6. PROJECT EVALUATION

6.1 General

An evaluation of the project should be made usually in view of economic and financial aspects, and project effects. The Scheme is an integrated rural and agricultural development in model areas, including various development programs such as establishment of agricultural station, strengthening of agricultural extension offices, rice banks, construction of rural water supply system and primary schools, reactivation of support services for women, etc. which could not be evaluated through quantitative analysis by estimating the tangible benefits of these programs. In addition, the Scheme will be the model and base for the integrated rural agricultural development for further expansion of such a development that will be carried out under the medium and long term phases. For these reasons, the evaluation of the Scheme made in this chapter is limited to financial evaluation and the effects to be expected from the implementation of the Scheme.

6.2 Financial Evaluation

Financial evaluation of the farm household was analyzed as the impact on the farm incomes which will directly be improved by the Scheme. Among the development programs in the Scheme, these directly related to increase in agricultural production are irrigation development, strengthening of extension services, and improvement and establishment of water users association, and together with the indirect impacts which will be born by the other development programs in the Scheme.

(1) Farm household economy

The impact of the project on farm incomes was analyzed on the farm household with an average size by ethnic groups in each model area. In this analysis, the present farm household economy was examined under both without-project and with-project conditions, based on the anticipated rice yields which will be achieved at the full target stage of the project. The average size of the farm household by ethnic group in each model area is as follows (for details, refer to Table F-21):

Farming Size	Xai		Beng	Hun	
	LL	Mix	LL	LL	LT
Lowland rice area (ha/family)	0.57	0.42	0.55	0.71	0.2
Upland rice area (ha/family)	0.0	0.31	0.19	0.28	0.9
Number of livestock:					
Buffalo (nos./family)	2.8	1.9	4.1	2.8	2.9
Cattle (nos./family)	2.0	1.8	3.5	0.7	0.1
Pig (nos./family)	1.6	0.4	3.4	1.8	1.2
Poultry (nos./family)	14.7	14.3	24.5	12.8	7.9

Note: LL=Lao Loum LT= lao Theung

The income and expenditures of the average farm households under without-project condition (present condition) are estimated as follows (for details, refer to Table F-17):

Unit: Kip 1,000

Income/Expenditures	Xai		Beng	Hun	
Without Project Condition	LL	Mix	LL	LL	LT
Lowland rice	106.4	78.4	102.7	164.1	89.8
Upland rice	0.0	30.7	19.0	27.9	0.9
Upland crops	0.0	6.7	10.9	6.0	19.4
Livestock	55.5	25.4	102.2	48.9	43.4
Income total	161.9	141.2	234.6	215.2	189.4
Expenditures	305.0	290.0	254.0	171.0	113.5
Balance	-143.1	-148.8	-19.4	44.2	75.9

At present most of farmers' activities are at subsistence level based on lowland and upland rice cultivation with some upland crops and livestock raising. In Xai model area, some of the farm households usually depend on lowland rice cultivation only and the rice production is not sufficient for annual consumption. The shortage of rice production and expenditures that exceed the family farm income are covered with working in government offices, private companies, or other labour work.

With the completion of the Scheme, the farmers income will be improved along with increase in rice production in lowland; 2.6 ton/ha at the present level to 4.0 ton/ha of the target yield and introduction of some second crops as shown follows (for details, refer to Table F-16):

Unit: Kip 1,000

Income/Expenditures	Xai		Beng	Hun	
With Project Condition	LL	Mix	LL	LL	LT
Lowland rice	186.3	137.2	127.1	164.1	46.2
Upland rice	0.0	30.9	19.0	27.9	89.8
Upland crops	0.0	6.7	10.9	6.0	19.4
Livestock	55.5	25.4	102.2	48.9	43.4
Income total	241.8	200.3	259.2	247.0	198.9
Expenditures	305.0	290.0	254.0	171.0	113.5
Balance	-63.2	-89.7	5.2	76.0	85.4

As seen in Table FF-16 , rice production of the average farm household in Xai area will be about 2 to 2.7 tons a year, and it will be sufficient for annual consumption of a family.

The details of assumptions used for this assessment are shown in Tables F-18 to 22.

(2) Project risks

The major risks foreseen in achieving the project's production targets may be insufficient performance of training and services by the extension workers and insufficient and not timely supply of the required farm inputs. It is therefore recommended to establish the proposed agricultural station in early stage of the Scheme in order to carry out necessary trials and training of extension workers and farmers. Establishment of rice bank is also necessary to be implemented not only for the saving cum credit activities but also for the supply of farm inputs. Since the supply system and prices of farm inputs have never been formulated in the model areas, it is inevitable to organize effective inputs supply system in the model areas.

6.3 Project Effects

The expected project effect varies with development programs proposed in the Scheme. The major effects for improvement of rural economy and living standard are evaluated in view of (i) improvement and stabilization of agricultural economy; (ii) food production increase; (iii) income generation; (iv) support for women in development; (v) increase in employment opportunity; (vi) control of slash and burn cultivation; and (vii) living condition and health. The results of the evaluation are summarized Table F-23.

(1) Effects on improvement and stabilization of agricultural production

Almost all development programs proposed in the Scheme will have both direct or indirect positive effects on the improvement and stabilization of agricultural production, except the program for construction of additional rural water supply. The direct high positive effects will be expected from such programs as strengthening of extension services, agricultural development in model areas, irrigation development in Xai, Beng and Hun model areas.

(2) Food production increase

The direct high effects on increase in food production will be brought by the implementation of such programs as strengthening of extension services, agricultural development in model areas, irrigation development in Xai, Beng and Hun model areas.

The expected increment of food production will be 1,800 tons of paddy. It is inevitable to implement the programs such as establishment and operation of integrated agricultural station, improvement and establishment of water users association which will support indirectly the increase in food production

(3) Income generation

The income generation effects will directly be born by the above mentioned programs for agricultural production. Besides these programs, direct effects will be expected from establishment of rice bank, and support services for women's group such as promotion of participation in rice bank and extension of sericulture technique.

(4) Support for women in development

The programs to support women in development in the Scheme are mostly services for women's group in such practical programs as women's school by extension office, promotion of participation in rice bank, extension of sericulture technique. Besides these support services for women, such programs as construction of additional water supply system will support women in development especially in views of hygiene and health in their living conditions.

(5) Increase in employment opportunity

The effects on increase in employment opportunity will be expected from the economic activity programs such as establishment of rice bank, agricultural development in model areas, irrigation development, and supporting programs for women such as extension of sericulture technique and promotion of participation in rice bank. The program for rehabilitation and construction of primary school is not the economic activity program, but it

will bring high effects for increase in employment opportunity by promoting enrollment in the primary education, which may also uplift the enrollment to higher education. The persons given higher education could find employment opportunity not only in simple labour work but also in the field of government offices or private companies.

(6) Control of slash-and-burn cultivation

In view of controlling slash-and-burn cultivation, the proposed programs in the Scheme will have no direct effects, but considerable indirect effects will be expected from these programs as seen in Table F-23. The expected 1,800 tons of increment in paddy would be equivalent to production from about 1,300 ha of slash-and-burn cultivation area. Among other programs proposed to be implemented in the Scheme, the agricultural station will contribute indirectly to control slash-and-burn cultivation through the study and planning programs for alleviation of environmental problems which will be carried out in the station under the Scheme for formulating necessary programs to be implemented in the medium and long term development phases.

(7) Improvement of living and health conditions

The direct effects on improvement of living and health conditions in the model areas will be expected directly by the programs of construction of additional rural water supply system for supplying clean and safe water for villagers. Rehabilitation and upgrading of district road network will also bring the good effects on rural life through convenient transportation of materials and information to the villagers. Other programs which contribute to improve rural economy will indirectly affects to uplift the living standard of villagers.

Table

Table F-1 Population and Number of Families

		Ethnic Group	Type of Village	No. of Family	Total Population
Xai	Done Xai*	LT	new	31	168
	Na Kang	LL	new	17	100
	Thin	LL	old	166	959
	Cheng	LL	old	132	832
	Na Lao	LL	old	135	894
	Na Mi	Mix	old	38	230
	Na Lee	LL	old	58	356
	Na Sao	LL	old	57	337
	Houay Khum	Mix	old	97	480
	Total			731	4,356
Beng	Pang Dua	LL	old	62	365
	Pho Keo	LL	old	74	477
	Beng Kham	LL	old	79	393
	Na Houay	LL	old	57	340
	Beng Louang	LL	old	93	502
	Takhat	LL	old	84	532
	Houay La*	LT	new	59	406
	Total			508	3,015
Hun	Mai	LT	new	54	262
	Na	LT	new	118	657
	Som Xai	LT	new	176	872
	Somphon	LT	new	126	641
	Nakham Nua	Mix	new	50	261
	Nakham Tai	LL	old	60	351
	Phonsavat	LL	old	85	491
	Total			669	3,535

None: LL = Lao Loum LT = Lao Theung
Type of village,
Old: Villagers settled in or near present place before 1970
New: Villagers settled in or near present place after 1970
*: The villages are indirectly related to the model areas.

Data Source: District Offices

Table F-2 Area of Rice Cultivation and Holding Size

		Ethnic Group	Type of Village	Lowland Rice Field (ha)		Upland Rice Field (ha)	
				Total	Per Family	Total	Per Family
Xai	Done Xai*	LT	new	8.0	0.26	5.0	0.16
	Na Kang	LL	new	5.0	0.29	0.0	0.0
	Thin	LL	old	101.6	0.61	0.0	0.0
	Cheng	LL	old	75.2	0.57	2.8	0.02
	Na Lao	LL	old	34.7	0.26	0.0	0.0
	Na Mi	Mix	old	25.3	0.67	24.1	0.63
	Na Lee	LL	old	54.2	0.93	0.0	0.0
	Na Sao	LL	old	54.1	0.95	2.2	0.04
	Houay Khum	Mix	old	31.4	0.32	18.0	0.19
	Total/Average			389.5	0.53	52.1	0.07
Beng	Pang Dua	LL	old	20.4	0.33	36.3	0.59
	Pho Keo	LL	old	37.3	0.50	5.0	0.07
	Beng Kham	LL	old	45.2	0.57	1.0	0.01
	Na Houay	LL	old	39.1	0.67	21.0	0.37
	Beng Louang	LL	old	64.7	0.70	1.4	0.02
	Takhat	LL	old	41.3	0.49	21.2	0.25
	Houay La*	LT	new	4.4	0.07	53.5	0.91
	Total/Average			252.4	0.50	139.4	0.27
Hun	Mai	LT	new	7.0	0.13	44.4	0.82
	Na	LT	new	34.0	0.29	71.0	0.60
	Som Xai	LT	new	36.4	0.21	163.0	0.93
	Somphon	LT	new	9.3	0.07	140.0	1.11
	Nakham Nua	Mix	new	19.0	0.38	26.3	0.53
	Nakham Tai	LL	old	53.5	0.89	10.9	0.18
	Phonsavat	LL	old	49.0	0.58	29.7	0.35
	Total/Average			208.2	0.31	485.3	0.73

None: LL = Lao Loum LT = Lao Theung
Type of village,
Old: Villagers settled in or near present place before 1970
New: Villagers settled in or near present place after 1970
*: The villages are indirectly related to the model areas.
Data Source: District Offices

Table F-3 Livestock Holding Size

(Unit: Number/family)

			Buffalo	Cattle	Pig	Poultry
Xai						
	Done Xai	LT	0.3	0.6	0.3	4.9
	Na Kang	LL	1.6	0.7	2.7	10.9
	Thin	LL	2.3	0.8	0.3	18.8
	Cheng	LL	4.0	3.3	2.5	8.3
	Na Lao	LL	2.5	0.7	2.7	13.2
	Na Mi	Mix	1.0	0.5	0.5	32.5
	Na Lee	LL	2.0	3.3	0.7	14.5
	Na Sao	LL	3.0	4.7	1.7	22.2
	Houay Khum	Mix	2.2	2.3	0.3	7.2
	Average		2.1	1.9	1.3	14.7
Beng						
	Pang Dua	LL	1.8	1.8	2.0	22.5
	Pho Keo	LL	4.5	7.5	3.0	31.2
	Beng Kham	LL	2.0	3.7	2.7	15.3
	Na Houay	LL	2.7	4.2	3.7	14.7
	Beng Louang	LL	4.3	3.7	5.8	44.2
	Takhat	LL	8.2	0.5	2.5	13.8
	Houay La	LT	2.6	0.4	2.3	1.1
	Average		3.7	3.1	3.1	21.8
Hun						
	Mai	LT	1.9	0.0	0.5	8.0
	Na	LT	3.0	0.3	2.5	17.8
	Som Xai	LT	3.7	0.0	1.2	3.8
	Somphon	LT	2.0	0.2	0.2	4.5
	Nakham Nua	Mix	2.7	0.5	2.0	15.8
	Nakham Tai	LL	4.3	0.8	5.8	19.2
	Phonsavat	LL	2.8	0.9	1.7	8.3
	Average		2.9	0.4	2.0	11.1

Table F-4 Number of Rice Mill in Model Areas

	Village	Ethnic group	No of Family	Popu-lation	No.of rice mill
I.	Tham Nhuang area:				
1	Done xai	LT	31	168	0
2	Na Kang	LL	17	100	0
3	Ban Cheng	LL	132	832	2
4	Ban Thin	LL	166	959	2
5	Na Lao	LL	135	894	2
6	Na Mi	LL	38	230	2
7	Na Le	LL	58	356	3
8	Na Sao	LL	57	337	1
9	Houy Khoun	Mix	97	480	2
	Total/average		731	4,356	14
	Total milling capacity(ton/hr)*				2.1
II.	Nam Hao area:				
1	Pang Dua	LL	62	365	1
2	Pho Keo	LL	74	477	2
3	Beng Kham	LL	79	393	3
4	Na Houay	LL	57	340	0
5	Bang Louang	LL	93	502	6
6	Houay La	LT	59	406	2
7	Ta Khat	LL	84	332	6
	Toal/average		508	2,815	20
	Total milling capacity(ton/hr)*				3
III.	Nam Kham area:				
1	Phonsavat	LL	85	491	3
2	Ban Mai	LT	54	262	1
3	Ban Na	LT	118	657	2
4	Som Xai	LT	176	872	2
5	Na Kahm Tai	LL	60	351	2
6	Na Kham Nua	Mix	50	261	1
7	Somphon	LT	126	641	2
	Total		669	3,535	13
	Total milling capacity(ton/hr)*				1.95

Data source: District office of each district.

* Total milling capacity is estimated applying milling capacity of 150kg/hr per unit.

Table F-5 Existing Irrigation Systems in the Model Areas

Model area	Water resource	Weir No.	Weir Type	Irrigable area	Const. year	Fund	Benefited village
Xai model area	Nam Mao	X1	Brushwood	- ha		Village	Nami, Nalao, Cheng, Houaykhoum, Nasao, Nale
(Tham Nhuang area)	Nam Mao	X2	Brushwood	- ha		Village	Nasao, Nale, Thin, Cheng
			Total	197 ha			
Beng model area	Nam Hao	B1	Brushwood	103 ha		Village	Nahouay, Bengkham, Phokeo, Pangdua
(Nam Hao area)	Nam Hao	B2	Brushwood	85 ha		Village	Bengluang, Thakat, Nahouay, Houayla
	Nam Hao	B3	Brushwood	10 ha		Village	Bengluang
	Nam Hao	B4	Brushwood	8 ha		Village	Nahouay
	Nam Hao	B5	Brushwood	15 ha		Village	Nahouay
			Total	221 ha			
Hun model area	Nam Kham	H1	Brushwood	40 ha		Village	Nakham-tai, Nakham-nua, Somphone, Mai, Na
(Nam Kham area)	Nam Ngat	H3	Brushwood	20 ha		Village	Somxai, Na, Mai, Nakham-nua, Nakham-tai
	Nam Ngat	H4	Concrete	50 ha	1976	Province	Somxai, Na
	Nam Ngat	H5	Concrete	30 ha	1991	District	Somxai, Na
	Nam Ngat	H6	Concrete	59 ha	1989	Quaker	Phonsavath, Nongboadeng
			Total	199 ha			

Table F-6 Production of Rice and Sesame in Model Areas

Crops	Xai	Beng	Hun	Total
I. Model areas total				
Lowland Rice:				
Planted area(ha)	382	248	208	838
Production(ton)*	1,528	992	832	3,352
Upland Rice:				
Planted area(ha)	47	86	500	633
Production(ton)*	66	120	700	886
Total production of rice(ton in paddy)	1,594	1,112	1,532	4,238
Tax(ton in paddy)**	56	39	54	149
No. of village	8	6	7	21
Tax/village(ton in paddy)	7	7	8	21
Sesame:				
Planted area(ha)***	5	9	50	64
Production(ton)*	3.5	6.3	35	44.8
II. Study area total:				
Lowland Rice:				
Planted area(ha)	1,120	660	780	2,560
Production(ton)*	4,480	2,640	3,120	10,240
Upland Rice:				
Planted area(ha)	3,600	3,900	5,700	13,200
Production(ton)*	5,040	5,460	7,980	18,480
Total production of rice(ton in paddy)	9,520	8,100	11,100	28,720
Tax(ton in paddy)	628	459	597	1,684
Sesame:				
Planted area(ha)**	360	390	570	1,320
Production(ton)*	252	273	399	924

* Production is estimated applying unit yield of 2.6, 1.4, 0.7 ton/ha for lowland rice, upland rice and sesame in the study area, respectively. The rice production in model area is estimated with unit yield 4.0 t/ha.

** Taxes for lowland rice and upland rice are estimated applying 140kg and 50 kg/ha , respectively.

*** Planted area of sesame is assumed at about 10% of upland rice field area.

Table F-7 Required Farm Input and Farm Labour for Lowland Rice Cultivation per Ha

Farming Practices	Labour Requirement	Equipment	Inputs Use per Ha
1. Nursery	10	Oxplow/buffalo	500 m2/ha Seed, 40 kg/ha
2. Plowing	20	Oxplow/buffalo	
3. Basal fertilizer	3	(manpower)	N: 15 kg P: 15 kg
4. Harrowing	10	Harrow/buffalo	
5. Puddling	40	Harrow/buffalo	
6. leveling	3	Leveling board/buffalo	
7. Transplanting	27	(manpower)	
8. Top dressing	2	(manpower)	N: 15 kg
9. Pest control	1	Knapsack sprayer)	
10. Weeding	27	(manpower)	
11. Reaping	27	(manpower)	
12. Threshing	24	(manpower)	
13. Transportation	7	Oxcart/buffalo	
Total	165		

Table F-8 (1/4) Crop Water Requirement

Crop : Rice (Wet season, Future condition)

Irrigation efficiency : 50 %

	Unit	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1. ETO	mm/day	2.6	3.4	4.3	5.0	5.0	3.6	3.5	4.0	3.7	3.2	2.6	2.3
2. Days	days	31	28	31	30	31	30	31	31	30	31	30	31
3. Cropping calender	days						15	31	31	30	28		
								15	31	30	31	28	
4. Crop coefficient(Kc)							1.10	1.10	1.09	1.04	0.95		
								1.10	1.10	1.07	0.99	0.93	
5. ETcrop							4.5	119.4	135.2	115.4	85.1		
								4.3	136.4	118.8	98.2	67.7	
Average	mm/month						2.2	61.8	135.8	117.1	91.7	33.9	
6. Puddling water	mm/month						75.0	75.0					
7. Percolation	mm/month						15.0	46.0	62.0	60.0	59.0	28.0	
8. Effective rainfall	mm/month	6.0	21.0	26.0	78.0	103.0	116.0	138.0	150.0	62.0	60.0	26.0	3.0
9. Net crop water req. (5)+(6)+(7)-(8)	mm/month						0.0	44.8	47.8	115.1	90.7	35.9	
10. Gross crop water req.	mm/month						0.0	89.7	95.6	230.2	181.3	71.7	
	l/s/ha						0.00	0.33	0.36	0.89	0.68	0.28	

Note:
1. ETO of Oudomxay Station is applied.
2. Rainfall data of Oudomxay station is applied.

