CHAPTER 5 DEVELOPMENT CATEGORIES AND SELECTION OF PRIORITY AREAS

CHAPTER 5 DEVELOPMENT CATEGORIES AND SELECTION OF PRIORITY AREAS

5.1 Categorization of Basic Development Plan

5.1.1 General Description

The categorization of basic development plans for 35 LRAs will be useful for understanding these plans as a whole, not separately and for utilizing these plans as one of guidelines when ALRO formulates basic development plans for LRAs out of the Study Area .

5.1.2 Categorization of Basic Development Plan

1) Sub-division of LRAs

The Study Area consists of 35 LRAs. They vary considerably in size and some are scattered in several fragments, so that the LRAs have been divided into 116 areas based on solely on topography. However, that is too many for studying the development plan. Therefore, 116 areas have been restructured into 44 sub-LRAs taking similarity of topography, land use, accessibility and distance of each top-area as criteria. Inventory and other data are compiled for the study based on the sub-LRAs. Sub-LRAs are as listed in Table 4.3-3, and locations are described in the Detailed Location Maps attached in this Report. Details of restructuring sub-LRAs are mentioned in Chapter 1 of Appendix-D.

2) Method of Categorization and Development Categories

Type of agricultural practices will be affected largely by the field conditions such as a) irrigation water availability, b) soil condition and c) possible duration of sunlight, etc.

Regarding condition c), there is no difference in LRAs in the Study Area. Therefore, categorization of basic development plans will be made based on condition a) and b). In addition, factors related to environmental conservation are adopted as factors for development categorization.

a) Irrigation water availability

Irrigation water availability will be expressed by percentage of possible irrigated area to corresponding LRA.

<Water Resources Potential>

Low:	less than 5 %
Medium:	5 % - 15 %
High:	more than 15 %

(Note) classified by the potential irrigation ratio.

b) Soil condition

Crops suitable to an area basically depend on its soil conditions, therefore soil conditions are expressed by recommended crops and farming types for the area. As shown in Chapter 4.2, twelve types of farming are recommended. Each LRA has a large area of about 40,000 rai (6,400 ha) in average and soil condition varies every part in the LRA. Therefore, 4 to 12 recommended farming types will be applied to each LRA based on the soil condition, existing land use, etc. (Recommended Farming Type)

c) Factors related to environmental conservation

As for factors related to environmental conservation, the existence of buffer zones and economic forests in LRAs will be adopted. (Existence of Buffer Zone, Existence of Economic Zone)

Twelve types of farming are recommended and 4 to 12 recommended farming types are applied to each LRA. In case that the recommended farming types are adopted as a factor for development categorization, it is necessary to subdivide each LRA into several parts. Farming types are basically recommended based on the soil condition, existing land use, etc. but final decision for selection of farming types should be made by farmer himself.

Based on the consideration mentioned above, simplified development patterns of LRAs are adopted as shown below.

Develop.Pattern = Develop. Category classified + Recommended Farming Types applied

Develop. Categories are classified into 12 categories as shown in Table 5.1-1 and development pattern is shown in Table 5.1-2.

Table 5.1-1 Development Category of the Study Area

Development Category	Irrig. Water Availability	Existence of Buffer Zone	Existence of Economic Zone	Khon Kaen (KK)	Maha Sarakham (MHS)	Sakhon Nakhon (SKN)	Mukdahan (MKD)
I	<Low>	Yes	Yes			3-2,4	
II			None			6-1,6-2	1,6,9-1
III		None	Yes	5,6	1~10		
IV			None				
V	<Medium>	Yes	Yes			3-1,5-1,5-2	11-1
VI			None				2,3,5,9-2
VII		None	Yes	1,2,3,4		1,2,7	
VIII			None				
IX	<High>	Yes	Yes			3-3	7,11-2
X			None				4,8-1~8-4,10,12
XI		None	Yes				
XII			None				

Table 5.1-2 Development Pattern of the Study Area

Study Area		Development Category	Recommended Farming Types													Total
			I. Paddy Prevailing Area			II. Upland Crop Prevailing Area						III. Steeply Sloped Area				
			A (%)	B (%)	C (%)	D (%)	E (%)	F (%)	G (%)	H (%)	I (%)	J (%)	K (%)	L (%)		
Khon Kaen	KK 1	VII	7.4%	11.1%	4.6%	27.1%	40.6%	3.8%	3.8%	0.0%	0.0%	0.2%	0.5%	0.5%	0.5%	100.0%
	KK 2	VII	5.2%	7.9%	3.3%	30.1%	45.1%	4.2%	4.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	KK 3	VII	10.9%	16.4%	6.8%	23.7%	35.6%	3.3%	3.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	KK 4	VII	2.8%	4.2%	1.8%	31.0%	46.5%	4.3%	4.3%	0.0%	0.0%	0.5%	1.5%	1.5%	1.5%	100.0%
	KK 5	III	6.6%	9.9%	4.1%	28.6%	42.9%	4.0%	4.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	KK 6	III	6.4%	9.6%	4.0%	28.8%	43.2%	4.0%	4.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Total			6.7%	10.1%	4.2%	28.2%	42.3%	3.9%	3.9%	0.0%	0.0%	0.1%	0.2%	0.2%	0.2%	100.0%
Maha Sarakham	MHS 1	III	0.0%	0.0%	0.0%	36.0%	54.0%	5.0%	5.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	MHS 2	III	0.0%	0.0%	0.0%	33.6%	50.4%	4.7%	4.7%	0.0%	0.0%	0.0%	2.2%	2.2%	2.3%	100.0%
	MHS 3	III	0.0%	0.0%	0.0%	36.0%	54.0%	5.0%	5.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	MHS 4	III	0.0%	0.0%	0.0%	36.0%	54.0%	5.0%	5.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	MHS 5	III	19.9%	29.8%	12.4%	13.6%	20.5%	1.9%	1.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	MHS 6	III	11.9%	17.8%	7.4%	21.5%	32.3%	3.0%	3.0%	0.0%	0.0%	0.3%	0.9%	0.9%	0.9%	100.0%
	MHS 7	III	31.0%	46.5%	19.4%	1.1%	1.7%	0.2%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	MHS 8	III	5.5%	8.2%	3.4%	26.6%	40.0%	3.7%	3.7%	0.0%	0.0%	0.9%	2.7%	2.7%	2.7%	100.0%
	MHS 9	III	0.0%	0.0%	0.0%	36.6%	53.8%	4.8%	4.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	MHS 10	III	5.6%	8.5%	3.5%	29.7%	44.5%	4.1%	4.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Total			6.7%	10.1%	4.2%	26.4%	39.6%	3.7%	3.7%	0.0%	0.0%	0.4%	1.7%	1.7%	1.7%	100.0%
Sakhon Nakhon	SKN 1	VII	8.1%	8.1%	0.0%	37.7%	37.7%	4.2%	4.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	SKN 2	VII	23.4%	23.4%	0.0%	23.9%	23.9%	2.7%	2.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	SKN 3	3-1 V / 3-2 I / 3-3 IX	14.8%	14.8%	0.0%	26.1%	26.1%	3.3%	3.3%	3.3%	3.3%	0.3%	1.3%	1.3%	2.3%	100.0%
	SKN 4	I	16.3%	16.3%	0.0%	27.0%	27.0%	3.4%	3.4%	3.4%	3.4%	0.0%	0.0%	0.0%	0.0%	100.0%
	SKN 5	5-1 V / 5-2 V	2.0%	2.0%	0.0%	25.6%	25.6%	3.2%	3.2%	3.2%	3.2%	1.6%	8.0%	8.0%	14.4%	100.0%
	SKN 6	6-1 II / 6-2 II	26.2%	39.4%	0.0%	6.4%	6.4%	0.8%	0.8%	0.8%	0.8%	0.9%	4.6%	4.6%	8.3%	100.0%
	SKN 7	VII	15.4%	15.4%	0.0%	31.2%	31.2%	3.5%	3.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Total			14.4%	15.8%	0.0%	24.6%	24.6%	3.0%	3.0%	2.4%	2.4%	0.5%	2.5%	2.5%	4.4%	100.0%
Mukdahan	MKD 1	II	14.7%	14.7%	0.0%	24.0%	24.0%	3.0%	3.0%	3.0%	3.0%	0.5%	2.7%	2.7%	4.8%	100.0%
	MKD 2	VI	5.3%	7.9%	0.0%	26.6%	39.8%	4.1%	4.1%	4.1%	4.1%	0.2%	1.0%	1.0%	1.7%	100.0%
	MKD 3	VI	19.9%	19.9%	0.0%	22.8%	22.8%	2.8%	2.8%	2.8%	2.8%	0.2%	0.8%	0.8%	1.5%	100.0%
	MKD 4	X	7.0%	10.6%	0.0%	14.0%	20.9%	2.2%	2.2%	2.2%	2.2%	2.0%	9.7%	9.7%	17.4%	100.0%
	MKD 5	VI	10.4%	15.6%	0.0%	14.4%	21.6%	2.2%	2.2%	2.2%	2.2%	1.4%	7.3%	7.3%	13.0%	100.0%
	MKD 6	II	3.3%	5.2%	0.0%	15.7%	24.2%	2.6%	2.6%	2.6%	2.6%	2.1%	10.3%	10.3%	18.5%	100.0%
	MKD 7	IX	23.4%	35.0%	0.0%	7.5%	11.3%	1.2%	1.2%	1.2%	1.2%	0.9%	4.5%	4.5%	8.1%	100.0%
	MKD 8	8-1 X / 8-2 X / 8-3 X / 8-4 X	7.5%	7.5%	0.0%	30.4%	30.4%	3.8%	3.8%	3.8%	3.8%	0.4%	2.3%	2.3%	4.1%	100.0%
	MKD 9	9-1 II / 9-2 VI	9.9%	9.9%	0.0%	28.3%	28.3%	3.5%	3.5%	3.5%	3.5%	0.5%	2.4%	2.4%	4.3%	100.0%
	MKD 10	X	34.3%	34.3%	0.0%	12.6%	12.6%	1.6%	1.6%	1.6%	1.6%	0.0%	0.0%	0.0%	0.0%	100.0%
	MKD 11	11-1 V / 11-2 IX	8.6%	8.6%	0.0%	29.2%	29.2%	3.6%	3.6%	3.6%	3.6%	0.5%	2.4%	2.4%	4.4%	100.0%
	MKD 12	X	0.0%	0.0%	0.0%	36.4%	36.4%	5.3%	5.3%	5.3%	0.0%	0.0%	2.9%	2.9%	5.4%	100.0%
Total			13.2%	14.8%	0.0%	24.1%	26.7%	3.2%	3.2%	3.2%	3.1%	0.4%	2.2%	2.2%	3.9%	100.0%
Grand Total (%)			11.3%	13.5%	1.5%	25.4%	31.1%	3.3%	3.3%	1.8%	1.8%	0.4%	1.8%	1.8%	3.0%	100.0%

The results of categorization are summarized as shown below:

Table 5.1-3 Area of Each Development Pattern

Type	Nos. of LRA	Area
I	2	93,170rai (6.7%)
II	5	178,100rai (12.9%)
III	12	374,650rai (27.0%)
IV	-	- -
V	4	177,040rai (12.8%)
VI	4	212,070rai (15.3%)
VII	7	191,470rai (13.8%)
VIII	-	- -
IX	3	86,110rai (6.2%)
X	7	73,940rai (5.3%)
XI	-	- -
XII	-	- -
ãl	44	1,386,550rai (100%)

Irrigation water availability

Low : 19 LRAs 645,920rai (46.6%)
Med. :15 LRAs 580,580rai (41.9%)
High :10 LRAs 160,050rai (11.5%)

Existence of Buffer Zone

Yes :25 LRAs 820,430rai (59.2%)
None :19 LRAs 566,120rai (40.8%)

Existence of Economic Zone

Yes : 28 LRAs 922,440rai (66.5%)
None : 16 LRAs 464,110rai (33.5%)

5.2 Selection of Priority Areas for F/S

5.2.1 General Description

The Study Area is 35 LRAs in the four provinces of Khon Kaen, Maha Sarakham, Sakhon Nakhon and Mukdahan. Because ALRO has a little experience in implementing integrated agricultural development projects, the results of this Study, which include the provision of guidelines for classification of LRAs into development categories, selection of priority areas and formulation of a development plan for each category, are expected to be one of the guidelines when ALRO formulates development plans for LRAs in the near future. Under such circumstances, one priority area is selected from each of the four provinces for the following reasons.

a) Wider demonstration effects will be expected when the projects are implemented.
b) One of the objectives of this Study is to carry out, in the course of the Study, technology transfer to Thai counterpart personnel concerned. As ALRO's development projects will be implemented under the control of Provincial Land Reform Office, the technology transfer to staffs in PLROs of the four provinces will be required. In order to accomplish this objective, the priority area should be selected from each of the four provinces.

5.2.2 Selection Criteria

A feasibility study will be carried out for each priority area, and a Guideline (2) will be prepared based on the results of the feasibility study so as to helpful to ALRO in

formulating the development projects of LRAs in future. Therefore, the selection of the priority areas should be made giving importance to the various types/nature of the development, which is more beneficial in preparing Guideline (2).

On the other hand, priority areas for ALRO will be defined as LRAs where early implementation of ALRO's development projects is necessary in each province. Priority of implementation of rural development projects by ARD and CDD of MOI has been decided on based on the existing level of development of each village, which is obtained from results of a Kor Chor Chor Survey carried out for each village through the country once every two years by the National Rural Development Committee. The development level of the Kor Chor Chor Survey is classified into three categories, backward village (Level 1), middle-level village (Level 2) and progressive village (Level 3).

Based on the above considerations, the selection criteria of the priority areas for F/S as shown below have been adopted.

Table 5.2-1 Selection Criteria of Priority Area for F/S

Step 1:To select backward LRAs. For this, screening of LRAs using the "Development Level" and "Income Level" obtained from Kor Chor Chor data will be made as follows:

- Calculate development level of each LRA as shown in Table 5.2-4.
- Calculate income level of each LRA as shown in Table 5.2-5.
- Calculate an average value for the above two levels.
- Select LRAs with an average value of less than 2 as backward LRAs.

Step 2:To select the priority areas by considering equal distribution of development categories, and the intentions of PLROs.

The development categories as a factor for selection of priority areas for F/S in Step 2 of the selection criteria will be established by modifying the development categories shown in Table 5-1. In this Study, the development categories are simplified by two factors such as high or low potential of water resources development and existence of buffer zones, and are shown below.

Table 5.2-2 Development Categories for Selection of Priority Area

Development Categories	Irrigation Water Availability	Existence of Buffer Zone
A	high potential irrigated Area ≧ 15%	exists
B		does not exist
C	low potential irrigated < 15%	exists
D		does not exist

5.2.3 Priority Areas for F/S

As shown in Table 5.2-6, the selection of backward LRAs was made by applying Step 1 of the selection criteria as shown in Table 5.2-1. Backward LRAs in each province are classified into the development categories shown in Table 5.2-2 and are shown below.

