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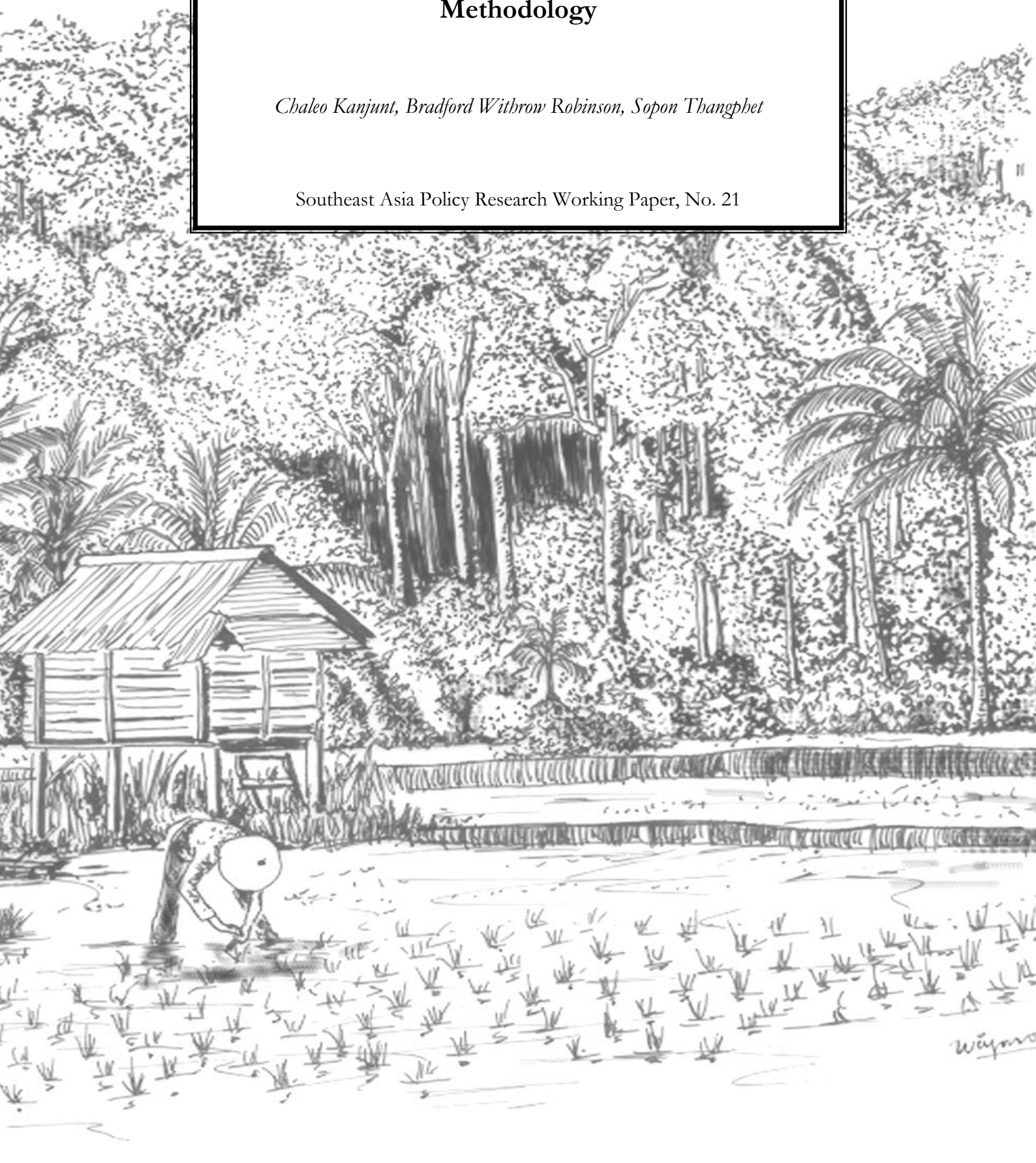

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Preface

This project is an early attemp to investigate the Karen farming system in the Mae Chaem watershed areas using the Policy Analysis Matrix (PAM) as a toll. The project was initiated under the auspices of the International Center for Agroforestry (ICRAF). Fieldwork was started in July 1996. Three Karen villages clusters, Ban Pa Tung, Ban Tien Pha, and Ban Pa Pong Pieng, were selected as research site. The analysis covers four major Karen farming systems; paddy rice, upland rice, upland soybean, and upland sweet corn. In addition, socio-economic characteristics of the research area were also collected. Private and social profitability were assessed. We, the authors, hope that our research findings will provide some development directions in promoting sustainable resource management and well-being of marginal hill farmers in Northern Thailand.

Acknowledgement

The authors would like to thank many persons and organizations for their supports in this study. The International Center for Research in Agroforestry (ICRAF) provided the research funding and logistics for this project. Thanks also go to Dr. David Thomas and all ICRAF staff for providing us a continuous and generous source of support. Without their leadership and commitment, the project would never get off the ground. We are also grateful to Mr. Sunthorn, our faithful and diligent field assistant, his friendship, companion, and hard work. Without his dedication, our work will be less completed.

Lastly, our greatest debt goes to Karen farmers who were patient in answering our questions. In return, we devote this study to them and hope that it will, direct or indirect, contribute to improving their lives.

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Contents

1. Background and Justifications

Topographically, Northern Thailand consists of two interdependent ecological/physical zones; hills and valleys. However, the region is dominated by a large portion of hill areas. And these areas have been largely occupied by ethnic minorities such as Karen, Hmong, and Lisu who have traditionally practiced shifting cultivation (Burling 1965)

During the past three decades, large changes have been occurred in the area through the process of development. Such changes, in return, create profound impact on various existing social and physical aspects. So far, we have witnessed problems of land shortage, enormous deforestation, soil erosion, decreasing water supply for domestic and agricultural uses, and conflicts between hill farmers and lowland farmers over resource use. These problems are increasingly evident yet there are still no appropriate measures and policies formulated to mitigate such crisis. In contrast, many development projects/programs, carried out in the hills, have aggravated such problems (Uraivan et al. 1988)

This study is an early attempt to analyze the present hill farming systems using the Policy Analysis Matrix (PAM) as a tool. This tool is used to calculate costs and benefits in both private and social terms (Pearson and Monke 1989). Profitability will be assessed as it faces farm operators as well as the whole society. The main objective of the study is to assess costs and benefits of current farming activities as well as for an application of the study's findings in the future highland agricultural development and extension. Given the existing problems in resource management in Northern Thailand, the study will be of great benefit in promoting sustainable resource management and development of the region.

