the households with savings possessed 0.01 more value of fruit evenness than those without savings.

3) Orchard management duration had positive relationship with the fruit evenness. According to the equation, every 1 more year of management affected 0.003 more value of fruit evenness.

4) Supporting organizations had positive relationship with the fruit evenness. According to the equation, the households supported by promoting organization had 0.01 more value of fruit evenness.

5) Successors had positive relationship with the fruit evenness. According to the equation, the households having successors had 0.01 more value of fruit evenness than those without successors.

6) The frequency of agricultural information acknowledgement had negative relationship with the fruit evenness. According to the equation, the households which acknowledge more agricultural information affected 0.001 less value of fruit evenness.

7) Agriculturists with different attitudes would reflect different relationship towards the fruit evenness. According to the equation, the details regarding attitudes are shown below.

- The households with the positive attitudes towards the notion that growing fruits was independent possessed 0.03 more value of fruit evenness.
- The households with the positive attitudes towards the notion that agriculturists were proud of their career had 0.03 more value of fruit evenness.
- The households with the positive attitudes towards the notion that market price did not force agriculturists to change the fruit species had 0.01 more value of fruit evenness.

6.3 Analysis with mind mapping

According to the study as well as data analysis from literature review and field work in Samut Songkhram, the mind map is then presented in details as follows:

6.3.1 Factors affecting the fruit tree biodiversity based on qualitative data analysis



Figure 6.1 Mind map presenting factors at household level quantitatively affecting the fruit tree biodiversity

6.3.2 Factors at community level affecting the fruit tree biodiversity based on qualitative data analysis



Figure 6.2 Mind map presenting factors at community level quantitatively affecting the fruit tree biodiversity

6.4 Discussion and conclusion

6.4.1 Overall trend of local fruit trees in Samut Songkhram

The overall study from the past until the present showed that the agriculturists had encountered many experiences, e.g. monoculture plantation, applying harmful chemical substance, and changing fruit species. All these experiences reflected current and future trends of agriculture including the change in strategies of agricultural sectors as appearing in the 10th economic develop plan to drive the development of the biodiversity and to sustain natural resources as well as environment. This still encouraged agriculturists to use less chemical substance, concern about food and health including resource management, the variety of communities, the revival of knowledge, intellect, plus the certain culture based on the ecosystem. It was to make us more realize the villagers' potential along with their roles. The revival of the natural resources and the local fruit varieties preservation which were affected to the provincial strategies encouraged agriculturists nowadays to be more aware of the significance of growing varieties of fruits depending on the soil conditions. Doing all these could yield benefits to the living organisms including agriculturists themselves.

Based on the pattern of the orchards, agriculturists regularly grew perennial plants according to the level of canopy with some annual plants to moisturize as well as shade the plants. Agriculturists also continued growing the new plants or replaced the less productive old plants and did other dynamic management. Additionally, the areas, time, and the use of the land for agriculture should be adapted for other usage. However, for some agriculturists, economic plants which were mainly grown were slightly changed since the plants took time to bear fruits; for local fruit plants, agriculturists did not expect much productivity because the plants were rare, grown for household consumption, and for souvenirs. Those plants were all local and offered shade. Generally, the local fruits with poor flavor and less productive were then replaced with new species continuously modified for better flavor and more productivity. Moreover, the other benefits of fruit plants were more neglected, e.g. being herbs, since most of the people cured the disease with medicine form hospital. This led to the extinction of these fruit plants.

Nowadays, the economy, society, and lifestyles of agriculturists had been changed in accordance with the modern society. Nevertheless, they all were still remained and adapted somewhat depending on the majority's professions, the existence of agriculture, and ecotourism. This province currently was well-known as one of the attractions where lots of tourists came to visit during the holidays. Hence, this had certainly affected the consumption and the garbage becoming the burden of the people in the province. Nonetheless, tourism had brought the local people incomes leading to the convenience of transportation. The local people's ways of living had changed to support tourism as well as investment of some investors or of local people themselves in the bright future. These changes offered the local people two choices: either keeping their own land or selling them for money as the returns. Most of the agriculturists decided to keep their pieces of lands for their descendants and continued their gardening. According to the economic model, the society involved in tourism had then altered the ways of living of the people in Samut Songkhram, influenced the orchard areas near the tourist attractions and also influenced the people's ways of living in modern society to comply with their own management integrated with the support from government sectors.

Most of the agriculturists in Samut Songkhram still growing fruits were the local people whose most of their life was spent in orchard. They were, therefore, rather old. Their families were small and medium as well as their orchard areas according to the subdivision system. By the way, the orchards in Mueang District, Amphawa District and Bang Khonthi District were obviously larger, and the labors were mainly 1-2 people of the parent generation. The employment would happen only for harvesting coconuts and lychees or for groove lifting – the main activities in gardening – according to the agriculturists' employment capacity which was once or twice a year averagely. Groove lifting was considered as the activity to welcome the new year of gardening. Fruit plants would receive the fertilized soil lying down under the stream along the groove throughout the whole year. The water would flow more conveniently leading easier approach to water of plants. Groove lifting once a year was labor saving and also budget saving since the expenses depended on the amount of soil including the amount of time the agriculturists had neglected their lands annually. With the primary education level, and experience of gardening throughout

their lives, the agriculturists then had gradually learned, experienced and perfectly understood the environment, the orchards, and how to select the appropriate plants to grow.

Moreover, fundamental characteristics of the lands and temperature in the present affected the inconsistency of productivity. The agriculturists then were more careful about the capital for the maintenance of growing fruits such as fertilizer and other chemical substances which affected the cost and worthwhile. They also concerned about modifying fruit species and varieties in the near future based on the weather condition influencing the productivity of all species. This reflected their inconsistent incomes and expenses. In the past, the consistence incomes as well as the governmental supports had inspired the agriculturists to enlarge their agriculturists to grow more fruit plants such as pomelos, lychees, mangoes, and etc. while uncomplicated maintenance and reasonable price had been the reasons why the agriculturists still grew coconuts. Yet, despite the high price of produce in the present days, the plants inconsistently bore fruits which were not worth investing when considering the labor wages and other expenses.

Nowadays, the booming of tourism had brought other supporting factors. Concerning the importance of the unique intellect such as sugar producing had revived the safe consumption of sugar. This led to the increase of growing coconuts for sugar. According to the study of Prapa Kongpanya and Asst. Dr. Wanika Benchapong (2004) about the assembly of agriculturists who concerned about the health of coconut sugar consumers and produced brown sugar without sodium hydrosulfite. At the beginning, only small amount of brown sugar could be sold since the consumers' demand for white sugar produced by using sodium hydrosulfite. But with righteousness, those agriculturists then produced pure sugar in spite of higher manufacturing cost. They had to use large amount of good quality sugar palm sap and simmer it until it became dry enough so that it would not change color and could be kept consistent. The cluster of these agriculturists attempted to preserve the original sugar production. Only little granulated sugar were utilized to help the sugar palm sap became dry, easy to shape, and to maintain its flavor. By doing so, the value and the production of pure coconut sugar were still preserved.

Due to the market demand and consistent sugar price, a simmer in household still existed. However, sugar simmers at factories were also increasing. Moreover, the spreading of leaf beetle, the pests destroying coconuts in southern provinces, the increase of capacity for product processing had increased the coconut price up to 20 baht each. Since the end of the year 2009, the increasing coconut price became one of the factors affecting growing coconuts besides the cost of the orchard maintenance as usual.

Productivity and fruit prices were only some parts having an effect on the agriculturists' decisions. Other factors should have been concerned such as orchard allocation based on the water systems, the size of the orchards, and the pattern of growing fruits based on relevant factors. Considering all these mentioned factors, the lower parts of Mueang District which were within salt water zones and had limited areas were connected to Bangkok. The orchards in these modern parts of Mueang District tended to disappear because of the change of society nearby. Of course, this led to the extinction of the fruit species and varieties which could be grown in the areas. Moreover, the tourism would boost the land prices which encouraged local people to sell their lands. Still, the land to be loved or realizing the importance of land preservation also increased. The climate of love surrounded sustainable and sufficiency agriculture encouraged by specialists as well as the president of fruit cluster made the orchards in the upper parts of Mueang District and Amphawa District be still preserved and protected. The medium size of the orchards, the brackish – fresh water zones, mixed gardening, and experience of monoculture plantation all affected the proportion of the changing fruit plants in the orchards at the household level. The current species and the varieties were still preserved as only few of them caused problems to fruits in some areas. There were still other kinds of fruits supporting the problems of economy, markets, and price.

The change related to fruits directly resulted from the climate change such as lychees, etc. was closely concerned in Bang Khonthi District where there were more monoculture plantations than Amphawa District and the upper dictrict – Mueang District which located in fresh water zones. Besides coconuts, sugar palm and young coconuts, 35% of the areas in Bang Khonthi District. This would change if the agriculturists did not earn enough and satisfying incomes to compare with their annual

expenses year after year. However, government sectors did not neglect. They tried to solve the problems and attempted to support the produce problems. Still, it was not certain how long they could help as the coconut price continued increasing. Perhaps, the agriculturists would change to grow only coconuts and would this lead to oversupply problem and decreasing prices in the future or not? The mistakes would be repeated and at that time no one could help the agriculturists except the agriculturists themselves. This issue needed some measures from government and the collaboration among fruit growers, government sectors, markets and consumers. Anyway, according to the interview, the agriculturists still hoped the produce in the next years and they felt regret to the fruit plants having been grown for a long time even though they said they would cut them all for firewood if they bore fewer fruits.

6.4.2 The trend of wisdom of orchard in the province

To reconsider about the meaning of intellect, it meant the local knowledge which occurred from relation between human beings and orchards in the aspects of learning, interdependent living and problem solving in ways of living of local people which would be transferred to the next generations. This knowledge or intellect also well reflected the life and living conditions of local people. Currently, the intellect of fruit production from growing until harvesting that the agriculturists accepted and followed were, for example, grove lifting, applying organic fertilizer, moss emerged around the mud , smoked vinegar, and burning charcoal. However, the use of technology with the intellect was increasing according to the factors of the orchard areas, labors, expenses, increasing age. The shortage of labor from people in and out of households should be concerned because the knowledge from parents and grandparents could not be transferred to the next generation. Due to the uncertainty of the situations, financial guarantee should be kept for the future. The value of financial status, the hope that their descendants would get good jobs so that the lives would not be as tough as theirs in the past, the agriculturists then supported their own descendants to have higher educational level in uptowns. So, there were only few chances that those descendants would return home at working age. The gap of the readiness in sending and receiving the useful intellect became bigger. As you can see in this day and age in Samut Songkhram during weekdays, there were only young

children ad elderly persons at homes and people at working age would return home during weekends only. This could lessen the infatuation between them and orchard. But when they return at the old age, there might be obstacles to learning the orchard management and intellect. Moreover, neglecting orchards, orchard modification, and selling the orchards to outsiders were also the major problems. Mr. Yongyut Nuamsuwan, a pomelo grower stated that,

"*In the near future, we might need to import the fruits abroad for our consumption which we need to buy only little since the people in the next generation might not grow fruits anymore. My generation would turn to be the history and pomelos (Khao Yai species) would not be found any longer. Our lives are not that tough today because the expenses are not that much. In the present days, we can eat kilos of rambutans while people in foreign countries can have little. Similarly, they can eat little of durians while we can eat many. This is because our lands are still fertile. But in the last few years, agriculturists haven't taught their children the useful knowledge or the intellect because they all go to school and go to work.*"

According to the statement above, it reflected that the agriculturists concerned their orchards and their descendants who would be the consumers in the future. The situations of each households were similar, i.e. that the agriculturists divided the orchards and gave to each of their descendants as legacy would absolutely lessen the size of the orchards, the number of orchards as well as the number of agriculturists. From these concerns, the new generation of agriculturists then tried to promote, support, and implement continuous activities to make the local fruits satisfying and attractive with reasonable prices. They all hope that their descendants would realize this importance and follow the gardening and wisdom gathered by the parents.

6.4.3 Relevant research

The study finding that the range of number of fruits that the agriculturists chose to grow the most were 11 – 20 varieties were compatible with the study by Sumontha Prombun, et al (1999) on the experiment of multi-storeyed cropping which found that growing 16 species of fruits could provide the most produce. In dry seasons, the areas with the most fruit species affected the produce only 25% and they

could be revived in shorter period of time to compare with those with the least species. Next, the studied range of 1 – 10 species was compatible with the study by Sujit Wongtat (2008). Sujit Wongtat stated that the agriculturists who had large orchards would grow only one species such as lychees, pomelos, betel palm, betel vine, and etc., but those who had small orchards would grow many species together in their orchards as we called them "mixed forest"

Regarding the relationship qualitatively affecting the fruit tree biodiversity, factors considered having overall relationship were water zones, hometown, educational level, savings, the time period for orchard management, the width of orchard areas, promoting organizations, successors, and the frequency of agricultural information acknowledgement. Additionally, the attitudes involved were the attitudes towards 1) gardening provided good income 2) growing fruits was to preserve the fruit species and varieties 3) chosen species are better than those from other places 4) wisdom is important to agriculturists 5) Gardening is independent 6) agriculturists are proud of their career and 7) market price do not force the agriculturists to change fruit tree species.

The study on factors affecting the fruit tree biodiversity were compatible with that of Ben Ja Somprakob (2005) on the evaluation of plant species preservation project which found that educational level had significantly relationship with fruit tree biodiversity. It was also in accordance with the conservative study on the life styles and the use of natural resources of Mong Tribe in Chiangmai conducted by Wutthichat Sriphaphlern (2002) which studied the behaviors in natural resource preservation. It found that educational level had positive relationship with forest and soil preservation behaviors. The study on the duration for orchard management was compatible with the study by Surayud Limtrakul (2001) which found that the living time period and the use of community forests were the factors with statistically significance affecting the collaboration among the people to preserve natural resources and the community forests in Huay Sa-Phan Village.

As Gordon W. Allport (as cited in Pitsamai Wibulswasdi, 1985: 81) said that attitudes were mental conditions which prepare a person to always respond to the environment. Experiences would define the direction for each person and urged that person to respond to relevant objects and events. The study result on the attitudes was

in accordance with the research result by Pinyaporn Penpinan (2001) of the information acknowledgement, realization, attitudes, collaboration for environment preservation among people at Bangpoo industrail estate in Samutprakarn. It discovered that attitudes towards the environment preservation had positive relationship with the collaboration for environment preservation. The study on information acknowledgement having negative relationship was compatible with the study by Summanus Meepian (2001) on the roles and factors affecting the coral resource preservation of local fishers in Koh Samui, Surat Thani which found that the perception about the coral and knowledge of the coral does not affect the role of coral reef conservation, attitudes towards the conservation of coral reefs as one variable affecting the role of coral reef conservation statistical significance. According to the factors of perception of agriculture to understand the importance of channels of learning on the diversity of the fruit. Meanwhile, the channel or media have focused on product promotion or only on the economy, resulting in the diversity of fruits decreased. Including information and knowledge may not be applied to all areas. Thus, in aspects of conservation, a variety of fruits and intellectual environment of the region should focus on channels of learning, derived from ancestors, the community, scholars in the area and finally a farmer's own experience or attitude towards the concept of market factors and fruit consumption in the household and the market does not affect the changes are consistent with the studies by Bhag Mal, et al (2011) which studied on the preservation and sustainable use of fruit biodiversity in Asia. They showed that the characteristics of economy and society of agriculturists in tropical zone and market-based mechanisms played a key role in the agriculturists' decisions in modifying their orchards to be more preservative and in compatible with sustainable ways of living.

CHAPTER VII
CONCLUSIONS AND RECOMMENDATIONS

From the overall study of biodiversity, this part concluded from the study presented in the form of discussion relating to recommendations to the points of view and attitudes of researcher after a field trip with farmers who cultivate fruit crops. Following to the objectives of the study viewing through relating factors: culture in community level; and socio-economy in household and in community level.