Table F-8 (2/4) Crop Water Requirement

Crop : Rice (dry season, future condition)

Irrigation efficiency : 50 %

	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1. ETO	mm/day	2.6	3.4	4.3	5.0	5.0	3.6	3.5	4.0	3.7	3.2	2.6	2.3
2. Days	days	31	28	31	30	31	30	31	31	30	31	30	31
3. Cropping calender	days	31	28	31	30	15							
			28	31	30	31	15						
4. Crop coefficient(Kc)		1.10	1.10	1.21	1.12	0.93							
			1.10	1.10	1.21	1.12	0.93						
5. ETcrop		6.6	104.7	161.3	168.0	69.8							
			7.9	146.6	181.5	173.6	50.2						
Average	mm/month	3.3	56.3	154.0	174.8	121.7	25.1						
6. Puddling water	mm/month	75.0	75.0										
7. Percolation	mm/month	31.0	56.0	62.0	60.0	46.0	15.0						
8. Effective rainfall	mm/month	6.0	21.0	26.0	78.0	103.0	116.0	138.0	150.0	62.0	60.0	26.0	3.0
9. Net crop water req. (5)+(6)+(7)-(8)	mm/month	103.3	166.3	190.0	156.8	64.7	0.0						
10. Gross crop water req.	mm/month	206.6	332.6	379.9	313.5	129.4	0.0						
	l/s/ha	0.77	1.37	1.42	1.21	0.48	0.00						

Note:

1. ETO of Oudomxay Station is applied.
2. Rainfall data of Oudomxay station is applied.

Table F-8 (3/4) Crop Water Requirement

Crop : Onion (dry season)

Irrigation efficiency : 43 %

	Unit	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1. ETO	mm/day	2.6	3.4	4.3	5.0	5.0	3.6	3.5	4.0	3.7	3.2	2.6	2.3
2. Days	days	31	28	31	30	31	30	31	31	30	31	30	31
3. Cropping calender	days	31	28	10									31
		31	28	21									20
4. Crop coefficient(Kc)		0.80	0.95	0.84									0.75
		0.67	0.96	0.87									0.50
5. ETcrop		64.5	90.4	36.1									53.5
		54.0	91.4	78.6									23.0
Average	mm/month	59.2	90.9	57.3									38.2
6. Puddling water	mm/month												
7. Percolation	mm/month												
8. Effective rainfall	mm/month	4.0	12.0	16.0	50.0	66.0	74.0	87.0	93.0	49.0	47.0	21.0	3.0
9. Net crop water req. (5)+(6)+(7)-(8)	mm/month	55.2	78.9	41.3									35.2
10. Gross crop water req.	mm/month	128.5	183.5	96.1									81.9
	l/s/ha	0.48	0.76	0.36									0.31

Note:
1. ETO of Oudomxay Station is applied.
2. Rainfall data of Oudomxay station is applied.

Table F-8 (4/4) Crop Water Requirement

Crop : Tobacco(dry season)

Irrigation efficiency : 43 %

	Unit	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1. ETO	mm/day	2.6	3.4	4.3	5.0	5.0	3.6	3.5	4.0	3.7	3.2	2.6	2.3
2. Days	days	31	28	31	30	31	30	31	31	30	31	30	31
3. Cropping calender	days	31	28	10								15	31
		31	28	31	5								20
4. Crop coefficient(Kc)		1.06	0.97	0.62								0.33	0.62
		0.71	1.09	0.91	0.50								0.35
5. ETcrop		85.4	92.3	26.7								12.9	44.2
		57.2	103.8	121.3	12.5								16.1
Average	mm/month	71.3	98.1	74.0	6.3							6.4	30.2
6. Puddling water	mm/month												
7. Percolation	mm/month												
8. Effective rainfall	mm/month	4.0	12.0	16.0	50.0	66.0	74.0	87.0	93.0	49.0	47.0	21.0	3.0
9. Net crop water req. (5)+(6)+(7)-(8)	mm/month	67.3	86.1	58.0	0.0							0.0	27.2
10. Gross crop water req.	mm/month	156.6	200.1	134.8	0.0							0.0	63.1
	l/s/ha	0.58	0.83	0.50	0.00							0.00	0.24

Note:
1. ETO of Oudomxay Station is applied.
2. Rainfall data of Oudomxay station is applied.

Table F-9 Diversion Water Requirement

Crops	Unit	Area in hectare Gross	Net	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Gross Crop Water Requirement															
Dry season rice	(l/s/ha)			0.77	1.37	1.42	1.21	0.48	0.00						
Wet season rice	(l/s/ha)								0.00	0.33	0.36	0.89	0.68	0.28	
Onion	(l/s/ha)			0.48	0.76	0.36									0.31
Tobacco	(l/s/ha)			0.58	0.83	0.50	0.00							0.00	0.24
Diversion Water Requirement															
(1) Xai Model Area															
Dry season rice	(m3/sec)	156	125	0.096	0.171	0.178	0.151	0.060	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Wet season rice	(m3/sec)	378	302	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.109	0.269	0.205	0.085	0.000
Onion	(m3/sec)	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Tobacco	(m3/sec)	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	(m3/sec)	534	427	0.096	0.171	0.178	0.151	0.060	0.000	0.100	0.109	0.269	0.205	0.085	0.000
(2) Beng Model Area															
Dry season rice	(m3/sec)	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Wet season rice	(m3/sec)	338	270	0.000	0.000	0.000	0.000	0.000	0.000	0.089	0.097	0.240	0.184	0.076	0.000
Onion	(m3/sec)	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Tobacco	(m3/sec)	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	(m3/sec)	338	270	0.000	0.000	0.000	0.000	0.000	0.000	0.089	0.097	0.240	0.184	0.076	0.000
(3) Hun Model Area															
(Nam Ngat Area)															
Dry season rice	(m3/sec)	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Wet season rice	(m3/sec)	252	202	0.000	0.000	0.000	0.000	0.000	0.000	0.067	0.073	0.180	0.137	0.057	0.000
Onion	(m3/sec)	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Tobacco	(m3/sec)	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	(m3/sec)	252	202	0.000	0.000	0.000	0.000	0.000	0.000	0.067	0.073	0.180	0.137	0.057	0.000
(Nam Kham Area)															
Dry season rice	(m3/sec)	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Wet season rice	(m3/sec)	71	57	0.000	0.000	0.000	0.000	0.000	0.000	0.019	0.021	0.051	0.039	0.016	0.000
Onion	(m3/sec)	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Tobacco	(m3/sec)	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	(m3/sec)	71	57	0.000	0.000	0.000	0.000	0.000	0.000	0.019	0.021	0.051	0.039	0.016	0.000
(4) Trial Farm (rice)															
Dry season rice	(m3/sec)	5	4	0.003	0.005	0.006	0.005	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Wet season rice	(m3/sec)	5	4	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.004	0.003	0.001	0.000
Total	(m3/sec)	10	8	0.003	0.005	0.006	0.005	0.002	0.000	0.001	0.001	0.004	0.003	0.001	0.000
(5) Trial Farm (sloped area)															
Upland rice (RS)	(m3/sec)	10	8	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.003	0.007	0.005	0.002	0.000
Upland crops (DS)	(m3/sec)	1	0.8	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	(m3/sec)	11	8.8	0.000	0.001	0.000	0.000	0.000	0.000	0.003	0.003	0.007	0.005	0.002	0.000

Table F-10 Water Balance of Potential Water Resource and Irrigation Requirement

Item	Unit	Area (km2)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Unit Runoff														
Category 1	(m3/s/km2)		0.0022	0.0019	0.0019	0.0055	0.0095	0.0134	0.0171	0.0200	0.0166	0.0129	0.0089	0.0039
Category 2	(m3/s/km2)		0.0006	0.0005	0.0006	0.0012	0.0027	0.0040	0.0050	0.0061	0.0061	0.0040	0.0031	0.0014
Category 3	(m3/s/km2)		0.0012	0.0009	0.0011	0.0024	0.0053	0.0081	0.0101	0.0122	0.0121	0.0081	0.0061	0.0028
Water Balance														
(1) Xai Model Area														
= Nam Mao (Category 1)														
1.Runoff	(m3/sec)		0.440	0.380	0.380	1.100	1.900	2.680	3.420	4.000	3.320	2.580	1.780	0.780
Catchment area		200												
2.Maintenance flow	(m3/sec)		0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
1.0 lit/s/km2		200												
3.Available runoff	(m3/sec)		0.240	0.180	0.180	0.900	1.700	2.480	3.220	3.800	3.120	2.380	1.580	0.580
4.Diversion req.	(m3/sec)		0.096	0.171	0.178	0.151	0.060	0.000	0.100	0.109	0.269	0.205	0.085	0.000
5.Balance	(m3/sec)		0.144	0.009	0.003	0.749	1.640	2.480	3.120	3.691	2.851	2.175	1.495	0.580
= Houay Phuk (Category 1)														
1.Runoff	(m3/sec)		0.002	0.002	0.002	0.006	0.010	0.013	0.017	0.020	0.017	0.013	0.009	0.004
Catchment area		1												
2.Maintenance flow	(m3/sec)		0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
1.0 lit/s/km2		1												
3.Available runoff	(m3/sec)		0.001	0.001	0.001	0.005	0.009	0.012	0.016	0.019	0.016	0.012	0.008	0.003
4.Diversion req.	(m3/sec)		0.000	0.001	0.000	0.000	0.000	0.000	0.003	0.003	0.007	0.005	0.002	0.000
5.Balance	(m3/sec)		0.001	0.000	0.001	0.005	0.009	0.012	0.013	0.016	0.008	0.006	0.006	0.003
(2) Beng Model Area														
= Nam Hao (Category 3)														
1.Runoff	(m3/sec)		0.083	0.062	0.076	0.166	0.366	0.559	0.697	0.842	0.835	0.559	0.421	0.193
Catchment area		69												
2.Maintenance flow	(m3/sec)		0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.069
1.0 lit/s/km2		69												
3.Available runoff	(m3/sec)		0.014	-0.007	0.007	0.097	0.297	0.490	0.628	0.773	0.766	0.490	0.352	0.124
4.Diversion req.	(m3/sec)		0.000	0.000	0.000	0.000	0.000	0.000	0.089	0.097	0.240	0.184	0.076	0.000
5.Balance	(m3/sec)		0.014	-0.007	0.007	0.097	0.297	0.490	0.539	0.676	0.526	0.306	0.276	0.124
(3) Hun Model Area														
= Nam Ngat (Category 2)														
1.Runoff	(m3/sec)		0.028	0.024	0.028	0.056	0.127	0.188	0.235	0.287	0.287	0.188	0.146	0.066
Catchment area		47												
2.Maintenance flow	(m3/sec)		0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047
1.0 lit/s/km2		47												
3.Available runoff	(m3/sec)		-0.019	-0.024	-0.019	0.009	0.080	0.141	0.188	0.240	0.240	0.141	0.099	0.019
4.Diversion req.	(m3/sec)		0.000	0.000	0.000	0.000	0.000	0.000	0.067	0.073	0.180	0.137	0.057	0.000
5.Balance	(m3/sec)		-0.019	-0.024	-0.019	0.009	0.080	0.141	0.121	0.167	0.060	0.004	0.042	0.019
= Nam Kham (Category 2)														
1.Runoff	(m3/sec)		0.033	0.028	0.033	0.066	0.149	0.220	0.275	0.336	0.336	0.220	0.171	0.077
Catchment area		55												
2.Maintenance flow	(m3/sec)		0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055
1.0 lit/s/km2		55												
3.Available runoff	(m3/sec)		-0.022	-0.028	-0.022	0.011	0.094	0.165	0.220	0.281	0.281	0.165	0.116	0.022
4.Diversion req.	(m3/sec)		0.000	0.000	0.000	0.000	0.000	0.000	0.019	0.021	0.051	0.039	0.016	0.000
5.Balance	(m3/sec)		-0.022	-0.028	-0.022	0.011	0.094	0.165	0.201	0.260	0.230	0.126	0.100	0.022

Table F-11 List of Irrigation Canals

Canal Name	Length (m)
(1) Xai Model Area	
1. Main Canal	
LMC	2,290
RMC	4,610
Total	6,900
2. Secondary Canal	
RSC-1	960
RSC-2A	580
RSC-2B	840
RSC-3	890
RSC-4	370
RSC-5A	1,220
RSC-5B	160
RSC-6	460
RSC-7	650
RSC-8A	375
RSC-8B	225
RSC-9	675
RSC-10	370
LSC-1	825
LSC-2	1,280
LSC-3	645
LSC-4	675
LSC-5	1,655
Total	12,855

Canal Name	Length (m)
(2) Beng Model Area	
1. Main Canal	
LMC	4,055
RMC	5,290
Total	9,345
2. Secondary Canal	
LSC-1	1,205
LSC-2	960
LSC-3	1,385
LSC-4	1,145
LSC-5	540
LSC-6	320
RSC-1	1,245
RSC-2A	1,080
RSC-2B	310
RSC-3A	1,900
RSC-3B	290
RSC-4	570
RSC-5	545
RSC-6	1,255
RSC-7	1,165
Total	13,915

Canal Name	Length (m)
(3) Hun Model Area	
1. Main Canal	
LMC-1	1,880
LMC-2	1,530
LMC-3	635
RMC	1,645
Total	5,690
2. Secondary Canal	
LSC-11	695
LSC-12	680
LSC-13	400
LSC-14	495
LSC-15	810
LSC-21	500
LSC-22	665
LSC-23	690
LSC-24A	930
LSC-24B	290
LSC-31	1,085
LSC-32	1,065
LSC-33	970
RSC-1	575
RSC-2A	860
RSC-2B	260
RSC-3	855
RSC-4	1,735
Total	13,560

Table F-12 (1/2) List of Related Structures to Irrigation Canals

Name of Structure	Main Canal					Secondary Canal	Grand Total	Main Canal					Secondary Canal	Grand Total
	Canal Type				Total			Canal Type				Total		
	I	II	III	IV				I	II	III	IV			
	(1) Xai Model Area							**(2) Beng Model Area**						
1. Settling Basin	0	1	1	0	2	-	2	0	1	0	0	1	-	1
2. Spillway	0	1	2	1	4	-	4	0	1	0	2	3	-	3
3. Bifurcation	0	0	0	0	0	-	0	0	1	0	0	1	-	1
4. Turnout	0	2	3	6	11	-	11	0	0	2	9	11	-	11
5. Tail Structure	0	0	0	2	2	-	2	0	0	0	0	0	-	0
6. Check	0	1	2	2	5	-	5	0	0	1	7	8	-	8
7. Check cum Drop	0	0	1	3	4	-	4	0	0	1	0	1	-	1
H = 0.3 - 0.7 m	0	0	0	0	0	-	0	0	0	0	0	0	-	0
H = 0.8 - 1.2 m	0	0	1	3	4	-	4	0	0	1	0	1	-	1
H = 1.2 - 1.5 m	0	0	0	0	0	-	0	0	0	0	0	0	-	0
8. Culvert	0	2	4	1	7	4	11	0	0	2	4	6	4	10
9. Cross Drain	0	1	6	2	9	2	11	0	0	1	5	6	5	11
10. Aqueduct	0	0	0	0	0	1	1	0	0	1	4	5	1	6
11. Division Box	-	-	-	-	-	79	79	-	-	-	-	0	70	70
12. Drop	0	0	0	5	5	20	25	0	0	9	9	18	22	40
H = 0.3 - 0.7 m	0	0	0	0	0	10	10	0	0	0	0	0	5	5
H = 0.8 - 1.2 m	0	0	0	5	5	10	15	0	0	7	0	7	17	24
H = 1.2 - 1.5 m	0	0	0	0	0	0	0	0	0	2	9	11	0	11

Table F-12 (2/2) List of Related Structures to Irrigation Canals

Name of Structure	Name of Structure	Main Canal Canal Type I	II	III	IV	Total	Secondary Canal	Grand Total
(3) Hun Model Area								
1. Settling Basin	1. Settling Basin	0	0	0	4	4	-	4
2. Spillway	2. Spillway	0	0	0	4	4	-	4
3. Bifurcation	3. Bifurcation	0	0	0	0	0	-	0
4. Turnout	4. Turnout	0	0	0	8	8	-	8
5. Tail Structure	5. Tail Structure	0	0	0	4	4	-	4
6. Check	6. Check	0	0	0	5	5	-	5
7. Check cum Drop	7. Check cum Drop	0	0	0	3	3	-	3
H = 0.3 - 0.7 m	H = 0.3 - 0.7 m	0	0	0	0	0	-	0
H = 0.8 - 1.2 m	H = 0.8 - 1.2 m	0	0	0	1	1	-	1
H = 1.2 - 1.5 m	H = 1.2 - 1.5 m	0	0	0	2	2	-	2
8. Culvert	8. Culvert	0	0	0	3	3	7	10
9. Cross Drain	9. Cross Drain	0	0	0	3	3	6	9
10. Aqueduct	10. Aqueduct	0	0	0	0	0	1	1
11. Division Box	11. Division Box	-	-	-	-	0	66	66
12. Drop	12. Drop	0	0	0	7	7	43	50
H = 0.3 - 0.7 m	H = 0.3 - 0.7 m	0	0	0	1	1	19	20
H = 0.8 - 1.2 m	H = 0.8 - 1.2 m	0	0	0	5	5	24	29
H = 1.2 - 1.5 m	H = 1.2 - 1.5 m	0	0	0	1	1	0	1

Table F-13 List of Drainage Canals

Canal Name	Length (m)	Canal Name	Length (m)	Canal Name	Length (m)
(1) Xai Model Area		**(2) Beng Model Area**		**(3) Hun Model Area**	
A-1	1,000	C-1	600	B-1	1,285
A-2	745	C-2	575	B-2	1,025
A-3	860	C-3	1,215	B-3	1,660
A-4	825	C-4	1,930	B-4	400
A-5	1,010	C-5	1,300	B-5	595
A-6	300	C-6	725	B-6	400
A-7	710			B-7	2,245
A-8	1,000	Total	6,345	B-8	500
A-9	550			B-9	1,050
Total	7,000			Total	9,160

Table F-14 List of Related Structures to Drainage Canals

Name of Structure	Canal Type				Total
	Type I	Type II	Type III	Type IV	
(1) Xai Model Area					
1. Culvert	1	1	1	0	3
2. Drop	10	4	7	8	29
H = 0.4 - 0.6 m	4	0	1	0	5
H = 0.7 - 1.2 m	6	4	6	4	20
H = 1.3 - 1.5 m	0	0	0	4	4
3. Junction					3
(2) Beng Model Area					
1. Culvert	2	0	1	0	3
2. Drop	6	6	5	0	17
H = 0.4 - 0.6 m	4	0	0	0	4
H = 0.7 - 1.2 m	2	5	5	0	12
H = 1.3 - 1.5 m	0	1	0	0	1
3. Junction					2
(3) Hun Model Area					
1. Culvert	1	1	0	0	2
2. Drop	33	8	10	0	51
H = 0.4 - 0.6 m	8	3	1	0	12
H = 0.7 - 1.2 m	25	5	0	0	30
H = 1.3 - 1.5 m	0	0	9	0	9
3. Junction					2

Table F-15 Annual Disbursement Schedule of Construction Cost

(Unit : US$ 1,000)

Items	Total Cost			1995		1996		1997		1998	
	FC	LC	Total	FC	LC	FC	LC	FC	LC	FC	LC
1. Preparatory Works	578	334	912	0	0	271	163	306	171	0	0
2. Irrigation and Drainage											
(1) Xai area	1,498	858	2,356	0	0	449	257	1,049	601	0	0
(2) Beng area	1,298	730	2,028	0	0	0	0	389	219	909	511
(3) Hun area	970	573	1,543	0	0	0	0	291	172	679	401
3. Social Infrastructures											
(1) District road											
- B.Nasao to B.Nale (Xai)	102	49	151	0	0	31	15	71	34	0	0
- Hun center to B.Somphon (Hun)	314	120	434	0	0	0	0	94	36	220	84
(2) Rural water supply											
- Houay Khoum system (Xai)	102	21	123	0	0	31	6	71	15	0	0
- Houay Lai system (Beng)	124	25	149	0	0	0	0	37	8	87	18
- Houay Phon system (Hun)	145	32	177	0	0	0	0	44	10	102	22
(3) Primary school											
- Xai area	63	94	157	0	0	19	28	44	66	0	0
- Beng area	59	87	146	0	0	0	0	18	26	41	61
- Hun area	42	62	104	0	0	0	0	13	19	29	43
4. Agricultural Station	754	479	1,233	0	0	226	144	528	335	0	0
5. Extension Office											
(1) Beng extension office	43	28	71	0	0	13	8	30	20	0	0
(2) Hun extension office	96	62	158	0	0	29	19	67	43	0	0
6. Rice Bank											
(1) Xai rice bank	56	40	96	0	0	17	12	39	28	0	0
(2) Beng rice bank	56	40	96	0	0	0	0	17	12	39	28
(3) Hun rice bank	56	40	96	0	0	0	0	17	12	39	28
Sub-total (1 - 6)	6,356	3,674	10,030	0	0	1,086	652	3,125	1,825	2,145	1,196
7. Equipment	1,559	0	1,559					1,559	0		
8. Administration cost	0	232	232	0	23	0	81	0	81	0	46
9. Engineering Services	927	0	927	93	0	324	0	324	0	185	0
Sub-total (1 - 9)	8,842	3,906	12,748	93	23	1,410	734	5,009	1,906	2,330	1,243
10. Physical Contingency	442	195	637	5	1	71	37	250	95	117	62
Sub-total (1 - 10)	9,284	4,101	13,385	97	24	1,481	770	5,259	2,002	2,447	1,305
11. Price Contingency	984	1,167	2,151	6	4	122	166	547	553	309	444
Total (1 - 11)	10,268	5,268	15,536	103	28	1,603	936	5,807	2,555	2,755	1,749