2. Objectives of Study

This study had three main objectives:

1. to asses the costs and benefits of current Karen farming systems in the study area using the Policy Analysis Matrix (PAM)
2. to assess the usefulness of the Policy Analysis Matrix (PAM) in studying upland farming systems and contributing to sustainable natural resource policy
3. to use the study results to make recommendations regarding highland agricultural development in Mae Chaem district, Northern Thailand

3. Methodology of the Study

Farming Analysis

This study employed the Policy Analysis Matrix (PAM) as a tool in assessing the key private and social costs and benefits of the current Karen farming system in the study area. The farming system included irrigated/paddy rice, upland rice, upland soybean, and upland sweet corn. However, the methodology was modified to suit farming conditions in the study area.

Site Selection

Three village clusters in the Chang Koeng subdistrict, Mae Chaem district, Chiang Mai province were selected as the site for the study. Our survey was mainly focused on Tien Pha village, the larger of the two satellite villages of Pa Tung, with additional data being collected in Pa Pong Pieng and Pa Tung. Three villages are located in the middle elevation zone and occupied mainly by the Karen ethnic group.

Selection of Respondents

Respondents were selected from the farming households in the three study villages. The selection began with an interview of key informants. After the researchers became familiar with farm households and farming practices in the area, the selection of individual household was made based on their typical farming characteristics. Fifteen respondents were initially selected to provide detail information on their farming activities. Besides these 15 respondents, 20 additional respondents were later selected to elicit more information about their specific farming operation in order to guarantee the representation of farming practices in the study area. Usually, the household heads were interviewed.

Field Data Collection

The fieldwork was carried out over 4 months from July to October 1997. Various research techniques were utilized during the data collection. The semi-structured interview was the major tool for collecting detailed data. An interview guide was developed to collect data on input-output in each household (see Appendix A). Following discussions of our Karen field assistant, he used the interview guide to conduct interviews in Karen. Participant observation, case history, and focused group interview were used to develop understanding of local farming practices.

4. The Setting

History and Village Characteristics

These three villages are located in the mountainous areas in the upper reaches of the Mae Uam catchment, adjacent to Inthanon National Park. Originally, the first village settlement was based in Ban Tien Pha, but other subvillage of Pa Tung and Pa Pong Pieng were also created in their present location. At present, Ban Pa Tung is the main village because of its land suitability for agricultural production in which can cater for the larger population. All villages are under the same village administrative system (so called mu 13). In 1997, the number of house hold were 148 in total with 100, 36, and 12 households in Ban Pa Tung, Ban Tien Pha, and Ban Pa Pong Pieng, respectively. The total population were 604. All of them were Karen. The family size was generally large with an average 0f 5.2 persons per household. Extended family was still the norm in the area, consisting of two or more generations living together in the same household. 54% of the total population were in 15-49 age bracket with 6.2% being those who were older than 60 years. Christianity are the main religion in the study area.

Village Access and Interactions

Market Access

The three villages were accessed by all weather roads although the roads were not paved and thus it becomes difficult in certain sections during the rainy season, especially Ban Pa Pong Pieng with steep sections near the village. As mentioned early, Ban Pa Tung was the center of the communication. It usually takes 1.5-2 hours from Mae Chaem District Center to reach the villages. Such difficult road conditions result in few market transactions and also prevent villagers for finding wage work in the District Center and elsewhere. Usually, villagers used private pick-up trucks of Ban Pa Tung, when they wanted to come to the District Center, with ton bahts fare for each trip.

Labor

The majority of the population (69%) are in the labor age group. Villagers usually used household labor in their farming activities. Like other areas in Northern Thailand, villagers in the area still maintained traditional labor exchange group in some farming activities which needed a large number of people. Cooperative labor exchange group enabled villager to carry out hard work in rice cultivation. Farmers were also used hired labor in farming but was relatively not prevalent. Wage rate in the area at the time of the study was 90 bahts a day. Wage labor outside the area was limited due to difficulty in transportation.

Education

There was a primary school in Ban Pa Tung. This school served as a major education institution in the area. The majority of village population finished Grade 4. Most young people finished Grade 6. Reading and writing Thai Language is still a problem. Some young people continued their studies in Mae Chaem Wittayakom to finish Grade 9. Due to insufficient financial resources, few were completed. However, they tried to obtain an education as high as they could. Usually, those who could continue their studies outside the village obtained the Christian funding.

Recent Projects and Programs in the Village

In the study are, the District Office had provided assistance for the construction of village infrastructures. In addition, the Siri Chareon Watsa Project provided funding for fruit trees, livestock, water resource development and the maintenance of village access road.

The Queen Sirikit Project has been established since 1992, aiming to involve local people in forest management and natural resources conservation and to generate household income through both on-farm and off-farm activities. Provisions of water supply, seedling of firewood, frog raising, handicraft, weaving and household industries have been carried out in the study area.

Local Social Organizations

Like elsewhere in Northern Thailand, cooperation among villagers is the basic village ideology (Chartchai 1983). In the past, customary leader, or Zhiko, played a dominant in assigning land for cultivation. Collective approval was required before the individual started the cultivation. Traditional shifting cultivation was done in communal plots with communal arrangements of farm activities. Such practices ceased to function in the past seven years and gave way to permanent and individual-based cultivation. However, other local organizations, such as local irrigation organization and community forest organization, are still active in the area. Usually, villagers join collectively in managing community resources. In addition, government initiated social groups also exist in each village. These include village committee, church committee, housewives committee, and youth committee.

5. Current Farming Opration

This section provides the discussion of current cropping pattern in the study area. In the area, rice was the major crop. Wet rice field was their main property. However, farmers planted crops in both upland and lowland areas. At present, many farmers reported that land productivity in upland area is now declining. In recent years, new cash crops were

introduced into the area in response to the market demand. The existing farming operation of each crop is described below.