Table 5.2-3 Backward LRAs and Development Category

Development Category	Khon Kaen	Maha Sarakham	Sakon Nakhon	Mukudahan
A	--	--	No3-3	(No8-2),8-3,8-4,12
B	--	--	--	--
C	--	--	(No3-1),3-2,6-1,6-2	No2,3
D	(No6)	(No5)	No2,7	--
Area Proposed by PLROs as Priority Area	No6	No5	No3	No8

In the provinces of Khon Kaen and Maha Sarakham, only one LRA for each province remains a backward LRA. These areas are the same as the areas proposed by the PLROs concerned and it should therefore be selected as a priority area for F/S. The priority areas in Khon Kaen and Maha Sarakham are classified as Category D. By considering equal distribution of development categories, proposals by PLROs, etc., the priority areas in Sakhon Nakhon and Mukdahan are selected by the LRA belonging to Categories C and A respectively. As a result, one priority area is selected for each of Categories A and C, and two priority areas for Category D. Reasons for selection of priority areas in Sakhon Nakhon and Mukdahan are as follows;

Sakhon Nakhon

The backward LRAs in Category C in Sakhon Nakhon are in area Nos. 3-1, 3-2, 6-1 and 6-2. Nos. 6-1 and 6-2 are ordinary areas where only paddy is cultivated in the wet season. In area No.3, there is a farmers' group which is engaged in ecological farming and is expected to be a leader in expanding sustainable agriculture in LRAs, and it is assumed that the demonstration effects from development in No. 3 area will be very high.

According, it has been decided that the priority areas should be from area No. 3, and area No. 3-1, where there is a large acreage compared with area No.3-2, has been selected as the priority in Sakhon Nakhon province.

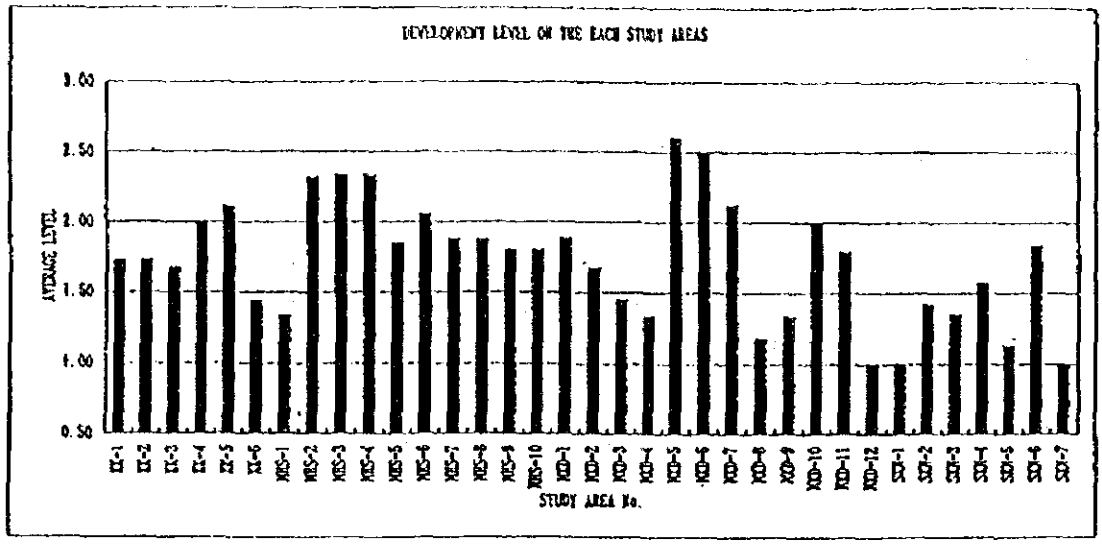
Mukdahan

Area Nos. 8-2, 8-3, 8-4 and 12 remains backward LRAs belonging to Category A. Nos. 8-3 and 12 are excluded from priority area selection because water resources in these areas have been developed to a comparatively high level.

A main road passes through the center of area No. 8-2, but area No. 8-4 is far from the main road. Area No. 8-2 has been selected as the priority area in Mukdahan province because higher demonstration effects than area No. 8-4 can be expected.

Table 5.2-4 Development Level Classification

The average development level of each LRA calculated from Kor-Chor-Chor data is shown in the following Figure.



Development Level Classification Criteria are as follows.

1. Level 1 (Low Level) $1 \leq A.L. \leq 1.5$
2. Level 2 (Medium Level) $1.5 < A.L. < 2.0$
3. Level 3 (High Level) $2.0 \leq A.L.$

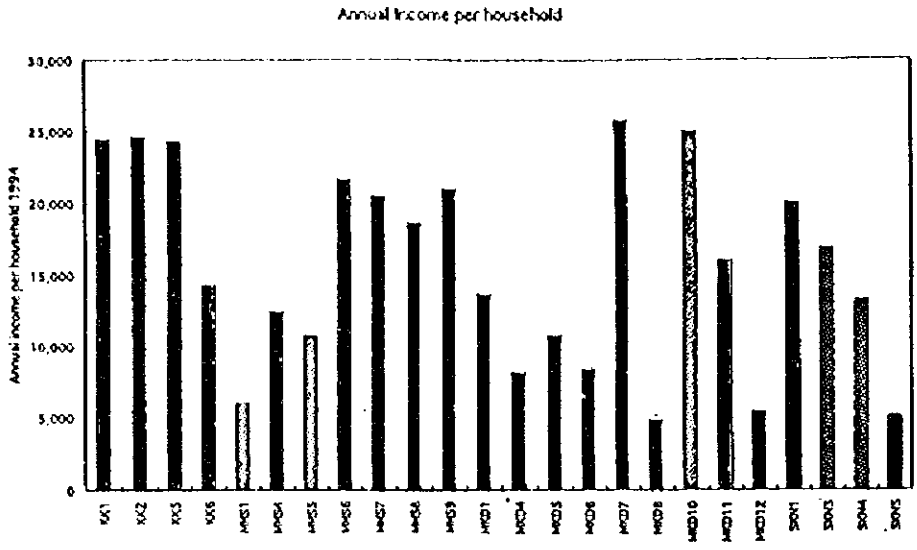
A.L. = Average Development Level

Development Levels of LRAs

Level	Prov.	LRA No.
I	K.K	6
	MHS	1
	MKD	3,4,8,9,12
12 villages	SKN	1,2,3,5,7
II	K.K	1,2,3
	MHS	5,7,8,9,10
	MKD	1,2,11
13 villages	SKN	4,6
III	K.K	4,5
	MHS	2,3,4,6
	MKD	5,6,7,10
10 villages	SKN	-

Table 5.2-5 Income Level Classification

The average income level of each LRA calculated from Kor-Chor-Chor data is shown in the following Figure.



Income Level Classification Criteria are as follows.

1. Level 1 (Low Level) A.I. ≤ 12,000 Baht/yr.
2. Level 2 (Medium Level) 12,000 < A.I. < 20,000 Baht/yr.
3. Level 3 (High Level) 20,000 Baht/yr. ≤ A.I.

A.I. = Average Income

Income Levels of LRAs

Level	Prov.	LRA No.
I	K.K	
	MHS	1,2,5
	MKD	2,3,4,5,6,8,12
14 villages	SKN	2,5,6,7
II	K.K	3,6
	MHS	3,4,8
	MKD	1,11
19 villages	SKN	3,4
III	K.K	1,2,4,5
	MHS	6,7,9,10
	MKD	7,9,10
12 villages	SKN	-

Table 6.2-5 Selection of Backward LRAs (Step 1 Selection)

LRA (Forest) No.		Khon Kaen			Maha Sarakham			Sakhon Nakhon			Mukdahan		
		Develop. Level	Income Level	Av.	Develop. Level	Income Level	Av.	Develop. Level	Income Level	Av.	Develop. Level	Income Level	Av.
1		2	3	2.5	1	1	1 *1)	1	3	2	2	2	2
2		2	3	2.5	3	1	2	1	1	1	2	1	1.5
3		2	2	2	3	2	2.5	1	2	1.5	1	1	1
4		3	3	3	3	2	2.5	2	2	2	1	1	1 *1)
5		3	3	3	2	1	1.5	1	1	1 *2)	3	1	2
6		1	2	1.5	3	3	3	2	1	1.6	3	1	2 *1)
7					2	3	2.5	1	1	1	3	3	3
8					2	2	2				1	1	1
9					2	3	2.5 *1)				1	3	2
10					2	3	2.5				3	3	3 *1)
11											2	2	2
12											1	1	1
Screening Ave. < 2		LRA No. 6			LRA No. 5			LRA Nos. 2, 3, 6, 7			LRA Nos. 2, 3, 8, 12		
Development Category	A	-			-			Nos. 3-3			[No. 8-2], 8-3, 8-4, 12		
	B	-			-			-			-		
	C	-			-			[No. 3-1], 3-2, 6-1, 6-2			Nos. 2, 3		
	D	[No. 6]			[No. 5]			Nos. 2, 7			-		

Note: *1) = Smaller LRA, *2) = ALRO Project Area, No. 8-1 (Mukdahan) = King's Project Area

CHAPTER 6 RECOMMENDATIONS FOR BASIC DEVELOPMENT PLAN

CHAPTER 6 RECOMMENDATIONS FOR BASIC DEVELOPMENT PLAN

1) ALRO should be responsible for development program in LRAs. Development to match the progress of land distribution is expected, but a target for LRA development seems not to have been defined yet. Development target or a master plan for developing all LRAs should be prepared by ALRO in the near future.

2) For LRAs where natural conditions are least favorable in terms of production potential, it is deemed that large-scale development is not possible and should not be introduced, but small-scale integrated farming, livestock breeding, fruit tree cultivation, plantation of fast growing tree, etc. should be introduced. In order to make such farming possible, ALRO should provide necessary agricultural infrastructure, support for farmers in forming and strengthening farmers' organization and loan with low interest for farmers who intend to introduce integrated farming.
Under the collaboration with DOAE, the Department of Industrial Promotion, etc., ALRO should also provide farmers' training for cloth weaving, small-scale agro-processing, sewing, etc. in order to increase non-farm employment opportunities.

3) Environmental degradation of the forest reserve areas adjacent to LRAs is recognized. Deforestation is frequently related to poverty. Therefore, backward LRAs adjacent to forest reserve area should be given high priority for development. In developing such LRAs, ALRO should take necessary measures to promote better understanding of farmers for importance of forest conservation.
A Kor Chor Chor 2 Khor database should be used for judging development level of LRAs and for planning the development projects in LRAs.

4) Because the proposed development project includes various components, i.e. agricultural extension services, supporting services in forming and strengthening farmers' organization, agricultural infrastructure development, non-farm employment promotion, etc., the project goal can be achieved only through the coordination of these activities with those activities of other agencies involved in the project. Therefore, coordinating committee should be established in order to assure smooth and successful implementation of the project.
In implementing the project, special attention should be paid to the followings;

a) Support for progressive farmers or farmers' group in LRAs.
b) Farmers' participation in all stages of the development process.
c) Participation of women in farmers' training courses.
d) Collaboration with NGOs in development.

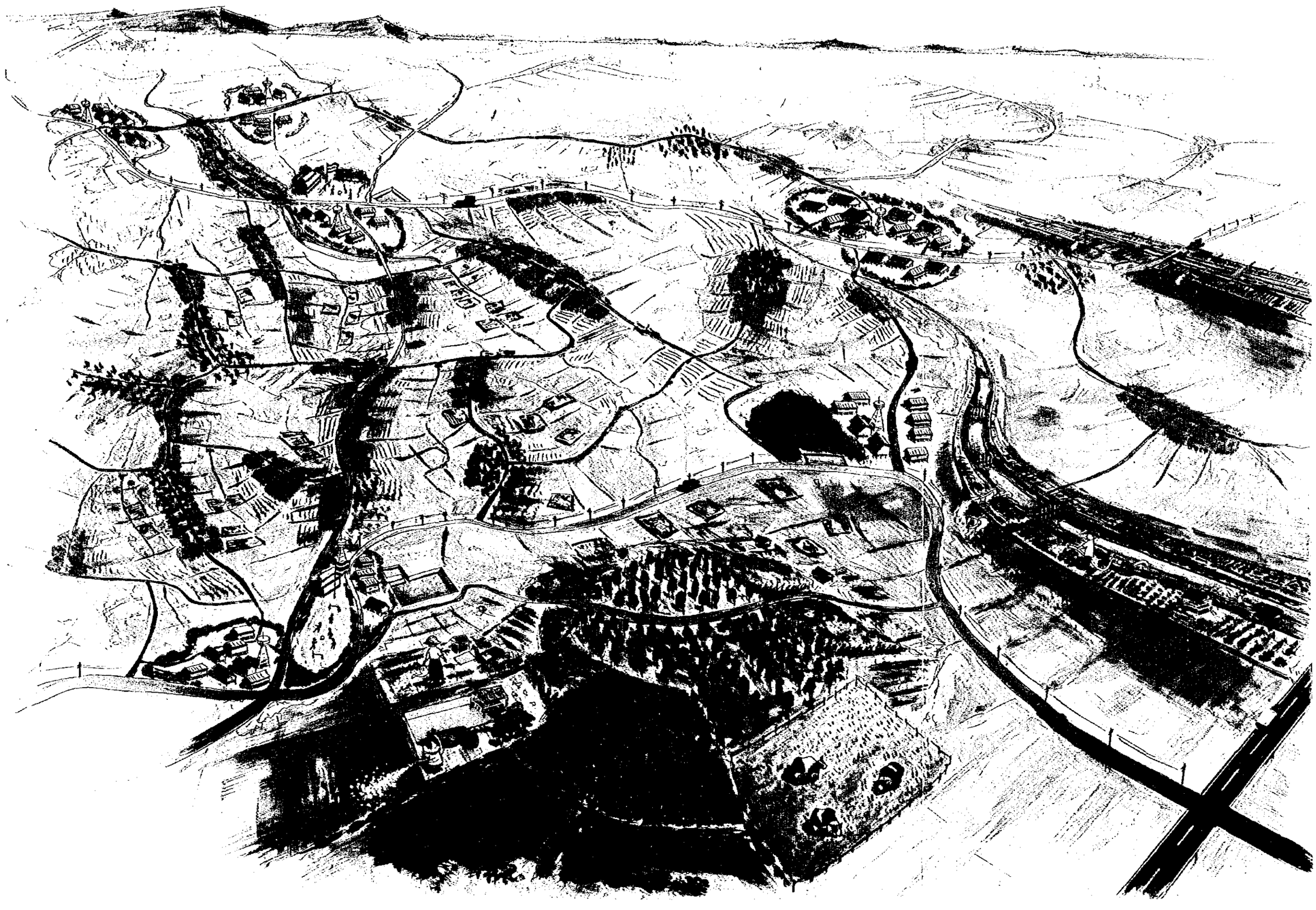
PART-II PHASE II STUDY (FEASIBILITY STUDY)

CHAPTER 7 KHON KAEN PRIORITY AREA (No. 6 LRA)

INTEGRATED AGRICULTURE DEVELOPMENT IN KHON KAEN PRIORITY AREA
(KK-6 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 7 KHON KAEN PRIORITY AREA (No.6 LRA)

7.1 Present Conditions of the Area

7.1.1 Location, Area and Population

The Khon Kaen Priority Area is a part of Khon Kaen LRA No.6 (KK-6), Non Nam Baeng Forest, which is located about 65 km. south of Khon Kaen, and is situated in the central part of KK-6.