Note: Price contingency is estimated based on the annual increase rate of 2 % and 5 % for foreign currency portion and local currency portion, respectively.
FC : Foreign currency portion, LC : Local currency portion

Table F-16 Farm Household under With-Project Condition

Unit of value: Kip in 1000

		Xai		Beng	Hun	
Ethnic group	(Unit)	LL	Mix	LL	LL	LT
A. Income:	(Kip)	241.8	200.3	259.2	247.0	198.9
1) Field crop		186.3	174.9	157.0	198.1	155.5
Lowland rice:						
Production	(ton/paddy)	2.7	2.0	1.9	2.5	0.7
Net reserve*	(Kip//ha)	326.8	326.8	231.1	231.1	231.1
Cultivated area	(ha)	0.57	0.42	0.55	0.71	0.20
Income	(Kip)	186.3	137.2	127.1	164.1	46.2
Upland rice :						
Production	(ton/paddy)	0.0	0.4	0.3	0.4	1.3
Net reserve*	(Kip//ha)	99.8	99.8	99.8	99.8	99.8
Cultivated area	(ha)	0.00	0.31	0.19	0.28	0.90
Income	(Kip)	0.0	30.9	19.0	27.9	89.8
Upland crop:		0.0	6.7	10.9	6.0	19.4
Sesame**						
Net reserve	(Kip//ha)	215.8	215.8	215.8	215.8	215.8
Cultivated area	(ha)	0.00	0.03	0.02	0.03	0.09
Income	(Kip)	0.0	6.7	4.1	6.0	19.4
Tobacco***						
Net reserve	(Kip//ha)	89.4	89.4	89.4	89.4	89.4
Cultivated area	(ha)	0.0	0.0	0.08	0.0	0.0
Income	(Kip)	0.0	0.0	6.8	0.0	0.0
2) Livestock****		55.5	25.4	102.2	48.9	43.4
B. Expenditure:		305.0	290.0	254.0	171.0	113.5
1) Cloth		59.0	54.0	49.0	43.0	29.0
2) Foods*****		118.0	110.0	82.0	53.0	33.0
3) Health		38.0	33.0	36.0	26.0	24.0
4) Education		12.0	9.0	19.0	9.0	6.0
5) Transportation		26.0	14.0	22.0	14.0	6.5
6) Others		52.0	70.0	46.0	26.0	15.0
C. Balance(A-B)	(Kip)	-63.2	-89.7	5.2	76.0	85.4

* The amount of net reserve for lowland and upland rice is based on Table F-18.
For Xai area about 41.4% of second crop of rice is introduced, then the net reserve is estimated at this increse rate(231.1*1.414=326.8)

** The cultivated area of sesame is estimated at about 10% of upland rice field.

*** The cultivated aea of tobacco is estimated at about 40% of the upland rice field only Beng area.

**** The income by livestock are based on Table F-20.

***** Most of families in Xai model area spend more expenses than farm income.
It may be erned by other than farming activities.

Table F-17 Farm Household under Without-Porject Condition

Unit of value: Kip in 1000

		Xai		Beng	Hun	
Ethnic group	(Unit)	LL	Mix	LL	LL	LT
A. Income:	(Kip)	161.9	141.2	234.6	215.2	189.4
1) Field crop		106.4	115.8	132.4	166.3	146.0
Lowland rice:						
Production	(ton/paddy)	1.5	1.1	1.4	1.8	0.5
Net reserve*	(Kip//ha)	186.7	186.7	186.7	186.7	186.7
Cultivated area	(ha)	0.57	0.42	0.55	0.71	0.20
Income	(Kip)	106.4	78.4	102.7	132.6	37.3
Upland rice :						
Production	(ton/paddy)	0.0	0.4	0.3	0.4	1.3
Net reserve*	(Kip//ha)	99.1	99.1	99.1	99.1	99.1
Cultivated area	(ha)	0.00	0.31	0.19	0.28	0.90
Income	(Kip)	0.0	30.7	18.8	27.7	89.2
Upland crop:		0.0	6.7	10.9	6.0	19.4
Sesame**						
Net reserve	(Kip//ha)	215.8	215.8	215.8	215.8	215.8
Cultivated area	(ha)	0.00	0.03	0.02	0.03	0.09
Income	(Kip)	0.0	6.7	4.1	6.0	19.4
Tobacco***						
Net reserve	(Kip//ha)	89.4	89.4	89.4	89.4	89.4
Cultivated area	(ha)	0.0	0.0	0.08	0.0	0.0
Income	(Kip)	0.0	0.0	6.8	0.0	0.0
2) Livestock****		55.5	25.4	102.2	48.9	43.4
B. Expenditure:		305.0	290.0	254.0	171.0	113.5
1) Cloth		59.0	54.0	49.0	43.0	29.0
2) Foods*****		118.0	110.0	82.0	53.0	33.0
3) Health		38.0	33.0	36.0	26.0	24.0
4) Education		12.0	9.0	19.0	9.0	6.0
5) Transportation		26.0	14.0	22.0	14.0	6.5
6) Others		52.0	70.0	46.0	26.0	15.0
C. Balance(A-B)	(Kip)	-143.1	-148.8	-19.4	44.2	75.9

* The amount of net reserve for lowland and upland crops is based on Table F-19.

** The cultivated area of sesame is estimated at about 10% of upland rice field.

*** The cultivated aea of tobacco is estimated at about 40% of the upland rice field only Beng area.

**** The income by livestock are based on Table F-5.

***** The paddy consumption per family is estimated about 1.8t/year(6 person/family x 300kg/person). Most of families in Xai model area need to buy paddy for food usually by income from other than farm income.

Table F-18 Typical Crop Budget(financial,with-project condition)

Items	Unit	Unit price	Lowland rice		Upland rice		Maize		Sesame*** (mixed with rice)		Cotton		Tobacco		Garlic		Soybean	
			Q'ty	Amount (Kip)	Q'ty	Amount (Kip)	Q'ty	Amount (Kip)	Q'ty	Amount (Kip)	Q'ty	Amount (Kip)	Q'ty	Amount (Kip)	Q'ty	Amount (Kip)	Q'ty	Amount (Kip)
A. Gross income				320,000		112,000		162,000		224,000		161,000		96,000		140,000		240,000
1) Unit yield *	(ton/ha)		4.0		1.4		1.80		0.80		0.7		3.2		1.4		1.2	
2) Unit price	(Kip/kg)		80		80		90		280		230****		30		100		200	
B. Production cost				114,375		43,938		18,038	34	8,995		37,413		40,588		82,313		28,938
1) Labor force	man -day/ha																	
Field preparation		250	20	5,000	20	5,000	0	0			10	2,500	12	3,000	20	5,000	10	2,500
Fencing		250	5	1,250	10	2,500	0	0			5	1,250	5	1,250	10	2,500	10	2,500
Nursery preparation		250	2	500	0	0	0	0			0	0	30	7,500		0		0
Trans planting/seeding		250	45	11,250	8	2,000	25	6,250	3	750	20	5,000	15	3,750	20	5,000	20	5,000
Weeding		250	2	500	60	15,000	0	0			25	6,250	25	6,250	15	3,750	30	7,500
Irrigation/Watering		250	5	1,250	0	0	0	0			0	0	0	0	0	0	0	0
Harvesting/threshing		250	55	13,750	45	11,250	30	7,500	27	6,750	65	16,250	60	15,000	20	5,000	25	6,250
sub-total			134	33,500	143	35,750	55	13,750	30	7,500	125	31,250	147	36,750	85	21,250	95	23,750
2) Animal power	head-day/ha			11,250														
Land preparation		250	15	3,750	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hired		1,500	5	7,500	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3) Materials				69,625		8,188		4,288		1,495		6,163		3,838		61,063		5,188
Seed/seedling	kg	80	50	4,000	80	6,400	40	3,600	4	1,120	20	4,600	4	2,000	600	60,000	20	4,000
Fertilize (15:15:15)	kg	304	100	30,400														
(Urea)	kg	254	33	8,382														
Chemicals	kg	12,584	2	25,168														
Others(tools etc.)	5% of labour cost			1,675		1,788		688		375		1,563		1,838		1,063		1,188
C. Net income**				239,125		103,813		157,713		222,505		154,838		92,163		78,938		234,813
D. Tax	kg/ha		100	8,000	50	4,000	3%	4,731	3%	6,675	3%	4,645	3%	2,765	3%	2,368	3%	7,044
E. Net reserve**				231,125		99,813		152,981		215,830		150,192		89,398		76,569		227,768

* The unit yield is assumed at 4.0 t/ha for glutinous and non-glutinous rice.

** Family labour wage is not counted in production cost.

*** Sesame is grown mixed with upland rice, about 10% of upland rice area.

**** Price of seed cotton.

Prices of fertilizers and chemicals are based on Table F-22.

Table F-19 Typical Crop Budget (financial, without-project condition)

Items	Unit	Unit price	Lowland rice		Upland rice		Maize		Sesame (mixed with rice)**		Tobacco		Garlic	
			Q'ty	Amount	Q'ty	Amount	Q'ty	Amount	Q'ty	Amount	Q'ty	Amount	Q'ty	Amount
				(Kip)		(Kip)		(Kip)		(Kip)		(Kip)		(Kip)
A. Gross income				208,000		112,000		162,000		224,000		96,000		140,000
1) Unit yield	(ton/ha)		2.6		1.4		1.80		0.8		3.2		1.4	
2) Unit price	(Kip/kg)		80		80		90		280		30		100	
B. Production cost				42,850		58,375	0	19,350	34	8,995		40,588		82,313
1) Labor force	man -day/ha													
Field preparation		250	37	9,250	43	10,750	0	0	0	0	12	3000	20	5,000
Fencing		250	0	0	16	4,000	0	0	0	0	5	1250	10	2,500
Nursery preparation		250	10	2,500	0	0	0	0	0	0	30	7500	0	0
Trans planting/seeding		250	28	7,000	17	4,250	25	6250	3	750	15	3750	20	5,000
Weeding		250	17	4,250	56	14,000	0	0	0	0	25	6250	15	3,750
Irrigation/Watering		250	0	0	0	0	0	0	0	0	0	0	0	0
Harvesting/threshing		250	56	14,000	66	16,500	35	8750	27	6,750	60	15000	20	5,000
sub-total			148	37,000	198	49,500	0 60	15,000	30	7,500	147	36,750	85	21,250
2) Animal power	head-day/ha													
Land preparation		250	15	3,750	0	0	0	0	0	0	0	0	0	0
Hired		1500	5	7,500	0	0	0	0	0	0	0	0	0	0
3) Materials				5,850		8,875		4,350		1,495		3,838		61,063
Seed/seedling	kg/ha	80	50	4,000	80	6,400	40	3600	4	1,120	0.4	2,000	600	60,000
Others(tools etc.)	5% of labour cost			1,850		2,475		750		375		1,838		1,063
C. Net income*				194,650		103,125		157,650		222,505		92,163		78,938
D. Tax		80	100kg/ha	8,000	50kg/ha	4,000	3%	4,730	3%	6,675	3%	2,765	3%	2,368
E. Net reserve				186,650		99,125		152,921		215,830		89,398		76,569

* Family labour wage is not counted in production cost.

** The planted area area of sesame is estimated about 10% of of the upland rice filed, on average for 1987 - 1991. Seame is usually grown mixed with upland rice.

Table F-20 Income of Livestock for Farmhousehold by Ethnic Group in Model Areas

Value in Kip 1,000

	Village	Livestock(head/family)				Total income /family
		Buffalo	Cattle	Pig	Poultry	
I.	Xai model area:					
	LL villages					
	No. of livestock/family(head)*	2.8	2.0	1.6	14.7	
	No. of livestock sold per year(%)	7	8	50	24	
	No. of livestock sold per year(head	0.2	0.2	0.8	3.5	
	Value(income per year)	22.0	14.0	16.0	3.5	55.5
	Mix villages					
	No. of livestock/family(head)*	1.9	1.8	0.4	14.3	
	No. of livestock sold per year(%)	7	8	50	24	
	No. of livestock sold per year(head	0.1	0.1	0.2	3.4	
	Value(income per year)	11.0	7.0	4.0	3.4	25.4
II.	Beng model area:					
	LL villages					
	No. of livestock/family(head)*	4.1	3.5	3.4	24.5	
	No. of livestock sold per year(%)	8	13	48	9	
	No. of livestock sold per year(head	0.3	0.5	1.6	2.2	
	Value(income per year)	33.0	35.0	32.0	2.2	102.2
III.	Hun model area:					
	LT villages					
	No. of livestock/family(head)*	2.9	0.1	1.2	7.9	
	No. of livestock sold per year(%)	11	0	35	25	
	No. of livestock sold per year(head	0.3	0.0	0.4	2.0	
	Value(income per year)	33.0	0.0	8.4	2.0	43.4
	LL villages					
	No. of livestock/family(head)*	2.8	0.7	1.8	12.8	
	No. of livestock sold per year(%)	4	36	41	23	
	No. of livestock sold per year(head	0.1	0.3	0.7	2.9	
	Value(income per year)	11.0	21.0	14.0	2.9	48.9

* Number of livestock per family is based on Table FB-7.

** Percentage of livestock sold per year is based on Table FB-8.

Farmgate prices applied for buffalo,cattle,pig and poultry are;
110, 70,20 and one(1) thousand Kip, respectively.

Table F-21 Farming Size of Farm Household in Model Areas (present)

	Village	Ethnic group	No of Family	Popu-lation	Lowland rice field		Upland rice field		Livestock(head/family)			
					Total (ha)	per family (ha)	Total (ha)	per family (ha)	Buffalo	Cattle	Pig	Poultry
I.	Xai model area:											
	Na Khang	LL	17	100	5.0	0.29	0.0	0.00	1.6	0.7	2.7	10.9
	Ban Thin	LL	166	959	101.6	0.61	0.0	0.00	2.3	0.8	0.3	18.8
	Ban Cheng	LL	132	832	75.2	0.57	2.8	0.02	4.0	3.3	2.5	8.3
	Na Lao	LL	135	894	34.7	0.26	0.0	0.00	2.5	0.7	2.7	13.2
	Na Lee	LL	58	356	54.2	0.93	0.0	0.00	2.0	3.3	0.7	14.5
	Na Sao	LL	57	337	54.1	0.95	2.2	0.04	3.0	4.7	1.7	22.2
	LL total/average		565	3478	324.8	0.57	5.0	0.00	2.8	2.0	1.6	14.7
	Na Mi	Mix	38	230	25.3	0.67	24.1	0.63	1.0	0.5	0.5	32.5
	Houy Khoum	Mix	97	480	31.4	0.32	18.0	0.19	2.2	2.3	0.3	7.2
	Mix total/average		135	710	56.7	0.42	42.1	0.31	1.9	1.8	0.4	14.3
	Xai model area total/average		700	4,188	381.5	0.55	47.1	0.07	2.6	2.0	1.4	14.6
II.	Beng model area:											
	Pang Dua	LL	62	365	20.4	0.33	36.3	0.59	1.8	1.8	2.0	22.5
	Pho Keo	LL	74	477	37.3	0.50	5.0	0.07	4.5	7.5	3.0	31.2
	Beng Kham	LL	79	393	45.2	0.57	1.0	0.01	2.0	3.7	2.7	15.3
	Na Houay	LL	57	340	39.1	0.69	21.0	0.37	2.7	4.2	3.7	14.7
	Bang Louang	LL	93	502	64.7	0.70	1.4	0.02	4.3	3.7	5.8	44.2
	Ta Khat	LL	84	532	41.3	0.49	21.2	0.25	8.2	0.5	2.5	13.8
	LL total/average		449	2,609	248	0.55	85.9	0.19	4.1	3.5	3.4	24.5
III.	Hun model area:											
	Ban Mai	LT	54	262	7.0	0.13	44.4	0.82	1.9	0.0	0.5	8.0
	Ban Na	LT	118	657	34.0	0.29	71.0	0.60	3.0	0.3	2.5	17.8
	Som Xai	LT	176	872	36.4	0.21	163.0	0.93	3.7	0.0	1.2	3.8
	Somphon	LT	126	641	9.3	0.07	140.0	1.11	2.0	0.2	0.2	4.5
	LT total/average		474	2,432	86.7	0.2	418.4	0.9	2.9	0.1	1.2	7.9
	Na Kahm Tai	LL	60	351	53.5	0.89	10.9	0.18	2.7	0.5	2.0	19.2
	Phonsavaat	LL	85	491	49.0	0.58	29.7	0.35	2.8	0.9	1.7	8.3
	LL total/average		145	842	102.5	0.71	40.6	0.28	2.8	0.7	1.8	12.8
	Na Kham Nua	Mix	50	261	19.0	0.38	26.3	0.53	2.7	0.5	2.0	15.8
	Hun modelarea total/average		669	3,535	208.2	0.31	485.3	0.73	2.8	0.3	1.4	9.6

Note; The figures in this table are based on data given in Tables FB-1and FB-2 for villages related directly to the model areas, see ANNEX -FB.
The number of livestock per family is based on TableFB-7.

Table F-22 Price Estimation of Fertilizers

Application rate		Basal dose (as 15:15:15)	Top dressing (as Urea, N=46%)
N:	30 kg/ha	100 kg	33 kg
P:	15 kg/ha	100 kg	0 kg
Total (kg/ha)		100	33
Total requirement for 955 ha/year(ton)		96	32
1. Price in Vientiane (Kip/ton)*		220,000	170,000
2. Handling charge (Vientiane)	(Kip/ton)	700	700
3. Port tax (Vientiane)	(2,800/50 ton)	56	56
4. Transpotation (VTE to Pakbeng=880km)	(85 Kip/ton/km)	74,800	74,800
5. Handling charge (Pakbeng)	(1,000Kip/ton)	1,000	1,000
6. Port charge (Pakbeng)	(2,800Kip/50ton)	56	56
7. Transportation	(7,000Kip/ton)	7,000	7,000
Transportation(2+7)(Kip/ton)		83,612	83,612
Prices at site		303,612	253,612

Estimated prices of inputs:

Fertilizers	Complex(15:15:15)	304 Kip/kg
	Urea(46%)	254 Kip/kg
Chemicals		12,584 Kip/kg

* Prices at Vientiane is based on Table ME-5.
Data for handling charge, tarnspotation are obtained through Pakbeng office of CTPC, Oudomxay Province.

