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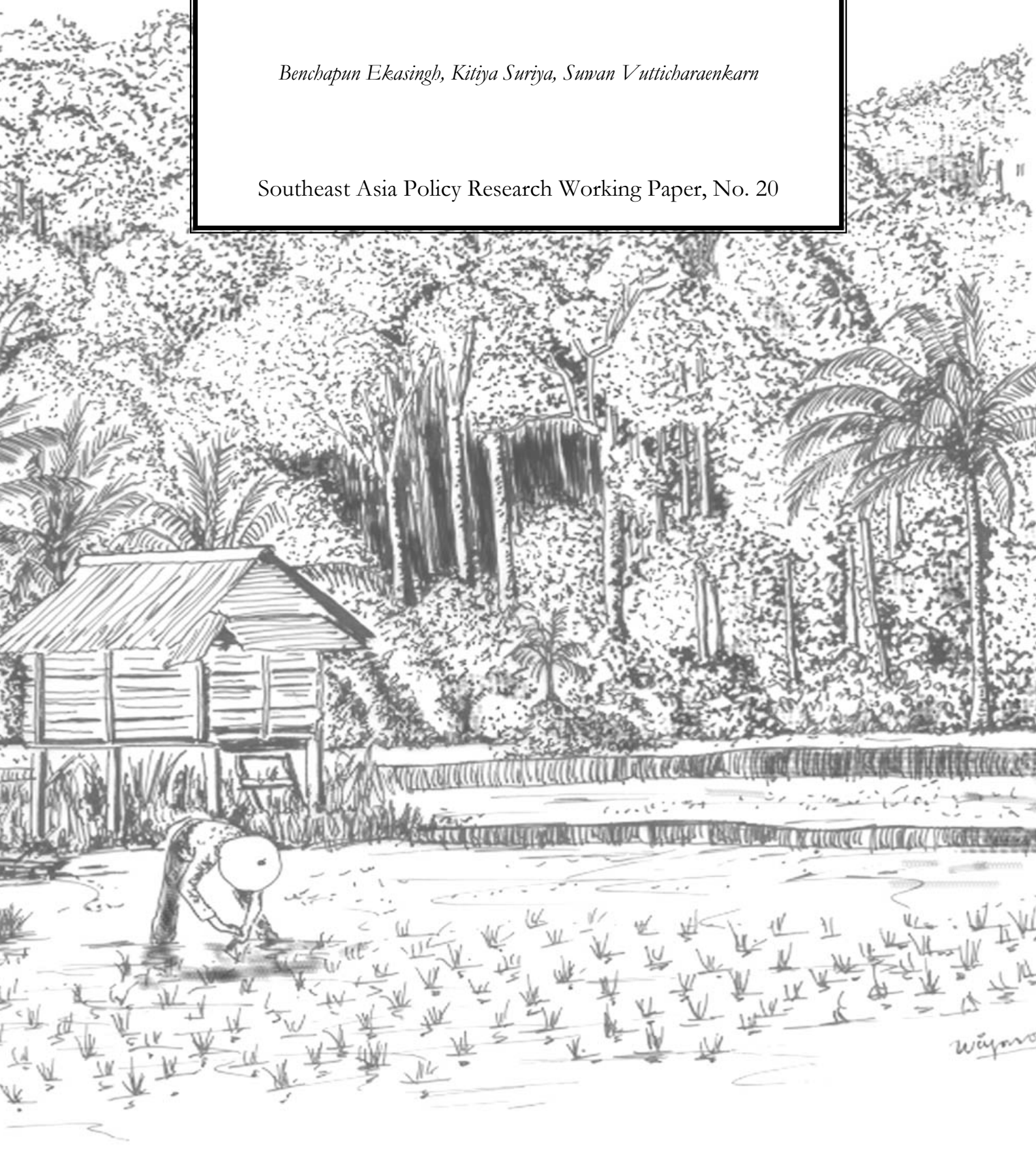

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Further information please contact:

ICRAF SE-Asia
Southeast Asian Regional Research Programme
PO Box 161
Bogor 16001
Indonesia
Tel: 62 251 625415, fax: 62 251 625416
Email: icraf-indonesia@cgiar.org
ICRAF Southeast Asia website: http://www.icraf.cgiar.org/sea

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Benchaphun Ekasingh,
Kitiya Suriya
and Suwan Vutticharaenkarn

The Multiple Cropping Center
Faculty of Agriculture
Chiang Mai University,
Chiang Mai, Thailand

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January, 1999

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Preface

Wat Chan is the name of a collection of villages in Ban Chan subdistrict, Mae Chaem district west of Chiang Mai Province, Thailand. The famous sites in Wat Chan include the 100-year-old temple, Wat Chan; the Queen Sirikit's Handicraft Center, the Forest Industry Organization Unit, and the Wat Chan Royal Project. Starting in 1993, a team of Chiang Mai University researchers have begun to conduct watershed research in this area covering many aspects e.g. hydrology, forest inventory, GIS and mapping, soil erosion, agronomy, and village land use. It started from a 3-year research grant from the Rockefeller Foundation, then followed by grants from the International Center for Research in Agroforestry (ICRAF). This study is a combined effort of these researches and research grants and covers mainly the economic aspects of land use. The authors hope that through these researches, sustainable agriculture and agroforestry practices in the highlands can be strengthened.

Benchaphun Ekasingh
Project leader,
The Multiple Cropping Center,
Chiang Mai University
January, 1999.

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The authors would like to thank the Multiple Cropping Center, Chiang Mai University for its technical support for this project. Thanks also the Rockefeller Foundation which initially supported the first phrase of the Chiang Mai University's Small Watershed studies in Wat Chan. Special thanks to go the Royal Project both in Chiang Mai and in Wat Chan which throughout the study provided continual logistic and technical support. The supply of the price data both for input prices and output prices were especially helpful to the analysis conducted in this study.

Lastly, the authors thank the farmers of Wat Chan who very patiently answered questions from researchers. The authors wish that the results of this study would be useful for decision-makers who have to decide on important policies affecting the lives of the people who live in the study areas.

Benchaphun Ekasingh
Kitiya Suriya
Suwan Vutticharaenkarn
January, 1999

About the Authors

Benchaphun Shinawatra Ekasingh

Associate Professor, the Department of Agricultural Economics and the Multiple Cropping Center, Faculty of Agriculture, Chiang Mai University, Chiang Mai, Thailand. She has a Bachelor degree in economics, Masters' degree in public policy, both from Victoria University of Wellington, New Zealand. Ph.D in agricultural economics, Michigan State University, U.S.A. Her specialization is in natural resource and environmental economics, agricultural and rural development. Her publications are many mainly dealing with farmers' decision making and roles of women in agriculture, impact assessment in farming systems research as well as property rights and institutions in forestry-related and highland development.

Kitiya Suriya

Her first degree is B.Sc. in Biology from Srinakharinvirote University, Bangsaen, Chon Buri, Thailand. Previous occupations included hygiene and food microbiology scientist in the Department of Livestock Development, Bangkok; quality control and quality assurance scientist. in the Bangkok Produce Merchandising Co. (C.P. group), and the assistant manager at the Forest Restoration Research Unit—a unit with collaboration between Chiang Mai University's Herbarium and the Royal Forestry Department's Doi Suthep Headquarter, Chiang Mai. She is now a Masters' Degree student in International Agricultural Systems Program, Faculty of Agriculture, Chiang Mai University.

Suwan Vutticharaenkarn

A graduate from Mae Jo University Department of Horticulture. He is a native Karen in Wat Chan who won a Queen's scholarship for his bachelor degree. He has worked in Wat Chan areas for the past 6 years as a research assistant for the Chiang Mai University Faculty of Agriculture and the Multiple Cropping Center.

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Abstract

8 crops in 6 farming systems grown by Karen highland communities in Wat Chan, Mae Chaem watershed, Chiang Mai, Thailand were investigated for their private and social profitability using the Policy Analysis Matrix (PAM) framework. The 8 crops were paddy rice, upland rice, ginger, taro, Japanese pumpkin, lettuce, green pepper and gladiolus. The latter 4 crops were the newly introduced crops by the Royal Project. They were found to be both privately and socially profitable and should be expanded. The other 4 crops were both traditional crops (paddy rice and upland rice) and commercial crops (ginger and taro). These were found to be privately unprofitable but when assessed using adjusted social prices, paddy rice and taro became socially profitable. Ginger and upland rice remained socially unprofitable crops and should be discouraged as a crop in the highlands, unless their productivity or prices improve. The examination of PAM ratios found that in all cases, there was a net negative transfer on these crops meaning that the government or the society were "taxing" the Karen highland farmers without adequate compensation. The net "taxes" came either in lower output prices, higher input prices or higher factor prices, even after transportation costs were taken into account. Policy corrections to address these net "taxes" were called for. Markets for capital, credit, output and input need to be improved to benefit these highland farmers to a greater extent.

Policy Analysis Matrix (PAM) is a tool to analyze land use systems both in terms of private costs/benefits as well as in terms of social costs/benefits (Pearson and Monke, 1989). Profitability will be assessed as it faces farm operators and again as it faces the society as a whole. Effective subsidies and taxes will be revealed through this analysis with implications for policy corrections. Effects of different policies on distortions of costs, benefits and thus profitability will be traced differentiating between market failures, efficient policies, and distorting policies. This study has as its objectives 1) to examine land use systems among farmers in a typical Northern Watershed of Thailand in Wat Chan areas and assess them in terms of private and social profitability using PAM as the framework and 2) to explore policy implications of these studies.

1. Research Site

A site in the northern part of Mae Chaem watershed, Mae Chaem district, Chiang Mai province, Thailand was selected for the purpose of this study. The site composed of 4 natural villages (in 2 administrative villages) in a subdistrict (*tambon*) called Wat Chan.

1.1. Village Characteristics

These 4 villages (*ban*) are *ban* Chan, Den, Nong Jet Noei, and Huey Bong, all populated by Karen ethnic groups. *Ban* Chan and Den are administratively the same village (called *mu* 3) while *ban* Nong Jet Noei and *ban* Huey Bong are part of the same formal village (called *mu* 8). The villages are situated in hill evergreen and pine forests between 19° 02' to 19° 06' North latitude and between 98° 16' to 98° 20' East longitude with an elevation of 900-1000 meters above sea level. Topographically, there are a mixture of paddy land, uplands, pine and evergreen forests. In 1995, the number of households were 263 in total with 81, 72, 76 and 34 households in *ban* Chan, Den, Nong Jet Noei, and Huey Bong village respectively. The population were altogether 1,561 persons in 1995 with 52% male and 48% female. The family size was generally large with an average of 6 persons per household. Extended family was still common in this area. Population growth was believed to be high as there was as high as 38.8% of the total population being those younger than 15 years of age in 1995. Those with 15-60 years of age constituted 55.9% of the population leaving around 5% being those who were older than 60 years.

The people had secure village and citizenship status. Village settlement history extended back 85-115 years in *ban* Chan, Nong Jet Noei and Huey Bong but around 50 years for *ban* Den. The people reportedly migrated from other areas of Mae Chaem district. *Ban* Nong Jet Noei was settled specifically as a Christian village where Christians came to live together. Other villages were Buddhism-based with presence of a Buddhist temple in *ban* Chan. *Ban* Den people were half Buddhists and half Christians.

