

3) Implementation schedule

The project will be implemented over five years, inclusive of detailed design. Figure 6.4.3-1 shows the implementation schedule of the project.

6.4.4 Project Cost

1) Conditions of cost estimation

The project costs were estimated under the following conditions

- The civil works are to be carried out on a contract basis, and the construction machinery and equipment required for the works will be provided by contractors.
- Project costs consist of construction cost, associated cost, physical contingency and price escalation cost.

Associated cost consist of land acquisition, engineering, administration cost.

- The exchange rate between Thailand Baht and U.S. Dollar is fixed as follows.

U.S. Dollar = 25.0 Thailand Bahts.

- The physical contingency related to the construction and associated cost is set at 10 percent of the direct costs.
The price escalation for foreign currency is applied for 3 percent inflation index and for local currency 7 percent inflation index is applied.

2) Construction cost

- The basic rate for labor, material and construction equipment is estimated considering the prevailing rate in Northeastern Region and RID, as of March 1996.

Table 6.4.3-1 Implementation Schedule

Works	Spec	1st year	2nd year	3rd year	4th year	5th year	Remarks
Dang Phuan							
1. Flood Protection							
1) Regulators (D/S)	2 Nos.						
Civil Works							
Gates Works	2.50+3.25						
2) Regulator (Rehabilitation)							
Gates Works	2.50+3.25+1						
3) Pumping Station	1 Nos.						
Civil Works							
Pump/Motor	φ 1000+2sets						
4) Drainage Canals							
Bypass	L=7 km						
Rehabilitation	L=9 km						
2. Swamp Area Development							
1) Reservoir Dredging	V=1.2 MCM						
2) Dike/Road	L=18 km						
3) Pumps	3 Nos.						
4) On-farm	A=880 ha						
5) Fishery Pond & Others	A=30+30 ha						
3. Engineering Work							
Vieng Kook							
1. Flood Protection							
1) Regulators (D/S)	-						
Civil Works							
Gates Works	-						
2) Regulator (Rehabilitation)							
Gates Works	2.50+3.25+2						
3) Pumping Station	1 Nos.						
Civil Works							
Pump/Motor	φ 1000+3sets						
4) Drainage Canals							
Bypass	-						
Rehabilitation	L=18 km						
2. Swamp Area Development							
1) Reservoir Dredging	V=0.7 MCM						
2) Dike/Road	L=16 km						
3) Pumps	4 Nos.						
4) On-farm	A=560 ha						
5) Fishery Pond & Others	A=20+20 ha						
3. Engineering Work							

- Unit cost of construction work are as follows, which are classified by construction methods, since the construction of the project will be executed on a contract basis with the cost of overhead, profit and tax used in current RID projects.

Major Unit Cost

Works	Specification	Unit	Cost(Baht)	F/C	L/C
				%	%
Stripping	by bulldozer	cu.m	14	80	20
Filling	Compaction	95%	45	55	45
		85%	39	55	45
	by manual	cu.m	223	0	100
Excavation	by backhoe	cu.m	23	80	20
Dredging	by dredger	cu.m	22	85	15
Sodding	w/transport	sq.m	29	5	95
R.Concrete	180 kg/sq.m	cu.m	4,700	45	55
	210 kg/sq.m	cu.m	5,240	45	55
Form work		sq.m	140	10	90
Masonry		cu.m	2,020	0	100
Riprap	w/mortal	cu.m	1,100	10	90
	Placing	cu.m	960	10	90

3) Construction cost

The construction costs are estimated based on the unit costs for individual working items. The construction cost will be divided into foreign and local currency portion. The local currency portion is to be estimated on the basis of above prices in Thailand in 1996, while the foreign portion is estimated on the CIF price in Thailand.

4) Project cost and disbursement schedule

a) Project cost

Project costs are estimated at about 1313 million Bahts, as shown in Table 6.4.4-1 & 2.

Table 6.4.4-1 Cost Estimation of Bang Phuan

Works	Size /Material	Unit Price(D)			Q'ty	Unit	Amount (1000B)		
		Total	L/C	F/C			Total	L/C	F/C
1. Preparation Work	(2) *5%						20950	7700	13250
2. Construction Work									
2-1. Flood Protection									
1) Regulators (D/S)									
Civil Works		8100000	4550000	3550000	1	L/S	8100	4550	3550
Gates Works	2.50*3.25*1	3500000	350000	3150000	1	L/S	3500	350	3150
2) Regulator (Rehabilitation)									
Gates Works	2.50*3.25*1	3500000	350000	3150000	1	L/S	3500	350	3150
3) Pumping Station									
Civil Works		23200000	13000000	10200000	1	L/S	23200	13000	10200
Pump/Motor	φ 1000*3sets	75000000	7500000	67500000	1	L/S	75000	7500	67500
4) Regulators (U/S)									
Civil Works		8100000	4550000	3550000	1	L/S	8100	4550	3550
Gates Works	2.50*3.25*1	3500000	350000	3150000	1	L/S	3500	350	3150
5) Drainage Canals									
Bypass		16600	7200	9400	7000	m	116200	60400	65800
Rehabilitation		8000	3100	4900	9000	m	72000	27900	44100
Sub Total							313100	108950	204150
2-2. Swamp Area Development									
1) Reservoir Dredging		22	3.3	18.7	1200000	cu.m	26400	3960	22440
2) Dike/Road (Fill)		45	20.3	24.8	288000	cu.m	12960	5830	7130
3) Dike/Road (laterite)		25	22.5	2.5	86400	cu.m	2140	1940	200
4) Pumps		1000000	500000	500000	3	Nos	3000	1500	1500
5) On-farm		30000	21000	9000	880	ha	26400	18480	7920
6) Fishery Pond (Cut)		22	3.3	18.7	300000	cu.m	6600	990	5610
7) Fishery Pond (Fill)		45	20.3	24.8	240000	cu.m	10800	4860	5940
8) Others					20	%	17600	7500	10100
Sub Total							105900	45060	60840
Total (1+2+3)							439950	161710	278240
3. Land Acquisition Cost		500000	500000	-	70	ha	35000	35000	-
4. Engineering Cost	(1+2) *3%						13200	4900	8300
5. Administration Cost	(1+2) *10%						44000	16200	27800
6. Contingencies	(1+2+3+4+5) *10%						53200	21800	31400
7. Price escalation L/C	(1+2+3+4+5) *40%						134300	87100	47200
F/C	(1+2+3+4+5) *16%								
Total Project Cost							719650	326710	392940
							720000	327000	393000