7.1 Conclusions

According to the fact that Samut Songkhram has 416.707 square kilometers (260,442 rais), which is considered as the smallest area in Thailand, as coastal wetlands, and as the area possesses the number of population ranking in the 75th of the country. In addition, due to the fact that such area is located near the sea, it consequently results in humid and exact climate. As a main blood vessel, Mae Klong River is a main resource flowing from Bang Khonthi District to the Gulf of Thailand in Mueang District. There are up to 366 canals along with others, facilitating in a combination of fresh and salt water under the influence of tidal flow throughout the province which is suitable for agriculture since the ancient time. With some passing events, those has affected in some changes that supporting the agriculturists' need such as modification of the structure, method, as well as species and genes which are suitable for the environment and the situation at that time. Way of life and intellectual of fruit gardening as well as plantation patterns, selection and preservation of species in the study area which are related to the objectives in number 2, agriculturists at the present have adjusted their way of life and orchard management in accordance with the changes in environment by urbanization and the travel industry introducing into this area.

In the area management, groove lifting has also been recognized nowadays and been being likely to be used in the future. Groove lifting would help alter from the

flood plain into the orchard which somewhat water level can be controlled and the salt water can be prevented. However, normally when flood immerses and the water level is higher than the orchard plot, it will cut off the outbreaks cycle and a number of insects each year which is beneficial to the agriculturists. Despite the dam built and such construction cut short the flooding duration, the agriculturists still maintain this kind of plantation in order to prevent and to support the water level from continuous raining. This also helps circulate the water flow throughout the area. Apart from own management intellectual, it displays the wisdom of the past that benefits to the agriculturists across the province as well.

In the management of species, there are factors in agriculturists' consideration: size of land in ownership; suitability of the area, water system, support from the government sector, and ability to handle things of the agriculturists. In marketing or pricing, most agriculturists thought that the fluctuation in price of fruit in the market has no effect to the changes of the genes and the species cultivated in the orchard because the agriculturists know the tendency of changes in price from their experience in gardening such as growing duration would take a long time from the beginning step until the last yielding, the agriculturists have changed the structure to be suitably applied with the area, and the management of fruit category to marketing problem suffered from mono crop crisis. The agriculturists mostly manage the area for the industrial crops for households by distinguishing plot separately, along with biennial plants or the specific species and genes that the agriculturists need to reserve around the orchard plot, between the main plots or around the house. The variety of planting secondary plots benefits in, directly that, the agriculturists have fresh and clean fruits consumable in their own households, and having extra earnings during main-plot harvesting season. Moreover, for indirect effect, having benefit towards the ecosystem in the orchard in that such way allows the moisture inside and concealed lighting to the baby fruits. It also reduces the heat derived from the variability of climate at the present, and decreases an erosion of top soil, along with provides a lot of benefits in other aspects.

In taking care of the crops until harvesting derived from the combination of wisdom from the past with the exchange of information among the agriculturists in the same area, academic information, technology supported by the government sector,

agriculture officers, outsource learning from other orchards, television programs nowadays which much effectively influences on the agriculturists, policies and the key strategies on the use of organic fertilizers or the reasonable use of chemicals in planting, soil padding -- natural fertilizing process succeeded with ridge orchard, charcoal burnt, wood vinegar, Khi-Dad-Na-Gluer -- the way to prevent insects after mowing, also the study form the past which emphasizes on the exceeding use of chemicals which has the bad effect to the plant, human, and environment. Such study helps provide acknowledgement in taking care of nature depending on the category and the species of fruits. The preservation of natural environment also supports one another. From the concept of sustainability in helping each other, not only the diversity of species and genes, but also the variety of the way of taking care that is the other significance. It is illustrated that human needs the variety of food for consumption, so do the fruits. From such statement, it exemplified human daily life to help get the clearer picture. At the present, the climate is rapidly changing and affecting to the main crops and uncertain income. Nevertheless, extra earning from the food processing, the intellectual from their ancestors, are another ways to help the agriculturists survive in such crisis by applying in, for example, baking, food preserving, adapting the leafs from some kinds of fruit as a food container among the agriculturist wives club, making ornaments, carving and making up a Thai traditional fiddle that is rare, unique and worth preserving in Samut Songkhram.

From the study of primary and secondary fruit plantation cultivated among the 3 districts, 390 households, it follows the objectives in number 1, that is, to study the varieties, species and ecosystems of fruit trees grown in the sampling area which has a total of 33 families, 56 genera, 68 types and 282 species, mainly is the woody plants, whose genes derived from 158 regional fruits and 124 exotic or new fruits. This shows that the proportion of the new genes into the area has similar amount to regional fruits in Samut Songkhram. However, when considering the overall selection of the growing numbers of households in the area, regional fruits were selected in households.

The fruits that are significant to the economy and more than 40% of most agriculturists have cultivated include coconut, followed by banana, mango, pomelo, papaya, and lychee. Most of the indigenous fruits the agriculturists mostly grow are

rose apples, star gooseberry, chammaliang, and pomegranate. The fruits that less than 10% of the agriculturists have cultivated are durian belanda, bael fruits, Indian gooseberry, nutmeg, Leech lime, takona, champada, zalacca, passion fruit, chestnut, Verbenacea, Philangkasa, Murobalan wood, watermelon, palmyra, date palm, wild apple, Yi, persimmon, and takhobpa. And varieties of fruit that agriculturists in the area held an average of 12.40 to 16.96 species and genes, respectively.

About the variety shown in a diversity index and an evenness of fruits is categorized into 4 parts:

1) **Province level**: a diversity index and evenness equal to 1.6 and 0.13 respectively.

2) **District level** which is divided into the following categories:

- Mueang District: a diversity index at 1.73 and evenness at 0.17
- Amphawa District: a diversity index at 1.64 and evenness at 0.15
- Bang Khonthi District: a diversity index at 1.43 and evenness at 0.13

3) **Water zone level**

- All freshwater area in Bang Khonthi: a diversity index at 1.43 and evenness at 0.13
- Brackish water area: a diversity index at 1.69 and evenness at 0.15
- Freshwater area: a diversity index at 1.1 and evenness at 0.15

Household Level: An average of diversity index and evenness of fruit species equal to 1.49 and 0.21 respectively.

The study of diversity index and evenness value in the district level, Mueang District possesses the highest value, followed by Amphawa District. The area of the water zones, brackish water area with the highest value, followed by fresh and salt waters of the diversity and uniform across the four sections can be seen that the value is not high because orchards are managed by men. Proportion of fruit from the main and minor differences clearly or uneven distribution which cannot be compared with the wild plant communities but led by a 1.5 basis in the related trade in tropical crops (Kent and Coker, 1996 as cited in Wisoot Srisanguan, 2008) used the break in the household.

The socio-economic at household level that affects a variety of fruit in a quantitative objective in number 3, that is, to determine the factors that affect the agriculturists' family. In conserving species and genes, it has been found that factors that are correlated with variables and related to biodiversity are the number of species, genes, diversity index and evenness of water zone, origin, educational background, saving money, management duration, area size, supported sectors, successor, and frequency of provision of agricultural information. For relating attitude are: 1) attitudes about growing fruit because of good income; 2) attitudes about growing fruit to maintain species and varieties; 3) attitudes about the selection of varieties by agriculturists than imported from the other areas; 4) attitudes about knowledge are important to agriculturists; 5) Attitudes towards planting orchard is independent; 6) Attitudes about professional pride to the working in the orchard; and 7) attitudes about the price in the market prices do not force agriculturists to change fruit species. All of the factors are the prediction of the quantity of genes, species, diversity index and evenness as 19, 19, 20, and 15, respectively. Management duration and educational background are effectively used for calculating the species and varieties. And the area is used for calculating diversity index and evenness.

The study shows the relationship between economic factors that affect the treatment of fruit tree biodiversity in the agricultural sector in the household, which can affect the level of provincial and national factors that have a relationship. Both positive and negative factors can be applied in the conservation of fruit tree biodiversity, or in considering policies and strategies to prevent the extinction of the fruit in the agricultural sector.

7.2 Recommendations

7.2.1 Recommendations for future areas of study

Due to the readiness of Samut Songkhram, guidelines for conservation of fruit tree biodiversity in many areas_are to look for more cooperation on the policy from the province, government sector and agriculturists as detailed below.

7.2.1.1 The recommendation in conservation of household fruit orchard

- Study the history of the area as well as history related to the orchard. Explain the story to the descendant to know and to understand the importance of the orchard from the past to the present time as well as to take a note of changes of the land under the ownership.

- Study, maintain and retain the detailed intellectuality related to fruit orchards, starting from the landscape characteristics, the appropriate management, planting, fruit supervision, diseases and insect protection, the harvesting as well as various processed products which are available in households of agriculturists.

- Due to problems in the governmental budget. Therefore, the way of how to take care of the orchard by the agriculturist is interested and concerns with the capital management which is processed by the way of experiment in order to exchange the information among the agriculturists to the advantages and disadvantages, making them as a part in the development of wisdom and benefits to the orchard as a whole.

- The agriculturists should plant various fruit trees because they cannot determine the exact cost of the production. Planting a variety of fruit trees that are appropriate in the area and suitability for growing together can result in a revenue increasing. Another profit is that to reduce costs within the orchard and to reduce household expenses, resulting in the increasing savings for the agriculturist

- Commitment to the plantation of fruit according to natural principal or the use of chemicals suitable for the fruit species and the amount of used in order to the safety of consumers and agriculturists themselves in which some agriculturists may be confused by the incentive effects of chemicals or its excessive use.

- When agriculturists have to modify the area to be applied with the other purpose, not only as the orchards, such as a homestay and so forth. They should pay attention to the features of such area and adjusted to an appropriate sustainable.

- Conserve the typical fruit tree of no economic importance and data storage of all species and all varieties of fruit trees in the household in order to be useful in data collection.

- Explain the method of fruit selection or of fruit consumption in each season for the consumers with no knowledge of the fruit to help them understand the nature of the fruit that is either important or not important to the economic.

- Promote the importance of orchards with the variety to the next generations to understand the value and other benefits rather than just only in the form of money.

- Promote local agriculturists of typical fruits consumption without focusing much on their flavor such as jambolan and local Thai wild berry due to the fact that they are useful in many aspects such as health benefits as well as the diversity of fruit trees in orchards of the agriculturists and others.

7.2.1.2 The recommendation in the conservation of the orchard conservation to the community

- Explore the species and variety of fruit trees, the position of households in the area and also other benefits in order to understand the present situation of fruits very clearly to prevent their extinction of both current and future time.

- Enhance the promotion on the conservation of the diversity of typical fruit trees that do not have economic importance in accordance with the factors affecting the variety of fruit which is the promotion agencies.

- Provide knowledge and understanding of the value and the benefits of biological diversity by region and clearly stated the time or season in order to a positive attitude towards the conservation of fruit trees along with the orchards through the intensive observation with the local agriculturists who can deal with the orchard management appropriately for a long while. Study the local wisdom and build up the atmosphere of love of home, considered as the good example of conservation based on factors that are consistent with the research.

- Promote the descendants to be educated in the current circumstance, combined with the knowledge of the importance of wisdom from the ancestors, from the agriculturists, or even from the local scholar in order to create a positive attitude to the descendants, considered as one of factors that are important to affecting the variety of fruit trees in the area.

- Support the agriculturists to participating with the others to strengthen the orchard today.

- Promote the agriculturists to join the conference or a visit of local biodiversity in order to create a positive attitude towards the agriculturists as factors in attitude and perception in agricultural news that affect a variety of fruit trees.

- Create the value to species and variety of typical fruit trees that do not belong to a group of main ones, and also to the market or public relation place in order to announce the knowledge associated with the local fruit trees with low population and endangered species nowadays

- Create understanding and consideration to the ecosystem in the area, optimizing to the capitalist or the outsiders who just move into by requesting assistance in the area management in order to sustain the overall ecosystem of the province to be still conducive to plantation agriculture and the orchard properly.

- Promote the holding of event of the typical fruits of either important main economic activity promotion as key. In order to conserve indigenous fruit trees in a local decrease in the Samut Songkhram to the next.

7.2.1.3 The recommendation in the conservation of the orchard conservation to the public

Study the importance of the typical fruits such as health benefits in terms of herbs, weird physical appearance with rarely-to-be-found feature. Such characteristics are appropriate to the area or the seasonal fruit consumption and the values adjustment of consumption of fresh of fruit rather than focusing on shell or skin of fruit in order to reduce chemical use, the construction or the modification of the areas should be studied. And consider the topography of the area beforehand to adjust the appropriate result after the building the construction of the modifying the surrounded area and lastly not to interfere negatively on the overall area.

7.2.2 Research recommendations

Apart from the factors of the study, the folkway and the wisdom which all affect to the biodiversity of fruit tree species, the characteristics of area in terms of the rental cost would last to the cost in finance that would bring about the amount of fruit in total. Not only that, but also the usage of chemical element without cautiousness

will defect the area in long term. The study of ecosystem in every aspect also can enhance the understanding in biodiversity.

- The additional study of the non-native fruit or insects which take the role over the cultivation areas such as outside bee help with pollination of lychee.
- The assessment study of proportion in diversity among fruits and other plants for agriculturists in the current situation
- The adaptation of orchard towards the unevenness of weather
- The change in the pattern of orchard according to socio-economic development

REFERENCES

Aaporn Chansomwong. (1998). Thai way of life and orchards in the context of development: a case study of a community of the agriculturist at Samut Songkhram Province. Thesis of Master's degree in Science. Technology of Environmental Management. Graduate Studies, Mahidol University.

Agricultural Products Group Bureau of Trade General. (2008). The situation of fruit: Statistics of January - June 2008. A group of agricultural products. Bureau of general trade. Access to information from: http://www.dft.moc.go.th. (Access on April 8, 2009).

Agriculture Office, Samut Songkhram Province. (2007). Information of Economics and Marketing. Provincial Commercial Office, Ministry of Commerce. Accessed at: http://www.samutsongkhram.go.th. (Accessed on February 8, 2009).

Agriculture Office, Samut Songkhram Province. (2009). Economics Information and Marketing. Provincial Commercial Office, Ministry of Commerce. Accessed at: http://www.samutsongkhram.go.th. (Accessed on February 8, 2009).

Agriculture Office, Samut Songkhram Province. (2010). Important Agricultural Information in the year of 2009. Provincial Commercial Office, Ministry of Commerce. Accessed at: http://www.samutsongkhram.go.th. (Accessed on March 3, 2010).

Ampol Senanarong. (1990). The Seminar on "Decade of Plant Conservation," "Why Plant Conservation should take palce" on July 26 to 27. Coordination Committee of Plant Genetic Resources.

Anchana Kaewchei and Malee Kuwarakul. (2000). Factors Affecting Household Savings. The research unit on the household agricultural, orchard management and production factors, Bureau of Agricultural Economic

REFERENCES (cont.)

Research. Access to information from: http://www.oae.go.th/model/ Malee/saving.htm. (Accessed on May 8, 2009).

Ben Ja Somprakob. (2005). An Evaluation of the Plant Conservation Project, Rajamangala Institute of Technology: a case study of areas of Moo 5 and 6, Pluang subdistrict, Khitchakut subdistrict, Chanthaburi Province. Master of Public Administration, General management, Burapha University.

Bhag, Mal. V., Ramanatha Rao. R.K., Arora. Percy, E. Sajise. and B., R. Sthapit. (2011). "Conservation and Sustainable Use of Tropical Fruit Species Diversity: Bioversity's Efforts in Asia, the Pacific and Oceania" Indian Journal of Plant Genetic Resources. 24 (1): p18.

Biodiversity-Based Economy Development Office. (Public Organization). (2010). Bioresources Information. Access to information from: http://www.bedo. or.th/lcdb/biodiversity/. (Accessed on September 15, 2010).

Boonpan Kamchaimun. (2004). Treaty signed under the FAO Thai, dreaded loss of food sovereignty. Accessed at: http://www.thaico.net/b_pnews/47010600.htm. (Accessed on 8 November 2008).