Irrigated Rice

Farmers usually non-glutinous rice varieties. In the past, they used traditional varieties. Only in recent years they have shifted to the new rice varieties such as mei nong. Before starting land preparation, farmers maintained the irrigation system, or locally called muang fai. The activity usually carried out in the first week of May and took about one to three days to complete depending on the condition of the irrigation system.

The nursery bed preparation began after the irrigation maintenance work was completed. They tiny piece of land near irrigation selected as a nursery bed was normally located in the upper field within the main field in order to avoid flooding. Around the beginning of May, farmers started sowing the rice seeds in the nursery bed. One rai of cultivated paddy area usually required one tang (equal 10 kg of unhusked rice) of seed. After sowing, the nursery bed was fenced to protect it from animals.

Seedbed preparation began around the end of May, when farmers started to plow their fields using walking tractor. Total tillage costs were 300 baht per rai. Simultaneously, farmers repaired the field bunds. The activity usually took about one week to complete. After that, farmers started harrowing their fields. By this time, the seedling in the nursery bed had grown and were ready for lifting.

Farmers usually used labor exchange for transplanting irrigated rice. As the farmers didn't use herbicides, they had to regulate the level of standing water once a week to control weed growth. Farmers used small amount of chemical fertilizer for irrigated rice. Farmers began harvest around the first week of October until the end of October, depending on the time of transplanting. This staggered harvesting helped spread out the labor demand. Farmers also used exchange for rice harvesting. The average yield was around 50 tang per rai. Normally, farmers kept their own rice seeds for the next cultivation season.

Upland Rice

Site preparation for upland rice, farmers started around the beginning of May. Typically a site was slashed, using exchange labor, and burned. After land clearing, farmers started planting upland rice, using dibbling planting technique. At present, most farmers used new upland rice varieties. As the farmers didn't use herbicides intensively, they had to weed their fields by hand once a month. Some farmers used salt to control weed growth. Farmers also used chemical fertilizer for upland rice. The harvest began around the end of October until mid-November, using exchange labor. The average yield for upland rice was around 30 tang per rai. Farmers normally kept their rice seeds for the next cultivation season.

Upland Soybean

For upland soybean, farmers started site preparation about the same time in the same manner as for upland rice. In the past, farmers used traditional varieties , but have shifted to improved varieties about seven years ago. At the time of the study, farmers used Chiang Mai 60 soybean variety as this variety gave higher yield with high resistance to the diseases. Following land clearing, farmers started planting around mid-May, using both the thousand and labor exchange group to dibble plant crop. Farmers used herbicides in upland soybean, but also did hand weeding once a month. They also used chemical fertilizer. Around the beginning of September, farmers began their harvest. Most farmers used their household members for this activity because they usually planted in small area. Soybean are typically raised as a seed crop in Tien Pha. The crop is typically sold standing, but on a per kg basis,

following shelling by the buyer. The average yield for upland soybean was around 150 kg per rai. Farmers usually kept their own seeds for the next cultivation.

Upland Sweet Corn

Sweet corn is a newly introduced crop and gained its popularity in the area just recently. It is purely a cash crop. All corn seeds were provided by the contracting buyer. For sweet corn, farmers started land clearing around April followed by burning and cultivating in the beginning of May. Farmers usually used hired labor for cultivation. After cultivation, they applied herbicides; however, they also had to weed their fields three times in the reason. Farmers regularly used chemical fertilizer. Around the first week of August, farmers started their harvest. Hired labor was mainly used to speed up the activity. The activity took one day to complete and farmers sold all of their fresh product directly to the contracting buyer. The average yield for upland sweet corn was 1,100 kg per rai.

Home Gardens

Karen farmers planted various vegetables for household consumption in their home garden. Vegetables were grown in home garden included chili, eggplant, melon, lemon grass, taro, coffee, cucumber, pumpkin, pineapple, banana, and different kinds of beans and peas. The size of home garden was small and scattered ranging from 0.5-1 rai depending on the household. These home grown vegetables supply most of the diet needed for the people in the study area. Aside from household consumption, some villagers were able to sell their products to their nearby neighbors.

Fruit Orchard

Lychee was grown in the study area. Farmers originally obtained the stock from the government. They started planting lychee eight years ago. About 50% of lychee grown in the village yielded the production. Due to the favorable climatic condition, lychee in the study area yielded its production twice a year. Around July, farmers started their first harvest, followed by the second harvest in January. In addition, farmers were able to sell lychee stocks as by-product.

Livestock

Livestock were mainly kept for consumption. These were mainly chicken and pigs and to a lesser extent cows and buffaloes. Buffaloes were also used as draft animals although increasingly farmers were turning to small walking tractor for land preparation. Cows were often regarded as household savings for emergency. Private merchants will come to the village to buy cows and buffaloes. Usually, the herd was left in the nearby forest with occasional visits by the owners. However, farmers reported that have suffered losses of their animals from diseases.

Forest Land and Community Forest

Forest around the area was mostly hill evergreen forest. It was used extensively for many purposes such as timber, grazing land, and various non-timber products. Villagers used forest products for both household use and consumption. Forest products and wild animals were mainly collected and hunted in the rainy season. Mushroom and bamboo shoot were the main items. In many cases, they were able to sell these products locally. In addition, villagers were also collected forest products for medical purposes.

In the study area, the community forest was initiated and collectively managed by three village clusters. Rules and regulations were formulated to protect the community

forest. It was divided into two types; the watershed forest and utility forest. All villagers in each village had access to different areas of the forest with different degree of restriction.

Land Use Conflicts

In the study area, forest area was classified as protected watershed forest. Thus, uses of this forest were subject to national laws and regulations. Conflict between forest officers and villagers was not uncommon. The threat of relocation inspired a lot of fear among villagers in the study area. Such hidden conflict is still active. Although the relocation has not yet occurred, it left some negative feelings between villagers and RFD officers. In order to solve the conflict, the RFD officers and Karen people have recently made an agreement on using agricultural lands, allowing Karen to cultivate the old plots of farmlands. In return, this helps to lesson the conflict.

