PALAWIJA NEWS

The CGPRT Centre Newsletter

Volume 12, Number 3 September 1995

Sustainable Upland Agriculture in South East Asia: Case Study in Mae Kham Pong Irrigation and Mae Lai Watershed Areas of Thailand

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1. Introduction

The Thailand economy has stayed on the fast growth track it has been following since 1987. The gross domestic product was estimated to grow by 8.3% in 1994 and the country reached an average growth of more than 8.0% in 1991 to 1994. The strong performance of the industrial sector has been the backbone of the high economic growth of the country. Despite this, agriculture is still an important sector of the Thai economy since it is a major source of food, it provides raw materials to the industrial sector, it is a means of foreign exchange earnings and it absorbs more than 60% of total employment.

The development efforts and the economic progress of the country have not been evenly distributed among groups of people. Farmers, the largest group, still have low incomes and a low standard of living compared to other sectors. The income gap between farm and non-farm sectors has widened; per capita income in non-farm sectors was about 6 times higher than in the farm sector in the period 1961 to 1982, and the gap continued to increase so that non-farm sectors reached about 12 times higher in 1990. The income disparity also appears to be varied within the agricultural sector itself, with the farmers cultivating uplands having the lowest level of income.

Upland agriculture constitutes a substantial part of agriculture in Thailand, as in many Southeast Asian countries, involving a large number of farmers. Upland agriculture is characterized by fragile environments, inferior infrastructure, and difficult access to markets, which hamper development. As a result, low income and poverty still prevail among many upland farmers.

In Southeast Asia, population pressure on already limited arable land has resulted in cultivation of marginal forest land. This causes serious problems for sustainability of agro-ecological systems in the area, particular in maintaining soil fertility.

The technology and methods of soil and water resource conservation for sustainable upland farming systems are a most urgent area for the development of these poverty prone regions.

To develop sustainable upland agriculture, this study aimed at identifying constraints and prospects for upland agriculture development, focusing on institutional improvement and resource management with emphasis on CGPRT crop development. This study is a joint country

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case study of the Sustainable Upland Agriculture in Southeast Asia Project, a study of the ESCAP CGPRT Centre.

The study was to review and analyze the effects the Agricultural Diversification and Peoples Irrigation Project (ADPIP) in Mae Kham Pong sub-project and Mae Lai Watershed Improvement sub-project. The study focused on the socio-economic aspects of resource management and farming for sustainable development of upland agriculture. Following a general summary of the ADPIP, the results of surveys of sample farmers will be discussed with respect to changes in farming and resource management activities and their impacts on the sustainability of upland agriculture. The constraints and prospects of sustainable upland agriculture will be discussed and further options will be suggested for policy and research in this domain.

Summary of ADPIP

The objectives of the ADPIP were: i) to improve production efficiency in existing irrigated areas; ii) to alleviate rural poverty, improve peoples economics and reduce income disparities; iii) to increase agricultural diversification to raise farm income sustainability; and iv) to increase participation of people in irrigation improvement planning, operation and maintenance, making farmers were self-reliant, and fostering peoples irrigation associations (PIAs).

The project comprises three main activities/ components: i) irrigation sub-projects (5 dams); ii) pioneer watershed improvement component (Mae Lai Watershed Improvement sub-project); and iii) institutional development and technical support, including monitoring and evaluation.

The irrigation sub-projects consist of construction of five small dams (Mae Kham Pong in Phrae province, Mae Prik in Lampang province, Mae Kon, Huai Dua and Mae Laeng Luang in Chiang Mai province) and improvement of associated downstream of Peoples Irrigation Projects (PIPs) through rehabilitation and reconstruction of existing traditional weirs and minor canal improvement, and expansion of the Royal Irrigation Department (RID Mobile Campaign Units (MCUs) to assist PIP participation, arrange operation and maintenance of reservoirs, provide agricultural extension, and improve water management.

A pioneer or pilot watershed component was established in Mae Lai basin. A major problem faced by PIPs was watershed degradation and deforestation, which increased flash floods in the wet season and reduced dry season flows. The primary objective of the project was to develop an integrated whole basin approach to catchment improvement and protection, linked to irrigation investment, which could later be expanded to other sub-basins. Watershed activities under the project focused on protection of water supplies for the sub-basin, primarily by raising farm income to discourage shifting cultivation and by promoting soil and water conservation. These activities concentrated on upland areas where deforestation and soil erosion constituted the most severe near-term threat to PIP water supplies. The Royal Forestry Department (RFD) is responsible for forest reserves where most project watershed activities were located, and their support services for land-use planning and soil and water conservation was essential. As forest reserves are presently closed to other agencies, RFD opened Mae Lai forest areas to all project agencies for activities under the project component.

Institutional development and technical support, included training for agency staff in the project and farmers on operation and water management and to improve organizational capabilities, and on soil and water conservation practices. Research and studies related to the project included monitoring and evaluation.

The project was implemented by 10 agencies in the Ministry of Agriculture and Cooperatives (MOAC). They are the Royal Irrigation Department (RID); Department of Agricultural Extension (DOAE); the Royal Forestry Department (RFD); Land Development Department (LDD); the Cooperative Promotion Department (CPD); Department of Fisheries (DOF); Office of the Permanent Secretary of MOAC; the Northern Regional Agriculture Center (NARC); and the Office of Agricultural Economics (OAE).

The period of the ADPIP was from 1989 until 1994 (five years). Total project costs were US$ 18.3 million, which was funded by an IFAD loan of US$ 10.0 million (55%), an OPEC loan of US$ 3.0 million (16%) and the Thai Government US$ 5.3 million (29%).

Message from the Director

Now we are heading to the end of the year 1995. This is the time of the Technical Advisory Committee (TAC) and the Governing Board (GB). The TAC is stipulated in the Centre's Statute as: "consisting of eminent scientists and experts directly connected with technical aspects, representing various fields of agricultural research, and shall meet at least once a year and be responsible for advising the director on the formulation of the work programmes and on other technical matters concerning the operations of the Centre". And the Governing Board as: "consisting of representatives of the host and member countries and associate members of ESCAP, shall meet at least once a year and review the operations of the Centre and consider and adopt the annual and long-term programmes of work of the Centre".

Accordingly, the TAC and GB meetings are most important events for the Centre. The TAC and GB meetings are opportunities for the Centre to display the results of activities which it has performed during the current year. Also, it is a good chance for members to provide advice and guidance to us on the Centre's programmes, plans and the future direction.