National Railway and Highway routes No. 2 from Bangkok to Nong Khai Province run from south to north through the west of the Priority Area. The area is administratively composed of Tambon Pa Por of Amphoe Ban Phai, Tambon Wang Hin of Amphoe Nong Song Hong and Tambon Ban Han, King Amphoe Non Sila.

Khon Kaen Priority Area is estimated at 43,400 rai or about 29 per cent of the KK-6, of which 36,700 rai is farm holding land. The average farm size per farm household in the area is about 20 rai. The area is in non-municipal areas and outside sanitary districts and covers 11 villages. Actually, these villages are located in the Priority Area; only Nong Wang No. 10 is adjacent to the area. The total population of the 11 villages amount to 6,419 people living in 1,201 households. The majority of villages have a population of less than 600 and the number of households is between 90 to 130, with an average family size per household of 5 persons. According to the results of the Study Team Survey 1997, it was found that about 83 per cent of population in the area have primary education, 11 per cent have secondary education and 3 per cent have no education. The general features of the 11 villages are shown as follows:

Table 7.1-1 Administrative Summary of KK-6 Priority Area

Province / Amphoe	Tambon	Village	Muban	H/H	Population	Ave. Family Size (person/H.H)	Villageland [1] (rai)
Khon Kaen							
Ban Phai	Pa Por	Don Puai	4	93	540	5.81	1,510
		Huai Sua Tao	5	180	1,130	6.28	*4,510
Nong Song Hong	Wang Hin	Wang Hin	1	96	456	4.75	*3,161
		Wang Thong	2	114	512	4.49	*1,595
		Nong Sala	3	113	558	4.94	*3,232
		Lak Dan	6	101	561	5.55	*2,512
King A. Non Sila	Ban Han	Nong Nam Khum Nua	8	165	1,080	6.55	3,984
		Nong Nam Khem Tai	9	100	470	4.70	2,460
		Nong Wang	10	78	300	3.85	610
		Nong Wang Noi	12	128	667	5.21	2,745
		Kud Lhong	14	33	145	4.39	280
			Total	1,201	6,419	5.34	26,599

Source: Interviewing local leaders by Study Team November 1997

[1] Kor Chor Chor 2 Khor 1996 * Amphoe Wang Hin and Ban Phai, Agricultural Extension Office 1992

Total households are 1,200 in the concerned 11 villages, while land holding farmers

in the priority area are reported at 1,840. From this fact, some 600 farmers are supposed living in other villages than the 11 villages.

7.1.2 Topography and Geology

Khon Kaen Priority Area locates on an isolated hilly mound in the flat land. Its elevation ranges from EL188m to EL.234m, and slope from 0.2% to 4.5%. Silty soils are washed away and sandy soils are dominant at the top layer in the area. Most areas are cultivated with upland crops in higher elevation so that soils are suffered from erosion at the steeper slope when heavy rain hits the area. The steep sloping land over 5% gradient shares only 0.1% or 40 rai in the area, where soils are suffered from erosion. Silty soils are deposited in the depressed area at the valley so that paddy fields are extent in such valley. Small individual farm ponds are also extent in such valley, which are used for supplemental irrigation for paddy.

Silt or silty clay soils lies at the depth of 1.5 m to 2.0 m from ground surface even at the hilly mound. Farm ponds can retain water for a certain period in such topography if enough depth is provided.

7.1.3 Meteorology and Hydrology

1) Meteorology

At the city of Khon Kaen, monthly mean temperature changes from 22.6℃ in December to 30.1℃ in April and mean of monthly maximum is 36.5℃ in April from the data of 30 year from 1965 to 1994. The maximum temperature of this period recorded 42.6℃ in April and minimum 5.6℃ during November to January with fairly large difference.

Mean relative humidity changes 59% in March to82% in September and annual comes to 71%.

Mean rainfall at Khon Kaen city is 1,200 mm and rainy day counted more than10 during May and September with 17 days in August and September. Annual rainy day is 106. Rainfall station (code 14022) is applied as representative for this priority area, it rains annually 1,021 mm as average of 1952 to 1995 changing from 628mm in 1974 to 1,495 mm in 1952. It rains 93% of annual rainfall during the period from April to October.

2) Hydrology

70% of this priority area are calculated to belong the range of less than 2 cu.m/hr as expected well yield, 20% to range of 2-10 cu.m/hr and 10% to range of 10-20 cu.m/hr respectively by means of the Groundwater Map by GREP, Department of Mineral Resources.

Table 7.1-2 Expected Well Yield in KK-6

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
23,967	70%	20%	10%	0%

High density TDS zone is concentrated in southern part of the province and extends to north in the center part of province. KK-6 located in the southern part of the province but belongs to the zone of low density as less than 500 mg/lit(TDS) concentration.

Table 7.1.3 Groundwater Quality in KK-6

Study Area	Acreage		Water Quality (TDS mg/lit)		
No.	A (rai)	A (ha)	< 500	500 - 1000	> 1000
KK-6	49,790	23,967	80%	10%	10%

7.1.4 Soil and Land Use

1) Soil

Soil in the Priority Area classified according to the Soil Survey Report by Department of Land Development into five groups namely Nos. 18, 20, 22, 36B and 41B as shown in Appendix E, Figure E-5 : Soil Map of Khon Kaen Priority Area. From the soil map, it can be seen that there are two main groups of soil that is, No. 41B and No. 18. Soil No. 41B occupies about 30,420 rai or 70 % of the total land area whereas 11,740 rai or about 27 % is under soil No. 18 and other groups occupy only a small area which is shown in Table 7.1-4.

Most of the soil in Khon Kaen Priority Area is Loamy Paleustults and Loamy Paleaquults as shown In Appendix E, Table E-6.

The characteristics of the soil are loamy sand and sandy loam in texture, light brown or yellowish brown in color, low in organic matter and C.E.C. Soil pH is 4.5 - 5.5 as shown in appendix E, Table E-6. According to soil suitability, upland crops and pasture are moderately suitable whereas rice is not suitable as shown in Appendix E, Table E-7and E-8.

Table 7.1-4 Soil Groups in KK-6 Priority Area

Soil Group	Land Area (rai)	Percentage (%)
18	11,740	27.1
20	460	1.0
22	180	0.4
36B	600	1.4
41B	30,420	70.1
Total	43,400	100.0

2) Land Use

Agricultural land use in Khon Kaen Priority Area out of farm area of 36,700 rai is 21.2 % or 7,760 rai of paddy land, and 20.6 % 7,576 rai is cassava, about 36.7 % or 13,478 rai is under sugarcane which is the main crop. Fruit trees and mulberry occupy a small area at 0.3 % or 105 rai and 1.1 % or 411 rai respectively. Among those land use only 0.1 % or 30 rai is under vegetables production which are cultivating in the area near water resources. There are about 20 % or 7,340 rai of fallow land which can be converted to grow fruit trees and fast growing trees in the future.

Table 9.1-5 Present Land Use in KK-6 Priority Area

Priority Area (rai)	Agricultural Land (rai)	Paddy Land (rai)	Cassava (rai)	Sugarcane (rai)	Fruit Tree Area (rai)	Vegetables Area (rai)	Mulberry Area (rai)	Maize (rai)	Fallow (rai)
Khon Kaen	36,700	7,760 (21.2%)	7,576 (20.6%)	13,478 (36.7%)	105 (0.3%)	30 (0.1%)	411 (1.1%)	-	7,340 (20.0%)

Source: Department of Agricultural Extension, 1996

7.1.5 Agricultural Infrastructure

1) Water Resources

Water resources are very scarce in the KK-6 Priority Area due to higher location and no land for water resources development. It is not accepted by farmers to bear land for its development. Major water resources are developed by means of creek dredging or community pond.

a) Dredging Project

Dredging projects have been developed by RID since 1987, and three dredging projects are so far developed in this area as shown in Table 7.1-6. Storage capacity reaches to 0.163 MCM in total. This type of project is excavating a gentle sloping creek to store water by means of check weirs, which are provided in appropriate intervals in the creek. It is utilized mainly for supplemental irrigation of wet season paddy rice by individual farmers along the creek by pumping water from creek. Irrigation area of this type project is, however, not monitored so that area of irrigation is not reported by RID.

Table 7.1-6 List of Dredging Project in KK-6 Priority Area

	Village	Project Name	Coordinate	Map No.	Storage Capacity (MCM)	Irrigation Area (rai)	Construction Year	Agency
89	Nong Nam Khun Tai	Huai Khan Re-excavation	572-623	5540-IV	0.049	0	1987	RID
97	Don Puaei	Huai Sua Thao Yai Re-excavation	643-536	5540-I	0.074	0	1988	RID
98	Huai Sua Thao	Huai Sua Thao Noi Re-excavation	575-627	5540-IV	0.040	Consumption	1996	RID
Total					0.163			

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

b) Community Pond

All villages in KK-6 Priority Area have community pond in the village, and total number of ponds are 14 ponds. Main purposes of utilization are irrigation, livestock water and fisheries. However, only 4 villages are utilizing ponds efficiently. Main reasons of poor utilization are mainly destruction of dike and sediment.

Table 7.1-7 Community Ponds and Utilization in KK-6 Priority Area

Village		General Information			Reasons of poor utilization				Purpose							Collecting capacity of runoff				Retention Capasity							
		Number of Ponds	constructed by	efficiently utilized ?	water pollution	distraction of dike	sediment	weeds	Irrigation	Livestock water	Drinking water	Domestic water	Fisheries	Swimming	Environment	Collecting of runoff	Enough catchment	Poor catchment	Poor rainfall	Water retention Capacity	blanket pavement	Good maintenance of dike	Good impermeable soil	High seepage	High evaporation	High leakage through dike	sediment
88	Nong Nam Khun Nua	1	ARD	yes					1	1	1	1	1	1	1	good	1			good	1						
89	Nong Nam Khun Tai	1	RID	no									1			good	1			good		1					
93	Kud Long	1	Changwat	no		1		1		1			1	1		good	1			good		1					
97	Don Puai	1	RID	no		1			1				1			good				good			1				
98	Huai Sua Thao	1	Tambon	no			1		1	1						good	1			poor							1
117	Wang Hin	1	Changwat	yes					1	1			1			good	1			poor					1		
118	Wang Thon	1	DLD	yes	1					1			1			poor			1	good			1				
119	Nong Sala	1	RID	no		1	1			1	1				1	poor		1	1	good							
124	Ban Lak Dan	4	ARD, RID	yes					1	1	1	1	1	1		good				good							
125	Ban Nong Yang	2	Tambon	no		1	1		1	1			1			poor			1	poor				1			

(Note) based on interview to village leaders

c) Wells

Wells are not commonly utilized except for village water source in this area.

2) Farm Pond

Individual small farm ponds are well developed and counted totally at 276 ponds in this area. It equivalents to 18% of farmers having a farm pond. Average size of farm pond is about 1 rai. They are utilized mainly for supplemental irrigation of paddy rice. Common problems of individual small farm pond are as follows;

a) No sufficient inflow (Reasons are considered due to small catchment or wrong site selection for pond.)
b) Weed control (removed by farmers in dry season when water depth is shallow.)
c) Sediment and heavy seepage are partly problem in this area. (removed by farmers in dry season when water depth is shallow.)
d) Too small for integrated farming. (Half of the farm ponds are less than 0.8 rai as shown in Table7.1-10.)

Table 7.1-8 Present Problems of Individual Small Farm Pond in KK-6 Priority Area

Village		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
88	Nong Nam Khun Nua										
89	Nong Nam Khun Tai		100		50	yes				yes	
93	Kud Long	100	100			yes				yes	
97	Don Puai	100			2				yes	yes	
98	Huai Sua Thao				50	yes				yes	
117	Wang Hin		70	70	100	yes	yes		yes	yes	
118	Wang Thon	100		30	30	yes				yes	
119	Nong Sala	100		20	10	yes		yes	yes		yes
124	Ban Lak Dan	100	40								
125	Ban Nong Yang	100			100	yes			yes	yes	

(Note) based on interview to village leaders.

3) Farm Road

Farm roads are also well developed in this area, and 65% of farmlands are accessed directly from road. Farm roads are generally passing on a ridge of mound, and running along a shorter side of farm plots. However, sandy soils are deeply deposited on surface of farm road, and trafficability is very low in the area.

Farm plots are generally rectangular and extending from a ridge to another ridge. General features of farm road and farm plots are as shown in Figure 7.1-1.

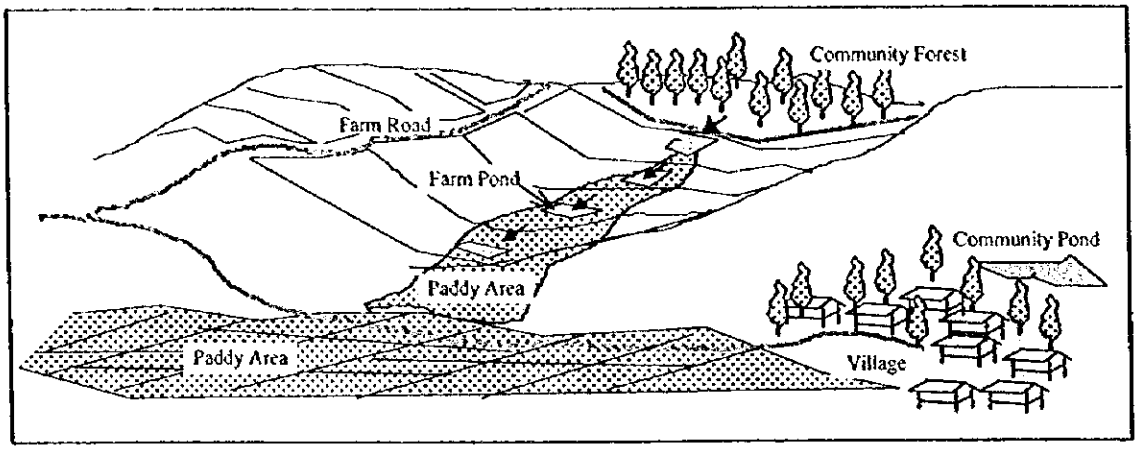


Figure 7.1-1 Farm Road and Farm Plot in KK-6 Priority Area

4) Farm Plot Size and Farming Type

Farming plot size and farming categories are analyzed based on the Land Reform Cadastral Map and land categories in 1/4,000 map.

Distribution of land holding size is analyzed as shown in Table 7.1-9, and average land holding is estimated at about 20 rai. As shown in Figure 7.1-2, land holdings are concentrated at 5 rai to 15 rai.