6. Farm-Level Budget Analysis

Private Budget Analysis

Private budget analysis of the Karen farming system was carried out for each crop typically grown in the study area. The calculation was based on per **rai** basis. The budgets were built from a table of input and outputs used and harvested for each crop along with a table of local (private) prices paid or received for each input and output. Results are presented in Table 1-3. Household profit was also calculated using the average size of farm per household for each crop. The average size of land per household was 3 rai,1.5 rai and 2.5 rai for both paddy and upland rice, upland soybean, and upland sweet corn respectively.

An initial analysis of the data indicated strikingly negative returns (profits) for all crops grown in the study area. Group discussion lead to the conclusion that the standard PAM methodology, which was first developed for use with commodity or large commercial crop production, was not wholly applicable to the situation in Mae Chaem and needed to be modified in several ways. First, labor costs should not be included in the calculation of working capital (which relates to interest costs). Labor was a large component of working capital. In contrast to the standard (commodity model) of PAM, very little labor is hired for crop production (cash or subsistence) in Mae Chaem, so its inclusion caused final costs to be overstated. Second, it was decided to calculate the implicit wage as an alternative to the local agricultural wage rate (90 Baht/day). The implicit wage is the value that can be applied to a unit labor used when profit is assumed to be zero (return to labor when total costs = total expenses), as might be figured for subsistence crops. Families in Mae Chaem prioritized production of their subsistence rice crops over cash crops, so the use of the implicit wage is justified. In the end, we did apply the implicit wage to the two rice crops, but kept the local agricultural wage for the cash crops. We applied it to reflect an opportunity costs, even though family labor is the norm, and wage opportunities are limited. All labor costs were considered as fixed rather than variable costs. Finally, land was excluded from the calculations because it is not regularly traded in the Mae Chaem area and so had no consistent, representative price.

Paddy Rice

With our modifications for the Mae Cahem PAM, paddy rice showed a net profitability of zero, consistent with the definition of the implicit wage. Prior to modifications, profits for paddy rice were –1,470 B/rai, which made paddy the most profitable (least negative) of the four crops. Consistent with the relative profitability at a

local wage rate, the paddy rice was the highest of the four crops. Variable costs were moderate (509 B/rai), as was the demand for labor (31 labor days/rai). Paddy yielded 500 kg/rai, which meant a return of 16 kg of rice for each day of labor applied.

Upland Rice

As with paddy, upland rice showed a net profitability of zone using our modified PAM. Prior to modification, upland rice was the least profitable (most negative) of the four crops (14,451 B/rai). The implicit wage rate is 30 B/rai, which is about half that of paddy rice. The labor demand of 44 labor days per rai of upland rice was the highest of the four crops grown (which relates to the very low profitability seed before modification). Upland rice yielded only 300 kg/rai, giving a return to labor of just under 7 kg of rice per day of labor applied. However, the gross margin for upland rice was the second highest of the four crops (1,354 B/rai) which reflected low use of inputs (variable costs) rather than high returns.

Upland Soybean

Because we retained the local wage rate for cash crops, soybeans showed a very negative net profitability of –2,224 B/rai, the less profitable of the two cash crops. The cash revenues for soybeans were low (1,014 B/rai) as were the variable costs (509 B/rai). Soybeans had a labor demand of 30 labor days/rai, which at the local wage rate produced very high fixed costs of 2,705 B/rai (and accounted for the negative profitability). The implicit wage was only 14 B/rai for soybean, making in the lowest of the four crops grown.

Upland Sweet Corn

Sweet corn also showed a negative net profitability (-1,285 B/rai). Cash revenues were quite high (2,200 B/rai), as were variable costs (1,315 B/rai). Gross margin was 855 B/rai, which was better than for soybean. Sweet corn had the lowest labor demand of the 4 crops (22 labor days/rai) and in implicit wage rate of 31 B/day, double that of soybean.

Household Budget

The household level calculations were based on a "representative" mixture of the four primary crops grown in the study area. This budget showed the overall economic situation of a 'typical" household growing 3 rai of paddy rice, ,3 rai of upland rice, 1.5 rai of soybean, and 2.5 rai of upland sweet corn. It was important to remember that this budget is not inclusive of all subsistence or economic activities that households are involved in, such as raising livestock, collecting forest products or raising minor cash crops.

Social Budget Analysis

Social budget analysis was calculated by multiplying social prices with the inputs and outputs in input-output table. As the private prices didn't reflect the true value, social budget analysis was able to show the differences between the true opportunity cost and the observed market price. When social prices were calculated, only upland sweet corn was socially profitable. In case of upland rice, the divergence of private prices and social process was mainly due to labor cost. For upland sweet corn, social output price was higher than what farmers were getting at the farm gate suggesting a market imperfection in its output market. With higher output price and lower input price, upland sweet corn was only socially profitable crop in the study area. However, it had the highest variable costs of the four crops. As upland sweet corn was purely cash crop and part of the contract system, farmers had to follow the specified cultivation procedures.

Measurement of Government Intervention/Market Imperfection

To evaluate the policy effects and market failures, the policy analysis matrix (PAM) was carried out in each crop grown in the study area. The divergences between the private and social prices indicate the taxing effects caused by government intervention or market imperfection or both. For four crops grown, upland soybean and upland sweet corn showed negative output transfers. This indicates that higher prices of output can be offered to farmers if these crops are linked to international market or better marketed. Such problem was also related to physical conditions of the area.

For tradable inputs, all four crops had positive divergences except upland rice. Such positive divergences indicated a tax on inputs.

In addition, the case of upland rice also showed the negative divergence in labor. This was due to the difference between the implicit wage rate used in private price and adjusted wage rate used in social price. For paddy rice, the implicit wage rate was higher than wage rate in social price. For the other two crops, upland soybean and upland sweet corn, they had positive divergences because local wage rate of 90 B/day was used in calculation of private prices.

Looking at profits of all crops in the area, producers of the two cash crops, upland soybean, and upland sweet corn, were effected by distorting policies and market failures. Negative transfer was higher in upland sweet corn (-4,612 B), while upland soybean was –2,017 B. For paddy rice and upland rice, total transfers were positive, with 151 B fro paddy rice, and 1,229 B for upland rice respectively.

PAM Ratios

Three PAM ratios were maculated to compare the profitability and efficiency of different (NPC), the effective protection coefficient (EPC), and the domestic resource cost coefficient (DRC).