1.2. Village Access and Interactions

1.2.1 Market Access

The 4 *ban* were accessed by all weather roads although the roads were not paved and access can be difficult in certain sections in the rainy season. Each *ban* was about 1 km from each other with *ban* Chan being the center of road

communication. *Ban* Chan was 136 km from Chiang Mai via Samoeng district, but was 166 km from Chiang Mai via Pai district. Travel time to Wat Chan from Chiang Mai on a motor vehicle is about 3-4 hours depending on route and road conditions. Although Wat Chan was administratively part of Mae Chaem district--being its northern subdistrict, but geographically was closer to Pai district, Mae Hong Son province, which was some 50 km away. People who wanted to travel to the heart of Mae Chaem district would often have to go south via Chiang Mai downtown and south again to Mae Chaem downtown, altogether around 220 km of travel distance. A dry season road from Mae Chaem downtown to Wat Chan was nevertheless available for those who wanted to use it.

Regular buses and trucks by private merchants and companies were available. In *ban* Den, there was a station of the King's Highland Development Project (called the Royal Project) which had many new highland crop extension activities. The Project had regular trucks transporting the Project's promoted produce at a cost to farmers. Private merchants came to the village for buying some other crops and forest products not promoted by the Royal Project e.g. taro, ginger and local chestnuts (*ko*). Other merchants came to sell things e.g. rice and miscellaneous consumer goods.

1.2.2. Labor

As paddy rice was a major crop for the Karen in this area, the people, like other farmers in traditional rice growing areas in Northern Thailand, still maintained traditional exchange labor mechanism in both rice planting, harvesting, and some other farm operations which needed a large number of people. This practice was even extended to some operations in a few of Royal Project crops. Hired labor was also used in the operations which did not use so much labor but was relatively not prevalent. Wage labor outside the area was also not common. Out-migration of people was mostly educational related. Highly educated persons also sought work in towns.

1.2.3. Education

There was a private secondary school in *ban* Nong Jet Noei run by Christian missionaries. This school served as a major educational institution in the area. Most young people were educated to Grade 9 while middle-aged people finished Grade 4 and old people usually could not read or write. A small number of people could continue their studies to finish Grade 12 and undergraduate level, in which case they had to go out of the villages to stay in major town centers like Chiang Mai or Mae Hong Son. A number of people who were Christians receive scholarship from the Church to continue their studies. Consequently, there is markedly difference in education levels between those in *ban* Nong Jet Noei and in other villages. Quite a number of people in *ban* Nong Jet Noei finished a Bachelor degree and they became teachers in this private school in the village.

1.2.4. Recent and Current Projects or Programs Active in the Villages.

The major project in this area was, as mentioned before, the King's Project. This Project had many sites in the highland of Northern Thailand with a headquarter in Chiang Mai. The station in Wat Chan was established in 1979. This station supplied much of the lettuce and Japanese pumpkin for the Project as a whole. This was done through long-term extension and marketing activities in the villages and

surrounding areas. Other new crops include green pepper, green pea, red cabbage, gladiolus, although there were only a small supplies of these latter crops. The Project had also introduced temperate fruit trees such as plum, peach, apple and avocado to farmers. These fruits had been introduced for 4-5 years and were starting to bear fruit.

There had been also in *ban* Chan a center of the Queen's Handicraft Project. This Project introduced weaving skills to village women who produced the material for the Project. A few other weaving groups involving dying, weaving, and sewing of materials among women were also present in *ban* Den, Nong Jet Nuei and Huey Bong. Some were introduced by the Church while others are introduced by NGOs.

In 1991-1993, a Chiang Mai University team conducted a research on watershed resource availability and use, covering both the biophysical and socio-economic aspects of the community resource use. Watershed modeling, soil analysis, forest inventory, GIS mapping and community profile and resource use were covered in that study (see Methi, et al, 1995, Methi, et al, 1996, Panomsak, 1997). This project was conducted with a support of the International Center for Research in Agroforestry (ICRAF) through its Alternative to Slash and Burn Project (ASB) and was intended as an extension of the above CMU set of studies.

1.2.5. Land Use Related Local Organizations

The Karen in Wat Chan, and elsewhere, were strong in their collective decision-making and community sense of belonging. In the past, decisions to farm particular land or even stay in the village needed collective approval. Traditional shifting cultivation was done in communal plots with communal arrangements of farm activities. Currently, these practices gave ways to much individualism in which farm land was more distinctively owned by individual households and decision-making with regard to farm activities was individually-based. Communal organizations, however, were still displayed in various forms, both formally and informally.

In each village, there are a Village Committee, Temple (Church) Committee, Rice Bank Committee, Housewives Committee and Youth Committee. Apart from these formal committees, villagers join collectively in water and watershed management, fire control and determination of rules for forest conservation and use. There was a network of watershed conservation outside the 4 villages called "*Hug Mae Chaem*" (Love Mae Chaem) which sometimes rallied for policy change concerning forest use. For example, in 1991, the network rallied against the joint plan of pine logging by the Forest Industry Organization (FIO) and the Royal Project claiming that it would conflict with villagers' livelihood systems.

1.3. Overall Village Land Use Status and Trends

1.3.1. Paddy Lands

Methi, et al (1995) found that in the 4 villages 86% of the farmers in the 4 villages have a paddy field with an average size of 0.66 ha per household. The yield of paddy land was reported at 2.56 ton per ha, rice production was 310 kg per person per year. Rice deficit in this area was estimated at 18 % of total requirement.

1.3.2. Rotational Shifting Cultivation (Swidden)

Traditionally, upland rice was planted in a communally arranged shifting cultivation plot (but individually farmed and produce was individually owned). The fallow period was approximately 10-12 years, after a one year cultivation. The current system wa modified due to higher man-land ratio. Shifting cultivation plots was at the time of survey (1996-1997) individually managed with a fallow of about 5-7 years after a one year planting. Many kind of vegetables were planted also in shifting cultivation plots so that productivity of shifting cultivation plots using only upland rice output underestimates its value. For example, corn, pumpkin, chili, gourd, cucumber, different kinds of beans, taro and green melon were planted either along the fence or intermixing with upland rice in the year of planting. During fallow periods, the plots were not used for vegetable planting and were left for weeds and coppice to recover. In the four villages under study, it was found that in 1993, farmers grew upland rice (with swidden plots) less in *Ban* Wat Chan (14% of the households) more in *Ban* Den (30% of the households), *Ban* Nong Jet Nui (51%) and the most in *Ban* Huey Bong (91% of the households) (Benchaphun, et al, 1995).

1.3.3. Permanent Upland Fields

There were in Wat Chan areas, some fields which were turned to permanent upland fields. These were those plots that were used for upland crop cultivation. Cash cropping was a common practice since the entry of the Royal Project. Apart from the Royal Project crops, farmers also had experiences growing some other crops e.g. taro, ginger and some vegetables but because of difficult transportation network, they always had difficulty of market access affecting both the market prices and outlets for their produce.

Many farmers were in the process of developing fruit orchards in these uplands. They often grew some upland annual crops such as pumpkin, gladiolus, lettuce or sweet pea intercropping with fruit trees such as plum, peach and persimmon trees. Some farmers were growing eucalyptus trees together with these new Royal Project crops. For some plots, it was hard to distinguish between permanent upland fields and their home gardens, especially as their permanent upland fields were right next door to their residence. Agroforestry systems in these areas were becoming more visible as they approached farmers' home. In the four villages, about 25% of the households were engaged in upland crop cultivation.

1.3.4. Home Gardens

Karen farmers always kept home gardens with many fruits and vegetables grown for home consumption. Tropical fruits were common such as mango, banana, pamelo, pineapple, papaya, etc but many farmers grew temperate fruit trees in their home gardens e.g. peach, plum, apple, avocado with the extension of the Royal Project. Vegetables were grown also in home gardens such as chili, eggplant, melon, pumpkin, ginger, green cabbage, cucumber and different kinds of beans and peas. The size of home gardens ranged from a few square meters to as large as 1 ha. depending on different households. The households were almost self-sufficient in terms of vegetable needs for home consumption as there were no daily fresh market in the area, unlike in other parts of rural areas. Home grown and wild food plants supply most of the diet for the people in this area. Some home gardens were small in size but some were large as orchards. Altogether, home gardens and orchards were kept by about 45 % of the households in the areas. Those in Ban Nong Jet Nui had more

orchards (55% of the households) than those in Ban Huey Bong (24% of the households).

1.3.5. Livestock

Livestock were also kept for home consumption. These were mainly chicken and pigs and to a lesser extent cows. Buffaloes were kept as draft animals although increasingly farmers were turning to small hand tractors for work power. Cows were often sold for cash and are regarded as savings for the households. They were also indicators for wealth among the village community. Cow raising was done in the forests especially in the rainy season. The herd was left in the forests with occasional visit by the owners every other week. Nevertheless, sometimes foot and mouth diseases attacked the herds and farmers report to have suffered heavily from the undue death of their cows. Many refused to invest more in livestock for this reason.

1.3.6. Forest Land

Forests around the study sites were mostly hill evergreen forests with pine as a dominant species. Forests were used extensively for many purposes such as sources of timber, grazing land, of various non-timber products. For household use, forest products sought for in the forests were timber for house construction, house poles, roofing materials, bamboo stripes for tying bundles, banana leaves, lighting sticks, fuelwood, pine raisin, color dyes for clothing and medicinal plants. For food, mushrooms, bamboo shoots, local chestnuts, banana stems for pig feed and banana flowers for human food, wild fruits, other wild vegetables, honey, wild animals such as rats, birds, squirrels, rabbits, boars, deers, as well as fish, crabs, turtles and shell fish were found from forest lands and rivers. Large wild animals such as tigers and bears were rarely seen around the forests anymore. Men specialized in house construction materials while women specialized in food and clothing preparation. Fuelwood collection is done both by men and women (see Shinawatra and Krummel, 1997) and was usually done in the dry seasons during January to March. Women extensively collect wild plants as food and there were dozens of species which can be studied and identified. Men specialized in long trips to the forests for animal hunting and certain food, utility items. Women collected food plants within a shorter distance around the village. Food plants and animals were collected and hunts in the rainy season i.e. during June-October. Given this environment, there was no fresh market for meat, fruit and vegetables in the area as villagers were mostly self-sufficient in these items in their daily life. Medicinal plants were collected by traditional doctors who learned their skills of traditional medicine from their ancestors. Traditional doctors could be both men and women.

Forest lands were classified into different categories by the villagers. There were watershed forests which were situated right next to rivers and streams, especially in the areas they classified as headwater areas. These watershed forests were protected by the villagers as a whole and particularly by the villagers who used water in the stream adjacent to those forests. There were utility forests which were used for many purposes, fuelwood collection, timber for house construction, grazing for livestock and so on. These forests were also protected for use by the villagers. There are “birth” forests which were used for spiritual purposes to identify the birth places of individual persons. There were “death” forests equivalent to cemeteries. Villagers in each village had access to different areas of forests. They had a loose

sense of boundary between villages. When the concept of "community forests" were discussed, they recognized the concept and confirmed that they existed in their community, although they admitted there was not yet a clear boundary between villages.

