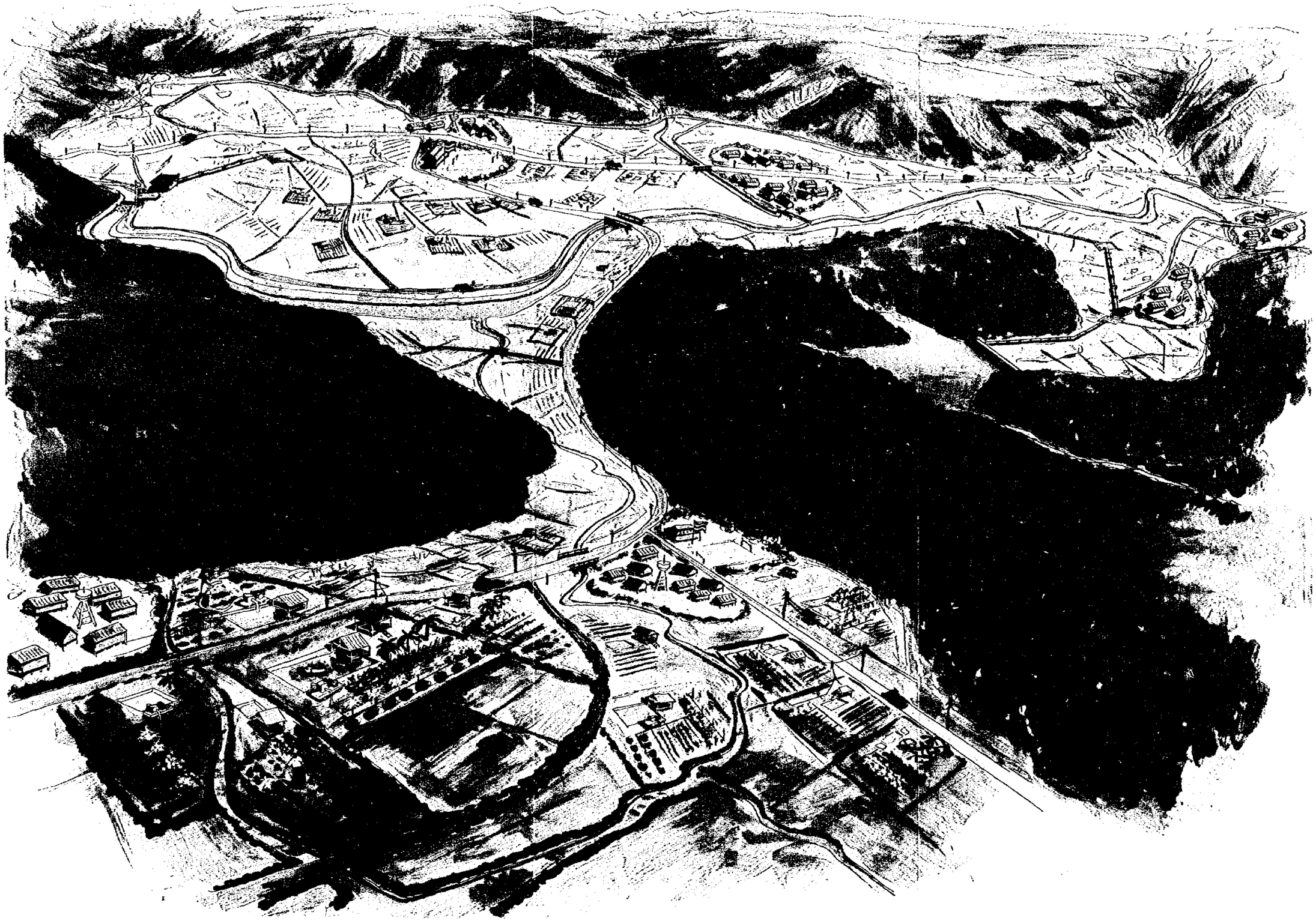
CHAPTER 10 MUKDAHAN PRIORITY AREA (No. 8-2 LRA)

INTEGRATED AGRICULTURE DEVELOPMENT IN MUKDAHAN PRIORITY AREA
(MKD-8.2 LRA)

The Feasibility Study on The Integrated Agriculture Development in The Agricultural Land Reform Areas in The Upper Northeastern Region, The Kingdom of Thailand
ALRO (MOAC), JICA, March 1998 (SANYU Consultants INC.)



CHAPTER 10 MUKDAHAN PRIORITY AREA (No. 8-2 LRA)

10.1 Present Condition of the Area

10.1.1 Location, Area and Population

The Mukdahan Priority Area is located in the northeastern border part of Mukdahan Province about 65 km. from Mukdahan. Road No. 2287 from Ban Khan Luang to Ban Khok Toom in Amphoe Dong Luang runs from east to west through the middle of the area. The Priority Area is covered by the sub LRA, MKD 8-2, Dong Phu Phan Forest in Tambon Phang Daeng, Amphoe Dong Luang with the total land area of 10,700 rai. The area is mostly surrounded by the mountains/hills, covering seven villages in Tambon Phang Daeng. The farm land is estimated at 8,600 rai with an average farm size of 13 rai per household.

These villages have the population of various ethnic origins and dialects, such as Phu-Thai, Thai Ka, Thai So and Thai Yor. These people migrated from what is now the Loa People's Democratic Republic to settle in this area about 100 years ago. The total number of households is 732, with a total population of 3,835 and an average family size of about five person per household.

A little more than half of the total villages in the Priority Area has between 300 - 500 people and the number of households is less than 100. Most villages in the area are below the development line. It has been found that about 57 per cent of the population have no education, 40 per cent have primary education and 3 per cent have secondary education. The landholding farmers in the priority area is estimated at about 660 while total household are about 730 in the concerned 7 villages. From this fact, almost landholding farmers in the priority area live in the 7 villages.

The names of villages, population, households, average family size per household and village land area in the Mukdahan Priority Area can be summarized as follows.

Table 10.1-1 Adiministrative Summary of MKD-8.2 Priovity Area

Province / Amphoe	Tambon	Village	Muban	H.H	Population	Ave. Family Size (person/H.H)	Villageland [1] (rai)
Mukdahan Dong Luang	Phang Daeng	Phang Daeng	1	177	970	5.48	2,540
		Tiu	3	163	731	4.48	948
		Na-Lak	4	65	389	5.98	1,000
		Nong Mu	5	96	570	5.94	1,600
		Pon Swang	6	75	336	4.48	1,100
		Hui Lao	7	53	349	6.58	1,400
		Nong Klong	8	103	490	4.76	1,860
			Total	732	3,835	5.23	10,448

Source: Interviewing local leaders by Study Team November, 1997

[1] *Kor Chor Chor 2 Khor 1996*

10.1.2 Topography and Geology

Mukdahan Priority Area has an area of 10,730 rai (1,720 ha), which is a part of MKD-8 LRA. It locates in a valley along the Huai Bang Sai river in Phu Phan Range. Its elevation ranges from EL160m to EL.200m, and slope ranges from 0.3% to 14%. The area is surrounded by the high and steep ranges of about EL.400m to EL.500m, which are designated as the national park and the reserved forest. This priority area is formed by the steepest topography among selected four priority areas. The steep sloping land over 5% gradient shares 8.0% or 690 rai in the area, where soils are suffered from erosion. Sandy soils are dominant at the top layer in the area while silt or silt clay extents in paddy area. The land of this area is cultivated with upland crops like cassava and maize in higher steep slopes and with paddy rice in lower alluvial flats.

Huai Bang Sai, which is a perennial river, is crossing the area from west to east. This river is flowing with a gentle gradient of about 1/6,000 and forming a deep and large U-shape river section of a depth about 12m and a width about 50m. River bed is composed of sand, and sandstone outcrops are observed. The river course seems, therefore, steady. Huai Lao and Huai Lak flow into Huai Bang Sai from south in the area.

The area consists of sandstone bedrock, residual soil, talus deposit and alluvial deposit. Sandstone bedrock can be observed in the area, which belongs to the Phu Phan Formation from lower Cretaceous age. It is composed of white and pink, orthoquartic, fine to medium grained, low to medium weathered, pebble layering on the upper bed, massive, cross-bedded sandstone. Perhaps some reddish brown conglomerate is commonly comprised.

Residual soil, which consists of weathering material of bedrock, is distributed widely in the hill areas and overlies bedrock. Soil is mainly composed of fine sand, silt sand and clay which includes the lithological characters of bedrock.

Alluvial deposits are widely distributed along the most recent river course. Talus deposit overlies residual soil at the base of the hillside and is presumably less than one meter thick. The deposit is formed mainly of sand, silt and clay.

10.1.3 Meteorology and Hydrology

1) Meteorology

At the city of Mukdahan, monthly mean temperature changes from 22.0℃ in December to 29.6℃ in April and mean of monthly maximum is 35.6℃ in April from the data of 30 year from 1965 to 1994. The maximum temperature of this period recorded 41.9℃ in April and minimum 5.3℃ during December and January with fairly large difference.

Mean relative humidity changes 60% in March to83% in August and annual comes to 72%.

Mean rainfall at Mukdahan city is 1,502 mm and rainy day counted more than10 days during May and September with maximum 22 days in August. Annual rainy day is 115. Rainfall station (code 023803) is applied as representative for this priority area, it rains annually 1,436 mm as average of 1968 to 1994 changing from 956mm in 1988 to 2,098 mm in 1994. It rains 95% of annual rainfall during the period from April to October.

2) Hydrology

a) Rivers

Hydrological observation stations are provided to Huai Bang Sai river, but no to its tributaries. Tributaries are seasonal and unsteady in flow regime. Flow regime of the tributaries is as follows.

Huai Lak River:

Flow condition of Huai Lak at proposed reservoir site: It normally starts stream in the river during May to June according the to beginning of rainfall of rainy season. River water flows at full of river section as about 2.5 m depth during August and September, and also it occurs flood within this period depend on the heavy rain. When it floods, water overflows the river section and the road around the river comes under submerge. But flood won't continue more than one day. The water depth gradually gets down to about 0.2 m in the river in November and there no flow in December. Condition of no-flow in the river continues from December to April. (information from the head of village)

Huai Lao River:

Flow condition of Huai Lao at proposed weir site : It normally starts stream in the river during April to May according to the beginning of rainfall of rainy season. Water flows at full of river section as about 2 to 3 m depth during July to August. Flood occurs during August to September almost every year submerging around land as 2 or 3 m depth but it continues only one or two hours and dissolved. The water flow is getting small and it flows as 0.2 m depth in November and river is dried up in February. No-flow condition continues 2 or 3 months from February. (information from the head of village)

b) Groundwater and quality

40% of this priority area are calculated to belong the range of less than 2 m^3/hr as expected well yield and 60% to range of 2-10 m^3/hr respectively by means of the Groundwater Map by GREP, Department of Mineral Resources.

Table 10.1-2 Expected Well Yield in MKD-8.2 Priority Area

Area	Area Ratio by Well Yield			
(ha)	< 2 m^3/hr	2 - 10 m^3/hr	10 - 20 m^3/hr	> 20 m^3/hr
2,970	40%	60%	0%	0%

The groundwater quality (TDS) in Mukdahan province is classified into 3 ranges as less than 750 mg/lit, 750 mg/lit to 1,500 mg/lit and more than 1,500 mg/lit. This priority area belongs to the range less than 750 mg/lit.

Table 10.1-3 Groundwater quality in MKD-8-2 Priority Area

Study Area	Acreage		Water quality mg/lit(TDS)			
No.	A (rai)	A (ha)	< 750	750 - 1500	> 1500	
MKH-8-2	10730	1716	100%			

10.1.4 Soil and Land Use

1) Soil

The soil in Mukdahan Priority Area is classified by the Department of Land Development into 6 groups as Nos. 17, 35B, 35C, 35E, 61/35 and 61D/35D as shown in Appendix E, Figure E-8 : Soil Map of Mukdahan Priority Area. Among those soil groups, soil No 35B covers about 71% of the total area and Soil No. 17 which is suitable for paddy occupy only 10% as shown in Table 10.1-4.

The soil is Loamy Paleustults and Loamy Paleaquults which is shown in Appendix E. Table E-6. Texture of the soil is loamy sand and sandy loam. The soil is low in organic matter and low in water-holding capacity. Growing crops in the types of soil is risky of a water deficit. Due to a lot of soil No. 35, upland crops, annual crops, fruit trees, tree crops and grass are suitable except rice as shown in Appendix E, Table E-7 : Land Classification System and Appendix E, Table E-8 : Soil Groups and Crop Suitability in Different Priority Areas.

Table 10.1-4 Soil Groups in MKD-8.2 Priority Area

Soil Group	Land Area (rai)	Percentage (%)
17	1,110	10.4
35B	7,620	71.2
35C	1,010	9.4
35E	350	3.3
61/35	10	0.1
61D/35D	600	5.6
Total	10,700	100.0

2) Land Use

Total farm land in priority area is 8,600 rai, 57.2% occupies by upland field, 37.2% is paddy field and only 5.6% is used for fruit trees. For upland area 45.3% or 3,894 rai is under cassava, 1.9% (167 rai) is maize, kenaf has about 1% (87 rai) and about 9% or 767 rai is under sugarcane. Fruit trees occupy 5.6% or 485 rai as shown in the table below.

Table 10.1-5 Present Land Use in MKD-8.2 Priority Area

Priority Area (rai)	Agricultural Land (rai)	Paddy Land (rai)	Cassava (rai)	Maize (rai)	Kenaf (rai)	Sugarcane (rai)	Fruit Tree (rai)
Mukdahan	8,600	3,200 (37.2%)	3,894 (45.3%)	167 (1.9%)	87 (1.0%)	767 (9.0%)	485 (5.6%)

Source : Department of Agricultural Extension, 1996.

10.1.5 Agricultural Infrastructure

1) Water Resources

Water resources are abundant in the MKD-8.2 priority area comparing to other priority areas. However, water resources are not yet fully developed in this area. Some community ponds and one weir have been so far developed, but they are not utilized effectively for irrigation only for livestock water.

a) Community Pond

Out of five villages, three villages have community pond in the village, and total number of ponds is 5 ponds. Main purposes of utilization are livestock water and fisheries. Out of 5 ponds, only 2 ponds are effectively utilized. Main reasons of poor utilization are destruction of dike and seepage. Collectivity and retention capacity are generally good except one due to high seepage.

Table 10.1-6 Community Ponds and Utilization in MKD-8.2 Priority Area

Village		General Information			Reasons of none effective utilization					Purpose of Utilization							Collecting capacity of runoff				Retention Capacity				
		Number of Ponds	constructed by	effieiently utilized ?	water pollution	distraction of dike	seepage	sediment	weeds	Irrigation	Livestock water	Drinking water	Domestic water	Fisheries	Swimming	Environment	Collectivity of runoff	Enough catchment	Enough collecting canal	Enough rainfall	Water retention Capacity	blanket pavement	Good maintenance of dike	Good impermeable soil	High seepage
66	Phang Daeng	1	Changwat	yes										1	1		good	1			good			1	
67	Tiu	0																							
68	Na Lak	1	RID	yes			1			1	1						good	1			good		1		
69	Nong Mu	2	natural pond	no		1			1		1			1			good			1	good			1	
71	Nong Klong	0																							
109	Huai Lao	1	Amphoe	no		1	1				1						good	1			poor		1		1
Total		5																							

(Note) based on Inventory of Irrigation Projects. (Table 6.1-1, Appendix-D)

b) Wells

Wells are not commonly utilized except for village water source in this area. Private wells are not developed other than few wells.

2) Farm Pond

Individual small farm ponds are not yet well developed in this area. Total number of farm ponds is counted at 66 ponds by interview to village leaders in this area. It equivalents to 10% of farmers having a farm pond. Average size of farm pond seems less than 1 rai. They are utilized mainly for supplemental irrigation of paddy rice.

Common problems of individual small farm pond are as follows;

- No sufficient inflow (Reasons are considered due to small catchment or wrong site selection for pond.)
- Weed control (removed by farmers in dry season when water is shallow .)
- Sediment problem arises where inflow is generally good (Soil protection will be necessary to prevent erosion in catchment of farm pond.)
- Heavy seepage (Enough depth should be kept to contact to impermeable soil lay

where talus deposit is thin.)

- Too small for integrated farming from economical viewpoint. (Economic analysis of larger farm pond will be necessary.)

Table 10.1-7 Present Number and Problems of Individual Small Farm Pond in MKD-8.2 Priority Area

Village No.	Village	Number of farm ponds	Ratio of integ. farming (%)	Problems on Farm Pond: No sufficient inflow (%)	Sediment (%)	Heavy seepage (%)	Heavy weeds (%)	Too small for integ. farming	No sufficient labour force	Much labour for irrigation	No budget for integ. farming	No sufficient benefit	No market
66	Phang Daeng	33	30	40	100	30	10						
67	Tru	25	0	100									
68	Na Lak	8	0	30		40	100	yes					
69	Nong Mu	0	0										
71	Nong Klong	0	0										
102	Huai Lao	0	0										
Total		66											

(Note) based on interview to village leaders.

3) Farm Road

Farm roads are not well developed in this area, but better than SKN-3.1 priority area. About 36% of farm plots has a access from farm road in this area.

4) Farm Plot Size and Farming Categories

Farming plot size and farming categories are analyzed based on the Land Reform Cadastral Map and land categories in 1/4,000 map. Average farm size in Land Reform Area is estimated at 13 rai for a farmer. Farming categories are analyzed based on ratio of upland field and paddy field in each cadastral block.