The CGPRT Centre is a non-profit institute for research and development, and human resources development and information services. The Centre is to be of service to member countries through its activities. The usefulness of the Centre is the most essential subject to be evaluated. The impact of the Centre as a whole is partly reflected in the stability and expansion of its relations with national partners in Asia. Direct outputs and findings of the collaborative projects are part of the impact of the Centre's activities. Though they are important, they are only a part of the broader function of the Centre.

The function and responsibility of the Centre are clearly stated in the long name of the institute. The functions of the Centre are: (1) to coordinate with the member countries and institutes, (2) to work on research and development of coarse grains, pulses, roots and tuber crops, (3) to work on the humid tropics of Asia and the Pacific, and (4) since the Centre is one of the subsidiary organizations of ESCAP, all of these efforts must relate to economic and social aspects.

To agriculturalists, the discussion of economic and social studies sometimes sounds like a discussion simply for the sake of discussion. Inversely, to administrators and development agencies, the more basic agricultural research seems sometimes far removed from the reality here and now. The Centre, through its socio-economic orientation and actual socio-economic work, seeks to bridge part of this gap. In doing so, the Centre has shown, over the years, a wide frame of topical orientation. It has in collaboration in national partners looked at international and local markets, farms, farming types, local adaptive research, sectors and sub-sectors, and spatial variability in crop performance, among others. The Centre has also created factual regional overviews on development issues such as women, sustainability, and agriculture research. The Centre's palette of topics has many colors.

Agricultural research throughout the region has been going through many changes recently. The challenge for the Centre is to find a mix between current and new colors, to reflect the dynamics of agriculture in the region. There are many ways to do this.

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Research methods

This case study on sustainable upland agriculture in Southeast Asia was done by rapid rural appraisal techniques involving sample farmers of the Mae Lai Watershed Improvement sub-project area. Sample farmers (25) were selected by random sampling in the study village. The interview was carried out by visiting farm households and collecting answers through pre-determined questionnaires. The questionnaires focused on the socio-economic aspects of their farming systems and activities before and after the project implementation.

The general impact or results of soil and water resource management conservation of the whole project area was analyzed using secondary data which was collected and analyzed by related research of the ADPIP and other related sources.

General description of the study sites

Topography

The Mae Lai Watershed area is located a short distance north-east of Phrae province covering 218,750 rai (1 ha = 6.25 rai), which comprises 4 sub-basins: Mae Kham Pong sub-basin (60,625 rai); Mae Thang sub-basin (79,690 rai); Mae Terk sub-basin (34,060 rai); and Mae Lai sub-basin (44,375 rai).

Most of Mae Lai Basin area is mountainous with 2-35% slope or more and 300-600 meters above sea level. Mae Lai Basin is fan-shaped and its drainage has a dendritic pattern. Now there are two dams, Mae Kham Pong dam (ADPIP sub-project) and Mae Thang dam (constructed by Thai government budget and completed in 1995). There are three river streams serving in this basin, Mae Kham Pong, Mae Thang and Mae Terk streams, which flow from the high mountains to the east of the project site. The three streams meet at the west of the project site forming Mae Lai river which flows down to Mae Yom river.

The area is covered by various types of forest. The lowland and upland are covered with deciduous dry dipterocarp forest, while its highland is mostly covered with mixed deciduous forest and hill evergreen forest. The mixed deciduous forest is presently degraded. Classified by land slope and type of its forest, and approved by the government, the basin has 5 classes; the same area fits into four land-use categories (Table 1).

Soil

Most soil series in the area are sandy clay loam, clay loam and clay. All soil series dispersions are higher than 10, which shows that it is easily eroded, especially the soil in uplands. Thus, soil has a rill and gully surface. Soil fertility is very high in the lowland and very low in the upland.

Table 1 Classification of land in the Mai Lai watershed.

Category	Area (rai)
Classification by Slope/Forest type	
1. First class (watershed and conservation forestry)	74,246
2. Second class (commercial forestry)	54,424
3. Thirdclass (commercialforestry andfruit trees)	31,358
4. Fourth class (cropping field)	14,946
5. Fifth class (flat/paddy field)	43,776
Total	218,750
Land-use Classification	
1. Agricultural land	56,530
2. Pasture	21,750
3. Forest	136,970
4. Others	3,500
Total	218,750

Climate

It is rather dry with a similar humidity all over the area. There is more rainfall in the upland than in the lowland. The climate is influenced by the southeast monsoon (May - October) because the area is located at the upper north of Thailand. Temperature is around 23-33oC. Rainfall is on average 1,088 millimeters and 121 rainy days per year; 90% of the rainfall comes in August and September.

Cropping pattern (1988)

Most irrigated areas (6,300 rai or 87.8%) were planted to paddy, and the remainder (9.4%) was planted to soybean, mungbean and others in the wet season. In the dry season, most areas (46.9%) were planted to soybean and 4.5% to others. Fruit trees occupied 1.3% of the land and fallow 5.7%. Cropping intensity was 150%.

On non-irrigated areas (16,100 rai), since the water supply was not sufficient, the paddy area was only 28.9%, soybean 20.3%, maize 11.5%, and others 7.2% in the wet season. In the dry season, the planted area was only 12.5% (soybean 10.3% and others 2.2%). There were fruit trees 1.9% and fallow land 33.8%. Cropping intensity was only 82% because of insufficient water supply.

On watershed areas, the paddy area was 2.2%, soybean 49.9%, maize 30.6% and others 6.7%. There were fruit trees (0.2%) and fallow fields (12.7%). Cropping intensity was 90%.

Resource management practices

The farmers in the ADPIP area implemented some resource management methods for soil and water conservation. They are summarized below.

Reforestation

Teak trees were planted in damaged areas in the class I and II watershed. The area of cultivated teak trees was 6,478 rai below the project target (52,806 rai). The unit cost was 1,448 baht/rai. Seedlings were produced in plastic bags (4"x4" size) in nurseries nearby the planting areas. The planting area was prepared by cleaning all weeds and staking 4x4 meters spacing (100 trees per rai). The planting time was in the rainy season.

Check dam construction

This measure was useful for sediment trapping and increasing stream flow to reduce flooding in downstream areas in the rainy season. The number of check dams constructed was 10 units less than the target (27 units). Unit cost was 10,000 baht for construction of a simple check dam.

