Doctor of Philosophy (Agricultural Research and Development)
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TITLE: Contribution to Sustainable Domestication of Sugar-Palm

(*Arenga westerhoutii* Griff.) (Palmae) at Pha Thong Sub-district,

Tha Wang Pha District, Nan Province, Thailand

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THESIS

CONTRIBUTION TO SUSTAINABLE DOMESTICATION OF
SUGAR-PALM (*Arenga westerhoutii* Griff.) (PALMAE)
AT PHA THONG SUB-DISTRICT, THA WANG PHA
DISTRICT, NAN PROVINCE, THAILAND

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A Thesis Submitted in Partial Fulfillment of
the Requirements for the Degree of
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The study on contribution to sustainable domestication of sugar-palm (*Arenga westerhoutii* Griff.) (Palmae) was conducted from October 2005 to June 2007 at San Charoen and Nam Ki villages, Pha Thong sub-district, Tha Wang Pha district, Nan province, Thailand. An increasing in the number of sugar-palm trees in Pha Thong community was obtained from good seedling practices through seed transplanting and seedling fertilization along with forest management training for villagers. There was no significant difference on community participation in forest management between the two villages. The villagers were trained on wise uses of seeds and leaves of the sugar-palm. Utilization of seeds included sugar-palm seeds in syrup and sugar-palm yam of either pineapple or strawberry. Broom and roofing were able to obtain from sugar-palm leaves. The commercial value of sugar-palm's fresh seeds and leaves was discussed.

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TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

CONTRIBUTION TO SUSTAINABLE DOMESTICATION OF SUGAR-PALM (*Arenga westerhoutii* Griff.) (PALMAE) AT PHA THONG SUB-DISTRICT, THA WANG PHA DISTRICT, NAN PROVINCE, THAILAND

INTRODUCTION

Sugar-palm or Tao, *Arenga westerhoutii* Griff. (Palmae) is an important economic plant of northern Thailand (Pongsattayapipat and Barfod, 2005; Chantaraboon, 2002; Whitmore, 1998; and Jones, 1994). *A. westerhoutii* has been mistakenly called *A. pinnata* with its common name entitled "Chid." In Thailand, the main consumption is utilization of young seed as dessert or as ice-cream topping. Young shoot can be used as a recipe in many varieties of Thai food. Sugar, wine, and alcoholic drinks are made-up from the sap. A starch called sago is made from the pith. The duration of the vegetative and fruiting stages of wild sugar-palm was 15 – 18, and 3 – 5 years, respectively. A sugar-palm tree can have 5 – 6 clusters of fruit, and the plant dies afterward (Chantaraboon *et al*., 2009, 2010). Because of this lengthened vegetative stage, sugar-palm is not grown as a plantation crop in Thailand, but it has been harvested from the forest as a non-timber forest product (Chantaraboon, 1998a, 1998b). Eighty percent of sugar-palm production area in Nan province is in Pha Thong sub-district of Tha Wang Pha district (Chantaraboon, 2002, 2005). In Pha Thong, the annual income from sugar-palm is approximately 10,000 – 20,000 Baht per household of hill tribe villagers. The overall annual production of sugar-palm in Nan province is about 300 – 350 tons with an estimate value of 5 million Baht (Chantaraboon *et al*., 2009, 2010).

The most important threat facing sugar-palm production in Nan is the decreasing of sugar-palm trees mainly those of the fruiting stage in the last three-year period (2001–2004) compared with the earlier period (1998–2001) (Chantaraboon, 2005). Five major causes of the decrease in sugar-palm studied by Chantaraboon (2002, 2005) were: (1) villagers cut down the entire fruiting clusters without leaving

any segments of the clusters to reproduce; (2) villagers cut down young trees in order to harvest the pith for food; (3) forest fire; (4) seed pests, i.e. wild boars (*Sus scrofa*), and the Asian palm civet (*Paradoxurus hermaphroditus*); and (5) intrinsically low survival rate of sugar-palm from seedling to the small trees. Moreover, most Pha Thong villagers, generally Hmean or Yao (hill tribe people), who harvest sugar-palm from the forest, have no interest in sugar-palm restoration.

All major causes mentioned above as well as the lack of knowledge in sugar-palm management of villagers placed the sugar-palm production in Nan at considerable risk of extinction. This study is intended to solve these problems, and to identify suitable methods contributed to the domestication of *A. westerhoutii* as a fruit crop. The objectives-oriented approach (Burikam, 2003) was planned for sustainable domestication of the sugar-palm.

OBJECTIVES

Specifically, the two specific objectives engaged in this study are: (1) an increasing in the number of sugar-palm trees in Pha Thong community; and (2) wise used of seeds and leaves of the sugar-palm. The first objective has 6 experiments: (1.1) practical seed germination method (1.2) suitable transplanting stage; (1.3) seedling fertilization; (1.4) training on forest management; (1.5) community participation; and (1.6) sugar-palm forest restoration. Wise use of sugar-palm's seeds and leaves consists of 2 experiments: (2.1) training on the fruit processing; and (2.2) training on the utilization of sugar-palm's leaves.

LITERATURE REVIEW

Study Site.

Nan Province

Nan is the borderland province, located in the north of Thailand. The distance from Nan to Bangkok is 668 kilometers. Map of Thailand and Nan province is show on Figure 1. The area of Nan province is 7,170,045 rai or 11,472.076 square kilometers. About 85% of are mountainous areas or with high slopes, the other 15% of the province are plain lands. The highest mountain in Nan is 2,115 meters above average sea level. The low land is about 200–300 meters above average sea level (A working group in plan, agricultural data and cooperative of Nan province, 1997). The important mountains are western Pee Pan Nam and Luang Pra Bang.
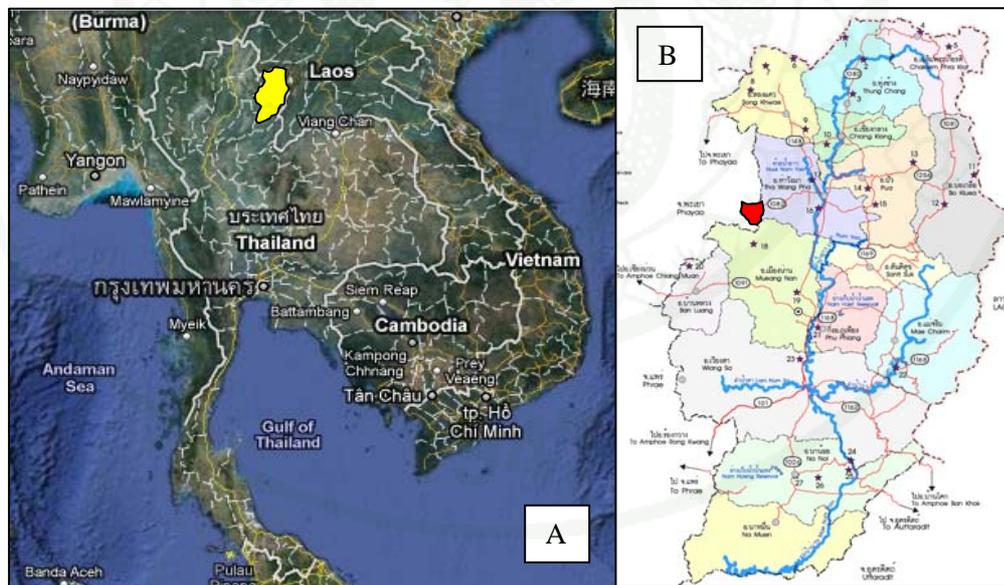
Figure 1 A) Map of Thailand showing yellow label is Nan province on the left side
B) Map of Nan province showing red label is Pha Thong sub-district on the right side

The forest of Nan province has continually decreased, in 1987 the forest of Nan was 3,201,750 rai or about 44.65% of Nan forest areas; while in 1998 it was about 2,995,238 rai or 41.77% of the whole province. The population in Nan was 427,676 in 1986, with the increment of 13.2% in 1987 to 484,116.

Pha Thong sub-district, Tha Wang Pha district

There are 4 Hmean hill tribe villages in Pha Thong sub-district which harvest sugar-palm, i.e. Nam Ki, San Charoen, Nam Pang, and Nam Lux Tai. The Hmean hill tribes earned their living by collecting non-timber forest products and shifting cultivation. Hmean planted upland rice for 2 – 5 years, then move elsewhere for another 2 – 5 years, and returned to the old land (Tarawan, 2001). In 1855, Thai government gave permission for a forest concession in Nam Lux Tai village. In 1858, forest fires burned and destroyed many trees in the forests. In 1962 Thai government gave second permission for the forest concession at Pang Tong village (located between Nam Lux Tai and Nam Ki villages). The logs were exhausted in 1966, these concessions destroyed many trees in the forest. In 1974, Royal Forestry Department established the Center of Forest Restoration at Pang Sa village for forest restoration of Pha Thong sub-district. In 1976 Thai government gave the third permission for forest concession again at Pang Tong village. The villagers migrated to live at Nam Ki village. The huge logs were transported out of the forest until the forest trees were depleted.

The forest of Pha Thong sub-district had been changed to grassland. The climate also changed and in consequence more incidence of forest fires (Zaetern, 1996). As a result of this action, few sugar-palm trees remained in Pha Thong sub-district areas were further decreased due to the annual forest fire.

Ecology system of Pha Thong sub-district

The Office of Policy and Environment Planning (1998) studied on the ecology and the quality of watershed of Pha Thong sub-district. The Nam Ki watershed was

encountered resources deterioration, the total area of 26,250 rai (42.0 square kilometer): there were agricultural area of 6,357 rai (24.22%), forest area of 19,893 rai (75.78%), non-disturb forest 6,338 rai (31.86%), and 13,555 rai (68.14%) of the deteriorate forest. Most agricultural area was lichi (*Litchi chinensis*) orchard. The sugar-palm ecological system was recognized in Nam Ki, San Charoen, Nam Pang and Nam Lux Tai villages.

The basin of Nam Ki, San Charoen, Nam Pang and Nam Lux Tai village areas were sub-evergreen forests and watersheds. Plants found in this areas included *Knema globularis* Warb., *Sapium baccatum* Roxb., *Pterospermum diversifolium* Bl., *Actinodaphne henryi* Gamble., *Xerospermum intermedium* Radlk., *Aphanamixis polystachne* Paker, and *Arenga westerhoutii* Griff. The classification on height of the trees separated them into three classes: (1) more than 15 meters, e.g. *Knema globularis* Warb., and *Xerospermum intermedium* Radlk.; (2) 8–15 meters, e.g. *Terminalia nigrovenulosa* Pierre ex. Laness, *Knema* sp., and *Pterocarpus macrocarpus* Kurz.; and (3) less than 8 meters, e.g. *Knema* sp., *Syzegium cumini* (L.) Skeels, *Spondias pinnata* Kurz, and *Arenga westerhoutii* Griff.

The soil in these areas is clay soil with deep soil profile. It derived from sedimentary rock and flint rock. The areas are mainly sloping lands. Soil has moderate water absorbency, good air ventilation, and pH of about 4.0–5.0.

The basin of Nam Ki, San Charoen, Nam Pang and Nam Lux Tai village had the areas of sub-evergreen forest, yet the areas had many differences, including deteriorating forest, deciduous forests, savannah areas, watershed areas and agricultural areas. Many wild animal species in habited the area, such as *Muntiacus muntijak*, *Sus scrofa*, *Pycnonotus melanicterus*, *Acanthosuara lepidogaster*, *Paradoxuru shermaphroditus*, *Aegithina lafranayei*, *Pycnonotus jocosus*, *Amalops afghanus*, *Rana linnocharis*.

The average temperature of Nan province is 25.1 °C, the highest average temperature in April is 28.5 °C, and the lowest average temperature recorded in

December is 19.6 °C. Average relative humidity is 80% RH, the highest average relative humidity is 94% RH, the lowest average relative humidity is 54% RH.

Palm Propagation

Seed Treatment

Seed treatment has been mentioned in details by Macus and Banks (1999). With most palms, propagation from seed is not difficult as long as a few basic requirements are met. Among the most important are fresh seed, good sanitation, proper medium, proper hydration, and adequate heat.

The fleshy or fibrous fruit pulp frequently contains growth inhibitors. Removing it before planting will improve results. Methods for doing this vary with the quantity and type of seeds, but most begin with a preliminary 48-72-hour soak in water. Soaking causes the pulp to ferment, which weakens it for easier removal. Fruit that is slightly immature should be placed in a tightly closed plastic bag and kept in a warm spot for a week or so. This promotes ripening and softens the outer flesh for cleaning. Sometimes the seeds need to be soaked further to soften the pulp, sometimes not.

Some seeds are brittle, and without proper care may be damaged by power cleaning. Among large-seeded palms, *Actinorhytis* is particularly brittle and prone to damage, and many smaller seeds, such as *Pinanga*, must also be handled with care. When cleaning seeds, remember that the flesh of some types contain crystals of calcium oxalate, a skin irritant that can cause severe pain on contact, depending on the individual's sensitivity. For this reason, *Ptychosperma*, *Arenga*, *Caryota*, and *Wallichia* should be handled with care.

Damaging insects such as seed-boring beetles may arrive with seeds. They may reduce germination and spread to other seed batches. To minimize these risks, seeds collected from the ground, whether in the wild or from cultivated plants, and

seeds collected under unknown conditions should be soaked in a contact insecticide solution once the fruit pulp has been removed. The insecticide solution should be prepared at the same concentration you would use to spray for pests. Soak small, thinner-shelled seed, such as *Pinanga*, for 15 minutes. Soak larger, harder and less permeable seeds longer, from 20 to 45 minutes. Examples of these latter seeds are *Mauritia flexuosa*, *Bismarckia nobilis*, *Parajubaea cocoides*, and *Jubaea child*. After the insecticide soaking, rinse the seeds in clean water for 20 minutes.

After cleaning the seeds, hydrate them by soaking them in water for 24 hours, especially if you did not soak them to help remove the pulp. Within 24 hours most fresh, viable seeds will sink. There are exceptions such as *Manicaria saccifera* and *Metroxylon vitiense*, whose viable seed will float even after cleaning and soaking.

Whether or not to discard a batch of heavily infested, damaged seeds depends on their rarity and your ability to get more. For very rare seeds, when even a single germination could be valuable, plant it. Remember, however, with heavily infested seeds, especially in large quantities, there is the danger of introducing pests into your nursery. Balance this risk against the desirability of propagating the seeds and follow the treatment procedures described above.