An NPC for tradable outputs of each crop grown in the area, paddy rice and upland rice were greater than 1 which meant that producers of these two crops received an implicit output subsidy from policies affecting crop prices. In contrast, producers of upland soybean and upland sweet corn were experienced taxing effects, with NPC less than 1. For tradable inputs, paddy rice, upland soybean, and upland sweet corn had NPC of tradable inputs greater than 1. This showed a negative transfer because input costs were raised. Only upland rice had NPC of tradable inputs less than 1, which meant that market prices of inputs fall below the prices that would result in the absence of distorting government policies.

The effective protection coefficient (EPC) indicates the combined effect of policies in tradable commodities market. Paddy rice and upland rice had EPC greater than 1 indicating a subsidy to producers. The other two crops had EPC less than 1, which meant the farmers experienced taxing effect.

With respect to the domestic resource cost coefficient (DRC), paddy rice, upland rice, and upland soybean had DRC greater than 1. Such results showed an inefficient use of domestic resources. In contrast, upland sweet corn showed the effective use of resources, with DRC less than 1.

7. Conclusion and Recommendations

The findings clearly indicate that current Karen farming systems are facing the negative effects of both policies and market failures. Karen farmers are producing crops which are not privately and socially profitable. Without taking land costs into consideration, all crops grown in the area have negative returns. Thus, the government should have clear

highland agricultural development policies in supporting upland farmers. As the national policy emphasizes that this underprivileged group should be given development priority so as to not to be by passed by development efforts. Such policies are needed to help these farmers to maintain their viable production systems and livelihood. Private and social profitability of current Karen farming system must be realized. Infrastructure development to increase access must be improved to open new economic opportunities to these upland farmers. In addition, production and marketing information should be provided to allow farmers to make cropping decision which has marketing feasibility.

Regarding PAM studies, this study modified PAM methodology to suit local farming conditions in the area. However, it doesn't yield complete understanding the Karen farming practices, total economic activities need to be calculated by using PAM. When it is undertaken, the complete understanding of Karen farming systems will be achieved. In conducting PAM, the team also encountered a number of physical and cultural challenges while working and research on agriculture employ a different perspective of units. Villagers do not figure everything by hours or per unit area as needed by our PAM forms.

In developing the private sector analysis, it is important to collect accurate and detailed information for labor inputs. We faced a couple challenges to this. Following discussions with our key informants in our early visits to the villages, we developed questionnaires to trace all key work activities for each crop. The villagers interviewed seemed most readily able to recall work inputs on a per day basis, so we used labor-days as our unit. However, it became clear to us that not all days were created equal. Length of day worked varied depending on the task, the season, or other factors. So it became necessary to augment our labor-day information with the respondent's estimates of the typical work day for each task, and then recalculate on a standard 8 hour workday day basis.

Another complicating factor is the very common and culturally important practice of exchanging labor among the villagers. Labor exchange is a traditional practice among Karen in Thailand to spend up farming and provide company in field. With each day of work by others accepted in their fields, a family incurs a debt of a day's return labor to each contributing family. However, the unit of measure is the day, independent of the length of day worked for that task. Some farming activities have very high labor input. This doesn't seem to be taken into account by farmers but related to social relationship in the village.

Also related to exchange labor is the cost of food and drink provided by the host family. This is one of the things we only gradually became aware of, so we were not able to include this expense in our analysis, ,but it can be as significant as some of the other inputs recorded.

The villagers in our study site also shared the responsibility of maintaining the irrigation infrastructure for the paddy fields. This was organized on a community level, by individual canals feeding a paddy area. Prior to the planting season, each family was responsible to provide labor to maintain ditches. The obligation was based on the number of plots held within an area fed by an individual canal, not the area of land within the canal area (quantity of units not area). For our convenience we converted it to days spent per rai, but it is not really the relevant/controlling measure.

Another challenge faced was in choosing the optimal size of the sample. We pursued a course of working with a core group of about 15 farmers that seemed to be representative. Not all of these farmers raised each crop, so the per crop sample was smaller. We later augmented this detailed information, interviewing 20 more families about specific labor tasks on particular crops.

In addition, none of PAM studies are conducted by incorporating sustainability and externality problems into our analysis of Karen farming system. As these two issues are

important for agricultural development, further PAM analysis can be attempted in this direction.

In conclusion, the Karen farming system was assessed through the use of the Policy Analysis Matrix (PAM). It was based on the fieldwork conducted in Mae Chaem district. Four types of land uses were observed included irrigated rice, upland rice, upland soybean, and upland sweet corn. The methodology was modified to suit farming conditions in the study area. The data showed the negative returns for all crops grown. Rice crops were given priority by the farmers. However, various farming practices are still unanswered. Ongoing PAM research needs to be carried on. Once data are in hand, types of crops and technological change and/or highland agricultural extension policy reform can be identified to achieve sustainable resource management of the region.

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Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Paddy rice												
Upland rice												
Upland soybean												
Upland sweet corn												

Crop	Task done	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Irrigation maintenance	X												
Nursery	X												
Irigate	X												
Plow	X												
Paddy bund maintenance	X												
Harrow	X												
Transplant	X												
Fertilize	X												
Weed	X												
Harvest	X												
Bind thresh + winnow	X												

Task	Task done	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Slash & burn	X												
Plant	X												
Weed	X												
Harvest	X												
Bind, thresh + winnow	X												

Task	Task done	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Slash & burn	X												
Plant	X												
Weed	X												
Harvest	X												
Bind, thresh + winnow	X												

Task	Task done	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Slash & burn	X												
Plant	X												
Weed	X												
Harvest	X												

Table 1. Input and Output of Four Crops Grown in the Study Area

	Quantities	Paddy Rice	Upland Rice	Upland Soybean	Upland Sweet corn
Tradable	Fertilizer (kg/rai)				
	16-20-0	16.7	15.0	25.0	50.0
	46-0-0	-	-	-	50.0
	Herbicide 1 (l/rai) Gramoxon	-	-	0.8	1.0
	Herbicide 2 (l/rai) 2E	-	-	0.1	-
	Seed (kg/rai)	10.0	10.0	15.0	2.0
	Fuel (liters/rai)	8.5	-	-	-
Factors	Labor (days/rai)				
	Canal maintenance	0.7	-	-	-
	Nursery	0.5	-	-	-
	Seedbed Prep	5.0	6.7	10.0	6.7
	Planting	6.0	7.8	5.4	5.3
	Crop care				
	Weeding	2.8	10.2	7.5	3.3
	Irrigation	0.8	-	-	-
	Fertilizing	0.6	1.3	0.7	1.2
	Fire lines/protection	-	0.4	-	-
	Harvesting	6.5	6.8	5.9	5.5
	Threshing/winnowing	6.8	8.8	-	-
	Transportation&storage	1.4	2.3	-	-
	Capital				
	Working Capital (B/rai)	509.1	146.0	508.8	1,315.0
	Tractor Services (day/rai)	1.7	-	-	-
Output	(Kg/rai)	500.0	300.0	152.0	1,100.0