Table F-23 Expected Major Effects in Model Areas Scheme

Development programs \ Expected effects	Improvement and stabilization of agri-cultural production	Food production increase	Income generation	Support for women in development	Increase employment opportunity	Control of slash-and-burn cultivation	Living condition and health
- Strengthening of extension serivces	◎	◎	◎	◎	○	○	◎
- Establishment of rice bank	○	○	◎	◎	◎	-	-
- Establishment and operation of integrated agricultural station	○	○	○	○	○	○	○
- Agricultural development in model areas	◎	◎	◎	-	◎	○	○
- Irriagation development in Xai, Beng and Hun model areas	◎	◎	◎	○	◎	○	-
- Improvement and establishment of water users association	○	○	○	-	-	-	-
- Strenthening and improvement of meteo-hydrological network	○	○	-	-	-	○	-
- Rehabilitation and upgrading of district road network	○	○	○	○	○	○	◎
- Costruction of additional rural water supply system	-	-	-	◎	-	-	◎
- Rehabilitation and construction of primary schools	○	○	-	○	◎	-	○
- Study and planning programs for environmental problems in agricultural station	○	-	-	-	-	○	○
- Support services for women's group :							
Women's school by extension office	○	○	○	◎	○	○	◎
Promotion of participation to rice bank	○	○	◎	◎	◎	-	-
Extension of sericulture tecnique	◎	-	◎	◎	◎	○	-

Legend: ◎:Direct high effect ○ : Indirect, good - : No strong effect

Figure

(Unit: ha in net)

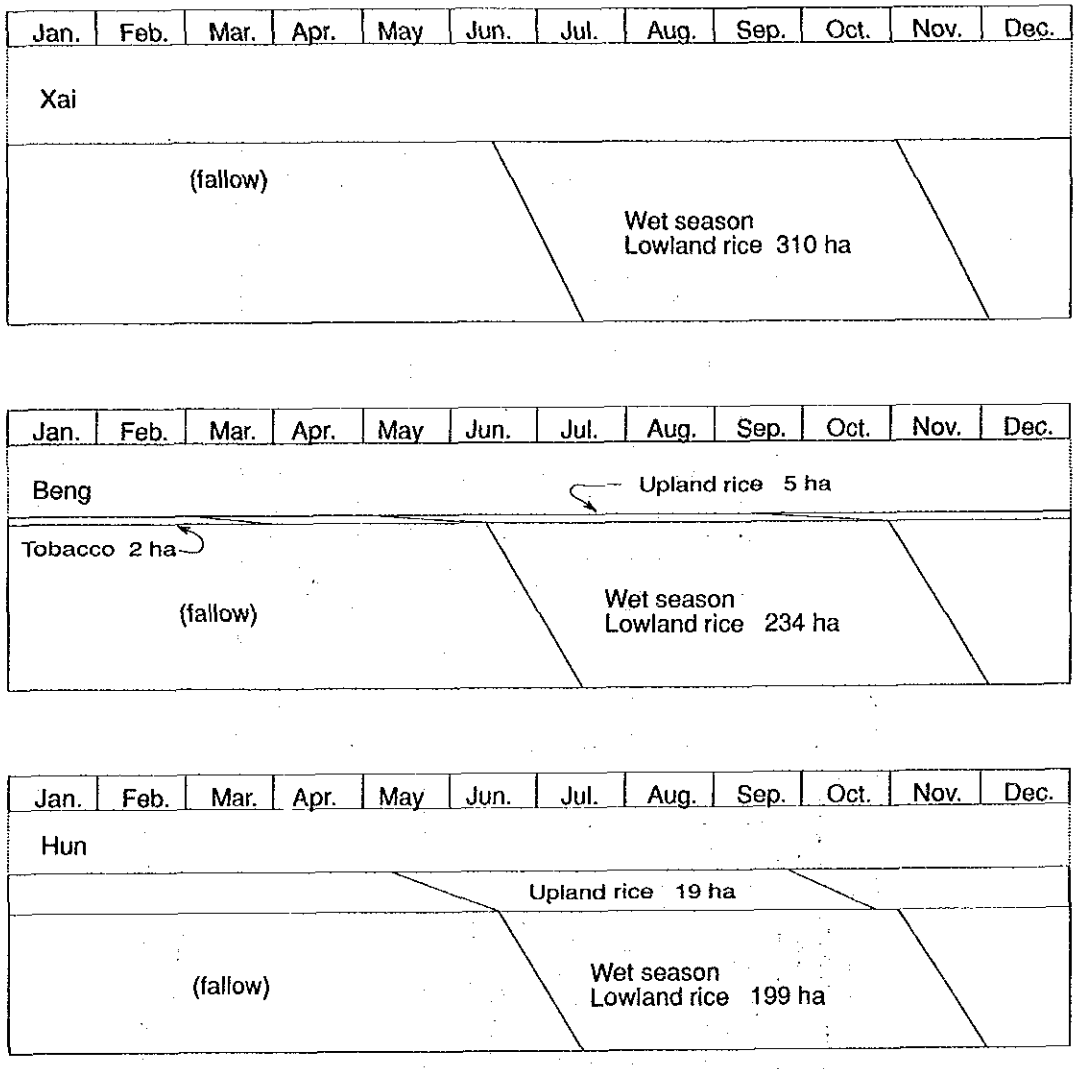


Fig. F-1 Present Cropping Pattern in the Model Scheme Area

THE LAO PEOPLE'S DEMOCRATIC REPUBLIC MINISTRY OF AGRICULTURE AND FORESTRY
AGRICULTURAL DEVELOPMENT PROJECT TO CONTROL SLASH AND BURN CULTIVATION IN OUDOMXAY PROVINCE
NIPPON KOEI CO., LTD. CONSTRUCTION PROJECT CONSULTANTS, INC.

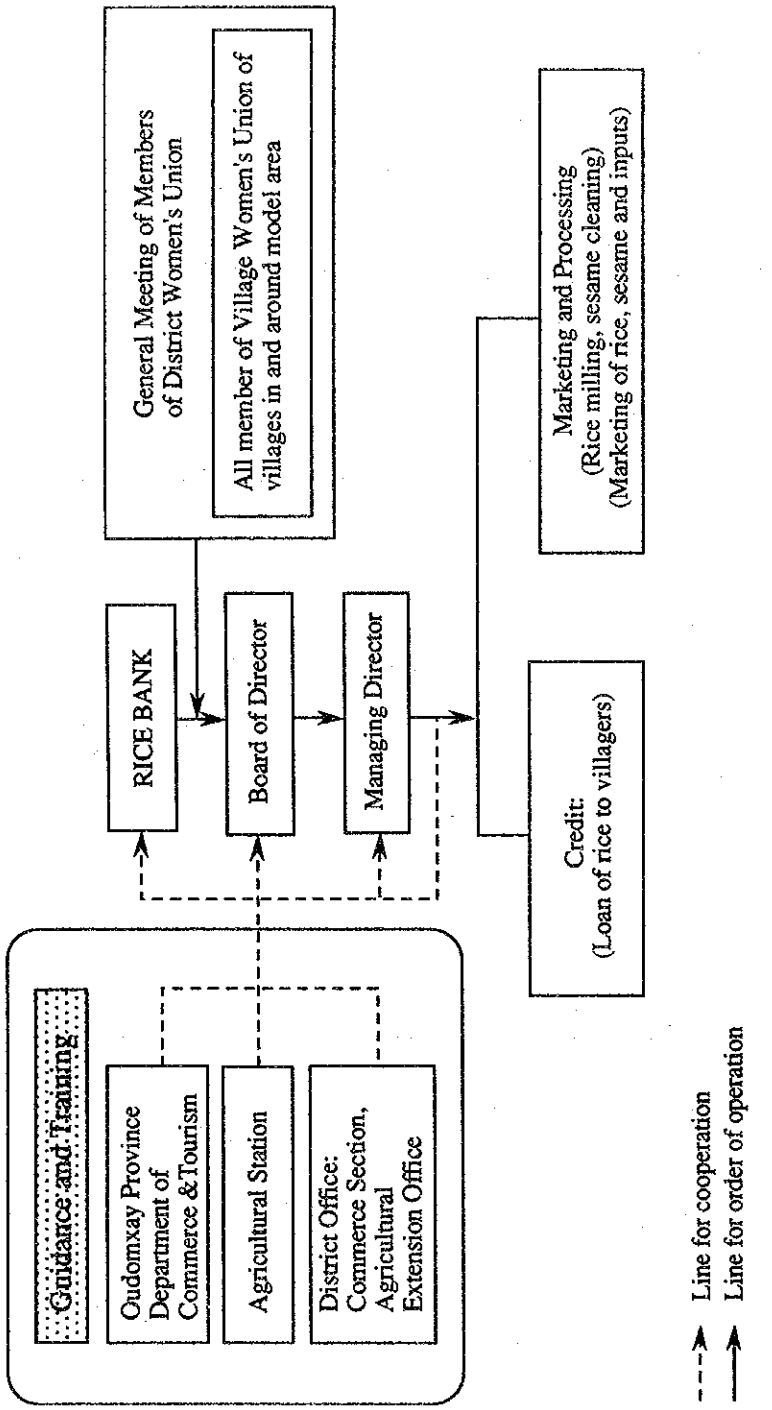
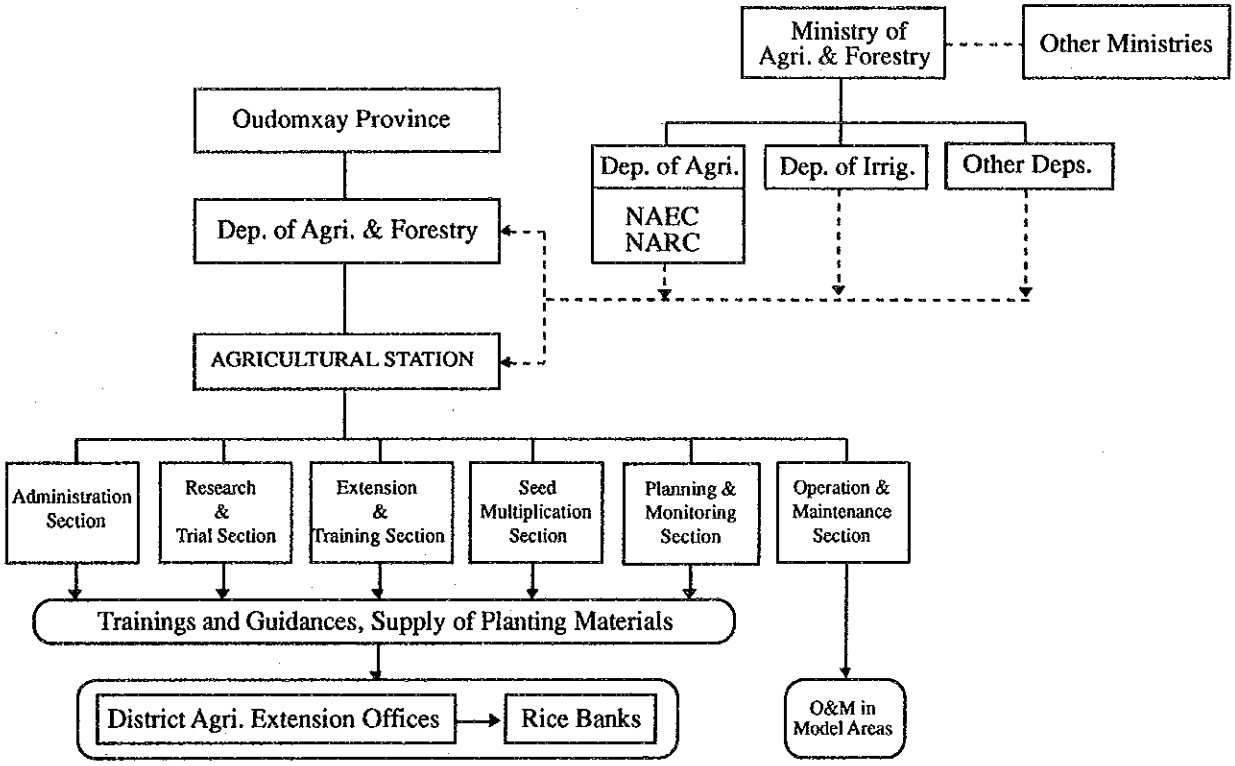


Fig. F-2 Organization and Cooperation Line of Proposed Rice Bank

THE LAO PEOPLE'S DEMOCRATIC REPUBLIC MINISTRY OF AGRICULTURE AND FORESTRY
AGRICULTURAL DEVELOPMENT PROJECT TO CONTROL SLASH AND BURN CULTIVATION IN OUDOMXAY PROVINCE
NIPPON KOEI CO., LTD. CONSTRUCTION PROJECT CONSULTANTS, INC.



Note *: National Agricultural Extension Centre
**: National Agricultural Research Centre

Fig. F-3 Proposed Organization of Agricultural Station and Concerned Authorities

THE LAO PEOPLE'S DEMOCRATIC REPUBLIC MINISTRY OF AGRICULTURE AND FORESTRY
AGRICULTURAL DEVELOPMENT PROJECT TO CONTROL SLASH AND BURN CULTIVATION IN OUDOMXAY PROVINCE
NIPPON KOEI CO., LTD. CONSTRUCTION PROJECT CONSULTANTS, INC.

(Unit: ha in net)

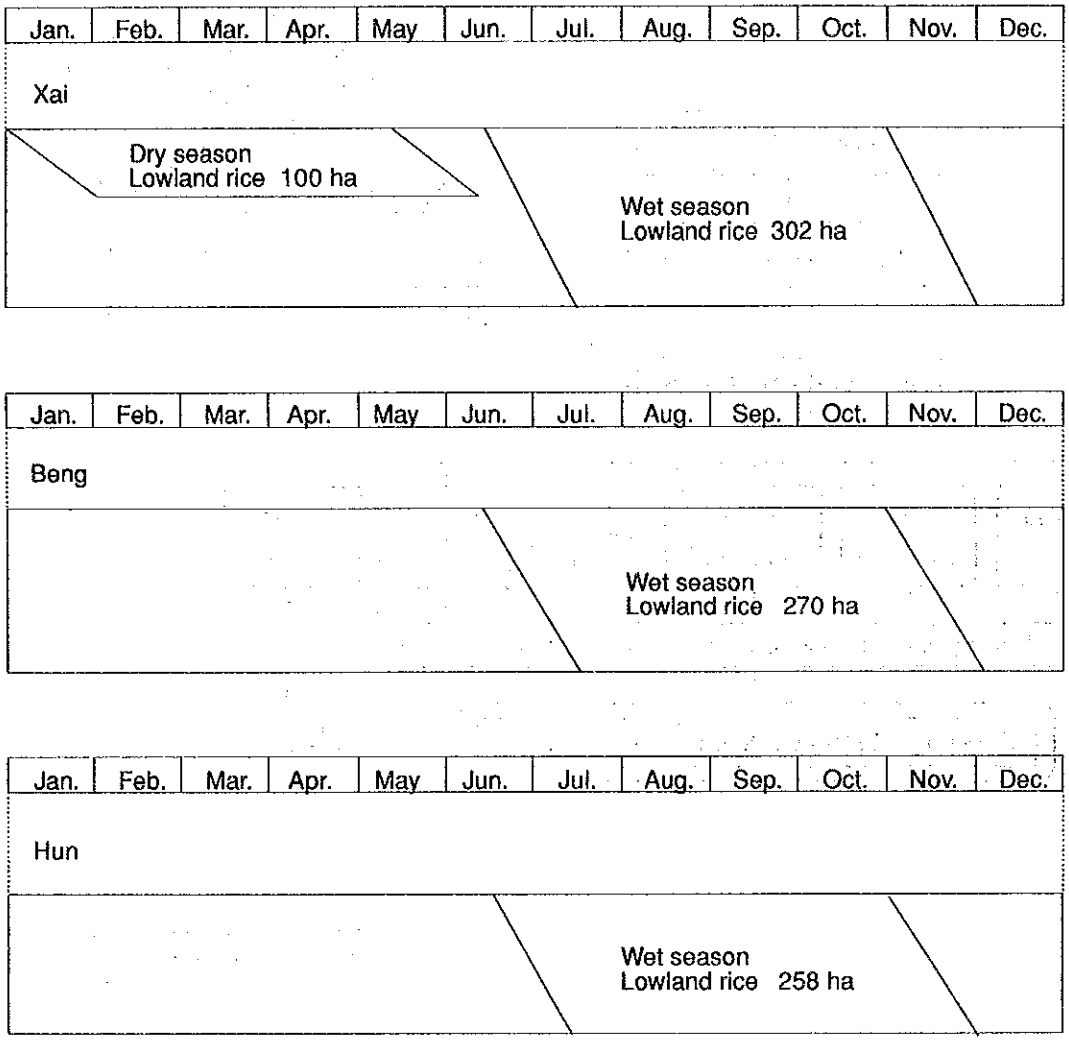


Fig. F-4 Proposed Cropping Pattern in the Model Scheme Area

THE LAO PEOPLE'S DEMOCRATIC REPUBLIC MINISTRY OF AGRICULTURE AND FORESTRY
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NIPPON KOEI CO., LTD. CONSTRUCTION PROJECT CONSULTANTS, INC.

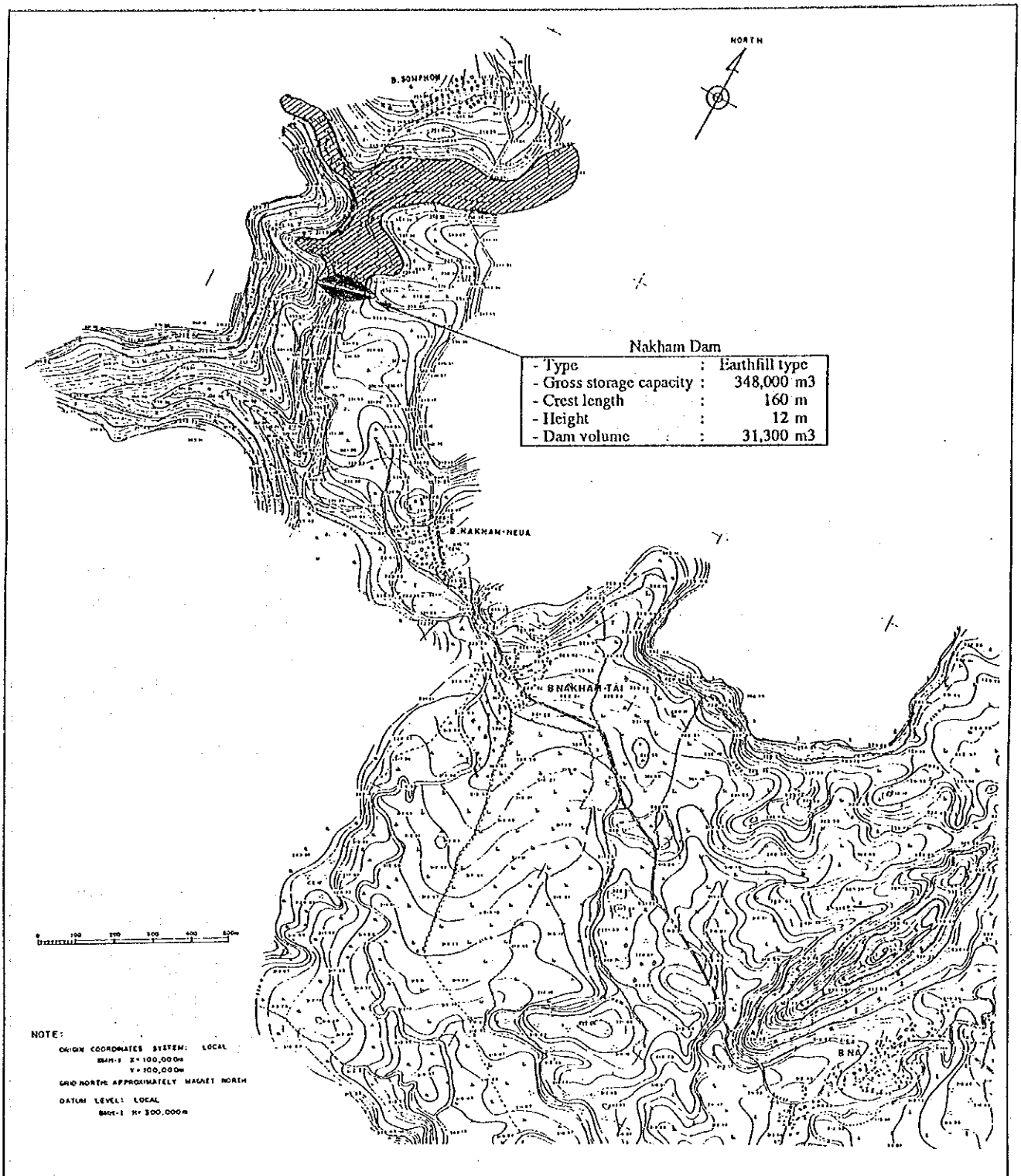

Fig. F-5 Nakham Dam Plan of Hun Model Area

THE LAO PEOPLE'S DEMOCRATIC REPUBLIC MINISTRY OF AGRICULTURE AND FORESTRY
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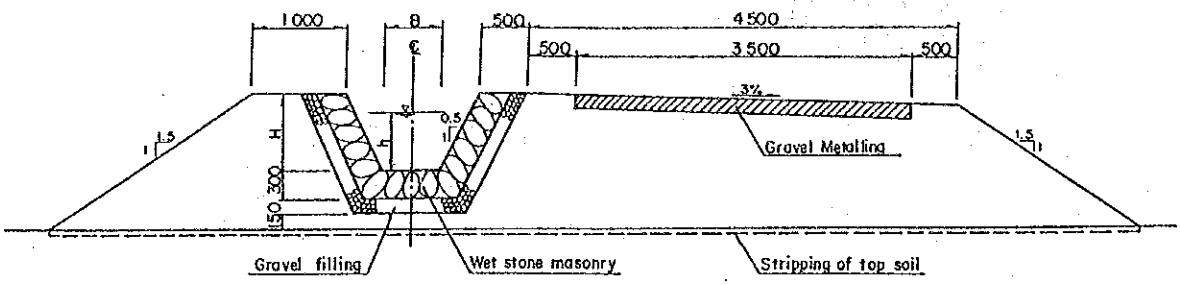
IRRIGATION CANAL