Fungi flourish in the heat and humidity necessary for good germination, so equipment, fixtures, seeds and growing medium must be kept clean to prevent damping-off and other disease problems. Thus, may want to soak seed in a fungicide before planting.

Planting Medium

Germinate the easy varieties in a commercial mix of peat moss or sterile sphagnum moss mixed with an equal amount of perlite or vermiculite. You may also use commercially prepared, finely cut coconut coir to which the same fast-draining material has been added. Sand, wood chips, screened rock or volcanic cinder screened to a maximum size of 9 mm can substitute for vermiculite or perlite. Whatever you

use, the medium should be very porous and drain extremely well. All containers should have plenty of holes in the bottom to ensure quick and thorough drainage (Macus and Banks, 1999).

When containers and planting medium are ready, lay out the seeds on the surface, and before covering them, dust with a commercial insecticide. Bury the seeds in the medium to a depth of half the seed diameter and then cover everything with finely screened cinder (3-6 mm particle size), thick enough so it will not wash away during watering. This top-dressing dries out quickly and discourages the moss that grows on peat. Sand or finely crushed rock would work just as well. When planting is complete, place the containers on clean benches, 60-90 cm above the ground. Be sure to label your containers with a waterproof and fade-proof marker (Macus and Banks, 1999).

Palm seeds known as remote germinators may require special treatment and a little extra patience. Remote germinators push a shoot downwards as much as 20-25 cm before sending up the first leaf. The larger ones such as *Voanioala* and *Borassodendron*, should be planted in deep containers such as citrus bags or large tubs, or be transferred to such containers soon after germination. If seeds and seedlings can be protected, the collector may want to plant large remote-germinators directly in the ground (Macus and Banks, 1999).

Hydration and Heat

The most important factor in seed germination is proper hydration, followed by constant high heat. Maintaining proper hydration is the trickier of the two. Water your containers thoroughly, but just as important, let them dry out thoroughly before watering again. Over-hydration can drastically reduce the germination percentage. Once seeds begin to germinate, the containers will require more frequent watering. Seeds should be kept at 26-35 °C. Some growers provide constant bottom heat by means of electric pads on their benches (Macus and Banks, 1999).

Difficult-to-germinate Seeds

For difficult seeds and rare seeds, the most reliable method of germination is the plastic bag method. For this method, seeds are blanketed in damp sphagnum moss and germinated in zipper-type, re-sealable plastic bags. Thoroughly saturate the sphagnum moss with water and wring it until no more can be expressed. Place the seeds and the sphagnum moss inside the plastic bags and keep the bags at 26-35 °C. Check inside the bags periodically to ensure that the sphagnum has not dried out. Once seeds have germinated, place them in community or individual pots containing the potting mix described above and the quick-drying top-dressing. Germination setups can also be improvised from plastic foam boxes with tight fitting lids, such as are used to pack fish or fruit. Fill the boxes 1/3 full of fine perlite pieces and lay the seeds on top. Use a hand mister to dampen thoroughly the seeds and perlite, replace the lid and place the box in a warm location. These germination boxes are space-savers, because they can be stacked. The tight-fitting lids help keep out fungus and insects, but the boxes should be checked periodically for hydration and germination (Macus and Banks, 1999).

A final method is simply to germinate the seed on the ground in an out-of-the-way part of the greenhouse or garden. Growers have had good results this way with *Pelagodoxa henryana, Jubaea chilensis*, and some *Acrocomia* sp. Discarded seed has also been found germinating in many a surprised grower's compost pile (Macus and Banks, 1999).

Palm Seed Propagation

The primary method by which all palms are propagated is by seed. Germination of seeds for many species is slow and erratic and germination percentage can be very low. Most palm seeds germinate best if they were picked when fully ripe, had the fleshy mesocarp removed, were planted promptly in a well-drained medium, and were maintained at temperatures of 30–35 °C. Palm seed loses its viability within 3 to 6 weeks due to dehydration, but can be stored for 8 months or longer if the seed is

cleaned, air-dried, dusted with a seed protecting fungicide, sealed in a plastic container, and stored at 18 to 23 °C. (Broschat, 2011)

There are three techniques to propagate date palm: Seed propagation, offshoot propagation (traditional methods), and the recently developed tissue culture techniques (Zaid and Wet, 2002).

Seed propagation is by far the easiest and quickest method of propagation. However, it is not a true to type propagation technique and no two seedlings will be alike. Because of its diversity, the seed approach could only be useful for breeding purposes. When conditions are known to be unfavorable for date fruit production, the planting of date seeds, for future selection on fruit quality, is the most economical way of selecting clones that have some desirable characters such as rain and/or salt tolerance (Zaid and Wet, 2002).

Community Forest

The community forest as the areas managed by community's process for positive results and objectives of community were sustainable (Royal forestry department, 1994). Sanmoon (1993) defined it as the villager's area to live and to earn a living, theirs to love, to be jealously guarded, to be bound by the forest; and the areas, villagers had selected for utilization, participation in the resource management systems, and with community's accepted on the resource management rules. Important principles of forest community such as: (1) the connection of social systems and cultures with forest and resources in the forest; (2) the forest could be either natural forest or restoration forest; (3) the land right of ownership may be government or public, but community had an authority with an independent administration; (4) the objective and goals of forest management were to be harmonious with the vast majority of villagers in the community; (5) to stress on the administration was to be harmonious with the customs, traditions, beliefs, and culture of the community; and the support and participation of community; and (6) the rules of forest and resource

administration to be decided by the community (The regional community forestry training center for Asia and pacific (RECOFTC), 1999).

Forest Management

Community forest management as everything done for maintain the forest and continuous utilization, the forest's components were an equality, and the forest protection, conservation, reform, and supplement income from the forest. Thus, the community forest management was to have the broad objectives of the conservation of the forest and diversity of forest, to stipulate conditions on resources from the forest utilization to have to do with the way of life, custom, tradition, diverse culture of the community (RECOFTC, 1999). As can be seen, the definition of the community forest has many definitions from the different peoples and organizations; yet the following shows the similarities to be found: 1) must have the forest areas, and the community was to manage the forest for the useful purposes of community; 2) must have community's processes on the management for the useful purposes of community; 3) must have the forest benefit from the sustainable community objectives and to have to do with the way of life of the community. Thus, the community forest refers to the areas managed by community's processes for the benefit of the forest as well as the sustainable community's objectives. All forests reported by RECOFTC (1999) were separated into three main patterns of the forest management based on the objectives for utilization of the community:

Pattern 1, the conservation community forest: the pattern of the community relating to the conservation of environment, soil, water, and other, protection from the natural harm and including with a local beliefs and the traditions. Almost were the natural forests, with only a few a restoration forests. Commonly the forests were a watershed forest, a field fringe forest, a cemetery forest, a temple forest, a school forest or forests in a town.

Pattern 2, an economic community forest: the pattern of the community to do with the economic product from trees or non - timber forest product. The economic forest communities were a spending forest and an economic community's forest.

Pattern 3, the multi-purpose community forest: the pattern of the community in which economic products from trees and environmental conservation were parallel with each other. The objectives were the combination of those in pattern 1 and 2.

Agroforestry System

Agroforestry system is the high efficiency land's utilization planning. In particular, for the watershed areas to be managed sustainably, a land use utilization system such as an agroforestry system must be employed. This system is to benefit both the conservation of the resources and economically parallel together (Jankaew, 1996).

Agroforestry systems is a land use utilization systems, the benefit from which a forestry and agriculture, in the same time or different time, to be an equality on ecology system, economically and the social of villagers who were used the land (Nair, 1993).

However, The researchers of the International Centre for Research in Agroforestry were improved the meaning of agroforestry as "an agroforestry is a dynamic, ecologically based, natural resources management system that, through the integration of trees on farm and in the agricultural landscape, diversifies and the sustains production for increased social, economic and environmental benefits for the land users at all levels" (ICRAF, 1998)

Moreover, Preechapanya (1982) increased the characteristics of an agroforestry system even more, to a system that must be; 1) decrease soil erosion; 2) decrease an energy radiation and temperature from the sun; 3) decrease the chemical using; 4) filter the runoff water at surface soil and gain soil; and 5) to be an appropriate as the socioeconomic source of the river community and the system

responded to the fourth necessity of life, with a system which could be easily reused by villagers. Preechapanya (2001) gave more an insight to better solve the problems of the high land tribes on the watershed management to be sustainable meant that in each community the villagers must be continually planning, implementing, and monitoring for watershed areas sustainably only. In other areas were difference on an ecology, economic, social, and population. Thus, in each area were many differences in the management. In this case, the extension to villagers for the watershed management areas or the community forest management must study an indigenous' community to be added with the scientific knowledge on each an indigenous' community. Then, attempts by the community to select an appropriate technology for their community to use, these results can solve the watershed management problem to be sustainable as a whole system. (Jankaew, 1996)

Forest Resources Utilization

Forest resources utilization was the utilization of resources in the community forest sustainable as the objective to establish the community forest; the goal being for everyone to receive equally benefits from the forest. Many communities in Thailand rely on the forests; villagers use the forest benefit for their entire lives. The community forest management is not only the forest maintenance, but includes controlling and managing for peoples to use the forest benefit sustainably (RECOFTC, 1999).

Non - timber forest products kept an impacted of the resources depending on the forest and how the forests kept the components of plant, what variety and how many of the plant was being kept. The utilization from the community forest was keeping the production of the forest. Moreover, the other activities were animal husbandry, hunting wild animals. The utilization from the community forest was the mechanism for control and utilize to sustainably (Peters, 2006).

The social mechanisms and community processes to control including customs, traditions, beliefs and an indigenous knowledge were the conditions, an

agreement to transfer this from the past. Not only that, some communities had the community forest planning to settle a criterion, the forest maintaining criterion the peoples in community participated and accepted, community forest planning was doing after the people organization was established, the community forest management were included forest protection, maintenance, regeneration, and sustainable utilization. For supporting community forest management by the people in the community, the criterion of maintenance and sustainable utilization were settled. Altogether, the regeneration, and forest abundance were continuous maintaining, and controlling, monitor the community forest utilization to sustainable. Many communities helped to collect the community and resources data for use in planning, if the community forest management was supported by the government and supervision was a law, peoples in the community understood and discharge under the law. The criterion, the community lacked enthusiasm for monitoring, controlling, maintaining to sustainable resources utilization. Many communities were used a custom, tradition, ritual religions, and an indigenous knowledge in forest monitoring. Community agreements and community mechanisms impacted the mind, there was protection, more quelling than treating strongly, and then a strong punishment. Thus, community organization must have the people's encouragement to an acceptable together, and to continue monitoring, utilization and all of the forest resources relying to sustainable (RECOFTC, 1999).

The Related Research

Villagers' fruit tree growing strategies in the humid forest zone of Cameroon and Nigeria, the objectives were studied and understood on strategies; villagers used to the fruit growing and studied on the relationship between the factors were involved on 5 villages in Cameroon and Nigeria. The results that, the factors were influence to the difference of the strategies to fruit growing of each village were the market accessing, size of areas to grown, forest resources accessing. In the factors were differences on the selected fruit trees to growing strategies of difference villages or difference community were the numbers of areas were occupied, and the size of farm. Moreover, the studied were finding the small farms must were the fruit trees was density than the large farms, the strong participate of the community was related with

the market accessing, and finding many the factors were highly relationship between the factors in each village and difference village were influence on the trees planting decision (Degrande *et al.,* 2006)

"Environmental knowledge and resources management: Sumatra's Kerinci-Sablat national park" was studied on the peoples participation in the national park of Indonesia to the acceptance on the roles were settled, the studied was finding the acceptance were occurs must passed into 4 steps such as; 1) must were developing the frame work together 2) must were the public hearing 3) peoples must were an accepted in the primary 4) peoples must were the participate on declaration to used and all of the proceeding, managing and all of the steps to the stakeholders were decision in all steps. As a results, the people were proud and accepted on the pattern of the management was them were participated on the establishment (Werner, 2006).

"Sustainable harvest of non-timber plant resources in tropical moist forest: An ecological Primer" the studied was finding the steps were to the plant resources management on the tropical zone which non-timber plant to sustainable on the production were separated into 6 steps such as; 1) must selected the plant to planting by the socioeconomic principles for selected the potential plant to managing 2) must studied on the size data, structure, and density of each plant in the areas, it was the principles data to collected 3) must study about the yields by estimated the production in each year 4) survey the cycle of growth or life cycle for separated the growth phases of plant to selected, generally, were surveyed in every 5 years 5) evaluated the harvest were evaluating on conditions of the plant was harvest and 6) adjusted the value of harvest, it was adjust the value harvesting by the phase of the primary growth phase, middle growth phase, or another phase, if was not the expected, may adjust the value by real harvesting. All of 6 steps were strategies to the plant resources management in the tropical zone which non-timber plant to sustainable (Peters, 2006).

"Resources development for the non-timber forest product" the studies were finding, the trend of research and development on the forest resources. Especially, the non-timber forest product for developing management to the sustainable technology were think of this topics: 1) the increasing knowledge about the forest resources

management on the non-timber forest product 2) were testing, evaluating, and separating on the non-timber forest product by the yield in each kind of plant 3) pushing the methodology of study and to do the pattern of production were difference on kind of plant 4) were advertising, public relation and pushing the non-timber forest product to an economically plant 5) introduce the non-timber forest product to planting and developing, breeding and improving by research on the farm pattern 6) moving up the non-timber forest product to the high product and developing to an economically plant 7) developing an agroforestry system by used the non-timber forest product to utilization 8) developing system and harvesting method, and all of studied about pre and post the harvest methods for the non-timber forest product 9) developing on the scientific and made the management system to used for the non-timber forest product situation only 10) developing a planting system of the non-timber forest product in the forest for increasing the number of non-timber forest product in the forest to increase 11) reserved the forest and natural to stand on the biodiversity 12) developing the transportation system, storage of the non-timber forest product, especially, perishable plant and 13) developing the diversity of the products and the method to increases quality of the non-timber forest product. All of 13 manners were an importance to research, development and improvement on the non-timber forest product (Reis, 2006).