Table 7.1-9 Distribution of Land Holding Size in KK-6 Priority Area

Section (rai)			Frequency		Accumulation
			Plots	%	
0 -	5	0< <=5	156	10.3%	10.3%
5 -	10	5< <=10	328	21.7%	32.0%
10 -	15	10< <=15	267	17.6%	49.6%
15 -	20	15< <=20	199	13.1%	62.7%
20 -	25	20< <=25	145	9.6%	72.3%
25 -	30	25< <=30	88	5.8%	78.1%
30 -	35	30< <=35	95	6.3%	84.4%
35 -	40	35< <=40	76	5.0%	89.4%
40 -	50	40< <=50	66	4.4%	93.8%
50 -	60	50< <=60	39	2.6%	96.4%
60 -		60<	56	3.7%	100.1%
Total		Ave= 20.7 rai	1,515		

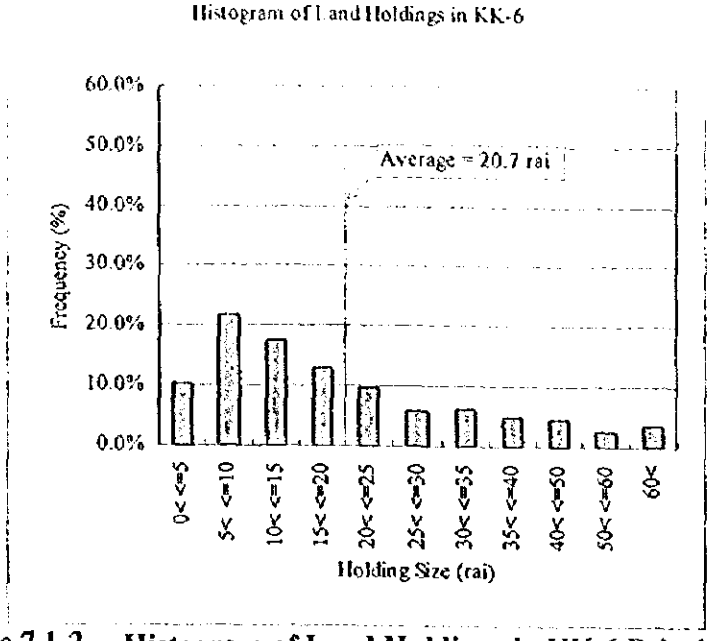


Figure 7.1-2 Histogram of Land Holdings in KK-6 Priority Area

Table 7.1-10 Present Farming Type and Farm Size in KK-6 Priority Area

Type of Land	Area (rai)	Paddy	Upland	Plots having Farm Road	Plots having Farm Pond	Plots Blocks & Block
Lowland Type	12.1% 3,775 rai Average 13.3 rai	82 % 3,095 rai	18 % 680 rai	54 % 155 plots Distance to village 1.2 km	15 % 42 plots Average 0.7 rai	285 plots 28 blocks 531, 534, 656, 657, 660, 661, 663, 669, 672, 674, 686, 687, 710, 715, 741, 742, 743, 744, 746, 748, 749, 769, 770, 817, 1570, 1571, 1575, 1580
Mixed Type	64.2 % 20,114 rai Average 21.9 rai	43 % 8,624 rai	57 % 11,490rai	67 % 617 plots Distance to village 1.5 km	20 % 185 plots Average 0.8 rai	919 plots 96 Blocks 500, 501, 503, 504, 505, 509, 513, 514, 517, 518, 520, 521, 524, 525, 526, 528, 529, 533, 535, 536, 545, 546, 547, 652, 653, 654, 662, 664, 667, 670, 671, 675, 685, 716, 720, 723, 745, 747, 750, 752, 753, 755, 756, 757, 759, 760, 761, 768, 779, 780, 781, 785, 786, 788, 789, 832, 833, 834, 836, 837, 838, 839, 840, 842, 848, 904, 906, 913, 924, 932, 935, 939, 947, 1513, 1534, 1536, 1537, 1565, 1566, 1567, 1583, 1651, 1674, 2896, 2897, 2909, 2910, 2919, 2920, 2931, 2932, 2933, 2938, 2947, 2949, 2956,
Upland Type	23.7 % 7,435 rai Average 23.9 rai	16 % 1,210 rai	84 % 6,225 rai	68 % 211 plots Distance to village 2.1 km	16 % 49 plots Average 0.7 rai	311 plots 44 blocks 506, 510, 512, 519, 522, 523, 527, 538, 668, 673, 762, 765, 766, 787, 800, 835, 841, 844, 845, 846, 847, 849, 902, 907, 925, 926, 931, 933, 936, 937, 938, 946, 949, 950, 1514, 1515, 1533, 1535, 1538, 1539, 2898, 2918, 2948, 2955
Total	100 % 31,324 rai Average 20.7 rai	41 % 12,928rai	59 % 18,396rai	65 % 983 plots Distance to village 1.6 km	18 % 276 plots Average 0.8 rai	1,515plots 168 blocks

Farming categories are classified into three groups as shown in Figure 7.1-3, 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%

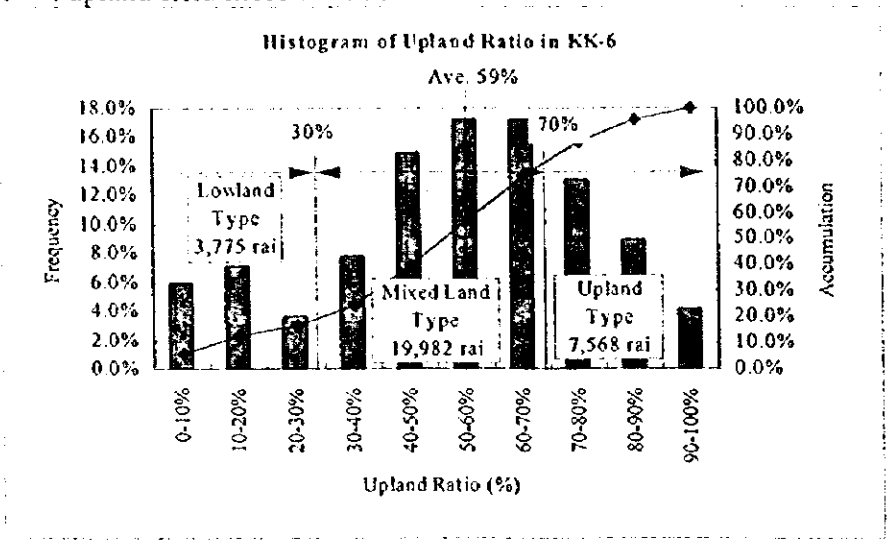


Figure 7.1-3 Upland Ratio in KK-6 Priority Area

7.1.6 Rural Infrastructure

1) Rural Road

Rural roads are mostly 4 m width and paved by laterite. Some of rural roads are recently improved with asphalt and enlarged to 6 m width partly. However, improvement of rural road is still limited in particular location, and its improvement is highly requested by villagers.

Table 7.1-11 Rural Road and Necessary Improvement in KK-6 Priority Area

No.	Existing Condition			Necessary Improvement		
	Length (km)	Width (m)	Pavement	Length (km)	Width (m)	Pavement
RR-1	8.44	6	Asphalt			
RR-2	1.84	4	Laterite	1.84	4	Asphalt
RR-3	9.20	4	Laterite	9.20	4	Asphalt
RR-4	5.36	2	none	5.36	4	Asphalt
RR-5	4.80	2	none	4.80	4	Asphalt
RR-6	3.32	4	Laterite	3.32	4	Asphalt
RR-7	0.84	4	Laterite	0.84	4	Asphalt
RR-8	3.40	2	none	3.40	4	Asphalt
RR-9	1.52	8	Asphalt			
Total	38.72			28.76		

(Note) Location of roads is shown in Figure 7.3-2.

As shown in Table 7.1-11, rural roads are estimated at about 39 km in KK-6 Priority Area. Out of 39 km, 29 km are requested to be improved by villagers in the area. Some roads like as width of 2m are very poor condition at present. Pavement is recommended by asphalt for better living condition for villagers.

2) Village Water

All villages have own village water supply system in the area. Coverage ratio of services is almost 100%. Most villages are depending on groundwater as a source of village water system. However, around half of villages are facing water shortage of groundwater.

3) Electricity and Communications

Electrification has been completed since 25 years before in first electrification, and 6 years before in latest village. Telephone system is now rapidly expanding, and covering 4 villages among 10 at the end of 1997.

4) Health Center

Health centers are located in three villages among 10 villages in the area. However, nearest centers are available within 7 km distance from every villages.

7.1.7 Rural Organization

At present, there are many kinds of people's organization in the area promoted by various government agencies. These organizations are involved in agricultural development, socio-economic and community development. The major people's organizations in Khon Kaen Priority Area may be classified as follows:

Table 7.1-12 Major People's Organizations in KK-6 Priority Area

No.	Type of Organization	Major Objectives	Responsible Agencies
1	Agricultural Cooperatives	The ultimate goal of farmers' institutions for agricultural development on credit, marketing, and extension services.	CPD
2	Farmers' Groups	To improve the agricultural productivity of farmers and develop their leadership performance	DOAE
3	Farmers' Housewives' Groups	To disseminate knowledge and promote home agro-processing and cottage industries	DOAE
4	Young Farmers' Groups	Training youth from farm families in rural areas.	DOAE
5	Farmers' Groups in a specific occupation e.g. silk worm group weaving group	Strengthening activities and improving their productivity in accordance with specific kinds of product	DOAE
6	Productive Saving Groups	Solution of shortage of funds at village level and developing mutual trust among villagers	CDD

According to the results of study team survey in 1997, the membership of the major groups or local organizations in the area may be summarized as follows:

Table 7.1-13 Membership Patio of Organizations in KK-6 Priority Area

Type of Organization	Membership % of total respondents (125)
BAAC	65.6
Agricultural Coop.	28.8
Housewives' Group	40.0
Youth Group	20.8
Productive Saving Group	27.2
Others	13.6

Table 7.1-14 shows the membership of agricultural cooperatives, farmers' groups with the same activity and BAAC by village in Khon Kaen Priority Area. Agricultural Cooperatives at Amphoe level are the major farmers' institution. The main purpose is to run multipurpose businesses for its members to increase farm productivity and income. However, the actual activities at present mainly deal with provision of credit services and agricultural inputs. Most of the people's organizations in the Khon Kaen Priority Area lack qualified staff with proper management capability, have insufficient credit capital, and have no experience in the specific subject of agricultural work. Hence, within the area there are very few successful people's organizations like as the BAAC and the housewives' groups.

Table 7.1-14 Membership of Agricultural Cooperatives, Farmers' Groups with the same activity and BAAC by village in KK-6 Priority Area

Village	No. [1] Household	No. [1] Population	Agricultural [2] Coop. Members (Household)	Member of all [2] farmers' groups with the same activity (person)	BAAC [1] members (Household)
Don Puai Mu 4	93	540	-	46	36
Huai Sua Tao Mu 5	180	1,130	-	20	100
Wang Hin Mu 1	96	456	NA	85	NA
Wang Thong Mu 2	114	512	NA	NA	NA
Nong Sala Mu 3	113	558	15	34	NA
Lak Dam Mu 6	101	561	-	16	46
Nong Nam Khun Nua Mu 8	165	1080	20	87	-
Nong Nam Khun Tai Mu 9	100	470	60	80	80
Nong Wang Mu 10	78	300	80	40	80
Nong Wang NoiMu 12	128	667	105	102	128
Kud Lhong Mu 14	33	145	10	32	30

Source : [1] Interview with local leaders, December 1997
[2] Kor Chor Chor 2 Khor, Khon Kaen Province 1996

7.1.8 Environmental Conditions

Economic Forests and the Land Reform Area co-exist in this area. Natural forest covers a very small area compared with the other three priority areas and the results of the social interview show that fuel wood is not sufficient for 74 % of villagers. Eucalyptus plantation is promoted for the purpose of reforestation and increase in income by sale to the pulp factory instead of cassava cultivation. In the village of Nong Nam Khum Nua, eucalyptus is planted on 500 rai of farmland.

Community Forest by the promotion of RFD is not planned in this area. Reforestation and Extension (REX) Project has been carried out by RFD Maha Sarakham nursery center with JICA experts. REX provides the extension service for forestry and seedlings including Khon Kaen. In 1996, 5,000,000 of seedlings were produced in which 46 % is *Pterocarpus macrocarpus*, one of the indigenous species. As for the seedling provision, 92 % is for farmers and the next, government agencies, schools and temples.

7.2 Present Agriculture

7.2.1 Agricultural Production

In Amphoe Ban Phai, the Priority Area is located in Villages 4 and 5 of Tambon Pa Por where lands are rolling with lowland and upland alternated. Agriculture in this area is rainfed and it depends entirely on rainfall. Average precipitation is 1,020 m.m. However, due to unreliable rain, dry spells and drought can be anticipated every year. Major crops in the area are rice, cassava and sugarcane. Mulberry and some fruit trees are alternative crop.

In Amphoe Nong Song Hong, the Priority Area is located in Villages 1, 2, 3 and 6 of Tambon Wang Hin. The four villages consist of both lowland and upland. Agriculture in the area is also rainfed, similar to the Ban Phai areas. Major crops grown are rice, cassava, and sugarcane with mango and vegetables as minor crops. The rice production is not enough because paddy land is small and drought and dry spells always occur during the growth period of the crops.

In Amphoe Non Sila, the Priority Area is located in Villages 8, 9, 10, 12 and 14 of Tambon Ban Han. Agriculture in all villages is rainfed and also depends entirely on rainfall. Major crops in the areas are rice, cassava, and sugarcane. Mulberry and vegetables are grown as minor crops.

Acreage and yield of crops are shown in Table 7.2-1.

Table 7.2-1 Acreage and Yield of Crops in KK-6 Priority Areas [1]

Locations	Crops	Areas (rai)	Production (ton)	Yield (kg/rai)
Ban Phai	Rice	3,880	892	230
	Cassava	1,259	2,770	2,200
	Sugarcane	3,436	29,206	8,500
	Mulberry	104	187	1,800
	Mango	54	59	1,100[2]
Nong Song Hong	Rice	2,025	466	230
	Cassava	1,902	4,182	2,200
	Sugarcane	4,709	40,026	8,500
	Mango	51	56	1,100[2]
Non Sila	Rice	1,855	464	250
	Cassava	4,415	8,830	2,000
	Sugarcane	5,333	63,996	12,000
	Mulberry	307	553	1,800
	Vegetables	30	75	2,500[2]
Total	Rice	7,760	1,822	235
	Cassava	7,576	15,784	2,083
	Sugarcane	13,478	133,228	9,885
	Mulberry	411	740	1,800
	Mango	105	115	1,100[2]
	Vegetables	30	75	2,500[2]
	Total Planted Land	29,360 rai		
	Fallow Land	7,340 rai		

Source: [1] Department of Agricultural Extension, 1996.
: [2] Estimated figures

7.2.2 Farming Practice

More than 95 per cent of paddy fields are planted using the transplanting method in the rainy season, the rest of the fields are direct seeded by either broadcasting or dibbling. The majority of rice varieties are recommended varieties. However, some local varieties are still planted by the farmers. These varieties are early-maturing and can be harvested before the recommended varieties.