Table 10.1-8 Land Holding Distribution in MKD-8.2 Priority Area

Section (rai)			Frequency		Accumulation
0 -	5	0< <=5	222	35.6%	35.6%
5 -	10	5< <=10	136	21.8%	57.4%
10 -	15	10< <=15	107	17.2%	74.6%
15 -	20	15< <=20	50	8.0%	82.6%
20 -	25	20< <=25	21	3.4%	86.0%
25 -	30	25< <=30	23	3.7%	89.7%
30 -	35	30< <=35	19	3.0%	92.7%
35 -	40	35< <=40	13	2.1%	94.8%
40 -	50	40< <=50	14	2.2%	97.0%
50 -	60	50< <=60	7	1.1%	98.1%
60 -		60<	11	1.8%	99.9%
Total		Ave= 12.6 rai	623		

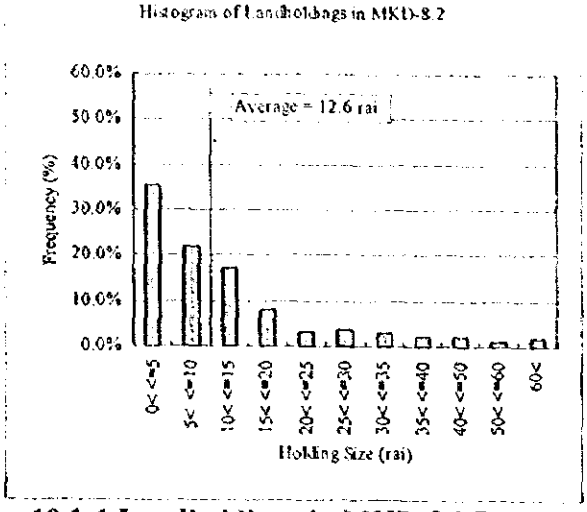


Figure 10.1-1 Landholdings in MKD-8.2 Priority Area

Farming categories are classified into three groups as shown in Table 10.1-9, namely Lowland Type, Mixed Type, and Upland Type based on upland field ratio.

Lowland Type : upland field less than 30%
Mixed Type : upland field from 30% - 70%
Upland Type : upland field more than 70%

Table 10.1-9 Present Farming Type and Farm Size in MKD-8.2 Priority Area

Type of Land	Area (rai)	Paddy	Upland	Plots having Farm Road	Plots having Farm Pond	Plots Blocks & Block
Lowland Type	18.8% 1,468 rai Average 7.3 rai	88 % 1,293 rai	12 % 175 rai	31 % 62 plots Distance to village 0.6 km	10 % 21 plots Average 0 rai	202 plots 8 blocks 166, 171, 174, 206, 207, 208, 215, 223
Mixed Type	37.9% 2,964 rai Average 12.8 rai	38 % 1,128 rai	62 % 1,836 rai	30 % 69 plots Distance to village 0.9 km	10 % 25 plots Average 0 rai	231 plots 16 Blocks 150, 160, 164, 165, 170, 175, 176, 184, 186, 194, 196, 210, 214, 217, 229, 237
Upland Type	43.3 % 3,385 rai Average 17.8rai	15 % 491 rai	85 % 2,894 rai	48 % 91 plots Distance to village 0.9 km	10 % 20 plots Average 0 rai	190 plots 18 blocks 143, 149, 162, 163, 172, 173, 179, 185, 188, 192, 193, 195, 197, 201, 235, 236, 238, 239
Total	100 % 7,816 rai Average 12.6 rai	37 % 2,912 rai	63 % 4,904 rai	36 % 222 plots Distance to village 0.9 km	10 % 66 plots Average 0 rai	623plots 42 blocks

(Note) Farm pond distribution is assumed based on total 66 ponds that is reported by the village leaders.

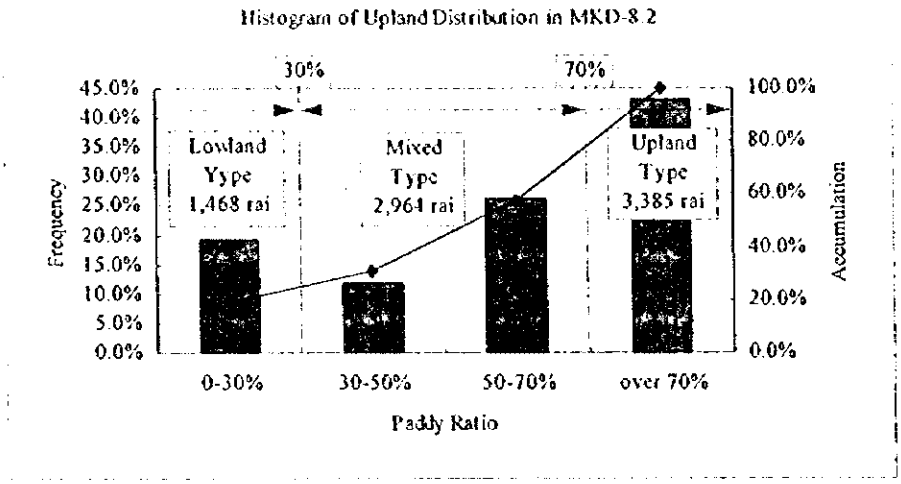


Figure 10.1-2 Upland Ratio in MKD-8.2 Priority Area

10.1.6 Rural Infrastructure

1) Rural Road

Rural roads are mostly 4 m width and paved by laterite. Main rural road Route 2287, which crosses the area west to east, is already paved with asphalt and improved to 6 m width at present. However, improvement of other rural road is still limited as Nong Mu village where a suspension bridge on Huai Bang Sai is connecting the village from main road. This bridge is passable only by walk or small cart, and restricting the transportation to the village. For development of the village, the bridge should be replaced by a permanent bridge in early stage for introduction of integrated farming.

Table 10.1-10 Rural Road in MKD-8.2 Priority Area and Necessary Improvement

Road	Name	Route			Present		Improvement		
No.		from	to	Leagth (km)	Width (m)	Pavement	Length (km)	Width (m)	Pavement
1	2287	Crossing the Area		8.7	6	Asphalt	Completed		
2		Phang Daeng(66	Huai Lao(109	6.8	6	Laterite	6.8	6	Asphalt
3		Nong Mu (69)	Route 2287	1.5	4	Laterite	1.5	4	Asphalt
							Suspension bridge to be replaced by a permanent bridge.		
Total				17.0			8.3		

(Note) Location of roads is shown in Figure 10.3-3.

2) Village Water

All villages have own village water supply system in the area. However, coverage ratio of services is limited at 10 to 30% in Na Lak, Nong Mu and Nong Klong villages. Most villages are depending on groundwater and some on spring water from mountain. However, over half of villages are facing water shortage of water source. In those villages, water supply hours are controlled to save water as well as stocking rainwater in a jar at each house.

3) Electricity and Communications

Electrification was started before 13 years, and completed since 5 years in this area. Telephone system is now rapidly expanding, and covering 5 villages among 6 as of the end of

1997.

4) Health Center

Health center is located only in Phang Daeng village, and other five villages are to access to this village. Access distance is within 7 km.

10.1.7 Rural Organization

The major local organizations in the Mukdahan Priority Area are agricultural cooperatives, farmers' housewives' groups, young farmers' groups, farmers' groups for specific kinds of product, rice banks, etc. All farmers' organizations in all of Tambon Phang Daeng covering 791 households in eight villages are as follows.

Table 10.1-11 Membership Ratio of Organizations in MKD-8.2 Priority Area

Type of Organization	Membership % of total respondents (317)
Agricultural Cooperative	75
Farmers' Housewives' Group	13
Young Farmers' Group	34
Farmers' Group for Specific Occupations	38

Source: Amphoe Don Luang Agricultural Extension Office, 1995

Most villages in the area are below the development line and are communities of weak solidarity. The majority of the local organization members still do not understand the important role of local organization. As a matter of fact, all existing peoples' organizations in the Priority Area are not strong enough and operation performance is very low. Major problems for future development of local organizations in the area may be summarized as follows.

a) Low education level.
b) Villagers are less progressive in community development.
c) Most villagers are not intending to leave their villages for non-agricultural income. As a result, they are low in their income.

10.1.8 Environmental Conditions

This area is surrounded by conservation forest and National Park. These villages were formed in 1897, while the conservation forest was established in 1964 and the National Park in 1988.

These villages were involved in the conflict between the government and the communists and this area was a very dangerous zone for a long time. Therefore, school construction was delayed and primary schools were started in the 1980s. For this reason, the education level is very low and only 43 % have graduated from primary school. Now, almost 100 % of children go to school, where the lunch is supported by government program.

Population increase has led to the encroachment of farmland in the conservation forest and National Park until now. Although villagers know the regulations concerning of conservation forest, they adopt illegal farming because of poverty. They pay a land tax of 5 baht per rai including illegal farmland to the district office. A large area of the conservation forest and the National Park has been encroached on cassava fields, especially along the road and three rivers of Huai Lak, Huai Kha Na, and Huai Lao. Even the area 3.5 km from the village Ban Huai Lao, around the waterfall in the National Park, is cultivated by villagers. Relation between villagers and RFD is not good because RFD is trying to stop this illegal farming.

According to the EIA report, average farmland is;

LRA : 12.4 rai/household,
Illegal : 41.6 rai/household and
Total : 54.0 rai/household.

The details of the conservation forest are as follows, and detailed environmental conditions are described in the EIA report.

Table 10.1-12 Condition of the Conservation Forest in MKD-8.2 Priority Area

	Huai Lak	Huai Kha Na
Soil Erosion	20.58 ton/rai/year	7.68 ton/rai/year
Illegal Farmland	Rice and cassava fields	Cassava field
Illegal Farmers	26 families from Ban Nong Mu, 2 families from Na Lak (including 13 landless families)	16 families from Ban Nong Khlong (including 11 landless families)

A community forest project is planned by RFD for 17 villages in Amphoe Dong Luang with a budget of 2.55 million baht and a target of 1,700 rai from 1997 to 2001. The project includes three villages in the priority area, Ban Na Lak, Ban Phang Daeng and Ban Tiu.

10.2 Present Agriculture

10.2.1 Agricultural Production

Major crops of the Priority Area in Mukdahan are rice and cassava. Minor crops are maize , kenaf, sugarcane and some fruit trees such as tamarind and mango.

Table 10.2-1 Acreage and Crop Yield in MKD-8.2 Priority Area [1]

Location	Crops	Area (rai)	Production (ton)	Yield (kg/rai)
Dong Luang	Rice	3,479	696	200
	Cassava	3,682	10,310	2,800
	Maize	167	100	600[2]
	Kenaf	87	22	250
	Sugarcane	700	8,400	12,000
	Tamarind	325	195	600[2]
	Mango	160	176	100[2]
	Total Planted Land	8,600 rai		

Source : [1] Amphoe Dong Luang Agricultural Extension Office, 1995
[2] Estimated Figures

10.2.2 Farming Practice

Pang Daeng is a remote area of the province and the people have a low level of literacy. Agriculture depends entirely on rain and soils are unfertile. Therefore, farming is relatively difficult and all farmers are subsistence farmers. Farming practice in the areas is still traditional. Advanced technology adopted by the farmers is only recommended crop varieties, few fertilizers and a little use of pesticides. Farm planning, soil improvement and appropriate land use have not been practiced. And, more over, cooperative channels and marketing systems are not sufficient.

10.2.3 Livestock and Fishery

There is little livestock. Cattle, water buffalo and poultry are scatteredly raised. Eighty per cent of these animals are sold for family income. Fish breeding is also scant even in the rainy season. Some farmers raise tilapia and some local fish species in shallow ponds. It is hardly practiced at all in summer when water is scarce.

Table 10.2-2 shows kinds of livestock and fish raised, the number of households involved, the total number of animals, and the number of animals per household.

Table 10.2-2 Livestock Number of in Phang Daeng, Amphoe Dong Luang, Mukdahan

Items	Cattle	Buffalo	Pigs	Ducks	Chickens
Households	210	680	80	320	590
Total Animals	393	1,983	408	720	4,530
No./household	1.9	2.9	5.1	2.2	7.7

Source : Amphoe Dong Luang Agricultural Extension Office, 1995.

10.2.4 Post-Harvest Handling and Marketing

Major crops in the study area are rice, cassava and sugarcane. Rice is usually harvested manually by farmers and dried in the same field for two to three days. Threshing is done by the family and relatives or sometimes hired labor. Estimated paddy production in

this priority area is approximately 0.6 million kg, and about 40 thousand kg is short when home consumption and seeds for next planting are deducted (refer to Appendix F : Table 7.2.5-1 Estimated Paddy Production and Surplus).

Marketing of rice is rarely conducted because surplus for sell is not expected. After threshing, paddy is stored in farmers' houses and warehouses. Warehouses for marketing are few (refer to Appendix F : Table 7.2.5-2 Inventory of Post-Harvest/Marketing Facilities in the Priority Area).

Marketing routes of cassava and sugarcane are fixed as same as in other priority areas. There is a less merit for farmers to enter into the market.

Cattle are usually sold through traders. Farmers can select how of selling themselves or by traders. However, they prefer to sell in the area to traders for convenience.

Other agricultural crops such as vegetables and fruit are planted in the area and they are generally cultivated for domestic consumption. No typical post-harvest handling and marketing scheme is found.

The marketing point for this area is King Amphoe Dong Luang. It may also be possible to use Amphoe Na Kae, King Amphoe Wan Yai or even Changwat Mukdahan. However, their market points are a little far from the area (refer to Figure 10.2-1 Marketing Points near the Priority Area). Unfortunately, roads are not enough and farmers have insufficient marketing information systems and lack of knowledge. They only get information from relatives or traders.

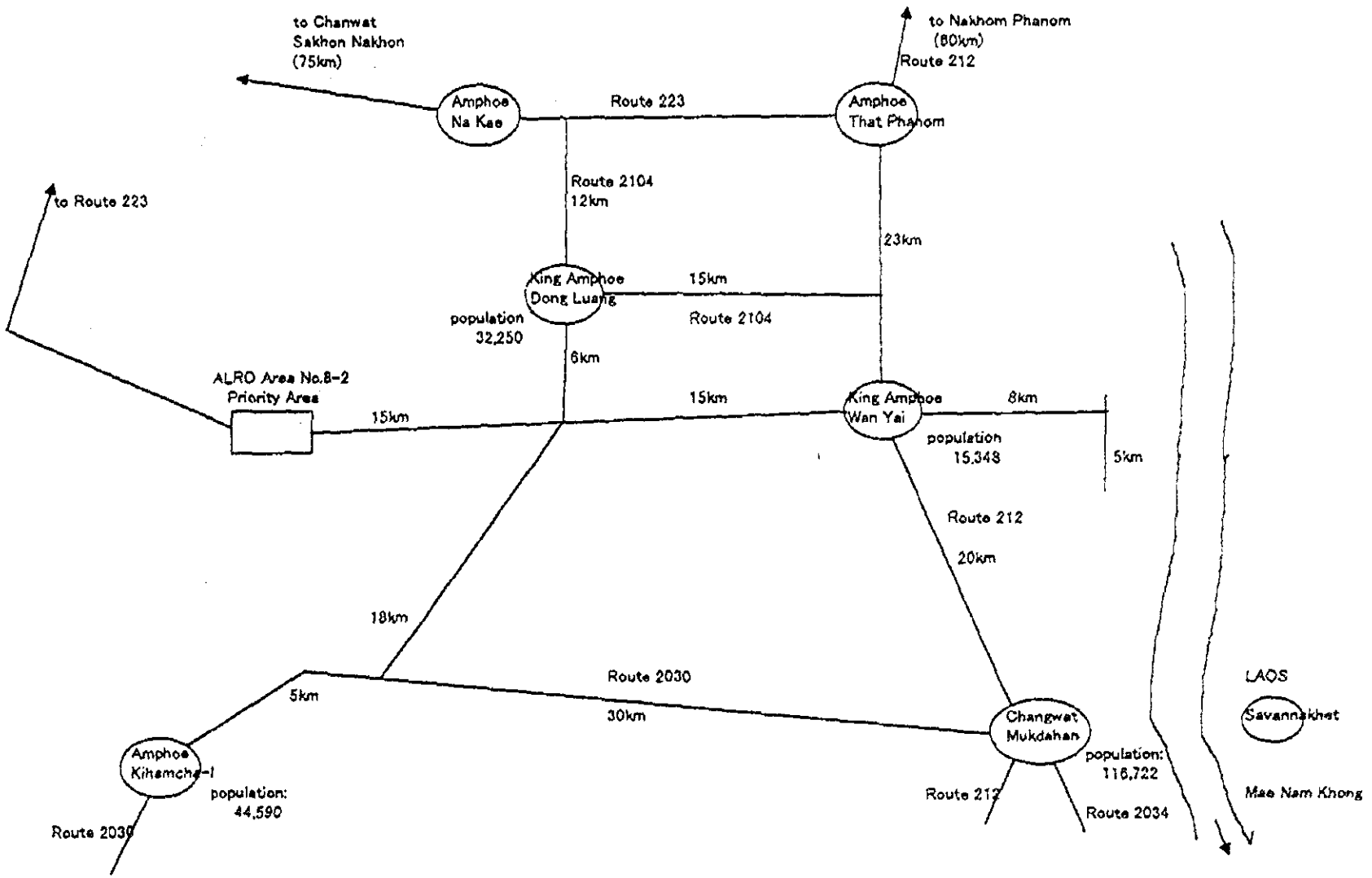


Figure 10.2-1 Marketing Points near the Priority Area (Mukdahan)

10.2.5 Farm Household Economy

The income of farmers living in Mukdahan Priority Area ranks worst of the four Priority Areas. This is because it is in a mountainous area which is more than one hour from the central part of Mukdahan city, and many farmers are not willing to work outside their village to get off-farm income. According to the survey by the Study Team, household income is estimated at 17,900 baht, which is composed of non-agricultural income 6,500 baht and agricultural income 11,400 bath. When comparing the income with those of average income of Mukdahan province which is 32,900 baht, it only accounts for 54% of the average. Major source of non-agricultural income is employment.

10.3 Development Plan

10.3.1 Objectives of the Development

The main objectives of the development have been established in Chapter 3.4.1 and are as follows :

a) To increase farmers' income,
b) To satisfy basic human needs, and
c) To conserve the forest reserve areas adjacent to LRAs.

Basic development strategy of this area is introduction of integrated farming (including vegetable production, fruit tree cultivation, poultry, fish breeding) and fast-growing trees based on farm pond development. The introduction of integrated farming is expected to contribute considerably in accomplishing objectives listed above. However, it should be understood that providing increased access to education is the most effective way for reducing pressure on forests and for increasing the effectiveness of the development.

10.3.2 Farming Plan

The development strategy of the Priority Area is to introduce integrated farming (including vegetable production, fruit tree cultivation, poultry, fish breeding) based on a farm pond and fast-growing trees in the farmland presently cropped with rice and cassava.