In Thailand, Researchers were related studied with researchers in aboard such as; Utumpan *et al*. (2005) were studied on the topic "the process of longan strategies development" the results were finding, the process to the development strategies of longan were; 1) syntheses of longan production data 2) repeated the situation and longan marketing the helping method from the government 3) work shop meeting by the stakeholders were to understanding together and revising, checking the data 4) before the end of each meeting, everyone were to received an assignment to searching data for the next meeting and 5) integrated the whole data together and doing longan solving problems planning or strategies for longan solving problems.

"Processing to make strategies of mango" in this research, processing to make strategies was; 1) syntheses the production system were to received from the secondary data, and research projects were doing by another researchers 2) doing an

activities with the villagers groups 3) visiting the mango orchard of villagers 4) visual education on the success mango orchard 5) work shop meeting for doing the mango group development strategies by used the groups participate of all the stakeholders to settled the strategies (Moonfear *et al*., 2005).

Biology and Economy of *Arenga westerhoutii*

Everyone knew about sugar-palm was an economically fruit of Nan province from the past up to the present, but in the present the number of the inflorescence sugar-palm trees were decreased, to be due to sugar-palm was hapaxanthic palm and was non the sugar-palm genetic conservation project before. From this reasons, many researchers were interested and began to study on sugar-palm. The first research article on sugar-palm in Nan province was "survey and study on sugar-palm (*Arenga pinnata*) characters in Nan province". (Chantaraboon, 1998a) In that time, in Thailand sugar-palm has *Arenga pinnata* in scientific name (Boonnak, 1992). Until, Pongsattayapipat and Barfod (2005) were studied about the difference between sugar-palm and Tao, the results from this studied were Tao was *Arenga westerhoutii* Griff. and sugar-palm or Chid was *Arenga pinnata* (Wurmb) Merr. and 2 palms are similarity. But the difference between sugar-palm and Tao are the rachis of Tao are arranged neatly, in seemingly perfect order; however the rachis of Chid followed no specific pattern and stuck out in many directions (Pongsattayapipat and Barfod, 2005; The Botanical Garden Organization, 2004) as can be seen in Figure 2.

Figure 2   Leaves of the two sugar-palms, on the left *A. westerhoutii* Griff.; and on the right *A. pinnata* (Wurmb) Merr.

If considering on the utilization, Tao is utilized from an endosperm to processing for make dessert, but sugar-palm is utilized by tapping of sap from the inflorescence for sugar, wine or vinegar and extracted of starch from the trunk for sago, the people are called sugar-palm. Sugar-palm is narrow distributed only the level 0-200 meter from MSL. and abundant on the limestone foothills, but Tao is widespread than sugar-palm, and about 0-1,200 meter from MSL., distributed in all the region of Thailand, abundant on the limestone and steep slopes. All of Tao is widespread in the evergreen and semi-evergreen forest in Thailand, but sugar-palm is always seen around the human habitation (The Botanical Garden Organization, 2004).

In terms of the utilization of these plants, Tao is mainly use their young endosperm while Chid is mainly used their sap from inflorescence for making brown sugar (Pongsattayapipat and Barfod, 2005; The Botanical Garden Organization, 2004).

Then, in this the literature review, if data of sugar-palm were occurred before 2005 were called all of sugar-palm and Tao. But next to 2005 were called Tao or *Arenga westerhoutii* Griff. only. The research on the title "survey and study on sugar-palm (*Arenga pinnata*) characters in Nan province" (Chantaraboon, 1998a, 1998b) the result from this study was Tao or Chid, sugar-palm, Black sugar-palm, Gomuti Palm and the scientific name was *Arenga pinnata* (Wurmb) Merrill (Mogea, 1999) or *Arenga saccharifera* Labill (synonyms). The original of this palm is the region of Thailand Malaysia and Borneo, sugar-palm is in Arecaceae or Palmae Family as coconut, toddy palm, or another palms. The fruits from this palm called "Chid" or "Tao" (Chantaraboon, 1998b). Chid is a monocotyledon plant, solitary, without branch, it take about 15-18 years of age to flowering stage, Chid is a single time flowering plant which its going to die after flowering, there are about 5-6 clusters of the fruits for a Chid tree, when the last cluster becoming to ripe its trunk is slowly die at the same time (Chantaraboon, 1998a), its called hapaxanthic (Whitmore, 1998; Jones, 1994) as Laan (*Carrypha* sp.) and some species of Tao-lang (*Caryota* sp.) and some species of Rattan (*Calamus* sp.) (Boonnak, 1992).

Chid is a single trunk palm, pinnate leaf, the bole of the leaf cover with the fibrous sheaths, Chid's flowers are polygamous as the staminate flower and the pistillate flower are on the whole tree, but still on an another inflorescence. The staminate flower is long about 1-2 meters; the pistillate flower is longer than the staminate flower. The time of the pistillate flower from flowering to fruiting and to the fruit is ripening and drop on the earth is about 30-36 month, and the height about 6-15 meters, the old leaves are hanging cover around Chid's tree. The young fruit about 12-18 months can eat, in this phase the villagers keep it to processing for made dessert as sugar-palm in syrup. The fruit when mature to ripening the fruit skin is dark purple to black, seed coat change from soft yellow shell to hard black thin shell, latex in the fruit (mesocarp part) is calcium oxalate substance, it is very itchy when it contact the skin (Chantaraboon, 1998a, 1998b).

The result of genetic survey in Nan by Chantaraboon (1998a, 1998b) was genetic registered only 7 districts of the 14 districts of Nan province, and registered only the 34 Chid trees, because in the 7 districts were not have the Chid trees on an inflorescence phase. In 7 districts were registered only 3 districts were kept the young Chid trees to planting in the villages (*ex situ*) but not many. The price of Chid was increasing from 1995 was 180-200 baht per a bin (20 liters) to 1997 was 220-230 baht per a bin (20 liter) because Chid trees were decreasing, due to villagers were destroyed Chid genetic, and Chid were non the opportunity to develop from the young fruit to the mature fruit and to germination to Chid seedling.

From the past confusions as to the identity of the two palms, it is often necessary to preset data in Thailand which researched the two fruits as one. However, this problem can be acceptably rectified by assuming that any studies of Tao or Chid were conducted in the northern regions of Thailand is a study based exclusively on the Tao. Of the past, in Thailand the data from research or the old knowledge should presented all of Tao and Chid, but the observation about this case were Chid was almost study in the southern region of Thailand, but other region was Tao. This confusion occurred in Laos also, and many articles used *A. westerhoutii* and *A. pinnata* for Mak Tao and sugar-palm in Laos (Mak means a fruit in Laos) (Food and

Agriculture Organization (FAO.), 2006). An author was surveyed on Tao in Laos and discovered that there existed only Tao and not Chid.

Nan province has the highest sugar-palm production in Thailand (Chantaraboon, 2005; The Botanical Garden Organization, 2004). Thus, the television program "Gob Nok Kara" (the frog outside coconut shell) selected to use Nan site as the feature of an article titled "Loog Chid Loog Lek Nai Paa Luck" ("A small seed of sugar-palm in a virgin forest") to broadcast on channel 9 of Thailand (Mass Communication of Thailand). In the "small seed of sugar-palm in a virgin forest", a merchant at Mahanark Market, Bangkok, narrates most of sugar-palm in syrup which is sold at Mahanark Market comes from Nan province. Then, the announcer explores the background of sugar-palm including its processing into sugar-palm syrup from Nan forest, until its arrival at the ice cream shop in Bangkok. This feature was broadcasted on February 10, 2006, and "a small seed of sugar-palm in a virgin forest" was showed about Nan was the most sugar-palm production in Thailand (TV Burapa Ltd., 2006).

The study on the quantity of sugar-palm production in Nan, has a little data because the production areas of Nan are distributed throughout the whole province, but the highest production area of sugar-palm can be found in Pha Thong sub-district, Tha Wang Pha district; which produces nearly 80% of the entire province's sugar-palm (Chantaraboon, 2002, 2005; Chang-ngun, 2001; Tharawan, 2001). The remaining 20% are produced in the other areas around Nan province including Pha Ka sub-district, Tha Wang Pha district, Bor sub-district, Muang Nan district, Puu Fah sub-district, Bo Kluea Tai sub-district Bo Kluea district, Chon Dan sub-district, Na Rai Loung sub-district, Song Kawae district, Peur sub-district, and Pra Thart sub-district, Chiang Klang district. Many researchers studied on sugar-palm in only village and hence the quantity of sugar-palm production in Nan has no the official data. Furthermore, while Nan has 2 sugar-palm processing factories, neither factory provided any data in regards to sugar-palm production. An author was interviewed 2 factories owners, which only gave data from Laos; they were obtained about 75% of the total annual production (Chantaraboon *et al*., 2009, 2010). However, an author collected data from the other researchers who had studied about sugar-palm in Nan.

The results of quantity of sugar-palm production in Nan were about 300 – 350 tons per year (Chang-ngun, 2001; Tharawan, 2001) and imported from Laos about 1,000 – 1,200 tons per year, the production power per year of 2 factories were 1,400 – 1,500 tons per year (Chang-ngun, 2001; Tharawan, 2001).

In 2000, villagers of San Charoen village, Pha Thong sub-district sold in total about 2,580,000 Baht is worth of sugar-palm (Chang-ngun, 2001); and in the year 1997-1998 the villagers of Nam Ki village, Pha Thong sub-district sold in total about 1,354,375 Baht is worth of the fruit. (Tharawan, 2001).

Pha Thong sub-district has 8 villages including, 3 villages of native Thai, Lour (hill tribe people) 1 village and Hmean (Yao) (hill tribe people) 4 villages. The population of Pha Thong sub-district is about 4,230 persons, or about 715 households, (Rean ruu ruam kan san sang chum chon Project, 2004). In all of the villages of Pha Thong sub-district, only 4 Hmean villages tribes harvested sugar-palm as a career from the forest.

This included 336 households, or about 47% of the total households in Pha Thong sub-district. In every year, the income from sugar-palm was about 4,000,000 Baht, averaging about 10,000-20,000 Baht per household per year. The production of sugar-palm per year of Nan was about 300-350 tons. The price was 15,000 Baht per ton (15 Baht per kilogram). Therefore, in every year the villagers of Nan province received an income from sugar-palm about 5,000,000 Baht per year. This income was used by the villagers to be spent on their families and to buy the chemicals for upland rice growing in the next season (Chantaraboon, 2005).

From the primary data, we seen that in the past 2 factories used 100% of sugar-palm for raw material from Nan's forest, nowadays only 25% came from Nan's forests and 75% imported from Laos. The causes were came from the numbers of sugar-palm in inflorescence phase in Nan's forest had decreased; sugar-palm forest management by villagers has had low effectiveness, and non sugar-palm restoration in Nan's forest. Conclude that, human beings are the largely cause of the decreasing numbers of sugar-palm problem (Chantaraboon, 2002, 2005).

In these times, the social science researchers were studied on Pha Thong sub-district together by Kanjanapan (n.d.) was studied about the community on Nan watershed area, and he said "the way of life of the man, who live with sugar-palm and the resources, realized on the cultural volume, resources management knowledge, and the way of life were to do a favor of an ecology, these community were the man who protect an environment social and cultural. The community must have an ability to maintain and manage resources in the community by themselves" and Kanjanapan (n.d.) said about Mr. Joylin Saetern, "he said as; the villagers lives with the mountain and the forest; they use the wood to build houses and they eat the food and the herbs from the forest, thus if the villagers does not conserve the forest, humans will die". The relationship between the forest and humans was previously one of integrated character of the sustaining life harmoniously. But when the old management system became impacted by the economic forest utilization for sugar-palm, the result is that the resources are largely destroyed. Until 1987, competing for resources was a strong trend. Therefore, villagers proposed an allotment area to harvest sugar-palm, and settled a commitment for everyone to maintain the forest; and when harvest began everyone harvested at the same time. But sometimes there were disputes as people did not follow these guidelines.

However, Nam Ki Klang village was different the management, in this village sugar-palm forest was cleared and divided into sections. Each household was assigned an area of forest to maintain and remunerate sugar-palm in these areas; however they did not have the right of ownership for this area or its wood. If in a given year villagers choose not to harvest this area, they must give an opportunity to other villagers to do also. The other villagers would be required to ask permission each year, and to agree about how much they will harvest. If the villagers do not carry out activities in this area, such as making the fire stripes to protect the trees, they must return the right of ownership. Kanjanapan (n.d.) Mr. Joylin Saetern established the rules for the forest conservation at Nam Ki Klang village on 1987 in the Chinese language in 9 matters as:

1. Do not cut down any tree along the stream in watershed areas.

2. Do not cut down a tree in a virgin forest.

3. Do not log for commercial purpose.

4. Villagers can use the dead log for housing.

5. Do not steal sugar-palm. If this crime is perpetrated, the fine would be double of the volume of the sugar-palm stolen. Half of the fine was to be paid to the sugar-palm owner and the other half paid to the village fund.

6. Do not burn the forest, if perpetrated this crime's punishment would be dealt with an according to the forestry official act by law.

7. Do not cut down the sugar-palm tree, if perpetrated a fine of 500 – 1,000 baht per tree must be penetrated.

8. If the owner of a sugar-palm area does not maintain on his/her area, the land may be occupied and delivered to the new owner who was maintaining this area.

9. If a sugar-palm forest is observed to be burning, and the owner of the sugar-palm area does not fire fighting; may be occupied and delivered to new owner who fighting the fire. Kanjanapan (n.d.)

In these times, Rajamangala university of technology Lanna, Nan Campus, settled the university vision to maintaining the environment of Nan province, thus the lecturers and students studied many the titles of sugar-palm in Pha Thong sub-district such as Rajchasan *et al*. (2000). Their studies about the situation of sugar-palm production in Nan province, the areas of the study were sugar-palm production areas as Song Kaware village, Na Rai Loung sub-district, Song Kawae district, Sob Khun village, Pha Ka sub-district, Tha Wang Pha district, Nam Ki village, San Charoen village, Pha Thong sub-district, and Tha Wang Pha district. The production was limited to providing for the raw material to processing factories, each household had earn their income from sugar-palms ranging from 1,750-62,150 Baht. Each a mean person harvested about 50-600 kilogram. In addition to this, 4 villages did not

restoration practice, did not maintaining the trees, and sugar-palm trees growing naturally only. Besides, Janpol and Muangchai (2000) were studied about the distribution of sugar-palm trees in watershed areas of Nan province, in these studied Janpol and Muangchai (2000); Chantaraboon (2005); and Ewers *et al.* (2001) were separated sugar-palm into 6 growth phases which were:

1) 3-6 year growth phase 2) 7-10 year growth phase

3) 11-14 year growth phase 4) 15-18 year growth phase

5) Inflorescence phase 6) Senescence phase

Phase 1-4 are the vegetative phases, and 5-6 are the reproductive phase. At the end of each phase sugar-palm trees were shown to have the following characteristics; (Chantaraboon, 2005)

1) 3 – 6 year growth phase: sugar-palm has the first true pinnate leaves (3 – 6 leaves), pinnate leaves were about 1 meter long, the trunk was not shooting above the ground, it was a shrub over the ground, the bole of leaf is covered with fibrous sheaths, and it covers the entire trunk.