1.3.7. Past or Current Land-Use Conflicts

Land use conflicts arose when it came to contact with formal institutions. Forest lands were classified and managed by the Royal Forestry Department. Forests were classified into watershed classes, 1-5. Class 1 was most restrictive in terms of use, while class 5 was allowed for agricultural uses. Formally, all classes of watershed land uses were subject to permission by the Royal Forestry Department. In other words, the land in which villagers were using fell within some categories of forest lands which was subject to national laws and regulations. In the past, the villagers in these areas had little difficulty in using the lands for their traditional livelihood. There was however in 1992 a conflict over pine forest concessions which would be administered by the Forest Industry Organization (FIO). FIO had plans to harvest pine forests, then replant pine trees and manage the forests in a sustainable forest management schemes with villagers' participation in various activities. The plan was met with intense opposition among villagers, NGOs and other conservation groups. Protests were staged claiming that villagers would like to protect the forests rather than having some agencies use them for the purposes not approved by the villagers. FIO and the forestry section of the Royal Project, which oversaw this issue claimed also that villagers themselves were not using the pine forests in a sustainable manner because when pine raisin was collected from pine trees, villagers would burn a lower section of pine trees thereby undermining the viability of pine trees. Because of this conflict, villagers agreed among themselves they would stop pine raisin collection activities but insisted that FIO and the forestry section of the Royal Project stayed out of the areas with their original intention. This conflict was resolved although it left some bad feelings within certain sections of villagers and the Royal Project.

Other types of land use conflicts were relatively insignificant in these village areas.

1.4. Major Village Land Use Systems

Given past and current land use changes in the areas, there were 4-5 major land use systems, namely;

1.4.1. Paddy Rice-Based Land Use System.

This land use system was predominantly practiced in lowland irrigated areas along rivers and streams. These areas were grown to non-glutinous, local rice variety with limited irrigation facilities in the dry season. Paddy rice was grown in July and harvested in December (Figure 1 and 2).

1.4.2. Upland Rice-Based Land Use System.

Upland rice was still grown in upland areas in shifting cultivation mode of production. The rotation period was 1 year cultivation 5-7 years fallow as contrast to the 10-12 years fallow period in the past. Upland rice productivity was low but farmers reported growing it because of inadequacy in lowland rice production for

household consumption. Along with upland rice, garden vegetables were grown in upland rice plots in the year of cultivation. In this mode of production, farmers will need a few plots of land to rotate their cultivation plots in each year. Nevertheless, land is scarce and most farmers did not have adequate land to complete the upland rice cycles. Sometimes, certain cash crops were grown in these areas instead of upland rice. Ginger and taro were the most common crops grown in the areas for cash. Vegetables like melon were also sometimes grown for home consumption in these cash crop plots.

1.4.3. Upland Cash Crops-Based Land Use System.

With the introduction of cash crops by the Royal Project, farmers in the areas had long experience with cash cropping through the extension and marketing services of the Royal Project. Common cash crops grown in the areas were Japanese pumpkin, lettuce, green pepper and gladiolus. The first two crops were the most common with double, triple cropping possible with certain areas with good water accessibility.

1.4.4. Other Land Use Systems.

Other land use systems involved orchard system like peach, plum, apricot and eucalyptus-silver dollar. These were land use systems which were still developing in terms of revenues because the fruits and products were still not earning a lot of income. After growing them for several years, farmers were expecting to have some income from them. Some were impatient to wait any longer and tend to cut these fruit trees for other more promising tree crops such as coffee.

2. PAM Analysis of Representative Land Use Systems

In order to investigate in more details land use systems in Wat Chan areas, Policy Analysis Matrix (PAM) is adopted as an exercise to quantify the inputs, outputs, costs and revenues of representative land use systems in the study area. Private profitability is assessed in the beginning. The analysis goes on to ascertain the social pricing of these inputs and outputs to see social profitability of such land use systems. Private profitability ascertain incentives to produce at the producer level. Social profitability on the other hand determine whether there is substantial tax or subsidy in the inputs and outputs of the land use systems and if so, whether these tax or subsidy is a result of market failures, efficient government policies or distorting government policies. The analysis of divergences between private costs/benefits and social costs/benefits form the core of policy analysis in PAM exercise (Monke and Pearson, 1989)

PAM tables, consisting of mainly input-output, private prices, private budget, social prices, social budget as well as summary and miscellaneous tables will be done for the following individual crops: paddy rice, upland rice, Japanese pumpkin, lettuce green pepper, gladiolus bulbs, ginger and taro. The first two crops were the farmers' traditional crops. The following 4 crops were the Royal Project crops and the last two crops were introduced by private merchants. Most PAM tables, except for the whole-farm budget table, will be constructed on a per rai basis (1 rai = 0.16 ha).

After individual crop analysis both at private prices and social prices, the whole-farm PAM table was constructed consisting of 6 patterns of land use, namely,

1. Paddy rice in lowlands, upland rice in uplands.
2. Paddy rice in lowlands, pumpkin and ginger in uplands

3. Paddy rice in lowlands, pumpkin and lettuce in uplands.
4. Paddy rice in lowlands, pumpkin and green pepper in uplands
5. Paddy rice in lowlands, gladiolus in uplands.
6. Paddy rice in lowlands, taro in uplands.

Private returns for operators were then calculated using the average size of plots per household for each crop giving a whole farm private profitability for each pattern of land use. Given these tables of data, analysis of divergences between private and social prices was then analysed.

2.1. Data Collection for PAM

Socio-economic data used in this study were initially from the existing project of Chiang Mai University Small-Scale Watershed study conducted by the Multiple Cropping Center, Faculty of Agriculture. In that study, population number, characteristics, land uses and many socio-economic variables were already available. In order to complete PAM analysis, In total, 40 households in 4 villages were interviewed with respect to their farming systems and selected aspects of crop production. The average sized farms were selected as to yield representatives of their crop production aspects. Despite these facts, there was still much variation in how these households handled their individual crops. Short questionnaires were prepared for respondents to answer. Household heads were selected for interviewed initially although when dealing with forest product collection, both men and women of the households were consulted. Informal interviews and village diagnostic visits and talks were employed throughout the studies. The Royal Project personnel were also interviewed for details concerning the marketing, prices and extension services provided to villagers.

2.2. Results of PAM Analysis

2.2.1. Private Profitability

Table 1 displays input-output for the 8 crops, table 2 displays private prices. These two tables were linked to give rise to costs, returns and thus private budgets for individual crops in Table 3. All data in these tables were displayed on a per rai (6.25 rai = 1 ha) basis. In Table 3, per household profit was also calculated using the average size of farms per household for individual crops. For paddy rice and upland rice, average size of land cropped per household was around 3.5 rai while for ginger and taro, around 1-2 rai. As for the Royal Project crops, the average size of farms per household for pumpkin was 1 rai, for lettuce 0.5 rai, for green pepper and gladiolus around 0.25 rai.

Without going into details of each crop and each category of input, one can assess overall private profitability of each crop in Table 3. Among the 8 crops investigated, only 4 crops were profitable for producers at the local level. The 4 crops were the Royal Project crops, namely pumpkin, lettuce, green pepper and gladiolus, all of which had private profits of 4,822 baht, 4,842 baht, 8,742 baht and 4,288 baht per rai respectively. Despite this high profit per rai, farmers only grew a quarter of a rai for green pepper and gladiolus, half a rai for lettuce and one rai for pumpkin, due to seed allocation by the Royal Project. Profit per household was therefore highest

for pumpkin (4,822 baht), second highest for lettuce (2,421 baht), third highest for green pepper (1,821 baht) and lowest for gladiolus (1,072 baht).

Other cash crops did not do well in terms of private profitability. They were taro and ginger. Both of these crops have high price fluctuations and for ginger, farmers lost as high as 6,732 baht per rai in 1997. Prices of ginger were as high as 19 baht per kg. in 1996 inducing farmers to expand areas of production while in 1997, reducing to only 2.5 baht per kg. Some farmers could not sell their products at all if they did not have good quality ginger. Part of the problem was connected to the Thai macroeconomic crisis in 1997 which stopped the flow of institutional credit to small and medium operators. As a consequence, they stopped buying output from farmers.

As far as the traditional crops are concerned, both paddy rice and upland rice yielded small negative private profit of –127 and –74 baht per rai respectively. Average yield of paddy rice was 400 kg per rai (2.5 ton per ha) while average yield of upland rice was about 50% of the paddy rice level (200 kg per rai or 1.25 ton per ha). Prices of rice were valued at 3.76 baht per kg and variable costs for paddy rice were evaluated at 234 baht per rai and for upland rice 52 baht per rai. Returns to land and labor were 833 baht per rai for paddy rice and 658 baht for upland rice. Labor costs were also evaluated at 960 baht for paddy rice (16.9 man-days per rai) and 732 baht for upland rice (13.3 man-days per rai). When all costs were calculated (including labor costs), farmers will have negative profit for these traditional crops. Nevertheless, despite low returns for rice production, farmers continued to grow them for subsistence purposes. For paddy production, the negative profit was also a result of high depreciation charges for the use of tractor services. For those who had a tractor for their use, they underutilised such tractor (due to small farm size) while those who had to pay for tractor services, there was an overcharge of tractor services in which case farmers have to pay 500-1,000 baht for a 2-3 rai paddy land.

The negative profit could also come about because of the existence of by-products of rice cultivation such as rice bran or garden vegetables grown in upland rice fields which was not evaluated in these tables. Given these by-products, the value of production in those rice fields was somewhat underestimated. If one takes into account those by-products, the households can just about break even.

2.2.2. The Calculation of Social Prices

Social prices of tradeable inputs and outputs are border prices of such commodities adjusted for transportation, marketing and processing costs to bring such commodities down (either buy or sell) to the operator level (see Table 8: social import and export parity prices). Border prices are the prices at which foreign suppliers would deliver the commodities to the domestic market or the price that foreign consumers would pay domestic suppliers to deliver the commodity to their markets. In the case of export or exportable commodities, the adjusted border prices are called social export parity prices. In the case of import or importable commodities, the prices are called the social import parity prices. These prices were calculated for inputs and crops which were not only exports or imports but also for those commodities which had a potential for imports and exports as well.

Social import and export parity prices are calculated as the border prices (c.i.f. or f.o.b. prices) evaluated at social exchange rate and adjusted (add or subtract) down to the farm gate. In the case of imports, c.i.f prices were evaluated at social exchange rate to give c.i.f. costs of inputs at domestic currency. Then marketing costs, transportation costs and processing costs (together with necessary conversion ratio)

were added to the c.i.f domestic prices to yield social import parity prices at the farm level. These were done for imports or importable items e.g. fuel, fertilizers, seeds of exotic flower and horticulture crops i.e. gladiolus, lettuce, green pepper and Japanese pumpkin.