Present farming type can be classified into 2 categories in the area, namely, lowland type (rice cultivation) and upland type. Farming plan of each type is proposed as shown below:

Table 10.3-1 Farming Plan for a Typical Household (13rai)

Land Use	Lowland Type (37%)	Upland Type (63%)
Rice	8 rai	3.5 rai
Cassava	-	3 rai
Sugarcane	-	-
Fruit tree	2.5 rai	2 rai
Fast-growing tree	-	2 rai
Vegetable	0.5 rai	0.5 rai
Pig breeding	(2 heads)	(2 heads)
Poultry	(100 heads)	(100 heads)
Fish breeding	-	-
Farm pond	1 rai	1 rai
House, etc.	1 rai	1 rai

By implementation of the farm pond and farm road project, farmland with a farm pond will be increased to increased to 4,290 rai or 50% of the whole, together with the present farmland with a pond. Present cassava field will be changed to fruit tree and fast-growing tree by 37% by the project as shown in Table 10.3-2. Recommended crops in this area are same as those recommended in Sakon Nakhon Priority Area. For the beneficial area of Huai Bang Sai Pump Irrigation Project, its proposed cropping pattern is shown in Figure 10.3-1.

Table 10.3-2 Present and Planed Cropped Area in MKD-8.2 Priority Area

Land Use	Present	Plan	Difference
Rice	3,200 rai	3,040 rai	(-) 160 rai
Cassava	3,894 rai	2467 rai	(-) 1,427 rai
Sugarcane	767 rai	760 rai	(-) 7 rai
Maize	167 rai	84 rai	(-) 83 rai
Kenaf	87 rai	44 rai	(-) 43 rai
Fruit tree	485 rai	964 rai	479 rai
Fast-growing tree	-	416 rai	416 rai
Vegetable	-	165 rai	165 rai
Farm pond	-	330 rai	330 rai
House, etc.	-	330 rai	330 rai
Total	8,600 rai	8,600 rai	0 rai

10.3.3 Agricultural Infrastructure Development Plan

1) General Direction of Agricultural Infrastructure Development

MKD-8.2 priority area has an high potential of water resources, but not development yet at reasonable level. On the other hand, farm pond and farm road are not also developed in sufficient level. Consequently, this priority area has to be investigated on agricultural infrastructure development from several viewpoints such as economic possibility, environmental impact and acceptance of villagers etc..

In this priority area, following three project have been investigated.

① Huai Lak Reservoir Project
② Hui Bang Sai Pump Irrigation Project
③ Farm Pond and Farm Road Project

2) Water Resources Development

a) Development Method of Huai Lak River and Huai Bang Sai River

As Huai Lak is a seasonal river, its discharge drops to zero in the dry season. And, its flow is unsteady even in the rainy season. In case of the development by a diversion weir, it is not only expected to get no water in the dry season but also farmers are forced to operate difficult gate operation due to unsteady flow in the rainy season. It is, therefore, recommended as the most effective way to develop a reservoir at the relatively narrow valley at 3 km upstream of the river. (Location is shown in Figure 7.1-7 in Appendix D.) Huai Lao river was also investigated in the same manner as Huai Lak river, that is same flow condition as Huai Lak river. But, there is no good site for reservoir construction unfortunately.

On the other hand, Huai Bang Sai river has a steady base flow as investigated in Chapter 5 in Appendix B. It is recommended to develop the base flow by pump.

The recommended development of water resources in this area is, therefore, concluded as follows;

Huai Lak River: Development by the reservoir type irrigation
Huai Bang Sai River: Development by the pump irrigation

b) Huai Lak Reservoir Development Project

As the first case (Case-1), a reservoir is considered at the narrow valley as mentioned above. The reservoir is to be constructed in the conservation forest, so that the forest of about 1 km^2 will be submerged. Further more, paddy field of about 110 rai, though illegal reclamation, will be also submerged. To avoid the submersion of paddy field, an alternative site, further 1 km upstream, is selected and studied as the second case (Case-2), although the topography is disadvantageous.

The results of the study are summarized as in Table 10.3-3.

Table 10.3-3 Dimensions and Economic Evaluation of the Huai Lak Reservoir

	Reservoir Case (1)		Reservoir Case (2)
	Case 1-1	Case 1-2	Case-2
Catchment Area	12 km^2		9.5 km^2
Annual Inflow	4.59 MCM		363 MCM
Dam Height	25.5 m	20.5 m	23.5 m
Effective Storage	4.79 MCM	3.32 MCM	1.65 MCM
Irrigation Area	1,170 rai	1,040 rai	1,020 rai
Project Cost	-	254 million baht	-
Unit Cost	-	244,000 baht/rai	-
B/C	-	0.23	-

(Note) 1) Details are in Appendix D, Chapter 7.1.4, Chapter 7.2.6, and Drawing No.5 to No.15.
2) Economic evaluation is described in Table 11.6-2, Main Report.
3) -: not investigated due to less advantage than Case 1-2.

As shown in Table 10.3-3, B/C of Reservoir Case (1-2), that is to be the most economical case among three cases, is evaluated at 0.23 below 1.0. This reservoir is, therefore, not feasible from an economic viewpoint.

c) Huai Bang Sai Pump Irrigation Project

As the 1/5 years drought flow of Huai Bang Sai river is estimated at about 1.5 m^3/sec, it is sufficient enough for irrigation in the area. For mitigating effects to the downstream, intake amount is limited at 1/5 of the drought flow or 0.30 m^3/sec. It is necessary to install a diversion weir due to less water depth of about 20cm during the drought. Taking high flood water level into consideration, a vertical mixed flow type pump has been selected. (Details are in Chapter 10.4.3.)

It is estimated to be able to irrigate 1,446 rai with an intake amount of 0.30 m^3/sec. (Cropping pattern is shown in Figure 10.3-1.) As the results of economic evaluation (Table 11.6-2), this project is evaluated economically feasible with the figures of 1.12 for B/C and 13.7% for EIRR. Major elements of the project are as follows:

<Project Feature of the Huai Bang Sai Pump Irrigation Project>

Irrigation Area = 1,446 rai (231 ha)
Paddy Land = 333 rai (53 ha)
Upland =1,113 rai (178 ha)
River: Huai Bang Sai (Catchment Area = 564 km2)
Flood: 1/500 years = 1,070 m3/sec (1.9 m3/s/km2)
1/100 years = 846 m3/sec (1.5 m3/s/km2)
Drought Flow: 1/10 years = 1.5 m3/sec (0.265 m3/s/100km2)
River Bed Gradient = 1/6,000 (based on 1:4,000 map)
Irrigation Operation Hour = 12 hrs/day in Maximum
Pump Capacity = 0.30 m3/sec (110kw×1 set, Pipe = Asbestos 500mm)
Operation Time = 6.3 hrs/day through the year (Max = 16 hrs/day in October)
Necessary Delivery Tank Capacity = (16 hours -12 hours)*0.3m3/sec = 4,500 m3
Water Distribution System : Main Rout = Pipeline, Terminal = Open Canal
(Location of the Project is shown in Figure 7.1-4.2 in Appendix D)
Project Cost: 53.52 million baht (37,000 baht/rai) (Table 10.5-4)
Economic evaluation: B/C=1.12, EIRR=13.7% (Table 11.6-2)

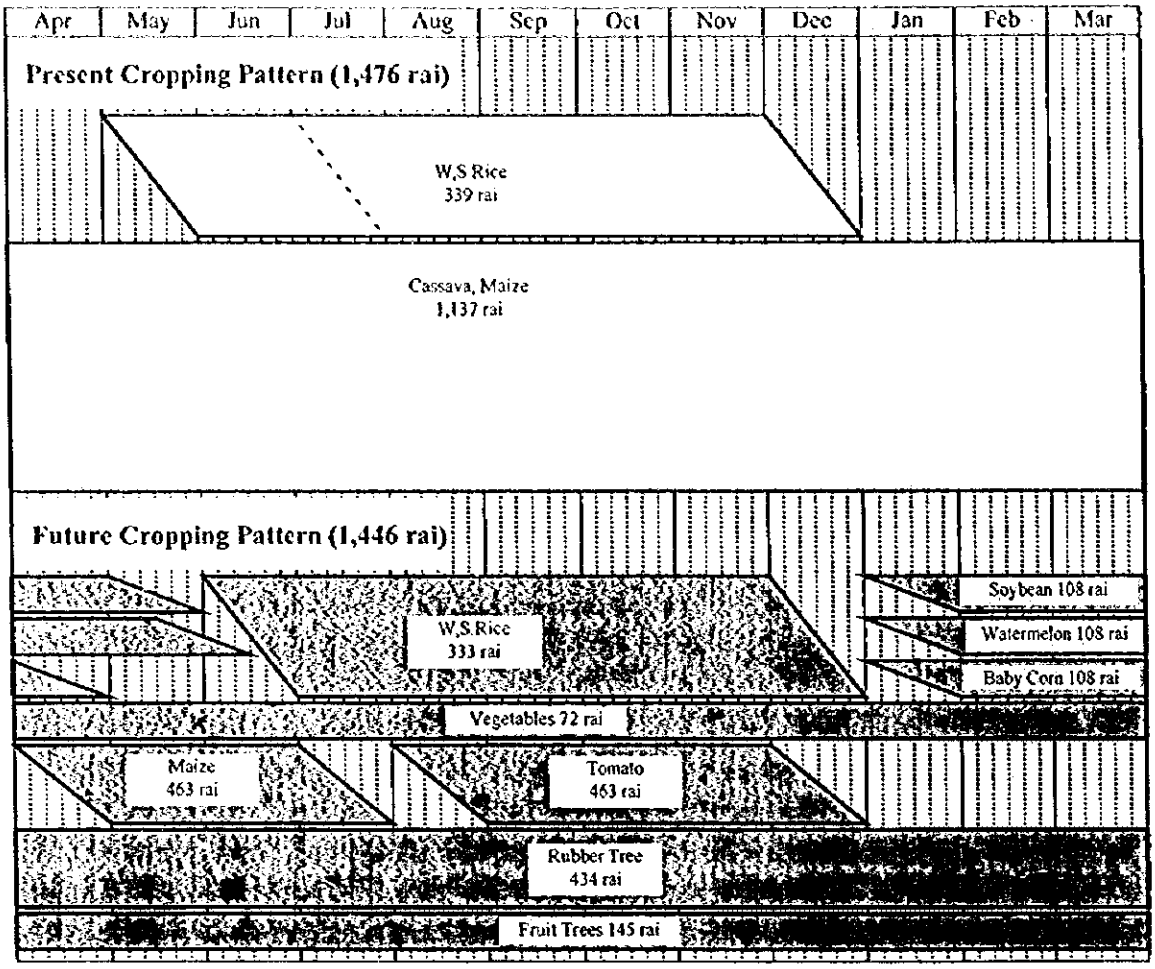


Figure 10.3-1 Proposed Cropping Pattern of Huai Bang Sai Pump Irrigation Project

3) Farm Pond Development

At present, 10% of farmers have a 1,200m^3 class farm pond in this area. Possible development of farm pond in this area has been analyzed based on following factors;

Table 10.3-4 Factors on Farm Pond Development in MKD-8.2 Priority Area

Factors	Dimensions
Average size of land holding	13 rai/farmer
Irrigable farming size (1/5 dry year)	
1,200m^3 Farm pond	1 rai vegetables through the year (3 cropping/year)
6,000m^3 Farm pond	1 rai vegetables through the year (ditto) and, 3 rai of fruit trees
Necessary Catchement	
1,200m^3 Farm pond	1.5 rai
6,000m^3 Farm pond	15 rai
Farm road accessibility	Lowland = 66%, Mixed land = 71%, Upland = 88%
Topographical suitability	Lowland = 100%, Mixed land = 95%, Upland = 90% (runoff from hilly slope can be expected even for upland)
Soil suitability	Lowland = 100%, Mixed land = 85%, Upland = 70%

Based on above factors, it is estimated that farm ponds will be expanded to the farmers as shown in Table 10.3-5. In case developed only by 1,200m^3 farm ponds, 40% to

58% of farmers will able to have 1,200m³ farm pond newly. In case introducing 6,000m³ farm pond, 27% of farmers will able to have 6,000m³.

Table 10.3-5 Physically Possible Farm Pond Development in MKD-8.2 Priority Area

Development of Farm Pond	Lowland	Mixed Land	Upland	Total
Present				
1,200m³ Farm Pond	10%	10%	10%	10%
Future Possible Expansion				
<In case developed only by 1,200m³ Farm Pond>				
In case accessibility considered	39%	40%	42%	40%
In case accessibility not considered	63%	61%	48%	58%
<in case developed mixed with 6,000m³ Farm Pond>				
6,000m³ Farm Pond	13%	28%	41%	27%
1,200m³ Farm Pond (accessibility counted)	26%	12%	1%	13%
1,200m³ Farm Pond (accessibility not counted)	50%	33%	7%	31%

(Note) Detail procedure of estimation and computation are shown in Table 10.3-6.

Table 10.3-6 Farm Pond Availability in MKD-8.2 Priority Area

Elements	Land Type Classification				Remarks
	Lowland	Mixed Land	Upland	Total	
Vegetable = 1rai					
1-1) Necessary Farm Pond (m3)	1,200	1,200	1,200		
1-2) Farm Pond Size (rai)	1	1	1		
1-3) Necessary Catchment (rai)	1.5	1.5	1.5		
1-4) Necessary Min. Farm (rai)	2	2	2		Veg. + F.Pond
1-5) Necessary Total Area (rai)	2.5	2.5	2.5		C.A + F.Pond
Vegetable = 1rai, Fruit Tree= 3rai (Total 4 rai)					
2-1) Necessary Farm Pond (m3)	6,000	6,000	6,000		
2-2) Farm Pond Size (rai)	2	2	2		
2-3) Necessary Catchment (rai)	15	15	15		
2-4) Necessary Min. Farm (rai)	6	6	6		Veg. + F.Tree + F.Pond
2-5) Necessary Total Area (rai)	17	17	17		C.A + F.Pond
Number of Farmers and Land Holdings					
3-1) Total 04-1 Area (rai)	1,468	2,964	3,385	7,817	
3-2) Total 04-1 Farmers	202	231	190	623	
3-3) Average Holdings (rai/farmer)	7.3	12.8	17.8	12.5	(3-1) / 3-2)
3-4) Total Farmers >= 2 rai	150	207	178	535	
3-5) Ratio	74.3%	89.6%	93.7%	85.9%	(3-4) / 3-2)
3-6) Total Farmers >= 6 rai	91	148	140	379	
3-7) Ratio	45.0%	64.1%	73.7%	60.8%	(3-6) / 3-2)
Farm Road Accessibility					
4-1) Present Accessibility	31%	30%	48%	36%	
4-2) Future Accessibility	66%	71%	83%	75%	
Suitability of Farm Pond Construction					
5-1) Topographical Suitability	100%	95%	90%		lower in upland due to catchment availability, but higher than other priority areas because mountains are adjucent to the area.
5-2) Soil Suitability	100%	85%	70%		assumed from a viewpoint of sandy texture.
5-3) Area for 1,200m3 pond	100%	100%	100%		(3-3) / 1-5)
5-4) Area for 6,000m3 pond	43%	75%	100%		(3-3) / 2-5)
Possibility of Farm Pond to Farmers					
<In case only 1,200 m3 Farm Pond>					
6-1) in case accessibility counted	49%	51%	52%	51%	(3-5)* 4-2)* 5-1)* 5-2)* 5-3)
(1) Farmers able to have 1,200m3 pond	99	118	99	316	(3-2) * 6-1)
6-2) in case accessibility not counted	74%	72%	59%	69%	(3-5)* 5-1)* 5-2)* 5-3)
(2) Farmers able to have 1,200m3 pond	149	166	112	427	(3-2) * 6-2)
<In case 6,000m3 Farm Pond introduced>					
6-3) 6,000 m3 Farm Pond	13%	28%	41%	27%	(3-7)* 4-2)* 5-1)* 5-2)* 5-4)
(3) Farmers able to have 6,000m3 pond	26	65	78	169	(3-2) * 6-3)
(4) 1,200m3 ponds when access counted	73	53	21	147	{(1)-(3) <> 3-5)* 4-2)* 5-1)* 5-2)* 5-3)* (3-1)-(3)*17rai}/2.5rai
(5) 1,200m3 ponds when access not counted	123	101	34	258	{(1)-(3) <> 3-5)* 5-1)* 5-2)* 5-3)* (3-1)-(3)*17rai}/2.5rai
Existence of Present Farm Pond					
7-1) 1,200 m3 Farm Pond	10%	10%	10%	10%	by interview to village leaders
(6) Farmers having 1,200m3 pond	21	25	20	66	(3-2) * 7-1)
7-2) 6,000 m3 Farm Pond	0%	0%	0%	0%	by 1:4,000 map
(7) Farmers having 6,000m3 pond	0	0	0	0	(3-2) * 7-2)
Future Expansion					
<Farmers able to have 1,200m3 pond>					
8-1) in case accessibility counted	78	93	79	250	(1) - (6)
(8) Ratio of Expansion of 1,200m3 pond	39%	40%	42%	40%	(8-1) / 3-2)
8-2) in case accessibility not counted	128	141	92	361	(2) - (6)
(9) Ratio of Expansion of 1,200m3 pond	63%	61%	48%	58%	(8-2) / 3-2)
<Farmers able to have 6,000m3 pond>					
8-3) Farmers able to have 6,000m3 pond	26	65	78	169	(3) - (7)
(10) Ratio of Expansion of 6,000m3 pond	13%	28%	41%	27%	(8-3) / 3-2)
<In case accessibility is counted>					
(11) Farmers with 1,200m3 pond	52	28	1	81	(4) - (6)
(12) Ratio of Expansion of 1,200m3 pond	26%	12%	1%	13%	(11) / 3-2)
<In case accessibility is not counted>					
(13) Farmers with 1,200m3 pond	102	76	14	192	(5) - (6)
(14) Ratio of Expansion of 1,200m3 pond	50%	33%	7%	31%	(13) / 3-2)

4) Farm Road Development

There exist 11.9 km of farm road in the area, and covering 36% of accessibility of farm plot. Farm road density is reaching 1.4 m/rai or 8.8 m/ha at present. Farm road will be extent to 57 km and density will reach 6.6 m/rai or 41 m/ha. Accessibility will be improved to 75% in future. Many farm plots are so irregular in shape that uneconomical farm road and unusable land will be rapidly increased if the accessibility is beyond 75%. It is considered that the accessibility of 75% may be limit for the farm road development.