2) 7 – 10 year growth phase: sugar-palm has the second true pinnate leaves (4-6 leaves), the pinnate leaves about 3 meters long, the young shoot looks like a sword, and is still located on the central part of the trunk, the young leaves are silver-purple, and the first true pinnate leaves (3-6 leaves) had died and dried, covering the bole of trunk, but had not rotted. In this phase the trunk is about 50 cm long, the trunk on the ground have the distinct fibrous roots, and the stem of the leaves accumulate on the tree trunk with the other dry leaves which were already present on the tree trunk. The death of the dry leaves were accelerated and began to rot quickly, and fern will germinate and growth in these bole nooks of the leaf.

3) 11 – 14 year growth phase: in these phase leaves are 3-5 meters long, the trunk is 1 meter long, if the soil is fertile the trunk may be 3 meters long. In this phase villagers often cut down the trunk for food because during this phase the tree is easily to cut down and the young shoot in the trunk can be eaten. In this phase the

second true pinnate leaves (4-6 leaves) had die and dried, covering the bole of the trunk, the stalk of leaves have not rotted, but the rachis had rotted and dropped onto the ground.

4) 15 – 18 year growth phase: sugar-palm leaves are 4-8 meter long. When finished this phase the trunk of the sugar-palm has reached its full size and will not grow any more, when finished this phase begins the reproductive phase. In Phase 4 the pistillate flower will appear at the nook leaf, but will not yet open.

5) Inflorescence phase: in this phase the first pistillate flower is in growth, and the developing flower will begin to be viewable from out of the trunk, after that the flower opens and pollination and developing to the fruit setting in the near time. The first pistillate flower is still the highest of the trunk and the second, third pistillate flower are lower respectively, in a tree which has about 5-6 clusters. In the end of this phase, the staminate flowers appear at the bole nook of the leaf, but are still lower than the pistillate flowers. The staminate flowers will open.

6) Senescence phase: in this phase, the staminate flowers open, and each tree has about 2-5 clusters. At the end of this phase the sugar-palm tree will die, at the age of about 25- 28 years.

The study of Janpol and Muangchai (2000) found that, the sugar-palm tree distribution in the other phases of Pha Thong sub-district area was different. The mean numbers of the sugar-palm trees per 1 rai area was less than the senescence phase, and in the future, the production of sugar-palm in Pha Thong sub-district was predicted to decrease, thus villagers in this area had an acceleration the sugar-palm forest conservation themselves.

Sugar-palm forest management of Nam Ki, Nam Pang, and San Charoen village, Pha Thong sub-district, Tha Wang Pha district. The study found that at the present, the resource degeneration problem was increasing greatly, as were a droughts and floods (Moonwong et al., 2000).

The study on sugar-palm forest management of Phu San group, San Charoen village, Pha Thong sub-district, Tha Wang Pha district. These studies found that, Phu San group had an effective method of the community forest management and sugar-palm forest management, which made use of the local indigenous knowledge and was involved with conserving biodiversity. The studies found that, the problems faced by the Phu San group were the rapidly increasing population of San Charoen village, as well as the government's announcement that it would declaration the community forest area as Nanta Buri national park area. An impact of the problem was mean that villagers do not have a consciousness of the forest matters and did not feel an ownership over the community forest (Chang-ngun, 2001).

The study on sugar-palm conservation and utilization in the 3 zones of Nam Ki village, the study found the differences of sugar-palm forest management in the 3 zones of Nam Ki village. Nam Ki Nuea zone practicing sugar-palm forest management on a condition, Nam Ki Klang zone practicing the sugar-palm forest management by separating areas for each household to manage; and Nam Ki Tai zone was the utilized a group management. Sugar-palm harvested produce of the 3 zones was sold to the factories for the raw material processing to sugar-palm in syrup (Tarawan, 2001).

The sustainable development of sugar-palm harvesting of Pha Thong sub-district, Tha Wang Pha district; and studied the causes of the decrease on the number of sugar-palm trees in the forest. Study found them to be; 1) the villagers cut down all the clusters of sugar-palm, they did not keep some pieces of the clusters for reproduction while during the senescent phase 2) The villagers cut the sugar-palm trees for using the young pith in cooking 3) The villagers did not maintain the forest well, until fire burn the sugar-palm forest 4) The villagers had not stopped hunting wild animals which benefited to sugar-palm, such as wild boars (*Sus scrofa*), and the Asian palm civet (*Paradoxurus hermaphroditus*), which ate the mature of sugar-palm fruit for food, and distributed sugar-palm seeds in the forest 5) The survival rate of sugar-palm from seedling to the small trees was too low, in particular because sugar-palm seedlings are naturally very slow to grow (Chantaraboon, 2002), and the author suggested that, in order for sugar-palm to remain a feasible tree for propagation, all

villages must establishing a sugar-palm conservation group to monitor the forest, protect it from fires, extend sugar-palm restoration and decrease hunting. Moreover, the local indigenous of sugar-palm forest conservation, finding that each village had established guidelines for sugar-palm forest conservation such as; do not to cutting down the tree in the watershed area, do not to cut down the tree in a virgin forest, do not to sawing off a log of wood for sale, do not to steal sugar-palm, do not burning the forest, do not to cutting down sugar-palm tree, do not harvesting sugar-palm before the designated day for harvest, do not to cutting down the clusters of sugar-palm which will over require more labor than one has in his family and do not harvesting sugar-palm far over 500 meters from squeeze area (Chantaraboon, 2002).

An acceptance of sugar-palm restoration and sugar-palm processing of villagers of Pha Thong sub-district. The study found that, in the past villagers in 4 villages (about 95.3%) had not an adapted sugar-palm tree restoration, and nearly 100% did not process sugar-palm. After introducing participatory action research (PAR) and AIC Technique, it was found that, about 96.9% of villagers participated in sugar-palm restoration and about 67.2% were interested in sugar-palm processing. These studies did not show the change in attitudes of villagers nor did it show sugar-palm restoration and processing; but studied the relationship between sugar-palm trees decreasing and an acceptance of sugar-palm restoration and sugar-palm processing, the studies was finding the decreasing of sugar-palm trees did not correlated with sugar-palm restoration and sugar-palm processing. Villagers seemed to have a change their attitudes due to an effect of PAR and AIC technique (Chantaraboon, 2002).

In the same year, the study on the plant community structure of sugar-palm in the Doi Pha Chang wildlife sanctuary, Nan province. The study found that in these areas, the average of sugar-palm trees were cut down for food 11.28 ± 6.47 trees per a rai area or about 21.60% of total sugar-palm trees in these areas. This factor was the importance information for the sugar-palm forest management and utilization to sustainable (Pampasit, 2002).

The ecology of sugar-palm under the different types of the forest management in Nam Ki village. The study found that, Nam Ki village has 3 patterns of the sugar-

palm forest management. Data from this study also revealed that stolen and cut down of sugar-palm trees for food and sold was the highest in the Nam Ki Tai zone, followed by Nam Ki Nuea zone, and Nam Ki Klang zone at about 6.57, 6.09, and 3.93% respectively (Wachirawongsagorn, 2002).

Age distribution of sugar-palm in the different management areas of Pha Thong sub-district, Tha Wang Pha district, Nan province. The studies found that, the sugar-palm age distribution from household forests was more regular and higher than in the communal forest; and found that the distribution on the undulating stream banks was higher than on the hill slopes. This was lead to the additional study of the management strategies of sugar-palm forest in order to increase the plant numbers and the products in the future (Padklang, 2002).

Age structure of sugar-palm of Pha Thong sub-district, Tha Wang Pha district, Nan province. The studies found that, the age structure of sugar-palm 6 growth phases in 4 villages were different, sugar-palm trees in the 3-6 year phase of development were the highest in the number; next to which was trees in the phase of senescence (23 years over), 7-10 year, 11-14 year, 15-18 year, and then the inflorescence phase (19-22 year) was lowest in the number respectively. An age structure of sugar-palm is present in the Figure 3 (Chantaraboon, 2004).
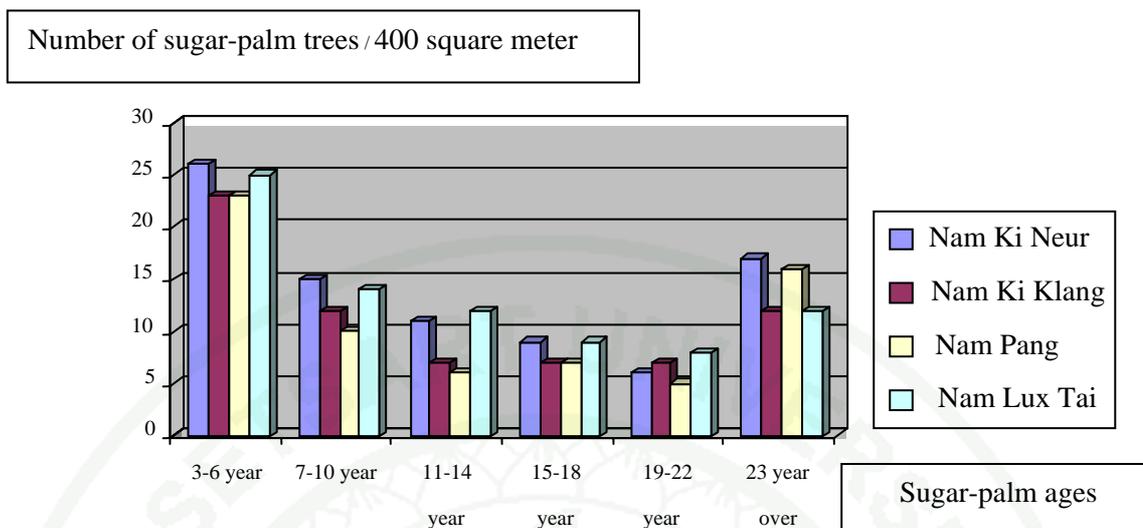
Figure 3 An age structure of sugar-palm trees of Pha Thong sub-district, Tha Wang Pha district, Nan province

From these results, it was concluded that the present sugar-palm production is less than in the past, and the present to 2013 will continue to be less than the past, yet the production will increase in 2014-2021 if the villagers will the good maintaining the sugar-palm's forest.

Moreover, on the issue of the decrease in sugar-palm trees as an affecting sugar-palm production and the income from sugar-palm in the future. If income from sugar-palm in the future decreases, it will have an impact to money for buy chemicals to use in agricultural activities, because villagers used the money from sold sugar-palm to buy them. An impact on agriculture production such as; upland rice, cotton, ginger, and litchi will be such that these crops decrease as well. However, these problems may have the positive effects extension because the villagers may learn to use the natural extracts, replacing the chemicals (Chantaraboon, 2004).

The botany character, ecology, the distribution and utilization of sugar-palm and Tao. In particular, the utilization from sugar-palm in the Southern region of Thailand, used only by tapping sap from the staminate inflorescence for making a brown sugar. In each trunk 15-20 liters of sugar was kept per day, between the months of December to April. In the Northern Thailand, in particular Nan province,

sugar-palm made an income to villagers who harvested sugar-palm of about 35,000-40,000 Baht per year (The Botanical Garden Organization, 2004).

The economic botany of two arborescent Arenga palms (*A. pinnata* and *A. westerhoutii*) in Thailand. They presented namely the main production from Tao for using an endosperm for processing to make sugar-palm in syrup.   Moreover, they mentioned that sugar-palm had the high potential for planting in an agroforestry systems for the communities in Thailand (Pongsattayapipat and Barfod, 2004).

In Palms Journal, the article title: the identities of Thai sugar-palms.   The studies identified that the sugar-palm or Chid or Chock (Southern Thailand language) was *Arenga pinnata* (Wurmb) Merr., but Tao was *Arenga westerhoutii* Griff. They noted that both were of the Arecaceae family, and differed only with respect to their rachis. The rachis of Tao is arranged in perfect order, but Chid's are less uniform. The study was reduced the confusion about Chid and Tao in Thailand (Pongsattayapipat and Barfod, 2005).

The study on the number of the inflorescence phase of sugar-palm at present (2002-2005) was less than that in the past (1998-2001) by about 109%. It concluded that, if villagers practiced the good forest maintenance, about 12 years in the future should bring the number of the inflorescence phase of sugar-palm will equally the past (1998-2001) (Chantaraboon, 2005).

MATERIALS AND METHODS

Seed Germination

Influence of seed ages and seed treatment methods on germination of *A. westerhoutii* were investigated by using a 2×4 factorial experiment. There were 2 age groups (30 and 35 month old), and 4 seed treatment methods, i.e. trimming one end of seed, trimming both end of seed, soaking seed in hot water (80 °C for 3 minutes), and no seed treatment (control). An experimental unit consisted of 10 seeds, placed on top of coconut's husk in a black plastic bucket of 5-liter in capacity. All units were randomly received 8 (2×4) treatment combinations. Each treatment was replicated four times with the total of 32 experimental units. The buckets were watered twice daily. Seed germination indicated by the appearance of root was observed at 3, 5, 7, 9 and 11 months. The percentage of seed germination was calculated for all experimental units. The treatment means, number of days at root germination were analyzed.

Transplanting Stage

The experiment was planned to indentify suitable transplanting stage of *A. westerhoutii* for domestication. Seedlings of different stages, i.e. with 1, 2, and 3 leaves were compared on their survival rates. An experimental unit consisted of 200 seedlings of the same stage (either 1 or 2 or 3 leaves). Each seedling was planted in the mixed media soil within a black plastic bag of 1/2-liter in capacity. Each treatment was replicated four times with the total of 12 experimental units. All units were watered twice daily. Seedling survival was observed at the end of 1, 2, and 3 months. The percentage of seedling survival was calculated for all experimental units. The treatment means, number of seedling survived in each experimental units at 1, 2, and 3 months were analyzed.