Not all farmers apply fertilizer to the rice fields. Only 50 per cent of the farmers use fertilizer either 16-20-0 or 16-16-8 at a low rate of 15 kg/rai while DOAE recommends to apply at least 25 kg of 16-16-8 to one rai. Some farmers can afford to top dress using 21-0-0 at 5 kg/rai, but low comparing to the recommended application in any case. The reasons for low application of fertilizer are that in some places there is no water at the application time, or some farmers cannot afford the investment.

With regard to cassava and sugarcane, the farmers may use 15-15-15 or 16-16-18 fertilizer at 10-35 kg/rai only once. Hand weeding is performed once one or two months after planting.

For mulberry, recommended varieties are partly planted. However, silkworm breeds are mostly domestic with a minority of hybrid lines.

7.2.3 Livestock and Fishery

Farmers in the Priority Area of Khon Kaen normally raise cattle and water buffalo for farm labor and family income. Some farmers may own American Brahman hybrid cattle that gain a premium price over domestic breeds. Pig raising is not popular in the area. Only some families in Ban Phai and Nong Song Hong own a few pigs.

Poultry, which includes ducks and chickens, are also loosely raised foraging for food on their own like cattle and water buffalo. Ducks and chickens are for household consumption and income.

Not much information is available about fish culture. However, information derived from Agricultural Extension Offices in Ban Phai, Non Song Hong and Non Sila indicate that digging ponds for fish culture in the area is too risky because water is scarce and it requires a big investment.

The number of cattle, water buffalo, ducks, chickens, and pigs are presented in Table 7.2-2.

Table 7.2-2 Number of Livestock's in KK-6 Priority Areas [1]

Locations	Cattle	Water Buffalo	Ducks	Chickens	Pigs
Ban Phai	374	79	65	2,017	2
Nong Song Hong	616	78	31	2,691	128
Non Sila	478	149	86	3,155	-
Total	1,468	306	182	7,863	130

Source:[1] Ban Pai, Nong Song Hong, and Non Sila Livestock Offices, 1997.

7.2.4 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 1.8 million kg provided 235 kg/rai yield, and its surplus is about 0.64 million kg after deducting home consumption and seeds for next planting (refer to Appendix F : Table 7.2.5-1 Estimated Paddy Production and Surplus).

Marketing of rice is conducted by dried paddy being sent from farm to rice miller by local traders, middlemen and representatives of large-scale rice millers immediately after threshing because they don't have enough warehouses for late selling (refer to Appendix F : Table 7.2.5-2 Inventory of Post-Harvest/Marketing Facilities in the Priority Area). Marketing of rice can be carried out by agricultural cooperatives and the Bank of Agriculture and Agricultural Cooperatives (BAAC) because almost all farmers in the area have membership. Farmers can select a buyer at any time, but as small-scale farmers have not enough capital to transport their products, they sometimes cannot help selling from the field or the farm gate at unreasonable prices. As loans from the agricultural cooperatives or BAAC are high interest and the loan regulations are severe on small-scale farmers, they

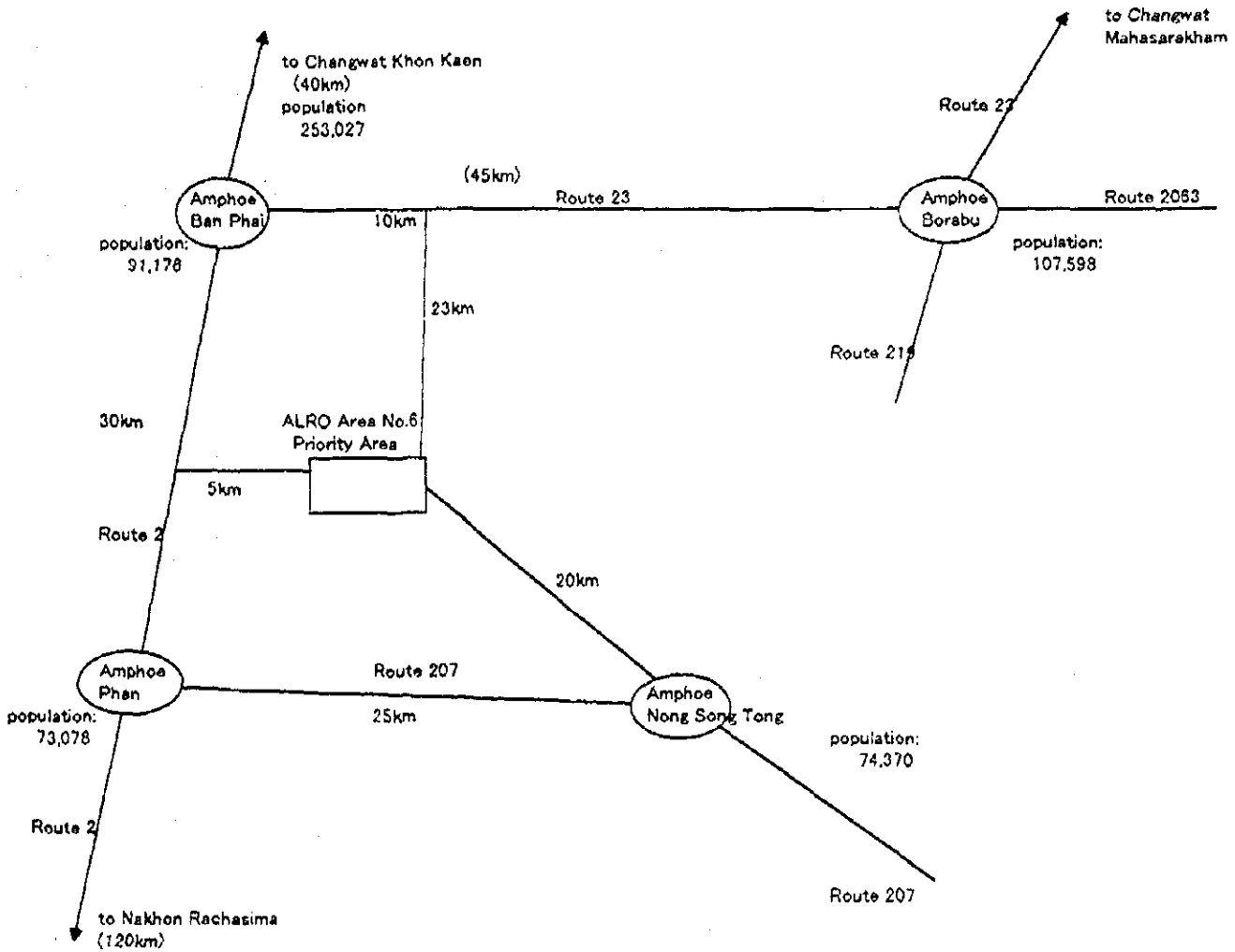
sometimes hesitate to take out loans.

Cassava is collected by traders or middlemen at the fields, individual stock-yards or the village collecting house. In the case of sugarcane, it is collected at the fields immediately after harvesting because of contract farming in most cases. Their marketing routes are, therefore, fixed. It is difficult for the small-scale farmers to slice, dry and transport the cassava by themselves. Moreover, the government has suggested decreasing the area of cassava due to the low price. It will be, therefore, not necessary for farmers to enter into the market of cassava and sugarcane.

Cattle graze in the area, and they are sold to markets nearby or far away through traders. Farmers, however, can select how they prefer to sell in the area for convenience and small price differences.

Other agricultural crops such as vegetables and fruit are planted in the area but they are generally cultivated for domestic consumption. No typical post-harvest handling and marketing scheme is found because only surplus products are sometimes sold at acceptable prices to traders or middlemen who come to do business for other purposes.

Marketing points in this area are Amphoe Ban Phai and Amphoe Nong Song Hong. It may also be possible to select Amphoe Phan or Amphoe Borabu. There may be enough marketing points in this area (refer to Figure 7.2-1 Marketing Points near the Priority Area). Unfortunately, farmers have inadequate marketing information systems as well as lack of knowledge and they get information from the relatives or traders.



Changwat Khon Kaen total population: 1,780,000

Figure 7.2-1 Marketing Points near the Priority Area (Khon Kaen)

7.2.5 Farm Household Economy

Farmers living in the Priority Area are rather richer than those in other Priority Areas because they can grow sugarcane and get a higher income as well as with some large landholding. Also better road access enables farmers to save on transport costs for their products and inputs.

The results of the Social Assessment Survey shows that the average income of KK-6 Priority Area is 44,800 baht of which 28,500 baht or 64% is by agriculture. Major source of non-agricultural income is by silk weaving and employment. Categorized level of agricultural income is as below :

Estimated net agricultural income	
Less than 15,000 baht	16.8%
15,000 baht	9.6%
More than 15,000 baht	72%
Others	1.6%
Mean	28,500 baht/year

7.3 Development Plan

7.3.1 Objectives of the Development

The main objectives of the development have been established in Section 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. (This is not concerned due to no conservation forest in the area.)

7.3.2 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, or integrated farming together with beef cattle breeding. As rice is a staple food in the area, fruit tree and grass should be introduced in cassava field first. Sugarcane can be increased in its cropping area when demand increases in sugar factories. Mulberry is cropped only in 411 rai or 1.1% of the area and it has a stable demand to produce cocoons, so that mulberry will remain as present. Traditional techniques should be, however, changed and improved. It is necessary to introduce recommended high yielding varieties of mulberry and cultivation techniques to increase production for high income. And for increasing production of cocoon, highbred silk worm and clean rearing house should be introduced.

Present farming type can be classified into 3 categories in the area, namely, lowland type (rice cultivation), upland type, and mixed type. Integrated farming will be introduced in all farming types. Especially in the mixed farming type, beef cattle rearing has been

proposed by introducing pasture in cassava field. Farming plan of each type is proposed as shown below:

Table 7.3-1 Farming Plan for a Typical Household (20rai)

Land Use	Low land Type (12%)	Upland Type (24%)	Mixed Type (64%)
Rice	12rai	-	5rai
Cassava	-	-	-
Sugercone	-	12rai	10rai
Fruit tree	5rai	5rai	-
Grassland	-	-	2rai
Fast growing tree	-	-	-
Vegetable	1rai	1rai	1rai
Beef cattle breeding	-	-	(5head)
Pig breeding	-	-	-
Poultry	(75head)	(75head)	(75head)
Fish breeding	(0.2rai)	(0.2rai)	(0.2rai)
Farm Pond	1rai	1rai	1rai
House, etc.	1rai	1rai	1rai

By implementation of the farm pond and farm road project, farmland with a farm pond will be increased to 21,400 rai or 58% of the whole, together with the present farmland with a pond. Present cassava field will be reduced to about half by introduction of fruit tree and pasture by the project. Cropping pattern of the area will be changed as shown in Table 7.3-2.

Table 7.3-2 Present and Planed Cropped Area

Land Use	Present	Plan	Difference
Rice	7,760rai	7,371rai	(-) 389rai
Cassava	7,576rai	3,743rai	(-) 3,833rai
Sugarcone	13,478rai	15,553rai	2,075rai
Mulberry	411rai	411rai	0rai
Fruit tree	105rai	1,969rai	1,864rai
Grassland	-	1,370rai	1,370rai
Vegetable	30rai	1,083rai	1,053rai
Fallow	7,340rai	3,060rai	(-) 4,280rai
Farm Pond	-	1,070rai	1,070rai
House, etc.	-	1,070rai	1,070rai
Total	36,700rai	36,700rai	0rai

7.3.3 Agricultural Infrastructure Development Plan

1) *General Direction of Agricultural Infrastructure Development*

Due to limitation of water resources in this area, individual farm pond development will be major direction in this area for expanding integrated farming. Furthermore, farm road system should be improved and expanded for increasing accessibility to conduct the integrated farming. Since farmers are facing difficulties in access due to narrow width and poor surface condition of farm road, they are acceptable to pay land for farm road improvement.

Following two projects are studied in this Priority Area.

(1) Four (4) Dredging Projects
(2) Farm Pond and Farm Road Project

2) Water Resources Development

There are no more public lands except creeks and few community forests suited to water resources development. Existing community ponds are excavated type in low land area so that it is difficult to increase the storage capacity in large scale. Only sediment removal and strengthening of dike are possible way. It is, therefore, limited to increase capacity of community ponds. From this aspect, there is some possibility to remove sediment in past dredging projects and to expand dredging to creeks that are gentle in gradient and not yet dredged. This type of dredging project is accepted by villagers because land loss is minimum and equally distributed to the farmers along the creek, and they can use water equally.

a) Dredging Projects

From above aspects, following four dredging projects have been proposed in the creeks, of which gradients are gentle of more or less 1/300.

Table 7.3-3 Dredging Projects in KK-6 Priority Area

Elements	Creeks				Total
	Huai Khan	Huai Sua Thao Yai	Huai Sua Thao Noi	Huai Lak Dan	
Length (m)	2,380	4,600	5,420	1,800	14,200
Excavation (m)	2,000	3,500	4,410	1,500	11,410
Transition (m)	380	1,100	1,010	300	2,790
Gradient	1/265	1/300	1/305	1/295	1/300
Type of Dredging	Expansion of Existing	Expansion of Existing	Expansion of Existing	New Excavation	
Irrigation Acreage (rai)	252	441	556	189	1,438
Wet S. Rice (rai)	160	280	353	120	913
Vegetables (rai)	92	161	203	69	525

Among 4 dredging projects, three creeks are expansion of existing dredging and Huai Lak Dan creek will be newly excavated. Total length of 14,200 m will be dredged, and an area of 1,438 rai will be irrigated.

b) Typical Model of Dredging Project

Figure 7.3-1 shows the typical model of dredging project. Gradients of the creeks in the area are not enough gentle to provide dredging project economically. The gradients are more or less about 1/300 in the area, so that check weirs are not able to cover a long distance of water retention for irrigation. As shown in Figure 7.3-1, maximum coverage will be 500m for one weir.

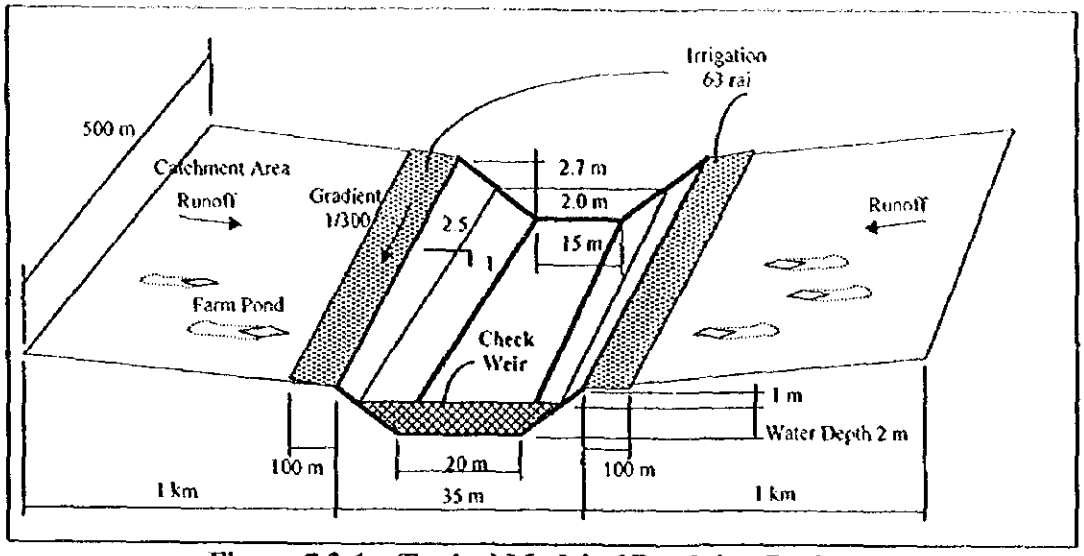


Figure 7.3-1 Typical Model of Dredging Project

c) Water Balance and Economical Evaluation of Typical Dredging Project Model

One typical dredging project with a capacity of 22,500 m^3 in a length of 500m is proposed to use it as a storage facility for irrigation along the existing creeks. A land of 63 rai within 100m at both sides of the creek is assumed to be irrigated by a tiller attached pump. Under available catchment area of 550 rai, following two cases of irrigation are found to be possible from a viewpoint of water balance.