Chai Potisita. (2004). Science and Art of Qualitative Research: Nakhon Pathom. Population and Social Research Institute, Mahidol University. Accessed at: http://202.29.15.3/re/research/1-15jan49.htm. (Accessed on February 12, 2009).

Chaiyaporn Wichawut and co. (1988). Ethical behavior in Thai Society: A Study of the Concept in Social Psychology. Printed no. 1. Research Dissemination Project Research, Chulalongkorn University.

Chakrit Kuanpoj. (2004). Treaty signed under the FAO Thai, dreaded loss of food sovereignty. Prachatham News Agency. Access to information from:http://www.thaico.net/b_pnews/47010600.htm. (Accessed on 8 November 2008).

REFERENCES (cont.)

Chanin Wasinondh, Surapin Khaokhan and Yipsy Chanpengpen. (2008). The study of marketing information of the lower basin in the market in district level: a case study of Akat Amnuai market, Sakon Nakhon Province and Si Songkhram market, Nakhon Phanom Province. Sakon Nakhon Rajabhat University.

Chanuan Rattanawaraha. (2009). Eco Natural Agriculture: Biodiversity and the balance. Accessed at: http://www.tungsong.com/Environment/Bio/Chanun/Bio_05.asp. (Access date: April 6, 2009).

Charoen Kampeerapap. (2004). Treaty signed under the FAO Thai, dreaded loss of food sovereignty. Prachatham News Agency. Accessed at: http://www.thaico.net/b_pnews/47010600.htm. (Accessed on 8 November 2008).

Charupat Thawarorit. (2001). Lisu, lowland Thai, news, knowledge, attitude, participation in forest restoration in Chiang Mai Province. Master of Arts Program in Communication Arts, Arts development in PR Arts, Chulalongkorn University.

Committee of documents and archival processing. (2001). Culture, historical development, identity and wisdom of Samut Songkhram Province. Printed No. 1. Bangkok: Committee documents and archival processing.

Community Development Department, Samut Songkhram Province. (2009). Number of Households and Population from the Survey Data of Jor Por Thor, Samut Songkhram Province in the year of 2008. Accessed at: http://cddweb.cdd.go.th/samutsongkhram/BMN51/pas51.htm. (Access date: April 7, 2009).

Department of Agricultural Promotion. (2001). Summary of the exhibition and international conference of banana no. 1. Bangkok: Department of Agricultural Promotion. Access to information from: http://www.doae.go.th/library/html/detail/banana/index1.html. (Accessed on June 24, 2010).

REFERENCES (cont.)

Department of Agricultural Promotion. (2010). Agricultural Resource Center "Fruit trees.". Access to information from: http://www.doae.go.th/library/html/fruit_all.html. (Accessed on June 24, 2010).

Department of Environment 8. (2009). Surface water quality report in the year of 2009. Ministry of Natural Resources and Environment Ratchaburi Province.

Department of Environmental Quality Promotion. (2009). Report of Environment Quality Act 2009. Ministry of Natural Resources and Environment. Access to information from: http://www.deqp.go.th/. (Accessed on September 15, 2010).

Department of Environmental Quality Promotion. (2010). Move ahead, "the year of biodiversity," although many species are extinct gradually. Access to information from: http://doc.deqp.go.th/blog_answer.php?genTopic=179. (Accessed on February 2, 2010).

Department of Mineral Resources. (2004). Thailand map showing the area of governance. Access to information from: http://www.dmr.go.th/images/scheme/1.jpg. (Accessed on September 10, 2010).

Electricity Generating Authority of Thailand. (2010). Benefits of Khao Laem Dam. Access to information from: http://vrk.egat.com/home/vrk/th/khl_1_2.htm. (Accessed on June 28, 2010).

Energy Research and Development Institute. (2006). The Geography of the Samut Songkhram Province. Chiang Mai University. Access to information from: http://www.thaienergydata.in.th/energynew/energyReview/energy/index_prv_geo.php?prv_id=75&year=2008. (Accessed on August 30, 2010).

Faculty of Agriculture, Chiang Mai University. (2008). Standard Pattern of Conservation. Accessed at: http://agronomy.agri.cmu.ac.th/elearning/agron482/lesson05.doc. (Accessed on 12 January 2009).

REFERENCES (cont.)

Faculty of Environment and Resource Studies. (2007). Central Research report on Guidelines for the management of natural resources and environment in accordance with the various principles of the convention on the natural resources and environment. Faculty of Environment and Resource Studies, Mahidol University.

Farida Duriyapong. (2007). "Insights ... International treaties on Genetic Resources for Food and Agriculture.". Faculty of Environment and Resource Studies, Mahidol University. Accessed at: http://www.measwatch.org/autopage/show_page.php?t=19&s_id=27&d_id=27. (Access to information on 8 October 2008).

Foundation for Sustainable Agriculture. (Thailand). Manual of Developers and Agriculturists on the matter of "Biodiversity and Sustainable Agriculture.". The Organization of Biodiversity and Thai Wisdom (BIOTHAI).

Google Map of Thailand. (2009). Map of Samut Songkhram Province. Access to information from: http://maps.google.co.th/ (Accessed on May 7, 2009).

Group Strategic Development, Samut Songkhram Province. (2007). Developmental strategy of Samut Songkhram Province in the year of 2010 - 2013. Access to information from: http://www.samutsongkhram.go.th/strategy/. (Accessed on September 20, 2010).

Harbor Department. (2006). Office of Marine 3 Samut Songkhram. Access information from: http://www.md.go.th/waterway_map/rongnam-samudsongkram.php. (Accessed on August 18, 2010).

Irrigation project in Samut Songkhram. (2006). Warning systems to prevent salt water in Samut Songkhram Province. Access to information from: http://ridceo.rid.go.th/smsongkh/pravat.html. (Accessed on July 15, 2010).

Jirawat Wongsawatdiwat. (1995). Attitudes, beliefs and behavior: measurement, prediction and change. Printed no. 2. Bangkok: Samdee publishing.

REFERENCES (cont.)

Jutamanee Saengsawang. (2000). Factors Affecting the Behavior on the use of natural resources at Toh Daeng peat forest in Narathiwat Province. Technology of Environmental Management, Mahidol University.

Kanchana Intecha. (1998). Status of production and distribution of winter fruit of agriculturists in Chiang Mai Province. Department of Agricultural Promotion. Chiang Mai University.

Kanungrat Kammanee. (2010). The knowledge integration based on local wisdom (Samut Songkhram part 1 of a salt field). Access to information from: http://gotoknow.org/blog/kanungrat/387314. (Accessed on October 15, 2010).

Kasem Chattakul. (1990). Factors associated with acceptance of modern science in conservation of soil and water of agriculturists in villages around the Khao Son Research and Development Centre under his royal patronage. Ph.D. thesis (Behavioral Science). Institute of Behavioral Science.

Kiat Kamsan. (2004). Treaty signed under the FAO Thai, dreaded loss of food sovereignty. Prachatham News Agency. Accessed at: http://www.thaico.net/b_pnews/47010600.htm. (Accessed on 8 November 2008).

Kriangkrai Kirtsiri. (2004). Wisdom of sustainable development. Referenced in the National Culture Commission, Ministry of Culture and the Faculty of Architecture, Silpakorn University. Guidelines for managing cultural landscapes. Printed no. 1. Office of the National Culture Commission

Land Development Department. (2006). Description of features and soil group management. "Soil group 8". Geographic information system development plan for the Program Planning and Project Development Department, Ministry of Agriculture.

Land Development Department. (2009). Program of database of the Land Use and Land Resource Development Action Plan 10. Ministry of Agriculture. Access to

REFERENCES (cont.)

information from: http://www.giswebr10.ldd.go.th/Landplan.htm. (Accessed on July 12, 2009).

Ludwig, J. A. and J. F. Reynolds. (1988). Statistical Ecology. John Wiley & Sons, New York. 337 p.

Natcha Sakulngam, Yossaporn Punnawattana, Wongsakorn Udomphot and Itsarachai. (2009). Local Architectures of Coconut Agriculturists: Relationship of life, environment and architectural case study of Ban Mob Rat and Ban Klong Dan, Laem Yai subdistrict, Samut Songkhram. Master of Arts, Local Architecture, Faculty of Architecture, Silpakorn University.

Non-Formal Education Center, Samut Songkhram Province. (2009). The Main Occupation of Samut Songkhram People. Access to information from: http://skm.nfe.go.th/tour3.html. (Access on April 2, 2009).

Nuansiri Paorohit. (1984). Introduction to Social Psychology. Bangkok: Psychology Department. Faculty of Education, Ramkhamhaeng University.

Office of Biodiversity. Office of Natural Resources and Environmental Policy and Planning. (2005). Agro Ecosystems. Accessed at: http://chm-thai.onep.go.th/National-Report/Agriculture.html. (Access date: 3 April 2009).

Office of Natural Resources and Environmental Policy and Planning. (1995). Thailand's Biodiversity. Print No. 3. Bangkok: Department of Biological Resources. Management Division of Natural Resources and Environment. Office of Natural Resources and Environmental Policy and Planning (ONEP).

Office of Natural Resources and Environmental Policy and Planning. (1996). Thailand's Biodiversity. Print No. 3. Bangkok: Department of Biological Resources. Management Division of Natural Resources and Environment. Office of Natural Resources and Environmental Policy and Planning (ONEP).

REFERENCES (cont.)

Office of Natural Resources and Environmental Policy and Planning. (2004). Thailand's Biodiversity. Print No. 3. Bangkok: Department of Biological Resources. Management Division of Natural Resources and Environment. Office of Natural Resources and Environmental Policy and Planning (ONEP).

Office of Natural Resources and Environmental Policy and Planning. (2006). Report of a seminar on biodiversity. Printed no. 1. Bangkok: Department of Biological Resources. Management Division of Natural Resources and Environment. Office of Natural Resources and Environmental Policy and Planning (ONEP).

Office of Natural Resources and Environmental Policy and Planning. (2003). Policies, measures and plans for the conservation and utilization of sustainable biodiversity between the years of 2003-2007.

Office of Soil Survey and Land Use Planning. (2009). Map of the State of Land Use of Samut Songkhram Province in the year of 2006. Department of Land Development. Access to information from: http://osl101.ldd.go.th/luse/web_lu/Lu_49/Lu49_C/Samutsongkram49.htm. (Accessed on 10 September 2010).

Office of Soil Survey and Land Use Planning. (2010). The Use of Land in the year of 2009. Access to information from: http://osl101.ldd.go.th/luse/luse_product52.htm. (Accessed on 15 September 2010).

Office of the National Culture Commission, Prachatham press. (2004). Treaty signed under the FAO Thai, dreaded loss of food sovereignty. Accessed at: http://www.thaico.net/b_pnews/47010600.htm. (Accessed on 8 November 2008).

Office of the National Culture Commission. (2006). Guidelines for Managing Cultural Landscapes. Printed no. 1. Ministry of Culture and the Faculty of Architecture, Silpakorn University.

REFERENCES (cont.)

Office of the National Economic and Social Development Board. (2008). Ecotourism. (Samut Songkhram). Office of the National Economic and Social Development Board Accessed at: http://cm.nesdb.go.th/cluster_ diamond.asp? ClusterID=C0047. (Accessed on November 10, 2008).

Office of the National Human Rights Commission of Thailand. (2009). Wisdom of the local residents in the Ecosystem of Samnam Management. Access to information from: http://www.nhrc.or.th/kcontent.php?doc_id=Research_ Water. (Accessed on July 14, 2009).

Operations Center, Department of Lands. (2010). The Amount of Documents of Right of Land across the Country (Regional). Access to information from: http://www.dol.go.th/doc/index.php?option=com_content&task=view&id= 542&Itemid=248. (Accessed on September 2, 2010).

Paibun Chaikaet. (1995). Factors Affecting on Behavior of Herbicide in Rubber Plantation in Phatthalung Province. Master of Science thesis, Business Environment, Graduate School, Mahidol University.

Pantong Techaplee. (1999). Som Kliang: Fruit of the Endangered Species at Thoen district, Lampang Province. Human and Environmental Management, Chiang Mai University.

Patcharawadee Kamrod. (2007). Sustainable production of palm sugar in Chainat Province. Master of Science, Environmental Planning for Rural Community Development, Graduate Studies, Mahidol University.

Pinyaporn Penpinan. (2001). Media Exposure,Knowledge, Attitude, Vision and Participation in Environmental Conservation of People in Bang Pu Industrial Estate, Samutprakan Province. Master of Arts, Chulalongkorn University.

Pitipong Pungbun Na Ayuthaya. (2006). The article in the seminar report on biodiversity. Printed no. 1. Bangkok: Department of Biological Resources, Natural Resources and Environment Management Division. Office of Environmental Policy and Planning (ONEP).

REFERENCES (cont.)

Pitsamai Wibulswasdi. (1985). Psychology of contemporary society. (Printed no. 1), Chiang Mai, Siam Suksa.

Pollution Control Department. (2004). The situation of surface water quality of year 2004. Ministry of Natural Resources and Environment.

Pongsa Chunam, Somkiat Tansakun and Chakrit Punsawaskitti. (2001). The local forest management in vegetable production, marketing and conservation: A Case Study of Local Vegetables Pak Suang , Phato district, Chumphon Province. Conservation and Watershed Management Phato Unit.

Pongsak Chat Techa. (1997). The participation of people in the conservation of forest resources in forest conservation of Mae Tho National Park, Chiang Mai Province. Master of Human and Environment Management. Chiang Mai University.

Pra Manote Potchanasiri. (Bun Manit.) (2004). Factors affecting on the change of sugar coconut agriculturists' way of life: a case study of agriculturists in Meung Mai district, Amphawa district, Samut Songkhram Province. Master of Arts, Thai study program, Graduate Studies, Rajabhat Institute Thonburi.

Prapa Kongpanya and Asst. Dr. Wanika Benchapong. (2004). Coconut Sugar. Access to information from: http://www.doctor.or.th/node/1757. (Accessed on May 20, 2010).

Prasan Taksikabut. (1984). Sociological factors that determine the pesticide of vegetable agriculturists in suburban areas. Thesis of Master's degree, Environment, Graduate School, Mahidol University.

Pratak Intarakanneod. (1996). The participation of shrimp agriculturists in mangrove conservation of Surat Thani Province. Master of Science, Agricultural Promotion, Mae Jo University.

Preapattra Kiewcha-Um. (2009). Attitude. Access to information from: http://gotoknow.org/blog/theories/280647. (Accessed on July 24, 2009).

REFERENCES (cont.)

Preuk Chirasattayaporn. (2007). Wetlands and Sufficient economy of the household level: a case study of the lower Songkhram river basin. Master of Science, Environmental Planning for Rural Community Development, Graduate Studies, Mahidol University.

Rot Chintamat. (2003). Wisdom of Sam Nam Ecosystem Management. Office of the National Human Rights Commission of Thailand.

Royal Thai Survey Department, The Military Supreme Command Headquarters. (2000). Map of Samut Songkhram Province. Thailand print time: EDITION 1-RTSD.

Saiyut Kongyarit. (1984). The Adoption of an Orchard through the Conservation of Soil and Water for Agriculturists in Mae Sa Watershed Management Projects in the district of Mae Rim, Chiang Mai Province. Thesis of Master's degree of Science, Environmental Science. Graduate School. Kasetsart University.

Sanun Chusakun and Weerawat Paputsaro, editor. (2000). Agro Forestry: Sustainable Agriculture in the Northeast, Guidebook to Agro Forestry. Printed no. 1. Rungsin Kanpim. Department of Environmental Quality Promotion, Ministry of Science. NGO Coordinating Committee on Rural Development of the Northeast.

Sarawut Srithananun. (2009). Analysis, "Som Kaew, the Best Orange of Maeklong—We have to conserve". Bank for Agriculture and Agricultural Cooperatives. Accessed at: http://www.pandinthong.com/View Content.php?ContentID=2467. (Accessed on March 28, 2009).