Table 10.3-7 Farm Road Development in MKD-8.2 Priority Area

Farm Road Total 8,600 (rai)	Number of Roads	Total Length (km)			Density (m/rai)		Width (m)	Pavement (km)		Cross-structures	
		Existing Improvement	New Provision	Total	Existing	Future		Asphalt	Laterite	Culverts	Bridge
Main Farm Road (MFR)	4	1.00	13.28	14.28	0.12	1.66	4	3.30	10.98	33	0
Lateral Farm Road (LFR)	8	1.85	7.92	9.77	0.22	1.14	4	1.30	8.47	12	1
On-Farm Road (OFR)	39	9.04	23.97	33.01	1.05	3.84	2	2.20	30.81	40	4
Total	51	11.89	45.17	57.06	1.38	6.63		6.80	50.26	85	5

(Note) 1) Above farm roads are converted for the whole farm area of 8,600 rai.
2) Lateral and on-farm roads have been increased in proportion with following area ratio.
8,600 rai / 7,817 rai = 1.100
3) Length of Bridges = 20m (One of On-Farm Road = 40 m)
4) Width of existing road is assumed at 2 m.
5) A concrete pipe of diameter 500 mm is assumed be installed for culvert.
(Each culvert to be reviewed by its drainage area at implementation stage)
6) Asphalt pavement of Main, Lateral and On-farm roads is considered for subject to flood.
Main and Lateral farm roads: 100m per culvert or bridge.
On-farm road: 50m per culvert or bridge.
7) Main farm road is assumed not to increase because Length is sufficient even for the whole farm land.

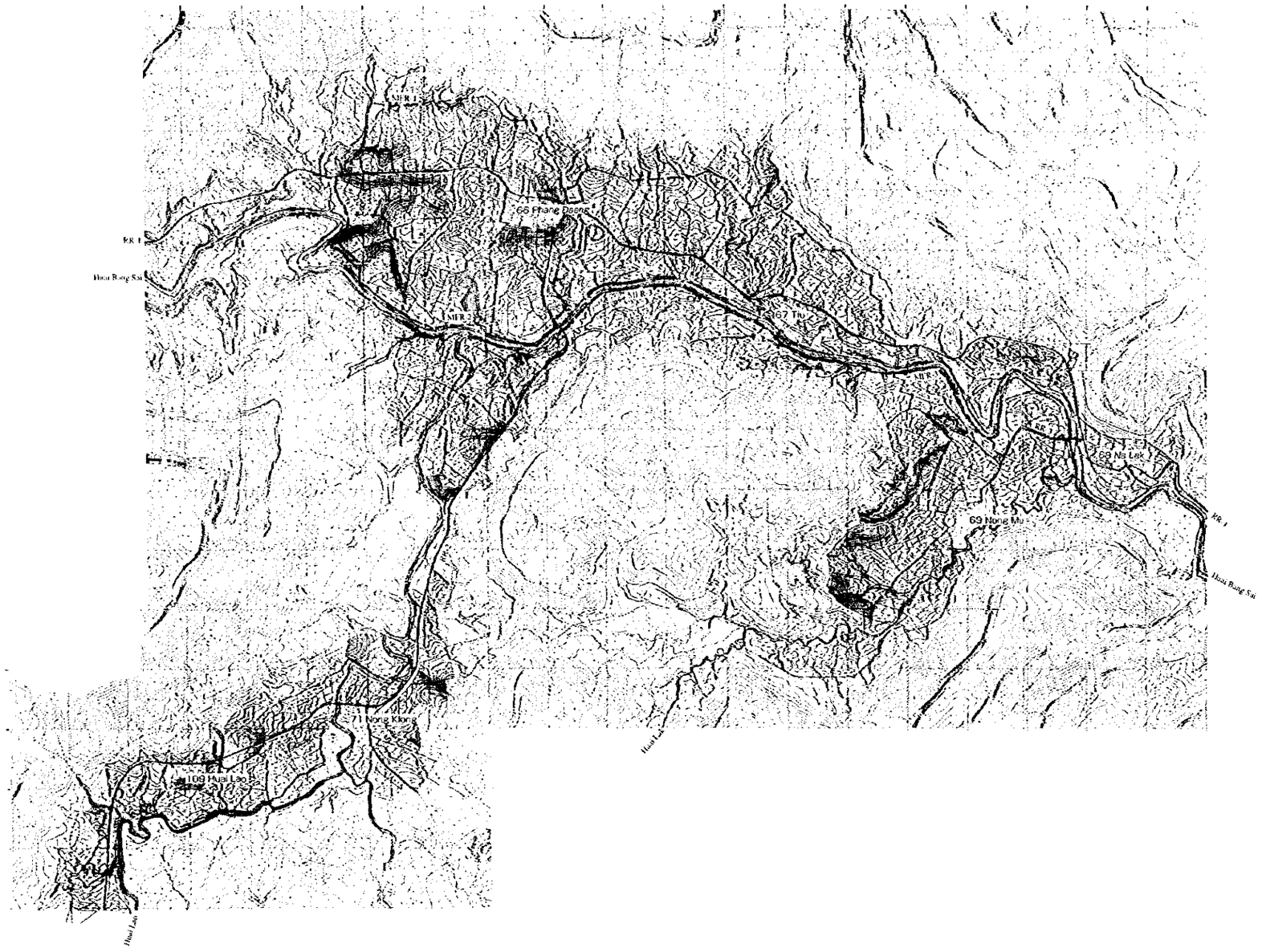
5) Rehabilitation of Existing Facilities

Deteriorated community ponds shall be rehabilitated to keep water retention capacity for various utilization for the villages. However, it will be less efficiency to increase capacity and irrigation. Improvement of Kolopokan pond in Nong Mu village is desired by the villages, but it is difficult to estimate effects of it. Therefore, its cost and rehabilitation plan are shown in Table 7.2-32, and Drawings No.34 and No.35 in Appendix D.

6) Soil Protection Measures

Steep lands over 5% slop, where soil protection measures are necessary, are 8% or 690 rai in the area. It is recommended to utilize those lands with fruit trees and fast-growing trees. It is necessary to request farmers to provide contour ditches in their fields and to protect the ditches with vertiver grass. Its nursery should be provided to the farmers. Location of steep lands is shown in Figure 10.3-2.

Figure 10.3-2 On-Farm Development Plan of Mukdahan Priority Area (MKD-8.2)



LEGEND OF PLAN

- Farm Plot accessible at Present
- Farm Plot accessible by Project
- Farm Plot by Footpath

Rural Road (RR)
- Existing (Improvement)
- Proposed

Main Farm Road (MFR)
- Existing (Improvement)
- Proposed

Lateral Farm Road (LFR)
- Existing (Improvement)
- Proposed

On-Farm Road (OFR)
- Existing (Improvement)
- Proposed

- Bridge, Culvert
- Steep Farm Land (slope>5%)

Scale 1:40,000

0 1,000 2,000 3,000 4,000m

The Feasibility Study on The Integrated Agriculture Development in The Agricultural Land Reform Areas in The Upper Northeastern Region

Agricultural Land Reform Office (ALRO), MOAC, The Kingdom of Thailand

Japan International Cooperation Agency (JICA)

10.3.4 Forest Conservation Plan

In principal, RFD takes part in forest conservation. However, extensive agriculture and population increase are main reasons for expansion of illegal farmland in the forest as well as the lack of social responsibility and awareness environmental knowledge as shown in Figure H-7, Appendix H. Therefore, the forest conservation plan should be based on environmental education, leadership training and regular meetings with villagers by ALRO, RFD and NGOs.

The community forest development plan will not be included in this area because there is very little suitable public land and RFD is planning the promotion of community forest in Amphoe Dong Luang including three villages in the priority area.

1) Afforestation Plan

Purpose:

- To reduce pressure on the conservation forest
- Improvement of soil fertility by fallen leaves
- Increase in income from forestry

For the purpose of the reduction in pressure on the conservation forest, it is important to select appropriate species as construction material and superior seedlings. RFD's Udonthani Nursery Center will support the provision of these seedlings.

Support by ALRO, RFD and NGOs:

a) Meeting with villagers to enlighten them about the importance of forest conservation
b) Leadership training
c) Meeting with villagers for the planning of afforestation
d) Provision of seeds and seedling
e) Regular meetings and technical advice

Note: Training will be carried out by ALRO for a) and d) in the same way as Khon Kaen (see Chapter 11.4.1).

Operation by villagers:

- Plantation of seedlings around/in farm plots.
- Protection of seedlings from livestock
- Logging and replanting trees at the proper time

2) Reforestation Plan

According to the EIA report, an area the size of the proposed reservoir shall be reforested RFD in the desolated forest in Mukdahan. The priority area will be; 1) Catchment area of the proposed reservoir, 2) Dong Phu Phan Forest and 3) Other forests in Mukdahan. However, the area shall be selected after sufficient surveying as to whether inhabitants are cooperative or not. Details are shown in the EIA report in Appendix H.

10.3.5. Strengthening People's Organizations

At present, most villages in the Priority Area are below the development line. Moreover, the majority of villagers have no education and villagers are less progressive in community development. ALTO should endeavor to strengthen the peoples' organization under collaboration among relevant agencies such as DOAE, CPD, and the Department of Industrial Promotion, etc. For successful implementation of agricultural development, ALRO should proceed the project under participation of people. For strengthening peoples' organization, ALRO should select progressive farmers and provide them with "Training of Leadership", mentioned in Chapter 11.4.1. In strengthening of peoples' organization in this area, seven(7) items mentioned in Chapter 7.3.5. are to be taken into consideration as well as followings;

a) As a strategy of rural development in the 8th plan, strengthening of the community is encouraged. ALRO should collaborate with the concerned agencies for farmers able to receive enough benefit through the implementation of this strategy.
b) ALRO should perform the training and the extension works, like as "Training of Leadership", more intensively in this area than in other priority areas.

10.4 Preliminary Design

10.4.1 Farm Pond

The design of farm pond is same as that shown in Chapter 7.4.1.

10.4.2 Farm Road

The design of farm road is same as that shown in Chapter 7.4.2.

10.4.3 Huai Bang Sai Pump Irrigation Development

1) Location and River Condition

Intake of Huai Bang Sai pump irrigation project is provided at the left bank of the Huai Bang Sai river located 2.0km west from Phang Daeng village. The present condition of the river are as follows;

a) The river bed slope is 1/6,000 and depth of the river valley is about 12.0m.
b) The surface of river bed is covered with sandy soil and rocks expose in places.
c) The trace of flood is observed at 9.0 m ~10.0 m high from the river bed.
d) The river channel is meandering but center of the stream is stable.
e) The water depth of the stream during the dry season (observed January. 1998) is about 0.20m.

2) Diversion Weir

The diversion weir is provided to intake water from the river that has an insufficient water depth during the dry season. The weir is designed as a concrete fixed type with 1.80m in height and 42.0m in length. Effect of the weir on backwater to the upstream portion is little by judging from the results of the flood analysis. Even if the river overflows, a great deal of damage will not occur because there are no houses and roads nearby. In case that the foundation is sandy soil, necessary length of the apron is 13.9 m for fixed weir portion and 25.0 m for scouring sluice portion. The scouring sluice is provided at the left bank for preventing that sediment enter into the intake and removing off sediment deposited near the intake. The scouring sluice is 3.0 m in width and is operated by the sluice gate.

Intake canal, which is a 1.5 m x 1.5 m box culvert, is provided at the left bank. The screen is provided at the entrance of the canal and sluice gate is installed at the end of the intake canal.

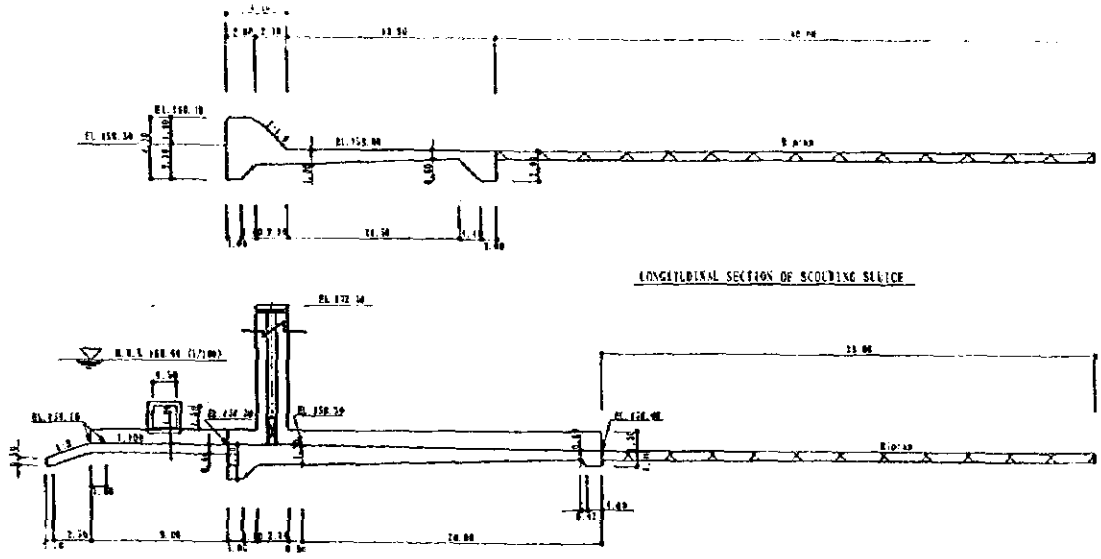


Figure 10.4.1 Longitudinal Section of the Huai Bang Sai Diversion Weir

3) Pump

The pumping facilities are provided at the top of the left bank of the river. The selected pump is a vertical mixed flow type ϕ350 mm pump with design discharge of 0.30 m^3/s, total pump head of 35.0 m and the fluctuation of suction level of 10.0 m. The electric prime mover is selected by reason of the average pump operation hour per day of 6.8 hr and that the power line is available at the main road about 500 m north from the site. The necessary power for prime mover is estimated at 160 kwh.

4) Water Conveyance System

The pipeline system is selected as a water conveyance system for this project. The pipe is a 0.50 m dia. asbestos concrete pipe which will be installed between the pump station and the 4,500m^3 capacity delivery tank provided at higher location.

10.5 Cost Estimation

1) Farm Ponds and Farm Roads Construction Project

a) Project Cost

The cost of the farm ponds and farm roads construction project in Mukdahan Priority Area is estimated at 42,793 thousand baht as shown below.

Table 10.5-1 Cost of Farm Ponds and Farm Roads in MKD-8.2 Priority Area

Item	Q'ty	Unit	Total Cost ('000Baht)
1.Civil Works			
1) 1,200m³ Farm Pond	270	Places	10,125
2) Farm Road	157,060	m	18,760
2.Enginerring Survey and Desigr	1	L.S	4,027
3.Administration	1	L.S	2,889
4.Physical Contingencies	1	L.S	3,580
Sub - Total			39,381
5.Price Escalation	1	L.S	3,412
Total			42,793

b) Annual Disbursement Schedule

The annual disbursement schedule is prepared as shown below.

Table 10.5-2 Annual Disbursement Schedule of Farm Ponds and Farm Roads in MKD-8.2 Priority Area

Item	Total Cost ('000Baht)	Year			
		1999	2000	2001	2001
1.Civil Works	28,885	0	0	14,443	14,443
2.Enginerring Survey and Design	4,027	2,014	2,014	0	0
3.Administration	2,889	173	173	1,271	1,271
4.Physical Contingencies	3,580	190	190	1,600	1,600
Sub - Total	39,381	2,377	2,377	17,314	17,314
5.Price Escalation	3,412	80	162	1,348	1,822
Total	42,793	2,456	2,538	18,662	19,136

c) Annual Operation and Maintenance (O/M) Cost

The annual O/M cost is estimated at 1,437,000 baht/year as shown below.

Table 10.5-3 Annual O/M Cost of Farm Pond and Farm Roads in MKD 8.2 Priority Area

Item	Q'ty	Unit	Total Cost ('000Baht)
1.1,200m³ Farm Pond and Well	330	Places	124
1.Main Farm Road	14.28	km	442
3.Lateral Road	9.77	km	349
3.On - Farm Road	33.01	km	522
Total			1,437

Remark ; The number of the farm pond is including the existing ponds.

2) Huai Bang Sai Pump Irrigation Project

a) Project Cost

The cost of Huai Bang Sai Pump Irrigation Project is estimated at 53,522,000 baht as shown below.

Table 10.5-4 Project Cost of Huai Bang Sai Irrigation Project

Item	Q'ty	Unit	Total Cost ('000Baht)
1.Civil Works			
1) Diversion Weir	1	L.S	8,548
2) Pump	1	L.S	17,413
3) Pipe Line Sistem	1	L.S	1,863
3) On - Farm Facilities	1	L.S	9,688
2.Engineering Survey and Desigr	1	L.S	3001
3.Administration	1	L.S	4,051
4.Physical Contingencies	1	L.S	4,456
Sub - Total			49,021
5.Price Escalation			4,502
Total			53,522

b) Annual Operation and maintenance (O/M) Cost

The annual O/M cost is calculated by multiplying the project cost by the percentage obtained on the basis of the working life of the facility and the coefficient as shown below.

Table 10.5-5 Standard Working Life of the Facility

Facility	Working Life (Year)	Coefficient (%)	Percentage (%)
Diversion Weir	50	50.0	1.0
Pipe Line	20	20.0	1.0
Canal	20	20.0	1.0
Pump	20	35.0	2.0

(Note) Percentage = 1 / Working Life x Coefficient
Working life and Coefficient refer to the projects in Japan and Thailand.
O/M cost of pump is not including the fuel or electricity charge.

The O/M cost of the project is estimated 779,000 baht as shown below.

Table 10.5-6 O/M Cost of Huai Bang Sai Pump Irrigation Project

Item	Annual Cost ('000Baht)
Diversion Weir	89.4
Pump	158.0
Pipe Line	18.4
On - Farm Facilities	95.9
Total	361.8

10.6 Project Evaluation

Agricultural development project of the Mukdahan Priority Area is composed of following two projects:

① Huai Bang Sai Pump Irrigation Project

This project constructs a pump station in Huai Bang Sai river and a delivery tank on

the top of mound to irrigate a farmland of 1,446 rai. The pump station and the delivery tank is connected with a pipeline of asbestos concrete pipe with a diameter 50 cm. For successful introduction of irrigated agriculture in this project, ALRO provides beneficial farmers with necessary training and in-sit farming support.

② Farm Pond and Farm Road Development Project

This project composed of farm road development and construction of 1,200m^3 capacity farm ponds of about 270. By implementation of this project, farmland with a farm pond will be 4,290 rai or 50% of the whole, together with the present farmland with a pond. In the farmland of 4,290 rai, integrated farming (including vegetable production, fruit tree cultivation, poultry, fish breeding, etc.) and fast-growing trees will be introduced. This project is also supported by ALRO on training and in-sit farming support for beneficial farmers.