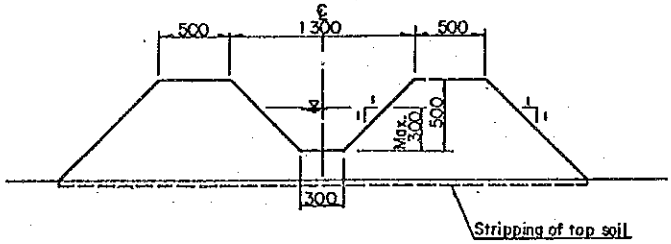
MAIN IRRIGATION CANAL

WET STONE MASONRY-LINED CANAL O & M ROAD



SECONDARY IRRIGATION CANAL

UNLINED CANAL

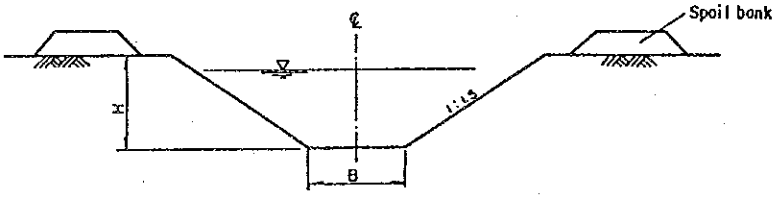


DIMENSION OF IRRIGATION CANAL

(Unit : mm)

Canal Type	B	H	h (max)
I	700	900	700
II	600	800	600
III	500	700	500
IV	400	600	400
V	300	500	300

DRAINAGE CANAL



DIMENSION OF DRAINAGE CANAL

(Unit : mm)

Canal Type	B	H
I	500	600
II	1,000	1,000
III	1,500	1,200
IV	2,000	1,500

Fig. F-6 Typical Cross Section

THE LAO PEOPLE'S DEMOCRATIC REPUBLIC MINISTRY OF AGRICULTURE AND FORESTRY
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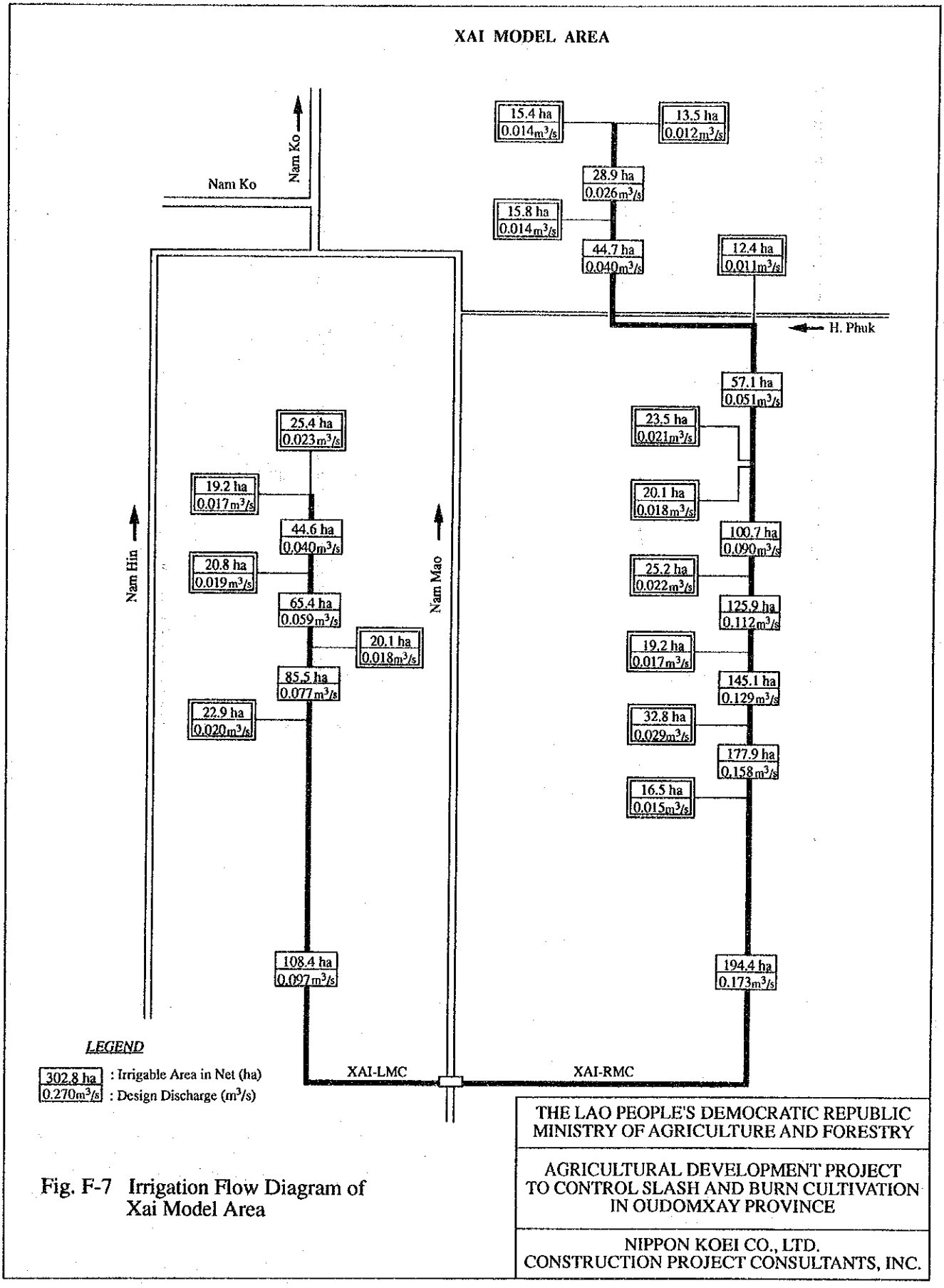

Fig. F-7 Irrigation Flow Diagram of Xai Model Area

THE LAO PEOPLE'S DEMOCRATIC REPUBLIC MINISTRY OF AGRICULTURE AND FORESTRY
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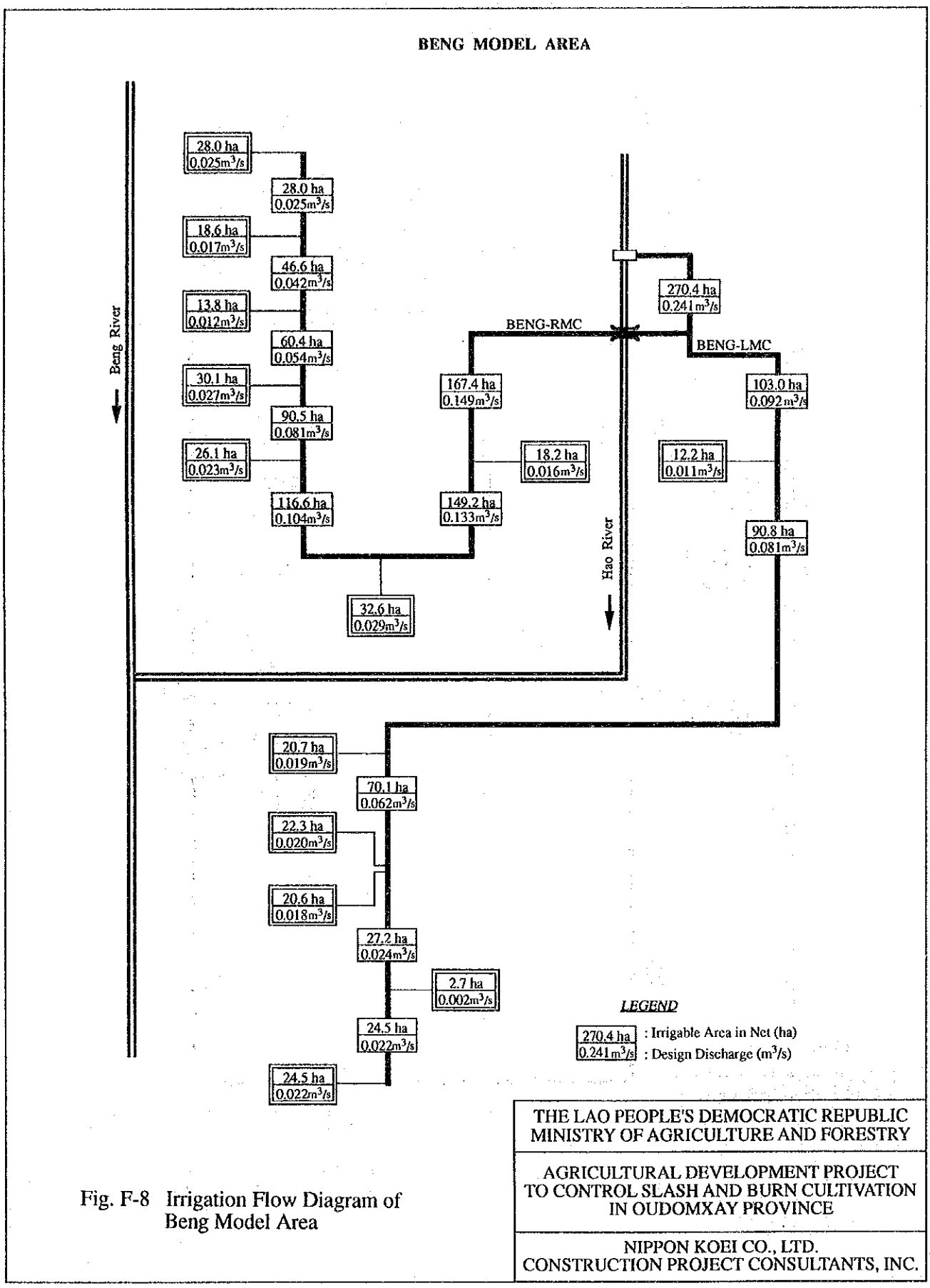

Fig. F-8 Irrigation Flow Diagram of Beng Model Area

THE LAO PEOPLE'S DEMOCRATIC REPUBLIC MINISTRY OF AGRICULTURE AND FORESTRY
AGRICULTURAL DEVELOPMENT PROJECT TO CONTROL SLASH AND BURN CULTIVATION IN OUDOMXAY PROVINCE
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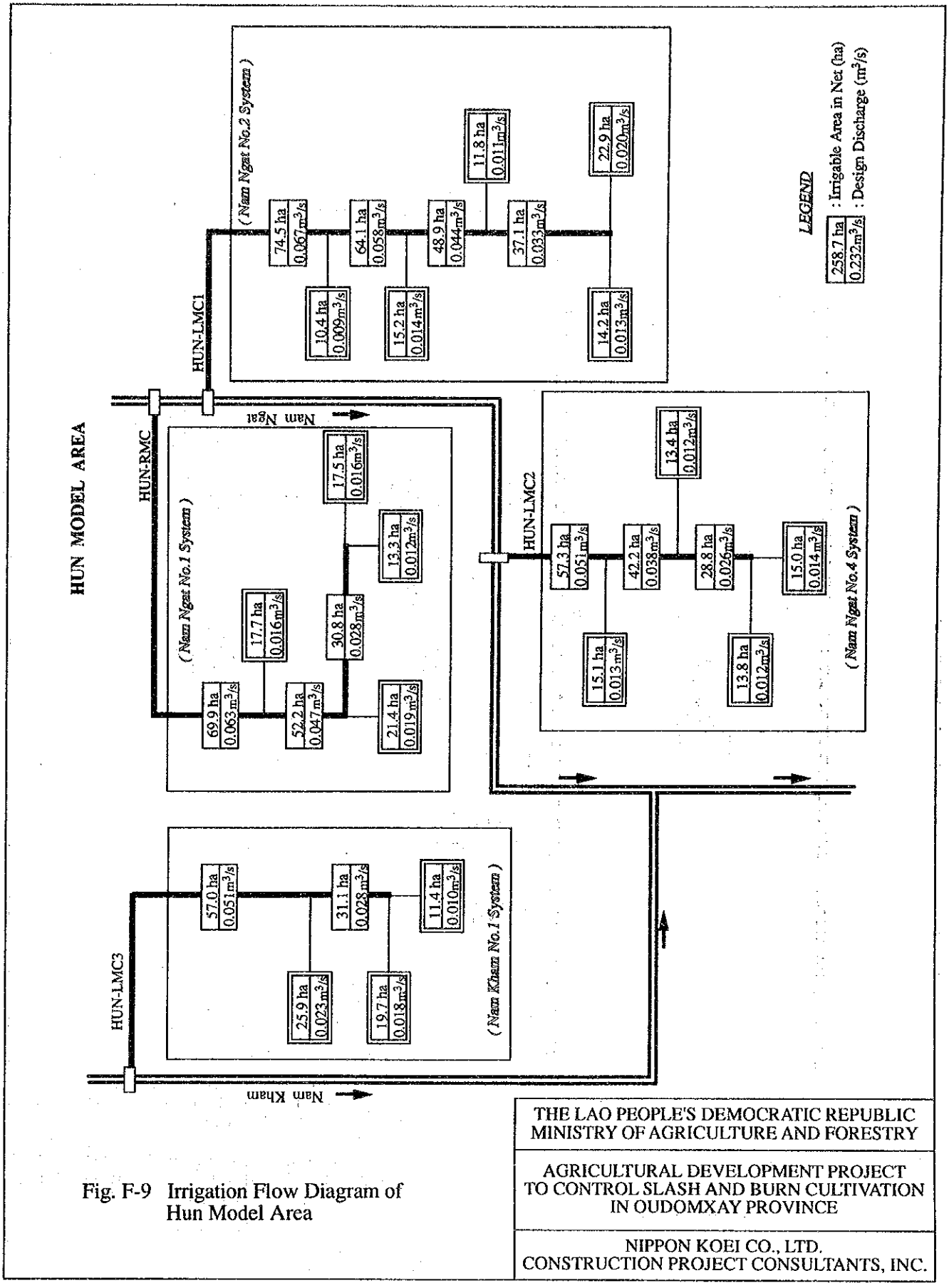

Fig. F-9 Irrigation Flow Diagram of Hun Model Area

THE LAO PEOPLE'S DEMOCRATIC REPUBLIC
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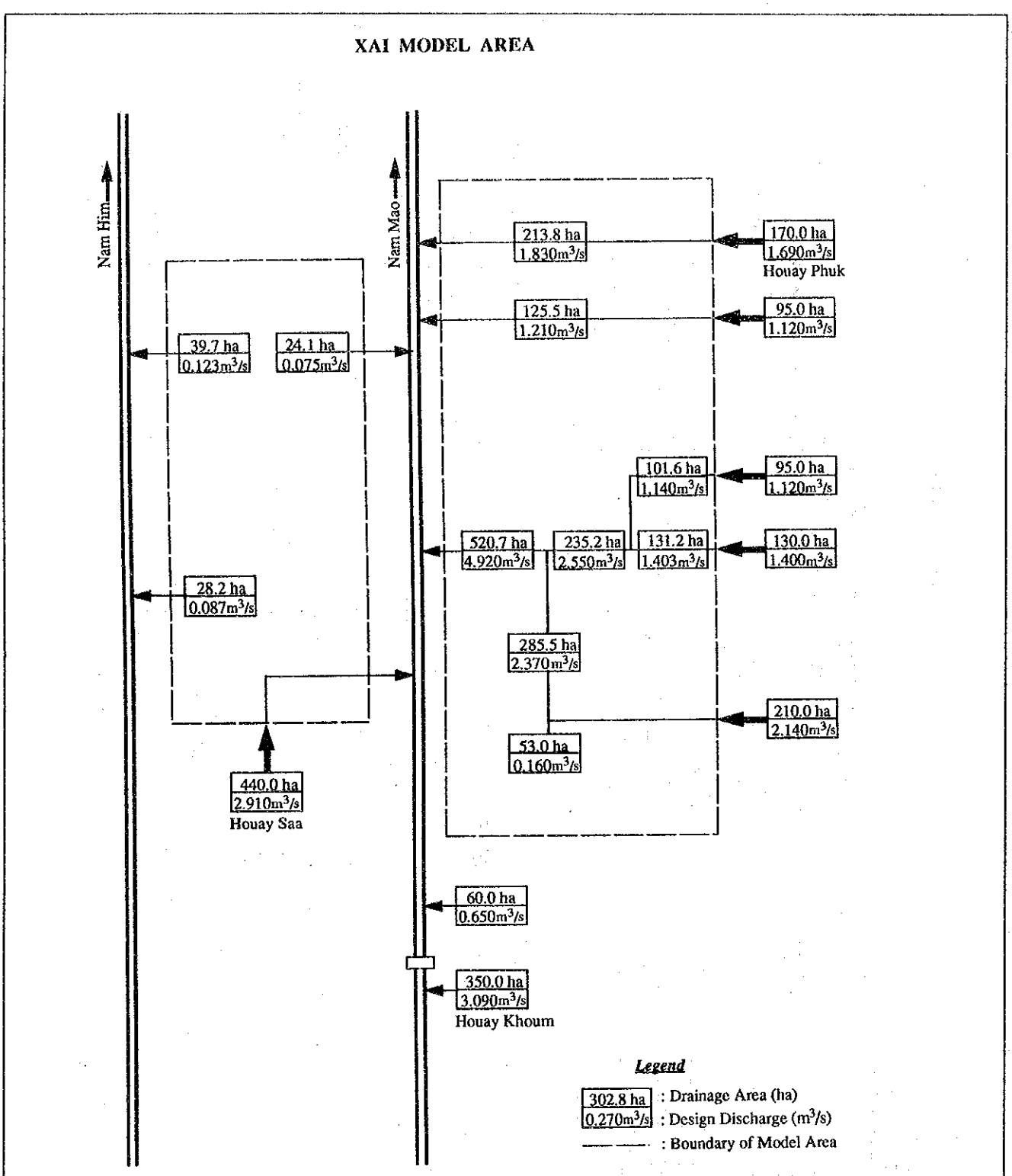