Siriwat Wong Siri and Supachai Lorlohakarn, editor. (1989). BIODIVERSITY IN THAILAND. Printed no. 1. Bangkok: Prachachon Limited Company.

Somchai Ratanachuesakul. (2006). Access and Benefit Sharing of Plant Genetic Resources: Policy Recommendations for Thailand. Management Unit Program of Knowledge in Erade and Environment in the International Situation.

REFERENCES (cont.)

Somchai Ratanachuesakul. (2008.) Certification System in Benefit Sharing Process under Convention on Biological Diversity. International Development Program of Knowledge and Strategic in Agreements between Multiple Sectors in the Environment. The Thailand Research Fund (TRF).

Somnuk Chaiyatham (1999). Karens, Forest Conservation, Agriculture, Chiang Mai. Bachelor of Science (Agriculture), Agricultural Promotion, Graduate School, Chiang Mai University.

Somsak Sukwong, Wiwat Katithammanit, editor (1994). Biodiversity with sustainable development "Conservation of Biodiversity in Forestry.". Printed no. 2. Bangkok: Institute of Local Community Development.

Songpol Somsri. (2008). "Technical Department of Agriculture identified many Thai indigenous vegetables are vulnerable to extinction." News. National news agency. Accessed at: http://thainews.prd.go.th/view.php?m_newsid=200805220341&tb=N200805. (Accessed on December 3, 2008).

Sorapong Buaroi. (2006). The Method in Making a Coconut Sugar with Green Agriculture, Samut Songkhram Province. Agriculture Office, Samut Songkhram Province.

Statistical Office, Samut Songkhram Province. (2004). Demographic Characteristics of Occupants and Household Members. Access to information from: http://service.nso.go.th/nso/nso_center/project/search_center/23project-th.htm. (Accessed on August 3, 2010).

Statistical Office, Samut Songkhram Province. (2005). Data Classification of Cultivated Area. Access to information from: http://samutsongkhram.nso.go.th/ smskhram/index_oldversion.htm. (Accessed on September 4, 2010).

Statistical Office, Samut Songkhram Province. (2005). Occupied Agricultural Area Classified by the Issued Document of Right. Access to information from:

REFERENCES (cont.)

http://samutsongkhram.nso.go.th/smskhram/index_oldversion.htm. (Accessed on September 4, 2010).

Study group to monitor and evaluate the outcome of negotiations made a free trade zone. (2009). Strategic coconut. Access to information from: http://www.ftamonitoring.org/FTA% 20RelatedTopics/FTArelated05.asp. (Accessed on April 8, 2009).

Subin Yoorarat. (2007). Theory of Attitude Measurement. Access to information from: http://www.bloggang.com/viewdiary.php?id=inthedark&month=06-2007&date=27&group=2&gblog=27. (Accessed on July 25, 2009).

Sudha, M and F Kruijssen. (2007). Economic analysis of value addition along the supply chain for fresh and semi-processed products-the case of totapuri mango in South India. In: P Batt and J Cadihon (eds) Proceedings of International Symposium on Fresh Produce Supply Chain Management.FAO, AFMA, Curtin University of Technology, Department of Agriculture of Thai Ministry of Agriculture and Cooperatives. RAP Publication 2007/21.

Sujit Wongtat. (2008). Historic Rivers (Printed no. 4). Bangkok: Ruankaew Kanpim publishing

Summanus Meepian. (2001). The Role of Coral Reef Conservation of the Local Fishermen: a Case Study of Koh Samui Island, Surat Thani Province. Thesis of Master's degree. Technology of Environmental Management. Graduate Studies, Mahidol University.

Sumontha Promboon and co. (1999). Biodiversity. Accessed at: http://www.swu.ac.th/royal/book2/b2c12.html. (Accessed on August 6, 2008).

Supatra Supap. (1988). Sociology. Bangkok: Thai Wattana Panich.

Supornchai Mangmeesit. (1992). A Study of Participation of Residents in Community of Forest Management Projects of NGOs: a Case Study of Community Forestry Projects initiated by the Integrated Rural Development Center,

REFERENCES (cont.)

Ban Phai district, Khon Kaen Province. Master of Arts, Sociology of Development, Khon Kaen University

Surachit Shirawet. (2008). Kon Mae Klong. Printed no. 6. Bangkok: Sor Asiapress (1989).

Surayud Limtrakul. (2001). Factors Influencing the Participation of People in the Conservation of Forest Resources: a Case Study of Ban Huai Saphan Nongrong sudistrict, Phanomtuan district, Kanchanaburi Province. Master of Arts, Social Development, Kanchanaburi Rajabhat University.

Suwannee Kongthong. (1993). The Participation of People in the Conservation of Mangrove, the Communities in the Area of Sikao district, Trang Province. Thesis of Master's degree. Environmental Science, Kasetsart University.

Suwannee Pornpanarom. (2005). Wisdom of Life and Resource Management, a Reflection from Literature of Suphan Buri Province. Thesis of Master's degree in Science, Technology and Environmental Management. Graduate School. Mahidol University.

Thawin Tarapot. (1989). Psychological Society. Printed no. 4. Bangkok: O.A. Printing House.

The Analysis of the State of Land Use 1. (2009). Map of State of Land Samut Songkhram Province in the year of 2006. Office of Soil Survey and Land Use Planning, Land Development Department. Access to information from: http://osl101.ldd.go.th/luse/web_lu/Lu_49/Lu49_C/Samutsongkram 49.htm. (Accessed on 15 September 2010).

The Bureau of Central Registration, Department of Provincial Administration. (2008). Number of people throughout the Kingdom, Separated into Bangkok and Other Provinces. Access to information from: http://www.dopa.go.th/ xstat/pop51_1.html. (Accessed on August 3, 2010).

The Organization of Biodiversity and Thai Wisdom (BIOTHAI). (2009). Guidebook of agriculturists and developers on agriculture on the matter of biodiversity

REFERENCES (cont.)

and sustainable agriculture. Foundation for Sustainable Agriculture (Thailand), the organization of biodiversity and Thai wisdom. Accessed at: http://www.biothai.net/web/file/BIO&SAFBOOKLET.pdf. (Access date: February 27, 2009).

The Thailand Research Fund (TRF). (2006). Focus Group Discussion. Department of Research for Locality. Access to information from: http://www.vijai.org/Tool_vijai/12/02.asp. (Accessed on April 3, 2009).

Thidarat Thananan. (2009). Knowledge and Behavior in Coastal Environment and Natural Resources. Funding from the Institute for the Promotion of Teaching Science and Technology (IPST). Access to information from: http://www.ipst.ac.th/research/resuit46-5.shtml. (Accessed on July 15, 2009).

Wandee Payab. (2004). Factors Affecting on Fruit Plantation Area in Surat Thani. Faculty of Management, Surat Thani Rajabhat University.

Waraporn Suntharapipat. (1990). The Social and Economic Factors of the People towards Conservation of Community Forest at Ban Kham, Dong Mun subdistrict, Nong Kung Si district, Kalasin Province. Thesis of Master's degree in Science, Forest Management, Kasetsart University.

Warat Yantassanakit. (2005). The participation of people in river conservation: a case study in the Tha Chin River, Nakornchaisri district, Nakhon Pathom Province. Master of Arts, Social Development, Thonburi Rajabhat University.

Warotai Kosolpisitkul. (2007). Debts of Agriculturists in Rural Thailand. Balance Financial Group of Savings and Investment, Fiscal Policy Office

Warunyupa Tongklom. (2007). Factors Affecting on the Participation of the Public to Reduce Solid Waste from Households: Case Study of Ubon Ratchathani City Municipal, Ubon Ratchathani Province. Thesis of Master's degree in Science,

REFERENCES (cont.)

Water Resource System Research Unit. (2009). The Water Situation: Samut Songkhram Province. Faculty of Engineering, Chulalongkorn University. Access to information from: http://thaiwaterplan.org/?q=node/ 1. (Accessed on August 10, 2010).

Wichien Sumantakan. (2008). Handout in conference with the topic of "Biodiversity: Research from the Past to the Future" at the Wiang Inn Hotel, Chiang Rai Province, 30 Aug - 3 Sep 2004. Accessed at: http://www.dnp.go.th/ development/conservation.htm. (Accessed on March 8, 2008).

Wisoot Srisanguan. (2008).The study of the effect of soil surface and plant due to the natural trail at Ao Chong Kad - Haad Mai Ngam, Koh Surin National Park. National Park section. Office of Conservation 5, the Department of National Parks of Wild Fauna and Flora.

Wisut Baimai (1995). Status of Biodiversity in Thailand. Printed no. 1. Bangkok: The Thailand Research Fund (TRF).

Wutthichat Sriphaphlern. (2002). Hmong, Way of Life, Resource Use, Chiang Mai. Master of Science, Agriculture, Graduate School, Chiang Mai University.

Yos Santasombat and Witoon Panyakun. (1994). Biodiversity: Social and Ecological Dimensions. Printed no. 2. Bangkok: Institute of Local Community Development.

Yos Santasombat. (1999). Biodiversity and Traditional Wisdom for Sustainable Development. Printed no. 1. Chiang Mai: Nop Buri Kan Pim.

APPENDIX

SAMPLING AND INTERVIEWER

Table A.1 รายละเอียดแสดงจำนวนตัวอย่างครัวเรือนสำหรับทดสอบคุณภาพเครื่องมือ

รายละเอียด	ขนาดตัวอย่างสำหรับทดสอบคุณภาพเครื่องมือ (pretest)		
	ตำบล	หมู่บ้านที่	จำนวนครัวเรือน
1. อำเภอเมือง	คลองเขิน	6	10
2. อำเภออัมพวา	สวนหลวง	9	10
3. อำเภอบางคนที	กระดังงา	10	10
รวมทั้งสิ้น	3 ตำบล	3 หมู่บ้าน	30 ครัวเรือน

ที่มา: ข้อมูลทางการเกษตรที่สำคัญ ปี 2551 (สำนักงานเกษตรจังหวัดสมุทรสงคราม, 2552)

Table A.2 รายละเอียดสรุปจำนวนตัวอย่างครัวเรือนชาวสวนผลไม้ในระดับหมู่บ้าน

อำเภอ/ตำบล		หมู่บ้านที่	จำนวนเกษตรกร (ครัวเรือน)	จำนวนตัวอย่าง (ครัวเรือน)
1. อำเภอเมือง				
1.1 บางช้างแดก		2	82	15
		3	89	16
		5	79	14
		7	129	22
		9	39	7
	รวม	5 หมู่บ้าน	418	74
1.2 ตำบลบ้านปรก				
		4	45	10
		8	72	15
		10	28	6
	รวม	3 หมู่บ้าน	145	31
1.3 ตำบลแม่กลอง				
		-	108	11
	รวม	1 หมู่บ้าน	108	11
รวมอำเภอเมือง		9 หมู่บ้าน	671	116
2. อำเภออัมพวา				
2.1 ตำบลอัมพวา		-	114	7
	รวม	1 หมู่บ้าน	114	7
2.2 ตำบลปลายโพงพาง				
		3	74	20
		4	131	35
		6	50	13

Table A.2 รายละเอียดสรุปจำนวนตัวอย่างครัวเรือนชาวสวนผลไม้ในระดับหมู่บ้าน

อำเภอ/ตำบล		หมู่บ้านที่	จำนวนเกษตรกร (ครัวเรือน)	จำนวนตัวอย่าง (ครัวเรือน)
2.2 ตำบลปลายโพงพาง		8	52	8
		9	82	22
	รวม	5 หมู่บ้าน	368	98
2.3 ตำบลบางช้าง				
		3	22	5
		6	55	12
		8	56	12
		9	71	16
	รวม	4 หมู่บ้าน	204	45
รวมอำเภออัมพวา		9 หมู่บ้าน	686	150
1. อำเภอบางคนที				
3.1 ตำบลดอนมะโนรา		1	67	13
		2	78	15
		4	85	17
		5	69	13
		6	72	14
	รวม	5 หมู่บ้าน	371	72
3.2 ตำบลบ้านปราโมทย์				
		1	50	5
		2	38	4
		4	35	4
		6	37	3
	รวม	4 หมู่บ้าน	160	16
3.3 ตำบลบางยี่รงค์				
		1	45	9
		3	39	8
		4	32	6
		10	62	13
	รวม	4 หมู่บ้าน	178	36
รวมอำเภอบางคนที		13 หมู่บ้าน	709	124
รวมทั้งหมด		31 หมู่บ้าน	2,066	390

ที่มา: ข้อมูลทางการเกษตรที่สำคัญ ปี 2551 (สำนักงานเกษตรจังหวัดสมุทรสงคราม, 2552)

Table A.3 รายชื่อผู้ให้ข้อมูลจากแบบสอบถาม

อำเภอ	ตำบล	หมู่	ชื่อ – นามสกุล
เมืองฯ	บางขันแตก	1	สุรพล อยู่ศิริ
		1	เกลื่อน เทียนทับทิม
		1	ไพฑูรย์ ช้างใหญ่
		1	พ.จ.อ.สมเดช เกตุแก้ว
		2	ปรีชา ชิณณะวิโรจน์ไพศาล
		2	มะลิ นาโค
		2	สมบูรณ์ ต้นติวิภาสิน
		2	สมนึก งามเผือก
		2	วัฒนา คำชู
		2	กัญญาลักษณ์ รักภักดี
		3	สำรวม ปิ่นส่งแสง
		3	จวง สำลี
		3	บุญชอบ ทิพย์คำรงพงษ์
		3	อรุณ กลิ่นขจร
		3	ชัยยุทธ สุวรรณรอด
		3	ประกอบ ต้นประเสริฐ
		3	สิริวรรณ เฮงวิวัฒนชัย
		3	ละออง บุญรอด
		3	บุญทรัพย์ ชูศรี
		3	พุธิดา ใจบุญเจริญพร
		3	เสียง อินทร์ประเสริฐ
		4	ม่วย จันทร์บัณฑิตย์
		4	โสภณ เนียมพิบูลย์
		5	ปราณี จันทร์เกลี้ยง
		5	นงเยาว์ นนทแก้ว
		5	ไชยชาญ แสงสว่าง
		5	วิฑูรย์ เนียมพิบูลย์
		5	กลอยใจ ครสวัสดิ์
		5	ศิริวรรณ เอี่ยมละออ
		5	วนิดย์ ชมละม้าย
		5	เกื้อ นวลจันทร์
		6	เสน่ห์ ครุฑศรี
		7	หน่อน นวลจันทร์
		7	สุนชิน บุญรอด

Table A.3 รายชื่อผู้ให้ข้อมูลจากแบบสอบถาม (ต่อ)

อำเภอ	ตำบล	หมู่	ชื่อ – นามสกุล
เมืองฯ	บางขันแตก	7	ประนอม น้อยสกุล
		7	เกลียว บำรุงศรี
		7	ประดับ บำรุงสุข
		7	ก้อยา ชุมพาลี
		7	จิตาภา พวงเขียว
		7	จรูญ ครุยกริ่ว
		7	สถาพร บำรุงสุข
		7	สมร คล้ายพันธ์
		7	หย่อน นวลจันทร์
		7	สุพัตรา เกิดศิริ
		7	วิระ พ่วงศิริ
		7	เอก บำรุงศรี
		7	ภาณี พ่วงศิริ
		7	พินิจธรรม ศรีคล้ำ
		7	มลฤดี พิมลเกตุ
		7	บุปผา เปรมใจชน
		7	สมพงศ์ แสงทับทิม
		8	สมจิตร กล่ำดวัด
		8	ภาณี จันทอง
		9	สาลี่ น่อมสวัสดิ์
		9	สารภี พงศ์สวัสดิ์
		9	นาตยา บุญมา
		10	ลิ้ม ลองทอง
		11	ละออง นวลจันทร์
		11	ปราณี เทียนถาวร
		11	สุปาคา สว่างหล้า
		11	ทองคำ ศรเดช
		11	น้อย กาเหว่า
		11	ทองเปลว เนียมพิบูลย์
		11	เครือวรรณ นาคทอง
		11	รัชนี ศรเดช
		11	อุษา นวลจันทร์
		11	สมพิศ เนียมพิบูลย์
		11	แหวน มาประกอบ
		11	นิวัติ เธียรจีรพล
		12	ละมัย พุ่มเทียน