Table 6.4.4-2 Cost Estimation of Vieng Kook

Works	Size /Material	Unit Price(D)			Q'TY	Unit	Amount (10000)		
		Total	L/C	F/C			Total	L/C	F/C
1. Preparation Work	(2)*5%						17200	5700	11500
2. Construction Work									
2-1. Flood Protection									
1) Regulators(D/S)									
Civil Works									
Gates Works	2.50*3.25*1					L/S			
2) Regulator (Rehabilita	tion)								
Gates Works	2.50*3.25*2	3500000	350000	3150000	2	L/S	7000	700	6300
3) Pumping Station									
Civil Works		29500000	16500000	13000000	1	L/S	29500	16500	13000
Pump/Motor	φ 1350*3sets	93000000	9300000	83700000	1	L/S	93000	9300	83700
4) Regulators(U/S)									
Civil Works									
Gates Works	2.50*3.25*1					L/S			
5) Drainage Canals									
Bypass		16600	7200	9400	-	m	0	0	0
Rehabilitation		8000	3100	4900	18000	m	144000	55800	88200
Sub Total							273500	82300	191200
2-2. Swamp Area Development									
1) Reservoir Dredging		22	3.3	18.7	660000	cu.m	14520	2178	12342
2) Dike/Road (Fill)		45	20.3	24.8	256000	cu.m	11520	6180	6340
3) Dike/Road (Laterite)		25	22.5	2.5	76800	cu.m	1920	1730	190
4) Pumps		1000000	500000	500000	3	Nos	3000	1500	1500
5) On-farm		30000	21000	9000	560	ha	16800	11760	5040
6) Fishery Pond (Cut)		22	3.3	18.7	200000	cu.m	4400	660	3740
7) Fishery Pond (Fill)		45	20.3	24.8	160000	cu.m	7200	3240	3960
8) Others					20	%	11740	6152	6588
Sub Total							71100	31400	39700
Total (1+2+3)							361800	119400	242400
3. Land Acquisition Cost		600000	500000	-	66	ha	32500	32500	-
4. Engineering Cost	(1+2)*3%						10900	3600	7300
6. Administration Cost	(1+2)*10%						36100	11900	24200
6. Contingencies	(1+2+3+4+5)*10%						44100	16700	27400
7. Price escalation L/C	(1+2+3+4+5)*40%						108100	67000	41100
F/C	(1+2+3+4+5)*15%								
Total Project Cost							593500	251100	342400
							593000	251000	342000

b) Disbursement schedule

The annual disbursement schedule for the project costs as mentioned above is estimated on the basis of the implementation schedule, and its summary is shown in Tables L.5-11 and L.5-12 of Appendix N.

6.5 Project Evaluation

6.5.1 Introduction

This project has been selected mainly aiming at flood protection. Flood damages on agriculture and social infrastructure, which may occur once 10 years (10 years return period), will be mitigated by implementing this project.

6.5.2 Economic Justification

Economic evaluation for this project has been made on the basis of the collected data which were available only for 1995 in the provincial offices concerned and data collected in the farm economic survey. Flood damage is composed of the following items:

- Livestock
- Fishery
- Agriculture
- Public facilities

As the result, flood damage per hectare in each province is estimated as shown below:

<u>Udon Thani</u>	<u>Nong Bua Lamphu</u>	<u>Nong Khai</u>
45,120 B/ha	95,900 B/ha	21,360 B/ha

As to project cost, after deducting the price contingency from the estimated financial investment cost of 1,313 million Baht, the economic cost has been estimated at 868 million Bahts, by applying the conversion factor (refer to Part-7 of Appendix G).

The economic cost for operation and maintenance after completion of this project is estimated at 11.1 million Bahts per year at full development stage.

Tangible benefit in monetary terms in this project are those generated from agricultural crops, fishery and animal husbandry. Table 6.5-2 shows these economic benefits.

Economic internal rate of return(EIRR) is calculated on the basis of 50 years project life in considering the synthetic durable life of major facilities. As the result, EIRR is calculated at 1.1 %, implying economically not feasible of this project which is lower than 12% of the opportunity cost of capital in Thailand.

However, taking into consideration the quality of life of the rural population, for example, indirect benefit will be generated by implementing the project as shown below:

- Cash income for farmers during construction works will be increased
- Poverty condition in the area will be alleviated
- Heavy labour on fetching water by female and children will be decreased
- Intake of animal protein will be increased
- Establishment of small industry on fish processing, beef processing can be expected to establish
- Migrant workers, in particular, young generation who are the successor of farm household, can be reduced

In addition to the said project evaluation for the overall project, the economic evaluations for the swamp development and flood protection were separately conducted. In regard to the swamp development, EIRR shows the project for this sector economically feasible at the rate of 21.7 %, however, for the flood protection, EIRR shows a negative effect at the rate of - 46.5 %.

6.5.3 Farm Budget Analysis

Farm budget analysis on two(2) types of farm model in case of with project was carried out in order to compare farm household income including off-farm incomes as shown below:

Farm Model-Without Project

1. Crop Production

	Area (ha)	Yield (kg/ha)	Production (kg)	Unit Price (Bahts/kg)	Value (Bahts)	Production Cost (Bahts)	Net Income (Bahts)
Paddy-irrigated	2.80	1,540	4,312	4.65	20,051	8,016	12,035
Tobacco	0.16	1,518	243	80.25	19,491	3,540	15,951
Cassava	0.32	11,659	3,731	0.78	2,910	1,480	1,430
Total	2.96						27,986

2. Off-farm Income (Bahts/year)	24,300
3. Total Income (Bahts)	52,286
4. Living Expense (Bahts/year)-Family size 5.4 person/family	39,214
5. Disposable Income (Bahts/year)	13,071

Farm Model-With Project (1)

1. Crop Production

	Area (ha)	Yield (kg/ha)	Production (kg)	Unit Price (Bahts/kg)	Value (Bahts)	Production Cost (Bahts)	Net Income (Bahts)
Paddy-irrigated	2.60	3,200	8,000	4.65	37,200	18,805	18,395
Soybean	1.65	1,700	2,635	11.94	31,462	14,953	16,509
Beef cattle	3 head	500kg	3 head	20.00	30,000	22,290	7,710
Total	4.05						42,614

2. Off-farm Income (Bahts/year)	24,300
3. Total Income (Bahts)	66,914
4. Living Expense (Bahts/year)-Family size 5.8 person/family	50,186
5. Disposable Income (Bahts/year)	16,729

Farm Model-With Project (2)

1. Crop Production

	Area (ha)	Yield (kg/ha)	Production (kg)	Unit Price (Bahts/kg)	Value (Bahts)	Production Cost (Bahts)	Net Income (Bahts)
Coconut	2.20	24,000	52,800	3.33	175,824	24,887	150,938
Maize	1.50	3,150	4,725	2.36	11,151	9,101	2,045
Vegetables	0.35	16,000	5,600	2.70	15,120	6,210	8,910
Beef Cattle	3 head	500kg	3 head	20.00	30,000	22,290	7,710
Total	4.05						169,602

2. Off-farm Income (Bahts/year)	24,300
3. Total Income (Bahts)	193,902
4. Living Expense (Bahts/year)-Family size 5.8 person/family	145,426
5. Disposable Income (Bahts/year)	48,476

CHAPTER 7. HUAI LUANG DEVELOPMENT PROJECT

CHAPTER 7 HUAI LUANG DEVELOPMENT PROJECT

7.1 Project Area

7.1.1 Project Location and Area

The Project Area is located in Muang Udon Thani and Amphoe Kut Chap of Udon Thani province where is a center of the Study Area.