In the case of exports or exportable commodities, either c.i.f. prices at foreign ports or f.o.b. prices at Bangkok were used, deducted any freight and insurance costs between countries, evaluated at social exchange rate. Then transportation costs, marketing costs and processing costs were deducted with the necessary unit conversion so as to yield social export parity ratio. This was done for outputs of all crops, namely, rice (35% rice equivalent), pumpkin, lettuce, green pepper, gladiolus, ginger and taro. When Thailand had exports of these items, f.o.b. prices at Bangkok were used (for ginger, taro and rice) but when Thailand did not export the crops, f.o.b. prices at foreign ports were used with added adjustment with respect to freight and insurance to Bangkok port. For details of the calculation, see Table 8. The estimated of social prices depending upon many data requirements and trade statistics, the social prices used in this study are thus one set of estimates which can be verified, challenged and for best uses, they should be subject of further refinement.

2.2.3. Social Profitability

Social profitability was calculated by multiplying social prices with the inputs and outputs in input-output tables. When social prices were calculated, 6 of the 8 crops considered in this study were socially profitable. Ginger and upland rice remained unprofitable after adjusting for social prices, bearing in mind that in the case of upland rice, there were few items that need adjustment from private prices as this crop used very few tradeable inputs. In upland rice case, the divergence of private prices and social prices came mainly in rice prices which was slightly different in the two cases. As for ginger, private prices and social prices diverged in fertilizer prices, seed prices and output prices. Social output prices were higher than what farmers were getting at the farm gate suggesting a market imperfection in its output market. Nevertheless, even with higher output prices, ginger was not socially profitable as a crop. Besides, it was expected that soil erosion in both upland field and ginger field could be high. If it was so, then the two crops were even more unprofitable from the society's point of view.

The other 6 crops, namely, paddy rice, taro, pumpkin, lettuce, green pepper and gladiolus were socially profitable. Lettuce, green pepper and pumpkin were among the most socially profitable crops per rai provided that farmers had a successful crop. Pumpkin was more reliable in terms of production than lettuce and green pepper in that its output was more pest and disease resistant. Lettuce required short growing period (2 months) and farmers could grow up to 3-4 crops in a year if they so wanted. The only problem with lettuce was that it was disease prone and sometimes farmers would lose an entire crop. The high social profit (16,503 baht/rai) for lettuce was somehow overestimated when production risks were taken into account. The divergences between social prices and private prices for lettuce lied in seed prices, fertilizer prices, fuel prices and output prices. Especially for output prices, lettuce import parity prices at farm gate could be as high as 20 baht per kg. Despite the fact that the prices fluctuate widely in a year, the 8 baht per kg received by farmers seemed to be rather low. Nevertheless, some farmers did get a higher prices than this depending upon particular periods of the year. If marketing and handling of lettuce output could be improved, farmers would earn substantially more

income than currently. In terms of profitability and market demand, it was a potentially a good crop to grow.

Green pepper was also a highly profitable crop. Social profit for green pepper was calculated at 15,421 baht per rai. In 1998, the Royal Project was limiting production and sales in the Wat Chan site and only allowed a few farmers to grow it and each only in a small sized land (0.25 rai). The social price of green pepper was calculated using U.S. import prices deducting freight, insurance and transportation costs to the farm gate. The social price of green pepper was calculated at 18.6 baht per kg as contrast to 15 baht per kg for its private price.

Pumpkin and gladiolus were also socially profitable at the level of social profit of 14,894 baht per rai for pumpkin and 9,579 baht per rai for gladiolus. Pumpkin social price was calculated to be at 17.8 baht per kg as compared to 8 baht per kg of its private price. The social price was calculated from Japanese import prices deducting transportation and marketing costs to the farm gate. As for gladiolus, the social price was calculated from U.S. export prices adjusted for quality of the produce minus transportation costs, etc., to the farm gate (see Monke and Pearson, 1989). Its social price was 2.13 baht per bulb as compared to 1.24 baht of its private price, while its social price of seeds was calculated at 70 baht per litre as compared with 30 baht per litre of private seed prices.

The two crops, which were not privately profitable but which, were socially profitable were paddy rice and taro. Both yielded a small social profit per rai (214 baht per rai for paddy rice and 1,162 baht per rai for taro). In the case of paddy rice, the divergences of private costs and social costs lied in the use of small tractors in which private costs were high while the social costs are not. This reflects the imperfect market in machinery sale and use. Either there was an under utilization of tractors in some households, thereby pushing the cost of machinery up than otherwise or in some households without their own machinery having to pay unusually high rental value. In the case of taro, the divergence between output prices in private and social context was the main reason for the difference in profitability.

2.2.4. Measurement of Government Intervention/Market Imperfection

Looking at the summary of PAM tables (Table 6) and PAM ratios (Table 7), one can make conclusions on the net effects of government intervention and/or market imperfection. If social prices in the revenue column are more than private prices, output divergence will be negative indicating a tax effect for producers. The tax effects can be from government intervention or market imperfection or both. Given the 8 crops in consideration, all crops suffered a net tax on output. Here, farmers obtained less for their product than what should be if they were evaluated at social prices. Negative output transfer (tax) was high for most of the Royal Project crops indicating that higher prices of output can certainly be offered to farmers if these crops can be better linked to international market and better marketed. Ginger and taro also had a relatively high negative output transfer indicating that social output prices were substantially higher than what farmers were obtaining in the field at farm gate. Market imperfection and credit crunch in 1997 could explain the low farm gate prices facing farmers in Wat Chan. The Thai economic crisis was felt directly by the upland farmers in Wat Chan as they participated in cash cropping.

Input transfers can be measured in similar ways but with opposite direction. If private prices of inputs are more than their social prices, the divergence (input

transfer) is positive, this indicates a tax on inputs. When the private prices are less than social prices, input transfer is negative and producers are subsidized.

In terms of tradeable (traded with foreign countries) inputs such as fertilizers, seeds and fuel, 3 crops enjoyed subsidy, namely lettuce, gladiolus, and taro, while 4 crops (paddy rice, pumpkin, ginger and green pepper) have net tax on inputs. To grow paddy rice and pumpkin, there was a net tax on fuel prices (social price of fuel was at 6.71 baht per litre as against 12 baht per litre of private prices). To grow green pepper, there was a net tax on seed prices (1 baht per seedling for private price compared to an estimated 0.61 baht per seedling for social price). In the case of subsidy for growing cash crops, farmers enjoyed subsidies on fertilizer prices. In 1997, private fertilizer prices were about 7-8 baht per kg. while the fertilizer prices (prices before devaluation), evaluated at social exchange rate (after devaluation, at 35 baht per $US 1) were 9-11 baht per kg. In the case of upland rice, neither tax nor subsidy is put on the crop as the crop uses few tradeable inputs.

Divergences between private and social prices of domestic factors are generally small as labor costs are more or less correctly priced at social opportunity costs without government intervention. Farmers reported the wage rate of 50 baht a day, paying slightly more in kind during rice planting and harvesting time. This is in line with the implicit wage rate calculated for paddy rice and upland rice cultivation (49 baht a day, see Table 3: Private Budget).

One important source of the divergence in domestic factor prices lie in the machinery and capital charges. Machinery charges in the case of paddy rice cultivation are high in private prices and are adjusted down in the case of social prices. Moreover, in the capital market, private interest rate is around 15% while the social interest rate measured at long-term lending rate for the Central Bank of Thailand is around 5% in real term. These rates are used in calculated costs of capital for private and social prices of inputs. The capital used for Royal Project crops is charged at 9% in private prices.

Taking all transfers together (net transfers--see PAM Summary Tables), producers of all crops were being penalized by the society/government. Equivalent negative transfer (tax) was highest in the case of lettuce (11,660 baht per rai) and then pumpkin (10,076 baht per rai). It was at an medium level for green pepper (6,678 baht per rai), gladiolus (5,291 baht per rai), ginger (5,858 baht per rai) and taro (2,179 baht per rai) and at a low level in the case of paddy rice (345 baht per rai) and upland rice (26 baht per rai). These negative transfers were the sum of all transfers, namely, output transfers (e.g. lower private output prices than social output prices due to imperfection of the market), input transfers (e.g. higher private input prices than the social prices due to taxes, imperfection of the market, high transportation and marketing costs) and factor transfers (e.g. higher private factor prices than the social factor prices mainly due to capital market imperfection). These results were very significant indicating the extent to which upland farmers in Wat Chan were being penalized by the society/ government through either government taxes, imperfection of the capital market, the imperfection of the input and output markets. When these markets can be corrected or improved, farmers would be much better off producing these crops. Most crops, except upland rice and ginger, were shown to be socially profitable and should be encouraged to be produced. Nevertheless, farmers were not getting adequate returns for their efforts. With better policies and management, farmers would either enjoy higher output prices, lower input prices, lower taxes, higher subsidies and all the above. Despite the claims that upland farmers were

enjoying a lot of subsidies from the society, the Royal Project and the government, this PAM analysis shows that the level of subsidies they were enjoying was minimal and they were actually taxed by the ways things were going. In some cases, the equivalent taxes were substantial. As the results show, increased subsidies in some cases may even be justified from the societal point of view.

Although these estimates cannot be held as exactly correct due to variations in estimation of various items, they should be viewed as approximately correct because as much as adjustment as to transportation costs, quality factors, necessary marketing costs were already allowed. The negative net transfers for all crops indicate a vast room for improvement in either the marketing, transportation or policies for these crops. They were potential gains, which were not yet realized in producing these crops.

2.3.5. Whole-farm PAMs

Whole-farm PAMs were derived from taking into account farmers' average farm size. 6 patterns of farming systems were studied for their private and social profitability as shown in Table 11. In this table, it was shown that 3 out of 6 farming systems were experiencing negative private profits, namely, paddy rice & upland rice, paddy rice & pumpkin/ginger, and paddy rice & taro. Nevertheless, assessing their social profitability, all farming systems farmers adopted were socially profitable in the aggregate. This was because the negative social profits were offset by the positive ones. The highest social profits were farming system no. 3 paddy rice & pumpkin and lettuce. This was also the most popular farming system in the area as well.

2.3.6. Relevant PAM Ratios

A further analysis of land use systems can be made through different ratios. These ratios can be calculated from PAM tables, which in a general case is shown below.

	Revenue	Costs		Profit
		Tradeables	Domestic Factor	
Private Prices	A	B	C	D
Social Prices	E	F	G	H
Divergences	I	J	K	L

The relevant ratios are

$$\text{Private Cost Ratio} = \frac{\text{Private Domestic Factor Costs}}{\text{Private Revenue} - \text{Private Tradeable Input Costs}} = C/(A-B)$$

$$\text{Domestic Resource Cost Ratio} = \frac{\text{Social Domestic Factor Costs}}{\text{Social Revenue} - \text{Social Tradeable Inputs}} = G/(E-F)$$

$$\text{Effective Protection Coefficient} = \frac{\text{Private Revenue - Private Tradeable Inputs}}{\text{Social Revenue} - \text{Social Tradeable Inputs}} = (A-B)/(E-F)$$

$$\text{Ratio of Private and Social Profit} = \frac{\text{Private Profit}}{\text{Social Profit}} = D/H$$

$$\text{Subsidy Ratio to Producers} = \frac{\text{Net Transfer}}{\text{Social Revenue}} = L/E$$

Table 7 shows such ratios for different crops.

Private cost and domestic resource cost ratio should be less than 1 to be privately and socially profitable respectively. As for effective protection coefficient, if this ratio is less than 1, it indicates a tax on producers while if it is more than 1, there is a subsidy (protection) for the crop. As mentioned earlier, all crops were not subject to protection by the government/society. Farmers were generally taxed by policies some ways or others.