Economic internal rate of return (EIRR) of the projects is as shown in table below by the results of project evaluation mentioned in Chapter 11.6.

Project	EIRR	B/C Ratio
① Huai Bang Sai Pump Irrigation Project	13.7	1.1
② Farm Pond and Farm Road Development Project	10.9	0.9

(Note) B/C ratio is based on the discount rate of 12%.

As the EIRR of Huai Bang Sai Pump Irrigation Project is higher than the rate 12% of the opportunity cost of capital set up in the Kingdom, the project is evaluated as economically feasible. On the other hand, the EIRR of Farm Pond and Farm Road Development Project is little lower than the rate 12%. However, in considering the characteristic of the project, it is due to carry out in Northeastern Region where is most populated and poor area. As the development of this area is one of the most important policies under promoting spatially balanced economic development of the Kingdom, the figure 10% mark would be highly enough because trickle-down effects can be expected by the project. As the unit investment cost of Huai Bang Sai Pump Irrigation Project is high about B37,000/rai, it is, therefore, recommended to implement the Farm Pond and Farm Road Development Project first, which is able to provide benefit to much more farmers.

Annual agricultural income of the typical farmers holding 13 rai farmland, an average in the area, will be increased as follows by the implementation of the planned farming in Table 10.3-1;

Annual Agricultural Income of Typical Farmers (Baht/Year/Farmer)

	Lowland Type	Upland Type
Present	11,753	11,190
Future	41,503	39,148

(Note) Details are in Chapter 11.6.5.

Average annual total income of farmers in the area is about 17,900 Baht. As shown in the above table, agricultural income of a typical farmer will be more than double of the average total income. Considerable number of farmers, therefore, can earn their income only on agriculture by the project.

CHAPTER 11 IMPLEMENTATION PROGRAM

CHAPTER 11 IMPLEMENTATION PROGRAM

11.1 Premises underlying Project Implementation

Even after water resources development has been carried out to the maximum possible effect, about 93 % of the Study Area remain rainfed. In this rainfed area, the major development activities will be to construct farm roads and farm ponds and to introduce integrated farming. Thai Government policy is to supply a farm pond of 1,200 cu.m storage capacity to every farm families lived in these rainfed areas without cost, and ALRO and other governmental agencies have been implementing this farm pond construction. However, the progress of the construction is slow due to budgetary constraints. For example, ALRO distributed about 1.8 million rai of land to 109,000 farm families in 1996, but ALRO constructed only 5,900 farm ponds in the same year.

The construction of farm ponds will be carried out in two ways as described below.

a) equal allocation every year to all LRAs.
b) concentrated construction in the project areas selected in the LRAs.

So far, ALRO has been constructing farm ponds in accordance with procedure a) above and it will be continued hereafter. The procedure a) above is a method to allocate equally a limited budget to each LRA but there is some problems listed below:

i) Because number of farm ponds to be allocated for each LRA is a few, it is rather difficult to provide a strong incentive to farm to the farmers and to strengthen people's organization.
ii) In order to introduce integrated farming, it is of vital importance to construct farm roads together with farm ponds. It will be difficult to construct effectively farm roads for LRAs having a few farm ponds.

By the reasons listed above, the development projects formulated in this Study include only the plans for concentrated construction of farm ponds in the project areas as well as construction of farm roads. The necessity of such development projects is to maintain the effectiveness of project implementation, namely to raise farmers' all-round welfare through project implementation. To achieve these objectives, the project areas should meet the following conditions in principle.

a) Implementation in less developed areas.
b) Establishment of productive farmers' groups.
c) Establishment of marketing groups.
d) Farmers to be willing, active and/or already in forming groups consisting of the majority of farmers.

The above conditions have proposed by the Study Team and agreed to by ALRO. In addition, ALRO intends to apply these conditions as possible to farm pond construction, which is presently implemented as a part of income generation and the restructure of agricultural production. These conditions place a considerable burden on the shoulder of farmers. However, it should be understood that ALRO takes responsibility upon itself for providing support to farmers in establishing productive farmers' groups and marketing groups. The productive farmers' group means farmer' groups (horticulture group, livestock breeding group, etc.) promoted by DOAE. The marketing group has a role to collect products from integrated farming such as fruits, vegetables, chicken, etc. , convey the products to markets and settle sales of the products, and composed of members of productive farmers' groups and people who have experience of business. ALRO should support for establishing and managing such farmers' groups in cooperation with DOAE, CPD, Ministry of Commerce and offer financial assistance by ALRO Fund required for providing collecting and loading warehouse, transportation means, etc.

In this Study, the agricultural infrastructure development project includes following projects.

① Farm pond and farm road construction (All Priority Areas)
② Creek dredging projects (Khon Kaen Priority Area only)
③ Huai Bang Sai pump irrigation project (Mukdahan Priority Area only)
④ Huai Lak reservoir irrigation project (Mukdahan Priority Area only)

Project① above should be implemented as soon as possible in order to the requests for earlier implementation but other projects may be implemented after confirmation of active activities by productive farmers' group and marketing group established in the stage of the project①. Therefore, projects ①-④ above are evaluated individually. Economic evaluation of Project ① is made taking no account of effects of 6,000 m^3 farm ponds which some farmers will provide by borrowing a long term loan from ALRO. Project ① is planned to be implemented during four years from 1999 to 2002 including project preparation period of two years (year 1999 and 2000) and construction period of two years (year 2001 and 2002). (refer to Chapter 11.5, 3))

11.2 Farm Pond Construction Planning

The Thai Government intends to construct a farm pond in all farm plots in rainfed areas, but it is assumed that the maximum possible amount of the farm plots with farm ponds constructed by the Government will be about 60 % because some farmers have no intention of dry season farming because their land-holding is too small to construct a farm pond. However, the development plan outlined in this report is formulated so as to construct a farm pond in each of the farm plots for 40 % of the farm plots located in each Priority Area with due consideration given to the following two factors.

Percentage of farm pond construction = factor (1) x factor (2)

where,

factor(1) : Possibility of farm pond construction estimated on this basis of physical conditions (Refer to Table 7.3-8 for Khon Kaen, Table 8.3-4 for Maha Sarakham, Table 9.3-6 for Sakhon Nakhon and Table 10.3-5 for Mukdahan)

factor(2) : Percentage of farm families who want a small-scale farm pond of 1,200m^3 capacity (based on results of social assessment)

Table 11.2-1 Possibility of 1,200 m^3 Farm Pond Construction

Priority Area	①	②	③
Khon Kaen (No.6 part)	54 - 61%	73%	39 -45%
Maha Sarakaham (No.5)	46 - 51%	99%	46 - 50%
Sakon Nakon (No. 3-1 part)	44 - 58%	94%	41 - 55%
Mukdahan (No. 8-2)	40 - 58%	73%	29 - 42%

When considering that the percentage of farm pond construction calculated in the above table ranges from 29 % to 55 %, the plan for constructing a farm pond for 40 % of farm plots, which is an average percentage, has been adopted for this Study. In the detailed design stage, thus should be decided after consideration of productivity of the farm lands and marketing conditions in and around the project areas. Number of existing and planned farm ponds for each Priority Area are shown in Table 11.2-3.

Based on the same calculation method, possibility of 6,000 m^3 farm pond construction is calculated at 9 - 17 % as shown below and 10 % of farmers, which is an average percentage, will have 6,000 m^3 farm pond.

Table 11.2-2 Possibility of 6,000 m^3 Farm Pond Construction

Priority Area	①	②	③
Khon Kaen (No.6 part)	40%	42%	17%
Maha Sarakaham (No.5)	18%	65%	12%
Sakon Nakon (No. 3-1 part)	15%	57%	9%
Mukdahan (No. 8-2)	27%	43%	12%

Table 11.2-3 Plan of Farm Pond (1,200m^3) Construction

Priority Area	(1) Total Farm Land (rai)	(2) Average Land Holding (rai)	(3) Total Household (Nos.)	Farm Pond Construction		Existing Farm Pond			Total Farm Pond		
				(4) Household (Nos.)	(5) Area (rai)	(6) Per cent %	(7) Household (Nos.)	(8) Area (rai)	(9) Household (Nos.)	(10) Area (rai)	(11) Per cent %
Khon Kaen (No. 6 part)	36,700	20	1,840	740	14,800	18	330	6,600	1,070	21,400	58
Maha Sarakham (No. 5)	14,600	12	1,220	490	5,880	23	280	3,360	770	9,240	63
Sakhon Nakon (No. 3-1 part)	25,100	10	2,510	1000*	10,000	7	180	1,800	1,180	11,800	47
Mukdahan (No. 8-2)	8,600	13	660	270	3,510	10	60	780	330	4,290	50
Total	85,000	13.6	6,230	2,500	34,190	14.8	850	12,540	3,350	46,730	55

(3) = (1)/(2), (4) = (3)x0.4, (5) = (2)x(4), (7) = (3)x(6)/100, (8) = (2)x(7), (9) = (4)+(7), (10) = (5)+(8), (11) = (10)/(1)x100

*: including wells of 750 Nos. for groundwater wihtdrawal

Farm Land Classified by Farm Pond Holding

Priority Area	Total Farm Land (rai)	Rainfed Area	
		w/ Farm Pond (rai)	w/o Farm Pond (rai)
Khon Kaen (No. 6 part)	36,700	21,400	15,300
Maha Sarakham (No. 5)	14,600	9,240	5,360
Sakhon Nakhon (No. 3-1 part)	25,100	11,800	13,300
Mukdahan (No. 8-2)	8,600	4,290	4,310
Total	85,000	46,730	38,270

11.3 Project Implementation Procedure

Farmers are main players and also beneficiaries of the development. Therefore, farmers' participation in all stages of the development process, from planning to implementation and monitoring, should be promoted. And, the efficiency of the development should be increased by developing the potentials of farmers and communities as much as possible. In this context, the following implementation procedure is proposed as well as the premises underlying project implementation mentioned in Chapter 11.1.

The main points for implementing the development projects are as follows:

a) To give high priority of project implementation to the following LRAs.
   - LRAs with progressive leader
   - LRAs with buffer zone

b) To implement the projects agreed by people lived in the project area through project explanation to people. People's participation at all stage of project implementation should be promoted.

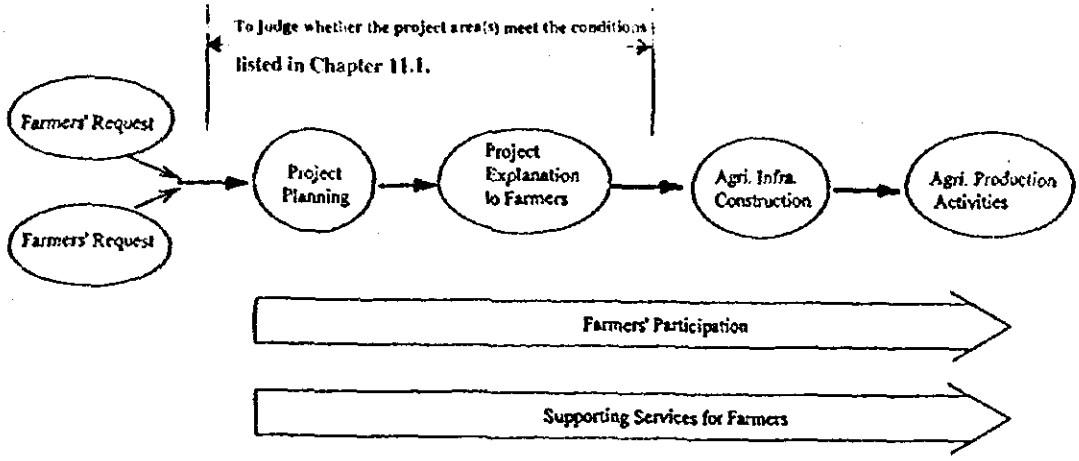


Figure 11.3-1 Project Implementation Procedure

11.4 Necessary Support Services for Farmers

11.4.1 Agricultural Extension Services

ALRO should implement necessary agricultural extension services in cooperation with DOAE, etc. with an eye on items listed in Chapter 4.6.1. In case that ALRO implements agricultural development project as a main implementing agency, ALRO should take

responsibility for serving the following farmers' training for 37 villages in the Priority Areas.

1) Required Farmers' Training

At present, ALRO has Training and Development Division, which is responsible for training and development of farmers in LRAs. With these expertise and experience, it is clearly seen that ALRO is capable of serving the project as "training coordinating agency". It is to be responsible for coordinating with supporting organizations i.e. DOA, DOAE, DOL, and DOF in searching for resource persons and in preparing technical know-how to develop and publish course manuals. The training coordinating agency will have to coordinate with PLROs in Khon Kaen, Maha Sarakham, Sakon Nakhon and Mukdahan to organize the training in term of training sites, transporting the farmers from the villages to the training sites and back home as well as taking care of the farmers during training period. The PLROs should serve the project as "training implementing agency".

a) Supporting Organizations

Even though there are several organizations serving as project members, only some departments are really relevant in training program. These departments are Department of Agriculture (DOA), Department of Agricultural Extension (DOAE), Department of Livestock (DOL) and Department of Fishery (DOF) and are essential for developing crop and animal production in integrated farming system activities. It is more appropriate to the progress and success of the project that these organizations are committed to provide resource persons either from central office or from provincial office, necessary training equipment and tools, and know-how to make training manuals.

Department of Agriculture has training center in the Regions. These training centers are equipped with classroom and dormitory for up to 40 persons, all essential audio visual aids. One center is located at Office of Agricultural Research and Development Region 3 in Khon Kaen and suitable for Khon Kaen and Maha Sarakham farmers' training. The another center, Sakon Nakhon Rice Research Center, is located in Sakon Nakhon and is suitable for Sakhon Nakhon and Mukdahan farmers' training.

Study trips of the farmers to other experiment stations to observe crop and animal productions in integrated farming system activities are readily found within the province.

b) Trainees

Field Working Group is assigned to select four progressive farmers from each village. Therefore, in 37 villages there will be 148 progressive farmers to be trained. Selection will base on readiness of the farmers in the project in term of cooperation, diligence and positiveness. It is aimed that these progressive farmers will serve as the project resources persons at farm level to disseminate what they learn from the training course to their fellow farmers while working on their own farms.

c) Training Subjects and Description

Training will be separated into four categories i.e. training for crop production,

training for animal production, training for integrated farming system and plant propagation, and training for leadership. In general, farmers have basic knowledge in agricultural subjects, therefore, training is provided to familiarize them with technological innovation of respective commodities. To facilitate the training manual, booklet and brochure concerning the subjects should be provided. These documents will help the farmers for understanding class lectures and for shortening training period.

Training for crop production comprises rice production, field crop production, vegetable production, fruit production and sericulture. It is proposed that one full day is required for each commodity. Therefore, five days are needed for this category. Subject descriptions are as follows:

i) Rice Production To familiarize the farmers with high quality rice varieties and high yielding varieties, and varieties suitable for the farmers' farm conditions. The farmers will also learn improved cultural practices, which include planting methods, fertilizer application, weeding and pest control to attain maximum yield.

ii) Field Crop Production To familiarize the farmers with improved cultural practices of some upland crop of improved varieties that can be grown in the Priority Areas such as sugarcane, corn, soybean, and mungbean.

iii) Vegetable Production To familiarize the farmers with innovative cultural practices of such important vegetables as cabbage, Chinese kale, tomato, chili and cucumber.

iv) Fruit Production To familiarize the farmers with good varieties of such fruit trees as mango, tamarind, pomelo and jackfruit. The farmers will learn about fertilizer requirement of each kind and branch pruning to obtain high yield and high quality fruits.

v) Sericulture This subject is to teach the farmers good varieties and cultural practices of mulberry and good sanitary of insect rearing. However, this subject is optional which means that in any batch of the training if there is no sericulture farmer this subject may be omitted.

Training for animal production comprises beef cattle raising, grassland management, poultry raising, pigs raising, and fish culture. This training course will also take five days - one day for each subject. Subject descriptions are as follows:

i) Beef Cattle Raising This is to familiarize the farmers with beef cattle breeds, their nutrient requirements and important diseases and control means.

ii) Grassland Management This is to introduce to the farmers high quality grass (refer to Chapter 4.2-4) that can be grown under rainfed conditions and grassland management for beef cattle supplementary diet.

iii) Poultry Raising Poultry includes muscovy duck and local breed chicken. The purpose of the subject is to familiarize the farmers common poultry management such as shelter, vaccination, diets, and weight building for market.

iv) Pig Raising This is to familiarize the farmers with swine breeds that are suitable for subsistent farming including their diets, diseases control, and slaughter weight.

v) Fish Culture This is to introduce to the farmers common fish varieties that can be easily cultured in farm ponds in short duration, such as tilapia and carp, and their inexpensive cultural practices.

Training for integrated farming system and plant propagation comprises introduction of integrated farming system, farm planning, farm accounting, and plant propagation. This training course takes four days; two days will be spent for introduction of integrated farming system, half a day each for farm planning and farm accounting, and one day for plant propagation. Subject descriptions are as follows:

i) Introduction of Integrated Farming System This is to introduce to the farmers basic concept of integrated farming system and interrelation among commodities productions within the system.

ii) Farm Planning This is to introduce to the farmers preparation of annual farm plan as to what to do and when to do at specific period of time to attain highest possible farm potential.

iii) Farm Accounting This is to introduce to the farmers basic farm account making to keep up with farm inputs and expenses, and all farm incomes.

iv) Plant Propagation This is to familiarize the farmers with asexual plant propagation i.e. layering, budding and grafting which is essential for fruit trees multiplication.

Training for leadership comprises the items shown below. This training course takes five days.

i) Training in managerial skills, business, production know-how, marketing, finance and general administration This is to widen leaders' knowledge required for forming, managing and strengthening farmers' organization.

ii) Training in community forest management and environmental conservation
This is to introduce to the farmers basic concept of community forest and know-how for community forest management and to teach importance of environmental conservation, especially conservation of forest.

d) Conclusion

Training Coordinating Agency:
Project Coordination Organizations proposed in this report and ALRO's Training and Development Division

Training Implementing Agency : Provincial Land Reform Offices

Training Places : Office of Research and Development Region 3 for training of farmers in Khon Kaen and Maha Sarakham Priority Areas.
: Sakon Nakhon Rice Research Center for training of farmers in Sakon Nakhon and Mukdahan Priority Areas.