The beneficial area is the suburban farm land area of some 7,200 ha for flood mitigation (river training) and 1,190 ha for irrigation, and extended over the Tambon Mu Mon, Ban Luem, Chiang Pin and Chiang Yun of Amphoe Muang, and Tambon Pa Ko of Amphoe Kut Chap of Udon Thani province. The area includes a part of existing Huai Luang Project area and Nong Sam Rom reservoir area.

Beneficial Area

	River Training	Irrigation
Muang Udon Thani	5,500 ha	1,190 ha
Ku Chap	1,700 ha	-
Total	7,200 ha	1,190 ha

7.1.2 Topography and Geology

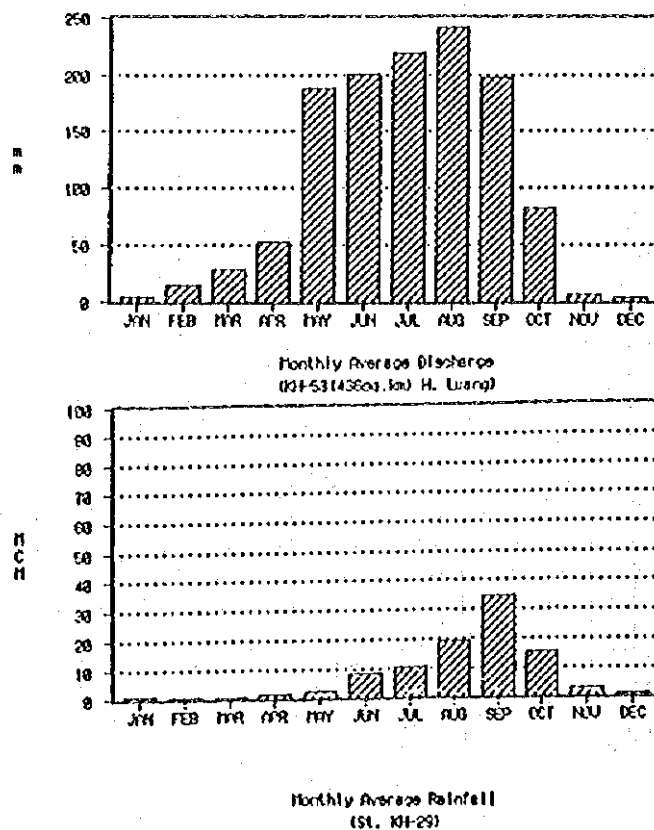
The land is generally flat but some are moderately sloped and undulated. Several swamps exist in the depressed land. The land consists of mudstone, shale and siltstone with rock salt and other evaporites of Maha Sarakham formation in the cretaceous tertiary age in geology.

7.1.3 Hydrology

The Project Area is located in the upstream of Huai Luang river. The source of water for the project is Huai Luang reservoir. The catchment area is 666.4 sq.km. Water surface area is 31 sq.km with the effective storage of 113.3 MCM. Dead storage 5.25 MCM. The annual average inflow(1987-95) is 127.43 MCM. There is another dam called Huai Luang(old dam) located about 7km down stream. The reserved water in the dam is used for irrigation, domestic and industrial purposes. The spilled water flows to the old dam. The old dam diverts

some water to the right main canal and during flood time it also release to the down stream of Huai Luang river.

The annual rainfall in the area is about 1,260mm and concentrates during the months of May through September. A graphical representation of monthly average(1972-95) rainfall of KH-29 which is located on the reservoir site and monthly average discharge of KH-53(C.A. = 436 sq.km) located on the Huai Luang river just upstream of the Reservoir are presented below.



Apart from the two main canal systems there are many small natural streams in the area. These streams act as a drainage canals for the Huai Luang project area. Flooding is not common in this area but heavy rainfall causes local flooding when it happens together with the release of water from the old dam.

7.1.4 Soil and Land Classification

The most of the paddy soil in the Huai Luang Development Project Area is Loamy Paleaquults. The most of the upland soil are Skeletal

Plinthustults and Loamy Paleustults in order of Ultisols by the USDA classification as already shown in Chapter 2.

These soil are low humid gray soil, red yellow podzolic soil and gray podzolic soil in Thai classification. Most of the soil in paddy field are loamy silt or sandy loam in texture, very deep in soil depth and low in organic matter and soil fertility. Soil pH are 5.0 to 6.0. CEC and available phosphate and potassium are also very low. Soil of the upland field are sandy loam or loamy clay with agglomerate laterite in texture, very deep in soil depth, very low or low in organic matter and fertility. Soil pH are 5.5 to 6.5.

In the Huai Luang Development Project Area, there are some area of severe saline. Some of these area are classified in grade 1 (very severely affected), 2 (severely affected) and 3 (moderately affected) in the total 7 classification. As the salt affection is markedly increased in dry season, so enclosure of saline soil by ridge and the careful selection of crops will be required in dry season.

The most of the soil are also classified in Grade P-2 to 3, by the classification of soil suitability for rice production. This means that the paddy soil of the Area is well or moderately suited for rice production.

7.2 Present Agriculture

7.2.1 Land Use

Agricultural land use in the Huai Luang Development Project Area including existing Huai Luang project area is shown in Table 7.2-1 of Appendix F.

The area of paddy field in the Area is 9,783 ha, occupying 79.8 % of the total agricultural land. The area of upland field is 1,376 ha and occupies 11.2 % of total agricultural land. Vegetable field and fruit trees field share only 1.5 % and 2.4 % respectively.

Cropping intensity in paddy field (total area of crops in dry season paddy /paddy field) was very low in the Area, and most of the paddy field were

used only for major rice in rainy season. The Area include irrigation area of Huai Luang project however, cropping intensity were very low at only 102. It reflects low utilization of irrigation water for dry season crops.

As the reason of low utilization of irrigation water, two points may be pointed out, one is on the irrigation facilities such as irrigation canal and pump, and another is on the crops management and low income caused by insects diseases, weeds problems, low yield and low farmgate prices of dry season crops. These are disturbing the desire of farmers to cultivate the crops in dry season.

Table 7. 2-1 Agricultural Land Use

(Unit : rai)

Tambon Field	Ban Luang	Chiang Yun	Chiang Pin	Mu Mong	Kut Chap	Pa Kho	Chiang Peng	Total Area(rai)	Total (ha)
Total Land Area	6,105	18,177	11,059	3,956	40,625	45,547	54,976	180,356	28,857
Paddy Field	3,274	10,050	7,735	2,195	9,114	12,288	16,512	61,142	9,783
Paddy % Agric. Ara	78.7	75.0	68.3	64.5	68.1	90.2	95.2	79.8	79.8
Upland Field	0	1,206	2,210	194	3,868	1,079	45	8,603	1,376
Begetables	11	677	184	216	1	18	3	1,111	178
Fruit Tress Field	4	307	794	19	259	240	150	1,774	287
Flower Field	5	51	0	4	0	0	0	60	10
Other Agric., Field	860	1,101	401	775	138	0	627	3,901	624
Total Agric. Area	4,154	13,392	11,325	3,403	13,381	13,625	17,337	76,591	12,258

Source : Data from the Muang Udon Thani and Kut Chap Amphoe Office.