Seedling Fertilization

The experiment was planned to accelerate the growth of *A. westerhoutii*. There were 4 treatments of fertilization, i.e. applying fertilizers (N-P-K) 46-0-0, 15-15-15, 13-13-21, and no fertilizer (control). Fertilization was done every month, applying 5 grams of each fertilizer per month per seedling. An experimental unit consisted of 100 seedlings, placed on the mixed media soil in a black plastic bag of 1-liter in capacity. Each treatment was replicated four times with the total of 16 experimental units. Seedling fertilization indicated by the appearance the number of leaves at the beginning and end of the experiment, the number of leaves increase, number of leaves which die, height of trees, data to be collected every month for 1 year. The number of remaining leaves and plant height were calculated for all experimental units. The remaining leaves and plant height in each experimental unit at 1 year were analyzed.

Training on Forest Management

The training was planned to train for the villager on the topic "Good forest management" by invite an expertise on the forest management to train for villager. Content of the training are including; the resources of Pha Thong community, what happen with Pha Thong resources, how to rectify the problems how to resources conservation, how to good care forest management. Before the training, pre-test tasting the villagers on the understanding level on forest management and maintaining. After finish the training, post-test tasting the villagers on the understanding level on forest management and maintaining, the satisfaction, the expectation of the villagers on the knowledge that received from the training tasted. The frequency, percentage, mean and standard deviation were analyzed.

Community Participation

The comparison on the community participation level of the forest conservation and management of 2 villages as Nam Ki and San Charoen village by designed a questionnaire for community participation on the community forest

conservation and management for collected data, and then questionnaire validity tested, improved of the questionnaire to the final issue. Collected data by villager's interview from 2 villages, settled the sampling group of population by Srisupan (1977) method, data analysis by percentage, standard deviation, t-test statistic. Community participation level analyzed to be carried out by the t-test was analyzed.

Sugar-palm Forest Restoration

The domestication was planed to sugar-palm forest restoration by villager's planted sugar-palm seedlings and maintenance seedling of sugar-palm trees until them strong, prepare the areas for planting sugar-palm restoration of 2 villagers, until an appropriate time, invited the villagers to planting restoration and maintaining after planting, if sugar-palm trees died villagers must planting sugar-palm seedling restoration.

Training on Fruit Processing

The training was planed to train for the villager on the topic "Sugar-palm fruit processing" by invite an expertise on the sugar-palm fruit processing to train for villager. Content of the training are including; how to make sugar-palm in syrup and sugar-palm yam with either pineapple or strawberry. After finish the training, the levels of villager's satisfaction was tested. The mean and standard deviation were analyzed.

Training on the Utilization of Sugar-palm's Leaves

The training was planed to train for the villager on the topic "Sugar-palm broom and sugar-palm roofing production" by invite an expertise on the sugar-palm broom and sugar-palm roofing making to train for villager. Content of the training are including; how to make sugar-palm broom and a strip of sugar-palm roofing. After finish the training, the levels of villager's satisfaction and expectation were tested. The mean and standard deviation were compared by using the R: A Language and environment for Statistical Computing (R Development Core Team, 2011).

RESULTS AND DISCUSSION

Results

Seed Germination

Experiment with the villager participation on the title "Comparison on the ages of seed and the treatment methods of sugar-palm seed influence on the seed germination" finish. The result is shown in Table 1.

There were no the significant differences between seed ages of 30 and 36 months old on the percentage of seedling germination and the germination period (Table 1). Sugar-palm seeds with one end trimming gave the better germination percentage than the both ends trimming and non treated method. However, seeds soaked in 80 °C for three minutes made the embryo died.

Figure 4 A) Sugar-palm 30 months of age B) 36 months C) sugar-palm seeds
D) Trimming seeds E, F) Planting in coconut's husk with 5 liters of
black plastic bucket

Table 1 The germination of *A. westerhoutii* seeds from the different seed treatment
techniques

Seed age (months)	Seed treatment	Germination	
		%	period (days)[1]
30	Trimming: one end	20	283.3 a
	Trimming: both ends	45	286.6 ab
	Hot water 80 °C; soaking 3 min	0	>365 c
	None	15	297.2 b
36	Trimming: one end	27.5	260.8 a
	Trimming: both ends	30	279.2 ab
	Hot water 80 °C; soaking 3 min	0	>365 c
	None	17.5	313 b
ns[2]			

[1] Means followed by the same letters are not significant difference at P-value $\geq$ .05
  by DMRT

[2] Non significance

From the Table 1, it was shown that sugar-palm seeds aged 30 months old
together with the both ends trimming had higher percentage of germination than 36
months old seeds, but non statistical difference. The germination percentage in this
experiment could not reach 50% because the data were based on the one year or 12
months observation. If we could extend the observation period up to twenty months,
the percentage of the germination could exceed 65% (Chantaraboon, 1998b).

It could be difficult to distinguish the germination differences between the
sugar-palm seeds of 30 and 36 months old (Table 1). However, it is easier to extract
the seeds out of 36 months old fruits compared with fruits aged 30 months old,
because the peel is softened by aging. In addition, 36 months old fruits have less itchy

latex than the 30 month fruits. This itchy substance causes severe skin allergy, normally the villagers get rid of the latex by boiling the fruit in hot water before squeezing the seeds out (Chantaraboon, 1998b).

Transplanting Stage

The comparison on the survival rate of sugar-palm seedlings" after planting in nursery of 1, 2, 3 leaves of sugar-palm seedlings. Activities are shown in the Figure 5.

The transplanting of sugar-palm seedlings with 1, 2, and 3 leaves indicated that young sugar-palm with 1 leaf had higher survival percentage than plants with 2 and 3 leaves throughout the three–month observation periods (Table 2). Average percentages over the three–month periods of sugar-palm seedlings with 1, 2, and 3 leaves were 83.3, 62.3, and 49.2%, respectively.

Figure 5 A, B) Pha Thong's villagers were transplanting sugar-palm seedlings in 4 x 6 inch of black plastic bag C, D) 1, 2, 3 leaves of sugar-palm seedlings

Table 2 Survival of sugar-palm seedlings after transplanting

No. of leaf	% Survival after transplanting[1]			Average (%)
	1 month	2 months	3 months	
1	85 a	82.5 a	82.5 a	83.3 a
2	64.5 b	61.5 b	61 b	62.3 b
3	52 c	48 c	47.5 c	49.2 c
CV (%)	11.13	12.30	12.32	

[1] Means followed by the same letters are not significant difference at P-value $\geq$ .01 by DMRT.

Cutting off 2/3 of the leaf area not only help the reducing sugar-palm's evaporation, but also assist the plant to rapidly produce the subsequent leaf (Chantaraboon *et al*., 2009, 2010). However, the application of intensive watering system every two-hour period during the first week of transplanting could increase survival percentage up to 82% regardless the number of leaves of the sugar-palm seedlings. This has been indicated in the several harvested plant (Gardiol *et al.*, 2003; Lund and Soegaard, 2003).

Seedling Fertilization

Study on "Growth acceleration of sugar-palm seedling by chemical fertilizer application" There were no significant differences on the using three inorganic fertilizers compared with no treatment during the early stage of sugar-palm development in terms of the number of leaves and plant height after one year of the monthly application (Table 3).

Table 3 Number of the remaining leaves and the plant height of sugar-palm seedlings

after one year of the monthly application (5 gm per month)

Treatment fertilizer,	Average[1]	
N-P-K	No. remaining leaves	Plant height (cm)
15-15-15	3.36 a	37.29 a
13-13-21	3.23 a	38.00 a
46-0-0	3.12 a	35.42 a
None treated	3.19 a	36.57 a
CV (%)	7.13	6.87

[1] Means followed by the same letters are not significant difference at P-value $\geq$ .05 by
   DMRT.

It may not be worthwhile to add fertilizer costs into the sugar-palm cropping system (Chantaraboon *et al*., 2007). This insensitivity behavior of the sugar-palm to inorganic fertilizers may be an affected from the several reasons, e.g. the organic fertilizer employed in soil preparation of the experiment trapped major components of an inorganic fertilizers; and an organic fertilizer in the soil had already provided enough the substances needed for the early stage of sugar-palm development. It had also been report that result did not show an effect of fertilizer treatment in any of the parameter measured. It may be possible that it would take a longer time than the experimentation period before an effect of fertilizer will be pronounced (Mak *et al*., 2008).

Training on Forest Management

Training to the villagers of 2 villages on the topic "good forest management and maintaining" by invited Mr. Banharn Silapetch, an agricultural extension who has expert on the forest management from Pha Sing Tumbon Administrative Organization (TAO), Pha Shing sub-district, Muang district, Nan province to training for villager

kept the knowledge to use on the forest management of village by themselves. The activities are shown in the Figure 6**.**

Figure 6 Training to villages on the topic "Good forest management and

maintaining"

After finish training, the satisfaction of the villagers on the knowledge that they received from the training was evaluated and the result is;

In this study was separated the understanding were into 5 levels as;

Maximum level	score	5
Rather maximum level	score	4
Optimum level	score	3
Rather minimum level	score	2
Minimum level	score	1

And separated the mean of the understanding were into 5 intervals as;

Maximum level	mean	4.51 – 5.00
Rather maximum level	mean	3.51 – 4.50
Optimum level	mean	2.51 – 3.50
Rather minimum level	mean	1.51 – 2.50
Minimum level	mean	1.00 – 1.50

Table 4 The levels of the understanding levels on "Forest management and maintaining" before the training

Level of the understanding	Freq.	%	Mean	SD	Meaning
Minimum level	1	3.7	2.77	0.75	Optimum
Rather minimum level	8	29.6			level
Optimum level	14	51.9			
Rather maximum level	4	14.8			
Total	27	100.0			

n = 27

Villagers who were trained on the topic "Good forest management and maintaining" were pre-tested on the forest management and maintaining before the training. The result is that the highest frequency on the understanding level was optimum level (51.9%) next to rather minimum level (29.6%), rather maximum (14.8%) and lowest minimum level (3.7%) respectively. The mean of the understanding before the training was 2.77±0.75, and the meaning was optimum level, as shows in the Table 4.

Table 5 The levels of the understanding levels on "Forest management and maintaining" after the training

Level of the understanding	Freq.	%	Mean	SD	Meaning
Optimum level	8	29.6	3.77	0.57	Rather
Rather maximum level	17	63.0			maximum
Maximum level	2	7.4			level
Total	27	100.0			

n = 27

Villagers who were trained on the topic "Good forest management and maintaining" they were post-tested on the forest management and maintaining after the training. The result is that the highest frequency on the understanding level was rather maximum level (63%) next to optimum level (29.6%), and lowest maximum level (7.4%) respectively. The mean of the understanding after the training was 3.77±0.57, and the meaning was rather maximum level, as shows in the Table 5.

Table 6 The levels of the satisfy of villagers on the knowledge was received
on title "Forest management and maintaining"

Level of the satisfy	Freq.	%	Mean	SD	Meaning
Optimum level	8	29.6	3.96	0.75	Rather
Rather maximum level	12	44.4			Maximum
Maximum level	7	25.9			Level
Total	27	100.0			

n = 27

Villagers who were training on the topic "Good forest management and maintaining" were post-tested on the forest management and maintaining after the training. The result is that the highest frequency on the satisfy level of the knowledge was received as rather maximum level (44.4%) next to optimum level (29.6%), and lowest maximum level (25.9%) respectively. And the mean of the satisfy level on the knowledge received after the training was 3.96±0.75, and the meaning was rather maximum level, as shows in the Table 6.

Table 7 The levels of the knowledge was received for forest management and
maintaining

Level of the knowledge	Freq.	%	Mean	SD	Meaning
Optimum level	8	29.6	3.92	0.72	Rather
Rather maximum level	13	48.1			Maximum
Maximum level	6	22.2			Level
Total	27	100.0			

n = 27

Villagers who were training on the topic "Good forest management and maintaining" were post-tested on the forest management and maintaining after the training. The result is that the highest frequency on the knowledge was received for forest management and maintaining was rather maximum level (48.1%) next to

optimum level (29.6%), and lowest maximum level (22.2%) respectively. And the mean of the level on the knowledge received after the training was 3.92±0.72, and the meaning was rather maximum level, as shows in the Table 7.

Community Participation

Comparison on the participation of community in the community forest conservation and management, the comparison of the participation level in the community forest conservation and management of 2 villages, Nam Ki and San Charoen village was carried out by creating a questionnaire for measuring the participation of the community on the community forest conservation and management. The study finds that;

Socioeconomic data

The analysis of 100 samplings, 45 from Nam Ki and 55 from San Charoen are: In term of the gender and age, in Nam Ki, 73.3% are man and 26.7% are woman. In all of Nam Ki sampling, the ages are; lower than 30 years (40.0%), and next to 31-45 years (28.9%), 46-60 years (22.2%), and more than 60 years (8.9%) respectively. In San Charoen, 83.6% were man and 16.4% were woman. In all of Nam Ki sampling, the ages are; 31-45 years (54.5%), and next to lower than 30 years (32.7%), 46-60 years (10.9%), and more than 60 years (1.8%) respectively.

In term of an education level, the academic level of villagers in Nam Ki is early secondary school (28.9%), and next to no learning (17.8%), later secondary school (11.1%), early primary school (4.4), and later primary school (2.2%) respectively and no answer 3 sampling. The academic level of villagers in San Charoen is no learning (30.0%), and next to later secondary school (29.1%), later primary school (18.2%), early secondary school (12.7%), early primary school (7.3%), and diploma (1.8%) respectively.

In term of the number's person per household and status, the average person per household in Nam Ki is 4-6 persons (64.4%), next to 7-9 persons (22.0%), 10-12 persons (8.8%), more than 12 persons (4.4%), and the status of people in Nam Ki is married (62.2%), single (24.4%) respectively and no answer 6 sampling. The average person per household in San Charoen is 4-6 persons (65.5%), next to 7-9 persons (16.5%), 10-12 persons (12.8%), 1-3 persons (3.6%), and more than 12 persons (1.8%), and the status of people is married (90.0%), single (7.3%) respectively and no answer 1 sampling.