Trainees : Progressive farmers - four from each village

Number of Villages :		
	Khon Kaen	11
	Maha Sarakham	7
	Sakon Nakhon	12
	Mukdahan	7

Training Period :
(i) Crop Production :5 days
(ii) Animal Production :5 days
(iii) Integrated Farming System and Plant Propagation : 4 days
(iv) Leadership Training :5 days

2) Supporting Services in the Project Areas

In addition to the farmers' training mentioned above, ALRO should carry out the technical supporting services for vegetables and fruits production, animal production, etc. at the sited of the Priority Areas by ALRO's Training and Development Division or specialists recruited by ALRO. For Mukdahan Priority Area, more intensive services as compared with other Priority Areas should be carried out.

11.4.2 Non- farming Employment Promotion Activities

The majority of farmers are interested in introducing farm pond based integrated farming which can be expected to earn the highest farm income in the Study Area, but it is

assumed that the maximum possible amount of the farm plots with 1,200 m^3 farm pond supplied by the Government without cost will be about 60 %. On the other hand, construction possibility of 6,000m^3 farm pond, which is enlarged 1,200m3 farm pond, is estimated to be about 10 %. About 40 % of all farm families can not introduced farm pond based integrated farming even after the farm pond construction has been carried out to be maximum possible. Therefore, non-farming employment should be promoted for LRAs. At present, such agencies as DOAE, CPD, the Department of Skill Development, the Department of Industrial Promotion, etc. carry out non-farm employment promotion. ALRO should provide effective supports for farmers in increasing non-farm employment opportunities with an eye on the following items.

a) Strengthening local organizations or farmer's groups and developing their capabilities so that they can play active roles in non-farming employment promotion.
b) Supporting the existing off-farm income-generating activities for women's groups and youth groups such as silk weaving, handicrafts and home processing of agricultural products.
c) Encouraging the private sector to assist farmers' groups or local organizations and communities by providing capital, technology, information services, and investment opportunities for small-scale agro-processing operations and cottage industries.
d) Providing information services and technical assistance for cottage industries and small-scale agro-processing at the village level.
e) Expand community funds and establish fund networks for supporting non-farming employment activities effectively.
f) Creating strong back-up bodies at provincial and/or Amphoe levels in all activities related to non-farming employment promotion.
g) Promote systematic and effective collaboration among various relevant agencies, i.e. ALRO, DOAE, CPD, the Department of Industrial Promotion and NGOs, for supporting non-farming employment activities in the Priority Areas.
h) Provide occupational skill training as mentioned in Chapter 4.6.2, 3).

11.4.3 Farmer Supporting Fund

1) Non-Agricultural Funds

Aside from the normal agricultural credit services through BAAC, Agricultural Cooperatives, Land Reform Fund and Commercial Banks, non-agricultural funds, i.e. fund for production saving groups, poverty eradication fund and funds for promotion of cottage industries and handicrafts are also lending to the farmers. At present, major source of non-agricultural funds to assist particular target groups in the Priority Areas may be summarized as follows:

Source of Fund	Agency Responsible	Value of Fund (Baht)
Poverty Eradication Fund	CDD	280,000/village
Women's Weaving Groups	CDD	100,000/4 villages
Water User's Groups	CDD	60,000/group
Fund for Promotion of Employment for Youth	CDD	5,000/group
Fund for Promotion of Cottage Industries and Handicrafts	Dept. of Industrial Promotion	not more than 500,000 baht depending on the project

Most of the CDD funds are lending to village or group for specific development projects without interest and are used as a revolving fund of the village or group. However, the poverty eradication fund has been implemented only in villages, which were below the development line. Also, a fund for the promotion of cottage industries and handicrafts through the Department of Industrial Promotion was recently implemented. In general, those funds offer communities the opportunity to develop community ownership and management skills. They establish the rules and lending conditions as well as determining who should receive the funds. Actually, the budget provided for those funds is insufficient compared to the need of farmers for future development. Following the promotion of integrated farming and non-farming employment programs in the future, the need for credit support in the form of both normal agricultural credit and non-agricultural funding in the Priority Areas will increase rapidly.

To effectively implement and strengthen the necessary support services for farmers, the following measures are deemed necessary.

a) Provide extensive training in establishment and operation methods of the funds for those who will ultimately administer the funds before their funds are initiated.
b) Provide technical support to communities at both initiation and implementation stages of their funds.
c) Encourage the amalgamation of many relevant funds at the village level promoted by the same government agency into a single fund that could be linked to a village saving group.
d) Expand the lending capacity of Land Reform Fund in the Priority Areas. Moreover, technical support should be provided by the government agencies concerned.
e) Strengthen financial management capability of staff working in Land Reform Fund services through: increasing efficiency in loan appraisal, provision of information networks linking the central office and provincial offices, training of staff and monitoring the loaning period.
f) Expand the lending capacity of existing lending institutions to solve the various problems related to the rural employment generating program, particularly, shortage of revolving fund for the promotion of cottage industries and handicrafts.
g) Support private financial institutions to arrange various forms of credit to help farmers in the Priority Areas towards integrated farming and the non-farming employment generating programs.
h) Establish systematic and effective collaboration among the relevant government agencies,

particularly, ALRO, CPD, CDD, BAAC and the Department of Industrial Promotion.

2) Necessary Loaning

The loan will be provided for farmers who are willing to start integrated farming in Priority Areas.

a) Number of target farms :

Total 3,350 farms with farm pond or wells as shown in Table 11.2-3.

Table 11.4-1 Number of Target Farms

Priority Area	1,200 cu.m F/P	6,000 cu.m F/P	Total
Khon Kaen	870	200	1,070
Maha Sarakham	627	143	770
Sakhon Nakhon	961	219	1,180
Mukdahan	269	61	330
Total	2,727	623	3,350

b) The volume of loan for agricultural activity

Loan with low interest rate of 5 % will be provided for agricultural activity of farmers.

Table 11.4-2 Loan for Agricultural Activity

Short term loan	3,369,644 Baht
Medium term loan	16,915,540 Baht
Long term loan	109,093,081 Baht
Sub total	129,378,265 Baht

c) The volume of loan for starting new agriculture

Furthermore, long term loan is provided for building coops for chicken and cow and pond construction. The amounts of loan needed for those are ;

Table 11.4-3 Loan for Starting New Agriculture

Loan for Pond	76,468,889 Baht (623 household)
Coop for chicken	6,700,000 Baht (3,350 household)
Coop for Beef cattle	4,737,003 Baht (1,184 household)
Sub total	87,905,892 Baht

The total volume of loan are;

Total 217,284,157 Baht

b) Loan Scheme Brief:

i) Short term loan will be provided for one-year crops, which are able to plant and harvest within one year. Recommended crops and livestock, which are possible to receive loan, are: Rice, Soybean, Groundnuts, Papaya, Banana, Vegetables, and Fish.

Normally, BAAC is promoting this short term loan for farmers. The Fund

supplements the shortage of interest of 4 % so those farmers can get loan at 5 % interest rate because BAAC loan annual interest rate is 9%. However, farmers who are not qualified for BAAC short term loan will be able to receive principally from the Fund. The estimated total amount of loan is shown in Appendix G, Table G-LO-2.

The borrowers can get loan at the time of planting and have to pay back it after selling products within one year.

ii) Medium term loan will be provided for livestock breeding which cannot get income within one-year, but able to get income during 2 or 3 years.

iii) Long term loan will be provided for planting fruit trees and fast growing trees, that cannot get income until trees grow enough to sell. The loan provides necessary budget for starting fruit tree planting and also supplements living expense for first five years.

The preferable amount of loan was estimated based on the average production cost of each crop per rai. For perennial crops, loan also would be used for compensation of living expense while farmers cannot get enough income from those farming.

iv) Loan for Pond Construction and Coops for livestock

ALRO Fund also provides loan for expanding pond and building coops for livestock. Regarding a farm pond of 1200m^3, ALRO will supply it without cost and the necessary cost to expand additional capacity of 4,800m^3, which costs 190,750 baht per pond will be provided by long term loan with 5 % interest rate. In starting to feed livestock, the Fund also provides a long term loan with 5 % interest rate for this initial investment.

Table below are estimated preferable amount of loan for each farming type.

Table 11.4-4 Amount of Loan for Each Priority Area

Kohn Kaen for 870 farms (Unit: Baht)

	Short term loan *1	Medium term loan	Long term loan	No. of farms	Total per farm
Lowland Type	660	0	75,000	104	75,660
Upland Type	1,510	0	75,000	209	75,510
Mixed Type	1,402	20,000	1,875	557	23,277
Each loan total	1,165,874	11,148,953	24,562,537	870	36,877,363

* 1 Amount of loan for short term loan is the supplemental cost for interest of 4 % of BAAC normal loan.

Maha Sarakam for 627 farms (Unit: Baht)

	Short term loan *1	Medium term loan	Long term loan	No. of farms	Total per farm
Lowland Type	487	20,000	0	144	20,487
Upland Type	616	20,000	0	144	20,616
Mixed Type	855	20,000	0	338	20,855
Each loan total	448,582	5,766,587	0	627	6,215,170

Mukudahan for 961 farms (Unit: Baht)

	Short term loan *1	Medium term loan	Long term loan	No. of farms	Total per farm
Lowland Type	571	0	37,500	355	38,071
Upland Type	517	0	50,000	605	50,517
Each loan total	515,557	0	43,585,193	960	44,100,750

Sakohn Nakon for 269 farms (Unit: Baht)

	Short term loan *1	Medium term loan	Long term loan	No. of farms	Total per farm
Lowland Type	491	0	37,500	91	37,991
Upland Type	435	0	53,500	177	53,935
Each loan total	121,969	0	12,910,351	269	13,032,319

6000m^3 Farm Pond for 623 farms (Unit: Baht)

	Short term loan *1	Medium term loan	Long term loan	No. of farms	Total per farm
For agri activity	1,794	0	45,000	623	46,794
Pond construction	-	-	122,743	623	122,743
Each loan total	1,117,662	0	104,503,889	623	105,621,551

The fund will be operated trough monitoring farmers' new farming for several times annually and giving advices to farmers about problems with that they will face financially and technically.

The fund has not intention to expand profit but provides opportunities to practice new farming for farmers who will not have initial investment money to start new agriculture.

11.4.4 Supporting Services for Post-Harvest Handling and Marketing

In the Priority Areas, development plan for agricultural infrastructure and farming is to promote integrated farming. Under that development plan, products for marketing will be vegetables and fruit. Products form livestock and fishery which are of small-scale would be for home consumption and sometimes sold, in case there are some surplus. Major measure

of integrated farming is construction of farm pond for individual farmers. One farm pond will be able to supply water to a one-rai vegetable field for year around cultivation. Under the condition of full-scale pond development which corresponds to development for 40% of all farmers, estimated vegetable production in one harvesting period will reach 851,000 kg, 563,500 kg, 310,500 kg and 1,150,000 kg in the Priority Areas of Khon Kaen, Maha Sarakham, Mukdahan and Sakon Nakhon respectively (refer to Appendix F : Table 11.4.4-1 Estimated Vegetable Production and Demand by Area). Estimated fruit production in one harvesting period is 2,468,640 kg, 1,634,640 kg, 900,720 kg and 830,493 kg respectively (refer to Appendix F : Table 11.4.4-2 Estimated Fruits Production and Demand by Area).

On the other hand, demand for vegetables is estimated at 488,000 kg, 1695,000 kg, 59,000 kg and 88,000 kg near the Priority Areas at Amphoe level. Demand for fruit is calculated at 318,000 kg, 1,104,000 kg, 38,000 kg and 57,000 kg respectively. However, provided the supply is adequate, demand would increase triple to fourfold. In this case, all products from the Priority Areas in Khon Kaen and Maha Sarakham will be able to be sold easily. However, selling from Mukdahan and Sakon Nakhon will be difficult as long as it will not be considered that diversification would be applied for marketing as well as products should be sold in Amphoe level and in provincial level. Especially in the Priority Area of Sakon Nakhon, not only vegetables and fruit but also specialized products such as herbs, wood and roots for medicine should be promoted considering the topographic conditions and marketing situation.

1) Post-Harvest / Marketing System Flow

At present, farmers grow vegetables and fruit individually for home consumption. In future, they will grow marketable products under the construction of an irrigation water supply system. This will constitute new and additional work for farmers. Since almost all vegetables and fruit are easily perish within a week and individual farmers have not enough marketing experience, it should be considered that post-harvest handling and marketing of products is conducted smoothly and systematically when the marketing volume of products is sufficient. Systematic operation will be able to be carried out by groups, which would be composed of small-scale farmers. Establishment of groups would be supported by the government agencies concerned. Activities of individual farmers and groups in future are shown in the following depiction on example (refer to Figure 11.4-1 "Depiction of Post-Harvest/Marketing Flow System"). In this depiction, farmers will be responsible from harvesting to conveying the product to collecting house. Farmers' groups will carry out tasks from grading to selling the products at farm gate and/or at the markets at Amphoe level. The government agencies concerned should support farmers and farmers' groups at every stage of activity by means of giving information of marketing conditions such as reasonable marketing points and prices as well as transferring technologies of group activities and systematic post-harvest handling and marketing.

2) Necessary Government Support for Farmers

Necessary government support for post-harvest handling and marketing are as follows:

a) Promotion of selection of marketing places and marketing channels: Generally, products such as vegetables and fruit will be sold within the Amphoe. However, products from Mukdahan and Sakhon Nakhon Priority Areas should be sold within and without the Amphoes because demand will be not enough in the Amphoes. Traders, middlemen, cooperatives, associations, wholesalers, retailers or factories would be selected and nominated in and around the Amphoe. At the beginning of the project, selection of marketing routes and buyers at the Amphoe level should be promoted. When the number of buyers is sufficient, auctions of achieving satisfactory commerce would be one of the recommended methods.

b) Setting-up quality standards for each product: Usually, good quality products can be sold for a high price. Size, length, weight, color, purity etc. of products should be decided as the quality standards between buyers and sellers for satisfactory commerce.

c) Establishment of a market price information system: At present, the Commercial Office conducts a survey of central market prices at provincial level and informs to the Amphoe and Tambon offices. Unfortunately, their information is too late for farmers who intend to sell vegetables and fruit, which perish easily. This information system should be expanded and up-to-date information should be provided by radio and television broadcasts and/or a telecommunication system.

d) Support for creation of a systematic marketing and working style: At present, farmers have not enough experience of selling products. Systematic handling should be considered for timely selling according to the market demand. Planting and harvesting patterns should be created and improved periodically by establishing a feedback system concerning the linkage of market information, quality standards, developed technology, etc. This feedback system should be conducted in a timely fashion.

e) Support for the introduction of equipment and facilities: When the handling volume of products increases in future, some farmers or farmers' groups will want to try and use equipment and facilities such as quality control equipment, grading and cleaning equipment as well as collecting and grading houses. Advices and suggestions about the selection of equipment and facilities should be provided.

f) Support for setting-up farmers' groups: It is necessary to explain the effectiveness of group activities for farmers. When farmers have the desire of setting up a group, technologies for group organization, accounting and operation should be transferred to the farmers and revolving fund necessary for operation of farmers' groups should be provided by government agency..

g) Promotion of sustainable development: One activity for sustainable development is the promotion of creating diversification of food preservation such as dry preservation, sugar preservation, vinegar preservation, retort preservation, juice, puree, etc. which will be able to be carried out by the farmer himself and/or cottage industries. One activity for sustainable development is the promotion of exhibition with prizes for technology of each category between the farmers, groups and villages as well as wider areas.

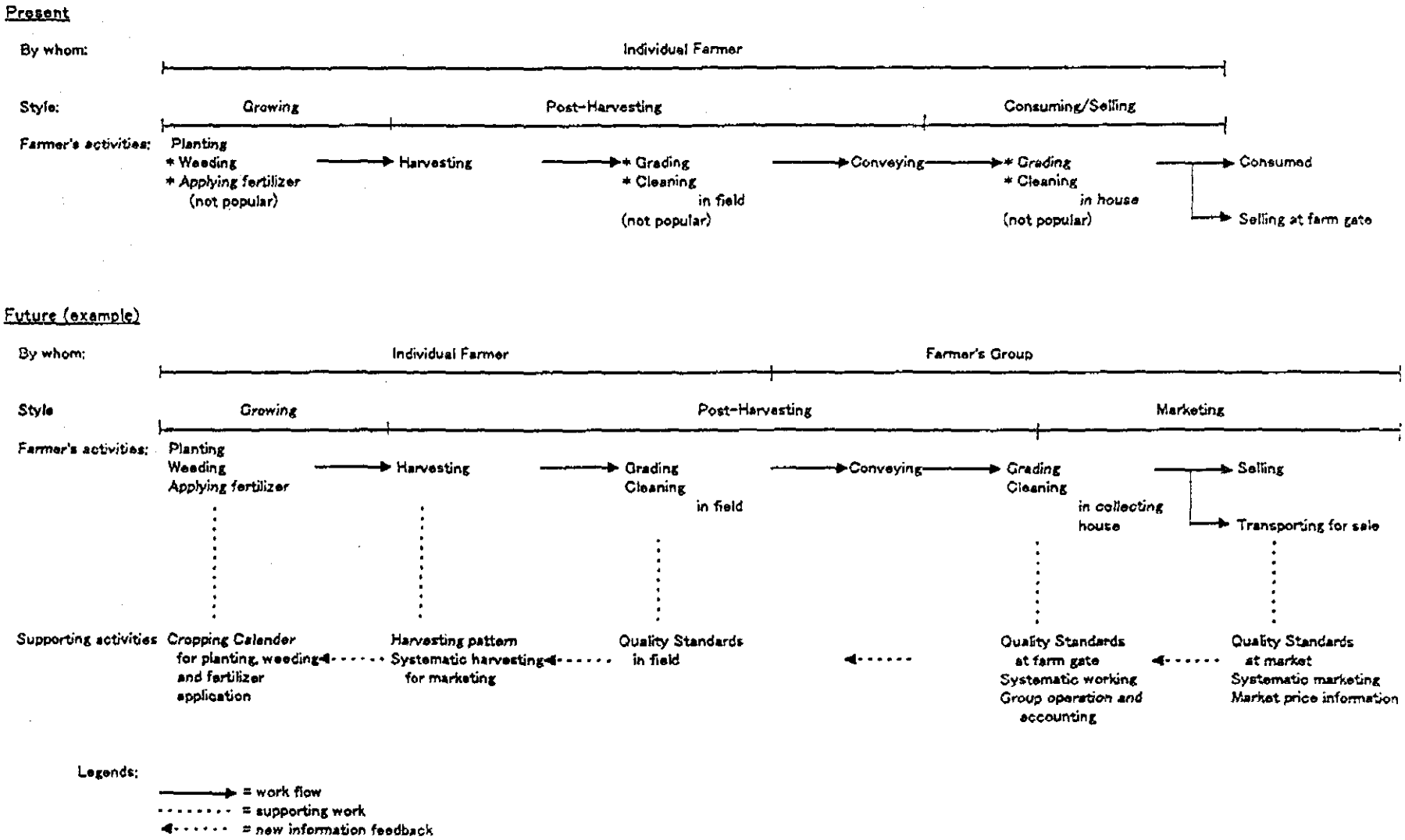


Figure 11.4-1 Project Implementation Procedure

11.5 Project Implementation Organizations

1) Project Coordination

Because the proposed development plan covers various components, i.e. agricultural infrastructure development, agricultural development, non-farming employment promotion and necessary supporting services for farmers, ALRO cannot handle all the components alone. Hence the project goal can be achieved only through the coordination of these activities with those of other agencies involved in the project. In order to assure smooth and successful implementation of this project, several levels of coordination are needed for project implementation, national level coordination of plans and budgets, provincial level coordination of local government agencies and project level coordination of manpower.