7. 2. 2 Water Use

This is the only area where water use may be estimated quantitatively. The major premises of water use are agriculture, domestic and industry. The source is Huai Luang Reservoir. The project is close to Udonthani provincial head quarter. Therefore, residents of municipality areas get the water supply. But the villages far from the center still has to depend on rain water or swamp water for their daily needs. Year by year the demand of domestic water and industrial water is increasing.

7. 2. 3 Population, Farm Household and Farm Labour Force

This project area covers Muang Udon Thani and Amphoe Kut Chap in Udon Thani Province. Population and its density are estimated at about 28,350 and 16 persons per sq.km.

Some 5,500 households and 4,950(90%) farm households of which exist in the area with 5.15 family size and 2.97 farm labour force per family.

7.2.4 Agricultural Production

Practical cropping area of major rice, main rainy season crops and dry season crops is shown in Table 7.2-2 and more detailed data are shown in Table 7.2-2 of Appendix F. Cropping area of major rice in the Area is 9,651 ha in 1995, including both glutinous and non-glutinous rice, and ratio of cropping area to total paddy field is 98.7 %. The main crops in upland field are cassava and sugarcane. These two crops occupies about 66.8 % of the upland field. Sweet corn, groundnut and mungbean occupy only 102 ha and 7.4 % of the total upland field.

The average agricultural area per farmhousehold were also shown in same Table. Average farm area per farmhousehold is little small in Chiang Yun, but others are 14.9 to 19.9 rai per one farmhousehold, and average area was 15.5 rai (2.48 ha/ farmhousehold). It is a little smaller area comparing with the other Amphoes in the Study Area.

Table 7.2-2 Cultivated Area of Main Crops

Tambon Field	Ban Luang	Chiang Yun	Chiang Pin	Mu Mong	Kut Chap	Pakho	Chiang Peng	Total (rai)	Area (ha)
Glutinous rice	3,162	7,004	5,569	1,407	8,125	10,766	14,424	50,457	8,073
Non-glutinous rice	85	2,789	2,166	223	989	1,523	2,088	9,863	1,578
Wet Season Upland Crops including cassava and suarcane :									
	0	1,155	754	10	3,597	546	18	6,080	973
Dry Season Crops including second rice:									
	23	245	109	43	64	290	247	1,021	163
Paddy use % in DS*	101	102	101	102	101	102	102	102	102
Vegetables	37	392	70	79	259	240	39	1,116	179
Croppng Intensity in Dry Season Paddy**	102	106	108	105	104	104	102	103	103
Average Area/ house***	15.1	10.9	14.7	19.9	16.6	18.0	18.3	15.5	2.48

Source: Data from the Amphoe Office in Udon Thani.

Notes: * Total area of dry season crops / Area of paddy field.

** Total area of dry season crops + area of vegetables/ Area of paddy field + vegetables area.

*** Average Area/house is total agricultural area/number of farmhousehold.

The number of farming machines in the Area is shown in Table 7.2-3.

Table 7.2-3 Number of Farming Machines

Tambon	Ban Luang	Chiang Yun	Chiang Pin	Mu Mong	Kut Chap	Pakho	Chiang Peng	Total
2 & 4 Wheel Tractor	0	0	2	1	3	1	-	6
Power Tiller	10	94	92	7	150	198	-	552
Chemical Sprayer	9	0	53	4	0	0	-	66
Water Pump	24	59	85	13	15	0	-	196
No. of farmhousehold	274	1,229	760	171	807	759	950	4,950

Source : Data from the Amphoe Office in Udon Thani. (1995)

The number of 2 & 4 wheel tractor in the Area is few, but the number of power tiller is comparatively large, and about 11 % of farmhousehold are holding the power tiller.

The number of water pump in the Area was very little in spite of the irrigation area, and the percentage of water pump holding farmhousehold was only 4 %.

7.2.5 Livestock

The number of livestock and the number of farmhousehold which are breeding livestock in the Area is as follows, and the number in each Tambon is shown in Table 7.2-5 of Appendix F.

As is shown in Table, the number of beef cattle in the Area is little few, comparing with that of buffaloes in the Area. Of course, the number of cattle in Tambon Pa Kho is not counted in the Table. However, this inclination is similar to other Tambon in Udon Thani and Nong Khai province.

Table 7.2-4 Number of Livestock

Name of Livestock	Buffaloes	Beefcattle	Swine	Chicken	Duck	Goose
No. of Livestock	7,560	2,818	6,644	38,524	25,680	1,211
No. of farmhousehold*	1,775	602	381	2,316	-	-

* farm house hold breeding livestock

Source: Data from the Amphoe Office in Udon Thani.

Using table, calculating the average number of livestock in one farmhousehold, average number of buffaloes by Tambon are from 3.2 to 10.3, average number of the Area is 4.3 heads per farmhousehold, beef cattle are from 3.0 to 9.7 by Tambon, average of the Area is 4.7 heads, swine are 1.4 to 47.0, average in the Area is 17.4 heads, chicken are 11 to 34, average is 16.6, and average number of duck was 8.1 to 8.8.

Total number of farmhousehold in the Area is 4,950, and the number which are breeding the buffaloes is 1,775, farmhousehold of breeding beef cattle is 602, swine is 381 and chicken is 2,316 in the Area. Of course, some of the farmhousehold will be overlapped, but the number will show that under half of the farmhousehold are breeding the buffaloes or beef cattle.

7.2.6 Inland Fishery

The number of fish pond, area of fish pond and the number of household rearing fishes is shown in Table 7.2-5.

Table 7.2-5 Number and Area of Fish Pond

Tambon	Ban Luang	Chiang Yun	Chiang Pin	Mu Mong	Kut Chap	Pakho	Chiang Peng	Total
Number of Fish Pond	44	10	56	25	44	12	11	202
Area of Fish Pond (rai)	71	13	150	26	68	16	17	359
Number of Fish House	44	9	41	11	44	12	11	171

Source : Data from the Amphoe Office in Udon Thani. (1995)

As shown in Table, inland fishery is not so active in the Area in spite of irrigation area.

7.2.7 Marketing

As this area was developed by the large scale irrigation project implemented by RID, dry season crops such as vegetable, soybean, second paddy etc. are planted, and major paddy, cassava in rainy season. Crops produced in the area are transported or marketed by middlemen to Muang Udon Thani which is the capital of Udon Thani Province

7.2.8 Agricultural Supporting Services

Provincial agricultural extension office is located at Muang Udon Thani to serve extension services and Amphoe agricultural offices are disposed in Kut Chap and Muang Udon Thani, respectively.

Main office of BAAC in Muang Udon Thani are available for agricultural credit services.

7.2.9 Farm Household Economy

Annual farm household incomes in this area are estimated at 25,000 Baht which is lower than the poverty line of 33,800 Baht/family/year. There are some disparity in the quality of life such that accomplishment of category among 37 categories in Kut Chap and Chiang Pen are lower than other Tambon in the area. Tambon benefited from the large scale irrigation project tends to attain higher quality of life(refer to Part-4 of Appendix G).