With respect to the ratio of private and social profit, we should look only for positive numbers as negative numbers can be misinterpreted. This ratio indicates how private profit is compared to social profit. If this ratio is greater than 1, farmers are subsidized and if it is less than 1, farmers are taxed. This ratio was lowest for lettuce, and pumpkin (0.29 and 0.32 --taxed heavily), moderately taxed for gladiolus (0.45) and green pepper (0.57).

Subsidy ratios to producers indicate how much net transfer is a ratio of social revenue. If the ratio is positive, it indicates a subsidy case and if it is negative, it indicated a case of tax. The ratios can also be compared across crops. For example, net negative subsidy (tax) for paddy rice and gladiolus is –0.22 as compared to –0.03 for upland rice and –0.58 for pumpkin, indicating that paddy rice and gladiolus were taxed more heavily than upland rice but less heavily than green pepper (-0.28), pumpkin (–0.58), lettuce (-0.59), ginger (-0.59) and taro (-0.52).

2.3.7. Sensitivity Analysis

To make full use of PAM analysis, sensitivity analysis was attempted for those variables, which are subject to great variability. The following cases were investigated

Price changes

a) Lettuce price increases to 15 baht per kg.
b) Ginger price increases to 10 baht/kg
c) Taro price increase to 5 baht/kg
d) F.o.b. rice (35%) export price increases 15%

Productivity changes

e) Lettuce output decreases to 50%
f) Paddy rice output increases by 30%
g) Paddy rice output decreases by 30%
h) Upland rice output increases by 20%
i) Ginger output increases by 15%

The following are the results of the sensitivity analysis

Crops	Situations	Results
a) Lettuce	Price increase: 15 baht/kg	Private profits increased to 11,831 baht per rai, net negative transfer decreased
b) Ginger	Price increase: 10 baht/kg	Negative private profits decreased but still negative
c) Taro	Price increase: 5 baht/kg	Negative private profits decreased but still negative
d) Rice	Export price increase: 15%	
d.1) Paddy rice		Private profits stayed the same, social profits doubled.
d.2) Upland rice		Private profits stayed the same, social profits became positive
e) Lettuce	Output decrease: 50%	Private profits substantially decreased from 4,842 baht per rai to 849 baht/rai social profits decreased from 16,503 baht per rai to 6,660 baht per rai
f) Paddy rice	Output increase: 30%	Private profits became positive (324 baht/rai), social profits tripled
g) Paddy rice	Output decrease: 30%	Private profits and social profits became negative
h) Upland rice	Output increase: 20%	Private and social profits both became positive
i) Ginger	Output increase: 15%	Private and social profits were still negative

The sensitivity analysis shows that even when prices increases 4 times for ginger or output increase 15%, ginger still had negative private and social profits. In the case of taro, even when price increased from 3.33 baht to 5 baht, private profits are still negative. These two crops would have difficulty in terms of farmers' adoption. Nevertheless, for upland rice, with an export price increase of 15% or an output increase around 20%, it would be socially profitable although in the former case not privately profitable. In this case, it indicates the sensitivity of upland rice to yield increase. With a 20% yield increase, upland rice could be made both privately and socially desirable at least in the particular year which it is grown.

As for other cases, an increase in output and prices would increase the private and social profitability and vice versa. If a decrease in output for paddy rice in one year was 30% reduction, paddy rice would become not socially profitable.

This sensitivity analysis revealed that traditional crops such as paddy rice and upland rice were more sensitive than cash crops in terms of conclusions. A reduction or increase in output yield and prices of the traditional crops would be more likely to

change the conclusion than for cash crops. A marginal improvement in yield and prices can change a crop from being non-profitable (privately or socially) to being profitable. Policy-wise, productivity improvement for paddy rice and upland rice would be a significant policy measure for these farming environments.

3. Implications

Looking at PAM ratios, one finds that the role of government intervention is still short of optimum. Upland farmers are being taxed indirectly in output prices (lower than social prices) and factor prices (higher than social prices). While there are some subsidy programs through input prices, these cannot be offset by negative output factor, and other input transfers. As a result, farmers are not being encouraged to produce crops which are socially profitable. The case of paddy rice and taro shows clearly this case where farmers are themselves experiencing a loss in their income, thus a reduction in welfare. The two crops are actually socially profitable and should be promoted by government agencies but currently through the imperfection of the capital and output markets, farmers were much discouraged by growing the two crops. As for other crops e.g. pumpkin, lettuce, green pepper and gladiolus bulbs, although they were privately and socially profitable, farmers were not getting as high a level of profits as indicated by their social profits.

From the results of PAM analysis, one finds a number of policy implications. In terms of the Royal Project crops, they proved to be both privately and socially profitable. These crops should be promoted and expanded to a greater extent. The problems lie in the details of management, whether output market, seed allocation, marketing of crops as much as agronomic improvement of the crops. Farmers were complaining about production input and output marketing information being inadequate, marketing with high handling losses, losses due to pests and diseases, etc. If these problems can be fixed with improved extension and marketing services, the benefits to farmers can be substantially increased. Communication between farmers and the Royal Project marketing and production personnel should be substantially improved. Policy-wise, the government extension agency dealing with highland agriculture, namely the Department of Agricultural Extension, should ensure greater participation of farmers in all lines of operation will improve communication channels and thus management of these upland cash crops.

The two crops which should be kept in check were ginger and upland rice. Both were unprofitable privately and socially. In the case of upland rice, even though the value of vegetables grown in upland rice fields were not included and potentially would improve the private and social profitability of this crop, but the fact that upland rice was grown on a rotational basis with a 5-7 years fallow made its profits per year much reduced. In the case of ginger, despite the high social price of 16 baht per kg as compared to 2.5 baht per kg. of private output prices in 1997, it could not yield positive social profits. This crop is subject to very high price and output variation. If the yield per rai cannot be improved, it will remain a socially unprofitable crop. In terms of environmental costs, which have not been evaluated as yet, it can also have even higher social costs.

4. Recommendations for Further PAM Studies.

This study covers only annual crops in the land use systems of the Karen. It revealed that paddy rice and taro was socially profitable but was subject to continued loss in terms of private profits. It also revealed that upland rice and ginger were socially unprofitable crops at this level of productivity and prices. They should be subject to some policy intervention. Alternative upland crops should be promoted in its place. The promotion and research on paddy rice should be intensified so those farmers do not have to rely on upland rice for subsistence. Alternatively, further agronomic research can be conducted to improve its yield. The results of the sensitivity analysis confirmed that a 20% increase in yield can turn upland rice to a privately and socially profitable crops on an annual basis. Nevertheless, multi-year analysis for this crop is still needed. Ways to improved marketing for Royal project vegetables should also be investigated. It is expected also that fruit trees, coffee and Royal Project vegetables should be investigated for serious extension in these uplands. While this study has not engaged in perennial tree crop evaluation, an initial interview with farmers revealed that with improved marketing, processing and extensions programs, these tree crops are of potential value.

PAM analysis can also be conducted by incorporating costs of soil erosion and environmental (including biological) degradation but to do this, one needs good physical estimates of the extent of such environmental degradation. In the future, with more studies conducted in the biological and physical aspects of land use, further PAM analysis can be attempted in such direction.

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Village: **Chan, Den, Nong Jet Nui** *Tambon:* **Ban Chan** *District:* **Mae Chaem** *Prov:* **CM**

Figure 1: ***Calendars for Representative Land Use Systems***

System 1: **Paddy rice, upland Rice**

Field	*Crop*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Jan*	*Feb*	*Mar*	*Apr*
		Rainy Season						Dry Season					
Paddy	Rice			←				→					
Swidden	Upland Rice	←						→					

System 2: **Paddy rice, pumpkin, ging**

Field	*Crop*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Jan*	*Feb*	*Mar*	*Apr*
		Rainy Season						Dry Season					
Paddy	Rice			←				→					
Swidden	Ginger	←						→					
Upland	Pumpkin	→		←				→		←			

System 3: **Paddy rice, pumpkin, lettu**

Field	*Crop*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Jan*	*Feb*	*Mar*	*Apr*
		Rainy Season						Dry Season					
Paddy	Rice			←				→					
Upland/Paddy	Pumpkin	→		←				→		←			
Upland/Paddy	Lettuce	→	←				→			←			

System 4: **Paddy rice, pumpkin, green pepper**

Field	*Crop*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Jan*	*Feb*	*Mar*	*Apr*
		Rainy Season						Dry Season					
Paddy	Rice			←				→					
Upland	Pumpkin	→		←				→		←			
Upland	Green Pepper	→	→								←		

System 5: **Paddy rice, gladiolus**

Field	*Crop*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Jan*	*Feb*	*Mar*	*Apr*
		Rainy Season						Dry Season					
Paddy	Rice			←				→					
Upland	Gladiolus							→					←

System 6: **Paddy rice, taro**

Field	*Crop*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Jan*	*Feb*	*Mar*	*Apr*
		Rainy Season						Dry Season					
Paddy	Rice			←				→					
Upland	Taro							→					←

Figure 2 : Labor Utilization ***Crop :*** **Paddy Rice**

Tasks	Task done	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
slash and burn	O												
seedbed preparation	X												
seedling taking care(age 60 days)	X												
land preparation	X												
transplanting (1-3 days)	X												
planting(1-3 days)	X												
1st fertilizing(after planted ~1 week)	X												
1st irrigation	X												
2nd irrigation	X												
harvesting	X												
threshing (5-7 days)	X												
handling(2-3 days)	X												
others													

X = yes O = no

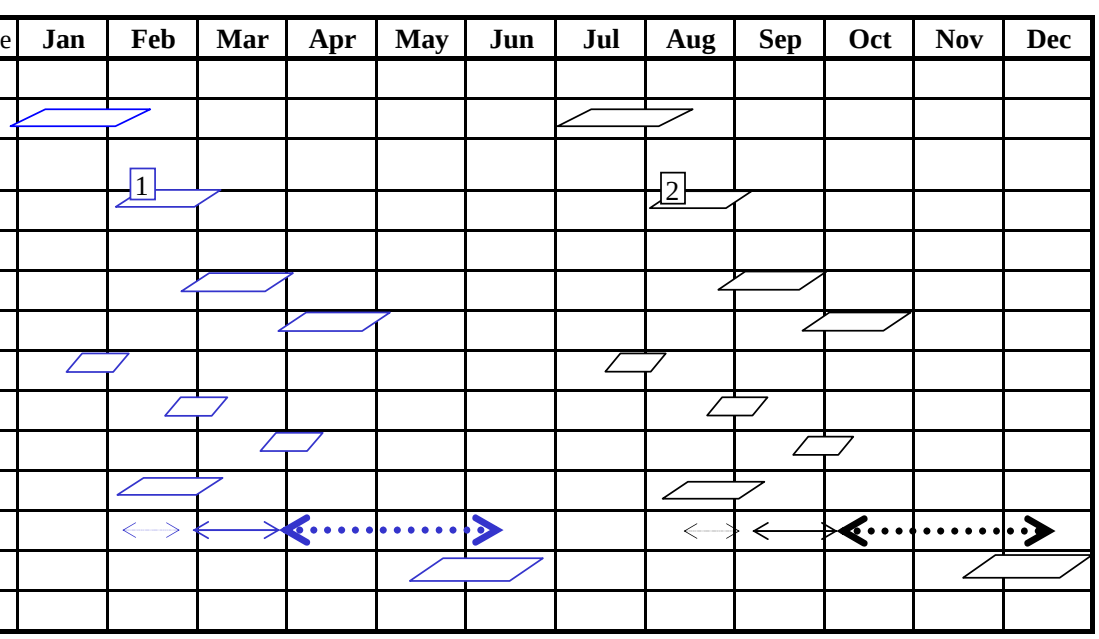
Figure 2 : Labor Utilizatio Crop : **Upland Rice**