Fig. F-10 Drainage Flow Diagram of Xai Model Area

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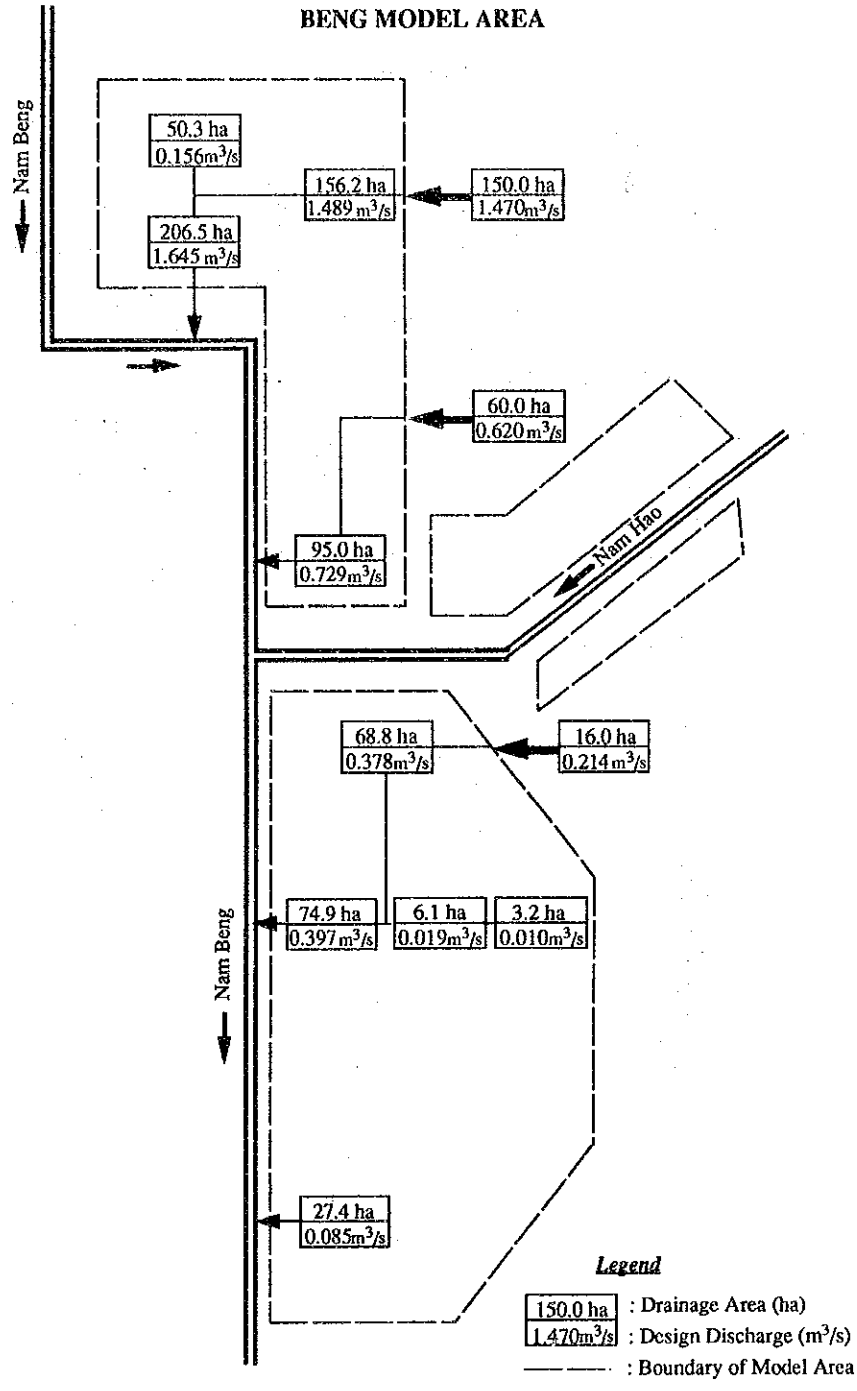

Fig. F-11 Drainage Flow Diagram of Beng Model Area

THE LAO PEOPLE'S DEMOCRATIC REPUBLIC MINISTRY OF AGRICULTURE AND FORESTRY
AGRICULTURAL DEVELOPMENT PROJECT TO CONTROL SLASH AND BURN CULTIVATION IN OUDOMXAY PROVINCE
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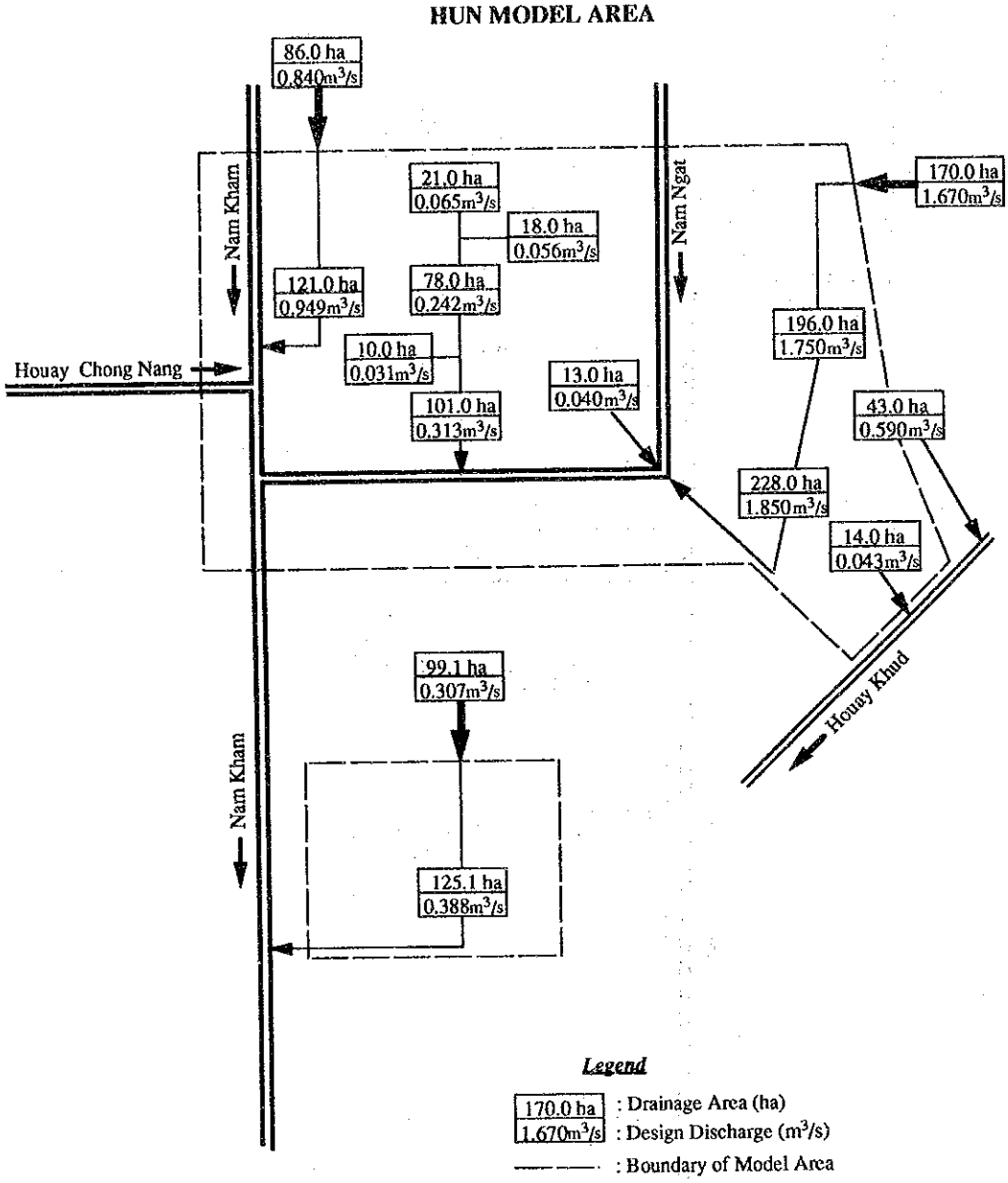

Fig. F-12 Drainage Flow Diagram of Hun Model Area

THE LAO PEOPLE'S DEMOCRATIC REPUBLIC MINISTRY OF AGRICULTURE AND FORESTRY
AGRICULTURAL DEVELOPMENT PROJECT TO CONTROL SLASH AND BURN CULTIVATION IN OUDOMXAY PROVINCE
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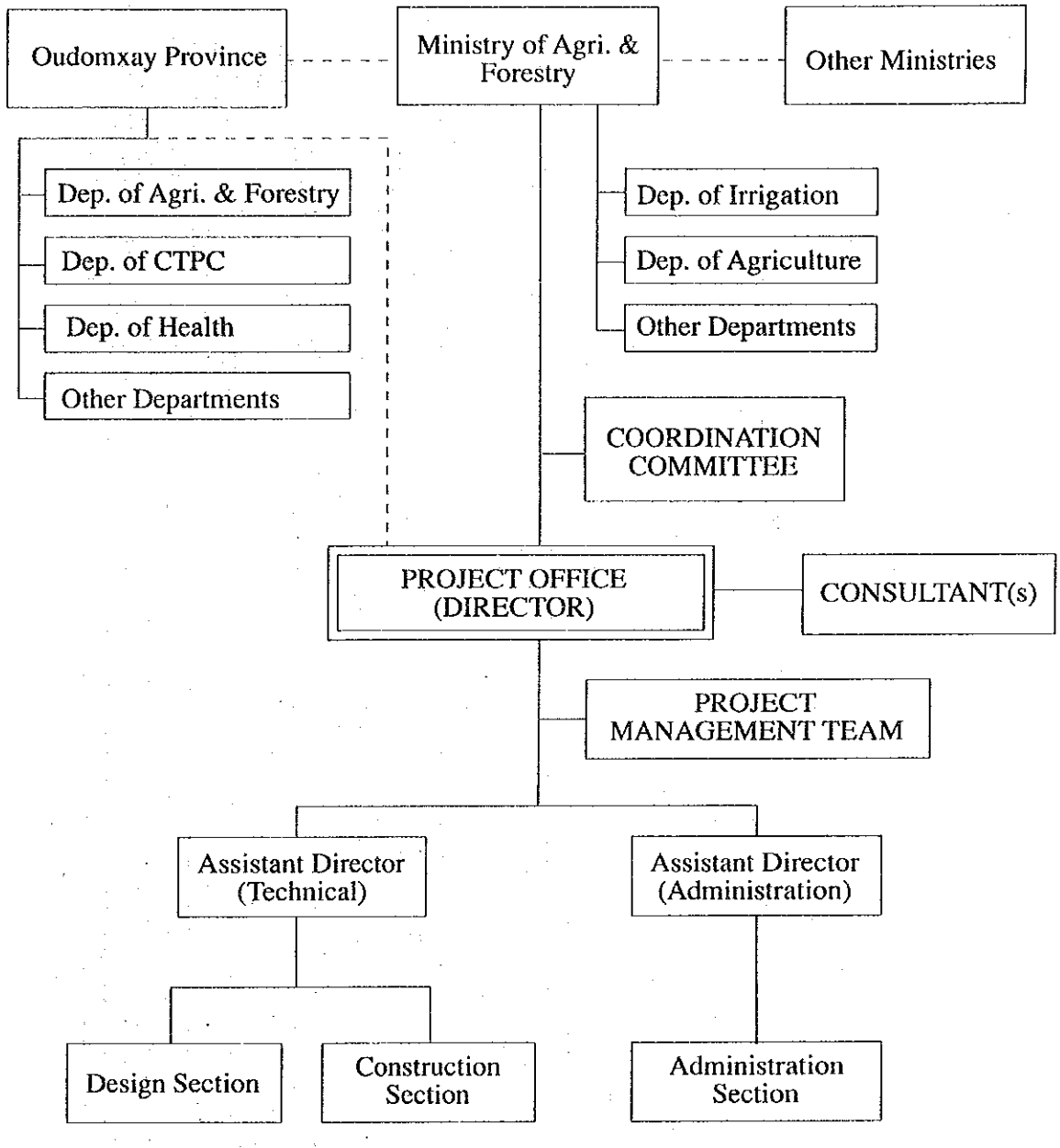

Note: - - - means coordination line

Fig. F-13 Proposed Organization for Implementation of Model Areas Scheme

THE LAO PEOPLE'S DEMOCRATIC REPUBLIC
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AGRICULTURAL DEVELOPMENT PROJECT
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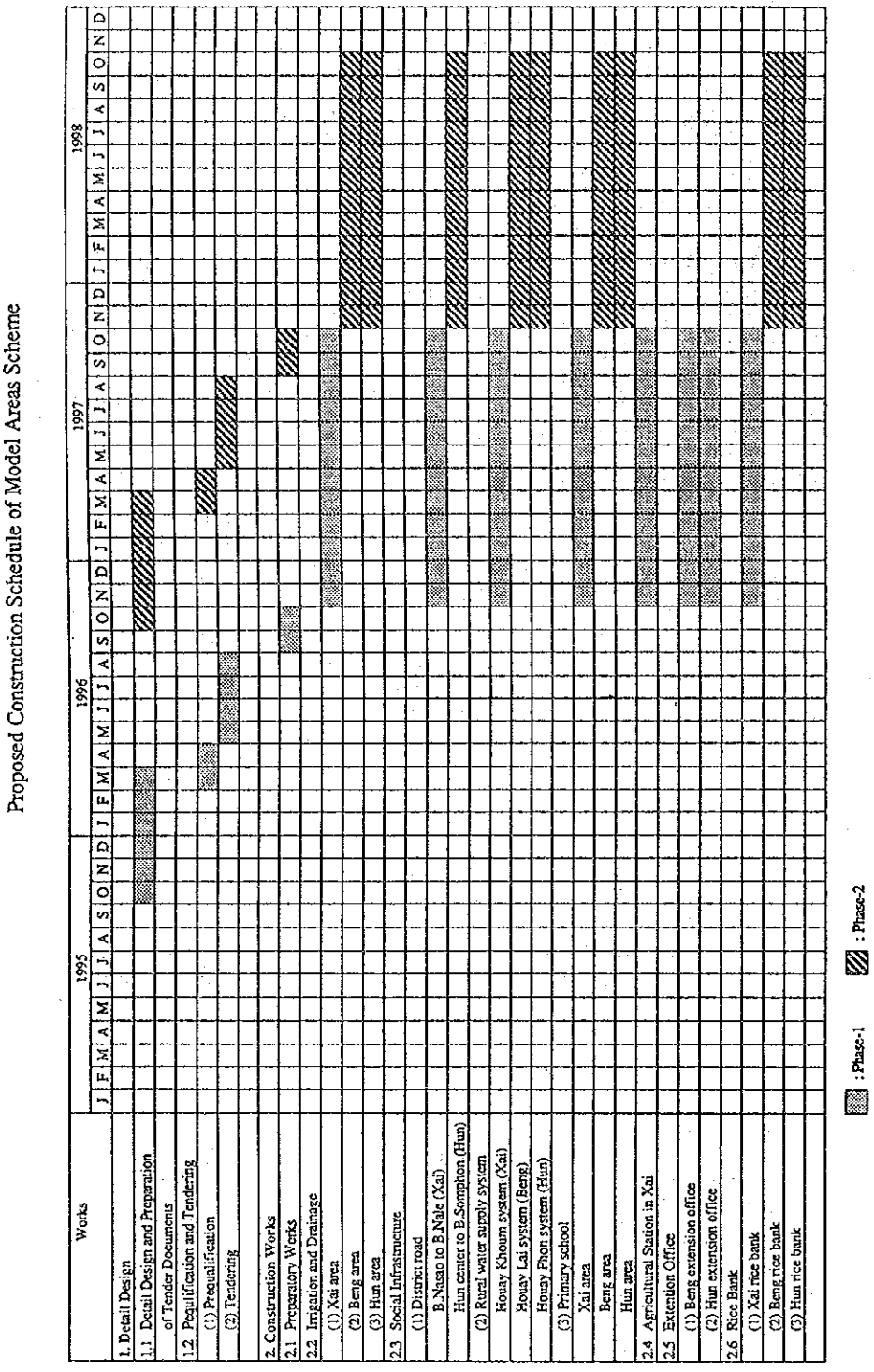

Fig. F-14 Proposed Construction Schedule of Model Areas Scheme

THE LAO PEOPLE'S DEMOCRATIC REPUBLIC
MINISTRY OF AGRICULTURE AND FORESTRY

AGRICULTURAL DEVELOPMENT PROJECT
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ANNEX-FA
SOIL AND LAND USE

ANNEX-FA SOIL AND LAND USE

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1. INTRODUCTION

This ANNEX-FA presents the results of soil and present land use survey carried out in the model areas selected in Xai, Beng and Hun districts.

Up to date, no comprehensive soil survey was carried out in the model areas, and specific information on soils of the areas is not available. A soil and land suitability survey was therefore carried out for the purpose of feasibility study on the agricultural development in the model areas. The survey was made at the semi-detailed level with a sampling intensity of one exploratory pit per 50 ha. Representative soil samples were selected for laboratory tests of relevant physical and chemical soil properties at the Soil Survey and Land Classification Centre in Vientiane.

The present land use in the model areas was surveyed and studied, using the topographic map of each model area on a scale of 1 to 5,000 which was prepared newly for this purpose.

The results of soil and land suitability classifications are also presented in this ANNEX.

2. SOIL SURVEY AND CLASSIFICATION

2.1 General

The soil survey at semi-detailed level was carried out in each model area, Xai, Beng and Hun. The location of each model area is summarized as follows :

Xai model area extends on both banks of the Nam Mao river, a tributary of the Nam Ko, and the National Road No.2 runs in the centre of the area. The area is located near Xai city, about 2 km south from the centre of the city. The area has approximately pear-shaped topography and extends within a flat to gentle sloping valley which is surrounded by hills. The approximate elevation is 650 m above sea level, and the gross area mapped is 685 ha.

Beng model area extends on a narrow valley which elongates along the National Road No.2 and on the left bank of the Nam Beng river. The area is located at administrative centre of Beng district and about 62 km south from Xai city. The approximate elevation is 530 m, and the gross area is 537 ha.

Hun model area is located at about 8 km west from Hun town and about 90 km south from Xai city. The area extends within a narrow valley surrounded by hills and has an approximate elevation of 470 m above sea level. The valley has irregular relief, varying from flat to gentle undulating slopes. The area is dissected by both the Nam Kham and Nam Ngat rivers that join at the centre of this area and flow into the Nam Beng. The total gross area is 685 ha.

Most of soil profiles at the exploratory pits was opened to a depth of 1.5 m. All the differential soil horizons in the open soil profiles were observed. The representative soil samples were tested at the laboratory in Vientiane, and the test items were soil particle size distribution, pH, electrical conductivity (EC), cation exchange capacity (CEC), exchangeable cations (Ca, Mg, K and Na), total nitrogen, total carbon and phosphorous. The results of laboratory tests are shown in Table FA-1. The soil classification is made on the basis of the Soil Taxonomy of the US Department of Agriculture, as presented below.

2.2 Soils in Xai Model Area

Soils in Xai model area originate in late Pleistocene. The soils are formed from mixed fine alluvium transported either by the main rivers or outwash from the nearby

mountains. The parent materials seem to be a mixture of acidic and basic igneous and metamorphic rocks.

2.2.1 Lithologic Characteristic of Soil Profile

Most of soil surface is free from rock materials, except for areas where large boulders are found at the soil surface. The soil profiles are generally deep, and the shallowest profile was 1.1 m deep. The shallow profile is limited by perched water table and/or gravel layer. The profiles are relatively uniform throughout the depth, and formed mainly of fine soil particles. The soil texture is mostly loamy and varies from sandy loam to clay. A hard pan at a depth from 20 to 30 cm is found in all over the lowland rice field.

2.2.2 Diagnostic Features for Soil Classification

The formation of both Argilic (Bt) and Cambic (Bw) sub-surface soil horizons is the essential features for classification of soil units in the corresponding order. Ochric epipedon, gleyzation and mottling are also diagnostic characteristics of soils in Xai model area.

2.2.3 Soil Moisture and Temperature Regime

Because of long dry season, most of soils in Xai model area have a Ustic soil moisture regime. Udic soil moisture regime is found in some exceptional areas where perched water table stays for long time within the soil moisture control section.

Since there are no data on soil temperature, the soil temperature regime in this area is considered to be hyperthermic on the basis of air temperature data.

2.2.4 Soil Classification in Higher Category

Based on the unique soil profile properties, the soils in Xai model area are classified as follows, mostly into the Inceptisol Order. Alfisol occurs in less extent, and very narrow strip of Entisol occurs along the Nam Mao.

Soil Order	Sub-order	Great group	Sub-Group
Inceptisol	Ochrept	Ustochrept	Udic Ustochrept
		Eutrochrept	Aquic Eutrochrept
Alfisol	Ustalf	Paleustalf	Aquic Pateustalf
Entisol	Fluvent		

(1) Udic Ustochrept

The Udic Ustochrept soils sub-group found in Xai model area are dark reddish brown soils with silt loam to fine sandy loam texture. The soils have low cation exchange capacity. The base saturation percentage is high, with Ca^{++} being the most large cation. The pH of soils varies from slightly acid to neutral. The soils are free from salinity and alkalinity problems. The organic matter content is medium in the surface Ap soil horizon, and low in the sub-surface horizons. The nitrogen content is low in all horizons. The phosphorous content varies from medium to low.

The soils have moderate permeability, and are moderately well-drained. There is no gravel or water table limitation down to a depth of 1.5 m.

The detailed description of a representative profile of Udic Ustochreptin Xai model area is shown in Table FA-2.