It is recommended that three levels of coordinating committee and field working groups be established as follows:

a) Project Executive Committee
b) Project Coordinating Committee
c) Provincial Coordinating Committee
d) Field Working Group

The Project Executive Committee will be the top executive body and will assume leadership of external coordination among the agencies concerned, which should be chaired by the Deputy Permanent Secretary of MOAC. This committee will set policies, approve coordinated annual operation planning, resolve any problems and difficulties in project implementation, budgetary and personnel matters of major importance, review the progress of the project and consider any necessary revisions or extension of the project. Members of this committee would be the Director General of the involved offices and departments.

The Project Coordinating Committee could be a group of working-level officials from the agencies involved who assist the executive committee in preparation of annual operation planning, budget and manpower requirements. This committee would have an important advisory role in project implementation and supervising the overall work performance. Members of this committee would be composed of Division Directors of the agencies involved who have direct authority to issue orders to field staff from their respective departments.

The Provincial Coordinating Committee would function as provincial level coordination. This committee should be chaired by the Deputy Governor. While members of the Provincial Coordinating Committee are composed of provincial officials of the agencies involved in the project and District officers of the districts concerned.

The Field Working Group plays a major role in coordination among the agencies concerned at the field level. In the project area, a Field Working Group should be established and the Director of Provincial Land Reform Office should act as chairman of this Field Working Group. Its members would be District officials of the active agencies

involved in the project. For successful implementation of the project at the field level, the Field Working Group needs strong back-up by ALRO and the agencies concerned in various fields regarding technical matters. Furthermore, its members should have regular formal and informal contact with each other and the Field Project Manager. In addition, the Field Working Groups should work together with local farmers' groups or local organizations and NGOs with respect to their specialized fields.

The organization structures for project coordination and implementation are shown in Figures 11.5-1 and 11.5-2. The members of organization are shown in Table 11.5-2.

2) Project Implementation

ALRO will be the leading executive agency responsible for project implementation. The organization structure for project implementation is shown in Figure 11.5-3. Personnel from other agencies would have to be assigned to the project through coordinated operational and manpower plans approved by the Project Executive Committee. This committee will appoint the Deputy Secretary General of ALRO as a Project Director who will act as the secretary of the Project Executive Committee as well as a chairman of the Project Coordinating Committee. Generally speaking, the Project Director exercises project management, financial control, and procurement administration. He also has line authority over project managers. Under the supervision of the Project Director, two project managers would be appointed, one as Bangkok office project manager for planning, management and administrative activities of the project, the other as field project manager for supervision of day-to-day operation in the project area. The ALRO Division Director of active involved division would be appointed Office Project Manager, while the Director of PLRO would be appointed Field Project Manager. For smooth project operation, a project support unit should be established to assist in day-to-day administration at the Bangkok office. However, in the case of a loan project, private consultants and contractors have to be considered in the organization of the project. If it is necessary for effective implementation, project operation at the field level should have technical assistance in the form of a technical advisory group to provide technical services for the Field Working Group. A technical advisory group should be staffed with subject specialists of different fields in accordance with farmers' request.

3) Project Implementation Schedule

The project implementation schedule is planned as shown below:

Table 11.5-1 Project Implementation Schedule

項　　目	1999	2000	2001	2002	2003	2004	2005
1)Project Preparation*1							
2)Agri. Infra. Development							
3)Farmers' Training*2							
4)Supporting Services by Agencies concerned							

Note) *1 : Including establishment of project implementation organization, detailed design study, preparation of contract documents, selection of contractor, etc.

*2 : including farmers' training and supporting services in the project areas mentioned in Chapter 11.4.1.

Structure	Chairman	Secretary	Members	Major Functions
Project Executive Committee	Chairman : MOAC Deputy Permanent Secretary Vice Chairman: Secretary General of ALRO	Deputy Secretary General of ALRO as Project Director (P/D)	DGs of involved officers and Depts	Formulated Policy or Program in accordance with the scope of the project. Approve annual plans, to coordinate and resolve any problems
Project Coordinating Committee	Project Director(P/D)	ALRO Division Director as Project Manager	Division Director of involved Divisions	Working-level officials from involved agencies, reviewing policy, operation plans and budget to coordinate and resolve any problems
Provincial Coordinating Committee	Provincial Deputy Governor	Director of PLRO as Field Project Manager	Provincial and District officials involved in the project	To coordinate and supervise over-all works at the provincial level
Field Working Group	Field Project Manager	Chief of Land Reform Management Branch	Active agencies in the project at Amphor level and local organizations	To cooperate and coordinate at the field level

Figure 11.5-1 Committee Structure for Project for Project Coordination (1/2)

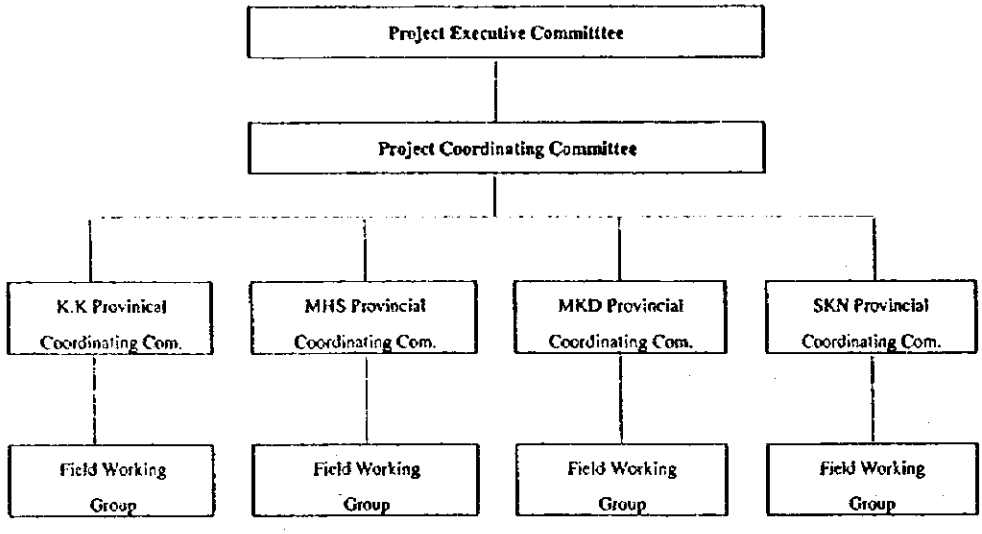


Figure 11.5-2 Committee Structure for Project for Project Coordination (2/2)

Table 11.5-2 Member of Committee for Project Coordination

Project Executive Committee

Project Executive Committee	
Deputy Permanent Secretary of MOAC	chairman
Secretary General of ALRO	vice chairman
Director Generals of:	
RID	member
RFD	member
DOAE	member
DOA	member
CPD	member
DLD	member
LDD	member
DOLA	member
ARD	member
CDD	member
DIP	member
Secretary General of OAE	member
Secretary General of NESDB	member
Director of the Bureau of the Budget	member
General Manager of the BAAC	member
Deputy Secretary General of ALRO	secretary

Project Coordinating Committee

Project Coordinating Committee	
Deputy Secretary General of ALRO	chairman
Division Director of :	
RID	member
RFD	member
DOAE	member
CPD	member
DOF	member
DLD	member
LDD	member
DOLA	member
ARD	member
CDD	member
DIP	member
OAE	member
NESDB	member
Bureau of the Budget	member
BAAC	member
Project Manager	secretary

Provincial Coordinating Committee

Provincial Coordinating Committee	
Deputy Governor	chairman
Head of Provincial Agricultural and Cooperative Office	vice chairman
Directors of Provincial Officers of:	
Agricultural Extension Office	member
Livestock Development Office	member
Forestry Office	member
Fisheries Office	member
Irrigation Office	member
Cooperatives Promotion Office	member
Representative of DLD	member
Commercial Office	member
Community Development Office	member
Accelerated Development Office	member
Department of Industrial Promotion	member
Branch of BAAC	member
District Chief Officer within the Implementing Area	member
Director of PLRO	secretary

Field Working Group

Field Working Group	
Director of PLRO	chairman
Heads of District Officers of:	
Agricultural Extension Office	member
Cooperatives Promotion Office	member
Fisheries Office	member
Livestock Development Office	member
Community Development Office	member
District Branch of BAAC	member
Representatives from local farmers' groups	member
Representatives from appropriate NGOs	member
Officer of PLRO	secretary

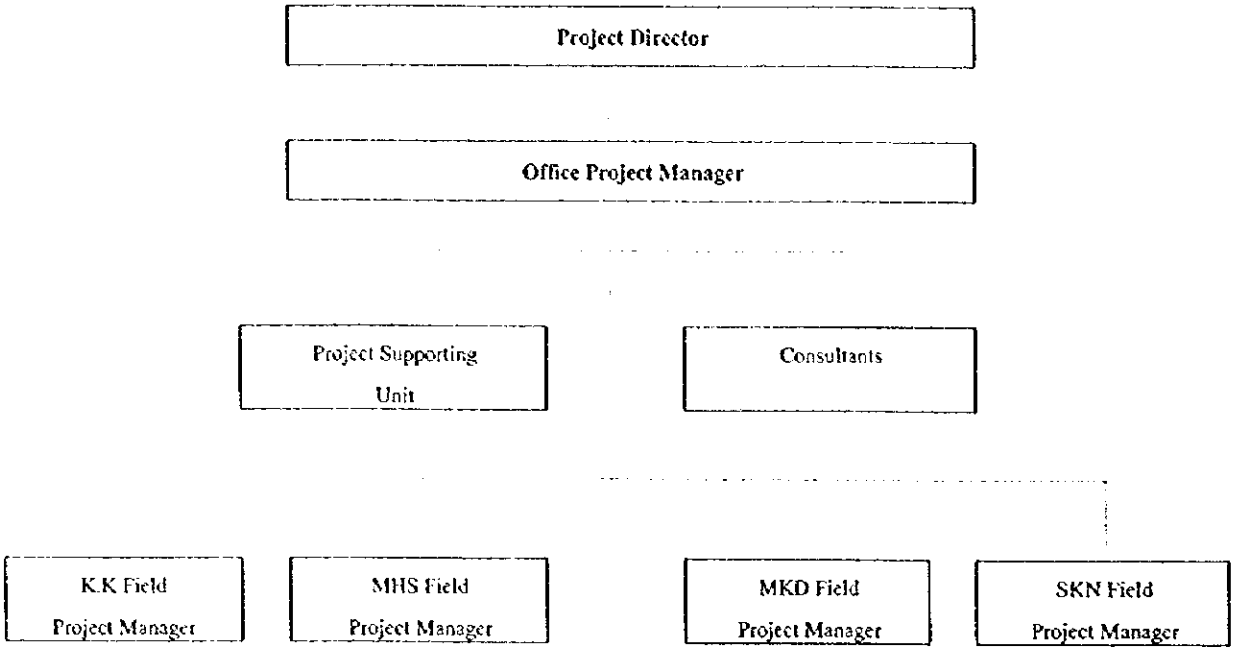


Figure 11.5-3 Project Implementation Group

4) Operation and Maintenance of Project Facilities

The proposed agricultural infrastructure are classified into two categories, namely, major facilities such as village link roads, weirs, main irrigation canals, etc. and on-farm facilities including farm ponds, wells, on-farm roads, irrigation ditches, etc. The operation and maintenance of the major facilities should be carried out by existing organization of the project implementation agencies. However, it is recommended that the village committees should have responsibility for daily operation and maintenance of community ponds and other facilities, which are constructed near the villages as much as possible. The on-farm facilities shall be operated and maintained by the beneficial farmers' group or individual farmer in principle, and the government agencies should provide necessary technical assistance with periodic visits to the project sites. The beneficial farmers' group for operating and maintaining the project facilities should be organized under guidance of ALRO and village committee.

11.6 Project Evaluation and Farm Budget Analysis

11.6.1 Introduction

The feasibility of project will be evaluated by two aspects :micro and macro level.

At micro level, the economic soundness of each farming type by looking at annual income, profit, and cash flow of each farm will be analyzed. The analysis is shown in Chapter 11.6.5 at macro level, project feasibility at national economy level will be evaluated. The analysis is shown in Chapter 11.6.3 and 11.6.4.

Due to the currency speculation of early 1997, the old exchange rate system collapsed because of huge loss of foreign reserve account of Bank of Thailand, and then a floating exchange rate system was adopted. The 60 billion-dollar private sector debt, which was not risk hedged, triggered the recent economic turmoil in Thailand. The GDP growth is close to zero in 1997 compared with the past high growth recorded 8 to 10 %.

The oversupply of loan to real estate sector is now accelerating the deprecation of Thai currency baht. The devalued baht recorded historical low value of 56 baht to 1 US dollar at Feb 1998.

In looking at future economy, the oversupply of housing continues up to 2001 and it is unlikely to sweep out non-performing loan, it tells that even Thai receives emergency loan of 19 billion dollar from international syndication including IMF, the current recession will continue at least around 2004 to 2005. This also would give a significant impact on agriculture because input costs such as those of fertilizer or fuel being imported will rise up. The uprising of input costs obliges the reduction of input for agriculture and leads to the yield decrease. This year's preferable export boosting according to the currency devaluation and El nino effect will not last for a long time because the currency devaluation occurred not only in Thailand but also other agricultural exporting countries in Asia. Thus comparative advantage for agricultural export oriented products of Thailand would not continue so long.

However, in this report, it is assumed that the effect from macro economy to agriculture in Priority Areas is rather small because project effect will continue for 30 years regardless of recent economic turmoil. Therefore, it is assumed that this project would be carried out under normal economic condition obtained before the devaluation of the Thai baht.

11.6.2 Evaluation Methodology for Project Evaluation at Macro Level

1) "Without project (W/O) " and "With project (W/)" situations of Agriculture

Farmers in the Priority Areas have been practicing same style of agriculture for

several decades. It is assumed that farmers will continue this agriculture style and basically "Without project" situation is same with "Current" situation.

In "With project" situation, through the provision of farm ponds, land use will change in large parts. Because availability of water will make farmers possible to plant vegetables and fruit crops, and to feed fish. Furthermore, access to low interest loan make them possible to start raising livestock which requires a initial investment or planting fruit crop and fast growing trees which give little income for first 5 years but high income after sixth years.

The execution of proposed projects contributes to get higher income for farmers.

2) The basic sets of economic evaluation of projects

The conditions below are set for evaluating economic feasibility of the proposed projects.

a) The benefits expected by the implementation of the project are composed of direct and indirect benefits. However, the evaluation focuses on tangibly direct benefit "crop production" from projects.
b) The "Without project" situation is assumed to be same with the "Current" situation.
c) All prices of inputs and outputs are expressed by domestic currency baht.
d) The exchange rate of 1 USD to 25 baht is used.
e) Estimation of project benefit will generate for project period of 30 years.
f) For crops which could be exported and substituted for imports, international prices by "World Bank commodity market review" is used for calculating farmgate price of crops. As for crops mainly consumed domestically, those prices of non-tradable are presented by adjusting market prices based on local market price survey.
g) The cropping pattern and unit target yield are based on the Agricultural Development Plan, as presented in Chapter 7 to 10.
h) To convert financial price to economic price, the following conversion factors are used.

Standard Conversion Factor (SCF)	0.92
Consumption Goods Conversion Factor (CGCF)	0.95
Construction Conversion Factor (CCF)	0.88
Electricity Conversion Factor (ECF)	0.9
Transportation Conversion Factor (TCF)	0.87
Labor Conversion Factor (LCF)	0.92

i) The discount rate, which reflects the average annual percent yield obtained by the best performing public sector investments, adopts the rate of 12 % in this evaluation.

3) Economic Evaluation Analysis Method

Project benefit in crop production is generated by comprehensive effect of project such as water use from newly constructed farm pond, low interest loan, and extension services etc.

Annual incremental benefit is presented by the difference between project benefit and project cost for project period. Benefit Cost Ratio (B/C Ratio) is computed for each Priority Area. Also based on annual incremental benefit to be generated for project period, project feasibility will be measured by Economic Internal Rate of Return (EIRR).

B/C ratio and EIRR of each project is calculated at two levels.

Evaluation of first level takes only effects to farming from increase of water availability into consideration. Evaluation of second level is the result to have considered all effects from projects. Major difference of the two levels depends whether benefits from livestock raising are taken into account or not.

11.6.3 Evaluation Summary

7 Projects are evaluated by B/C Ratio and EIRR.

Table 11.6-1 EIRR and B/C Ratio of Farm Pond & Farm Road Const. Project

Items	EIRR (%)		B/C Ratio	
Project effects	effects from only water	all effects	effects from only water	all effects
Kohn Kaen Area	17.7	24.69	1.373	1.891
Maha Sarakham Area	10.58	20.98	0.915	1.615
Mukudahan Area	10.90	18.23	0.935	1.565
Sakohn Nakon Area	11.37	19.62	0.963	1.503

In considering all effects from projects, 4 projects in each Priority Areas are proven to be feasible. In considering effect from increase of water availability, EIRR of 3 Priority Areas except Kohn Kaen Priority Area fall short under opportunity cost of capital of 12 % which is set at Chapter 11.6.2, 2).