7.3 Development Plan

7.3.1 Objectives of the Project

The Project aims to increase the farm income and create the employment opportunity in the rural areas and improve the living standard of the people in the Project Area through the improvement of the Huai Luang and river water impounding in the natural reservoir, to provide the water for domestic and agricultural use under small scale project type. The life of people in the project area are poor, as pointed out to be lower satisfying only 7 to 8 items out of 37 items of the Basic Minimum Needs prepared by MOI. The project will also be expected to increase the job opportunity by cultivation with cash crops and improve the quality of life.

7.3.2 Agricultural Development

1) Irrigation Area and Selection of Crops

The area of paddy field in the Huai Luang Project Area is 13,760 ha by the projection of Huai Luang Irrigation Office. The paddy field in the area is supplementary irrigated for the major rice in rainy season and partly irrigated for the crops in dry season paddy field.

The irrigation area of the Project is a paddy field adjoining to the downstream end of the beneficiary area of Huai Luang project. The area is 1,190 ha, and the area is projected for the cultivation of major rice with the supplemental irrigation in transplanting and growing season of rice. In dry season, 40 %, 476 ha of the paddy field in the paddy field is projected for the cultivation of dry season crops.

The main projection in the newly selected area is stable and high yielding production of major rice and dry season crops both in rainy and dry season paddy. Following is the outline of projection in the selected area for the agricultural development.

(a) Stable production of major rice by supplemental irrigation

The selected area is the area for the stable production of major rice in rainy season by supplemental irrigation. The area is 1,190 ha, and in the cultivation plan, major rice is intensively managed under supplemental irrigation in transplanting time and growing period accompanying with some levels of fertilization and pest control. High yielding variety of non-glutinous rice are used to get higher yield.

(b) Stable and high yield production of second rice

As a dry season crop in the selected area, second rice was selected. The area is 76 ha. Second rice is one of the traditional crops that were intended to decrease the area by the government policy. However, second rice is cultivated for long time by the farmers, very easy to cultivate than other upland crops. Second rice is also one of the most labor saving crops and farmers have some level of techniques to cultivate the rice. So, in the plan, second rice is projected

to cultivate under labor saving management with irrigation in land preparation time, broadcasting time of seed and growing period.

(c) Stable and high yield production of soybean

For the stable and high yield production of soybean, 200 ha of dry season paddy is selected. Soybean is one of the most promising crops in the dry season paddy in irrigation area. So, in the plan, soybean will be sown by hill sowing to save the seed and to secure the growth of individual plant. Comparatively intensive management with irrigation in sowing time and in growing period will be practiced.

(d) Stable and high yield production of upland crops

In the plan, the areas of 30 ha of sweet corn, 30 ha of baby corn and 40 ha of groundnut are projected for the dry season crops in the irrigated paddy. For the stable and high yielding of these crops, irrigation will be enforced in some fixed interval, and relay cropping will be also carried out to avoid the concentration of labors for the cultivation of baby corn.

(e) Production of vegetables in dry season paddy field

In the plan, 100 ha of vegetable area is proposed in the dry season paddy field in irrigation area. There are two purposes of the cultivation of vegetables, one is production of fresh vegetables for inhabitants, and the other is for rural industries.

The irrigation area is located in the suburban farm land area of Udon Thani. This is favorable location to supply the fresh vegetables to the inhabitants of Udon Thani. So, the farmers in the area can produce many kinds of fresh vegetables using the irrigation water. Proposed fresh vegetables are cucumber, Chinese cabbage, string bean, lettuce, kale, asparagus, water melon, tomato, big chilli, onion, shallot and so forth. For the cultivation of rural industries, some of these vegetables can be selected and cultivated accompanying with the demand from industries.

The outline of the projection in the irrigation area of the Area is shown in Table 7.3-1 and Cropping season of main crops in the plan is shown in Figure 7.3-2 of Appendix F.

Table 7.3-1 Outline of Agricultural Development Plan

(Unit : ha)

Plan	Area (ha)	Outline
(a) Stable Production of Major Rice	1,190	Supplement irrigation, high yield variety
(b) High Yield Production of Second Rice	76	Labor saving production with irrigation
(c) High Yield Production of Soybean	200	Intensive and high yield production
(d) High Yield Production of Upland Crops	30	Sweet Corn, relay cropping.
	30	Baby Corn (for human and industries).
	40	Ground Nut, stable production
(e) Production of Fresh Vegetables	100	For inhabitants and Industries

2) Yield Projection

Expecting the stable and better yield of major rice in the Area, high yield variety will be introduced. Supplementary irrigation will be also carried out in land preparation, transplanting time and growing period, and intensive management will be practiced on fertilization and weed and insect control.

Soybean is also irrigated in sowing time and in growing period for several times under the intensive management. Other crops such as second rice, sweet corn and baby corn are also managed in same level and irrigated in several times. So the yield of these crops will be expected to be higher than usual yield in the Area.

The outline of cultivation and yield projection of major rice and the selected dry season crops are shown in Table 7.3-2 to 7.3-5 of Appendix F.

In addition to projection, on the projection (e) (Production of fresh vegetable of in Table 7.3-1), cooperative cargo and shipping system among farmers should be projected to enable the effective booking and shipping.

Extension office in the Amphoe also should take the leadership on making the system and introducing new variety of vegetables and cultivation

techniques, and on presenting the information on marketing and the organization of farmers

3) Development of Integrated Agriculture

(a) Development of Inland Fishery by Increasing the Area of Fish Pond

In the Area, there are 359 rai (57.4 ha) of fish ponds, but more than 100 ha of fish ponds should be developed combining with the breeding of local variety of chicken.

As the species of fishes, Nile tilapia, cat fish and mirror carp etc. will be recommendable. The expected yield of capture fish is 6,250 kg/ha (100 kg/rai).

(b) Development of Animal Husbandry

Existing number of buffaloes and beef cattle in the all over irrigation area are 7,560 and 2,818 heads respectively. The most of buffaloes are breeding as the draft animal. However, in the future, beef cattle should be more increased in number than buffaloes using the byproducts in paddy and upland field. Local variety of broiler chicken should also be increased in combination with inland fishery.

(c) Development of Fruit trees

There is 174 ha of cassava field in irrigation area, and some of the cassava area should be converted to the field of fruit trees such as mango, some kind of orange, cashew nut, sweet tamarind and so forth. These fruit trees have high demand in the region, and high quality of fruits should be produced by the scrupulous management.

(d) Formation of the Organization of Farmers and Women

For the development of agriculture and rural districts, organizing of the farmers and women is very important. Organization should be started from the practical problems such as utilization of irrigation water and cooperative booking and marketing of agricultural products.

(e) Introduction of Rural Industry

The introduction of rural industry that is based on the agricultural products in the area has a big role for the development of the agriculture and the rural districts. It can also absorb the labor in rural districts, and stimulate the agricultural production and their economy.

As the rural industry, canned factory for vegetables, vacuum packing of vegetables, young bamboo shoot and baby corn etc. processing of local chicken and swine, food production for animals and fishes using the corn and sorghum, and others can be considered.

4) Changes in Farming Types

By the projection, the area of supplemental irrigation paddy field for major rice, upland crops and vegetables in dry season paddy increase. Agricultural development plans will also make the area of fruit trees and number of beef cattles increase. According to these changes, farming types will also change.