Table 7.3-4 Irrigation Plan and Economic Evaluation of Typical Dredging Project

Irrigation Plan	Irrigated Crops	B/C
Case-1	Wet Season : Rice = 63 rai Dry Season : Dry S. Crop= 13 rai	0.1
Case-2	Wet Season: Rice = 40 rai Year round: Vegetables= 23 rai	1.0
Plan Conditions	- Dredging project is considered to be constructed newly. - Check weir shall cover a length of 500m length.	
Construction Cost	Weir : B1,237,500 (B=27.5m by RID Standard) Dredging : B1,023,000 (62,000m3/500m) Total : B2,260,500	
Maintenance Cost	B64,356/year (Weir 2%, Dredging 1%)	
Operation Cost (by fuel cost)	Case-1 : Irrigation Water 117,500m^3/yr x B0.25/m^3 = B29,400/yr Case-2 : Irrigation Water 80,100m^3/yr x B0.25/m^3 = B20,000/yr	
Benefit	by irrigated crops in each case as above.	

In above two cases, Case-1 is prepared as a plan for easier operation and maintenance of irrigation in the low land along the creeks. On the other hand, vegetables in Case-2 are necessary to be cultivated at an elevated banking land which is free from floods. It is, therefore, better to apply Case-1 as a plan of irrigation of the dredging project because no elevated banking land is necessary and irrigation is easier, if Case-1 is economically feasible. However, B/C is only 0.1 in Case-1. Consequently, Case-2 should be considered as a irrigation plan of dredging project.

Table 7.3-5 Water Balance of Irrigation Case-2 in Typical Dredging Project

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Year
Rainfall (mm)	54	123	107	96	112	191	72	9	4	3	10	26	810
Inflow (m^3)													
Runoff	14,282	32,419	28,222	25,238	29,674	51,163	18,876	2,482	1,135	792	2,719	6,732	213,734
Direct rain to Creek	947	2,142	1,871	1,673	1,962	3,392	1,251	165	75	53	180	446	14,162
Total	15,229	34,568	30,093	26,911	31,641	54,555	20,127	2,647	1,210	845	2,899	7,178	227,903
Irrigation (m^3)	0	3,165	4,736	29,632	10,304	8,064	15,790	4,992	0	7,728	5,226	0	89,637
Water loss (m^3)	2,951	2,454	2,587	2,673	2,286	2,503	2,716	2,503	2,228	2,306	2,013	2,354	29,574
Balance (m^3)	12,278	22,500	22,500	17,106	22,500	22,500	22,500	17,652	16,634	7,445	3,105	7,929	

(Note) 1) Condition: 1/5 drought Year, Catchment area: 550 rai, Direct Catchment: 17,500m^2 (10.9 rai), Storage Volume: 22,500m^3, Initial storage (end of Mar.) is at 0 m^3,
2) Crops: Wet Season Rice = 40 rai, Vegetables = 23 rai
3) Overflow occurs in 5 months; May, June, August, September, and October.

As shown in Table 7.3-5, critical supply of water occurs in February. Water remains only 3,105m^3 in the creek in this month..

Annual irrigation amount per 500m distance of dredging will be 89,637m^3 in 1/5 drought year and 80,124m^3 in a normal year. Annual irrigation amount of normal year will be utilized for estimating the operation cost of irrigation.

Table 7.3-6 Annual Irrigation Amount of Dredging Project per 500m Length

Return Period	Crops (rai)		Annual Irrigation Requirement (mm/yr)		Annual Irrigation Amount (m^3/year)
1/5 Drought Year	Wet Season Rice:	40 rai	Wet Season Rice:	1,124 mm	89,637 m^3
	Vegetables:	23 rai	Vegetables:	481 mm	
1/2 Normal Year	Wet Season Rice:	40 rai	Wet Season Rice:	1,007 mm	80,124 m^3
	Vegetables:	23 rai	Vegetables:	426 mm	

3) Farm Pond Development

At present, 18% of farmers have a 1,200m^3 class farm pond in this area. Among three types of lands, farm pond holding is high as 20% in the mixed land, and low as 15% in the lowland. Possible development of farm pond in this area has been analyzed based on the following factors;

Table 7.3-7 Factors on Farm Pond Development in KK-6 Priority Area

Factors concerning to the Development of Farm Pond	
Average size of land holding	20 rai/farmer
Irritable 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 wet season rice and dry season crop like water melon.
Necessary Catchement	
1,200m^3 Farm pond	3 rai
6,000m^3 Farm pond	30 rai
Farm road accessibility	Lowland = 93%, Mixed land = 93%, Upland = 88%
Topographical suitability	Lowland = 100%, Mixed land = 90%, Upland = 80%
Soil suitability	Lowland = 100%, Mixed land = 90%, Upland = 80%

Based on above factors, it is estimated that farm ponds will be possibly expanded to the farmers as shown in Table 7.3-8. In case developed only by 1,200m^3 farm ponds, 54% to 61% of farmers will able to have 1,200m^3 farm pond newly. In case introducing 6,000m^3 farm pond, 40% of farmers will able to have 6,000m^3 farm pond. (Farm pond construction is

planed in Section 11.2.)

Table 7.3-8 Physically Possible Farm Pond Development in KK-6 Priority Area

Development of Farm Pond	Lowland	Mixed Land	Upland	Total
Present				
1,200m³ Farm Pond	15%	20%	16%	18%
Future Possible Expansion				
<In case developed only by 1,200m³ Farm Pond>				
In case accessibility considered	70%	54%	39%	54%
In case accessibility not considered	77%	60%	47%	61%
<in case developed mixed with 6,000m³ Farm Pond>				
6,000m³ Farm Pond	28%	45%	37%	40%
1,200m³ Farm Pond (accessibility counted)	42%	9%	2%	14%
1,200m³ Farm Pond (accessibility not counted)	49%	15%	10%	20%

(Note) Detail procedure of estimation and computation are shown in Table 7.3-10.

4) Farm Road Development

Farm road development has been studied on the map 1:4,000 in accordance with the criteria for alignment of farm road, which are mentioned in Section 4.3.2.

Total farm road will be 197 km for 36,700 rai of farm land in KK-6 Priority Area, which is corresponding to 5.4 m/rai or 34 m/ha. Out of 197 km of farm road, 116 km of existing farm road will be improved and utilized, and remaining 81 km will be newly provided as shown in Table 7.3-9. Accessibility will be improved from 65% to 92% as mentioned in Table 7.3-10.

Table 7.3-9 Farm Road Development in KK-6 Priority Area

Farm Road	Number	Total Length (km)			Density (m/rai)		Width	Pavement (km)		Cross-structures	
Total 36,700 (rai)	of Roads	Existing Improvement	New Provision	Total	Existing	Future	(m)	Asphalt	Laterite	Culverts	Bridge
Main Farm Road (MFR)	7	27.36	0.84	28.20	0.75	0.77	4	1.20	27.00	12	0
Lateral Farm Road (LFR)	21	38.34	2.47	40.81	1.04	1.11	4	2.60	38.21	25	1
On-Farm Road (OFR)	151	50.34	77.67	128.01	1.37	3.49	2	6.80	121.21	136	0
Total	179	116.04	80.98	197.02	3.16	5.37		10.60	186.42	173	1

(Note) 1) Above farm roads are converted for the whole farm area of 36,700 rai. (Farm road have been studied for the area of 31,324 rai that is corresponding to the area of ALRO 4-0. Details of farm roads are listed in Section 7.1, Appendix-D)

2) Lateral and on-farm roads have been increased in proportion with following area ratio.
36,700 rai / 31,324 rai = 1.172

3) Length of Bridge = 20 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 farmland.

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.

6) Soil Protection Measures

Steep lands over 5% slope are only 0.1% or 40 rai in this area as shown in Figure 7.3-2. It is recommended to utilize those lands with fruit trees or pasture, which are effective for soil protection.

Table 7.3-10 Farm Pond Availability in KK-6 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)	3	3	3		
1-4) Necessary Min. Farm (rai)	2	2	2		Veg. + F.Pond
1-5) Necessary Total Area (rai)	4	4	4		C.A + F.Pond
Vegetable=1rai, W.S.Rice+W.Melon=3rai (Total 4rai)					
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)	30	30	30		
2-4) Necessary Min. Farm (rai)	6	6	6		Veg. + F.Tree + F.Pond
2-5) Necessary Total Area (rai)	32	32	32		C.A + F.Pond
Number of Farmers and Land Holdings					
3-1) Total 04-1 Area (rai)	3,775	20,114	7,435	31,324	
3-2) Total 04-1 Farmers	285	919	311	1,515	
3-3) Average Holdings (rai/farmer)	13.2	21.9	23.9	20.7	(3-1) / 3-2)
3-4) Total Farmers >= 2 rai	262	906	304	1,472	
3-5) Ratio	91.9%	98.6%	97.7%	97.2%	(3-4) / 3-2)
3-6) Total Farmers >= 6 rai	211	811	274	1,296	
3-7) Ratio	74.0%	88.2%	88.1%	85.5%	(3-6) / 3-2)
Farm Road Accessibility					
4-1) Present Accessibility	54%	67%	68%	65%	
4-2) Assumed Future Accessibility	93%	93%	88%	92%	
Suitability of Farm Pond Construction					
5-1) Topographical Suitability	100%	90%	80%		lower in upland because some area locating at top of hill
5-2) Soil Suitability	100%	90%	80%		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	41%	68%	75%		(3-3) / 2-5)
Possibility of Farm Pond to Farmers					
<In case only 1,200m3 Farm Pond>					
6-1) in case accessibility counted	85%	74%	55%	72%	(3-5)* 4-2)* 5-1)* 5-2)* 5-3)
(1) Farmers able to have 1,200m3 pond	242	680	171	1,093	(3-2) * 6-1)
6-2) in case accessibility not counted	92%	80%	63%	79%	(3-5)* 5-1)* 5-2)* 5-3)
(2) Farmers able to have 1,200m3 pond	262	735	196	1,193	(3-2) * 6-2)
<In case 6,000m3 Farm Pond introduced>					
6-3) 6,000 m3 Farm Pond	28%	45%	37%	40%	(3-7)* 4-2)* 5-1)* 5-2)* 5-4)
(3) Farmers able to have 6,000m3 pond	80	414	115	609	(3-2) * 6-2)
(4) 1,200m3 ponds when access counted	162	266	56	484	{(1)-(3) <> 3-5)* 4-2)* 5-1)* 5-2)* 5-3)* {3-1)-(3)*32rai}/4rai
(5) 1,200m3 ponds when access not counted	182	321	81	584	{(1)-(3) <> 3-5)* 5-1)* 5-2)* 5-3)* {3-1)-(3)*32rai}/4rai
Existence of Present Farm Pond					
7-1) 1,200 m3 Farm Pond	15%	20%	16%	18%	(6)/ 3-2)
(6) Farmers having 1,200m3 pond	42	185	49	276	by 1:4,000 map
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	200	495	122	817	(1) - (6)
(8) Ratio of Expansion of 1,200m3 pond	70%	54%	39%	54%	(8-1) / 3-2)
8-2) in case accessibility not counted	220	550	147	917	(2) - (6)
(9) Ratio of Expansion of 1,200m3 pond	77%	60%	47%	61%	(8-2) / 3-2)
<Farmers able to have 6,000m3 pond>					
8-3) Farmers able to have 6,000m3 pond	80	414	115	609	(3) - (7)
(10) Ratio of Expansion of 6,000m3 pond	28%	45%	37%	40%	(8-3) / 3-2)
<In case accessibility is counted>					
(11) Farmers with 1,200m3 pond	120	81	7	208	(4) - (6)
(12) Ratio of Expansion of 1,200m3 pond	42%	9%	2%	14%	(11) / 3-2)
<In case accessibility is not counted>					
(13) Farmers with 1,200m3 pond	140	136	32	308	(5) - (6)
(14) Ratio of Expansion of 1,200m3 pond	49%	15%	10%	20%	(13) / 3-2)

Figure 7.3-2 On-Farm Development Plan of Khon Kaen Priority Area (KK-6)