Tasks	Task done	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
slash and burn	X												
cleaning after slash&burn	X												
fence making	X												
making cottage	X												
planting/sowing	X												
1st weeding	X												
2nd weeding	X												
harvesting	X												
threshing (5-7 days)	X												
handling(2-3 days)	X												
others													

X = yes O = no

Figure 2 : Labor Utilization ***Crop :*** **Pumpkin**

Tasks	Task done	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
slash and burn	O												
seedbed preparation	X												
cleaning	O												
planting	X												
pruning	O												
1st weeding	X												
2nd weeding	X												
1st fertilizing	X												
2nd fertilizing	X												
3rd fertilizing	X												
chemical spray	X												
irrigation	X												
harvesting	X												
others	O												



X = yes O = no

Figure 2 : Labor Utilization ***Crop :*** **Lettuce**

Tasks	Task done	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
sowing	X												
seedbed preparation	X		1					2					
cleaning	O												
planting	X												
1st weeding	X												
2nd weeding	O/X												
1st fertilizing	X												
2nd fertilizing	O												
3rd fertilizing	O												
chemical spray	X												
irrigation	X												
harvesting	X												
others	O												

X = yes O = no

Figure 2 : Labor Utilization ***Crop:*** **Ginger**

Tasks	Task done	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
slash and burn	X												
1st land preparation	X												
2nd land preparation	O												
planting	X												
weeding	X												
fertilizing	X												
harvesting	X												
sowing	O												
others	O												

X =yes O = no

Figure 2 : Labor Utilization ***Crop :*** **Taro**

Tasks	Task done	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
slash and burn	X												
1st land preparation	X												
2nd land preparation	O												
planting	X												
1st weeding	X												
2nd weeding	X												
3rd weeding	X												
1st fertilizing	X												
2nd fertilizing	X												
3rd fertilizing	X												
chemical spray	X												
irrigation	O												
harvesting	X												
sowing	O												
others	O												

X = yes O = no

Figure 2 : Labor Utilization ***Crop :*** **Green Pepper**

Tasks	Task done	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
slash and burn	O												
seedbed preparation	X												
planting	X												
1st weeding	X												
2nd weeding	X												
3rd weeding	X												
4th weeding	X												
1st fertilizing	X												
2nd fertilizing	X												
3rd fertilizing	X												
chemical spray	X												
irrigation	X												
harvesting	X												
others													

X = yes O = no

Figure 2 : Labor Utilization ***Crop:*** **Gladiolus**

Tasks	Task done	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
slash and burn	O												
1st land preparation	X												
2nd land preparation	O												
planting	X												
1st weeding	X												
2nd weeding	X												
3rd weeding	X												
1st fertilizing	X												
2nd fertilizing	X												
3rd fertilizing	X												
chemical spray	O												
irrigation	O												
harvesting	X												
others	O												

X = yes O =no

Table 1 Input-Output Table of Important Crops Grown by Karen Communities in Watchan, Mae Chaem Watershed, 1997

Input/output		Paddy rice	Upland rice	Pumpkin	Lettuce	Ginger	Taro	Green pepper	Gladiolus
Tradables									
Fertilizer (kg/rai)									
	16-20-0	10.21							
	15-15-15			10.00	25.00	8.33	15.00	14.00	16.00
	13-13-21			14.00	20.00	12.50		53.33	33.00
	46-0-0			14.00	30.00	8.33	25.00	53.33	42.00
	12-24-12							26.67	
	manure	31.25		95.63	129.75	85.71	60.00	280.00	75.00
Fungicide (cc/rai)									
	Dithane							77.3	
	Manzate								3.0
	Kumulus			400.0					200.0
	Afugan			170.0		3.3			240.0
Insecticide (cc/rai)									
	Ambush				640.0			1120.0	0.0
Seed (unit/rai)		8.6	13.5	650.0	15.0	252.2	80.0	5600.0	108.0
(seed unit)		kg	kg	no.	gram	kg	kg	no.seedling	litre
Fuel (litres/rai)		7.2		4.4					
Labor (mandays/rai)									
slash and burn			0.36				0.63		
seedbed/seedling preparation		0.84		1.88	4.60				
tillage		0.28		0.21					
1st land preparation		1.62	1.86	7.16	8.00	10.56	28.03	8.00	8.00
2nd land preparation		1.79	0.26			2.52			
planting		2.97	1.86	3.16	8.00	6.22	3.16	8.00	11.60
1st weeding		1.17	2.11	1.16	3.00	3.78	3.02	1.60	12.00
2nd weeding		0.52	2.31	0.21	0.80	3.93	1.79	1.60	12.00

Table 1 Input-Output Table of Important Crops Grown by Karen Communities in Watchan, Mae Chaem Watershed, 1997

Input/output	Paddy rice	Upland rice	Pumpkin	Lettuce	Ginger	Taro	Green pepper	Gladiolus
3rd weeding		0.43			1.11			4.66
1st fertilizing	0.20	0.00	1.63	3.20	0.15	0.62	6.40	7.77
2nd fertilizing		0.00	1.11	1.60			6.40	7.77
chemical spray		0.00	1.09	0.07			0.91	0.66
irrigation	0.15	0.00	0.96	1.80			2.06	
harvesting	4.69	2.49	3.26	3.83	4.44	2.95	8.00	18.88
threshing	2.62	1.20						
handling	0.05	0.03	0.84	0.14	0.04	0.06	1.14	
others		0.43	0.11			1.26		24.11
Total labor use/rai	16.90	13.33	22.77	35.04	32.75	41.52	44.11	107.45
Capital								
Working capital	583.83	89.75	1623.88	1277.25	5172.94	611.50	7387.11	3983.00
Tractor services (days/rai)	1.00					1.00		
Transportation (trip)		1.00	1.00	1.00	1.00	1.00	1.00	1.00
Land (rai)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Output per rai	400.1	202.5	966.4	998.3	341.7	528.7	1,266.7	11,282.7
(Unit of output)	kg	kg	kg	kg	kg	kg	kg	no. (heads)
Coefficient of variation	0.33	0.36	0.39	0.83	1.07	1.14	0.51	0.46
Risk level	Low	Low	Low	Med	Med	Med	Low	Low

Table 2 Private Prices of Inputs and Outputs of Important Crops Grown by Karen Communities in Wat Chan, Mae Chaem Watershed, 1997.

Input/Output	Paddy rice	Upland rice	Pumpkin	Lettuce	Ginger	Taro	Green peppe	Gladiolus
Tradables								
Fertilizer (baht/kg)								
16-20-0	8.00							
15-15-15			7.00	8.00	8.00	7.50	6.00	6.00
13-13-21			7.00	8.00	8.00		6.00	6.00
46-0-0			6.50	6.00	8.00	7.00	6.33	6.00
12-20-12							7.00	
manure	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Fungicide (baht/cc)								
Dithane							2.00	
Manzate								2.00
Kumulus			0.15					0.10
Afugan			0.25		3.50			0.15
Insecticide (baht/cc)								
Ambush				0.25			0.20	0.20
Seed (baht/unit)	4.00	3.84	1.00	3.00	19.00	3.30	1.00	30.00
(seed unit)	kg	kg	no.seed	gram	kg	kg	no.seedling	litre
Fuel (baht/litres)	12.00		12.00					
Labor (baht/manday)								
slash and burn	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
seedbed preparation	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
tillage	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
1st land preparation	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
2nd land preparation	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
planting	65.00	65.00	50.00	50.00	50.00	50.00	50.00	50.00
1st weeding	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
2nd weeding	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00

Table 3 Private Budget for Important Crops Grown by Karen Communities in Wat Chan, Mae Chaem Watershed, 1997

Input/Output		Paddy rice	Upland rice	Pumpkin	Lettuce	Ginger	Taro	Green pepp	Gladiolus
Tradables									
Fertilizer (baht/rai)									
	16-20-0	81.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	15-15-15			70.0	200.0	66.7	112.5	84.0	96.0
	13-13-21			98.0	160.0	100.0	0.0	320.0	198.0
	46-0-0			91.0	180.0	66.7	175.0	337.8	252.0
	12-24-12							186.7	0.0
	manure	31.3	0.0	95.6	129.8	85.7	60.0	280.0	75.0
Fungicide (baht/rai)									
	Dithane							154.7	0.0
	Manzate							0.0	6.0
	Kumulus			60.0	0.0	0.0	0.0	0.0	20.0
	Afugan			42.5	0.0	11.7	0.0	0.0	36.0
Insecticide (baht/rai)									
	Ambush				160.0			224.0	0.0
Seed (baht/rai)		34.4	52.0	650.0	45.0	4,792.2	264.0	5,600.0	3,240.0
Fuel (baht/rai)		86.5	0.0	53.0	0.0	0.0	0.0	0.0	0.0
Labor (baht/rai)									
slash and burn		0.0	17.8	0.0	0.0	0.0	31.6	0.0	0.0
seedbed preparation		42.2	0.0	94.0	230.0	0.0	0.0	0.0	0.0
tillage		13.8	0.0	10.5	0.0	0.0	0.0	0.0	0.0
1st land preparation		81.0	92.9	357.9	400.0	527.8	1,401.5	400.0	400.0
2nd land preparation		89.7	13.1	0.0	0.0	125.9	0.0	0.0	0.0
planting		192.8	120.7	157.9	400.0	311.1	157.9	400.0	580.0
1st weeding		58.6	105.7	57.9	150.0	188.9	151.1	80.0	600.0
2nd weeding		25.9	115.7	10.5	40.0	196.3	89.5	80.0	600.0
3rd weeding		0.0	21.4	0.0	0.0	55.6	0.0	0.0	233.0
1st fertilizing		10.0	0.0	81.6	160.0	7.4	30.8	320.0	388.5
2nd fertilizing		0.0	0.0	55.3	80.0	0.0	0.0	320.0	388.5

Table 3 Private Budget for Important Crops Grown by Karen Communities in Wat Chan, Mae Chaem Watershed, 1997