Most of the farming types in the Area is paddy farming which is cultivating the major rice in rainy season and is cultivating upland crops and some vegetables in small area of dry season paddy field.

However, by the projection, farmers can cultivate the upland crops and vegetables in dry season. Farming types will change to the paddy and upland farming and paddy and vegetables farming reflecting the projection. In paddy and upland farming, farmers can cultivate soy bean and ground nut in dry season paddy field using the irrigation water. In paddy and vegetables farming, farmers can cultivate the vegetables in dry season paddy field to supply the fresh vegetables to the inhabitants in the city and vegetables for rural industries.

7.4 Project Engineering

7.4.1 Improvement and Rehabilitation of Existing Project

Nong Samrong reservoir, constructed for the purpose of irrigation and domestic water supply to the Udon Thani urban area in 1952, has a catchment area of some 82.0 sq.km and have also been receiving the water from the right main canal of Huai Luang project. The reservoir, however, seems to be used only for domestic water and has a function of water tank for the drainage area at present. The dikes have been provided only for about 2.2km against about 6.6km in the circumference of the reservoir, to drain the excess water from the vicinity of the reservoir, while, the existing dikes are irregular shaping and the reservoir is being silted up.

The proposed project will improve the reservoir by rehabilitating the dike and providing the drainage canal to convey the excess water to the downstream area, and rehabilitate and improve the existing irrigation facilities together with the provision of on-farm facilities. Moreover, the reservoir will be upgraded in its storage capacity by receiving the water from the Huai Luang river. The dike will be heightened up by 1.0 m so that reservoir capacity will be increased from its present capacity of 5.17 MCM to 8.75 MCM.

7.4.2 River Training and Water impounding Project

1) Huai Luang River Training

The Huai Luang river is narrow and considerably meandered. It spills the water during flooding and inundates the land along the river. To improve this situation, the Project proposes to train the river by dredging and provide the dike for the section between the confluence of Huai Raeng and the railway bridge. The dike will be constructed considering a design discharge of 510 cu.m/s, corresponding to 50 years flood, for a length of 20 km.

2) River Water Impounding

The Project will provide the weir across the river to distribute water to the Bung Sang and Nong Bo Kong natural reservoirs in addition to the Nong Samrong reservoir by constructing the dike around those reservoirs and feeder

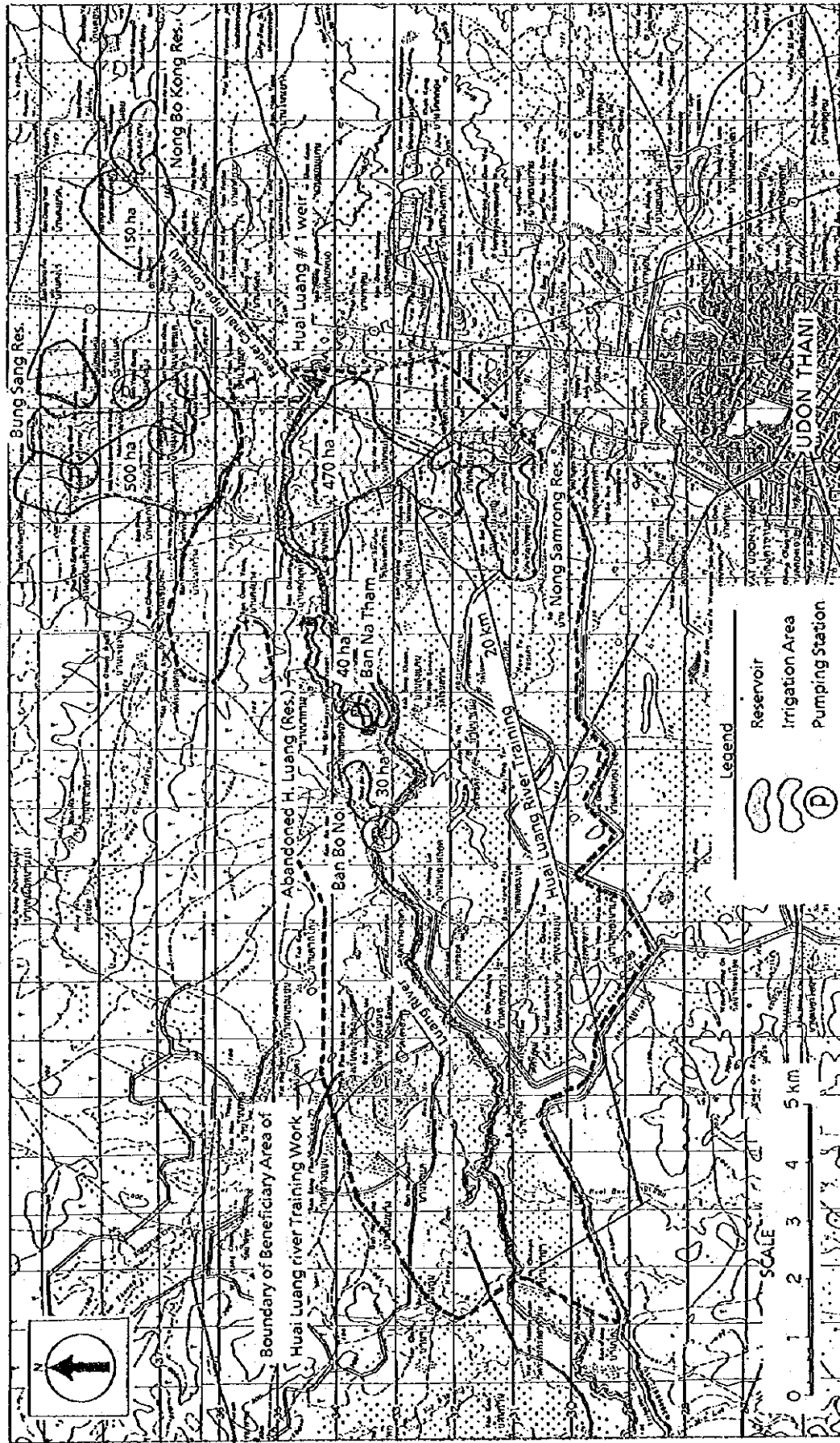


Figure 7.4-1 General Map of Huai Luang Development Project

canal. The abandoned river land, which is brought about by the river training, will impound the water by providing the crossing dikes with control gate in both the upstream and downstream sides. The river water of about 108 MCM a year mostly in the rainy season is available at Ban Tha Tum gauge station on the Huai Luang at a small distance downstream from the Project Area. In this plan the drainage in the surrounding area shall be carefully studied before the construction. The proposed reservoirs are listed below.

Proposed Water Impounding Reservoirs

Reservoir	Feeder Canal	Storage	Irrigable A.
Nong Samrong	2.3 km	3.60 MCM	470 ha
Bung Sang	2.1 km	5.64 MCM	500 ha
Nong Bo Kong	5.0 km	1.56 MCM	150 ha
Abandoned H. Luang	-	0.40 MCM	40 ha
Total		11.20 MCM	1,160 ha

The proposed project will also provide the Huai Luang #1 weir at the immediate upstream of the railway bridge, to divert the water to the said reservoirs and store the water in the river course for the purposes of irrigation/domestic water use, as follows.