Table 1. Prices Paid Locally for Input and Output of Four Crops Grown in the Study Area

	Private Prices	Paddy Rice	Upland Rice	Upland Soybean	Upland Sweet corn
Tradable	Fertilizer (B/kg)				
	16-20-0	6.4	6.4	6.4	6.4
	13-13-21	-	-	-	7.6
	Herbicide 1 (B/l) Gxn	-	-	115.0	115.0
	Herbicide 2 (B/l) 2E	-	-	750.0	-
	Seed (B/kg)	5.0	5.0	15.0	250.0
	Fuel (B/liter)	12.0	-	-	-
Factors	Labor (B/day)				
	Canal maintenance	61.6	-	-	-
	Nursery	61.6	-	-	-
	Seedbed Prep	61.6	30.1	90.0	90.0
	Planting	61.6	30.1	90.0	90.0
	Crop care				
	Weeding	61.6	30.1	90.0	90.0
	Irrigation	61.6	30.1	90.0	90.0
	Fertilizing	61.6	30.1	90.0	90.0
	Fire lines/protection	61.6	30.1	90.0	90.0
	Harvesting	61.6	30.1	90.0	90.0
	Threshing/winnowing	61.6	30.1	-	-
	Transportation&storage	61.6	30.1	-	-
	Capital				
	Working Capital (%)	0.15	0.15	0.15	0.15
	Tractor Services (B/day)	150.0	-	-	-
Output	(B/Kg)	5.0	5.0	6.7	2.0

Table 3. Private Budget for Four Crops Grown in the Study Area

	Private Prices	Paddy Rice	Upland Rice	Upland Soybean	Upland Sweet corn
Tradable	Fertilizer (B/rai)				
	16-20-0	107.0	96.0	160.0	320.0
	13-13-21	-	-	-	380.0
	Herbicide 1 (B/rai) Gxn	-	-	86.0	115.0
	Herbicide 2 (B/rai) 2E	-	-	38.0	-
	Seed (B/rai)	50.0	50.0	225.0	500.0
	Fuel (B/rai)	102.0	-	-	-
Factors	Labor (B/rai)				
	Canal maintenance	41.0	-		
	Nursery	31.0	-		
	Seedbed Prep	308.0	201.0	900.0	600.0
	Planting	369.0	235.0	486.0	473.0
	Crop care				
	Weeding	175.0	307.0	675.0	297.0
	Irrigation	49.0	-	-	-
	Fertilizing	37.0	39.0	61.0	108.0
	Fire lines/protection	-	12.0	-	-
	Harvesting	400.0	205.0	531.0	495.0
	Threshing/winnowing	419.0	265.0	-	-
	Transportation&storage	86.0	68.0	-	-
	Capital				
	Working Capital (B/rai)	76.00	21.00	76.00	197.00
	Tractor Services (B/rai)	251.0	-	-	-
Output	Total revenue (B/rai)	2,500	1,500	1,014	2,200
	Total cost (excluding land) (B/rai)	2,500	1,500	3,238	3,485
	Net profit (excluding land) (B/rai)	-	-	(2,224)	(1,285)
	(all on a per rai basis)				
	Total Variable Costs	509	146	509	1,315
	Gross Margin	1,991	1,354	505	885
	Fixed Costs				
	Depreciation				
	Interest	76	22	76	197
	Rent				
	Taxes				
	Insurance				
	Labor	1,915	1,332	2,653	1,973
	Total Costs	2,500	1,500	3,238	3,485
	Return to land and labor	1,915	1,322	429	688
	Return to Management	-	-	(2,224)	(1,285)
Calculation of "implicit wage rate" (Baht/day)		61.6	30.1	14.5	31.4

Table 4. Social Prices Paid for Input and Output of Four Crops Grown in the Study Area

	Social Prices	Paddy Rice	Upland Rice	Upland Soybean	Upland Sweet corn
Tradable	Fertilizer (B/kg)				
	16-20-0	8.19	8.19	8.19	8.19
	13-13-21	-	-	-	16.67
	Herbicide 1 (B/l) Gxn	-	-	0.03	0.03
	Herbicide 2 (B/l) 2E	-	-	0.03	-
	Seed (B/kg)	3.84	3.84	10.88	30.47
	Fuel (B/liter)	7.63	-	-	-
Factors	Labor (B/day)				
	Canal maintenance	50.0	-	-	-
	Nursery	50.0	-	-	-
	Seedbed Prep	50.0	50.0	50.0	50.0
	Planting	50.0	50.0	50.0	50.0
	Crop care				
	Weeding	50.0	50.0	50.0	50.0
	Irrigation	50.0	50.0	50.0	50.0
	Fertilizing	50.0	50.0	50.0	50.0
	Fire lines/protection	50.0	50.0	50.0	50.0
	Harvesting	50.0	50.0	50.0	50.0
	Threshing/winnowing	50.0	50.0	-	-
	Transportation&storage	50.0	50.0	-	-
	Capital				
	Working Capital (%)	0.05	0.05	0.05	0.05
	Tractor Services (B/day)	150.0	-	-	-
Output	(B/kg)	3.84	3.84	10.88	4.98