(2) Aquic Eutrochrept

The Aquic Eutrochrept soils in Xai model area have reddish brown surface layer and brownish gray sub-surface layer. The soil texture varies from silt loam to fine sandy loam. These soils have low cation exchange capacity, and the base saturation percentage is high, with Ca^{++} being largelly present cation. The pH varies from slightly acidic to neutral. The soils are free from salinity and alkalinity problems. The organic matter and nitrogen contents are low in all soil layers. The soil permeability is low, and the soils have imperfect internal drainage in the sub-surface horizons below 60 cm in depth. During the dry season, the ground water table is at a depth between 110 and 150 cm from the soil surface.

The detailed description of a representative profile of Aquic Eutrochrept in Xai model area is presented in Table FA-3.

(3) Aquic Paleustalf

The aquic paleustalf soil sub-group in Xai model area is dark brown to reddish brown soils with loam to clay loam texture. The cation exchange capacity of these soils is medium, and the base saturation percentage is high,

with Ca^{++} being the most abundant cation. The soil pH varies from slightly acidic to moderately alkaline. The soils are free from salinity and alkalinity problems. The organic matter content is medium in the surface horizon, but low in the sub-surface horizons. The nitrogen content varies from low to very low.

The detailed description of a representative profile of Aquic Paleustalf in Xai area is shown in Table FA-4.

2.2.5 Soil Classification in Lower Category

The soils within a sub-group are further sub-divided according to physical and chemical properties that affect their use and management, as shown below. For classification of soils in Xai model area at Family and Series levels, the texture and structure class are taken as the most important properties, because of their effect on the water holding characteristics and rooting condition of the soils. The soil map of Xai model area is shown in Fig. FA-1.

Soil Sub-Group	Soil Family	Mapping Unit
Aquic Paleustalf	Fine, Mixed, Hyperthermic	XMA-1, XMA-1.1
Udic Ustochrept	Moderately fine, Mixed, Hyperthermic soils	XMA-2; XMA-3, XMA-7; XMA-8; NM-1; NM-2
Aquic Eutrochrept	Moderately fine, Mixed, Hyperthermic soils	XMA-4
Association of Udic Ustochrept and Aquic Eutrochrept	Association of Moderately fine, Mixed, Hyperthermic Udic Ustochrept and Aquic Eutrochrept	XMA-5; XMA-6
Fluvent	---	NM-3

The XMA-1 soil unit is the member soil of fine, mixed, hyperthermic family of Aquic Paleustalf. The soil is deep with clay loam texture. The physical characteristics of the soil are good. The natural soil fertility is medium.

XMA-2, XMA-3, XMA-7, and XMA-8 are members of moderately fine, mixed, hyperthermic family of Udic Ustochrept. These soils vary from moderately deep to deep profiles, and the general physical condition is good to moderately good. The natural fertility is low.

XMA-4 soil unit is the member of moderately fine, mixed, hyperthermic family of Aquic Eutrochrept. The soil permeability is slow, and the the soil presents poor rooting condition for upland crops.

2.3 Soils in Beng Model Area

Soils in Beng model area originate in the late Pleistocene. The soils are formed from mixed fine alluvium. The parent materials from which those alluvium derived seem to be a mixture of acidic and basic igneous and metamorphic rocks.

2.3.1 Lithologic Characteristic of Soil Profiles

All the soil surface is free from rock material. The soil profiles have at least 150 cm depth without major physical constraints. The soil profiles are formed mainly of fine soil particles. The soil texture varies from sandy loam to clay. A hard plow pan at approximately depth between 20 to 30 cm is found in all over rice field, but in some cases it is thin and not very hard.

2.3.2 Diagnostic Features for Soil Classification

In all soil profiles, the Argilic (Bt) sub-surface soil horizon is present, and is the essential feature for classifying the soil units in the corresponding Order. Ochric epipedon, gleyzation and mottling are also diagnostic characteristics presented in soils of Beng model area.

2.3.3 Soil Moisture and Temperature Regimes

Because of long dry season, most of the soils in Beng model area have a Ustic soil moisture regime. The soils are dry up to a depth of about 60 cm from the surface, and generally wet from the depth of 60 cm down.

Since there are no data on the soil temperature in this area, the soil temperature regime is considered to be hyperthermic, based on the air temperature data.

2.3.4 Soil Classification in Higher Category

Based on the unique soil profiles features, the soils in Beng model area are classified into Order, Sub-Order, Great Group, and Sub-Group, as follows:

Soil Order	Sub-Order	Great Group	Sub-Group
Alfisol	Ustalf	Haplustalf	Aquic Haplustalf
Alfisol	Ustalf	Paleustalf	Typic Paleustalf Aquic Paleustalf
Inceptisol	Tropept	Ustropept	Typic Ustropept

(1) Aquic Haplustalf

Aquic Haplustalf soils found in Beng model area are grayish brown soils with clay texture. The soils have high cation exchange capacity and high base saturation percentage with Ca^{++} being the most abundant cation. The soil pH is moderately alkaline. The soils are free from salinity and alkalinity problems. The organic matter content is medium in the surface horizon, and low in the sub-surface horizons. Nitrogen content is low in all horizons.

The detailed description of a representative profile of Aquic Haplustalf found in Beng model area is presented in Table FA-5.

(2) Aquic Paleustalf

Aquic Paleustalf soils in Beng model area are deep with reddish brown color. The texture is sandy clay loam. The cation exchange capacity is low, and the base saturation percentage is high with Ca^{++} being the most abundant cation. The pH ranges from slightly acidic to moderately alkaline.

The soil permeability is slow, and the internal drainage is imperfect. The water table is at about 150 cm depth during the dry season.

The description of a representative soil profile of Aquic Paleustalf is shown in Table FA-6.

(3) Typic Paleustalf

The Typic Paleustalf soils in Beng model area are deep with reddish brown. The soil texture varies from sandy loam in the surface to sandy clay loam in sub-surface B1 horizon. The cation exchange capacity is low, and the base saturation percentage is high. The pH is medium acidic in the surface horizon and mildly alkaline in the sub-surface horizons. There is no salinity or alkalinity problems in these soils. The organic matter content is low. The

soils have moderately well permeability with moderately well internal drainage.

The description of a representative soil profile of Typic Paleustalf is shown in Table FA-7.

2.3.5 Soil Classification in Lower Category

The soils within a sub-group are further sub-divided into family and series, according to the physical and chemical properties that affect their potential use and management requirement, as shown below. In classification of soils in Beng model area at family and series levels, the textural and structural classes were taken as the most important properties, because of their effect on the water holding characteristics and rooting condition of the soils. Soil map of Beng model area is shown in Fig. FA-2.

Soil Sub-Group	Soil Family	Mapping Unit
Aquic Haplustalf	Fine, Mixed, Hyperthermic soils	BMA-1, BMA-2, BMA-7
Association of Aquic Haplustalf and Paleustalf	Moderately fine, Mixed, Hyperthermic soils	BMA-3; BMA-5, BMA-6
Aquic Paleustalf	Moderately fine, Mixed, Hyperthermic soils	BMA-8
Typic Paleustalf	Moderately fine, Mixed, Hyperthermic soil	BMA-9
Typic Ustropept	Mixed, Hyperthermic soils	BMA-4

2.4 Soils in Hun Model Area

Soils in Hun model area are considered to be of the Pleistocene age. The soils are formed from fine alluvium.

2.4.1 Lithological Characteristic of Soil Profiles

The soil surface is mostly free from large size rock materials. The profiles are moderately deep. The shallowest profile was 120 cm depth. The soil texture is mostly from loam to clay loam. The pedon are very hard when dry, and firm when wet. A very hard plow pan is found at approximately 20 to 30 cm depth.

2.4.2 Diagnostic Features for Soil Classification

The formation of Argillic (Bt) horizon is the essential feature for classifying the soils in higher categories. Plinthite and mottling are also diagnostic characteristics presented in soils of Hun model area.

2.4.3 Soil Moisture and Temperature Regime

Because the soil moisture control section is in dry condition for several months every year, the soil moisture regime is considered to be Ustic. The soil temperature is assumed to be similar to that of Xai soils with hyperthermic soil temperature regime.

2.4.4 Soil Classification in Higher Category

Based on the unique soil profiles features, the soils in Hun model area are classified as follows:

Soil Order	Sub-Order	Great Group	Sub-Group
Alfisol	Ustalf	Haplustalf Plinthustalf	Vertic Haplustalf (no subgroup)
Inceptisol	Tropept	Ustropept	Vertic Ustropept
Entisol	Fluvent	---	(no subgroup)

(1) Vertic Haplustalf

Vertic Haplustalf found in Hun model area is relatively deep soil with reddish brown color, and clay loam to clay texture. A very hard plow pan at a depth from 20 to 30 cm is found in all over the lowland rice field. The cation exchange capacity is medium, with Ca^{++} being the predominant cation. The pH varies from neutral to moderately alkaline. There are no salinity or alkalinity problems. The organic matter content is medium in the surface Ap horizon, and low in the sub-surface soil horizons. The nitrogen content is low in all horizons.

The soils have moderate permeability and moderately well internal drainage. There is no physical limitation up to a depth of 150 cm.

The description of a representative profile of Vertic Haplustalf in Hun model area is shown in Table FA-8.

(2) Plinthustalf

The Plinthustalf soils great group found in Hun model area are grayish soils with loam to clay loam texture. A hard plow pan is found at 20 to 30 cm depth. The soils have moderate permeability. The cation exchange capacity is medium, and the base saturation percentage is high with Ca^{++} being the most abundant cation. The soil pH varies from neutral to moderately alkaline. The soils are free from alkalinity and salinity problems. The organic matter content is medium in the surface Ap horizon, and is low in the sub-surface horizons. The nitrogen content is very low.

The description of a representative profile of Plinthustalf is shown in Table FA-9.

2.4.5 Soil Classification in Lower Category

The soils within a sub-group are further sub-divided into family and series, according to the physical and chemical properties that affect their potential use and management requirement, as follows: In classifying the soils in Hun model area at family and series levels, the textural and structural classes are taken as the most important properties, because of their effect on the water holding characteristics and rooting condition of the soils. Soil map of Hun model area is shown in Fig. Fig. FA-3.

Soil Sub-Group	Soil Family	Mapping Unit
Vertic Haplustalf	Fine, Mixed, Hyperthermic soils	HMA-1, HMA-2, HMA-4, HMA-5, HMA-6
Plinthustalf	Moderately fine, Mixed, Hyperthermic soils	BHMA-9
Vertic Ustropept	Moderately fine, Mixed, Hyperthermic soils	HMA-3, HMA-7, HMA-8, HMA-10, NK-2
Fluvent*	_	HMA-11, NK-1

* No classified in lower category

3. LAND SUITABILITY CLASSIFICATION

3.1 Basis for Land Classification

3.1.1 Structure of Land Suitability Classification

The land suitability classification is made, based on the principles and concepts of FAO's Framework for Land Evaluation. The FAO's categories for suitability classification are:

(1) Order: which indicates the kind of Suitability. There are two orders, Suitable (S) and Not Suitable (N). Conditionally Suitable (Sc) is a phase of the Suitable order ;

(2) Class: which indicates degree of suitability, such as Highly Suitable (S1), Moderately Suitable (S2) and Marginally Suitable (S3);

(3) Sub-class: which indicates kinds of limitations, such as soil depth, rooting condition, soil moisture, erosion and degradation hazard, etc.; and

(4) Unit: which indicates the productivity characteristics of the land or the management requirements for any specified use.

The structure of land suitability classification based on the FAO Framework is summarized as follows :

Order	Class	Sub-class	Unit
Suitable S	Highly Suitable S1	(no sub-class)	
	Moderately Suitable S2	S2 e, S2 m	S2 e 1, S2 e 2
	Marginally Suitable S3	S3 e, S3 m	
Not Suitable N	Current Not Suitable N1	N1 e, N1 m	
	Permanent Not Suitable N2		

3.1.2 Definitions of Land Class according to FAO Framework

Highly Suitable (S1) are the lands having no significant limitations for sustained use or only minor limitations that will not reduce productivity or benefits significantly and, will not increase the use of farm inputs more than acceptable levels.

Moderately Suitable (S2) are the lands having moderately severe limitations for a sustainable use. Limitations may reduce productivity or benefits, and increase farm input requirements to the extent that the overall advantage to be gained from the use, although still attractive, will be appreciably inferior than the expected on class S1 lands.

Marginally Suitable (S3) are the lands having limitations which, in aggregate, are severe for sustained application of a given use. The use of S3 class lands will yield low productivity or benefits, or increase required inputs, making it only marginally justifiable.

Currently Not Suitable N1 are the lands having limitations which may be surmountable in time, but which cannot be corrected with existing knowledge at currently acceptable cost. The limitations are so severe as to preclude successful sustained use of the lands in the given manner.

Permanently Not Suitable N2 are the lands having limitations which are very severe to preclude any possibility of successful sustained use.

3.1.3 Land Classification Criteria

The land suitability classification is made at semi-detailed level. The assumptions made for the suitability classification for Xai model area are that the land use is for irrigated annual crops, mainly rice. Two harvests might be obtained per year in areas where irrigation water could be supplied during the dry season. In these lands where the soils have good moisture retention characteristics, second crops can be cultivated even under dry farming condition, if land and crop management practices were improved.

The class determining factors taken into consideration for suitability rating are land slope, soil depth, texture, rooting condition, and soil moisture characteristic, as shown below.

Land suitability classification criteria

Diagnostic factors	Unit	S 1	S2	S3	N
Land slope	%	< 3	3 to 6	6 to 9	> 12
Soil depth	m	>1.5	1 to 1.5	0.5 to 1	> 0.5
Texture	class	Loamy	Loamy	Clayey	Sandy
Rooting Condition	class	Very good	Good	Poor	Very poor

3.2 Proposed Land Utilization Types

3.2.1 Proposed Land Utilization Types in Xai Model Area

The land utilization types (LUT) to be considered in this suitability classification are:

LUT-1, one irrigated rice crop during the rainy season, and one irrigated upland crop during the dry season;

LUT-2, two irrigated rice crops per year; and

LUT-3, two irrigated upland crops per year.

These land utilization types are proposed for the land suitability classification of Xai model area shown below.

Mapping Land Unit	Area (ha)	One Rice Crop and One Upland Crop per Year (LUT-1)	Two Rice Crop per Year (LUT-2)	Two Upland Crops per Year (LUT-3)
XMA-1	131.0	S1	S1	S1
XMA-1.1	9.6	S2	S2	S2
XMA-2	19.6	S3	S2	S3
XMA-3	46.8	S1	S1	S1
XMA-4	96.3	S3	S2	N1
XMA-5	52.1	S3	S3	S3
XMA-6	95.0	S3	S3	S3
XMA-7	58.8	S2	S2	S2
XMA-8	42.0	S2	S2	S2
NM-1	6.0	S3	S3	S2
NM-2	24.0	S3	S3	S3
NM-3	62.8	N1	N1	N1
BUA*	40.8	N2 (Built-up area)	N2	N2
TOTAL	684.8			

*Homestead, Road, Airport, etc. The area is of mapping area.

The land unit XMA-1 presents minimum limitations for the different land utilization types considered here. The soils are highly suitable for both rice and irrigated upland crops. The mapping unit XMA-1.1 has soil properties similar to those of XMA-1; the difference is the concave micro relive of XMA-1.1 unit. The XMA-2 soil unit is moderately suitable for rice cultivation, and marginally suitable for upland crops; its limitation for upland cultivation is because of the soil hardness when it is under dry condition.

XMA-3 land unit is highly suitable for the different proposed land utilization types, namely rice field and upland cultivation. The XMA-4 unit is moderately suitable for rice

cultivation, but not suitable for upland crops, because of its poor structure and low permeability. XMA-5 unit is marginally suitable for both rice and upland crops cultivation. It has large rock in some parts of the land surface. XM-6 is considered here as marginally suitable for rice cultivation, and it is moderately suitable for upland crops cultivation. XMA-7 and-8 are moderately suitable for both rice and upland crops cultivation. The unit NM-3 is the land along the Nam Mao river, and this area is not suitable for cultivation because of coarse sandy soils.

The land utilization types of Xai model area is shown in Fig. FA-1..

3.2.2 Proposed Land Utilization Types in Beng Model Area

The land categories, the classification criteria, class determining factors, and proposed land utilization types of Beng model area are as shown below.

Mapping Land Unit	Area (ha)	One Rice Crop and One Upland Crop per Year (LUT-1)	Two Rice Crop per Year (LUT-2)	Two Upland Crops per Year (LUT-3)
BMA-1	166.9	S2	S1	S3
BMA-2	23.3	S2	S1	S3
BMA-3	49.3	S3	S3	S3
BMA-4	52.5	N1	N1	N1
BMA-5	14.9	S3	S3	S3
BMA-6	22.7	S3	N1	S3
BMA-7	60.2	S2	S2	S2
BMA-8	31.6	S3	S2	S3
BMA-9	105.1	S1	S2	S1
BUA	10.0	N2 (Built up Area)	N2	N2
Total	536.5			

Note: The area is of mapping areas.

The land units BMA-1 and BMA-2 are highly suitable for rice cultivation, and because of their clayey soil texture, these units are also marginally suitable for upland crops cultivation.

BMA-3, BMA-5 and 6 land units are marginally suitable for upland crops cultivation, and not suitable for rice. The land unit BMA-4 is not suitable for neither irrigated rice nor upland crops cultivation because of the topographic conditions and shallow soil layer.

The land unit BMA-7 is moderately suitable for both rice and upland crops cultivation. The land unit BMA-8 is moderately suitable for rice, and marginally suitable for upland crops.

The land unit BMA-9 is highly suitable for upland crops cultivation, and moderately suitable for rice cultivation.

The land utilization types of Beng model area is shown in Fig. FA-2.

3.2.3 Proposed Land Utilization Types in Hun Model Area

The land categories, the classification criteria, class determining factors, and proposed land utilization types for land suitability classification are the same as those defined for Xai model area. They are as follows:

Mapping Land Unit	Area (ha)	One Rice Crop and One Upland Crop per Year (LUT-1)	Two Rice Crop per Year (LUT-2)	Two Upland Crops per Year (LUT-3)
HMA-1	68.8	S2	S1	S3
HMA-2	17.5	S3	S3	S3
HMA-3	73.5	N1	N1	N1
BMA-4*	20.8	S2	S2	S3
BMA-5*	88.8	S3	S3	S3
BMA-6	137.0	S2	S1	S3
HMA-7	21.2	S3	S3	S3
HMA-8	48.3	S3	S3	S3
HMA-9	86.2	S2	S1	S3
HMA-10	41.3	N1	N1	S3
HMA-11	16.6	S3	S3	S3
NK-1	41.6	N1	N1	N1
NK-2	24.0	S3	S3	S3
Total	685.6			

*BMA-4 includes 12.5 ha of homestead and yards; BMA-5 includes 12.3 ha of homestead and yards area. The area is of mapping area.

Because of the clayey soil texture and the hard soil consistence even under wet soil condition, the lands in Hun model area are marginally suitable for upland crop cultivation, and best suited for rice. Relief condition is the main limiting factor for the use of lands under irrigated condition in Hun model area.

The land utilization types of Hung model area is shown in Fig. FA-3.

4. PRESENT LAND USE IN MODEL AREAS

The present land use in each model area is estimated on the basis of topographic maps (scale 1: 5,000), and aerial photo interpretation and field check survey. The present land use in each model area is shown in Fig. FA-4, FA-5, FA-6, and summarized as follows:

Land Use	Xai		Beng		Hun	
	(ha)	(%)	(ha)	(%)	(ha)	(%)
Lowland Rice Field	387.3	56.6	290.9	54.2	263.6	38.5
Upland Field*	18.1	2.6	34.6	6.5	69.7	10.2
Trees/Bush/Grass	191.2	27.9	196.6	36.6	319.3	46.6
Fish Pond	3.0	0.4	-	-	0.5	0.1
Others **	85.2	12.5	14.4	2.7	32.5	4.6
Total	684.8	100.0	536.5	100.0	685.6	100.0

Note * includes upland rice by slash-and-burn, bananas, vegetable, tobacco, etc.
** includes homestead and yards, roads and path way, airport and river courses.
The area is mapping area of each model area.

The agricultural land in the model areas is currently used at very low intensity. Only one time of harvest is made annually in almost the entire model areas. Most of the land is left fallow and used for livestock grazing during the dry season, except for very limited areas where vegetable is grown.

REFERENCES

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2. FAO, 1976, A Framework for Land Evaluation, Soil bulletin 32.