Weir Length	51.0 m
Weir Height	1.0 m
Rubber Dam	
Height	2.8 m
Length	24.0 m
Span	2 Nos.
Storage	0.38 MCM
Irrigable A.	30.0 ha

3) Small Scale Irrigation Projects

The Project will also provide the small scale irrigation projects for the domestic use and the dry season crop irrigation by using the impounded water in the reservoirs and river. The proposed projects are listed below:

Proposed Small Scale Projects

Name	Tambon	Province	Irr. A.	Irr.Method
Bung Sang	Mu Mon	Udon Thani	500 ha	Pump
Nong Bo Kong	Kut Sra	Udon Thani	150 ha	Pump
Ban Na Tham	Mu Mon	Udon Thani	40 ha	Pump
Ban Bo Noi	Mu Mon	Udon Thani	30 ha	Pump
Total			720 ha	

All area will be supplied with pumps, because the natural reservoirs are located in the lower land. Bung Sang area will receive the water in October because there is no adequate drainage method due to lower lying reservoir. Its pumping irrigation method will convey the water to the water tank within the village compound for domestic water use, and the irrigation water will be delivered from the tank to the farm plot by the gravity. Nong Bo Khong area may be applied mainly for irrigation, expecting intensive farming. Ban Na Thum area water will be supplied directly from the river by pump. Ban Bo Noi area will receive the water from the Nong Bo Noi existing reservoir near the village. The construction of canals and structures are suggested up to the commanded area of some 10 ha (60 rai).

7.4.3 Implementation Program

The Project will be implemented by the RID within the period of 5 years. The RID staff, who will deal with the organization of Water Users' Cooperatives and assist in the construction of on-farm facilities, should be assigned in the RID Changwat office for the smooth implementation of the Project.

The land acquisition shall be finished before the start of the respective works.

7.4.4 O/M Plan

The major project facilities will be operated and maintained by the RID. While, on-farm facilities and small scale projects will be done by the Water Users Cooperatives with the assistance of Udon Thani Irrigation Office.

For the efficient use of the water, the proper water management will be required. In the sense of the above, the close coordination between the RID and water users will be very important, and the efficient organization of the RID for the water management is expected.

7.4.5 Project Cost

The project costs have been estimated to be about 744.3 Million Baht for the contract based works at the price of 1995 level, including the costs for engineering, land acquisition, administration, project contingencies and price escalation.

Project Costs

<u>Item</u>	<u>Quantity</u>	<u>Amount</u> (Million B)
Improvement and rehabilitation		
Nong Samrong Reservoir	L.S.	13.4
On-farm Facilities	470 ha	1.9
Sub-total		15.3
River Training and Water Impounding		
Huai Luang River Training	20.0 km	113.2
Water Impounding	4 Res.	251.0
Huai Luang #1 Weir	L.S.	82.2
Sub-total		436.4
Small Scale Projects	720 ha	20.9
Total for Field Costs		472.6
Land Acquisition Costs	160 ha	41.7
Engineering Costs (3%)		14.2
Administration Costs (10-12%)		56.3
Contingencies (10%)		58.5
Price Escalation (7%)		101.0
Total Project Costs		744.3

7.5 Project Evaluation

7.5.1 Introduction

1) Project Components

The project can be characterized as river training, water impounding work and rehabilitation/improvement of the irrigation facilities which was implemented by RID. As the area is located at the vicinity of Muang Udon Thani, agricultural plan will aim at intensified agriculture to supply people in the urban area fresh vegetables etc. by improvement of existing irrigation systems. Major components will be as follows:

- Improvement of the existing facilities
- River training & water impounding

7.5.2 Economic Justification

Economic evaluation for this project area has been made in the same way and in the same condition as the other two projects mentioned before.

After deducting the price contingency, cost for land acquisition, taxes, compensation and so on from the estimated financial investment cost (690.7 million Baht), the economic cost has been estimated at 559.4 million Baht, by applying the conversion factor (refer to Part-7 of Appendix G).

The annual economic operation and maintenance cost after completion of this project is estimated at 3.1 million Baht per year at full development stage.

Tangible benefits in monetary terms in this project are those generating from crops such as paddy and upland crops.

Economic internal rate of return (EIRR) is calculated on the basis of 50 years project life taking into consideration the five (5) years gestation period until attaining full benefit. As the result, EIRR is calculated at 11.4 %. Which is a little lower than 12% of opportunity cost of capital in Thailand.

7.5.3 Farm Budget Analysis

In order to compare farm budget in case of "with" and "without" project, financial analysis has been made for the typical farms in this area as shown below. As to off-farm incomes and household expenditure in this area, the results of the farm economic survey conducted in November 1995 were referred.

Farm size: 3.4ha
Farm Model-Without Project

1. Crop Production

	Area (ha)	Yield (kg/ha)	Production (kg)	Unit Price (Bahts/kg)	Value (Bahts)	Production Cost (Bahts)	Net Income (Bahts)
1. Paddy-irrigated	2.66	3,610	4,096	4.65	19,048	7,080	11,968
2. Vegetables	0.18	13,000	2,340	2.70	6,318	3,016	3,302
3. Groundnut	0.15	1,150	173	9.68	1,670	1,447	223
Total	2.99						15,510

2. Off-farm Income (Bahts/year)	32,600
3. Total Income (Bahts)	47,810
4. Living Expense (Bahts/year)-Family size 5.2 person/family	37,338
5. Disposable Income (Bahts/year)	10,472

Farm Model-With Project (1)

1. Crop Production

	Area (ha)	Yield (kg/ha)	Production (kg)	Unit Price (Bahts/kg)	Value (Bahts)	Production Cost (Bahts)	Net Income (Bahts)
1. Paddy-irrigated	3.44	3,200	11,008	4.65	51,187	15,044	36,143
2. Soybean	0.60	1,700	1,020	11.94	12,179	3,469	8,710
3. Groundnut	0.57	1,620	923	9.68	8,939	4,652	4,287
4. Mango	0.20						7,000
5. Beef cattle	4 head	500kg	4 head	20.00	40,000	29,720	10,280
Total	4.81						66,420

2. Off-farm Income (Bahts/year)	32,600
3. Total Income (Bahts)	99,020
4. Living Expense (Bahts/year)-Family size 5.2 person/family	77,236
5. Disposable Income (Bahts/year)	21,784

Farm Model-With Project (2)

1. Crop Production

	Area (ha)	Yield (kg/ha)	Production (kg)	Unit Price (Bahts/kg)	Value (Bahts)	Production Cost (Bahts)	Net Income (Bahts)
1. Paddy-irrigated	3.44	3,200	11,008	4.65	51,187	15,044	36,143
2. Vegetables	0.50	16,000	8,000	2.70	21,600	10,292	11,308
3. Mango	0.87						7,000
4. Beef cattle	4 head	500kg	4 head	20.00	40,000	29,720	10,280
Total	4.81						64,732

2. Off-farm Income (Bahts/year)	32,600
3. Total Income (Bahts)	97,332
4. Living Expense (Bahts/year)-Family size 5.2 person/family	76,919
5. Disposable Income (Bahts/year)	20,413

PART-3 RECORDS OF SEMINAR AND RECOMMENDATION

CHAPTER 8. RECORDS OF SEMINAR

CHAPTER 8 RECORDS OF SEMINAR

8.1 Objectives

The draft final report for the Master Plan Study on the integrated agriculture and water resources development project of Huai Mong, Nam Susi and Huai Luang river basins had been completed and the seminar with the following objectives was held on June 21, 1996 at Udon Thani, as a part of the technology transfer.