Establishment of forest fire breaks

Forest fire was an important threat to the watershed. It is necessary to construct forest fire breaks to prevent uncontrolled spread of forest five for watershed protection. Forest fire breaks with 6-12 meters width were set up around forest areas larger than 100 rai by weeding and hoeing or using tractors. Total establishment of forest fire break was 93 km more than the project target (53 km). The unit cost was 2,105 baht/km.

Access road improvement

The measure was important to keep roads open all year. The high slope roads were easily damaged and immediately needed to be improved to prevent more damage. The amount of road improvement was 69 km less than the project target (184 km). The unit cost was 10,970 baht/km.

Promotion of improved fruit tree planting

Improved fruit trees (mango and sweet tamarind) were given to farmers for planting in cultivated upland areas. Total fruit tree plantation was 4,120 rai lower than the project target (40,000 rai). The unit cost was 441 baht /rai.

Demonstration of soil and water conservation

The total demonstration area was 647 rai greater than the target (600 rai) but less than the damaged area of more than 50,000 rai. There were three measures as follows:

* *Hillside ditch:* Ditches were built along hillsides and planted with fruit trees (mango and sweet tamarind) every 10 meters. Soybean and mungbean were planted between each ditch (10 meters). The unit cost was 5,022 baht/hectare.
* *Ruzi grass strip:* Ruzi grass was planted along hillsides as a buffer strip and fruit trees (mango and sweet tamarind) were planted along the grass strip every 10 meters. Soybean and mungbean were planted between each grass strip (10 meters). The unit cost was 3,630 baht/hectare.
* *Pigeonpea strip:* Pigeonpea was planted along hillsides as a buffer strip. Fruit trees (mango and sweet tamarind) were planted along the pigeonpea strip every 10 meters, and soybean and mungbean were planted between each pigeon pea strip (10 meters). The unit cost was 2,942 baht/hectare.

Sample farmers did not follow the project directions. The main reason was that they were not familiar with these measures they and needed high investment for construction and a lot of labour input for maintenance.

Impact of resource management treatment

To determine the impact of resource management treatment for upland soil and water conservation, it is necessary to measure the effect of their treatments for soil erosion, water conservation and soil fertility. The following discusses the results of the pilot demonstration sites which were established by the Department of Land Development for the project. In the study there were five soil conservation treatments at the Mae Lai tributaries watershed since 1989 as follows: i) mixed deciduous and dry dipterocarp forest, ii) planting soybean and mungbean without conservation measures, iii) planting soybean and mungbean with soil and water conservation measures by building ditches along hillsides, planting fruit trees (mango and sweet tamarind) along ditch every 10 meters and between each ditch (10 meters) planting soybean and mungbean,

iv) planting soybean and mungbean with soil and water conservation measures by planting ruzi grass along hillsides as a buffer strip, planting fruit trees (mango and sweet tamarind) along the grass strip every 10 meters, and between each grass strip (10 meter) planting soybean and mungbean, and v) planting soybean and mungbean with soil and water conservation measures by planting pigeonpea along hillsides as a buffer strip, planting fruit trees (mango and sweet tamarind) along pigeonpea strips every 10 meters, and between each pigeonpea strip (10 meters) planting soybean and mungbean.

Soil erosion of the treatments is shown in Table 2. There were only two treatments with the levels of soil erosion below the tolerable erosion level (acceptable soil erosion value of 4.5 tons/ha/year at rooting depth of 40-60 cm for soil favorable substrata). They are the forest watershed and the cultivated watershed after construction of hillside ditches (treatment i and iii) with soil erosion, rates of 0.427 and 2.806 tons/ha/year.

It is clear that without proper soil and water conservation methods, such as forest or hillside ditches, planting annual crops including soybean and mungbean in upland areas would cause serious degradation by soil erosion, which would result in an adverse impact on the development of sustainable upland agriculture.

Table 2. Impact of use and soil and water conservation treatments on soil erosion.

Treatment	Soil erosion (ton/ha/year)
Forested watershed	0.427
Cultivated watershed without conservation measures	5.770
Cultivated watershed:	
- before built hillside ditch	9.266
- after built hillside ditch	2.806
Cultivated waterside with ruzi grass strip	5.215
Cultivated waterside with pigeonpea grass strip	5.268

Source: Department of Land Development 1989.

Socio-economic aspects of farming systems for sustainable upland agriculture

Farm household

There were 3.84 persons/household on average in 1995, 0.4 persons fewer than the household size in 1988 (4.24 persons/household). The main reason for the decrease of farm family size is migration off farm to other sectors. The gender ratio was male 51.04% and female 48.96% in 1995, which might indicate more female labour movement off farm.

The majority of farm household members are 14-60 years old. Most household heads were between 31 and 60 years of age. Farm household members are older in 1995 compared to 1988; the proportion of younger people (31-40 years of age) has decreased from 25.84% to 8.00% and the older generation (41-50 and over 60 years of age) has increased from 29.12% to 44.00% and from 20.33% to 28.00% respectively. This indicates that the average age of farm household members in 1995 is greater than in the 1988.

Most farm household heads were educated to primary 4-6 level. The level of education of farm household members is increasing as seen in Table 3. The proportion with no schooling at all decreased from 13.19% to 12.00%, and that with more than middle school 1 level increased from 6.04% to 12.00%. This indicates that the higher education level will be effective in strengthening upland agricultural development.

The average labour force per farm household was 2.80 persons in 1995, about 31% less than that in 1990 (4.04 persons/household). Out of this, 40% worked as full time labourers and 41.43% were part time workers for farm activities in 1995. These figures indicate a decrease of 23.61% in the full time labour force (63.61% in 1990) and an increase of 25.09% in the part time component (16.34% in 1990). This shows that the number of persons who are working off farm is increasing. This change in the labour force working in the farming sector will impact to force more labour-saving farming technology or crops and mechanization of farm management.

Table 3 Farm household size, gender composition, age and education in 1990 and 1995.

Description	1990 (%)	1995 (%)
Household size	4.24 persons	3.84 persons
Gender composition		
male	48.35	51.04
female	51.65	48.96
Age (years)		
Household member		
under 14	28.16	25.35
14 - 60	67.69	73.24
over 60	4.15	1.41
Household head		
31 - 40	25.83	8.00
41 - 50	29.12	44.00
51 - 60	24.72	20.00
over 60	20.33	28.00
Education		
no school at all	5.05	2.82
lower than P.4	22.56	16.90
P.4-P.6	56.50	59.15
higher than MS.1	15.89	21.13
Labour force	4.04 persons	2.80 persons
Use of labour force on farm		
full time	63.61	40.00
part time	16.34	41.43
none	20.05	18.57

The average land holding per farm household in 1995 was 9.39 rai. Of this, 8.12 rai was for cultivation (paddy 5.52 rai, field crops 0.44 rai and fruit trees 2.16 rai) as shown in Table 4. Most land was owned by the farm household in 1995, on average 8 rai per household (85.20%). Only 1.38 rai per household was rented land (14.70%). Land title was established on all of the land, compared to 1990 when only 64.35% was under title. Farmers are willing to invest to improve their land because most of the land was owned and farmers held title to all of the land.