Table A.3 รายชื่อผู้ให้ข้อมูลจากแบบสอบถาม (ต่อ)

อำเภอ	ตำบล	หมู่	ชื่อ – นามสกุล
เมืองฯ	บางขันแตก	12	กรองแก้ว นวลจันทร์
		13	ทองทรัพย์ เมืองรมย์
เมืองฯ	บ้านปรก	4	อำนวย ทองหยั่ง
		4	ประนอม ฉายแสง
		4	ทัศนา พึ่งสังวาลย์
		4	บุญทรง ชำครุฑ
		4	ลิ้นจี่ แสงสาคร
		4	จง แสนสาคร
		4	บุญตา แก้วจิตร
		4	พิชัย พ่วงเบีย
		8	สุภาพ คชสาร
		8	ประไพ รักธรรม
		8	ละออ รักธรรม
		8	หรรษา เจี๊ยบหนู
		8	สมทบ วงศเกษม
		8	ไสว ปลียานนท์
		8	เกล้า สกุลนุ่ม
		8	ชด ชื่นสมบัติ
		8	ชนิษฐา ปรียานนท์
		8	ประเสริฐ อารมณ์ดี
		8	ส้มแป้น โสคปิฒะ
		8	สมพร ชื่นสมบัติ
		8	สถาพร ชื่นสมบัติ
		8	สามารถ จันทรอิน
		8	บุญลือ ทรัพย์เจริญ
		10	สมหมาย สกุลดี
		10	สมกิจ บุญอมร
		10	ประจิม พวงแก้ว
		10	มณี เพื่องฟู
		10	ผ่อง ด้นวาตะ
		10	จู เลิศประถมกุล
เมืองฯ	แม่กลอง	เทศบาลเมืองฯ	มนัส มิกกา
		เทศบาลเมืองฯ	ปราณี จันทราทิพย์
		เทศบาลเมืองฯ	ปรียา บุศรน้ำพชร
		เทศบาลเมืองฯ	แอ้ว หวังกิจ
		เทศบาลเมืองฯ	สมาน แสงกระจ่าง

Table A.3 รายชื่อผู้ให้ข้อมูลจากแบบสอบถาม (ต่อ)

อำเภอ	ตำบล	หมู่	ชื่อ – นามสกุล
เมืองฯ	แม่กลอง	เทศบาลเมืองฯ	นันทวัน จันทราทิพย์
		เทศบาลเมืองฯ	สมจิตต์ จันทราทิพย์
		เทศบาลเมืองฯ	ประนอม จันทราทิพย์
		เทศบาลเมืองฯ	สมร วัฒนา
		เทศบาลเมืองฯ	อารมณ์ แจ้งกระจ่าง
อัมพวา	อัมพวา	เทศบาลตำบลอัมพวา	นิทัศน์ สุทธิศักดิ์ศรี
		เทศบาลตำบลอัมพวา	พินิจ สะคะรัตน์
		เทศบาลตำบลอัมพวา	ปิยะ ด้วงคุ้ม
		เทศบาลตำบลอัมพวา	อมรรัตน์ ณ บางช้าง
		เทศบาลตำบลอัมพวา	ถาวร ฐจิตร
		เทศบาลตำบลอัมพวา	ธนากร สุทธิศักดิ์ศรี
		เทศบาลตำบลอัมพวา	สมศักดิ์ นวลศิริ
อัมพวา	ปลายโพงพาง	1	ไพโรจน์ จงแจ่มใส
		3	สมคิด คารารักษ์
		3	เกตุ เรืองรักษ์
		3	หลาบ คีชัยยะ
		3	อุไรวรรณ ดวงพุมเมศ
		3	ประชุม สุทระจันทร์
		3	สุทธิพัฒน์ แก้วจันทร์
		3	นิค โชติธวัชชัย
		3	สมาน จันทร์เพ็ง
		3	วงศ์ เอี่ยมสะอาด
		3	ชาญยุทธ ปานคล้ำ
		3	พรม พุ่มเทียน
		3	ศักดิ์ชาย แสงสูง
		3	สุจินต์ เพ็ชร์น้อย
		3	ถวิล บุชาเทียน
		3	สมบูรณ์ ปานดำ
		3	สมพงษ์ พวงพัฒน์
		3	สมหมาย ศิวกุล
		3	สมบุญ แย้มหัตถา
		3	เฉลิม อุดมสวัสดิ์
		4	จรูญ แซ่ตัน
		4	ทองใบ ศิริขันธ์
		4	ลำยอง เวชกิจ
		4	ปรานี เพ็ญสว่าง

Table A.3 รายชื่อผู้ให้ข้อมูลจากแบบสอบถาม (ต่อ)

อำเภอ	ตำบล	หมู่	ชื่อ – นามสกุล
อัมพวา	ปลายโพงพาง	4	อารมณ์ ปลายพฤกษ์
		4	ประยงค์ น้อยกาญจนะ
		4	สมคิด บุญประยนต์
		4	ปทุม ถ้วยทอง
		4	นิล นันทศักดิ์
		4	สุภาพร ตันประเสริฐ
			ประเสริฐ คารารักษ์
		4	พวงมาลา คารารักษ์
		4	สำรอง น้อยกาญจนะ
		4	อารมย์ ดวงมรกต
		4	สุชิน ยังวัฒนา
		4	เทียมเหมือง แซ่เตียว
		4	อัญชลี วงศ์กัลยา
		4	ทองหล่อ จันทร์เพ็ง
		4	สุนันท์ โตวัฒนา
		4	โป่ง นาคสิน
		4	เล็ก ทัศนา
		4	มาลี ยิ้มย่อง
		4	บุญมา ดวงมรกต
		4	ชื้น มงคลศรีสำราญ
		4	ลออ หนุ่มสุวรรณ์
		4	คนัย ถ้วยทอง
		4	สำลี วิทยาคม
		4	สร้อย สั่งข์ศิริ
		4	บังอร จันทร์เพ็ญ
		4	สมถวิล นาคหุ่ม
		4	คำรง แสงทอง
		4	มะลิวรรณ โตวัฒนา
		4	อรุณ น้อยกาญจนะ
		4	อุดม ถ้วยทอง
		4	เมี้ยน ทองเปลว
		4	เอนก พัฒนะ
		6	วารุณี กลัดสมบูรณ์
		6	จำเนียร ใจอ่อน
		6	บุญช่วย ชมละม้าย
		6	ชรินทร์ ณ บางช้าง

Table A.3 รายชื่อผู้ให้ข้อมูลจากแบบสอบถาม (ต่อ)

อำเภอ	ตำบล	หมู่	ชื่อ – นามสกุล
อัมพวา	ปลายโพงพาง	6	สุวัตน์ มีสุข
		6	ชัยมังคล จันทร์เสนา
		6	ขาว บัณฑิต
		6	วิเชียร ชมละม้าย
		6	สุทธิ เดชสุวรรณ
		6	เฉื่อม สะอาด
		6	ทองสุข ยมะสมิต
		6	ปรุง ขจรผล
		8	สมพร ใจอ่อน
		8	นิทัศน์ อุดมสุข
		8	บุญมา ปานประเสริฐ
		8	บุญช่วย สร้อยสงิม
		8	ฐิดาภา โคงศรี
		8	วิโรจน์ หลั่งทรัพย์
		8	แดงอ่อน ฟ้างเขียว
		8	ฉลวย อิ่มอาบ
		9	ศรีไพร จันทร์ปราณี
		9	อุดม สีสอาด
		9	เสริม สามีหวัง
		9	วาสนา ลูมิงค์
		9	เกษมสันต์ พราหมพิชัย
		9	เปรมจิตต์ บุญสุข
		9	ประจวบ พิมเทพ
		9	สมวงษ์ พิมพ์สร้อย
		9	ชม ยิ้มย่อง
		9	บุญส่ง เหลาะหลง
		9	อนงค์ กลิ่นจิ๋ว
		9	ประเชาะ สหพงษ์
		9	อำนาจ ประสบบุช
		9	มัค ภักดีเจริญ
		9	สาหะ สีสอาด
		9	เซ็ม เหลาะหลง
		9	วรรณา เขาเล็ก
		9	คำรง ศรีวรรณศิริ
		9	ฉรงค์ เต็มวิจิตร
อัมพวา	บางช้าง	1	ชลอ มีคง

Table A.3 รายชื่อผู้ให้ข้อมูลจากแบบสอบถาม (ต่อ)

อำเภอ	ตำบล	หมู่	ชื่อ – นามสกุล
อัมพวา	บางช้าง	1	กมล เกิดดี
		2	วนัช สุทธสกุล
		2	น้อย หลังเงิน
		3	จำนงค์ พงษ์พิทักษ์
		3	ศิริ ครุฑทะยาน
		3	วันทณีย์ ครุฑทะยาน
		3	อุไร นาคะ
		3	ทองเจือ ฉายแสง
		3	รัชนี กล่อมเดช
		3	ถาวร เวชประเสริฐ
		3	มงคล ศรีสวัสดิ์
		6	ธนรัตน์ นาคบุตร
		6	สามารถ กลิ่นหวน
		6	หลาบ ชมประเสริฐ
		6	สุนทร เกิดจิ๋ว
		6	อุดม ม่วงเส็ง
		6	บรรจง นาคบุตร
		6	วาส นาคบุตร
		6	ไสว จตุรภิสมาจาร
		6	ไพบูลย์ เกิดปัญญา
		6	สมพร ศรีโหร
		6	ไพโรจน์ เกิดปัญญา
		6	ถาวร ฉิมพาลี
		7	ไพบูลย์ ชงสกุล
		7	ประสิทธิ์ เอมโกษา
		8	นลินี่ สกุลนุ่ม
		8	นคร ศรีใจดี
		8	ปทุม ขันกำนิด
		8	สมพิศ สุนทราลักษณ์
		8	เชม สงวนจิต
		8	อุไร เหลี่งสกุล
		8	ส.จ.อ.นิคม สกุลนุ่ม
		8	สำเนียง เหลี่งสุดใจ
		8	พิศมัย ทุ่มทอง
		8	ทองเจือ นาคยงค์
		8	วสันต์ แทนศรราม

Table A.3 รายชื่อผู้ให้ข้อมูลจากแบบสอบถาม (ต่อ)

อำเภอ	ตำบล	หมู่	ชื่อ – นามสกุล
อัมพวา	บางช้าง	9	สมบูรณ์ นิลพงษ์
		9	สมทรง นิลพงษ์
		9	นงเยาว์ จรรยาธรรม
		9	สมบูรณ์ รุ่งแสงเงิน
		9	สมชาย แก้วทอง
		9	ชุติมา ฉิมเครือวัลย์
		9	วรพล สุดสงวน
		9	แอ้ว ศรีคำ
		9	โหม เข็มหนู
		9	อำพล เล็กเนตรทิพย์
		9	วาสนา เหล่าชูชัยสกุล
		9	สุรชีพ ฉิมเกื้อวัลย์
บางคนที	คอนมะโนรา	1	ทิพวัลย์ วรรณศรี
		1	กลอย วรรณศรี
		1	กรอง รุกจะโพธิ์
		1	นุกูล แซ่หลิม
		1	สมหวัง ธรรมะสวัสดิ์
		1	สนั่น สุขเกิดผล
		1	จันทรานนท์ ทองพุ่ม
		1	อำนวย ธนิกกุล
		1	ทองหล่อ พงษ์ประยูร
		1	สมศักดิ์ พงษ์ประยูร
		2	วิชาร ฮู้ดี้
		2	มาน้อม ภูประเสริฐ
		2	เนตรนภา ลิ้มอิ่ม
		2	ไตรรงค์ แพทย์เจริญ
		2	เดชา พ่วงพิศ
		2	แจ้ว จันทร์ประเสริฐ
		2	สมพร พงษ์ประยูร
		2	สำราญ อรุณรักษา
		2	วิเชียร จันทร
		2	จำนงค์ โพธิสุทธา
		2	สมจิตร ซื่อสัตย์
		2	ประทีป จันทร
		2	เกษม ง้าวแก้ว
		2	อำนาจ ตันเปา

Table A.3 รายชื่อผู้ให้ข้อมูลจากแบบสอบถาม (ต่อ)

อำเภอ	ตำบล	หมู่	ชื่อ – นามสกุล
บางคนที	คอนมะไนรา	2	ประดิษฐ์ ธนิกกุล
		2	สมพงษ์ พงษ์สวัสดิ์
		4	ศิริ ชัยศิริโภค
		4	สำอางค์ วิไลศรี
		4	ประเสริฐ จังหวัดกลาง
		4	สำหนึง ลำจียก
		4	บุญเอม ลิ้มเรืองอนันต์
		4	จรูญ โสภี
		4	ถาวร อี้สกุล
		4	สวัด ลิ้มอิ่ม
		4	ธนพัธ จิวขิ้น
		4	กรกนก ด่วนดี
		4	บนดร์ เหมือนแจ่ม
		4	ภูมรินทร์ เร่งหวด
		4	บุญส่ง แซ่งอึ้ง
		4	ไสว บัวจีด
		4	โสธิดา น้อยแก้ว
		4	สราชุทธ์ สายแจ้ง
		4	ศักดิ์ชัย ธนิกกุล
		5	วิชัย จันทร
		5	สังวาน เจริญยิ่ง
		5	นิตยา ธนิกกุล
		5	บุญปลูก ศิริจันทร์
		5	รัตนา แซ่ลิ้ม
		5	ชิด ทองพุ่ม
		5	ตุ๊กตา วิไลลักษณ์
		5	บังอร วิไลลักษณ์
		5	สมชาย ธนิกกุล
		5	หนู เจริญศรี
		5	วรรณี ซื่อสัตย์
		5	น้อย กองสุทธิ์
		5	สมบูรณ์ ธนิกกุล
		6	สมชาย พุ่งพิศ
		6	ประสาน ภูศรี
		6	สุทัน ทองอารมณ์
		6	ณัฐวุฒิ ศรีเจริญจิระ

Table A.3 รายชื่อผู้ให้ข้อมูลจากแบบสอบถาม (ต่อ)

อำเภอ	ตำบล	หมู่	ชื่อ – นามสกุล
บางคนที	คอนมะโนรา	6	จำนงค์ รอดเทศ
		6	เลื่อม สัมพันธารักษ์
		6	ฮวด บุศอลันพงศ์
		6	ประทุม ลิ้มอิ่ม
		6	ลำดวน บุญสวัสดิ์
		6	สุวรรณา ลิ้มเล็ก
		6	สอน เทียมสมชาติ
		6	สุนันท์ ธนิกกุล
		6	อุบล ลิ้มอิ่ม
		6	นงนุช ฤทธิ์ผสมเงิน
บางคนที	บ้านปราโมทย์	1	อุไร เย็นประดู่
		1	กาญจนา เลิศฤทธา
		1	สอิตย์ วิหคหาญ
		1	สันทิฏฐ์ จิตต์อุทัศน์
		1	นาตยา รัตนหิรัญ
		1	จำรูญ อรุณรักษา
		2	ประไพศรี จันตโลหิต
		2	จันตมาศ สมบูรณ์ศักดิ์ศิริ
		2	อมรา เนติพัฒน์
		2	อุบล ครุฑเลิศ
		2	บุญมี ดุษฎี
		4	วิไลลักษณ์ รอดพงษา
		4	บานชื่น เกิดพุ่ม
		4	บรรจง คงแคล้ว
		4	สำรวย ต้นเรืองศรี
		4	บุญเฮี่ยม ปรีชาโชติ
		4	ประมวล พงษ์ประดู่
		4	วาสนา พงษ์ประดู่
		6	พเยา ศิริวิลาศ
		6	วิชัย รัตนหิรัญ
		6	ศักดา รัตนหิรัญ
		6	ประเทือง โชคอำนวย
		6	ชาญชัย พิมพ์พา
บางคนที	บางชี่รงค์	1	นิพงศ์ ยอแซฟ
		1	วรันทร รุจิรัตน์
		1	เดชศักดิ์ สาครนิล