1) To present the draft final report, which is composed of agricultural water resources development plans, flood protection plans, project planning capable of application to the other areas etc., for the government agencies concerned in the Study Area and to confirm the contents of the report.

2) To exchange opinion and experience amongst the different government agencies concerned in order to increase the efficiency in the integrated agriculture and water resources development to be carried out in the Study Area.

3) Make use of the important advises in the final report for future project implementation.

8.2 Major Topics in the Seminar

1) Master Plan on the Integrated Agriculture and Water Resources Development Project

It was agreed in the seminar on the Master Plan for the development of integrated agriculture and water resources of Huai Mong, Nam Suai and Huai Luang river basins, that further study into F/S and the subsequent implementation shall be considered.

The final report should be sent to all the officers of the government agencies concerned in the Study Area. By this way, the integrated agriculture and water resources development can be proceeded more effectively.

2) Development Plan for Small Scale Water Resources

Huai Luang development project is one of the project which is being studied for a small scale water resources development by introducing the water feeder system. This study will be important for increase in the efficiency of water resources utilization in the future. However, for successful implementation of this small scale project, the farmer's participation will be necessary in early stage of the project.

For the development of a small scale water resources, water is to be fed from the other sources by pumping or gravity through a pipeline or open channel, to increase the water storage in small scale reservoirs during the dry season. Provision of manual/standard for implementation of such project will be necessary, so that the RID and the other government agencies concerned will be able to make use of the manual/standard to apply for the other areas.

3) Feasibility of the Project

In the study on the feasibility of the medium scale project, it is necessary to evaluate other factors such as an increase in the standard of living, social condition, etc., in addition to an economical evaluation by EIRR. It is noted that in the development of water resources for agricultural use, the value of EIRR will probably turn out low due to the fact that agricultural products are low in price. However, other evaluation factors should also be taken in consideration for the promotion of the project as well.

8.3 Recommendation to RID

1) In the development of Huai Luang river basin, a detailed study focusing on flood protection during the rainy season is needed, as the land on both sides of Huai Luang river are often affected by the flood. Though it is proposed to dredge and train the river and to construct a rubber dam for the mitigation of flood, yet a more detailed study on the river hydrology is deemed necessary for further implementation of the development.

2) Organizational establishment of a farmers' groups so as to let them participate in the development is important. The groups have to participate from the beginning stage of the project till the final stage of the O/M.

3) In the process of agricultural development, it is quite important to make farmers learn about the integrated agriculture. At the same time, farmers have to be trained so that they have confidence in the integrated agriculture. Besides, the supporting of the equipment supplies and the financial means are also needed.

4) High priority should be given in the construction of a dike or a canal embankment to protect the land from the flood. However, in such a place where water in the canal can not be drained due to a high water level of the Mekong river during the rainy season, this shall be accompanied with the construction of regulator with drainage pumps which release water into the Mekong river.

5) The development of small scale water resources is an important mean for the Study Area - whether it is a swamp dredging, improvement of a natural reservoir or construction of new reservoir, study of the appropriate implementation procedure shall be carried out first.

CHAPTER 9. RECOMMENDATION

CHAPTER 9 RECOMMENDATION

- 1) Since there are very few damsites and on the other hand the agricultural water demand is very high, water resources should be developed as much as possible in the Study Area. It is recommended that the agricultural water resources development (1) within the Study Area should be given first priority and (2) to the use of Mekong water. The target year of the agricultural water resources development within the Study Area is set to be the year of 2006 or the end of the 9th Plan period(2001-2006).

When RID formulates a plan regarding the utilization of Mekong river water for irrigation in the Study Area, the facilities and O/M plan included in the plan should be well-coordinated with the existing facilities and concept of on-going project of DEDP. In addition, negotiation for an agreement with Mekong River Commission is necessary.

- 2) As per the result of the Study, Huai Mong project and Huai Luang Development project have been judged to be not very feasible in terms of its economic evaluation. Taking into account the social implication involved in the significance to develop this rural area, however, it is recommended that the feasibility study for the two projects should be implemented in near future.

In order to estimate more accurate river runoff of the Huai Mong, observation of river discharge should be immediately commenced at suitable location near the damsite. Promotion of positive participation of the farmers in early stage of the project implementation will be necessary for successful implementation of the project.

- 3) In Thailand, small scale water resources development projects are implemented with an emphasis on areas which are less well developed. The Study Area is one such less developed area, and therefore the small scale projects should be implemented continuously in consideration of the following matters.

- To increase soundness of project planning.
 - Promotion of farmer's participation at all stages of project implementation.
 - Major factors impeding canal construction are difficulty in getting right-of-way, absence of proper cooperation among the benefiting farmers and lack of budget. Among these factors, the proper cooperation among the beneficiary farmers is of most importance. Therefore, technical staffs, who are well acquainted with the local conditions and can provide technical advice in the course of the project implementation for the benefiting farmers, should be assigned in the RID Changwat offices.
- 4) For the improvement and upgrading of distribution canals, a pipeline distribution system should be introduced, taking into account effective utilization of the water resources, lessening of right-of-way problems and introduction of upland crop irrigation. The followings will be required for construction of the pipeline distribution system.
- The pipeline distribution system should be formulated according to sound planning.
 - The pipeline distribution system constructed should be used permanently by the beneficiary farmers.
- 5) In order to increase water storage in small scale reservoirs during the dry season, the feeder canal system, which feed water from rivers or other reservoirs by pumping or gravity into the small scale reservoir, should be introduced for the agricultural water resources development within the Study Area.
- 6) In general, a flood protection scheme may not always carries high economic return, however, measures for flood protection are of vital importance in securing peoples' life and properties among various types of social infrastructure facilities. In other words, it may be noted that a safe and active society could be realized only after the flood protection measures be implemented and people there could live well at ease and feel easy circumstances. From view of the above, it is recommended that the flood protection plan should be implemented

one after another depending on the priority orders based on humanitarian grounds as per the available budget.

As regards the flood protection project in the Huai Vieng Kook and Huai Bang Phuan Areas, improvement of existing canals and regulator gates and swamp area development should be implemented. However, the construction of drainage pump stations should be studied more carefully.

- 7) Rehabilitation plan of existing Huai Luang project is being studied by RID. It is expected that an effective plan will be established and implemented for the benefiting farmers.
- 8) Nam Suai basin project and Lower Huai Luang project planned by DEDP should be implemented soon with the cooperation of RID and other government agencies concerned.
- 9) In the process of agricultural development which aims to introduce diversified cropping and integrated farming, the supporting services for agricultural research and experimentation, agricultural extension, agricultural credit, etc. should be strengthened.

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