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%)*

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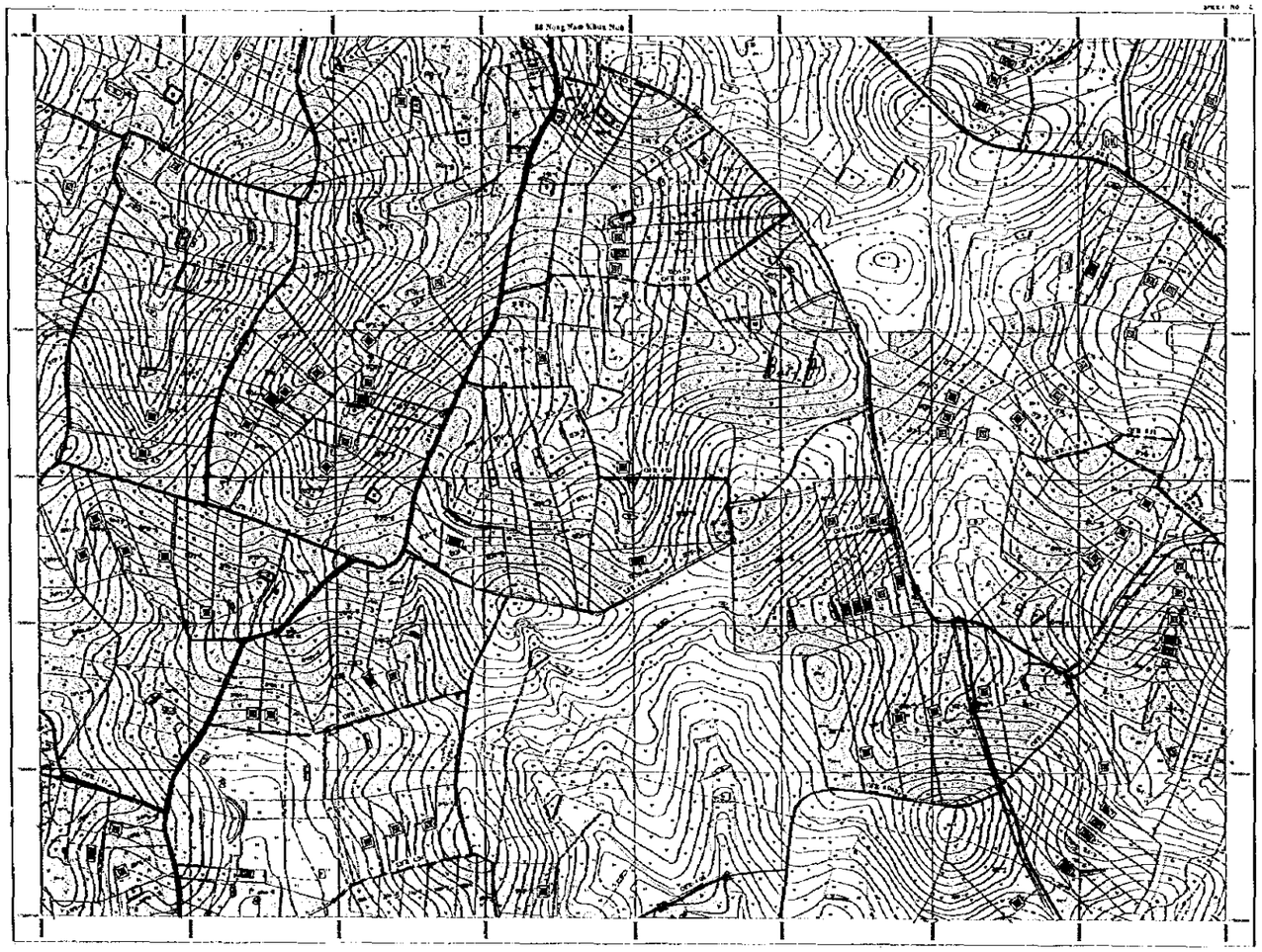
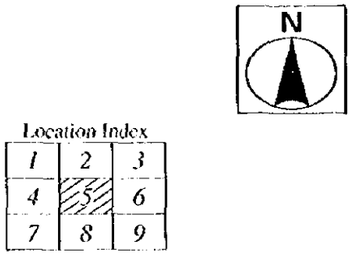
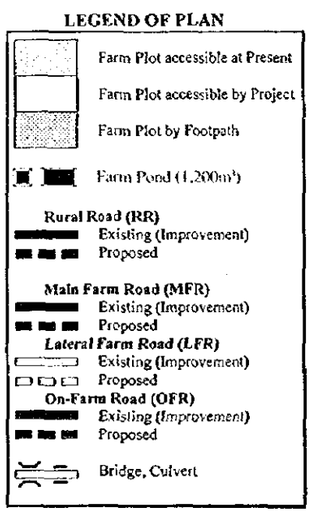
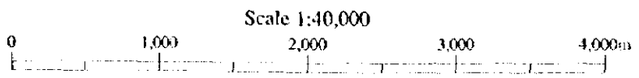
Figure 7.3-3 Arrangement Sample of Farm Pond in Khon Kaen Priority Area (KK-6)









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

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7.3.4 Forest Conservation Plan

In principal, RFD takes part in forest conservation. However, extensive agriculture is the main reason for the expansion of illegal farmland into the forest as well as the increase in population, the lack of social responsibility and awareness and environmental knowledge as shown in Figure II-7, Appendix II. Therefore, the forest conservation plan should be based on environmental education, leadership training and regular meetings with villagers by ALRO, RFD and NGOs. It will include support for community forest development and the afforestation plan. The support by ALRO, RFD and NGOs will include the following items.

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

Among above 5 items, the items a) and d) shall be included in the leadership training for the management of community forest and the conservation of environment, that is the ALRO responsible training program as mentioned in the Chapter II.4.1. Basically RFD should cover the all items from a) to e), especially for e) and f) as the main responsibility.

1) Community Forest Development Plan

Purpose:

Improvement of communal forest by the community for soil and water conservation and improvement of diet.

Operation by villagers:

- Comprehensive regulations to prohibit private logging and farming
- Seeding and planting seedlings
- Protection of seedlings from livestock
- Collection of vegetables, mushrooms, firewood, etc.

2) Afforestation Plan

Purpose:

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

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

Operation by villagers:

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

7.3.5 Strengthening People's Organizations

Peoples' organization has an important role on strengthening of link between rural people and also between government agencies and rural people. ALRO 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, following maters are to be taken into consideration as well as basic measures mentioned in Chapter 4.5.

a) Provide peoples' organization members with appropriate information and understanding of all aspects of the formation and management of groups or local organizations such as the rights, duties and roles of local organizations.
b) Promote training and disseminate know-how for production, marketing, accounting, finance and general administration.
c) Provide and transfer knowledge and technology to farmers' housewives' groups, farmers' groups and youth groups being able to play a greater role in integrated farming development as well as handicrafts, cottage industries and home processing of agricultural products.
d) Strengthening the existing farmers' groups or local organizations and campaign for establishment of professional farmers' groups, particularly, vegetable farmers' groups, fruit farmers' groups, livestock breeding farmers' groups, and marketing farmers' groups.
e) Provide community funds and low interest rate credit to support the formation and operation of all types of peoples' organizations, particularly business initiatives launched and run by groups or local organizations.
f) Promote networking among peoples' organizations for the exchange of information, experience and local wisdom and for improving administrative skills.
g) Formulate strong back-up bodies at provincial and/or Amphoe levels in all activities related to strengthening peoples' organizations, not only at the initial stage of establishment but also during the subsequent operation period.

7.4 Preliminary Design

7.4.1 Farm Pond

The location of 1,200m^3 farm pond and land use plan for each type of land is shown

in Figure 7.4-1. Structural dimensions of farm ponds are shown below and typical sections are shown in Figure 7.4-2.

Table 7.4-1 Structural Dimensions of Farm Ponds

Item	1,200m³ Farm Pond	6,000m³ Farm Pond
Bottom of Pond	12.0m×15.0m	28.0m×31.0m
Top of Pond	28.0m×31.0m	48..0m×51.0m
Depth of Pond	4.00m	5.00m
Slope	1:2.0	1:2.0
Width of Pond Crest	4.00m	4.00m
Water Depth	3.00m	4.00m
Height of Embankment	1.00m	1.00m
Seepage Control	not carried out	should be carried out if necessary
Compaction Criteria	not specified	85% Standard Proctor Compaction

Farm ponds are to be constructed in parallel with farm roads in regard with subgrade material of from road as mentioned in Chapter 4.3.2, 3), e). ALRO will proceed construction of farm ponds based on the request of farmers as well as construction of farm roads. Residual soil of farm pond is treated as shown in Figure 4.3-3.

7.4.2 Farm Road

The design of main and lateral farm road is carried out according to ALRO's standard design. On-farm road with a width of 2 m is designed based on ALRO's standard design of main and lateral farm roads, because ALRO has no standard design of on-farm road. The typical cross section of farm road is shown in Figure 7.4-3.

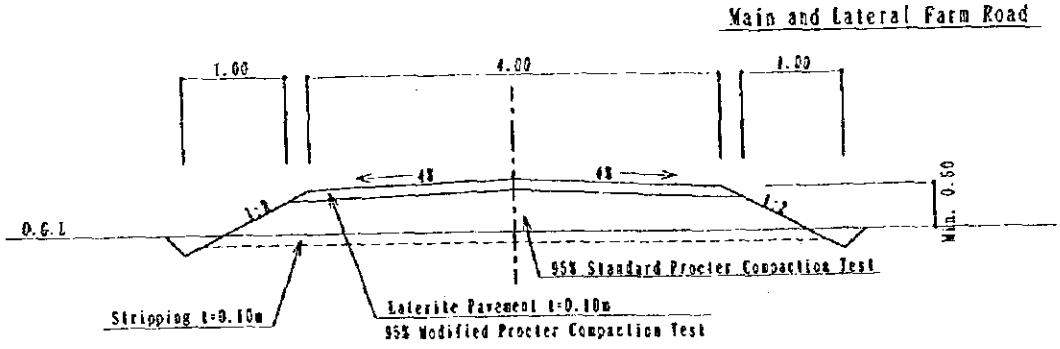
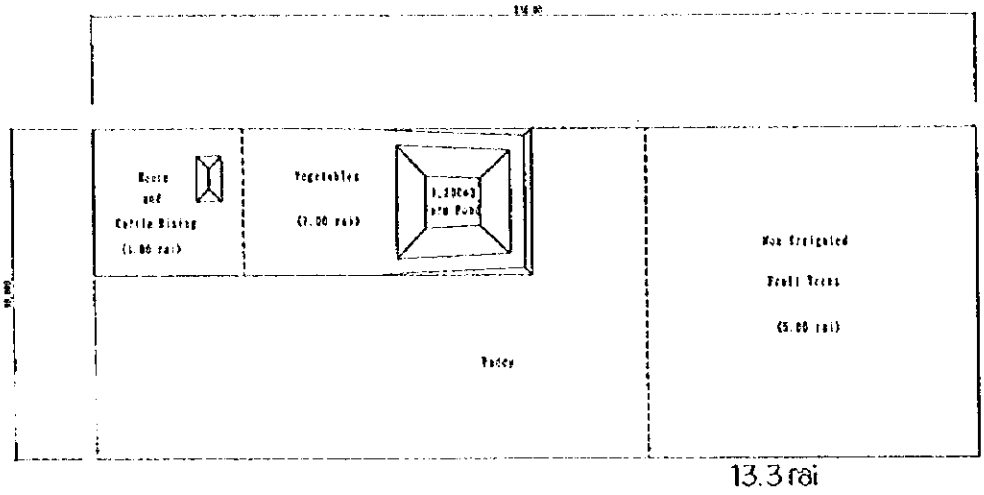
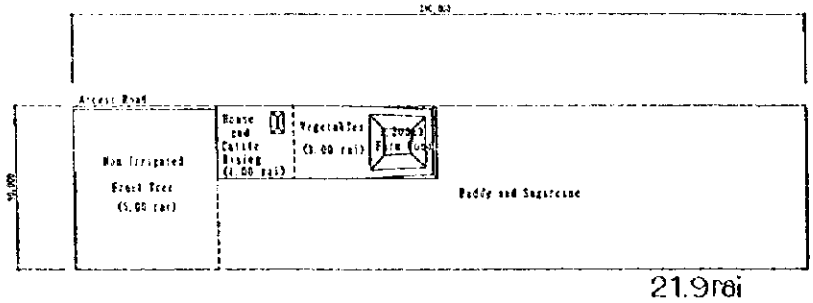


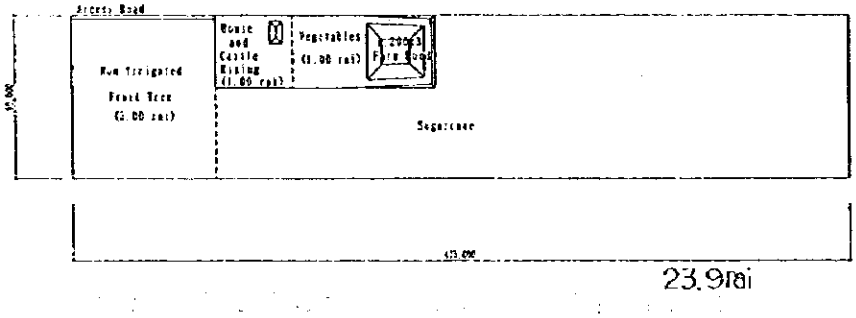
Figure 7.4-3 Typical Cross Section of Farm Road



Typical Layout of Farm at Khon Kaen Lowland Type



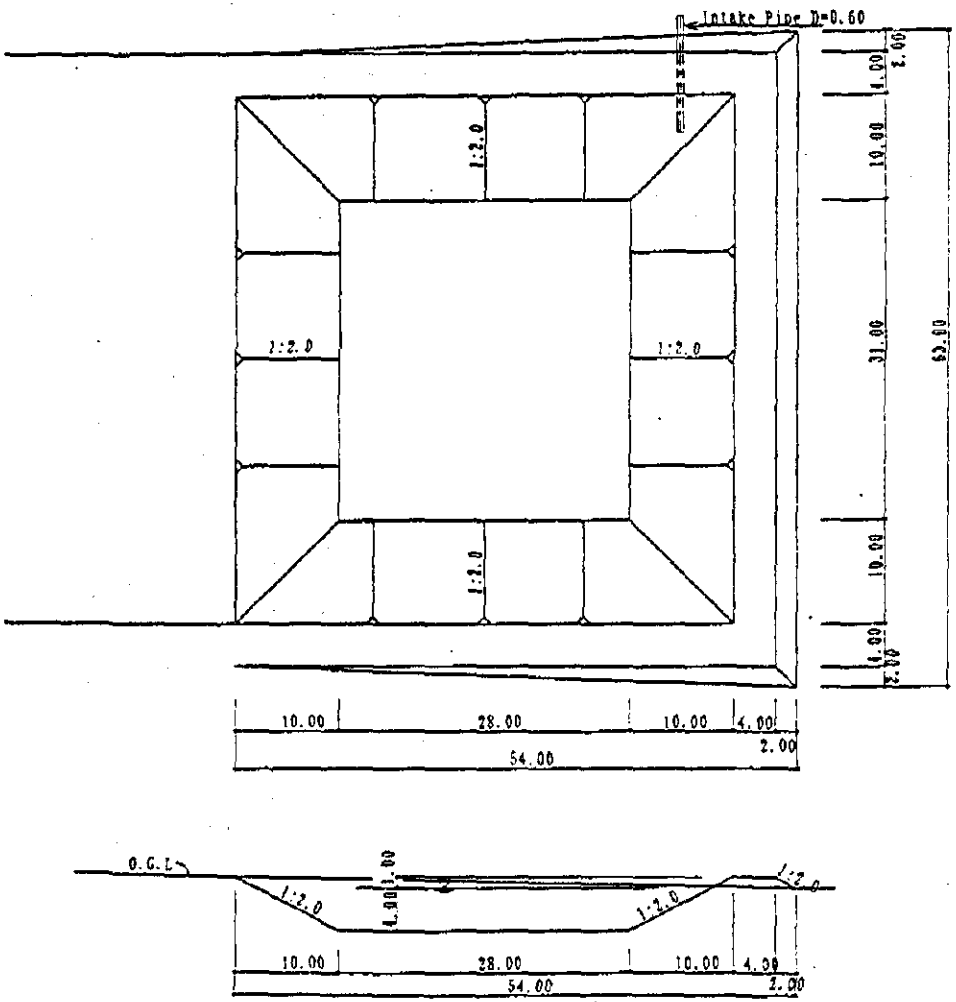
Typical Layout of Farm at Khon Kaen Mixedland Type