Changes in cropping systems

Before the project in 1988/89, all farm households planted a mono-crop in the wet season (Table 5). They could not plant any crops in the dry season because of lack of water. They planted mainly rice (72%), soybean (8%), maize (8%) and fruit trees (8%).

After the project in 1994/95, farmers could plant crops in the wet season and even in the dry season on some of their lowlands with the availability of water. The land use for farming in the wet season was 5.72 rai on average per household, an increased of 1.35 rai above that in

Table 4 Land holding, tenure and title by farm household at the study site.

Description	1990		1995	
	rai/household	percent	rai/household	percent
Land holding				
Residential	0.61	7.24	0.51	5.43
Cultivation	7.55	89.67	8.12	86.48
Pady	3.50	41.57	5.52	58.79
Field crop	3.50	41.57	0.44	4.69
Fruit tree	0.55	6.63	2.16	23.00
Idle land	0.26	3.09	0.76	8.09
Total	8.42	100.00	9.39	100.00
Land tenure				
Owning	7.32	86.94	8.00	85.20
Rented	0.60	7.12	1.38	14.70
Free of charge	0.50	5.94	0.01	0.10
Land title				
Have title	4.71	64.35	8.00	100.00
No title	2.61	35.65	-	-

1988/89 (4.36 rai/household). This resulted from the assurance of water availability even in the wet season after completion of irrigation in the lowland. They planted rice (5.28) rai, soybean (0.20 rai), groundnut (0.12 rai), and roselle (Hibiscus sabdariffa; stem fibre used as a jute substitute) (0.12 rai). In the dry season, farmers could plant crops in lowlands such as soybean which they could not plant before the project. On average, 0.48 rai per household of soybean was planted after the project. This double cropping in the dry season could be responsible for the decrease of soybean planting to 0.20 rai on average (around 37.5%) mainly in upland areas. Planting of groundnut and roselle instead of maize in the wet season may be due to the profitability of these crops, which indicates more market oriented farming rather than subsistence farming.

One other change in farming systems is the increase in planting of fruit trees to 1.08 rai per household from 0.90 rai/household. The effect of planting fruit trees such as mango and sweet tamarind along ditches was confirmed to be efficient for soil conservation in the research by the Department of Land Development. The farmers surveyed proved the impact of this result by increasing the area for fruit trees especially in the upland hillside areas. When the fruit trees mature and bear fruit at full capacity, they will contribute to increased farm income from sales of fruit in markets.

As a result of this farming systems change, the average cropping intensity in 1994/95 was 89.65%, 24.87% higher than the value of 64.78% in 1988/89. Thus, farmers could plant more crops in both the wet and dry seasons and more fruit trees after the project because there was increased irrigated water supply from the Mae Kham Pong sub-project (Table 5).

Table 5 Land utilization and cropping intensity in 1988/89 and 1994/95.

Land utilization	1988/89		1994/94	
	rai/ household	percent percent	rai/ household	percent percent
Wet season	4.36	82.89	5.72	78.57
Rice	3.80	72.25	5.28	72.53
Soybean	0.32	6.08	0.20	2.74
Groundnut		-	0.12	1.65
Roselle		-	0.12	1.65
Maize	0.24	4.56		
Dry season			0.48	6.59
Soybean			0.48	6.59
Fruit trees*	0.90	17.11	1.08	14.84
Total land utilization	5.26	100.00	7.28	100.00
Cultivation land holding	8.12		8.12	
Cropping intensity (%)		64.78		89.65

* Mango, sweet tamarind and banana.

Inputs for farming

Farming inputs of the sample farmers were surveyed. For rice production farmers used seed (9.80 kg/rai), chemical fertilizer (11.38 kg/rai), and manure (178.26 kg/rai). For soybean production, they used only seed (15 kg/rai) and chemical fertilizer (30 kg/rai). For groundnut, only seed was used at 33.33 kg/rai and for roselle only 0.03 kg/rai. In the dry season, they used a little less soybean seed (13.08 kg/rai) and chemical fertilizer (23.50 kg/rai) than in the wet season. Seeds are mainly improved varieties introduced by the project for rice and soybean. Data on inputs before the project were unavailable due to the lack of records of remembrance by the farmers surveyed. The amounts of chemical fertilizer and pesticide inputs are relatively low with an increasing trend of use.

Labour inputs were 12.71 man-days for rice, 14.20 man-days for soybean, 13.33 man-days for groundnut, and 6.11 man-days for roselle per rai in the wet season in 1994/95 (Table 6). In the dry season, soybean used less labour than in the wet season. Those labour inputs came from family, exchange and hired sources. Exchange labour is the main source and the next family labour.

Table 6 Use of labour in crop production in 1994/95 by study farmers.

Crop	Labour (man-day)			
	Family	Exchange	Hired	Total
Wet season				
Rice	2.15	9.65	0.91	12.71
Soybean	0.20	14.00		14.20
Groundnut	5.33	8.00		13.33
Roselle	6.11			6.11
Dry season				
Soybean	4.62	5.17		9.79
Total	18.41	36.82	0.91	56.14
	(32.79)	(65.59)	(1.62)	(100.00)

Yield

After the project, there was more irrigated water from the Mae Kham Pong sub-project, which contributed to increased yields of crops (Table 7). Rice increased 50.9 kg/rai to 585.65 kg/rai from 534.75 kg/rai. Groundnut increased from 75 kg/rai to 83.33. For soybean the yields were different according to the season. In the dry season, yield increased 47.94% to 225.08 kg/rai in 1994/95 from 152.14 kg/rai in 1988/89. However, the yield in the wet season decreased to 82.40 kg/rai from 158.26 kg/rai. It is presumed that the yield differences are caused by the availability of water during the growing season. It was increased in the dry season by sufficient irrigation water, but in the wet season, the decrease in yield might be influenced by a lack of water mainly in upland areas of cultivation.

Table 7 Yield of crops in 1989/90 and 1994/95 of the study farmers.