In term of the landholder status and the number of the land's holder, Nam ki have the land themselves (93.3%) and have no land for themselves (6.7%), and the number of the land's holder per household is 21-30 rai (28.9%), next to 11-20 rai (26.7%), 31-40 rai (17.8%), less than 10 rai (15.6%) and 41-50 rai per household (6.7%) respectively. San Charoen have the land themselves (89.1%), and have no land for themselves (9.1%), and the number of the land's holder per household is more than 50 rai (36.4%), next to 31-40 rai and 41-50 rai (14.5%), 21-30 rai (10.9%), 11-20 rai (9.1%) and less than 10 rai per household (7.4%) respectively.

In term of the primary occupation, secondary occupation and an income per month, in Nam Ki, the primary occupation is the farmers 91.1%, next to the merchant 4.4% and the general employer 2.2%, and the secondary occupation is the farmers 35.6%, next to the general employer 31.1%, next to the merchant 15.6%, and no secondary occupation 13.3% respectively. A total income per month in 2008 is highest 2,001-4,000 Baht/month 42.2%, next to less than 2,000 Baht 26.7%, 4,001-6,000 Baht 15.6%, 6,001-8,000 Baht 8.9%, and 8,001-10,000 Baht 4.4% respectively.

In term of the primary occupation, secondary occupation and an income per month, in San Charoen, the primary occupation is farmers 96.4%, next to the government official 1.8%, in the second occupation were the farmers 10.9%, next to the general employer 7.3%, next to the merchant 1.8% respectively. A total income per month in 2008 is highest more than 10,000 Baht/month 36.4%, next to 8,001-10,000 Baht 25.5%, 6,001-8,000 Baht 16.4%, 2,001-4,000 Baht 9.1%, less than 2,000 and 4,001-6,000 Baht 5.5% respectively. It shows in Table 8.

Table 8 The number and percentage of socioeconomic data of Nam Ki and
San Charoen village

(unit: number and percentage)

Socioeconomic data	Nan Ki (n = 45)	San Charoen (n = 55)	Total (n = 100)
Gender			
Man	33	46	79
	(73.3)	(83.6)	(79)
Women	12	9	21
	(26.7)	(16.4)	(21)
Ages			
Lower than 30 years	18	18	36
	(40.0)	(32.7)	(36.0)
31 – 45 years	13	30	43
	(28.9)	(54.5)	(43.0)
46 – 60 years	10	6	16
	(22.2)	(10.9)	(16.0)
Upper than 60 years	4	1	5
	(8.9)	(1.8)	(5.0)
Education level			
No learning	13	17	30
	(28.9)	(30.9)	(30.0)
Early primary school	2	4	6
	(4.4)	(7.3)	(6.0)
Later primary school	5	10	15
	(11.1)	(18.2)	(15.0)
Early secondary school	13	7	20
	(28.9)	(12.7)	(20.0)

Table 8 (Continued)

Socioeconomic data	Nan Ki (n = 45)	San Charoen (n = 55)	Total (n = 100)
Lather secondary school	8	16	24
	(17.8)	(29.1)	(24.0)
Early diploma	-	1	1
	(0)	(1.8)	(1.0)
Diploma	1	-	1
	(2.2)	(0)	(1.0)
No answer	3	-	3
	(6.7)	(0)	(3.0)
Status			
Single	11	4	15
	(24.4)	(7.3)	(15.0)
Married	28	50	78
	(62.2)	(90.9)	(78.0)
No answer	6	1	7
	(13.3)	(1.8)	(7.0)
The number of persons per household			
1 – 3 persons	-	2	2
	(0)	(3.6)	(2.0)
4 – 6 persons	29	36	65
	(64.4)	(65.5)	(65.0)
7 – 9 persons	10	9	19
	(22.0)	(16.5)	(19.0)
10 – 12 persons	4	7	11
	(8.8)	(12.8)	(11.0)
More than 12 persons	2	1	3
	(4.4)	(1.8)	(3.0)

Table 8 (Continued)

Socioeconomic data	Nan Ki	San Charoen	Total
	(n = 45)	(n = 55)	(n = 100)
landholder status			
No the land of themselves	3	5	8
	(6.7)	(9.1)	(8.0)
Have the land of themselves	42	49	91
	(93.3)	(89.1)	(91.0)
No answer	-	1	1
	(0)	(1.8)	(1.0)
The number of the land's holder			
Lower than 10 rai	7	5	12
	(15.6)	(9.1)	(12.0)
10 – 20 rai	12	5	17
	(26.7)	(9.1)	(17.0)
21 – 30 rai	13	6	19
	(28.9)	(10.9)	(19.0)
31 – 40 rai	8	8	16
	(17.8)	(14.5)	(16.0)
41 – 50 rai	3	8	11
	(6.7)	(14.5)	(11.0)
More than 50 rai	-	20	20
	(0)	(36.4)	(20.0)
No answer	2	3	5
	(4.4)	(5.5)	(5.0)

Table 8 (Continued)

Socioeconomic data	Nan Ki (n = 45)	San Charoen (n = 55)	Total (n = 100)
Main occupation			
Farmer	41 (91.1)	53 (96.4)	94 (94.0)
General employer	1 (2.2)	- (0)	1 (1.0)
Government official	- (0)	1 (1.8)	1 (1.0)
Merchant	2 (4.4)	- (0)	2 (2.0)
No answer	1 (2.2)	1 (1.8)	2 (2.0)
Second occupation			
Farmer	16 (35.6)	6 (10.9)	22 (22.0)
General employer	14 (31.1)	4 (7.3)	18 (18.0)
No second occupation	6 (13.3)	29 (52.7)	35 (35.0)
Merchant	7 (15.6)	1 (1.8)	8 (8.0)
Etc.	- (0)	4 (7.3)	4 (4.0)
No answer	2 (4.4)	11 (20.0)	13 (13.0)

Table 8 (Continued)

Socioeconomic data	Nan Ki (n = 45)	San Charoen (n = 55)	Total (n = 100)
Income per month			
2,001 – 4,000 Baht	19	5	24
	(42.2)	(9.1)	(24.0)
4,001 – 6,000 Baht	7	3	10
	(15.6)	(5.5)	(10.0)
6,001 – 8,000 Baht	4	9	13
	(8.9)	(16.4)	(13.0)
8,001 – 10,000 Baht	2	14	16
	(4.4)	(25.5)	(16.0)
More than 10,000 Baht	-	20	20
	(0)	(36.4)	(20.0)
No answer	1	1	2
	(2.2)	(1.8)	(2.0)

The participation of community on the community forest conservation and management

Level of the villagers' participation on the community forest conservation and management, in this study was separated the participation were into 4 levels;

Excellent level	score	4
Good level	score	3
Fair level	score	2
Poor level	score	1

And separated the mean of the participation were into 4 intervals;

Excellent level	mean	3.51 – 4.00
Good level	mean	2.51 – 3.50
Fair level	mean	1.51 – 2.50
Poor level	mean	1.00 – 1.50

The study of Nam Ki villagers' participation on the community forest conservation and management; all of the participation had 5 steps as; 1) searching the cause of the problems' of community forest conservation step, 2) planning on the conservation step, 3) putting down the capital and implement step, 4) proceed on the furrow up and control step and 5) evaluation of the conservation step. In this study, it was shown that;

Nam ki villagers had the participation on the community forest conservation and management on the good level in all aspects (2.80 ± 0.58). Step of the planning on conservation was the higher mean score 3.13 ± 0.86, and the step of an evaluation was 2.86 ± 1.03, and the step of the furrow up and control was 2.84 ± 1.04, and the step of the putting down the capital and implement was 2.71 ± 0.58, and the lowest mean score was the step of the searching the cause of the problems was 2.53 ± 0.69 respectively as shown in the Table 9.

San Charoen villagers had the participation on the community forest conservation and management on the good level in all aspects (2.67±0.90). Compared to Nam Ki villagers' score, San Chareon villagers scored the highest in the step of the planning on searching the cause of the problems (2.92±1.05). The others scores of each step were 2.81±0.77 for the step of the putting down the capital and implement, 2.60±1.08 for the step of the planning on the conservation, 2.56±1.13 for the step of the furrow up and control was, and 2.34±1.18 for the step of the evaluation, which was the lowest mean score, as shown on the Table 10.

Table 9 The percentage, mean and standard deviation of Nam Ki villagers'
participation on the community forest conservation and management

Step and Sub-step	Level of participation (n = 45)				Mean	S.D.
	Excellent	Good	Fair	Poor		
Step of searching the cause of the problems					2.53	0.69
1 Participation on the meeting for searching the cause of the problems in the past	3 (6.7)	16 (35.6)	25 (55.6)	1 (2.2)	2.36	0.66
2 Present an opinion about the problems of their forest	5 (11.1)	13 (28.9)	26 (57.8)	1 (2.2)	2.48	0.72
Step of planning on the conservation					3.13	0.86
3 Consider and setting the areas And boundary of the community forests	20 (44.4)	13 (28.9)	8 (17.8)	4 (8.9)	3.08	0.99
4 Consider and setting the method of the conservation community forest and setting the punishment for violator	19 (42.2)	8 (17.8)	14 (31.1)	4 (8.9)	2.93	1.05
5 Consider and setting an activities on the forest protection	18 (40.0)	13 (28.9)	14 (31.1)	- (0)	3.08	0.84
6 Consider the method for weeds prevention and eradication in the community forest	18 (40.0)	7 (15.6)	19 (42.2)	1 (2.2)	2.93	0.96
7 Consider the method for fire protection	23 (51.1)	13 (28.9)	9 (20.0)	- (0)	3.31	0.79
8 Consider and setting the areas for restoration in the community forest	19 (42.2)	10 (22.22)	16 (35.6)	- (0)	3.06	0.88

Table 9 (Continued)

Step and Sub-step	Level of participation (n = 45)				Mean	S.D.
	Excellent	Good	Fair	Poor		
Step of putting down the capital and implement					2.71	0.58
9 Supervise on a community boundary signboard	17 (37.8)	12 (26.7)	9 (20.0)	7 (15.6)	2.86	1.09
10 Supervise on the timber steal in the community forest	20 (44.4)	10 (22.2)	11 (24.4)	4 (8.9)	3.02	1.03
11 Weed control in the community forest	19 (42.2)	6 (13.3)	17 (37.8)	3 (6.7)	2.91	1.04
12 Forest restoration	7 (15.6)	12 (26.7)	25 (55.6)	1 (2.2)	2.55	0.78
13 Done the fire strip protection	7 (15.6)	17 (37.8)	20 (44.4)	1 (2.2)	2.66	0.76
14 Done the fire extinguish	8 (17.8)	15 (33.3)	20 (44.4)	2 (4.4)	2.64	0.82
15 Done the plan seedling for restoration	2 (4.4)	8 (17.8)	15 (33.3)	20 (44.4)	1.82	0.88
16 Developed the facilitation as cut the weed two side of streets and the thoroughfare in the forest	4 (8.9)	25 (55.6)	13 (28.9)	3 (6.7)	2.66	0.73
17 Welcome and gave a knowledge on the community forest to the visitor	5 (11.1)	7 (15.6)	27 (60.0)	6 (13.3)	2.25	0.82
Step of furrow up and control					2.84	1.04
18 Participate on the furrow up and control in the community forest proceed	16 (35.6)	11 (24.4)	13 (28.9)	5 (11.1)	2.84	1.04
Step of an evaluation					2.86	1.03
19 Participate on the considerate reward and etc. in the community forest proceed	17 (37.8)	9 (20.0)	15 (33.3)	4 (8.9)	2.86	1.03
				Total mean	2.80	0.58

Table 10 The percentage, mean and standard deviation of San Charoen villagers' participation on the community forest conservation and management

Step and Sub-step	Level of participation (n = 55)				Mean	S.D.
	Excellent	Good	Fair	Poor		
Step of searching the cause of the problems					2.92	1.05
1 Participation on the meeting for searching the cause of the problems in the past	18 (32.7)	15 (27.3)	14 (25.5)	8 (14.5)	2.78	1.06
2 Present an opinion about the problems of their forest	21 (38.2)	15 (27.3)	11 (20.0)	8 (14.5)	2.89	1.08
Step of planning on the conservation					2.60	1.08
3 Consider and setting the areas and boundary of the community forests	17 (30.9)	10 (18.2)	18 (32.7)	10 (18.2)	2.61	1.11
4 Consider and setting the method of conservation community forest and setting the punishment for violator	16 (29.1)	9 (16.4)	19 (34.5)	11 (20.0)	2.54	1.11
5 Consider and setting an activities on the forest protection	14 (25.5)	13 (23.6)	16 (29.1)	12 (21.8)	2.52	1.10
6 Consider the method for weeds prevention and eradication in the community forest	14 (25.5)	12 (21.8)	13 (23.6)	14 (25.5)	2.47	1.13
7 Consider the method for fire protection	13 (23.6)	15 (27.3)	13 (23.6)	14 (25.5)	2.49	1.12
8 Consider and setting the areas for restoration in the community forest	15 (27.3)	9 (16.4)	16 (29.1)	15 (27.3)	2.43	1.16
Step of putting down the capital and implement					2.81	0.77
9 Supervise on a community boundary signboard	11 (20.0)	9 (16.4)	17 (30.9)	18 (32.7)	2.23	1.12
10 Supervise on the timber steal in the community forest	13 (23.6)	10 (18.2)	14 (25.5)	18 (32.7)	2.32	1.17
11 Weed control in the community forest	18 (32.7)	14 (25.5)	8 (14.5)	15 (27.3)	2.63	1.20
12 Forest restoration	39 (70.9)	14 (25.5)	2 (3.6)	- (0)	3.62	0.54
13 Done the fire strip protection	40 (72.7)	11 (20.0)	3 (5.5)	1 (1.8)	3.63	0.67
14 Done the fire extinguish	39 (70.9)	5 (9.1)	6 (10.9)	5 (9.1)	3.41	1.01

Table 10 (Continued)

Step and Sub-step	Level of participation (n = 55)				Mean	S.D.
	Excellent	Good	Fair	Poor		
15 Done the plan seedling for restoration	2 (3.6)	3 (5.5)	8 (14.5)	42 (76.4)	1.36	0.75
16 Developed the facilitation as cut the weed two side of streets and the thoroughfare in the forest	22 (40.0)	20 (36.4)	10 (18.2)	3 (5.5)	3.10	0.89
17 Welcome and gave a knowledge on the community forest to the visitor	19 (34.5)	12 (21.8)	16 (29.1)	8 (14.5)	2.76	1.08
Step of furrow up and control					2.56	1.13
18 Participate on the furrow up and control in the community forest proceed	14 (25.5)	17 (30.9)	10 (18.2)	14 (25.5)	2.56	1.13
Step of an evaluation					2.34	1.18
19 Participate on the considerate reward and etc. in the community forest proceed	14 (25.5)	13 (23.6)	11 (20.0)	17 (30.9)	2.34	1.18
				Total mean	2.67	0.90

The comparison of villagers' participation levels of Nam Ki and San Charoen village on the community forest conservation

The comparison on the community forest conservation, The Nam Ki samplings were 45, and San Charoen were 55. The comparison of 5 steps of the community forest conservation as; 1) searching the cause of the problems' of community forest conservation step, 2) planning on the conservation step, 3) putting down the capital and implement step, 4) proceed on the furrow up and control step and 5) evaluation of the conservation step. In the all 5 aspects were not statistical difference, and the t-test volume was -0.85.