Table 5. Social Budget for Four Crops Grown in the Study Area

	Costs and Returns (B/rai)	Paddy Rice	Upland Rice	Upland Soybean	Upland Sweet corn
Tradable	Fertilizer (B/rai)				
	16-20-0	136.36	122.85	204.75	409.50
	13-13-21	-	-	-	533.50
	Herbicide 1 (B/rai) Gxn	-	-	0	0
	Herbicide 2 (B/rai) 2E	-	-	0	-
	Seed (B/rai)	38.40	38.40	163.20	60.94
	Fuel (B/rai)	64.86	-	-	-
Factors	Labor (B/rai)				
	Canal maintenance	33.00	-		
	Nursery	25.00	-		
	Seedbed Prep	250.00	334.00	500.00	334.00
	Planting	300.00	390.00	270.00	263.00
	Crop care				
	Weeding	142.00	510.00	375.00	165.00
	Irrigation	40.00	-	-	-
	Fertilizing	30.00	65.00	34.00	60.00
	Fire lines/protection	-	20.00	-	-
	Harvesting	325.00	340.00	295.00	275.00
	Threshing/winnowing	340.00	440.00	-	-
	Transportation&storage	70.00	113.00	-	-
	Capital				
	Working Capital (B/rai)	24.51	8.06	18.40	50.20
	Tractor Services (B/rai)	251.00	-	-	-
Output	Total revenue (B/rai)	1,920.00	1,152.00	1,653.76	5,478.00
	Total cost (excluding land) (B/rai)	2,069.62	2,380.31	1,860.37	2,150.17
	Net profit (excluding land) (B/rai)	(149.62)	(1,228.31)	(206.61)	3,327.83
	(all on a per rai basis)				
	Total Variable Costs	490.12	161.25	367.97	1,003.97
	Gross Margin	1,429.88	990.75	1,285.79	4,474.03
	Fixed Costs				
	Depreciation				
	Interest	24.51	8.06	18.40	50.20
	Rent				
	Taxes				
	Insurance				
	Labor	1,555.00	2,211.00	1,474.00	1,096.00
	Total Costs	2,069.62	2,380.31	1,860.37	2,150.17
	Return to land and labor	1,405.38	982.69	1,267.39	4,423.83
	Return to Management	(149.62)	(1,228.31)	(206.61)	3,327.83
Calculation of "implicit wage rate" (Baht/day)		45.19	22.22	42.99	201.82

Table 6. Input and Output per Household for Four Crops Grown in the Study Area

	Quantities		Paddy Rice	Upland Rice	Upland Soybean	Upland Sweet corn
Tradable	Fertilizer (B/kg)					
		16-20-0	50.00	45.00	37.50	125.00
		46-0-0	-	-	-	125.00
	Herbicide 1 (l) Gxn		-	-	1.10	2.50
	Herbicide 2 (l) 2E		-	-	0.10	-
	Seed (kg)		30.00	30.00	22.50	5.00
	Fuel (liters)		25.50	-	-	-
Factors	Labor (day)					
		Canal maintenance	2.0	-	-	-
		Nursery	1.5	-	-	-
		Seedbed Prep	15.0	20.0	15.0	16.7
		Planting	18.0	23.4	8.1	13.1
	Crop care					
		Weeding	8.5	30.6	11.3	8.3
		Irrigation	2.4	-	-	-
		Fertilizing	1.8	3.9	1.0	3.0
		Fire lines/protection	-	1.2	-	-
		Harvesting	19.5	20.4	8.9	13.8
		Threshing/winnowing	20.4	26.4	-	-
		Transportation&storage	4.2	6.8	-	-
	Capital					
		Working Capital (B)	1,527.20	438.00	763.10	3,287.50
		Tractor Services (days)	5.0	-	-	-
	Land (rai)		3.00	3.00	1.50	2.50
Output	(kg)		1,500.00	900.00	228.00	2,750.00

Table 7. Private Budget per Household for Four Crops Grown in the Study Area

	Costs and Returns (B/rai)	Paddy Rice	Upland Rice	Upland Soybean	Upland Sweet corn	Household Total
Tradable	Fertilizer (B/rai)					
	16-20-0	320	288	240	800	1,648
	13-13-21	-	-	-	950	950
	Herbicide 1 (B) Gxn	-	-	129	288	417
	Herbicide 2 (B) 2E	-	-	56	-	56
	Seed (B)	150	150	338	1,250	1,888
	Fuel (B)	306	-	-	-	306
Factors	Labor (B)					
	Canal maintenance	122	-	-	-	122
	Nursery	92	-	-	-	92
	Seedbed Prep	923	603	1,350	1,501	4,377
	Planting	1,108	705	729	1,181	3,723
	Crop care					
	Weeding	525	922	1,013	743	3,201
	Irrigation	148	-	-	-	148
	Fertilizing	111	117	92	270	590
	Fire lines/protection	-	36	-	-	36
	Harvesting	1,200	615	797	1,238	2,849
	Threshing/winnowing	1,256	795	-	-	2,051
	Transportation&storage	259	203	-	-	462
	Capital					-
	Working Capital (B)	229	66	114	493	902
	Tractor Services (B)	752	-	-	-	752
						-
Output	Total revenue (B)	7,500	4,500	1,521	5,500	19,021
	Total cost (excluding land) (B)	7,500	4,500	4,857	8,713	25,570
	Net profit (excluding land) (B)	(0)	-	(3,337)	(3,213)	(6,549)
	(all on a per rai basis)					-
	Total Variable Costs	1,527	438	763	3,288	6,016
	Gross Margin	5,973	4,062	758	2,213	13,005
	Fixed Costs					
	Depreciation					
	Interest	229	66	114	493	902
	Rent					
	Taxes					
	Insurance					
	Labor	5,744	3,996	3,980	4,932	18,652
	Total Costs	7,500	4,500	4,857	8,713	25,570
	Return to land and labor	5,744	3,996	643	1,719	12,103
	Return to Management	(0)	0	(3,337)	(3,213)	(6,549)

Table 8. Policy Analysis Matrix of Four Crops Grown in the Study Area

Policy Analysis Matrix: Paddy Rice

	Tradables		Domestic Resources		
	Output	**Inputs**	**Labor**	**Capital**	**Profit**
Private	2,500	259	1,915	326	0
Social	1,920	240	1,555	276	(151)
Divergence	580	19	360	50	151

Policy Analysis Matrix: Upland Rice

	Tradables		Domestic Resources		
	Output	**Inputs**	**Labor**	**Capital**	**Profit**
Private	1,500	146	1,332	22	0
Social	1,152	161	2,212	8	(1,229)
Divergence	348	(15)	(880)	14	1,229