Input/Output	Paddy rice	Upland rice	Pumpkin	Lettuce	Ginger	Taro	Green pepp	Gladiolus
chemical spray	0.0	0.0	54.5	3.6	0.0	0.0	45.7	33.0
irrigation	7.5	0.0	48.1	90.0	0.0	0.0	102.9	0.0
harvesting	304.8	161.6	163.2	191.4	222.2	147.4	400.0	944.0
threshing	131.0	60.0	0.0	0.0	0.0	0.0	0.0	0.0
handling	2.7	1.6	42.1	7.1	2.1	3.0	57.1	0.0
others	0.0	21.4	5.3	0.0	0.0	63.2	0.0	1,205.5
Capital								
Working capital	87.6	13.5	146.1	115.0	775.9	91.7	664.8	358.5
Tractor services	350.0							
Transportation		37.8	463.8	402.5	50.0	0.0	200.0	60.0
Land charges (baht)	0	0	0	0	0	0	0	0
Total revenue (baht/rai)	1,504	761	7,731	7,987	854	1,762	19,000	14,002
Total variable costs	234	52	1,160	875	5,123	612	7,187	3,923
Gross Margin	**1,270**	**709**	**6,571**	**7,112**	**-4,269**	**1,151**	**11,813**	**10,079**
Depreciation and interest	438	51	610	517	826	92	865	418
Return over land and labor	**833**	**658**	**5,961**	**6,594**	**-5,095**	**1,059**	**10,948**	**9,660**
Labor costs	960	732	1,139	1,752	1,637	2,076	2,206	5,373
Total costs	1,631	835	2,909	3,144	7,586	2,779	10,258	9,714
Profit (return to management)	**-127**	**-74**	**4,822**	**4,842**	**-6,732**	**-1,017**	**8,742**	**4,288**
Implicit wage rate	**49**	**49**	**262**	**188**	**-156**	**26**	**248**	**90**
Average area (rai)/household	3.63	3.58	1.00	0.50	1.13	1.90	0.21	0.25
Profit per household	**-461**	**-265**	**4,822**	**2,421**	**-7,574**	**-1,932**	**1,821**	**1,072**

Table 4 Social Prices of Inputs and Outputs of Important Crops in Wat Chan, Mae Chaem Watershed, 1997

Input/Output	Paddy rice	Upland rice	Pumpkin	Lettuce	Ginger	Taro	Green pepper	Gladiolus
Tradables								
Fertilizer (baht/kg)								
16-20-0	8.19							
15-15-15			11.40	11.40	11.40	11.40	11.40	11.40
13-13-21			10.68	10.68	10.68	10.68	10.68	10.68
46-0-0			8.83	8.83	8.83	8.83	8.83	8.83
12-24-12							12.90	
manure	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Fungicide (baht/cc)								
Dithane							2.00	
Manzate								2.00
Kumulus			0.03					0.03
Afugan			0.03		0.03			0.03
Insecticide (baht/cc)								
Ambush				0.03			0.03	0.03
Seed (baht/unit)	3.84	3.84	0.23	3.23	15.93	3.30	0.61	70.18
(unit)	kg	kg	no.seed	gram	kg	kg	no.seedling	litre
Fuel (baht/litre)	7.63		7.63					
Labor (baht/day)								
slash and burn	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
seedbed preparation	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
tillage	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
1st land preparation	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00

Table 4 Social Prices of Inputs and Outputs of Important Crops in Wat Chan, Mae Chaem Watershed, 1997

Input/Output	Paddy rice	Upland rice	Pumpkin	Lettuce	Ginger	Taro	Green pepper	Gladiolus
2nd land preparation	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
planting	65.00	65.00	50.00	50.00	50.00	50.00	50.00	50.00
1st weeding	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
2nd weeding	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
3rd weeding	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
1st fertilizing	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
2nd fertilizing	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
chemical spray	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
irrigation	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
harvesting	65.00	65.00	50.00	50.00	50.00	50.00	50.00	50.00
threshing	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
handling	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
others	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
Capital (baht)								
Working capital	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Tractor services	150.00					168.00		
Transportation		37.78	463.75	402.50	50.00		200.00	60.00
Land (baht/rai)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Output (baht/kg)	3.84	3.84	17.84	19.72	15.93	7.88	18.57	2.13

Table 5 Social Budget of Important Crops Grown in Wat Chan, Mae Chaem Watershed, 1997

Input/Output		Paddy rice	Upland rice	Pumpkin	Lettuce	Ginger	Taro	Green pepp	Gladiolus
Tradables									
Fertilizer (baht/rai)									
	16-20-0	83.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	15-15-15	0.0	0.0	114.0	285.0	95.0	171.0	159.6	182.4
	13-13-21	0.0	0.0	149.5	213.5	133.4	0.0	569.4	352.3
	46-0-0	0.0	0.0	123.6	264.8	73.6	220.7	470.8	370.8
	12-24-12	0.0	0.0	0.0	0.0	0.0	0.0	344.0	0.0
	manure	31.3	0.0	95.6	129.8	85.7	60.0	280.0	75.0
Fungicide (baht/rai)									
	Dithane	0.0	0.0	0.0	0.0	0.0	0.0	154.7	0.0
	Manzate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0
	Kumulus	0.0	0.0	12.5	0.0	0.0	0.0	0.0	6.3
	Afugan	0.0	0.0	4.6	0.0	0.1	0.0	0.0	6.6
Insecticide (baht/rai)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Ambush	0.0	0.0	0.0	18.7	0.0	0.0	32.7	0.0
Seed (baht/rai)		33.1	52.0	150.4	48.5	4,016.9	264.0	3,406.9	7,579.7
Fuel (baht/rai)		55.0	0.0	33.7	0.0	0.0	0.0	0.0	0.0
Labor (baht/rai)									
slash and burn		0.0	17.8	0.0	0.0	0.0	31.6	0.0	0.0
seedbed preparation		42.2	0.0	94.0	230.0	0.0	0.0	0.0	0.0
tillage		13.8	0.0	10.5	0.0	0.0	0.0	0.0	0.0
1st land preparation		81.0	92.9	357.9	400.0	527.8	1,401.5	400.0	400.0
2nd land preparation		89.7	13.1	0.0	0.0	125.9	0.0	0.0	0.0
planting		192.8	120.7	157.9	400.0	311.1	157.9	400.0	580.0
1st weeding		58.6	105.7	57.9	150.0	188.9	151.1	80.0	600.0
2nd weeding		25.9	115.7	10.5	40.0	196.3	89.5	80.0	600.0
3rd weeding		0.0	21.4	0.0	0.0	55.6	0.0	0.0	233.0

Table 5 Social Budget of Important Crops Grown in Wat Chan, Mae Chaem Watershed, 1997

Input/Output	Paddy rice	Upland rice	Pumpkin	Lettuce	Ginger	Taro	Green pepp	Gladiolus
1st fertilizing	10.0	0.0	81.6	160.0	7.4	30.8	320.0	388.5
2nd fertilizing	0.0	0.0	55.3	80.0	0.0	0.0	320.0	388.5
chemical spray	0.0	0.0	54.5	3.6	0.0	0.0	45.7	0.0
irrigation	7.5	0.0	48.1	90.0	0.0	0.0	102.9	0.0
harvesting	304.8	161.6	163.2	191.4	222.2	147.4	400.0	944.0
threshing	131.0	60.0	0.0	0.0	0.0	0.0	0.0	0.0
handling	2.7	1.6	42.1	7.1	2.1	3.0	57.1	0.0
others	0.0	21.4	5.3	0.0	0.0	63.2	0.0	1,205.5
Capital								
Working capital	18	4	57	68	223	44	281	432
Tractor services	150	0	0	0	0	168	0	0
Transportation	0	38	464	403	50	0	200	60
Land charges (baht)	0	0	0	0	0	0	0	0
Total revenue (baht/rai)	1,538	778	17,238	19,686	5,441	4,166	23,525	23,990
Total variable costs	203	52	684	960	4,405	716	5,418	8,579
Gross Margin	**1,335**	**726**	**16,554**	**18,726**	**1,037**	**3,450**	**18,107**	**15,411**
Depreciation and interest	168	42	521	471	273	212	481	492
Return over land and labor	**1,167**	**684**	**16,033**	**18,255**	**764**	**3,238**	**17,626**	**14,919**
Labor costs	960	732	1,139	1,752	1,637	2,076	2,206	5,340
Total costs	1,331	826	2,344	3,183	6,315	3,004	8,105	14,410
Profit (return to management)	**207**	**-48**	**14,894**	**16,503**	**-873**	**1,162**	**15,421**	**9,579**

Table 6 PAM Tables: Private and Social Profitability Per Rai

A: *Paddy rice*

		Costs		
	Revenue	**Tradeables**	**Domestic factor**	**Profits**
Private prices	1,504.2	202.6	1,428.9	-127.3
Social prices	1,537.8	171.6	1,158.9	207.3
Divergences	-33.6	31.0	269.9	-334.6

B. ***Upland rice***

		Costs		
	Revenue	**Tradeables**	**Domestic factor**	**Profits**
Private prices	761.1	52.0	783.1	-74.0
Social prices	778.1	52.0	774.1	-48.0
Divergences	-17.0	-0.1	9.0	-25.9

C. ***Pumpkin***

		Costs		
	Revenue	**Tradeables**	**Domestic factor**	**Profits**
Private prices	7,731.0	1,064.5	1,844.2	4,822.3
Social prices	17,238.2	588.3	1,755.5	14,894.4
Divergences	-9,507.2	476.2	88.8	-10,072.1

D. ***Lettuce***

		Costs		
	Revenue	**Tradeables**	**Domestic factor**	**Profits**
Private prices	7,986.7	745.0	2,399.3	4,842.3
Social prices	19,685.9	830.6	2,352.5	16,502.8
Divergences	-11,699.2	-85.6	46.8	-11,660.4

Table 6 PAM Tables: Private and Social Profitability Per Rai

E.		***Green pepper***		
		Costs		
	Revenue	**Tradeables**	**Domestic factor**	**Profits**
Private prices	19,000.0	6,907.1	3,350.6	8,742.3
Social prices	23,525.2	5,138.0	2,966.6	15,420.5
Divergences	-4,525.2	1,769.1	383.9	-6,678.2

F.		***Gladiolus***		
		Costs		
	Revenue	**Tradeables**	**Domestic factor**	**Profits**
Private prices	14,001.8	3,848.0	5,866.0	4,287.8
Social prices	23,989.8	8,504.0	5,906.4	9,579.3
Divergences	-9,988.0	-4,656.0	-40.5	-5,291.5

G.		***Ginger***		
		Costs		
	Revenue	**Tradeables**	**Domestic factor**	**Profits**
Private prices	854.2	5,037.2	2,549.0	-6,732.0
Social prices	5,441.4	4,319.0	1,995.8	-873.4
Divergences	-4,587.2	718.2	553.2	-5,858.6

H.		***Taro***		
		Costs		
	Revenue	**Tradeables**	**Domestic factor**	**Profits**
Private prices	1,762.2	551.5	2,227.7	-1,016.9
Social prices	4,165.9	655.7	2,348.1	1,162.1
Divergences	-2,403.7	-104.2	-120.5	-2,179.0