Crop	Yield (kg/rai)		B/A (%)
	1989/90 (A)	1994/94 (B)	
Wet season	534.75	585.65	109.5
Rice	158.26	82.40	52.1
Soybean	75.00	83.33	111.1
Groundnut	-	37.00	-
Roselle	390.78		
Dry season	152.14	225.08	147.9
Soybean			

Income

The income of farmers from crop cultivation in the project area in general increased after the project compared that of before the project. Rice income was increased 370 baht per rai to 2,782 baht after the project from 2,412 baht before the project in the wet season. Soybean in the dry season increased income 490 baht to 1,810 baht from 1,320 baht per rai. For the sample farmers surveyed in this study, the income per rai in the wet season of 1994/95 was 2,130 baht for rice, 659 baht for soybean, 500 baht for groundnut and 667 baht for roselle. Soybean in the dry season brought an income of 1,179 baht per rai, much higher than that of the wet season, mainly due to the higher yield in the dry season.

Income per household from crop cultivation in 1994/95 was higher than income from crops in 1988/89. This increase in income was attributed to the availability of crop cultivation, such as soybean in the dry season, and the increase in yield. Farmers earned more income (3,738 baht per household) from farming activities other than crop cultivation, such as livestock, fisheries, fruit trees and mushroom growing. The income from livestock was 832 baht, fisheries 26 baht, fruit trees 1,920 baht and mushrooms 960 baht.

Most households kept sufficient rice for home consumption and sold the rest. Other farm products were all sold to local merchants or agricultural cooperatives at prices influenced by the overall conditions of demand and supply in the country. In view of increasing production of commercial crops such as horticultural crops, farmers need more information on price, marketing, supply and demand to make planting decisions. Transportation from farm to market was not difficult because of good road conditions to the villages.

Income from off-farm activities in 1994/95 was much higher at 54,004 baht than the 10,841 baht in 1988/89. Most of this income came from non-farm employment (25,168 baht) and trading (13,176 baht). The rest came from monthly wages, handicrafts, gift from children, rent and others (Table 8).

Table 8 Income of sample farmers from off-farm activities in 1988/89 and 1994/95.

Component	Off-farm Income (baht/household)	
	1988/89	1994/95
Employed in non-farm work		25,168
Monthly wage earning		8,648
Trading		13,176
Handicrafts		2,740
Gift from children		1,520
Rent		1,440
Others		1,312
Total	10,841	54,004

Sustainability of resource management

The experiment on soil and water conservation methods conducted by the Department of Land Development (DLD) in the ADPIP area revealed that only two treatments were below the tolerable erosion level. Those treatments were forested watershed and cultivated watershed with construction of hillside ditches. If the watershed area is cultivated without conservation measures, soil erosion reaches 5.770 tons/ha/year, higher than the acceptable soil erosion level of 4.5 tons/ha/year. In the survey of this watershed area, it was found that farmers practiced the soil conservation measures only in the areas of the experimental pilot project, becaused of the requirement for high inputs for construction of soil conservation measures, such as hillside ditches, which exceeded farmers availability of cash and labour. Farmers also worried about the need for maintenance of soil and water conservation measures, which would require a lot of labour input over a long period of establishment.

Farming systems in the project area were changed to double cropping in irrigated areas where crops such as soybean were grown during the dry season. This cropping system contributed to reduce the area of soybean during the wet season on the unfavorable upland where erosion problems easily occurred with cultivation. It could benefit soil and water conservation in the watershed area if this farming system change were sustained to increase lowland dry season cultivation instead of wet season upland cultivation.

Maize was not grown any more during the wet season. This crop was mainly for food consumption of farm families, not for sale in the upland areas before the project. After the project, farmers changed crops to more commercial-

oriented crops such as groundnut and roselle. This change might contribute to more effective soil and water conservation.

In view of the cultivation practices, the agricultural extension service agencies encouraged farmers to follow favorable techniques such as i) not using tractors for plowing and shallow ploughing, ii) not burning grass stubble, iii) cropping along contour lines, and iv) cultivating of crops with soil and water conservation methods, such as bean or grass strips (vetiver, ruzi grass), and hillside ditches.

Planting fruit trees, such as mango, sweet tamarind and banana, in the upland watershed areas may be included in the category of forested watershed, keeping soil erosion under the tolerable level. Planting these fruit trees in the watershed area, instead growing annual crops such as soybean or maize may contribute to soil and water conservation in the upland areas.

Livestock in farming systems contributed to soil and water conservation in two ways; i) producing manure which could be returned to soil; and ii) using the grass from the grass strips or hedgerows. In the survey, sample farmers used on average 178.26 kg of manure for rice cultivation, which could be produced by including cattle or poultry in the farming system. For maintaining soil fertility, it is very important to apply organic fertilizers such as manure which can be produced by livestock.

Sustainability of the farm economy

The title ownership of land by farmers was well established after the project. It is an important factor if farmers are to invest in soil and water conservation measures on their land. If land title were not registered or guaranteed, farmers would be reluctant to construct hillside ditches or hedgerows which cost a lot and have a slow return to investment. In this connection, it is also difficult to induce soil fertility improvement of land rented by farmers, who are seeking a short term profit rather than a long term investment.

Land utilization after the project in 1994/95 increased in the wet season as well as in the dry season because of the availability of irrigation water from the Mae Kham Pong sub-project. Cropping intensity increased from 64.78% in 1988/89 to 89.65% in 1994/95, utilizing more farm labour and contributing to increased farm household income.

The farm household labour force trend has been decreasing. The number of family members decreased and the proportion of aged members increased after the project. Off-farm activities are rapidly increasing as the economy of other sectors is developing much faster than that of the agricultural sector. These factors will compel more efficient use of farm labour and higher productivity in upland farming systems. It may be implied that farm labour cost will increase as the wage of the off-farm activities increases. Actually, farmers changed their farming systems to more profitable crops such as groundnut and roselle instead of maize, and also to lowland soybean in the dry season instead of upland cultivation in the wet season. The labour force must be equipped with more effective farm machinery in order to increase labour productivity.

Farm inputs, such as fertilizer, chemicals and improved variety seeds, were more widely used to increase the yield per unit of farm land and labour input. In subsistence farming such as in shifting cultivation which is commonly done in some mountainous areas, farmers mainly rely on the natural fertility of the soil itself for the yield. This cultivation practice may be maintained under conditions of low population pressure. However, with low productivity of land and destructive effects on soil and water conservation of farm land especially in upland areas, it is imperative to maintain the productivity level by using inputs such as chemical fertilizers and manure in upland farming. Considering the marginal productivity of such inputs in upland farming the optimum levels of inputs for maximum yield and sustainability for a long term basis should be determined by scientific approaches.