Table A.3 รายชื่อผู้ให้ข้อมูลจากแบบสอบถาม (ต่อ)

อำเภอ	ตำบล	หมู่	ชื่อ – นามสกุล
บางคนที	บางยี่รงค์	1	เดือนฉาย จรัสศรี
		1	ทวี นิตยธรรม
		1	อำนาจ สัตย์วินิจ
		1	สนิท ศิริกุล
		1	วันดี นาคกลิ้ง
		1	สุดใจ รุจิรัตน์
		3	สาคร เอี่ยมสุวรรณ
		3	ประเสริฐ ช่างเสียง
		3	สมชาย งามมณฑา
		3	นิพนธ์ กิติศักดิ์
		3	เพทาย เอี่ยมสำอางค์
		3	บุญมา วนะรุจิ
		3	อักษร นาคผจญ
		3	นิภา ม้องวง
		4	สุรพิน จิตเจริญ
		4	วิเวก พฤกษากร
		4	สมชาย สุขพิศาล
		4	ธนู เข็มทอง
		4	ประจวบ เทศเจริญ
		10	จินตนา เปียประเสริฐ
		10	อรพิน จิตร์บรรจง
		10	มนัส บรรเลิงกิจ
		10	จิรารัตน์ ว่องวารี
		10	มงคล เปรมรัตน์
		10	ทิพวัลย์ รุ่งรัศมี
		10	สุรสิทธิ์ เปียมศิริ
		10	พงษ์พัฒน์ สุริยะฉันทนานนท์
		10	นฤมล บุญเจริญ
		10	นิดา ศรีมงคล
		10	วิศักดิ์ ศรมงคล
		10	ลำจวน สงวนวงศ์
		10	ไพศาล รังสิกุล

รายชื่อของผู้ให้ข้อมูลจากการสัมภาษณ์เชิงลึก ซึ่งแบ่งเป็นเกษตรกรชาวสวนที่มีประสบการณ์มานาน และเกษตรกรในพื้นที่ให้การยอมรับ และเจ้าหน้าที่จากสำนักงานเกษตรจังหวัดสมุทรสงครามที่ปฏิบัติงานมาเป็นเวลานานเข้าใจถึงความเป็นมาของนโยบาย และความสัมพันธ์ระหว่างชาวสวนกับภาครัฐบาล

Table A.4 รายชื่อเจ้าหน้าที่สำนักงานเกษตรจังหวัดฯ ผู้ให้ข้อมูลในการสัมภาษณ์เชิงลึก

อำเภอ	ตำแหน่ง	ชื่อ – นามสกุล
เมืองฯ	เจ้าหน้าที่พนักงานเกษตรชำนาญการ	รังสรรค์ จันทร์สมวงศ์
อัมพวา	นักวิชาการส่งเสริมการเกษตรชำนาญการ	ไพรินทร์ ภัควันต์
อัมพวา	นักวิชาการส่งเสริมการเกษตรชำนาญการ	ประจิบ เนียมสุวรรณ์
อัมพวา	นักวิชาการส่งเสริมการเกษตรชำนาญการ เกษตรกรในพื้นที่	ชูศักดิ์ คีสวาสดิ์
บางคนที	เจ้าพนักงานเกษตรชำนาญการ	ศักดา อรุณรุ่งโรจน์

Table A.5 รายชื่อเกษตรกรผู้ให้ข้อมูลจากการสัมภาษณ์เชิงลึก

อำเภอ	ตำบล	ตำแหน่ง	ชื่อ – นามสกุล
เมือง	บางขันแตก	เกษตรกร ปราชญ์หมอดินอาสา ประธานกลุ่มส้มโอปลอดสารพิษ	เสียง อินทร์ประเสริฐ
เมือง	บางขันแตก	เกษตรกร กรรมการศูนย์ถ่ายทอดเทคโนโลยี	โสภณ เนียมพิบูลย์
เมือง	คลองเขิน	เกษตรกร เป็นประธานกลุ่มเกษตรกรคลองเขิน	เรือโทสัญญา แย้มด้วง
อัมพวา	บางนางลี่	เกษตรกร ปราชญ์หมอดินอาสา ประธานศูนย์เครือข่ายปราชญ์ชาวบ้าน	อดิศักดิ์ ช่วงแย้ม
อัมพวา	บางนางลี่	เกษตรกร ปราชญ์สวนส้มโอ	ยงยุทธ นวมสุวรรณ
อัมพวา	สวนหลวง	เกษตรกร	อรุณ ดีประเสริฐ
บางคนที	บางสะแก	เกษตรกร ประธานกลุ่มเลี้ยงผึ้งวิสาหกิจชุมชน สมาชิกกลุ่มเทคโนโลยีการเกษตร สมาชิกกลุ่มสมัชชาอาหารปลอดภัย ปราชญ์หมอดินอาสา	นายอางค์ น่วมด้วง

Table A.5 รายชื่อเกษตรกรผู้ให้ข้อมูลจากการสัมภาษณ์เชิงลึก (ต่อ)

อำเภอ	ตำบล	ตำแหน่ง	ชื่อ – นามสกุล
บางคนที	บางพรม	เกษตรกร ประธานกลุ่มเกษตรสตรีพัฒนา	ฉวีววรรณ หัตถกรรม
บางคนที	บางพรม	เกษตรกร ปราชญ์ด้านการทำขอฮู้และขอด้วง	สมพร เกตุแก้ว
บางคนที	บางพรม	เกษตรกร กรรมการศูนย์เกษตรฯ ปราชญ์น้ำส้มควันไม้เผ่าถ่าน	สถาพร ตะวันขึ้น
บางคนที	บางพรม	เกษตรกร ปราชญ์ชีววิถีเกษตรธรรมชาติ	สมทรง แสงตะวัน

QUANTITATIVE AND QUALITATIVE QUESTIONNAIRES

ส่วนที่ 1 แบบสอบถามเชิงปริมาณสำหรับการศึกษาปัจจัยด้านเศรษฐกิจสังคมระดับครัวเรือน จำนวนสายพันธุ์ และชนิดพันธุ์ของไม้ผล โดยแบ่งออกเป็น 4 ส่วนดังนี้ มีคำถามดังต่อไปนี้

1. ข้อมูลส่วนบุคคล และข้อมูลเฉพาะของแต่ละครัวเรือนของเกษตรกร
2. ช่องทาง และความถี่ในการรับรู้ข่าวสารเกี่ยวกับการทำสวนผลไม้ และการเกษตรด้านอื่นๆ
3. ข้อมูลด้านทัศนคติด้านต่างๆ ที่เกี่ยวกับความหลากหลายของไม้ผลพื้นที่
4. ตารางข้อมูลด้านชนิดพันธุ์ และสายพันธุ์ของไม้ผลทุกชนิดที่ปลูกในพื้นที่ถือครองของเกษตรกร

แบบสอบถาม

ความหลากหลายทางชีวภาพของไม้ผล ภูมิปัญญา และปัจจัยที่มีผลต่อการเปลี่ยนแปลง: กรณีศึกษาสวนผลไม้ในจังหวัดสมุทรสงคราม

เกษตรกรผู้ให้สัมภาษณ์ ชื่อ-นามสกุล _____

บ้านเลขที่_____ หมู่ที่_____ตำบล_____

เบอร์ติดต่อ_____วันที่ให้สัมภาษณ์_____

<u>ส่วนที่ 1</u> ข้อมูลส่วนบุคคล และข้อมูลเฉพาะของแต่ละครัวเรือนของเกษตรกร

คำชี้แจง: โปรดทำเครื่องหมายถูก (✓) หรือคำตอบใส่ลงในช่องว่างให้ตรงกับความเป็นจริง หรือตามความคิดเห็นของผู้ตอบคำถามให้ครบทุกข้อ

1. เพศ 1) ☐ ชาย 2) ☐ หญิง
2. อายุ _____ปี
3. สถานภาพ 1) ☐ โสด 2) ☐ สมรส 3) ☐ หม้าย 4) ☐ หย่าร้าง
4. ภูมิลำเนา
   1) ☐ อยู่อาศัยที่นี่ตั้งแต่เกิด
   2) ☐ ย้ายมาจากตำบล (4.1) _____ (4.2) อำเภอ _____
      (4.3) จังหวัด_____
      (4.4) อยู่อาศัยที่บ้านปัจจุบันรวมเป็นระยะเวลานาน _____ ปี
5. จำนวนสมาชิกทั้งหมดในครัวเรือน _____คน
   5.1 เด็กที่ยังไม่ศึกษา _____คน
   5.2 กำลังศึกษาอยู่ _____คน
   5.3 วัยแรงงาน _____คน
   5.4 ไม่ได้ทำงาน _____คน
6. ระดับการศึกษาของผู้ให้สัมภาษณ์_____

7. พื้นที่ที่ใช้ทำสวนในจังหวัดสมุทรสงคราม

7.1 เป็นกรรมสิทธิ์ของตนเอง

1) ห่างจากที่พัก (7.1.1)_____ เมตร พื้นที่ (7.1.2)____ ไร่_____งาน

2) อยู่ในพื้นที่เดียวกันกับที่พัก (7.1.3)_____ไร่_____งาน

7.2 เช่าที่คนอื่นสำหรับทำสวน

1) ห่างจากที่พัก (7.2.1)_____ เมตร พื้นที่ (7.2.2)____ ไร่_____งาน

2) อยู่ในพื้นที่เดียวกันกับที่พัก (7.2.3)_____ไร่_____งาน

8._การเดินทางเพื่อไปดูแลสวนใช้วิธีการใด (✔ ได้หลายข้อ)

8.1 ☐ เดินเท้า 8.2 ☐ รถจักรยาน 8.3 ☐ รถจักยานยนต์

8.4 ☐ รถยนต์ 8.5 ☐ เรือ 8.6 ☐ อื่นๆ ระบุ _____

9._อาชีพหลัก _____

10. อาชีพเสริม อื่นๆ _____

11. รายได้จากอาชีพทำสวนผลไม้ (ไม่หักค่าใช้จ่าย) _____ บาท ต่อ

_____ (ระบุรอบ/ปี)

12. รายได้จากอาชีพอื่น (ไม่หักค่าใช้จ่าย) _____ บาท ต่อ

_____ (ระบุรอบ/ปี)

13. รายจ่ายจากในสวน _____ บาท ต่อ

_____ (ระบุรอบ/ปี)

14. รายจ่ายในครัวเรือนทั้งหมด_____ บาท ต่อ

_____ (ระบุรอบ/ปี)

15. รายจ่ายส่วนใหญ่ของการทำสวนผลไม้ คือ _____

16. เงินออม 1) ☐ ไม่มี 2) ☐ มี

17. หนี้สิน 1) ☐ ไม่มี 2) ☐ มี

17.1 สาเหตุที่กู้ – ยืมเกี่ยวข้องกับอาชีพไม้ผลหรือไม่ 1) ☐ ไม่เกี่ยวข้อง

2) ☐ เกี่ยวข้อง

18. เกษตรกรทำสวนผลไม้ต่อจากบรรพบุรุษ 1) ☐ ไม่ใช่ ปลูกเองมา (18.1)_____ปี

2) ☐ รับช่วงเดิมตัวต่อจากบรรพบุรุษมา (18.1)_____ปี

3) ☐ ปลูกเอง และรับช่วงต่อ (18.1) _____ปี

19. แรงงานคนที่ใช้ในสวน

19.1 เป็นสมาชิกในครัวเรือน _____คน

19.2 จ้างแรงงาน _____คน

19.2.1 แรงงานส่วนใหญ่มาจาก 1) ☐ เป็นคนในตำบล 2) ☐ ต่างอำเภอ

3) ☐ ต่างจังหวัด 4) ☐ ประเทศเพื่อนบ้าน

20. ในพื้นที่ชุมชนมีปัญหาการขาดแรงงานในสวนหรือไม่

1) ☐ ไม่มีปัญหา 2) ☐ มีปัญหาขาดแรงงาน

21. ลักษณะของการจัดการสวนผลไม้ส่วนใหญ่ในพื้นที่

1) ☐ ปล่อยตามธรรมชาติ

2) ☐ เข้าไปจัดการดูแล (21.1) 1) ☐ บ่อยครั้ง 2) ☐ นานๆ ครั้ง

22. สายพันธุ์ไม้ผลที่ใช้ในสวน (คิดจาก 10 ส่วน)

22.1 เกษตรกรเป็นผู้คัดเลือก เพาะพันธุ์เองจากในสวน _____ ส่วน

22.2 นำพันธุ์มาจากภายนอก _____ ส่วน

22.2.1 นำมาจากที่ไหน _____

23. หน่วยงานที่ส่งเสริมในการปลูกไม้ผล

1) ☐ ไม่มี

2) ☐ มี ระบุ (23.1) _____

24. มีผู้สนใจมาศึกษาดูงานในพื้นที่สวนผลไม้ของเกษตรกร หรือไม่

1) ☐ บ่อยครั้ง 2) ☐ นานๆ ครั้ง 3) ☐ ไม่เคยเลย

25. มีการรวมกลุ่มภายในชุมชนเกี่ยวกับการทำสวนผลไม้หรือไม่

1) ☐ ไม่มี

2) ☐ มี (25.1) เกษตรกรดำรงตำแหน่ง _____

(25.2) การประชุม 1) ☐ บ่อยครั้ง 2) ☐ นานๆ ครั้ง

26. เกษตรกรมีผู้ที่จะสืบทอดการทำสวนผลไม้หรือไม่

1) ☐ ไม่มี 2) ☐ มี (ระบุ เช่น บุตร) (26.1) _____

3) ☐ ไม่แน่ใจ

27. ท่านและครอบครัวเคยประสบอุบัติเหตุจากการทำสวนผลไม้หรือไม่

1) ☐ ไม่เคย

2) ☐ เคย เกิดจาก (27.1) _____

28. ถ้าผลไม้ที่ได้ (คิดจาก 100 ส่วน) บริโภคเองกี่ ส่วน หรือ เปอร์เซ็นต์

29. ในอนาคตข้างหน้าท่านจะเปลี่ยนอาชีพหรือไม่

1) ☐ ไม่เปลี่ยน เพราะ (29.1) _____

2) ☐ เปลี่ยน เพราะ (29.1) _____

เปลี่ยนไปประกอบอาชีพ (29.2) _____

3) ☐ ไม่แน่ใจ

วนที่ 2 ช่องทาง และความถี่ในการรับรู้ข่าวสารเกี่ยวกับการทำสวนผลไม้ และการเกษตรด้านอื่นๆ

able A.6 แบบสอบถามช่องทาง และความถี่ในการรับรู้ข่าวสารเกี่ยวกับการทำสวนผลไม้ และการเกษตร

เลขที่	ช่องทางในการรับรู้ข่าวสาร	ความถี่ในการรับรู้ข่าวสาร			
		บ่อยครั้ง 1)	บางครั้ง 2)	นานๆ ครั้ง 3)	ไม่เคยเลย 4)
1.	โทรทัศน์				
2.	วิทยุ				
3.	สิ่งพิมพ์ทางการเกษตร				
4.	อินเตอร์เน็ต				
5.	ชมนิทรรศการ ดูงานภายนอกตำบล				
6.	เจ้าหน้าที่รัฐ ภายในและภายนอกชุมชน				
7.	หน่วยงานเอกชน				
8.	โรงเรียน				
9.	หอกระจายข่าว				
10.	เพื่อนบ้าน / ญาติพี่น้อง / ลูกหลาน				