Policy Analysis Matrix: Upland Soybean

	Tradables		Domestic Resources		
	Output	**Inputs**	**Labor**	**Capital**	**Profit**
Private	1,014	509	2,653	76	(2,224)
Social	1,653	368	1,474	18	207
Divergence	(639)	141	1,179	58	2,017

Policy Analysis Matrix: Upland Sweet corn

	Tradables		Domestic Resources		
	Output	**Inputs**	**Labor**	**Capital**	**Profit**
Private	2,200	1,315	1,973	197	(1,285)
Social	5,478	1,004	1,097	50	3327
Divergence	(3,278)	311	876	147	(4,612)

Table 9. PAM Ratios

Ratios of Protection and Efficiency

	NPC		EPC	DRC
	Outputs	**Inputs**		
Paddy Rice	1.30	1.07	1.33	1.08
Upland Rice	1.30	0.90	1.36	2.24
Upland Soybean	0.61	1.38	0.39	1.16
Upland Sweet corn	0.40	1.30	0.19	0.25

Table 10. Social Import Parity Prices

	Seed					Chemical		
	Corn	**Pumpkin**	**Lettuce**	**Green Pepp**	**Gladiolus**	**Kumulus**	**Afugan**	**Ambush**
Social import parity prices								
F.o.b ($/ton)					0.125			
Freight/Insurance ($/ton)					0.03125			
c.i.f ($/unit)	830.00	221.97	89.55	42.10	0.16	0.04	0.04	0.04
unit	ton	kg	kg	kg	bulb	kg	litre	litre
Exchange rate (baht/$)	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)	1,000	1,000	1,000	1,000	1	1,000	1,000	1,000
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	0.273438			
Marketing costs (baht/unit)		0.1	0.1	0.1	0.273438	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	0.90			
Import parity value at wholeshale (baht/kg)	29.97	7.77	3.13	1.67	6.68			
Processing cost (Baht/unit)		0	0	120	0.334201	0.02	0.02	0.02
Distribution costs to farm (baht/kg)	0.50	0.1	0.1	0.10	0.334201	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 10. 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 ($/unit)	136.5	293.67	890	20	240.04	165.29	236.45	183.64	300
unit	ton	ton	ton		ton	ton	ton	ton	ton
Exchange rate (baht/$)	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	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
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	10.4	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 wholeshale (baht/kg)	5.78	11.38	41.4375	6.65	10.4	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	11.4	8.19	1067575	8.83	12.9
Adjustment of unit			0.5						
Import parity at farm gate (baht/unit)			19.72						

Table 11. Social Export Parity Prices

	Seed					
	Paddy	**Pumpkin**	**Ginger**	**Taro**	**Green Pepp**	**Gladiolus**
Social export parity prices						
c.i.f ($/ton)		736.00			1,146	0.125
Freight and Insurance ($/ton)		12			41	0.03125
f.o.b ($/unit)	224	724	770	410	1,105	0.09375
Exchange rate (baht/$)	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
Equilibrium exchange rate	35	35	35	35	35	35
f.o.b in domestic currency	7,840	25,340	26,950	14,350	38,675	3.28
Weight conversion factor (kg/ton)	1,000	1,000	1,000	1,000	1,000	1.00
f.o.b in domestic currency	7.84	25.34	26.95	14.35	38.68	3.28
transportation costs (from factory) ($/ton)	0.35	0.65	0.65	1	3.00	0.33
Marketing costs (baht/unit)	0.50	0.33	0.33	1	2.0	0.330000
Value after processing (baht/unit)	6.99	24.36	25.97	12.35	33.68	2.63
Processing conversion factor (%)	0.65	0.8	0.8	0.8	0.70	0.90
Import parity value at wholeshale (baht/kg)	4.54	19,488	20,776	9.88	23.57	2.36
Processing cost (Baht/unit)	0.20	1	4.20	1	3	0.12
Distribution costs to farm (baht/kg)	0.50	0.7	0.7	1	2	0.12
Import parity at farm gate (baht/unit)	3.84	17.84	15.93	7.88	18.57	2.13

APPENDIX A
Input-Output Interview Guide

Irrigated Area

1. Activities related to an irrigation system
2. Time undertaken these activities
3. Labor and materials used
4. Type of crop planted
5. Size of area cultivated (rai)
6. Type of land tenure: in case of rented land, what is the rental
7. Nursery
    - When do you start land preparation
    - Activity and procedures
    - Fencing
    - Labor utilized
    - Expense in each activity
8. Land preparation
    - When do you start land preparation
    - Activity and procedures
    - Plowing
    - Bund maintenance
    - Harrowing
    - Labor utilized
    - Expense in each activity
9. Cultivation
    - Time planted
    - Cultivation technique
    - Type of variety
    - How to obtain the seedling
    - Fertilizing
    - Crop care
    - Labor utilized
    - Expense of each activity
10. Weeding
    - Time for weeding
    - Equipment used
    - Weed control technique
    - Expense
11. Harvesting
    - Time for harvest
    - Harvesting process
    - Labor utilized
    - Expense
    - Production level
        - total production (kg)
        - consumption (kg)

    - sale (kg)
    - seedling (kg)
    - price received (baht)
12. Threshing and winnowing
    - Threshing activity
    - Labor utilized
    - Expense
13. Cultivation problems in irrigated area

Upland Area

1. Type of crop planted
2. Size of area cultivated
3. Type of land tenure: in case of rented land, what is the rental agreement
4. Land preparation
    - When do you start land preparation?
    - Activity and procedure
    - Labor utilized
    - Expense in each activity
5. Cultivation
    - Time planted
    - Cultivation technique
    - Type of variety
    - How to obtain the seedling
    - Labor utilized
    - Expense of each activity
6. Crop care
    - Fertilizing
    - Weeding
    - Weed control technique
    - Period of crop care
    - Expense
7. Harvesting
    - Time for harvest
    - Harvesting process
    - Labor utilized
    - Expense
    - Production level
        - total production (kg)
        - consumption (kg)
        - sale (kg)
        - seedling (kg)
        - price received (Baht)
8. Threshing and winnowing
    - Threshing activity
    - Labor utilized
    - Expense
9. Cultivation problems in upland area

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