Typical Layout of Farm at Khon Kaen Upland Type

Figure 7.4-1 Typical Layout of Farm with 1,200m³ Farm Pond in KK-6 Priority Area

Typical Design of 6,000m3 Farm Pond



Typical Design of 1,200m3 Farm Pond

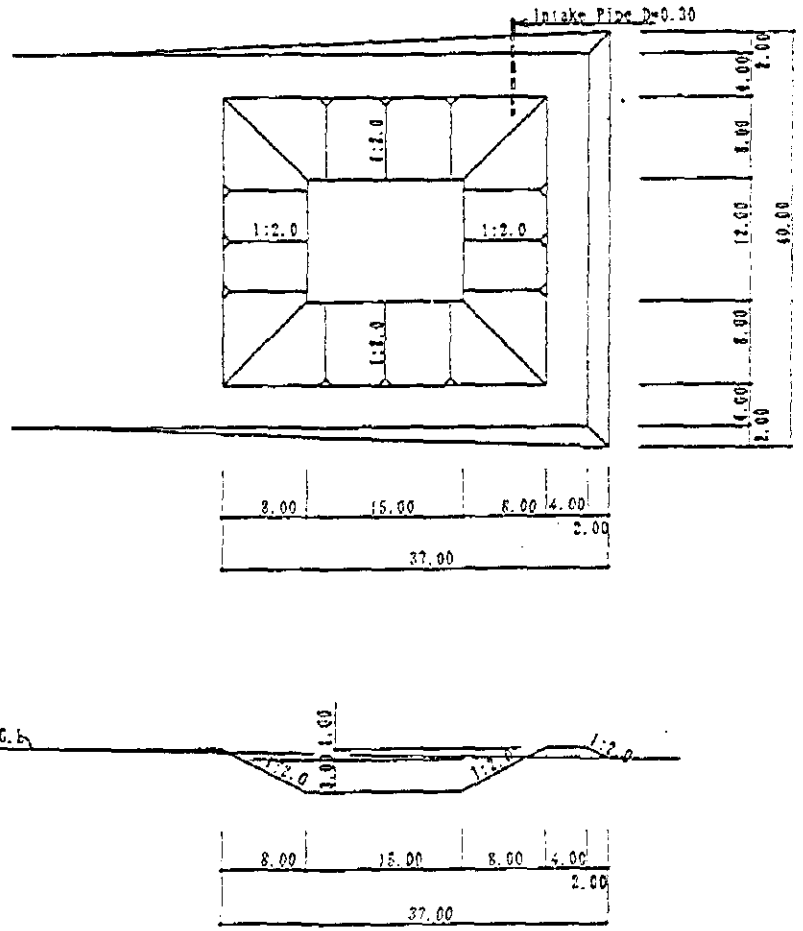


Figure 7.4-2 Typical Design of Farm Pond

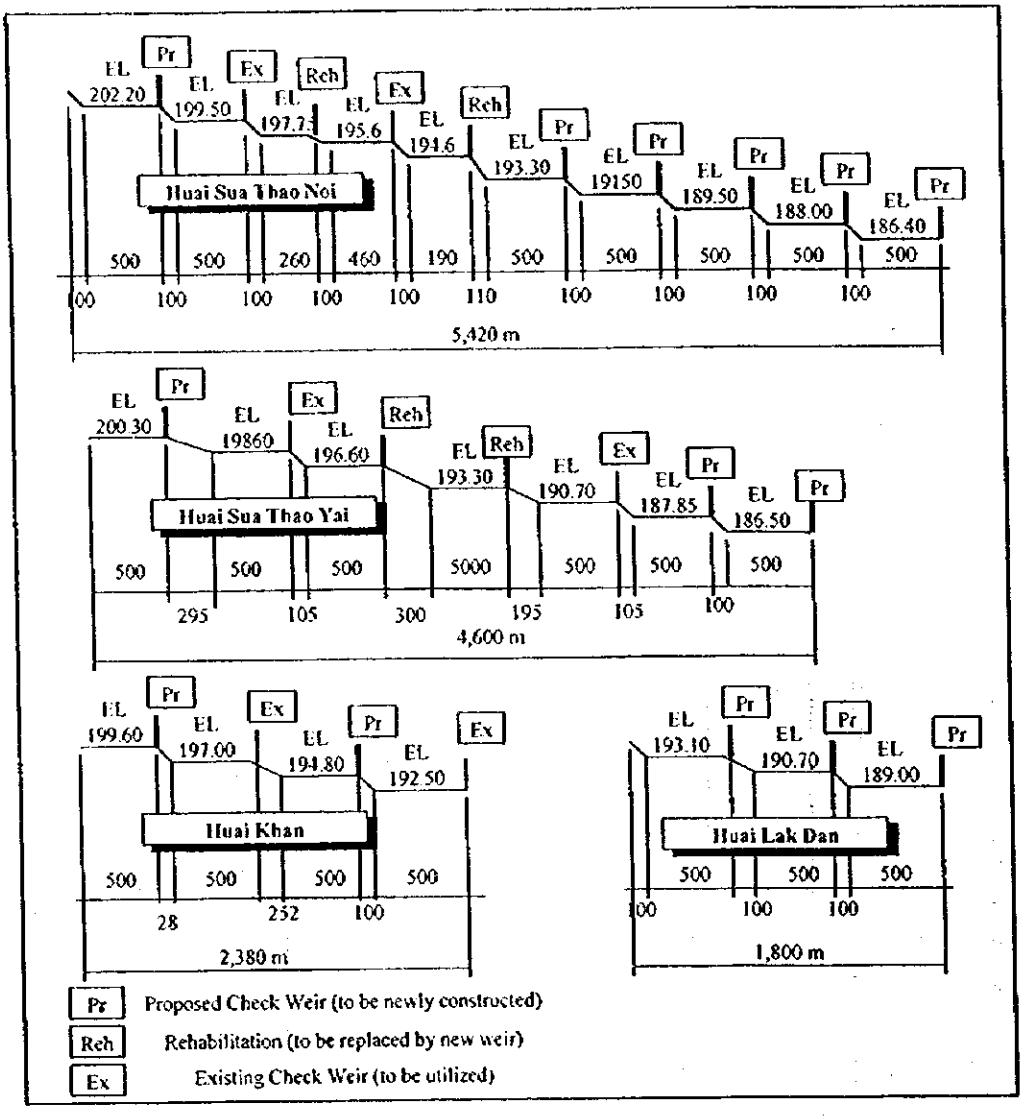
7.4.3 Dredging of Creeks

As mentioned in Chapter 7.3.2, there is four creek dredging projects in Khon Kaen Priority Area. Outline of these projects are shown in Table 7.4-2

Table 7.4-2 Dredging Projects in Khon Kaen Priority Area

Elements	Creeks				Total
	Huai Khan	Huai Sua Thao Yai	Huai Sua Thao Noi	Huai Lak Dan	
Length (m)	2,380	4,600	5,420	1,800	14,200
Excavation (m)	2,000	3,500	4,410	1,500	11,410
Transition (m)	380	1,100	1,010	300	2,790
Gradient	1/265	1/300	1/305	1/295	1/300
Type of Dredging	Expansion of Existing	Expansion of Existing	Expansion of Existing	New Excavation	
Irrigation Acreage (rai)	252	441	556	189	1,438
Wet S. Rice (rai)	160	280	353	120	913
Vegetables (rai)	92	161	203	69	525
Civil Works					
Dredging(m3)	108,000	207,000	224,000	187,000	727,000
Num. of Weir(Place)	2	5	8	3	18

(Note) The number of weir is including replaced weir.



7.5 Cost Estimation

7.5.1 Conditions of Cost Estimation

The project cost is estimated under the following conditions;

a) The civil works are carried out on the contract basis. The construction machinery and equipment which are required for construction works will be provided by the contractors.
b) The project cost consists of the following items.

   i) Civil Works
   ii) Engineering Survey & Design
   iii) Administration
   iv) Physical Contingency
   v) Price Escalation

c) The administration cost is set at 10 % of the cost of civil works, and the physical contingency cost is set at 10 % of the total amount of the costs of civil works, engineering survey & design and administration.
d) The price escalation is predicated by applying the international inflation index established by the world bank and bank of Thailand. Annual inflation rate is assumed at [1]2.15 % for local portion and [2]3.41 % for foreign portion.

   1) Price Index Economic Research Dept. Bank of Thai
   2) Commodity Markets and Developing Countries. Aug. 1997 World Bank

e) The basic rate of labor, material and construction machinery is estimated considering the prevailing rate in Thailand, as of 1997.
f) For the cost estimation, the unit costs of construction works authorized by ALRO or other agencies are adopted. The overhead, profit and tax are calculated by using some percentage to the direct cost. The percentage authorized by Thailand government in 1997 are shown below.

Percentage of Overhead, Profit and Tax to Direct Cost

Total Direct Cost (Baht)	Percentage (Factor F)	
	Road, Canal, Pond and Dam works	Bridge and Pipe Works
5,000,000	41.47	29.47
10,000,000	37.46	27.95
15,000,000		27.31
20,000,000	32.67	25.88
25,000,000		26.22
30,000,000	29.24	26.57

7.5.2 Project Cost

The project cost is estimated based on the quantity of the civil works and unit cost

for individual working items.

1) Farm Ponds and Farm Roads Construction Project

a) Project Cost

The cost of the farm ponds and farm roads construction project in Khon Kaen Priority Area is estimated at 112,081 thousand baht as shown below..

Table 7.5-1 Cost of Farm Ponds and Farm Roads in KK-6 Priority Area

Item	Q'ty	Unit	Total Cost ('000Baht)
1. Civil Works			
1) 1,200m3 Farm Pond	1,070	Ponds	27,750
2) Farm Road	197,000	m	47,620
2. Engineering Survey and Design	1	L.S	10,944
3. Administration	1	L.S	7,537
4. Physical Contingencies	1	L.S	9,385
Sub-Total			103,236
5. Price Escalation	1	L.S	8,845
Total			112,081

b) Annual Disbursement Schedule

The annual disbursement schedule is prepared based on the project implementation plan of four years consisting of project preparation period of two years (year 1999 and 2000) and the construction period of two years (year 2001 and 2002).

Table7.5-2 Annual Disbursement Schedule of Farm Ponds and Farm Roads in KK-6 Priority Area

(Unit : '000 Baht)

Item	Total Cost ('000Baht)	Year			
		1999	2000	2001	2001
1. Civil Works	75,370	0	0	37,685	37,685
2. Engineering Survey and Design	10,944	5,472	5,472	0	0
3. Administration	7,537	420	420	3,348	3,348
4. Physical Contingencies	9,385	497	497	4,195	4,195
Sub-Total	103,236	6,390	6,390	45,229	45,229
5. Price Escalation	8,845	214	435	3,486	4,710
Total	112,081	6,604	6,825	48,715	49,938

c) Annual Operation and Maintenance (O/M) Cost of Farm Pond and Farm Road

The annual O/M cost is estimated at 3,735,000 Baht/year according to the following conditions.

- Farm Pond 1.00 % *1)of the project cost
- Farm Road 7.00 % *2)of the project cost

*1) Percentage of annual O/M for farm pond is defined as follows;
Percentage = 1/ Working Life x Coefficient
Working Life20 years (from an example in Japan)
Coefficient 20.0 % (same as above)

*2) Percentage of annual O/M cost for farm road is calculated as follows;
General Construction Cost of Road in Thailand582,900 Baht / km
General Maintenance Cost of Road in Thailand39,300 Baht / km
Percentage = 39,300 / 582,900 = 7.00 %
(Note) Above unit costs are authorized by the government.

Table 7.5-3 Annual O/M Cost of Farm Ponds and Farm Roads in KK-6 Priority Area

Item	Q'ty	Unit	Total Cost ('000Baht)
1. 1,200m3 Farm Pond	1,070	Place	401
2. Farm Road			
1) Main Farm Road	28.20	km	728
2) Lateral Road	40.81	km	1,162
3) On-Farm Road	128.01	km	1,443
Total			3,735

(Note) number of farm ponds is including the existing ponds.

2) Creek Dredging Project

The cost of creek dredging project consists of the following items

- Project Cost
  - Civil Works Cost
    - Dredging Cost
      - Soil Dredging Cost
      - Soil Embankment Cost
      - Other Works Cost
    - Construction Cost of Weir
      - Earth Works
      - Concrete Works
      - Other Works
  - Engineering Survey and Design Cost (8% of Civil Works)
  - Administration Cost (10% of Civil Works)
  - Physical Contingencies (10% of Civil Works, Engineering Survey and Design Cost and Administration Cost)
  - Price Escalation
  - O/M Cost

The conditions of the cost estimation are same as that in Chapter 7.5.1. The percentages of O/M cost to civil works cost are defined as follows;

Facility	Working Life (Year)	Coefficient (%)	Percentage (%)
Canal	20	20.0	1.0
Weir	30	50.0	1.6

(Note) Percentage = (1 / Working Life)×Coefficient

Working life and Coefficient refer to the projects in Japan and Thailand.

The project costs and annual O/M costs are estimated as shown below;

Table 7.5-4 Project Cost and O/M Cost of Creek Dredging Project

(Unit : '000 Baht)

Item	Huai Khan	Huai Sua Thao Noi	Huai Sua Thao Yai	Huai Lak Dan	Total
1. Civil Works					
a) Dredging	4,681	9,706	8,983	8,071	31,441
b) Weir	2,470	9,882	6,176	3,706	22,234
Sub-Total	7,151	19,588	15,159	11,777	53,675
2. Engineering	572	1,567	1,213	942	4,294
3. Administration	715	1,959	1,516	1,178	5,368
4. Physical Contingencies	844	2,311	1,789	1,390	6,334
Sub-Total	9,282	25,425	19,677	15,287	69,671
5. Price Escalation	245	683	523	402	1,853
Total (Project Cost)	9,527	26,108	20,200	15,689	71,524
O / M Cost	616	1,384	1,062	519	3,581

7.6 Project Evaluation

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

① Creek Dredging Irrigation Project

This project dredges 4 creeks of a total length about 14.2 km to irrigate 1,438 rai. 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 740. By implementation of this project, farmland with a farm pond will be increased to 21,400 rai or 58% of the whole, together with the present farmland with a pond. In the farmland of 21,400 rai, integrated farming (including vegetable production, fruit tree cultivation, poultry, fish breeding, etc.) and integrated farming together with beef cattle breeding 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
①Creek Dredging Irrigation Project	17.1	1.4
②Farm Pond and Farm Road Development Project	17.7	1.4

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

As EIRR of both projects is higher than the rate 12% of the opportunity cost of capital set up in the Kingdom, the projects are evaluated as economically feasible. Unit investment costs of both projects are B49,800/rai for the project ①, and B5,200/rai for the project ② respectively, so that the unit cost of the project ② is much less than that of the project ①. It is, therefore, recommended to implement the project ② first, which is able to provide benefit to much more farmers.

Annual agricultural income of the typical farmers holding 20 rai farmland, an average in the area, will be increased as follows by the implementation of the planned farming in Table 7.3-1;

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

	Lowland Type	Upland Type	Mixed Type
Present	19,315	28,099	26,716
Future	71,086	76,633	55,056

(Note) Details are in Chapter 11.6.5.

Average annual total income of farmers in the area is about 44,800 baht. As shown in the above table, agricultural income of a typical farmer will be more than the average total

income. Considerable number of farmers, therefore, can earn their income only on agriculture by the project.