The comparison step by step between Nam Ki and San Charoen village were as; Step 1) the mean of participation of San Charoen was higher than Nam Ki village as the significant statistical difference, and the t-test volume was 2.24. Step 2) the mean of participation of Nam Ki was higher than San Charoen village as the significant statistical difference, and the t-test volume was -2.73. Step 3) the mean of participation of San Charoen was higher than Nam Ki village as the significant statistical difference, and the t-test volume was 0.77. On the contrary, step 4, 5 the mean of participation of both villages were not statistical difference and the t-test volume were -1.28 and -1.91 respectively, and it shows on the Table 11.

Table 11 The comparison of villagers' participation levels of Nam Ki and San Charoen village on the community forest conservation

Step and Sub-step	Nam Ki (n = 45)		San Charoen (n = 55)		t	Sig (2-tailed)
	Mean	S.D.	Mean	S.D.		
Step of searching the cause of the problems	2.53	0.69	2.93	1.05	2.24	0.03
1 Participation on the meeting for searching the cause of the problems in the past	2.47	0.66	2.78	1.07	1.81	0.07
2 Present an opinion about the problems of their forest	2.49	0.73	2.89	1.08	2.21	0.03
Step of planning on the conservation	3.13	0.87	2.60	1.08	- 2.73	0.01
3 Consider and setting the areas and boundary of the community forests	3.09	1.00	2.62	1.11	- 2.20	0.03
4 Consider and setting the method of conservation community forest and setting the punishment for violator	2.93	1.05	2.55	1.12	- 1.77	0.08
5 Consider and setting an activities on the forest protection	3.09	0.85	2.53	1.10	- 2.88	0.01
6 Consider the method for weeds prevention and eradication in the community forest	2.93	0.96	2.47	1.14	- 2.16	0.03
7 Consider the method for fire protection	3.31	0.79	2.49	1.12	- 4.28	0.00
8 Consider and setting the areas for restoration in the community forest	3.07	0.89	2.44	1.17	- 3.06	0.00
Step of putting down the capital and implement	2.71	0.59	2.82	0.77	0.77	0.45
9 Supervise on the community boundary signboard	2.87	1.10	2.24	1.12	- 2.82	0.01
10 Supervise on the timber steal in the community forest	3.02	1.03	2.33	1.17	- 3.11	0.00

Table 11 (Continued)

Step and Sub-step	Nam Ki (n = 45)		San Charoen (n = 55)		t	Sig (2-tailed)
	Mean	S.D.	Mean	S.D.		
11 Weed control in the community forest	2.91	1.04	2.64	1.21	- 1.20	0.23
12 Forest restoration	2.56	0.78	3.67	0.55	8.08	0.00
13 Done the fire strip protection	2.67	0.77	3.64	0.68	6.71	0.00
14 Done the fire extinguish	2.64	0.83	3.42	1.01	4.12	0.00
15 Done the plan seedling for restoration	1.82	0.89	1.36	0.75	- 2.80	0.01
16 Developed the facilitation as cut the weed two side of streets and the thoroughfare in the forest	2.67	0.74	3.11	0.90	2.66	0.01
17 Welcome and gave a knowledge on the community forest to visitor	2.24	0.83	2.76	1.09	2.71	0.01
Step of furrow up and control	2.84	1.04	2.56	1.13	- 1.28	0.21
18 Participate on the furrow up and control in the community forest proceed	2.84	1.04	2.56	1.13	- 1.28	0.21
Step of an evaluation	2.87	1.04	2.44	1.18	- 1.91	0.06
19 Participate on the considerate reward and etc. in the community forest proceed	2.87	1.04	2.44	1.18	- 1.91	0.06
Total	2.80	0.59	2.67	0.90	- 0.85	0.40

Sugar-palm Forest Restoration

The 2 villager took care of sugar-palm seedlings until they were strong, and the villagers also prepared the area to plant sugar-palm for restoration. At the appropriate time, invited villagers to plan and maintain sugar-palm trees for restoration. The survival rate was checked every month and data was collected 3 times (1, 2, 3 month). If sugar-palm trees died villagers must plant sugar-palm seedling to restore the number of tree. Finally, the results of sugar-palm planting restoration was reported.

Figure 7 Villagers were transplanting sugar-palm's seedlings in the black plastic bag

Figure 8 Sugar-palm seedlings maintaining in the nursery until they strong

Figure 9 An activity of sugar-palm restoration at Pha Thong community forest

Figure 10 An activity of sugar-palm restoration at Pha Thong community forest

Figure 11 The method to prepare a hole for sugar-palm planting

Figure 12 Sugar-palm was planted into the ground

Training on Fruit Processing

Training to villagers in 2 villages on the title "Sugar-palm processing" for the interested villagers was done by inviting an expert of the sugar-palm processing to train the villagers on making sugar-palm in syrup and sugar-palm yam. The villagers were expected to receive knowledge and develop skill to use on sugar-palm processing by themselves. Finally, the conclusion of the training was made, and the result was shown on the Figure 13.

Figure 13 Training for the villagers on the title "Sugar-palm fruit processing"
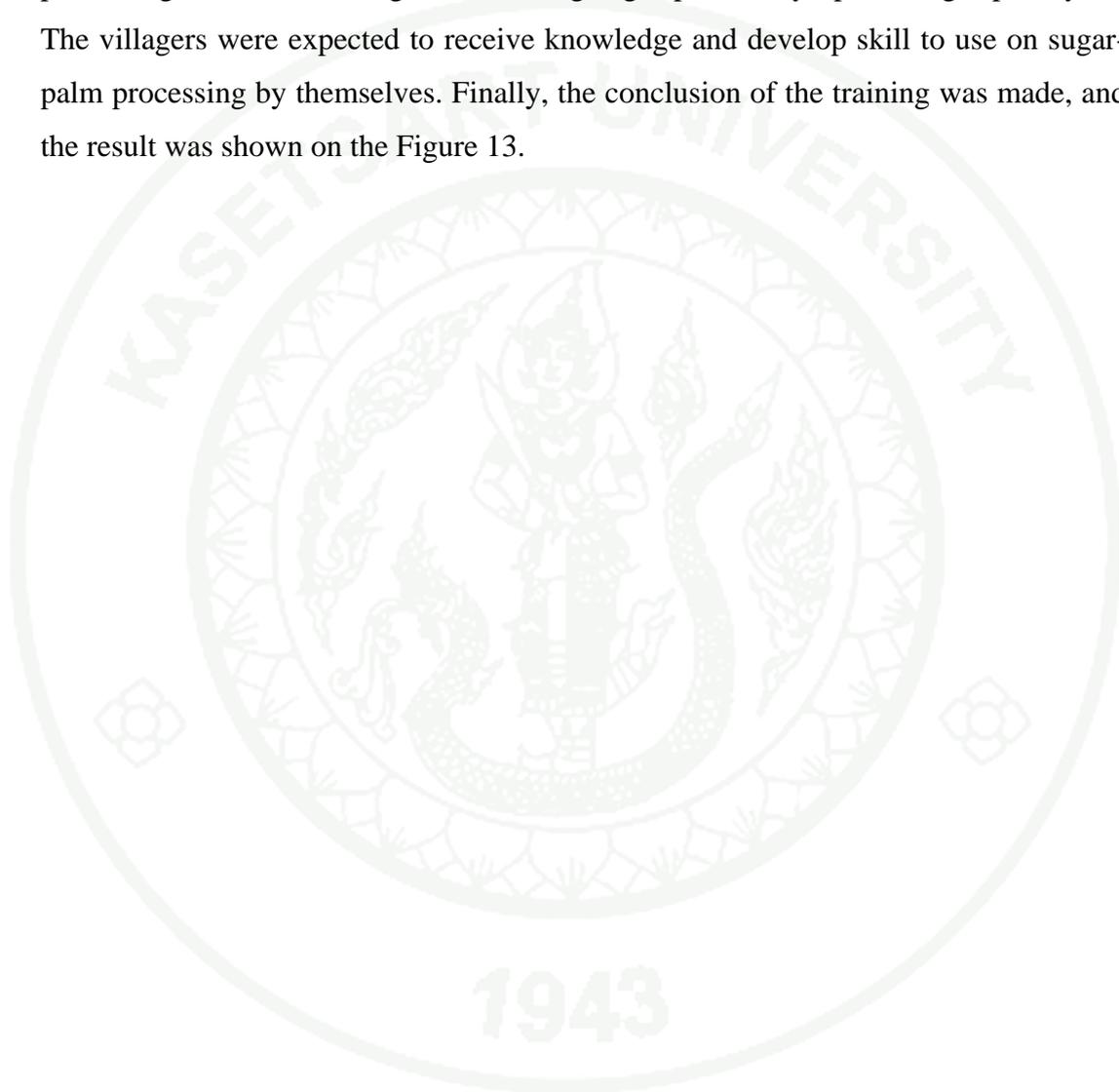
After finish the training, the satisfaction of the villager on the knowledge, they received from the technology transfer, was studied and the result were;

In this study was separated the satisfaction were into 5 levels as;

Maximum level	score	5
Rather maximum level	score	4
Optimum level	score	3
Rather minimum level	score	2
Minimum level	score	1

And separated the mean of the satisfaction were into 5 intervals as;

Maximum level	mean	4.51 – 5.00
Rather maximum level	mean	3.51 – 4.50
Optimum level	mean	2.51 – 3.50
Rather minimum level	mean	1.51 – 2.50
Minimum level	mean	1.00 – 1.50

Villagers who were training on the topic "Sugar-palm fruit processing", after training, they were tested on the satisfaction of the villagers on the knowledge they received from the training. The results were;

1) Knowledge was received; the mean of the satisfaction level on the knowledge was received after the training was 3.95 ± 0.76, and the meaning was rather maximum level.

2) Benefit for uses; the mean of the satisfaction level on a benefit for uses after the training was 3.65 ± 1.15, and the meaning was rather maximum level.

3) Ability of the trainers, the mean of the satisfaction level on ability of the trainers after the training was 4.52 ± 0.59, and the meaning was maximum level.

4) Ability of the trainer's assistant, the mean of the satisfaction level on ability of the trainer's assistant after the training was 4.30 ± 0.82, and the meaning was rather maximum level.

5) An appropriate of the training's documents, the mean of the satisfaction level on an appropriate of the training's documents after the training was 4.21 ± 0.99, and the meaning was rather maximum level.

6) An appropriate of the training's time, the mean of the satisfaction level on an appropriate of the training's time after the training was 3.78 ± 0.79, and the meaning was rather maximum level.

7) Satisfaction of the products, the mean of the satisfy level on satisfaction of the products after the training was 3.78 ± 0.79, and the meaning was rather maximum level, as shows in the Table 12.

Table 12 The satisfaction of the villagers on the training title "Sugar-palm fruit processing"

Items	Level of the satisfy					Mean	SD
	Maximum	Rather maximum	Optimum	Rather minimum	Minimum		
1 Knowledge was received	6 (26.1)	10 (43.5)	7 (30.4)	-	-	3.95	0.76
2 A benefit for to uses	7 (30.4)	6 (26.1)	7 (30.4)	2 (8.7)	1 (4.4)	3.65	1.15
3 An ability of the trainers	13 (56.5)	9 (39.1)	1 (4.4)	-	-	4.52	0.59
4 An ability of the trainers assistant	12 (52.2)	6 (26.01)	5 (21.7)	-	-	4.30	0.82
5 An appropriate of the training's documents	13 (56.5)	3 (13.0)	6 (26.0)	1 (4.4)	-	4.21	0.99
6 An appropriate of the training's time	4 (17.4)	11 (47.8)	7 (30.4)	1 (4.4)	-	3.78	0.79
7 The satisfy of the products	10 (43.5)	8 (34.8)	5 (21.7)	-	-	4.21	0.79

n = 23

Training on the Utilization of Sugar-palm's Leaves

Training for villagers in 2 villages on the title "Sugar-palm broom and a strip of sugar-palm roofing production" the results were shown in the Figure 14, 15.

Figure 14 Training for villagers on the title "sugar-palm broom production"

Figure 15 Training for villagers on the title "A strip of sugar-palm roofing
production"

After finish the training on the topic "Sugar-palm broom and a strip of sugar-palm roofing production", the satisfaction and the expectation of the villagers on the knowledge received from the training were studied and the result was;

In this study was separated the satisfaction and the expectation were into 5 levels as;

Maximum level	score	5
Rather maximum level	score	4
Optimum level	score	3
Rather minimum level	score	2
Minimum level	score	1

And separated the mean of the satisfaction and the expectation were into 5 intervals as;

Maximum level	mean	4.51 – 5.00
Rather maximum level	mean	3.51 – 4.50
Optimum level	mean	2.51 – 3.50
Rather minimum level	mean	1.51 – 2.50
Minimum level	mean	1.00 – 1.50

Villagers who were trained on the topic "Sugar-palm broom and a strip of sugar-palm roofing production", after the training, they were tested on the satisfaction and the expectation of the villager on the knowledge received from the training, and the results were;

1) Satisfaction level of sugar-palm bloom production by themselves; the mean of the satisfaction level after the training was 4.44±0.50, and the meaning was rather maximum level.

2) Level of an increased knowledge on sugar-palm bloom production; the mean of an increased knowledge after the training was 4.44±0.57, and the meaning was rather maximum level.

3) An expectation of the villagers to make sugar-palm bloom for uses by themselves; the mean of an expectation after the training was 4.29±0.66, and the meaning was rather maximum level.