A yield increase is one factor that maintains sustainability of the farm economy in upland agriculture. The increase in yield of rice and soybean in the dry season of the surveyed farmers after the project was distinct. The factors related to this yield increase were not clear, but inputs of fertilizers, improved seeds and technical improvement of cultivation might have contributed jointly. The yield of soybean in the wet season decreased, contrary to that in the dry season. The reasons for this effect are not clear. Farmers may analyze the reasons for the yield decrease and will respond to prevent adverse effects to farming systems.

Average annual farm household income increased to 70,117 baht in 1994/95 from 22,671 baht in 1988/89, around three times higher than before the project. This increase originated mainly from off-farm activities, even with an increase in farm activities.

Conclusions

Resource management

The soil and water conservation measures in the ADPIP were reforestation, check dam construction, establishment of forest fire breaks, access road improvement, promotion of improved fruit tree plantation and demonstration of soil and water conservation. There were only two treatments of soil and water conservation from five treatments which were below the tolerable erosion level. They were forest watershed and cultivated watershed with construction of hillside ditches, treatments resulting in soil erosion of 0.427 and 2.806 tons/ha/year. Farmers did not follow the treatments of the project demonstration because they were not familiar with these measures and because of the need for high investment for construction and maintenance.

Socio-economic aspects

The average farm household consisted of 3.84 persons in 1995, fewer than in 1988 because of off farm migration. Most household members were 14-60 years old and educated to P.4 - P.6. The average labour force was 2.80 persons per household and 40% of them worked as full time labourers and 41.43% as part time farmers in 1995. The average land holding was 9.39 rai per household. Most land was owned land and all land was certified.

After the project in 1994/95, some farmers planted more crops both in the wet and dry seasons and more fruit trees because there was increased irrigated water supply from the Mae Kham Pong sub-project. Land use per household was 5.72 rai in the wet season, 0.48 rai in the dry season and 1.08 rai for fruit trees. Land use per household increased from 5.25 rai in 1988/89 to 7.28 rai in 1994/95. Cropping intensity increased from 64.78% in 1988/89 to 89.65 % in 1994/95.

Most crop yields increased from 1988/89 to 1994/95. Rice increased from 534.75 kg/rai to 585.65 kg/rai; groundnut from 75 kg/rai to 83.33 kg/rai, and soybean in the dry season increased from 152.14 kg/rai to 225.08 kg/rai.

In 1994/95, total income per household was 70,117 baht which originated from farm activities (16,113 baht) and off-farm activities (54,004) baht. Total expenditure was 38,585 baht per household, which consisted of 14,115 baht for farm activities and 24,470 baht for household expense. Net return was 31,532 baht per household, higher than in 1988/89.

Constraints and prospects of sustainable resource management

Inadequate land holding and lowland

Farmers in the project area had inadequate land for cultivation. They moved to plant in the watershed area destroying forest by shifting cultivation and illegal logging to increase income. This is one important factor in natural resource degradation.

Lack of proper soil and water conservation

In watershed areas, most farmers planted crops without soil and water conservation, except for the farmers in the experimental demonstration areas. The level of soil erosion was higher than the tolerable erosion level in areas without proper soil and water conservation measures. The main reason that farmers did not follow the soil and water conservation measures was that they were not familiar with these measures and they required high investment and labour for construction and maintenance.

Decrease of cultivation in watershed areas

With the availability of irrigation water after the project, double cropping of such crops as soybean, groundnut and roselle in lowland resulted in a decrease of upland crop cultivation. Crops such as soybean and maize in the wet season on upland caused high levels of soil erosion. If farmers could earn more from intensification of lowland farming, including high value crops, livestock and fisheries, they might reduce crop cultivation in upland areas.

Increased soil and water conservation measures in upland

If farmers reduce crop cultivation and increase planting of fruit trees soil and water conservation may be improved. Farmers should be introduced to soil and water conservation measures and their benefits to their resource management and farm economy through demonstration projects and extension programs.

Options for policy and further research

Promotion of reforestation

It is very important to improve natural resources by promotion of reforestation. It is especially urgent in the areas where natural forests were destroyed by shifting cultivation through slash and burn practices or illegal logging. In the project area alone, this reached around 50,000 rai of forest requiring reforestation. The effect will be recovery of the natural resource sustainability.

Promotion of soil and water conservation

Severe soil erosion occurred in watershed areas because forests were destroyed and crops were cultivated without proper soil and water conservation measures in upland areas. If this cultivation practice continues, the result may be detrimental for maintaining sustainability of soil and water resources in the area. It is essential to prevent further increases in the level of soil erosion and even to restore the soil productivity level by improving soil fertility and water conservation. If the measures for soil and water conservation require greater inputs than farmers can afford, government agencies should find ways to help farmers. Considering the high input costs for construction of soil and water conservation measures such as making terraces, subsidy from the government budget is one key factor to motivates farmers to participate in the soil and water conservation program.

Promotion of agricultural development in lowland

This activity is very important to reduce cultivation of crops in watershed areas, especially shifting cultivation. One of the important causes of deforestation was the lack of land for cultivation to earn sufficient income. If the income from lowland cultivation through intensive farming were sufficient, the need to cultivate upland areas would decrease. An increase of income was achieved by double cropping such crops as soybean, groundnut and roselle in the lowland during the dry season after completion of the irrigation system. This resulted in reduced cultivation of maize in the wet season in uplands, which are more susceptible to soil erosion. With the intensification of more profitable crops, such as horticultural crops and inclusion of livestock and fisheries in the farming systems, farmers can earn more income and the need to cultivate the upland areas will be reduced.

Conservation-friendly cultivation practices

Farmers can reduce soil erosion when cultivating upland areas by using soil and water conservation friendly practices or techniques. Among these, use of only small machines for ploughing, use of small hoes and not burning the grasses on hedgerows are examples of soil and water conservation. The extension agencies encourage of farmers to follow such practices in their farming. The construction of check points to prevent heavy machinery use in upland agriculture is effective in controlling the movement of these machines from lowland to upland areas.