2. ความรู้เกี่ยวกับการทำสวน และการเกษตร ที่เกษตรกรสนใจ คือ _____

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วนที่ 3 ข้อมูลด้านทัศนคติด้านต่างๆ ที่เกี่ยวกับความหลากหลายของไม้ผลพื้นที่

able A.7 แบบวัดทัศนคติด้านต่างๆ ที่เกี่ยวกับความหลากหลายทางชีวภาพของไม้ผลในพื้นที่

ข้อ	ทัศนคติ	ระดับความคิดเห็น				
		มากที่สุด	มาก	ปานกลาง	น้อย	น้อยที่สุด
1.	กายภาพของพื้นที่ศึกษาในจังหวัดสมุทรสงคราม					
1.	ดินในพื้นที่ มีความเหมาะสมต่อการปลูกไม้ผล					
2.	อากาศในพื้นที่ มีความเหมาะสมต่อการปลูกไม้ผล					
3.	ธาตุอาหารในพื้นที่ มีความอุดมสมบูรณ์					
2.	ไม้ผลพันธุ์พื้นเมือง					
4.	มีความทนทานต่อโรคและแมลงมากกว่าพันธุ์ไม้ผลที่ปรับปรุงใหม่					

able A.7 แบบวัดทัศนคติด้านต่างๆ ที่เกี่ยวกับความหลากหลายทางชีวภาพของไม้ผลในพื้นที่

ข้อ	ทัศนคติ	ระดับความคิดเห็น				
		เห็นด้วยมากที่สุด	เห็นด้วย	ไม่แน่ใจ	ไม่ค่อย	ไม่เห็นด้วย
5.	มีประโยชน์ต่อระบบนิเวศ ระบบในธรรมชาติ					
6.	มีคุณค่าทางเศรษฐกิจ					
3.	การอนุรักษ์สายพันธุ์ไม้ผล หรือ สาเหตุที่เกษตรกรรักษาการปลูกไม้ผลต่อไป					
7.	ปลูกเพื่อสืบทอดอาชีพบรรพบุรุษ					
8.	รายได้ดี					
9.	ราคาที่จำหน่ายในปัจจุบันมีความเหมาะสม					
10.	อาชีพทำสวนผลไม้เป็นอาชีพที่อิสระ					
11.	ต้องการรักษาสายพันธุ์ และชนิดพันธุ์ของไม้ผลไว้					
12.	ชนิดพันธุ์ สายพันธุ์ที่ปลูกอยู่ในปัจจุบันดีอยู่แล้ว					
13.	การคัดเลือกสายพันธุ์จากเกษตรกรเองดีกว่านำมาจากที่อื่น					
14.	อาชีพทำสวนผลไม้ในปัจจุบันมีความมั่นคง					
15.	มีความภาคภูมิใจในอาชีพทำสวนผลไม้					
4.	การละทิ้งไม้ผล สาเหตุที่ทำให้เกษตรกรมีแนวโน้มที่จะเลิกปลูกไม้ผล					
16.	รายได้ไม่ดี					
17.	ผลผลิตน้อย					
18.	ระบบและคุณภาพน้ำไม่ดี					
19.	คุณภาพอากาศไม่ดี					
20.	คุณภาพดินไม่ดี					
21.	ต้องการเปลี่ยนไปประกอบอาชีพอื่น					
22.	อายุมากขึ้น ทำการเกษตรไม่ไหว					
23.	ขาดแรงงาน					
24.	เป็นงานที่เสี่ยงอันตราย					
5.	วิถีชีวิต ภูมิปัญญา ที่เกี่ยวข้องกับอาชีพการปลูกไม้ผล					
25.	ภูมิปัญญามีความสำคัญต่อเกษตรกร					

Table A.7 แบบวัดทัศนคติด้านต่างๆ ที่เกี่ยวกับความหลากหลายทางชีวภาพของไม้ผลในพื้นที่

ข้อ	ทัศนคติ	ระดับความคิดเห็น				
		เห็นแย้งอย่างยิ่ง	เห็นแย้ง	ไม่แน่ใจ	เห็นด้วย	เห็นด้วยอย่างยิ่ง
6. ปัจจัยภายนอกที่ส่งผลต่อการปลูกไม้ผล						
29.	ราคาตลาดทำให้เกษตรกรต้องปรับเปลี่ยนชนิดพันธุ์ สายพันธุ์ไม้ผล					

<u>ส่วนที่ 4</u> ตารางข้อมูลด้านชนิดพันธุ์ และสายพันธุ์ของไม้ผลทุกชนิดในพื้นที่ถือครองของเกษตรกร

Table A.8 แบบสอบถามตารางข้อมูลด้านชนิดพันธุ์ และสายพันธุ์ของไม้ผล

ชนิดพันธุ์ไม้ผล	สายพันธุ์	จำนวนต้น	สายพันธุ์	จำนวนต้น	สายพันธุ์	จำนวนต้น

ส่วนที่ 2 แนวคำถามเชิงคุณภาพสำหรับการสัมภาษณ์เชิงลึก โดยแบ่งแนวคำถามออกเป็น 2 ส่วน คือ ส่วนสำหรับเกษตรกร และส่วนของเจ้าหน้าที่เกษตรตำบลที่เป็นตัวแทนของภาครัฐบาล

แนวคำถามที่ใช้สัมภาษณ์เชิงลึกกับเกษตรกรชาวสวนผลไม้

1. ประวัติของสวนผลไม้ หรือเหตุการณ์สำคัญที่มีผลกระทบต่อสวนผลไม้ในตำบล หรือเกษตรกรได้รับผลกระทบ หรือผลประโยชน์จากเหตุการณ์ต่างๆ เหล่านี้
   - เหตุการณ์น้ำท่วมช่วงปี 2539, 2549, 2553
   - โรงงานไฟฟ้าราชบุรี
   - ปัญหาน้ำเค็ม
     ปัญหาการเปลี่ยนแปลงของโลก เช่น ภาวะโลกร้อน
   - และอื่นๆ ที่มีผลกระทบต่อชาวสวน
2. มีการอนุรักษ์แม่น้ำลำคลองอย่างไรบ้าง
3. การเลือกปลูกชนิดพันธุ์ และสายพันธุ์ของไม้ผลในช่วงปัจจุบัน เหตุผลในการเลือก
   - ปลูกเป็นหลัก เพื่อขายเป็นอาชีพ (เช่น การดูแลยาก ง่าย ราคา ความต้องการของตลาด)
   - ปลูกไว้กินเอง เพราะอะไร (เช่น ใช้บริโภค เป็นไม้ผลหายาก เอามาใช้ประโยชน์ด้านอื่นๆ หรือดีต่อดิน น้ำ อากาศ)
4. ไม้ผลพื้นบ้านของสมุทรสงครามมีชนิดใดบ้าง
5. ไม้ผลพื้นเมืองมีความเหมาะสมต่อพื้นที่อย่างไรบ้าง
6. การดูแลรักษาไม้ผลอื่นๆ นอกจากไม้ผลหลัก
7. ไม้ผลพื้นบ้านที่มีความเสี่ยงต่อการสูญพันธุ์ คาดว่าจะสูญพันธุ์ หรือไม่ เพราะอะไร
8. ความแตกต่างของชาวสวนในอดีต ปัจจุบัน และในอนาคตจะเป็นอย่างไรต่อไป ทั้งในด้านของจำนวนของชาวสวน จำนวนที่ดิน และวิถีชีวิต
9. แบบแผนวิถีชีวิตของชาวสวนในการดูแลสวนผลไม้ในปัจจุบัน
   - กิจกรรมของชาวสวนในแต่ละช่วงฤดูกาลของไม้ผล
   - ความสัมพันธ์ระหว่างเกษตรกรภายในชุมชน กิจกรรมในการช่วยเหลือกัน
     การเดินทางของชาวสวนในปัจจุบัน การเดินทางโดยเรือยังคงมีความสำคัญอยู่หรือไม่
   - การนำเทคโนโลยีเข้ามาใช้ในสวน ทำให้ภูมิปัญญาที่มีส่วนเกี่ยวข้องกับไม้ผลอะไรบ้างที่สูญหายไป
10. ภูมิปัญญาที่เกี่ยวข้องกับไม้ผลที่ได้รับตกทอดมาจากบรรพบุรุษ หรือเกิดจากประสบการณ์ของเกษตรกรเอง
    - ระบบในการจัดการ ดูแล (การยกร่อง ปลูกแบบเชิงเดี่ยว หรือผสมผสาน การแบ่งตามชนิดไม้ผลและอื่นๆ อย่างไร)
    - องค์ความรู้ต่างๆ ที่เกี่ยวข้องกับสวนผลไม้ของจังหวัด เช่น น้ำส้มควันไม้ ขี้แดดนาเกลือ
      ความรู้ภายนอกที่เข้ามามีบทบาทในพื้นที่
    - มีความเชื่อ พิธีกรรม หรือกฎระเบียบ อะไรบ้างที่ต้องทำในการทำสวนผลไม้
    - ภูมิปัญญาใดที่ยังคงอยู่ และสูญหายไปบ้าง เพราะอะไร (ตั้งแต่การเลือกพันธุ์ การดูแลต้น ผลผลิต และการแปรรูป)

- แนวคิดในเรื่องภูมิปัญญา
- แนวคิดในการสอนคนรุ่นต่อไป ทั้งในระดับครัวเรือน และชุมชน

11. ปัญหาในด้านราคาของผลผลิตที่ส่งผลต่อการเลือกปลูกไม้ผลของเกษตรกรหรือไม่ อย่างไร
12. ตลาดที่รองรับผลผลิตภายใน และภายนอกประเทศ
13. ระบบตลาดในปัจจุบันเหมือนเดิมกับในอดีตหรือไม่
14. ปัญหาการขาดแคลนแรงงานจ้าง จากโรงงานรอบๆ และการสืบทอดอาชีพเกษตรกรรมของคนท้องถิ่นในการปลูกไม้ผลในรุ่นต่อไป
15. นโยบาย และผลจากการส่งเสริมเกษตรกรในการปลูกไม้ผลด้านการผลิต ความรู้ หรือเทคโนโลยีต่างๆ
    - ได้รับ หรือมีส่วนร่วมอย่างไรบ้าง
    - มีผลต่อเกษตรกรอย่างไรบ้าง
16. ผลของอิทธิพลจากภายนอก เช่น วัฒนธรรมของสังคมเมือง การท่องเที่ยว และการเข้ามามีส่วนของรัฐบาลในด้านอื่นๆ ที่มีผลต่อความหลากหลายของไม้ผล และแผนการรองรับของเกษตรกรชาวสวน
    - ความเป็นมาของการส่งเสริมการท่องเที่ยว
    - ตลาดมีผลต่อสวนหรือไม่ อย่างไร
17. ปัจจัยทั้งภายใน และภายนอกในด้านอื่นๆ ที่ส่งผลต่อการเปลี่ยนแปลงในการเลือกปลูก และละทิ้งของชนิดพันธุ์ และสายพันธุ์ในสวนผลไม้ในพื้นที่ศึกษา
18. ปัจจัย ปัญหา และคำแนะนำอื่นๆ ที่เกี่ยวข้องกับการเปลี่ยนแปลงของไม้ผลในจังหวัดสมุทรสงคราม

แนวคำถามที่แนวคำถามที่ใช้สัมภาษณ์เชิงลึกกับเจ้าหน้าที่เกษตรกรตำบล

1. ประวัติของสวนผลไม้ หรือเหตุการณ์สำคัญที่มีผลกระทบต่อสวนผลไม้ในตำบล หรือเกษตรกรได้รับผลกระทบ หรือผลประโยชน์จากเหตุการณ์ต่างๆ เหล่านี้
    - เหตุการณ์น้ำท่วมช่วงปี 2539, 2549, 2553
    - โรงงานไฟฟ้าราชบุรี
    - ปัญหาน้ำเค็ม
      ปัญหาการเปลี่ยนแปลงของโลก เช่น ภาวะโลกร้อน
      การปรับเปลี่ยนวิธีการดำเนินงานของภาครัฐ
      การปรับเปลี่ยนสวนตาล มาเป็นสวนผลไม้
    - และอื่นๆ ที่มีผลกระทบต่อชาวสวน
2. มีการอนุรักษ์แม่น้ำลำคลองอย่างไรบ้าง
3. การสนับสนุนส่งเสริมในส่วนของรัฐบาล
    - ชนิดพันธุ์ และสายพันธุ์ของไม้ผลในปัจจุบัน
    - การอนุรักษ์ไม้ผลที่เสี่ยงต่อการสูญพันธุ์
    - ภูมิปัญญาที่เกี่ยวกับไม้ผล
    - โครงการ การจัดงานนิทรรศการต่างๆ ที่เกี่ยวข้องกับไม้ผล เช่น งานส้มโอ
    - ราคา และตลาดที่รองรับผลผลิตจากสวนผลไม้

4. ไม้ผลพื้นเมืองมีความเหมาะสมต่อพื้นที่อย่างไรบ้าง
5. นโยบายในการส่งเสริมของอดีต และปัจจุบัน มีความแตกต่างกันอย่างไร และอนาคตมีแนวโน้มอย่างไร
6. การประสานจากจังหวัดใกล้เคียงหรือเครือข่ายของสวนผลไม้
7. จำนวนชาวสวน และจำนวนพื้นที่สวนผลไม้จากอดีต ปัจจุบัน และอนาคตเป็นอย่างไร
8. ปัญหา หรืออุปสรรคในการส่งเสริมชาวสวนผลไม้
9. แรงงานในสวนผลไม้ในปัจจุบัน และแนวโน้มในอนาคต
10. มีความเห็นเกี่ยวกับอิทธิพลภายนอก สังคมเมือง การท่องเที่ยว มีผลต่อสวนผลไม้อย่างไรบ้าง มีแผนในการรองรับอย่างไร
11. ปัจจัยภายใน และภายนอกอื่นๆ ที่มีส่วนเกี่ยวข้องกับความหลากหลายของไม้ผล หรือสวนผลไม้ในพื้นที่
12. ปัจจัย ปัญหา และคำแนะนำอื่นๆ ที่เกี่ยวข้องกับการเปลี่ยนแปลงของไม้ผลในจังหวัดสมุทรสงคราม

Finding of Effectiveness of Data Collection Instrument

การหาค่าประสิทธิภาพอำนาจจำแนกของแบบวัดทัศนคติ

1.1 การหาค่าประสิทธิภาพอำนาจจำแนกของแบบวัดทัศนคติ

1.1.1 รวมคะแนนของทุกคนแล้วเรียงลำดับคะแนนจากสูงไปต่ำ แล้วแบ่งคะแนนออกเป็นกลุ่มสูงกลุ่มต่ำดังใน Table C.1

1.1.2 นำคะแนนกลุ่มสูง และกลุ่มต่ำมาคำนวณหาค่าอำนาจจำแนกตามสูตร

$$t = \frac{\bar{x}_h - \bar{x}_l}{\sqrt{\frac{s_h^2}{n_h} + \frac{s_l^2}{n_l}}}$$

t คือ ค่าอำนาจจำแนก

$\bar{x}_h$ คือ คะแนนเฉลี่ยของกลุ่มสูง

$\bar{x}_l$ คือ คะแนนเฉลี่ยของกลุ่มต่ำ

s_h^2 คือ คะแนนความแปรปรวนของกลุ่มสูง

s_l^2 คือ คะแนนความแปรปรวนของกลุ่มต่ำ

n_h คือ จำนวนของกลุ่มตัวอย่างในกลุ่มสูง

n_l คือ จำนวนของกลุ่มตัวอย่างในกลุ่มต่ำ

$\bar{x} = \frac{\sum x}{n}$ (* สูตรหาค่า $\bar{x}_h$ และ $\bar{x}_l$)

$\sum x$ คือ ผลรวมของคะแนนทั้งหมดในกลุ่ม (ของแต่ละข้อ)

n คือ จำนวนคนในกลุ่ม (กลุ่มละ 8 คน)

$s^2 = \frac{n\sum x^2 - (\sum x)^2}{n(n-1)}$ (** สูตรหาค่า s_h^2 และ s_l^2)