4) Satisfaction level of sugar-palm strip production by themselves; the mean of the satisfaction level after the training was 4.48±0.64, and the meaning was rather maximum level.

5) Level of an increased knowledge on sugar-palm strip production; the mean of an increased knowledge after the training was 4.48±0.57, and the meaning was rather maximum level.

6) An expectation of the villagers to make sugar-palm strip for uses by themselves; the mean of an expectation after the training was 4.29±0.82, and the meaning was rather maximum level. It shows in the Table 13.

Table 13 The level of satisfaction and expectation on sugar-palm broom and a strip
of sugar-palm roofing production

Items	The level					Mean	SD
	Maximum	Rather maximum	Optimum	Rather minimum	Minimum		
1 Satisfaction level of sugar-palm bloom themselves production	12 (44.4)	15 (55.6)	-	-	-	4.44	0.50
2 Level of an increased knowledge on sugar-palm bloom production	13 (48.1)	13 (48.1)	1 (3.7)	-	-	4.44	0.57
3 An expectation the villagers will make sugar-palm bloom for uses themselves	11 (40.7)	13 (48.1)	3 (11.1)	-	-	4.29	0.66
4 Satisfaction level of sugar-palm strip themselves production	15 (55.6)	10 (37.0)	2 (7.4)	-	-	4.48	0.64
5 Level of an increased knowledge on sugar-palm strip production	14 (51.9)	12 (44.4)	1 (3.7)	-	-	4.48	0.57
6 An expectation the villagers will make sugar-palm strip for uses themselves	14 (51.9)	7 (25.9)	6 (22.2)	-	-	4.29	0.82

n = 27

Discussion

Seed Germination

The comparison on the ages of seed and treatment methods of sugar-palm seed influenced on seed germination, in this study, seeds soaking in 80 °C for three minutes made killed the embryo, suggesting that the temperature to soak the seeds should be reduced to improve the percentage of the germination. In term of the age of seeds, 36 month-old seed was better than 30 month-old seed due to 36 month-old was easier to extract seeds out of the fruit because the skin soften and the itchy latex was lower than 30 month-old. In term of seed treatment, although the percentage of the germination of the both ends seed trimming was higher than one end seed trimming in 12 months of collection data, but there was no statistical difference. If the time of the data collection was expanded to two years, the germination percentage may be exceeded 65-70% related with the study of Chantaraboon (1998) because the period for Sugar-palm seeds germination was about 4-24 months normally.

Transplanting Stage

The comparison on the survival rate of sugar-palm seedlings after planting in nursery of sugar-palm seedlings with 1, 2, 3 leaves. In this study, normally sugar-palm seedlings were always deaths in the first three weeks, after that if not death in the three weeks they are surviving to three months majority. The method to help to increase sugar-palm seedling survival rate was cutting off 2/3 of the leaf area to reduce the evaporation, and also help sugar-palm seedlings to rapidly produce the subsequent leaf. Moreover, the application of intensive watering system every two-hour during the first week of transplanting can increase the survival percentage up to 82%. This is relevant result with the study of Gardiol *et al.* (2003) and Lund and Soegaard (2003).

Seedling Fertilization

The comparison on growth acceleration of sugar-palm seedling by chemical fertilizer application. In this study, the majority parameter measurement are non significant different. Thus, in case putting the fertilizer into sugar-palm seedling for growth accelerating is the meaning to add the costs, especially the fertilizer costs into the sugar-palm cropping system (Chantaraboon *et al*., 2007). This insensitivity behavior of the sugar-palm to inorganic fertilizers may be an effect from the several reasons, e.g. the organic fertilizer employed in soil preparation of the experiment trapped major components of an inorganic fertilizers or an organic fertilizer in the soil were already provide enough the substances need for the early stage of sugar-palm development. It was also reported that results are not show an effect of fertilizer treatment in any of the parameter measure. It may be possible that it will take a longer time than the experimentation period before an effect of fertilizer will be pronounce (Mak *et al*., 2008).

Training on Forest Management

Training of 2 villages on the topic "Good forest management" finish. In both aspects of the training, villagers have had increased knowledge on the forest management and maintenance. Villagers were satisfied on the training and would use the knowledge to implement. It is a natural for human behavior; when they study they have knowledge, when they practice, they have a skill, and if they practice many times, they will be the expert. However, in the forest management, it uses a long time for a success. Thus it is necessary for the villagers to get trained many times for the forest management lesson along with the study and practice of the natural cycle before the forest sustainable management will appear.

Community Participation

The comparison step by step between Nam Ki and San Charoen village on villagers' participation levels into 5 steps of the community forest conservation as;

1) searching the cause of the problems' of community forest conservation step, 2) planning on the conservation step, 3) putting down the capital and implement step, 4) furrow up and control step and 5) evaluation of the conservation step. In the all 5 aspects were no statistical difference on villagers' participation, but in step 4, 5 both villages are not different participation level, but step 1, 3 San Charoen is higher than, on the contrary step 2 Nam Ki is higher than San Charoen. Due to San Charoen have the community forest area larger than Nam Ki and the benefit from the community forest and income from the past year was also more than Nam Ki. Thus in step of putting down the capital and implement and searching the cause of the problems' of community forest conservation, the score of San Charoen was higher than Nam Ki village because San Charoen gained higher benefit from the forest.

Sugar-palm Forest Restoration

Villagers are planting sugar-palm forest restoration; in this study the most villagers have not perceived the benefit from sugar-palm restoration for long time, which relevant with the study of Chantaraboon (2002). Moreover, the villagers have many activities around the year, and they do not perceive the true social benefit, then they do not good participation on sugar-palm restoration. In the long time, if they want to the forest management sustainable, villagers must to sugar-palm's restoration and dual activation to the villager's conscious on the forest management.

Training on Fruit Processing.

Training on sugar-palm fruit processing; in this study villager have an alternative option on sugar-palm utilization and sugar-palm value added, however for the future; villagers must first, develop on the quality and taste, then make standard of the product, and finally, develop on the marketing system, including promotion or development of products to be One tumbon one product (OTOP). Beyond, the government mechanism as Tumbon administrative organization (TAO), District agricultural official will help the villagers to be successful on the sugar-palm fruit

processing. Moreover, Pha Thong villagers must set one's mind to make sugar-palm to the product of community also.

Training on the Utilization of Sugar-palm's Leaves

Training on the beneficial uses of all sugar-palm parts by practical training for villagers in 2 villages on the title "Sugar-palm broom and sugar-palm roofing production"; in this study the villagers are very interested on the training, because the villagers are Hmean or Yao (hill tribe) who have the hands skill. They are also very interested on the training of high quality sugar-palm bloom and sugar-palm roofing production because they normally use the natural materials from their forest to make product can be used for their household. The study on satisfaction of villagers shows a high to high level.

CONCLISION AND RECOMMENDATION

Conclusion

An Increasing in the Number of Sugar-palm Trees in Pha Thong Community

In the first objective the results are; First, in term of seed germination, uses sugar-palm 36 months of seed and treatment with the both end trimming gave a better result on the seed germination. Second, in term of transplanting stage, uses sugar-palm seedling with one leaf together with 2/3 cutting off leaf and watering every 2 hours in the first week are helping to increase the survival rate. Third, in term of seedling fertilization, no fertilizer treat are better than fertilizer treatment, due to in an economic aspect of fertilizer treatment is not to be worthwhile, therefore conclude that villagers only tillage and watering to sugar-palm seedlings are enough. Fourth, in term of training on forest management on the title "Good forest management", the villagers have learned and understood the resources management more than before the training. Fifth, in term of community participation on management and conservation forest in 2 villages, the levels of 2 aspects are not different. Finally, sugar-palm forest restoration, villagers of both villages was planting sugar-palm in community forest about 2,000 trees.

The Villagers Wise Used of Seeds and Leaves of the Sugar-palm.

Villagers are able to utilize sugar-palm more effectively. The results are; First, in term of the training on fruit processing, the villagers have an alternative option on sugar-palm utilization and sugar-palm value added, they are able to respond to the consumer needs including the quality of safety of the product. Finally, in term of the training on the utilization of sugar-palm's leaves, by practical training for villagers in 2 villages on the title "Sugar-palm broom and sugar-palm roofing production", in this study the villagers were very interested on the training because they can immediately utilize an output from this training.

However, knowledge that they received in this project, if the villagers use to true implementation, and implement in each year by planning, implementation, evaluation and keep an evaluate data to revise, from the old method to an appropriate method and planning to the next cycle (PDCA Deming; Plan Do Check Action). The expected of sugar-palm production at Pha Thong community will be sustainable development in the near time.

Recommendation

For the sustainable development of sugar-palm production at Pha Thong community an author recommend that;

Recommendation for utilizing an out put from this research

In Nan province, there are many areas for sugar-palm production such as Pha Ka sub-district, Tha Wang Pha district, Chon Dan sub-district, Song Kware district and Phu Faa sub-district, Bor Kluea district, the knowledge from this project should be adaptation and use for conservation and utilization the sugar-palm forests in other areas of Nan province. Many areas of sugar-palm's forest are similar as Pha Thong community, that have some problems and wait for to rectify, therefore sugar-palm's forest conservation from Hmean's indigenous from these project may be helps some community by the methodology in this project.

Recommendation for the next research

1 In this study the target groups are villagers in 2 villages, however there are some problems about an appointments, because generally Hmean or Yao (hill tribe), who harvest sugar-palm from the forest, believe that sugar-palm must be grown in nature. The villagers have no interest in sugar-palm restoration, and Hmean's tradition that they do not work, but they stays in their houses on the holidays. From the beginning reasons, the acceptant on sugar-palm restoration of villagers are rather low

level. In the next research, if change the target group from the villagers to the youth, who studies in the school of 2 villages may be help to increase an acceptant, because the youth are eager to learn a new thing. By create a community curriculum on "Natural and environmental conservation: Planting and maintaining of sugar-palm" for teach the youth and to assign the youth for sugar-palm seedlings transplanting at their home and bring them to grow at their school in an appropriate time. Sugar-palm's activity of youth at their home may be able to indirectly change an attitude of the parents for sugar-palm restoration in the future.

2 There should be a study on sugar-palm forest management in other Hmean's lineage; due to sugar-palm forest in the other areas in Nan are other lineage, some knowledge from Hmean's lineage may not be uses in the other lineage. Then, researchers should study in the other lineages for the sustainable development of sugar-palm production in Nan province.

3 There should be a study on sugar-palm processing development for make many difference products of sugar-palm, which will help the villagers to gain more income than selling sugar-palm as the raw material, only.

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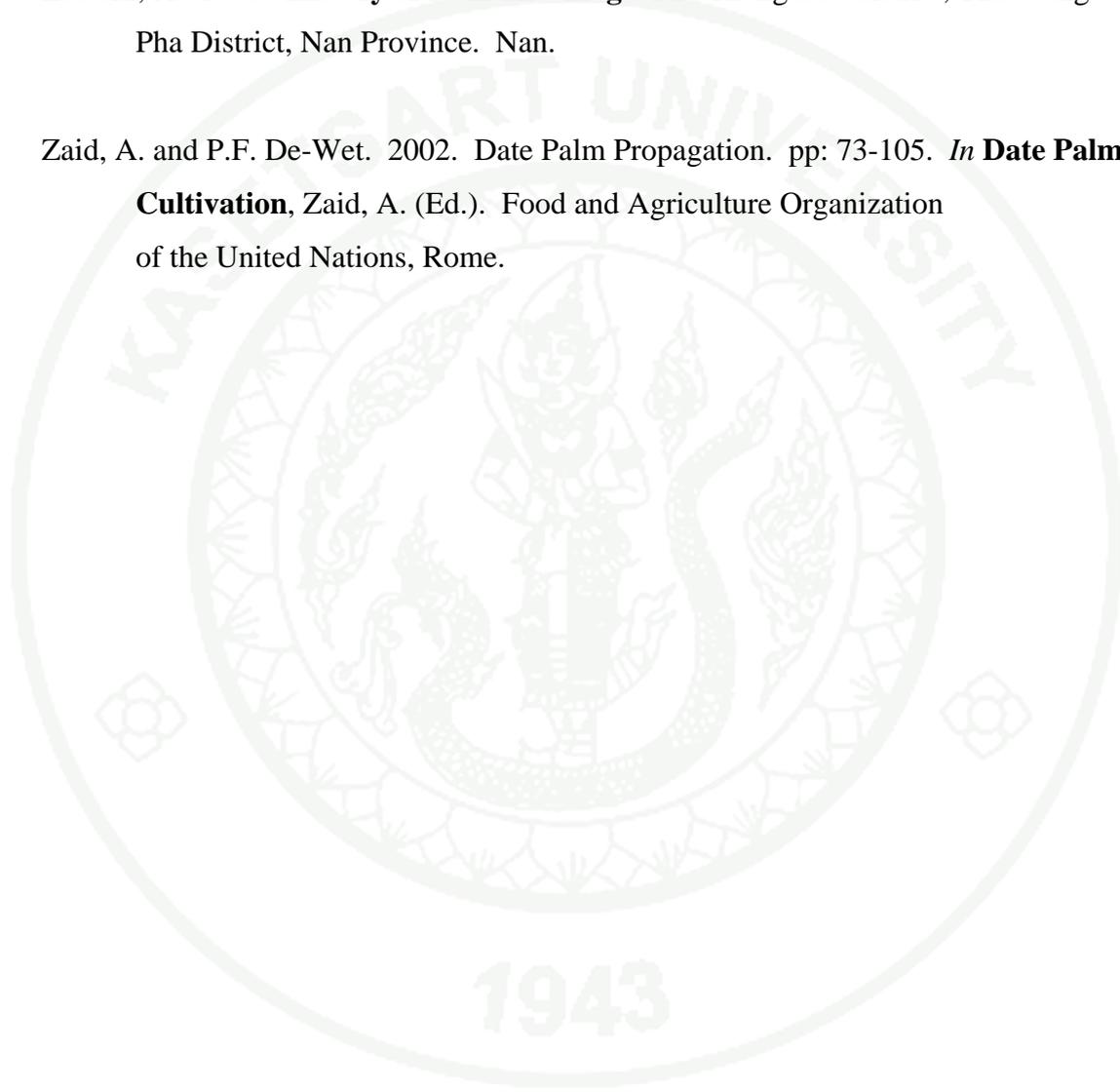
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