Table 7 PAM Ratios

	Paddy rice	Upland rice	Pumpkin	Lettuce	Green pepper	Gladiolus	Ginger	Taro
Privately profitable	No	No	Yes	Yes	Yes	Yes	No	No
Socially profitable	Yes	No	Yes	Yes	Yes	Yes	No	Yes
Output transfer	tax	tax	tax	tax	tax	tax	tax	tax
Input transfer	tax	none	tax	subsidy	tax	subsidy	tax	subsidy
Factor transfer	tax	tax	tax	tax	tax	tax	subsidy	subsidy
Net transfer	tax	tax	tax	tax	tax	tax	tax	tax
Private cost ratio	1.10	1.10	0.28	0.33	0.28	0.58	-0.61	1.84
Domestic resource cost ratio	0.85	1.07	0.11	0.12	0.16	0.38	1.78	0.67
Effective protection coefficient	0.95	0.98	0.40	0.38	0.66	0.66	-3.73	0.34
Ratio of private and social profits			0.32	0.29	0.57	0.45		
Subsidy ratio to producers	-0.22	-0.03	-0.58	-0.59	-0.28	-0.22	-1.08	-0.52

Table 8 Social import parity prices

	Output			Fuel	Fertilizers				
	Corn	Soybean	Lettuce		15-15-15	16-20-0	13-13-21	46-0-0	12-24-12
Social Import parity prices									
F.o.b ($/ton)	104	252.67							
Freight/Insurance ($/ton)	32.5	41							
c.i.f ($/unit)	136.5	293.67	890	20	240.04	165.29	236.45	183.64	300
unit	ton	ton	ton	barrel	ton	ton	ton	ton	ton
Exhange rate (baht/$)	26.13	26.13	26.13	26.13	26.13	26.13	26.13	26.13	26.13
Exchange rate premium	0.3395	0.3395	0.3395	0.3395	0.3395	0.3395	0.3395	0.3395	0.3395
Equilibrium exchange rate	35	35	35	35	35	35	35	35	35
c.i.f in domestic currency	4777.5	10278.62	31150	700.00	8401.4	5785.15	8275.75	6427.4	10500
Weight conversion factor (kg/ton)	1000	1000	1000	158.99	1000	1000	1000	1000	1000
c.i.f.in domestic currency	4.7775	10.28	31.15	4.40	8.40	5.79	8.28	6.43	10.50
transportation costs (to factory)($/ton)	23								
transportation costs (to factory)	0.805	0.6	1	0.87	1	1	1	1	1
Marketing costs (baht/unit)	0.5	0.5	1	1.05	1	1	1	1	1
Value before processing (baht/unit)	6.08	11.38	33.15	6.32	10.40	7.79	10.27575	8.43	12.5
Processing conversion factor	0.95	1	0.8	0.95	1	1	1	1	1
Import parity value at wholesale (baht/kg)	5.78	11.38	41.4375	6.65	10.40	7.79	10.27575	8.43	12.5
Processing cost (baht/unit)	0.5	0	1	0.8731	0	0	0	0	0
Distribution costs to farm (baht/kg)	0.3	0.5	1	0.1	1	0.4	0.4	0.4	0.4
Import parity at farm gate (baht/unit)	4.98	10.88	39.44	7.63	11.40	8.19	10.67575	8.83	12.9
Adjustment of unit			0.5						
Import parity at farm gate (baht/unit)			19.72						

Table 8 Social import parity prices

	Seed					Chemical		
	Corn	Pumpkin	Lettuce	Green Pepper	Gladiolus	Kumulus	Afugan	Ambush
Social Import parity prices								
F.o.b ($/ton)					0.125			
Freight/Insurance ($/ton)					0.03125			
c.i.f ($/unit)	830.00	221.97	89.55	42.10	0.16	0.04	0.04	0.04
unit	ton	kg	kg	kg	bulb	kg	litre	litre
Exhange rate (baht/$)	26.13	26.13	26.13	26.13	26.13	26.13	26.13	26.13
Exchange rate premium	0.3395	0.3395	0.3395	0.3395	0.3395	0.3395	0.3395	0.3395
Equilibrium exchange rate	35	35	35	35	35	35	35	35
c.i.f in domestic currency	29,050.00	7,768.85	3,134.33	1,473.40	5.47	1.26	1.47	1.35
Weight conversion factor (kg/ton)	1000	1000	1000	1000	1	1000	1000	1000
c.i.f.in domestic currency	29.05	7.77	3.13	1.47	5.47	0.00	0.00	0.00
transportation costs (to factory)($/ton)								
transportation costs (to factory)	0.92	0.1	0.1	0.1	0.2734375			
Marketing costs (baht/unit)		0.1	0.1	0.1	0.2734375	0.00	0.00	0.00
Value before processing (baht/unit)		7.97	3.33	1.67	6.02	0.00	0.00	0.00
Processing conversion factor		1	1	1	0.9			
Import parity value at wholesale (baht/kg)	29.97	7.77	3.13	1.67	6.68			
Processing cost (baht/unit)		0	0	120	0.3342014	0.02	0.02	0.022
Distribution costs to farm (baht/kg)	0.5	0.1	0.1	0.1	0.3342014	0.01	0.01	0.01
Import parity at farm gate (baht/unit)	30.47	7.87	3.23	121.67	7.02	0.03	0.03	0.03
Adjustment of unit		34		200				
Import parity at farm gate (baht/unit)		0.23		0.61				

Table 9 Social export parity prices

	Output					
	Paddy	Pumpkin	Ginger	Taro	Green pepp	Gladiolus
Social export parity values						
c.i.f. ($/ton)		736			1146	0.125
Freight and Insurance ($/ton)		12			41	0.03125
f.o.b. ($/ton)	224	724	770	410	1105	0.09375
Exhange rate (baht/$)	0	0	0	0	0	0
Exchange rate premium	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Equilibrium exchange rate	0	0	0	0	0	0
f.o.b in domestic currency	0	0	0	0	0	0.00
Weight conversion factor (kg/ton)	1000	1000	1000	1000	1000	1.00
f.o.b in domestic currency	0	0	0	0	0.00	0.00
transportation costs (from factory)(baht/kg)	0.35	0.65	0.65	1	3.00	0.00
Marketing costs (baht/kg)	0.5	0.33	0.33	1	2.00	0.00
Value after processing (baht/kg)	-0.85	-0.98	-0.98	-2	-5.00	0.00
Processing conversion factor (%)	0.65	0.8	0.8	0.8	0.70	0.90
Import parity value at wholesale (baht/kg)	-0.55	-0.784	-0.784	-1.6	-3.50	0.00
Processing cost (baht/kg)	0.2	1	4.2	1	3	0.00
Distribution costs to farm (baht/kg)	0.5	0.65	0.65	1	2	0.00
Import parity at farm gate (baht/kg)	-1.25	-2.43	-5.63	-3.60	-8.50	0.00

Table 10 Whole-farm Private Budget for Farmers in Wat Chan, Mae Chaem Watershed, 1997

		Paddy rice	Upland rice	Pumpkin	Lettuce	Ginger	Taro	Green pepper	Gladiolus	Total profit
Pattern I	Paddy rice, Upland rice	3.33	3.58							-689.31
Pattern II	Paddy rice, Pumpkin, Ginger	6.25		2.38		2.00				-2,806.62
Pattern III	Paddy rice, Pumpkin, Lettuce	4.83		1.61	0.61					10,113.26
Pattern IV	Paddy rice, Pumpkin, Green pepper	4.00		1.00				0.25		6,498.77
Pattern V	Paddy rice, Gladiolus	4.17							0.25	541.68
Pattern VI	Paddy rice, Taro	7.33					0.83			-1,780.75
	Private profits	-127.27	-73.98	4,822.25	4,842.32	-6,732.03	-1,016.95	8,742.33	4,287.83	

Pattern for upland rice

Pattern I (traditional)	upland rice 1 year, fallow 7-10 years
Pattern I (current)	upland rice 1-2 years, fallow 5-7 years
Pattern II	upland rice 1 year, ginger 1 year, taro 1 year, fallow 5-8 years

Pattern for pumpkin and lettuce

Pattern III in paddy field	paddy rice in wet season-pumpkin in dry season followed by lettuce
Pattern III in upland	pumpkin followed by lettuce intercropped with fruit trees
Pattern III in upland	pumpkin in upland fields followed by lettuce

Other vegetables are planted in upland fields sometimes with fruit trees

Table 11 Wholefarm PAMs

Farming System 1	Paddy rice	Upland rice	
	3.33	3.58	*rai*

		Costs		
	Revenue	**Tradeables**	**Domestic factor**	**Profits**
Private prices	7741.20	861.53	7568.98	-689.31
Social prices	7914.38	758.46	6637.06	518.86
Divergences	-173.18	103.07	931.93	-1208.17

Farming System 2	Paddy rice	Pumpkin	Ginger
	6.25	2.38	2.00

		Costs		
	Revenue	**Tradeables**	**Domestic factor**	**Profits**
Private prices	29470.50	13868.78	18408.35	-2806.62
Social prices	61434.84	11107.87	15404.05	34922.92
Divergences	-31964.34	2760.91	3004.30	-37729.54

Farming System 3	Paddy rice	Pumpkin	Lettuce
	4.83	1.61	0.61

		Costs		
	Revenue	**Tradeables**	**Domestic factor**	**Profits**
Private prices	24606.38	3149.46	11343.66	10113.26
Social prices	47235.69	2284.91	9867.38	35083.41
Divergences	-22629.31	864.55	1476.29	-24970.15

Table 11 Wholefarm PAMs

Farming System 4

Paddy rice	Pumpkin	Green Pepper
4.00	1.00	0.25

	Revenue	Costs		Profits
		Tradeables	Domestic factor	
Private prices	18497.67	3601.61	8397.29	6498.77
Social prices	29270.75	2559.28	7132.81	19578.66
Divergences	-10773.09	1042.33	1264.48	-13079.89

Farming System 5

Paddy rice	Gladiolus	
4.17	0.25	*rai*

	Revenue	Costs		Profits
		Tradeables	Domestic factor	
Private prices	9767.81	1806.10	7420.04	541.68
Social prices	12405.01	2841.02	6305.44	3258.55
Divergences	-2637.20	-1034.93	1114.60	-2716.87

Farming System 6

Paddy rice	Taro	
7.33	0.83	*rai*

	Revenue	Costs		Profits
		Tradeables	Domestic factor	
Private prices	12499.07	1945.19	12334.63	-1780.75
Social prices	14748.90	1804.87	10455.51	2488.52
Divergences	-2249.82	140.32	1879.12	-4269.26

Table 12 Assumptions Table

Macro-Economic Assumptions	
Nominal interest rate (%)	15%
Social interest rate (%)	5%
Official exchange rate	26.13
Exchange premium (%)	34%
Long-term exchange rate	35

Table 13 Sensitivity Analysis

	Crops	Situations		Private profitability		Social profitability	
				Base	Results	Base	Results
a)	Lettuce	Price increase to :baht/kg	15	4,842	11,831	16,503	16,503
b)	Ginger	Price increase to :baht/kg	10	-6,732	-4,170	-873	-873
c)	Taro	Price increase to :baht/kg	4	-1,017	-136	1,162	1,162
d.1)	Paddy Rice	Export Price increase:	10%	-127	-127	207	407
d.2)	Upland rice	Export Price increase:	10%	-74	-74	-48	48
e)	Lettuce	Output decrease:	50%	4,842	849	16,503	6,660
f)	Paddy rice	Output increase:	30%	-127	324	207	669
g)	Paddy rice	Output decrease:	30%	-127	-579	207	-254
h)	Upland rice	Output increase:	20%	-74	78	-48	108
I)	Ginger	Output increase:	15%	-6,732	-6,604	-873	-57

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