CGPRT Centre News and Activities

Market Prospect of Upland Crop Products and Policy Analysis in Selected Countries in Asia

The Centre started this project in September 1994 aiming to identify the market opportunities of upland crop products and policy directions to increase farm income from them. Seven countries: India, Indonesia, the Philippines and Thailand for the first year group and China, Pakistan and Vietnam for the second year group, are participating.

From 27 to 29 September 1995, the Centre held the draft report meeting of the first year group in Bogor with the attendance of Dr. Boonjit Titapiwatanakun, Kasetsart University, Thailand, as the regional advisor of the project. At the meeting each national expert from the four participating countries presented a country report on domestic food consumption, the domestic demand of upland crop products, their market potentials and policy recommendations.

Regarding domestic food consumption, the Thai and Indian national experts reported similar significant shifts from the traditional food consumption pattern to a new dietary pattern with a greater use of fruit, vegetables and livestock products. The Indonesian national expert also reported that the consumption of fish, meat, egg and milk and prepared food as well as dining out was rapidly increasing, although significant change was hardly found in the national statistics on food consumption in the last ten years. In the Philippines, demand projections expected that the demand of major upland crop products would increase, in particular demand from the livestock and food processing sector reflecting the changes in dietary patterns as well as the high growth rate of income and population.

After review of the existing policy measures concerned and market structures of upland crop products in those countries, analyses on the following new/emerging products were reported: mango, grape, apple, onion, mango pulp and mushroom in India; cabbage, mango and potato in Indonesia; cut flowers, yam and fresh young coconut in the Philippines; longan, durian, mangosteen and baby corn in Thailand. Moreover, case studies of three successful and three failed attempts for improving market potentials in each country were introduced and discussed.

The last day the participants discussed necessary policy measures for improving the market potentials of upland crops in the region and confirmed that the issues listed below should be emphasized:

* increased investment in research and extension for yield augmentation;
* strengthening of linkages between production, processing and export;
* generation of adequate infrastructure, e.g., roads, storage, cooling, processing and shipping facilities;
* provision of market information and marketing support;
* higher domestic prices for upland crop products;
* efforts to promote domestic consumption of processed products;
* .enforcement of the private sectors involvement and establishment of more business oriented cooperatives;
* efficient post-harvesting handling and grading, and development of high quality products to the export market;
* better access to low cost credit; and
* provision of high quality planting material along with rejuvenation of existing orchards.

Based on the discussions at the meeting, the country reports will be finalized and submitted to the Centre in due course. The planning meeting of the second country group will take place in December 1995.

Book Review

Prices, Products and People: Analyzing Agricultural Markets in Developing Countries

Editor: Gregory J. Scott. Boulder Colorado: Lynne Rienner Publishers, Inc.

Population growth, rural-urban migration, technological innovation, environmental concerns, and policy shifts - both domestic and international - are but a few of the more prominent factors introducing new pressures to which markets must respond. This book addresses the critical task of understanding these ongoing changes and responding with effective marketing arrangements.

The authors go beyond the traditional presentation of economic principles, offering instead a series of applied methods for data collection and analysis. Drawing on extensive experience in Africa, Asia, and Latin America, they not only describe specific procedures, but also provide a wealth of illustrative research results. This book will be particularly useful to teaching professionals, development specialists, and applied researchers working in developing countries.

Research techniques

Nearly all the chapters include examples of the application of research techniques to specific commodities based on research in different developing countries around the world. The intent here is to enrich the general exposition of a series of methods with an array of commodity-specific experiences involving their use. Those readers with a working knowledge of agricultural marketing research in Africa, for example, may well find the procedures based on studies in Latin America or Asia thought-provoking. In this regard, many of the authors also include an assessment of the strengths and weaknesses of the methods described and/or some all-too-rare reflections on the methodological lessons learned from marketing research in a developing country context based on their years of experience.

The methods for agricultural marketing research presented in this volume cover both field and analytical procedures (Table 1). The field methods have a stronger bent towards data collection procedures, whereas the analytical methods are more focused on interpretation of quantitative information. In actual practice, this arbitrary distinction between the two types breaks

Table 1 Methods for agricultural marketing research.

Author	Framework	Commodity	Country
Morris	Sub-sector	Maize	Paraguay
Holtzman et al.	Sub-sector	Sorghum, maize	Mali ,
Shapiro & Staal	PAM	Dairy marketing	Kenya
Loveridge	Sub-sector	Beans	Rwanda
Scott	Food system	Table potato	Peru, Bangladesh, Burundi
Porter	Geography/economic anthropology	Various	Nigeria
Pomeroy & Trinidad	Industrial organization	Fish	Costa Rica, Philippines, Malaysia
Immink et al.	Household models	Vegetables	Guatemala
Scott	Institutional	Processed products	India, Peru, Colombia
Della Vedova & Brieva	Input demand	Seed potato	Argentina
Mendoza	Marketing margin analysis	Potato, tomato	Dominican Rep., Bolivia, Chile
Tschirley	Time-series price analysis	Rice, maize	Ecuador
Harriss	Static and dynamic margin analysis	Cotton, groundnut, rice	India
Goletti	Horizontal price integration	Rice, maize	Bangladesh, Malawi
Mendoza & Rosegrant	Bivariate autoregressive model	Copra	Philippines
Ostertag & Wheatley	Financial accounting	Cassava	Colombia
Goetz	Selectivity models	Coarse grains	Senegal
Fuglie	Partial equilibrium model	Potatoes	Tunisia
Krishnaiah	Spatial equilibrium models	Rice, sorghum, pulses	India
Jeffrey and Faminow	Linear programming	Wheat	Canada
Piggot	Equilibrium displacement model	Rice	Indonesia

down. Field work also requires analytical procedures, if not to analyze data, then to systematically organize their collection as well as to ensure congruence between the theoretical concepts employed and the empirical measures being used to quantify them. In the same way, data analysis of marketing phenomena that is not grounded in a firm understanding of how and why the figures were collected in the first place is subject to some serious errors of interpretation.

With that caveat and given that typically agricultural marketing research requires first data collection and then data analysis, the first part of this book concentrates on field methods and the second on analytical methods.

The book will be a welcome contribution in the field of market research, and it provides a good basis for strengthening the understanding of how agricultural markets actually work.

International Courses

Training Course in Quality Control Technology for Legume Inoculant Production

5 - 10 February 1996 Suranaree University of Technology, Nakhon Ratchasima, Thailand

Presented by the BNF Regional Center, Suranaree University of Technology, in cooperation with the University of Hawaii, NifTAL Center.