$\sum x$ คือ คะแนนรวมของข้อที่ i

$\sum x^2$ คือ ผลรวมของคะแนนข้อที่ i ยกกำลัง 2

n คือ จำนวนคน

Table A.9 การเรียงค่าคะแนน และแบ่งกลุ่มสูง กลุ่มต่ำของแบบวัดทัศนคติ

ลำดับที่	คนที่	คะแนนรวม	การแบ่งกลุ่ม
1	6	166	สูง
2	20	164	สูง
3	21	156	สูง
4	16	152	สูง
5	25	151	สูง
6	13	150	สูง
7	28	148	สูง
8	17	147	สูง
9	29	143	ปานกลาง
10	3	142	ปานกลาง
11	7	142	ปานกลาง
12	5	140	ปานกลาง
13	23	138	ปานกลาง
14	19	137	ปานกลาง
15	1	136	ปานกลาง
16	27	136	ปานกลาง
17	18	134	ปานกลาง
18	14	132	ปานกลาง
19	2	129	ปานกลาง
20	8	128	ปานกลาง
21	15	124	ปานกลาง
22	11	122	ปานกลาง
23	4	121	ต่ำ
24	10	121	ต่ำ
25	24	121	ต่ำ
26	22	120	ต่ำ
27	30	120	ต่ำ
28	9	117	ต่ำ
29	12	117	ต่ำ
30	26	116	ต่ำ

Table A.10 แสดงค่าอำนาจจำแนกของแบบวัดทัศนคติ

ข้อที่	x_h	x_l	$\bar{x}_h$	$\bar{x}_l$	s_h^2	s_l^2	t
1	37	30	4.63	3.75	0.27	0.50	2.82*
2	35	30	4.38	3.75	0.27	0.79	1.72
3	35	26	4.38	3.25	0.55	0.21	3.63*
4	35	24	4.38	3.00	0.55	0.29	4.25*
5	38	31	4.75	3.88	0.21	0.41	3.13*
6	37	32	4.63	4.00	0.27	0.29	2.38*
7	37	30	4.63	3.75	0.27	0.50	2.82*
8	40	31	5.00	3.88	0.00	0.70	3.81*
9	36	26	4.50	3.25	0.29	0.79	3.42*
10	31	23	3.88	2.88	0.13	0.41	3.86*
11	38	32	4.75	4.00	0.21	0.29	3.00*
12	38	31	4.75	3.88	0.21	0.41	3.13*
13	36	30	4.50	3.75	0.29	0.21	3.00*
14	38	33	4.75	4.13	0.21	0.41	2.24*
15	37	29	4.63	3.63	0.27	0.27	3.86*
16	39	32	4.88	4.00	0.13	0.29	3.86*
17	34	24	4.25	3.00	0.50	0.57	3.42*
18	34	24	4.25	3.00	0.50	0.57	3.42*
19	32	28	4.00	3.50	1.14	0.86	1
20	29	21	3.63	2.63	2.84	0.55	1.54
21	27	22	3.38	2.75	3.41	1.93	0.77
22	31	19	3.88	2.38	1.84	1.70	2.26*
23	32	17	4.00	2.13	1.71	1.27	3.07*
24	30	18	3.75	2.25	2.21	1.64	2.16*
25	38	26	4.75	3.25	0.21	1.07	3.74*
26	32	17	4.00	2.13	1.43	0.98	3.42*
27	28	20	3.50	2.50	1.71	0.86	1.76*
28	34	21	4.25	2.63	0.50	0.27	5.25*
29	37	32	4.63	4.00	0.27	0.29	2.38*
30	37	31	4.63	3.88	0.55	0.41	2.16*
31	36	29	4.50	3.63	0.29	0.84	2.33*

Table C.2 แสดงค่าอำนาจจำแนกของแบบวัดทัศนคติ (ต่อ)

ข้อที่	x_h	x_l	$\bar{x}_h$	$\bar{x}_l$	s_h^2	s_l^2	t
32	37	31	4.63	3.88	0.27	0.41	2.58*
33	32	34	4.00	4.25	0.86	0.50	-0.61
34	31	34	3.88	4.25	1.27	0.50	-0.80
35	31	17	3.88	2.13	1.27	0.98	3.30*
36	25	18	3.13	2.25	1.84	0.50	1.62

* มีค่าอำนาจจำแนกอยู่ในเกณฑ์ที่กำหนด

1.1.3 เกณฑ์ของค่าอำนาจจำแนกแบบที ต้องมีค่าอำนาจจำแนกตั้งแต่ 1.75 หรือมากกว่า ในการหาประสิทธิภาพของแบบวัดทัศนคติทั้งหมด 36 ข้อ พบว่าข้อที่มีอำนาจจำแนกอยู่ในเกณฑ์มาตรฐานจำนวน 29 ข้อ คือ ข้อ 1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, และข้อ 35 ส่วนข้อ 2, 19, 20, 21, 33, 34 และข้อ 36 จำนวน 7 ข้อ มีค่าน้อยกว่า 1.75 ซึ่งถือว่าน้อยกว่าเกณฑ์มาตรฐาน

1.2 การหาความเชื่อมั่น (reliability) โดยการพิจารณารวมทุกข้อคำถามในแบบสอบถาม โดยใช้วิธีการของครอนบาค (Cronbuch) เป็นสูตรสัมประสิทธิ์แอลฟา (coefficient) ซึ่งในแบบวัดทัศนคติชุดนี้มีค่าความเชื่อมั่นอยู่ที่ระดับ 0.85 ตามสูตรในการคำนวณดังต่อไปนี้ (พวงรัตน์ ทวีรัตน์, 2538 อ้างอิงใน พัชราวดี คำรอด, 2550)

$$\alpha = \frac{N}{N-1}\left(1 - \frac{\sum s_i^2}{s_t^2}\right)$$

α คือ สัมประสิทธิ์ความเชื่อถือได้ของเครื่องมือที่ใช้ในการวัด

$\sum s_i^2$ คือ ผลรวมของความแปรปรวนของคะแนนที่วัดได้จากแต่ละข้อ *

s_t^2 คือ ค่าความแปรปรวนของคะแนนจากคำถามทุกข้อ **

N คือ จำนวนข้อคำถามหรือจำนวนรายการทั้งหมดที่ใช้วัด

$$s^2 = \frac{N\sum x^2 - (\sum x)^2}{N(N-1)}$$ (* สูตรหาค่า s_t^2 รายละเอียดใน Table C.3)

$\sum x$ คือ คะแนนรวมของข้อที่ I (4,070)

$\sum x^2$ คือ ผลรวมของคะแนนข้อที่ i ยกกำลัง 2 (558,110)

N คือ จำนวนคน (30)

แทนค่า s_t^2 จากสูตร

$$s_t^2 = \frac{30(558{,}110) - (4{,}070)^2}{20(30-1)}$$

$$s_t^2 = \frac{16{,}743{,}300 - 16{,}564{,}900}{870}$$

$$s_t^2 = 205.58$$

การหาค่า s_i^2จากสูตร

$\sum x$ = คะแนนรวมของข้อที่ i

$\sum x^2$ = ผลรวมของคะแนนข้อที่ iยกกำลัง 2

การหาค่า s_i^2ของแต่ละข้อจนครบ แล้วนำค่า s_i^2 มารวมกัน ตามรายละเอียดใน Table C.4

$$\sum s_i^2 = 36.28$$

แทนค่าเพื่อหาค่าความเชื่อมั่น

$$\alpha = \frac{36}{36-1}\left(1 - \frac{36.28}{205.58}\right)$$

$$\alpha = 1.03(0.82)$$

$$\alpha = 0.85$$

Table A.11 ค่า S_t^2 ของแบบวัดทัศนคติ

คนที่		x		x^2
1		136		18,496
2		129		16,641
3		142		20,164
4		121		14,641
5		140		19,600
6		166		27,556
7		142		20,164
8		128		16,384
9		117		13,689
10		121		14,641
11		122		14,884
12		117		13,689
13		150		22,500
14		132		17,424
15		124		15,376
16		152		23,104
17		147		21,609
18		134		17,956
19		137		18,769
20		164		26,896
21		156		24,336
22		120		14,400
23		138		19,044
24		121		14,641
25		151		22,801
26		116		13,456
27		136		18,496
28		148		21,904
29		143		20,449
30		120		14,400
รวม	$\sum x$	4,070	$\sum x^2$	558,110
			S_t^2	205.58

Table A.12 ค่า $\sum x_i$, $\sum x_i^2$ และ $\sum s_i^2$ ของแบบวัดทัศนคติ

ข้อที่	$\sum x_i$	$\sum x_i^2$	s_i^2
1	130	16,900	0.57
2	129	16,641	0.63
3	117	13,689	0.64
4	111	12,321	0.91
5	129	16,641	0.63
6	128	16,384	0.41
7	125	15,625	0.63
8	135	18,225	0.60
9	107	11,449	0.87
10	98	9,604	0.69
11	130	16,900	0.44
12	136	18,496	0.40
13	125	15,625	0.42
14	131	17,161	0.45
15	122	14,884	0.62
16	135	18,225	0.47
17	100	10,000	0.99
18	104	10,816	0.74
19	103	10,609	1.22
20	100	10,000	1.54
21	95	9,025	2.63
22	93	8,649	2.23
23	92	8,464	2.20
24	90	8,100	2.34
25	120	14,400	1.17
26	87	7,569	2.30
27	91	8,281	1.55
28	91	8,281	1.41
29	133	17,689	0.39
30	128	16,384	0.41
31	122	14,884	0.62

Table A.12 ค่า $\sum x_i$, $\sum x_i^2$ และ $\sum s_i^2$ ของแบบวัดทัศนคติ

ข้อที่	$\sum x_i$	$\sum x_i^2$	s_i^2
32	132	17,424	0.46
33	124	15,376	0.74
34	116	13,456	1.29
35	85	7,225	1.45
36	76	5,776	1.22
		$\sum s_i^2$	36.28

1.3 รายละเอียดแบบวัดทัศนคติหลังจากการหาประสิทธิภาพอำนาจจำแนก แบบวัดทัศนคติมีทั้งหมด 36 ข้อ แบบสอบถามเชิงบวก 22 ข้อ และเชิงลบ 14 ข้อ จากการหาค่าอำนาจจำแนกแล้ว ข้อ 2, 19, 20, 21, 33, 34 และข้อ 36 จำนวน 6 ข้อไม่ผ่านเกณฑ์ ทำให้เหลือแบบสอบถามเชิงบวก 19 ข้อ และเชิงลบ 10 ข้อ จำนวน 29 ข้อตามรายละเอียดต่อไปนี้

Table A.13 แสดงการคัดเลือกแบบสอบถามทัศนคติ

ข้อใหม่	ข้อเก่า	คำถามทัศนคติ	ผ่าน / ไม่ผ่าน
กายภาพของพื้นที่ศึกษาในจังหวัดสมุทรสงคราม			
1.	1.	ดินในพื้นที่มีความเหมาะสมต่อการปลูกไม้ผล	ผ่าน
-	2.	น้ำในพื้นที่มีความเหมาะสมต่อการปลูกไม้ผล	ไม่ผ่าน
2.	3.	อากาศในพื้นที่มีความเหมาะสมต่อการปลูกไม้ผล	ผ่าน
3.	4.	ธาตุอาหารในพื้นที่มีความอุดมสมบูรณ์	ผ่าน
ไม้ผลพันธุ์พื้นเมือง			
4.	5.	มีความทนทานต่อโรคและแมลงมากกว่าพันธุ์ไม้ผลที่ปรับปรุงใหม่	ผ่าน
5.	6.	มีประโยชน์ต่อระบบนิเวศ	ผ่าน
6.	7.	มีคุณค่าทางเศรษฐกิจ	ผ่าน
การอนุรักษ์สายพันธุ์ไม้ผล หรือสาเหตุที่เกษตรกรรักษาอาชีพการปลูกไม้ผลต่อไป			
7.	8.	ปลูกเพื่อสืบทอดอาชีพบรรพบุรุษ	ผ่าน
8.	9.	รายได้ดี	ผ่าน
9.	10.	ราคาที่จำหน่ายในปัจจุบันมีความเหมาะสม	ผ่าน
11.	12.	ต้องการรักษาสายพันธุ์ และชนิดพันธุ์ของไม้ผลไว้	ผ่าน
10.	11.	อาชีพทำสวนผลไม้เป็นอาชีพที่อิสระ	ผ่าน

Table A.13 แสดงการคัดเลือกแบบสอบถามทัศนคติ (ต่อ)

ข้อใหม่	ข้อเก่า	คำถามทัศนคติ	ผ่าน / ไม่ผ่าน
12.	13.	ชนิดพันธุ์ สายพันธุ์ที่ปลูกอยู่ในปัจจุบันดีอยู่แล้ว	ผ่าน
13.	14.	การคัดเลือกสายพันธุ์จากเกษตรกรดีกว่านำมาจากที่อื่น	ผ่าน
14.	15.	อาชีพทำสวนผลไม้ในปัจจุบันมีความมั่นคง	ผ่าน
15.	16.	ท่านมีความภาคภูมิใจในอาชีพทำสวนผลไม้	ผ่าน
สาเหตุที่ทำให้เกษตรมีแนวโน้มที่จะเลิกปลูกไม้ผล			
16.	17.	*รายได้ไม่ดี	ผ่าน
17.	18.	*ผลผลิตน้อย	ผ่าน
-	19.	*การรบกวนจากการสร้างเขื่อน	ไม่ผ่าน
-	20.	*การรบกวนจากสังคมเมือง	ไม่ผ่าน
-	21.	*การรบกวนจากโรงงานอุตสาหกรรม	ไม่ผ่าน
18.	22.	*ระบบและคุณภาพน้ำไม่ดี	ผ่าน
19.	23.	*คุณภาพอากาศไม่ดี	ผ่าน
20.	24.	*คุณภาพดินไม่ดี	ผ่าน
21.	25.	*ต้องการเปลี่ยนไปประกอบอาชีพอื่น	ผ่าน
22.	26.	*อายุมากขึ้น ทำการเกษตรไม่ไหว	ผ่าน
23.	27.	*ขาดแรงงาน	ผ่าน
24.	28.	*เป็นงานที่เสี่ยงอันตราย	ผ่าน
ด้านวิถีชีวิต ภูมิปัญญา ที่เกี่ยวข้องกับอาชีพการปลูกไม้ผล			
25.	29.	ภูมิปัญญามีความสำคัญต่อเกษตรกร	ผ่าน
26.	30.	การปลูกไม้ผลมีความสำคัญต่อการดำเนินชีวิตของเกษตรกร	ผ่าน
27.	31.	ภูมิปัญญาที่สำคัญเกิดจากการทำสวนผลไม้	ผ่าน
28.	32.	คนในชุมชนควรอนุรักษ์ภูมิปัญญาท้องถิ่นไว้	ผ่าน
ปัจจัยภายนอกที่ส่งผลต่อการปลูกไม้ผล			
-	33.	การส่งเสริมการเกษตรของรัฐบาลมีความสำคัญ	ไม่ผ่าน
-	34.	แรงงานเป็นส่วนสำคัญของการปลูกไม้ผล	ไม่ผ่าน
29.	35.	*ราคาตลาดทำให้เกษตรกรต้องปรับเปลี่ยนชนิดพันธุ์ สายพันธุ์ไม้ผล	ผ่าน
-	36.	*กระแสของสังคมเมือง เทคโนโลยี ทำให้แนวโน้มการปลูกไม้ผลลดลง	ไม่ผ่าน

* ทัศนคติในเชิงลบ

BIOGRAPHY

NAME	Miss Dalin Phunbamphen
DATE OF BIRTH	30 July 1980
PLACE OF BIRTH	Bangkok, Thailand
INSTITUTIONS ATTENDED	King Mongkut's University of Technology North Bangkok, 2001-2002 Bachelor of Science (Computer science) Mahidol University, 2006-2011 Master of Science (Technology of Environmental Management)