However, in considering the characteristic of these projects, which are due to carry out in the Northeastern Region where is most populated and poor area, as the development of this area is one of most important policies under promoting spatially balanced economic development of Kingdom of Thailand, the figures which has gotten would be highly enough because trickle- down effects can be expected by the projects in these areas.

Results of other three projects are ;

Table 11.6-2 EIRR and B/C Ratio of Water Resources Development Project

Items	EIRR (%)	B/C Ratio
Mukdahan Priority Area: Huai Bang Sai Pump I. Project	13.68	1.122
Mukdahan Priority Area: Huai Lak Resrvoir I.Project	n.a.	0.23
Kohn Kaen Priority Area: Dredging Projects (4 Nos.)	17.13	1.358

Huai Bang Sai irrigation project and Kohn Kaen dredging project are proven to be feasible. Huai Lak reservoir irrigation project is proven to be unfeasible because of relative

higher construction cost compared with expected benefit.

11.6.4 Sensitivity Analysis

Sensitivity Analysis is carried out for following two cases: Case 1 Construction cost 10 % up and Case 2 Construction cost 10 % down.

Table 11.6-3 Farm Pond & Farm Road Const. Project(including all benefits)

	Construction cost 10% down		Construction cost 10% up	
Items	IRR (%)	B/C Ratio	IRR (%)	B/C Ratio
Kohn Kaen Area	27.32	2.101	22.96	1.719
Mahasarakam Area	23.33	1.794	18.98	1.468
Mukudahan Area	20.41	1.565	16.37	1.281
Sakohn Nakon Area	21.91	1.670	17.68	1.367

Table 11.6-4 Farm Pand & Farm Road Const. Project (benefits from only water)

	Construction cost 10% down		Construction cost 10% up	
Items	IRR (%)	B/C Ratio	IRR (%)	B/C Ratio
Kohn Kaen Area	19.85	1.526	15.88	1.248
Mahasarakam Area	12.27	1.017	9.13	0.832
Mukudahan Area	12.63	1.039	9.41	0.850
Sakohn Nakon Area	13.15	1.070	9.84	0.875

	Construction cost 10% down		Construction cost 10% up	
Projects	IRR (%)	B/C Ratio	IRR (%)	B/C Ratio
Huai Bang Sai Pump Irrigation Project	15.33	1.247	12.28	1.02
Haui Lak Reaervoir Irrigation Project	n.a.	0.255	n.a.	0.209
Dredging project	19.23	1.508	15.39	1.234

Although the fluctuation of cost brings the fall of EIRR, EIRRs of 6 projects except Huai Lak reservoir irrigation project keep well above 9 % while construction cost is 10 % up. It can be said that 6 projects except Huai Lak reservoir irrigation project would be feasible in case projects lend loan with less than 9 % interest rate.

11.6.5 Farm Budget Analysis

1) Basic sets for Farm Budget Analysis

a) The size of one farm in each Priority Area is 20 rai for Khon Kaen, 12 rai for Maha Sarakam, 13 rai for Mukdahan and 10 rai for Sakohn Nakon.
b) One farm family has 5 family members and 3 agricultural labors.
c) Based on the topographical conditions, the farming types are classified into three types, i.e.
Lowland (paddy fields) Type, Upland Type and Mixed Type (Lowland plus Upland).

d) Profit of each farm was calculated based on income and expense per rai or head of each crop, livestock, and fish.
e) A farm pond of 1200 m^3 is provided without cost.
f) Vegetables are planted three times for a year and chicken is rotated two times for a year.

2) Farm Budget Analysis in Khon Kaen Area

Table 11.6-5 Land Use Change of Each Farming Type in Khon Kaen (rai)

Farming Type	Lowland		Upland		Mixed Type	
	Current	Future	Current	Future	Current	Future
Paddy Glutinous	12	12			5	5
Cassava	7		7		4	
Sugarcane			12	12	10	10
Mango		5		5		0.125
Papaya(Banana) (Intercropping)		0.5		0.35		0.1
Chicken (Duck)	60	150	60	150	60	150
Beef Cattle						5
Vegetables(String bean)		1.5		1.5		1.5
Vegetables(Chili)		1.5		1.5		1.5
Tilapia		0.2		0.2		0.2
Grass						2
Pond		1		1		1
Non-cropped area	1	1	1	1	1	1
Sub total	20	22	20	22	20	22

Note ;The Sub total excludes the required area for feeding fish and for intercropping.
Unit of livestock refers to the number. Non-cropped area includes Road, Livestock yard etc.

Table 11.6-6 Annual Profit of Each Farming Type (Khon Kaen)

	Low land Type	Upland Type	Mixed type
Current	19,315	28,099	26,716
Future	71,086	76,633	55,056

Unit : bath/year/farm

In integrated farming at lowland area, cassava area will be substituted into mango, vegetables, and farm pond. Also fruits such as papaya or banana will be planted around pond. Pond water is mainly used for vegetables and fish feeding. Although mango is not irrigated basically, the existence of pond itself makes it possible for farmers to plant mango because the risk of shortage of water will alleviated.

The income will increase from 19,315 baht to 71,086 baht.

Same as with lowland farming, upland farming represented by cassava area will be changed into mango, vegetables, and farm pond. Income will increase from 28,099 baht to 76,633 baht. The disparity in income between those of lowland and upland is based on income difference of paddy and sugarcane planting.

At mixed type, instead of mango planting, farmers will raise 5 beef cattle and plant grass of 2 rai. As the income from livestock is not so high as that from mango, the income will increase from 26,716 baht to 55,056 baht.

In Kohn Kean Priority Area, fruits and vegetables contribute the increase of income in large part and sugarcane provides stable income.

3) Farm Budget Analysis in Maha Sarakam Area

Table 11.6-7 Land Use Change of Each Farming Type in Maha Sarakam (rai)

Farming Type	Lowland Type		Upland Type		Mixed Type	
	Current	Future	Current	Future	Current	Future
Paddy Glutinous	5	5	3		6	5
Non-glutinous						
Cassava	6		8	5	6	
Sugarcane						
Papaya(Banana)(Intercropping)		0.16		0.25		0.16
Chicken (Duck)	60	150	60	150	60	150
Beef Cattle		5		5		5
Vegetables(String bean)		1.5		1.5		1.5
Vegetables(Chili)		1.5		1.5		1.5
Tilapia		0.2		0.2		0.2
Grass		4		4		4
Fallow						
Pond		1		1		1
Non-cropped area (Livestock yard etc.)	1	1	1	1	1	1
Sub total	12	14	12	14	12	14

Note; The Sub total excludes the required area for feeding fish and for intercropping.
Unit of livestock refers to the number. Non-cropped area includes Road, Livestock yard etc.

Table 11.6-8 Annual Profit of Each Farming Type (Maha Sarakham)

	Low land Type	Upland Type	Mixed type
Current	10,654	10,952	10,654
Future	36,454	38,865	36,439

Unit : baht/year/farm

In lowland area in Maha Sarakam Priority Area, cassava-growing areas will be substituted by vegetables, grassland, and farm ponds. Also, fruits will be planted around pond and 5 beef cattle will be raised through feeding on 4 rai of grassland.

Income of lowland farming will increase from 10,654 baht to 36,454 baht.

In upland area, a part of cassava area and all paddy fields will be substituted by Grassland, Vegetables, and Farm Ponds. The income of upland and mixed type will be almost same with that of lowland.

Instead of Mango planting in Kohn Kean Priority Area, livestock will be promoted in Maha Sarakam Priority Area. Income increase in this area is highest among 4 priority areas.

4) Farm Budget Analysis in Mukdahan Area

Table 11.6-9 Land Use Change of Each Farming Type in Mukdahan (rai)

Farming Type	Lowland Type		Upland Type	
	Current	Future	Current	Future
Paddy Glutinous	7	8	6	3.5
Non-glutinous				
Cassava	5		6	3
Sugarcane				
Soybeans		0.5		
Groundnuts		0.5		
Mango		2.5		2
Papaya(Banana)(Intercropping)		0.25		0.35
Chicken (Duck)	60	200	60	200
Vegetables(String bean)		0.75		0.75
Vegetables(Chili)		0.75		0.75
Acacia(Eucalyptus)				2
Tilapia		0.2		0.2
Pond		1		1
Non-cropped area	1	1	1	1
Sub total	13	15	13	14

Note; The Sub total excludes the required area for feeding fish and for intercropping.
Unit of livestock refers to the number. Non-cropped area includes Road, Livestock yard etc.
Soybeans and Groundnuts are planted after rice harvesting.

Table 11.6-10 Annual Profit of Each Farming Type (Mukdahan)

	Low land Type	Upland Type
Current	11,753	11,190
Future	41,503	39,148

Unit : baht/year/farm

In Mukdahan Priority Area locating at mountainous area, where is now very poor, income will increase to a great extent by practicing proposed farming. In integrated farming at lowland, cassava area will be substituted by mango, vegetables, and farm pond. Also after harvesting rice, soybean or groundnuts will be grown on paddy fields. Because the Area has more rainfall than other areas. Pond water is used for vegetables and raising fish. As the result, the income will increase from 11,753 baht to 41,503 baht.

In upland farming, half of paddy fields and cassava area will be substituted by mango, vegetables, fast-growing trees, and farm ponds.

The income will increase from 11,190 baht to 39,148 baht.

5) Farm Budget Analysis in Sakhon Nakhon Area

Table 11.6-11 Land Use Change of Each Farming Type in Sakhon Nakhon (rai)

Farming Type	Lowland Type		Upland Type	
	Current	Future	Current	Future
Paddy Glutinous	6	5	3	3
Non-glutinous				
Cassava			3	
Sugarcane	3		3	
Soybeans		0.5		
Groundnuts				
Mango		2.5		2.5
Papaya(Banana)(Intercropping)		0.25		0.25
Chicken (Duck)	100	200	100	200
Vegetables(String bean)		0.75		0.75
Vegetables(Chili)		0.75		0.75
Acacia(Eucalyptus)				2
Tilapia		0.2		0.2
Pond		1		1
Non-cropped area	1	1	1	1
Sub total	10	11.5	10	11

Note; The Sub total excludes the required area for feeding fish and for intercropping.
Unit of livestock refers to the number. Non-cropped area includes Road, Livestock yard etc.
Soybeans and Groundnuts are planted after rice-harvesting.

Table 11.6-12 Annual Profit of each farming type (Sakhon Nakhon)

	Low land	Upland
Current	13,900	13,159
Future	40,241	38,742

Unit : baht/year/farm

In lowland areas in Sakhon Nakhon Priority Area, sugarcane growing area and some paddy fields will be substituted by mango, vegetables, and farm pond. Soybean will be planted after rice harvesting and 200 chicken will be raised. As the result, the income of lowland farming will increase from 13,900 baht to 40,241 baht.

With regard to upland areas, cassava area of 3 rai and sugarcane area of 3 rai will be substituted by mango, vegetables, fast growing trees and farm pond.

The income will increase from 13,159 baht to 38,742 baht.

6) Farm Budget Analysis in 6,000 m^3 Farm Pond Type

Table 11.6-13 Land Use Change of Farming Type with 6,000 m^3 Farm Pond (rai)

	Current	Future
Paddy Glutinous	8	8
Non-glutinous		
Cassava	8	
Sugarcane	6	6
Soybeans		1
Groundnuts		1
Mango		3
Papaya(Banana)(Intercropping)		2
Chicken (Duck)	100	200
Vegetables(String bean)		1.5
Vegetables(Chili)		1.5
Acacia(Eucalyptus)		
Tilapia		1
Pond		2
Non-cropped area	2	1
Sub total	21	25

Note; The Sub total excludes the required area for feeding fish and for intercropping.
Unit of livestock refers to the number. Non-cropped area includes Road, Livestock yard etc.
Soybeans and Groundnuts are planted after rice harvesting.

Table 11.6-14 Annual Profit of Farming Type with 6,000m^3 Farm Pond

Current	26,544
Future	126,278

Unit : baht/year/farm

In this project, 10 % of all farms will construct 6,000 m^3 pond and practice integrated farming. The expansion of small pond makes it possible to plant more fruit trees and vegetables, which need more water to grow but profitable.

With the increase of available water, more Tilapia will be raised. Income will increase 26,544 baht to 126,278 baht. However, in considering loan payment, the average net saving for 15 years will be around 58,000 baht / year. (Refers to Table 4.8-1)

7) Summary

By practicing proposed integrated farming, income of farmers in the Priority Areas will improve dramatically and make it possible to accomplish better living conditions.

Table 11.6-15 Annual Profit Increase from Current to Future Proposed Agriculture

Kohn Kaen	Current	Future	Change of %
Lowland Type	19,315	71,086	368
Upland Type	28,099	76,633	273
Mixed type	26,716	55,056	206

Maha Sarakam	Current	Future	Change of %
Lowland Type	10,654	36,454	342
Upland Type	10,952	38,865	355
Mixed type	10,654	36,439	342

Mukdahan	Current	Future	Change of %
Lowland Type	11,753	41,503	353
Upland Type	11,190	39,148	350

Sakon Nakhon	Current	Future	Change of %
Lowland Type	13,900	40,241	290
Upland Type	13,159	38,742	294

6000m³ F/P	Current	Future	Change of %
	26,544	126,278	349

CHAPTER 12 RECOMMENDATIONS

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1) In the Study Area, the potential for water resources development is very low and more than 90% of farming families in the area have no other choice but to depend for their water for farming either on farm ponds and/or wells. In view of this, the implementation of integrated agricultural development projects including construction of farm roads coupled with the provision of farm ponds and/or wells in the selected area may contribute a lot to inceasing farmers' income and to conserve the forest reserve areas adjacent to LRAs through the introduction of integrated farming and can be considered necessary to be actively promoted.
   In all stages of the project implementation , special attention should be paid to the conservation and rehabilitation of natural resources and the environment , and necessary measures such as farmers' training in environmental conservation , community forest management ,etc. should be taken as a pat of the project implementation.

2) In order to maintain the effectiveness of project implementation, the project areas should meet the following conditions in principle.

a) Implementation priority given to less developed areas.
b) Establishment of productive farmers' groups.
c) Establishment of marketing groups.
d) Farmers be willing and active in forming and/or already having groups consisting of the majority of farmers.

   These conditions will place a considerable burden on the shoulders of farmers. However, it should be understood that ALRO takes sufficient responsibility and provide strong support to farmers in establishing productive farmers' groups and marketing groups. All this support to farmers shall preferably be carried out with due cooperation by the government agencies concerned, leader farmers in the project areas and NGO personnel as much as possible.

3) Because the project covers various development components, well coordination among government agencies concerned is of great importance for smooth and successful implementation of the project. It is, therefore, recommended that the project implementation organizations composed of three coordinating committees and field working groups as shown in Chapte 11.5 be established. As the activities of the field working groups have much more effect on farmers' own interests and a successful issue of the project, the coordinating committees should provide strong and sufficient support for them.

The field working groups should have intensive consultation with farmers' groups about the following key elements and should provide necessary support for them.

a) Establishment of necessary farmers' groups for better project implementation.
b) Introduction and expansion of integrated farming, ecological farming, agro-forestry, etc.
c) Creation of marketing systems at village level.

4) All the government agencies concerned are currently working to provide free farm ponds with 1,200m^3 storage capacity for farm families in rainfed areas. There are, however, a number of farm families in need of expansion of farm pond storage capacity for more stabilized farm management and increasing of farm income, and for this purpose there is considerable demand by active farmers for longer term and lower interest rate loans for the construction of larger farm ponds and operation funds. Other than this, there is a need for long, medium and short term loans in order to support the establishment of productive farmers' groups and marketing groups and for daily farming activities and management. In order to make these loans available in co-operation with BAAC, the Agricultural Land Reform Fund shall be strengthened in terms of its operation and amount of capital.

5) To ascertain the positive effects to be derived from the integrated development plan, relevant farmers themselves and such rural communities would have to be better developed to a certain level. From this viewpoint, the following measures are considered very important and should be pushed forward in parallel with the development project implementation.

a) Farmers' participation in project implementation
b) Strengthening of farm families and their communities
c) Development of human potential
d) Farmers' participation in forest management

6) ALRO should support progressive farmers and communities who are presently engaged in integrated farming, ecological farming, agro-forestry, etc. in LRAs. They are expected to be leaders in expansion of a sustainable agriculture in LRAs.
In-Paeng Network in Sakhon Nakhon Priority Area, which is a networks of several tens of communities surrounding the Phu Phan Range, is a local environmental organizations aiming at native plant conservation and alternative agriculture. "Forest is life, love the forests as you love yourself." is the slogan of the Network. Because the activities of the Network are very beneficial for conservation and rehabilitation of forests and environments, expansion of sustainable agriculture in LRAs, etc.,ALRO should incorporate their activities in the development projects and should provide technical and financial support, if necessary.

7) It is necessary to prepare 1/4,000 scale topo maps covering all the project area to finalize the project development plan and for briefing/explanation of the project plan to relevant farmers. The scale 1/4,000 is the same as the cadastral map. For this reason, it is recommended that ALRO take necessary measures to strengthen the capacity of section/divisions concerned with topo maps to cover more than the annual development target.

8) Thailand has been experiencing an acute economic crisis as well as unemployment. Laid-off workers, who had migrated to Bangkok from rural areas such as LRAs, have now returned to these areas. In LRAs of the Northeastern Region where natural conditions are least favorable in terms of production potencial and the ratio of poor people is the highest in Thailand, it is assumed that the ratio of poor people has been increasing and the degree of poverty has been becoming more serious. Because it is difficult to take non-farming jobs at present, the implementation of integrated agricultural development projects, which leads the way to absorb the workers laid off and returned to rural areas through its job creation in the dry season and to boost the livelihood of LRAs, should be promoted without delay with due consideration on the social benefits to be derived.

   By introducing the integrated farming system in LRAs, the labor requirement will be increased by about 50% more than the current farming system.

9) The development project should be implemented by considering existing development level, poverty, various development potentials, etc. of the project area, efforts as a model project, size of the project, etc. Especially, the project for the LRAs with small acreage should be implemented together with the projects for adjacent LRAs and the projects for the LRAs with large acreage should be implemented by subdividing the project area into some areas of adequate acreage.


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