The course will combine lectures, discussion, and hands-on exercises in qualitative and quantitative microscopic, enumerative, culture and serological procedures for quality control of legume inoculants in a production setting. Participants will be able to design QC protocols for their own facilities.

For further information, please contact:
Dr. Nantakorn Boonkerd
Institute of Agricultural Technology
Suranaree University of Technology
111 University Avenue
Nakhon Ratchasima 30000, Thailand
Fax: 66-44-216-102

IIRR International Training Courses, 1996-1997

The International Institute of Rural Reconstruction offers regular, international training courses on a range of topics. These courses are designed for development managers and leaders and focus on field experience and participatory approaches.

Applying indigenous knowledge in development
3 weeks September 30 - October 18, 1996; September 29 - October 17, 1997

Designed for development practitioners and managers in Asia interested in incorporating indigenous knowledge approaches into development activities. The course will analyze the characteristics, strengths and limitations of indigenous knowledge, focusing on the value of such knowledge as a resource for development.

Development approaches in the third world: a critical review
2 weeks October 7 - 18, 1996; October 13 - 24, 1997

For senior officials and planners in rural development organizations. The course emphasizes data - what is actually happening, rather than theories of what should be happening. It promotes the sharing of information and an understanding of how we can use the experiences of almost half a century of development efforts.

Development communication
4 weeks February 26 - March 22, 1996; February 24 - March 21, 1997

Designed to assist program managers and trainers who wish to integrate communication approaches into field programs and training activities. The course includes hands-on experience with video, desktop publishing, slide-tape programs and such "small media" as posters and flip charts.

Environmental management: Integrated conservation and development
3 weeks March 18 - April 5, 1996; March 10 - 28, 1997

Designed for managers of integrated conservation and development projects. The course will focus on the design and implementation of projects that attempt to integrate local resource use with the conservation of biodiversity.

Gender analysis in agriculture, forestry and natural resources
3 weeks September 16 - October 4, 1996; May 5 - 23, 1997

Designed for men and women involved at different levels in the planning, research and implementation of programs and projects relating to agriculture, forestry and natural resources. The course will cover gender concepts in agriculture, forestry and natural resources; methodologies and skills for gender analysis, and developing gender-responsive projects and programs.

Household food security through home gardening
3 weeks November 25 - December 13, 1996; November 24 - December 12, 1997

For participants with experience in rural or peri-urban development, with emphasis on gardening or family food production. Participants design and implement gardening programs that address the nutritional and economic needs of the poor.

Regenerative agriculture
4 weeks September 2 - 27, 1996; September 1 - 26, 1997

For project managers, trainers and extension supervisors with government and non-government organizations. Participants learn a range of environmentally sensitive, low-cost and sustainable techniques appropriate to poor families.

Rural development management
4 weeks April 8 - May 3 and August 5 - 30, 1996; April 7 - May 2 and August 4 - 29, 1997

For senior and midlevel development managers. This course covers development issues, managing sustainable and people-centered development programs and managing a development organization.

Training of trainers on sustainable agriculture
3 weeks July 8 - 26, 1996; July 7 - 25, 1997

Designed for development practitioners who organize or conduct training on sustainable agriculture and related topics. Participants will develop their own training designs and present one of the topics they have developed.

For further information, please contact:
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6th International Course on Food Processing

International Agricultural Centre Wageningen/the Netherlands

Quality Assurance and Marketing
August 11 - November 16, 1996

This programme aims to broaden participants' views on problems of small and medium scale food processing, to upgrade participants' knowledge concerning the analysis of problems and the selection of appropriate technologies, and to impart techniques for the implementation of selected technologies, focusing on quality assurance and marketing.

Fortification Management
October 6 - November 16, 1996

This programme aims to provide participants with insight and views on how to develop and refine the skills to promote and manage the fortification of strategic foods with micronutrients for national programmes and to create acceptance of food fortification among concerned groups, i.e. the government, private enterprises and consumers.

26th International Course on Vegetable Production

Selected Topics in Vegetable Production

August 11 - November 16, 1996

International Agricultural Centre
Wageningen/the Netherlands

The course intends to extend and deepen participants' knowledge of vegetable growing and to acquaint them with various production and post harvest aspects. The course aims at providing participants with information, tools and insights on how to make farmers achieve the vegetable production potential and to acquaint them with post harvest aspects such as handling and marketing.

45th International Course on Rural Extension

June 09 - July 06, 1996

and

International Course on Rural Extension and Specializations

June 09 - July 20, 1996

International Agricultural Centre
Wageningen/the Netherlands

ICRE is offered each year in an English and a French version. To accommodate their personal interests, candidates for ICRE/English 1996 will be offered four course options. All options consist of the three-week core course in Rural Extension, followed by either a one-week extension or a three-week specialization. The options are:

1. a four-week option from 09 June to 06 July. It consists of the core course and a one-week extension on Issues in Extension Management;
2. three six-week options from 09 June to 20 July. They include the core course and one of the following three-week specializations:
   a. Management of Extension Programmes;
   b. Training of Trainers in Extension Work;
   c. Research-Extension-Farmer Linkages.

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CGPRT Centre

The Regional Co-ordination Centre for Research and Development of Coarse Grains, Pulses, Roots and Tuber Crops in the Humid Tropics of Asia and the Pacific (CGPRT Centre) was established in 1981 as a subsidiary body of UN/ESCAP.

Objectives

In co-operation with ESCAP member countries, the Centre will initiate and promote research, training and dissemination of information on socio-economic and related aspects of CGPRT crops in Asia and the Pacific. In its activities, the Centre aims to serve the needs of institutions concerned with planning, research, extension and development in relation to CGPRT crop production, marketing and use.

Programmes

In pursuit of its objectives, the Centre has three programmes which are mutually supportive:

1. Research, which entails the preparation and implementation of studies covering production, utilization and trade of CGPRT crops in the countries of Asia and the South Pacific.
2. Training of national research and extension workers,
3. Information and documentation which encompasses the collection, processing and dissemination of relevant information for use by researchers, policy makers, and extension workers.

Palawija News

Contributors are invited to submit concise summaries of significant social research related to CGPRT crops for publication. Figures (graphs or tables) may accompany the article. All articles are subject to editing to meet space limitations.

Please send all queries relating to articles in *Palawija News* to Publications Section, CGPRT Centre, Jalan Merdeka 145, Bogor 16111, Indonesia.

Palawija News is distributed free of charge to interested individuals and institutions. Please send address corrections and additions to the Distribution Officer, Publications Section.

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Palawija News
Volume 12, Number 3