3. FAO, 1983, Guidelines: Land Evaluation for Rainfed Agriculture, Soil bulletin 52.

4. FAOFAO, Guidelines: Land Evaluation for Irrigated Agriculture, Soil bulletin.

5. FAO, Guidelines for Soil Profile Description.

6. US Department of Agriculture, 1951, Soil Survey Manual, Handbook 18.

Table

Table FA - 1 Laboratory Test Result for Soil of Model Area

Soil Sample	Depth (cm)	Particle Size (%) Sand	Silt	Clay	Texture	pH	EC (mmhos/cm)	CEC (meq/100g)	Exchangeable Cations (meq/100 g) Ca	Mg	K	Na	O. C. (%)	O. M. (%)	N (%)	C/N	P2 O5 (ppm) Total	Avail.
Xai Model Area																		
1 NM 1	0-30	30	51	19	SiL	6.2	0.068	13.51	8.20	2.00	0.17	0.26	1.70	2.91	0.11	15	640	35.3
2 NM 1	30-60	42	36	22	L	7.0	0.288	12.41	7.80	2.80	0.15	0.29	0.80	1.38	0.06	14	530	26.1
3 NM 3	0-30	51	29	20	SL	5.9	0.058	14.04	7.90	2.10	0.13	0.27	1.00	1.64	0.11	8	620	2.2
4 NM 3	30-60	81	15	4	LS	6.8	0.029	9.86	6.70	1.30	0.08	0.26	0.80	1.38	0.07	11	480	17.3
5 NM 5	0-20	65	28	7	SL	5.5	0.033	10.44	5.30	1.10	0.09	0.22	1.20	2.03	0.11	11	390	17.3
6 NM 5	20-50	82	13	5	LS	7.0	0.033	6.58	4.30	1.10	0.07	0.19	0.60	1.09	0.06	11	340	15.8
7 NM 6	0-25	48	32	20	L	6.1	0.061	15.34	8.90	2.40	0.18	0.23	1.30	2.31	0.13	11	1,080	38.0
8 NM 6	25-70	53	30	17	SL	7.2	0.043	13.09	9.80	1.70	0.14	0.23	0.80	1.45	0.07	12	690	26.1
9 NM 8	0-20	70	23	7	SL	5.6	0.031	5.59	1.70	0.40	0.06	0.06	1.50	2.53	0.11	13	340	25.0
10 NM 8	20-60	65	23	12	SL	7.2	0.044	8.17	3.60	2.00	0.08	0.10	0.40	0.72	0.03	12	340	20.8
11 NM 10	0-20	65	26	9	SL	7.0	0.034	9.74	6.70	1.30	0.12	0.25	0.40	0.72	0.04	10	370	22.2
12 NM 10	20-60	51	39	10	L	5.4	0.023	9.03	3.80	0.70	0.09	0.10	1.60	2.72	0.17	9	390	17.3
13 NM 13	0-15	32	43	25	L	5.7	0.037	15.19	7.70	2.30	0.22	0.29	1.90	3.26	0.13	15	460	26.1
14 NM 13	15-50	36	41	23	L	7.3	0.055	14.84	11.50	2.10	0.17	0.30	0.80	1.45	0.08	10	340	25.0
15 NM 14	0-25	39	33	28	L	6.1	0.063	14.56	9.20	2.10	0.22	0.32	1.70	2.91	0.16	11	440	28.9
16 NM 14	25-60	46	23	31	SCL	8.0	0.068	16.38	10.20	5.30	0.13	0.29	0.60	1.09	0.06	11	340	30.0
17 NM 16	0-25	30	40	30	CL	6.3	0.072	16.67	11.80	1.90	0.22	0.33	1.60	2.72	0.13	13	530	38.0
18 NM 16	25-60	30	30	40	C	7.7	0.055	15.99	12.40	2.30	0.16	0.36	0.80	1.31	0.08	9	460	30.0
19 NH 1	0-20	30	32	38	CL	7.7	0.139	25.94	21.30	2.70	0.30	0.41	1.90	3.26	0.13	15	460	39.2
20 NH 1	20-50	36	29	35	CL	7.4	0.139	22.05	18.10	2.60	0.25	0.33	1.00	1.74	0.07	14	370	28.9
Beng Model Area																		
21 NB 1	0-25	22	33	45	C	8.1	0.260	30.83	23.00	5.00	0.41	0.37	2.02	3.48	0.13	15	410	40.6
22 NB 1	25-60	25	25	50	C	8.1	0.186	35.24	30.00	3.90	0.31	0.38	0.95	1.64	0.08	11	370	32.8
23 NB 1	60-120	17	28	55	C	8.2	0.186	41.93	36.00	3.80	0.19	0.47	0.63	1.15	0.06	12	250	30.0
24 NB 2	0-20	42	41	17	L	6.2	0.054	15.20	9.40	2.40	0.19	0.18	1.61	2.76	0.13	13	320	26.1
25 NB 2	20-50	38	31	31	CL	8.0	0.093	16.78	13.00	2.50	0.22	0.24	0.71	1.22	0.07	10	280	17.3
26 NB 4	0-25	52	37	11	SL	5.9	0.031	12.12	6.50	1.80	0.16	0.12	1.64	2.83	0.11	15	340	17.3
27 NB 4	25-60	50	23	27	SC	7.5	0.043	11.62	9.40	1.30	0.12	0.18	0.84	1.45	0.10	9	230	14.4
28 NB 6	0-20	46	33	21	L	5.9	0.036	11.92	6.90	1.10	0.12	0.13	1.47	2.53	0.11	13	370	39.2
29 NB 6	20-60	30	34	36	CL	8.0	0.042	13.64	11.00	1.80	0.12	0.21	0.84	1.45	0.06	13	340	34.1
30 NB 8	0-20	47	32	21	L	5.6	0.032	10.38	6.00	1.10	0.10	0.12	2.02	3.48	0.15	14	340	31.4
31 NB 8	20-60	27	32	41	C	8.1	0.087	17.71	15.00	2.00	0.14	0.16	0.84	1.45	0.06	14	370	32.8
32 NB 9	0-25	62	17	21	SCL	6.2	0.036	9.43	5.20	1.20	0.08	0.22	1.26	2.17	0.08	15	440	39.2
33 NB 9	25-60	47	27	26	SCL	6.5	0.037	11.43	8.30	1.10	0.09	0.27	0.63	1.09	0.06	10	410	28.9
34 NB 11	0-25	58	22	20	SL	5.6	0.051	7.26	8.10	0.90	0.07	0.14	1.26	2.17	0.11	11	370	39.2
35 NB 11	25-60	51	20	29	SCL	7.3	0.037	10.32	8.40	0.80	0.09	0.26	0.34	0.59	0.03	10	330	34.0
36 NB 12	0-20	56	30	14	SL	5.8	0.051	15.50	9.20	2.10	0.17	0.23	1.18	2.03	0.11	11	440	126.1
37 NB 12	20-60	59	22	19	SL	7.7	0.064	22.09	16.00	2.30	0.22	0.30	0.84	1.45	0.07	12	340	15.8
Hun Model Area																		
38 NK 2	0-25	35	41	24	L	6.8	0.260	30.83	23.00	5.00	0.41	0.37	2.02	3.48	0.13	15	410	40.6
39 NK 2	25-70	44	27	29	CL	7.0	0.186	35.24	30.00	3.90	0.31	0.38	0.95	1.64	0.08	11	370	32.8
40 NK 4	0-25	34	32	34	CL	7.2	0.186	41.93	36.00	3.80	0.19	0.47	0.63	1.15	0.06	12	250	30.0
41 NK 4	25-70	48	29	23	SCL	8.0	0.054	15.20	9.40	2.40	0.19	0.18	1.61	2.76	0.13	13	320	26.1
42 BS 2	0-30	27	29	44	C	8.0	0.093	16.78	13.00	2.50	0.22	0.24	0.71	1.22	0.07	10	280	17.3
43 BS 2	30-70	39	52	9	SiL	7.6	0.031	12.12	6.50	1.80	0.16	0.12	1.64	2.83	0.11	15	340	17.3
44 MH 1	0-20	37	43	20	L	7.0	0.043	11.62	9.40	1.30	0.12	0.18	0.84	1.45	0.10	9	230	14.4
45 MH 1	20-60	41	35	24	L	7.9	0.036	11.92	6.90	1.10	0.12	0.13	1.47	2.53	0.11	13	370	39.2
46 MH 1	60-80	35	35	30	CL	8.2	0.042	13.64	11.00	1.80	0.12	0.21	0.84	1.45	0.06	13	340	34.1
47 NV 1	0-35	18	49	33	SiCL	6.7	0.032	10.38	6.00	1.10	0.10	0.12	2.02	3.48	0.15	14	340	31.4
48 NV 1	35-70	26	28	46	C	7.4	0.087	17.71	15.00	2.00	0.14	0.16	0.84	1.45	0.06	14	370	32.8

Table FA-2 Description of representative Profile of Udic Ustochrept in Xai Model Area

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- Ap horizon (0 to 30 cm):
  Dark reddish brown, 5YR 4/4 when dry, and 5YR 3/4 when wet. Silt loam, without large soil particles in the horizon. Non sticky, non plastic. Very hard when dry, but friable when wet. Moderate sub-angular blocky structure. Common fine mottling. Many medium size pores, and many fine roots. Plow pan from 20 to 30 cm depth. Very dry soil layer. The soil pH is 6.2, and the cation exchange capacity is 13.5 milliequivalents per 100 grams of soil. The organic matter content is 2.9%.

- B1w horizon (30 to 60 cm):
  Dark reddish brown, 5YR 3/4 when dry and 5YR 3/3 when wet. Loam texture, without large size soil particles. Non sticky, non plastic. Very hard when dry, but friable when wet. Weak sub-angular blocky structure. Many medium size mottling. Medium size pores, few roots. Dry soil layer. The soil pH is 7.0, and the cation exchange capacity is 12.4 milliequivalents per 100 grams of soil. The organic matter content is 1.4 %.

- B2 horizon (60 to 110 cm):
  Dark reddish brown. Silt loam, without large size particles. Hard when dry, but friable when wet. Structureless; very few pores, no roots. Slightly wet layer. The soil pH is 7.2.

- B3 horizon (110 to 150 cm)
  Dark reddish brown. Silt loam, without large size particles. Many medium mottling. Very few fine pores, no roots. Wet soil layer.

Table FA-3 Description of Representative Profile of Aquic Eutrochrept in Xai Model Area

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- Ap horizon (0 to 25 cm):
  Reddish brown color, 5YR 5/4 when dry and 5YR 4/4 when wet. Silt loam, without large size particles in the horizon. Non sticky, non plastic. Very hard when dry, but friable when wet. Weak angular blocky structure. Common coarse prominent mottling. Few medium size pores, many fine roots. Plow pan from 18 to 25 cm depth. The pH is 6.9, and the cation exchange capacity is 14 milliequivalents per 100 grams of soil. The soil layer is very dry.

- B1w horizon (25 to 60 cm):
  Reddish brown 5YR 5/4 when dry and 5YR 5/6 when wet. Loam, without large size particles. Non sticky, non plastic. Hard when dry, but friable when wet. Structureless. Many coarse prominent mottling. Few fine pores, and few fine roots. Dry soil layer. The pH is 7.2, and the cation exchange capacity is 10 milliequivalents per 100 grams of soil.

- B2 horizon (60 to 110 cm):
  Grayish brown 7.5 YR 5/2 wet. Silt loam texture, with few iron concretions of about 3 cm in diameter. Friable when wet. Many coarse prominent mottling. Very few roots. The pH is 7.3. The layer is wet.

- B3g layer (110 cm):
  The ground water table is at 110 cm depth. The soil layer has gley condition. The color is brownish gray.

Table FA-4 Description of Representiative Profile of Aquic Paleustalf in Xai Model Area

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- Ap horizon (0 to 25 cm):
  Dark reddish brown 5YR 4/4 when dry, and 5YR 3/4 when wet. Clay loam, without large size particle. Non sticky, and non plastic. Very hard when dry, but friable when wet. Moderate angular blocky structure. Common fine mottling. Many small pores, and many fine roots. The soil pH is 6.3; the cation exchange capacity is 16.7 milliequivalents per 100 grams of soil. The organic matter content is 2.7%, and nitrogen content is low. The soil permeability is moderately slow, and the soil is moderately well drained. The horizon is very dry.

- B1t horizon (25 to 50 cm):
  Dark brown 7.5YR 4/4 when dry, and 7.5YR 3/4 when wet. Clay, without large size particles. Slightly sticky, non plastic. Very hard when dry, and firm when wet. Weak angular blocky structure. Common medium mottling. Few fine pores, and fine roots. Plow pan between 25 to 32 cm. The soil pH is 7.7, and the cation exchange capacity is 16 milliequivalents per 100 grams of soils. The organic matter content is 1.3%, and nitrogen content is very low. The horizon permeability is moderately slow, and it is moderately well drained. The horizon is dry.

- B2t horizon (50 to 100 cm):
  Grayish red 7.5YR 4/3 when dry, and 7.5YR 4/2 when wet. Clay loam, without large size particles. Slightly sticky, non plastic. Hard when dry, but friable when wet. Structureless. Many medium size prominent mottling. Few fine pores, and very few roots. The soil pH is 7.4, and the cation exchange capacity is 15 milliequivalents per 100 grams of soil. The horizon is wet.

- B3g horizon (100 to 150 cm):
  Grayish brown, 7.5YR 5/2 wet. Loam texture. Non sticky, non plastic. Structureless. Slightly hard when dry, and friable when wet. Many coarse prominent mottling; the layer is very wet and presents gley condition.

Table FA-5 Description of Representiative Profile of Aquic Haplustalf in Beng Model Area

The profile is located in Done Keo village, 300 m west from the National Road No.2.

- Ap (0 to 25 cm):
  Grayish brown 7.5YR 4/1 when wet and 7.5YR 5/2 dry. Clay texture, without large size particles. Slightly sticky, non plastic. Moderate, coarse angular blocky structure. Extremely hard when dry, very firm when wet. Fine pores, and many fine roots. Common reddish mottling. Very dry layer; clear smooth boundary with underlying horizon. The pH is 8.1; the cation exchange capacity is 30.8 milliequivalents per 100 grams of soil. The organic matter content is 3.5%.

- B1t (25 to 60 cm):
  Brown 10YR 4/1 when wet and 10YR 4/1 dry. Clay, without large size particles. Slightly sticky, slightly plastic. Moderate angular blocky structure. Very hard when dry, and very firm when wet. Fine pores, and few fine roots. Plow pan between 25 to 33 cm. Common yellowish mottling. Dry horizon, with clear smooth boundary with underlying horizon. The pH is 8.1, and the cation exchange capacity is 35.2 milliequivalents per 100 grams of soil. The organic matter content is 1.6%.

- B2t horizon (60 to 100 cm):
  Grayish brown 10YR 5/2 when wet and 10YR 5/2 dry. Clay loam texture. 3% of soil volume is covered by coarse particles of 2 to 3 cm in diameter. Slightly sticky, and slightly plastic. Structureless; very hard when dry, and firm when wet. Fine pores, and very few fine roots. Many, coarse yellowish mottling; wet horizon, with gradual boundary with underlying horizon. The pH is 8.2, and the cation exchange capacity is 41.9 milliequivalents per 100 grams of soil. The organic matter content is 1.15%.

- B3g horizon (100 to 150 cm):
  Brownish gray 10YR 5/1 when wet. Loam texture, with 5% of soil volume composed of large particles of 2 to 3 cm in diameter. Slightly sticky, non plastic. Structureless; hard when dry, but very friable when wet. Fine pores, none roots. Very wet layer; with gley condition.

Table FA-6 Description of Representative Profile of Aquic Paleustalf an Beng Model Area

The profile is located at Na Houay village, about 800 m west from the National Road No.2.

- Ap horizon (0 to 25 cm):
  reddish brown 2.5YR 4/4 when wet and 2.5YR 5/4 dry; Sandy Clay Loam, without large size particle. Non sticky, and non plastic. Moderate, medium sub-angular blocky structure. Slightly hard when dry, but very friable when wet. Many medium pores, and many fine roots. Common, medium, yellowish mottling. Dry layer, with clear smooth boundary with underlying horizon. The pH is 6.2, and cation exchange capacity is 9.4 milliequivalents per 100 grams of soil. The organic matter content is 2.17%.

- B1t horizon (25 to 60 cm):
  Reddish brown 2.5YR 5/3 when wet and 2.5YR 4/3 dry. Sandy Clay Loam, without large size particles. Non sticky, and non plastic. Moderate angular blocky structure. Soft when dry, and very friable when wet. Many medium size pores, and many fine roots. Thin, and no very hard plow pan between 25 to 28 cm. Many yellowish mottling. Slightly wet horizon, with clear, smooth boundary with underlying horizon. The pH is 6.5.

- B2 horizon (60 to 150 cm):
  Reddish brown 2.5YR 5/2 when wet. Sandy loam, without large size particles. Non sticky, and non plastic. Structureless; loose when wet. Many fine pores, and very few fine roots. Many, coarse yellowish mottling. Wet horizon, the water table is at 150 cm.

Table FA-7 Description of Representative Profile of Typic Paleustalf in Beng Model Area

The profile is located at mile post KM-70 along the National Road No.2.

- Ap horizon (0 to 25 cm):
  Reddish brown 2.5YR 5/4 when wet and 2.5YR 6/4 dry; Sandy Loam, without large size particles. Non sticky, and non plastic. Moderate, medium angular blocky structure. Very hard when dry, but friable when wet. Many medium pores, and many fine roots. Common, fine reddish mottling. Dry layer, of clear smooth boundary with underlying horizon. The pH is 5.6, and the cation exchange capacity is 7.3 milliequivalents per 100 grams of soil. The organic matter content is 2.17%.

- B1t horizon (25 to 60 cm):
  Reddish brown 5YR 4/5 when wet and 5YR 4/4 dry. Sandy Clay Loam, without large size particles. Slightly sticky, non plastic. Moderate angular blocky structure. Soft when dry, and very friable wet. Many medium size pores, fine roots. Thin, and not very hard plow pan between 25 to 30 cm. Few, fine yellowish mottling. Slightly wet horizon, of clear, smooth boundary with underlying horizon. The pH is 6.0, and the cation exchange capacity is 10.3 milliequivalents per 100 grams of soil. The organic matter content is 0.6%.

- B2 horizon (60 to 150 cm):
  Reddish brown 2.5YR 5/2 when wet. Sandy loam, without large size particles. Non sticky, and non plastic. Structureless; loose when wet. Many fine pores, and very few fine roots. Many, coarse yellowish mottling. Wet horizon, not water table up to 150 cm depth.

Table FA-8 Description of Representative Profile of vertic Haplustalf in Hun Model Area

The profile is located in Na Kham village, about 400 m south-west of the village.

- Ap horizon (0 to 25 cm):
  Reddish brown, 2.5YR 4/3 when wet, and 2.5YR 6/3 dry. Loam texture, without large size particles. Non sticky, and non plastic. Moderate, medium angular blocky structure. Extremely hard when dry, and firm when wet. Fine pores. Fine roots concentrated in the first 15 cm. Many medium, reddish mottling. Very dry layer; Clear smooth boundary with underlying horizon. The pH is 6.8, and the cation exchange capacity is 21.2 milliequivalents per 100 grams of soil. The base saturation percentage is high, being Ca^{++} the most abundant cation. The organic matter content is 3.3%.

- B1t horizon (25 to 70 cm):
  Reddish brown, 10YR 4/1 when wet, and 10YR 4/2 dry. Clay Loam texture, without large particles. Slightly sticky, and non plastic. Moderate angular blocky structure. Extremely hard when dry, and firm when wet. Many medium size pores, and many fine roots. Very hard plow pan from 25 to 30 cm depth. Many medium, yellowish mottling. Dry horizon, with Clear smooth boundary with underlying horizon. The pH is 7.0, and the cation exchange capacity is 18.9 milliequivalents per 100 grams of soil. The organic matter content is 1.1%.

- B2 horizon (70 to 150 cm):
  Reddish brown, 10YR 5/2 when wet, and 10YR 5/3 dry. Clay loam, without large size particles. Slightly sticky, and non plastic. Structureless; Very hard when dry, and firm when wet. Few fine pores, and very few fine roots. Many medium, yellowish mottling. Slightly wet layer.

Table FA-9 Description of Representative Profile of Plinthustalf in Hun Model Area

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- Ap horizon (0 to 20 cm):
  Grayish brown, 10YR 4/2 when wet and 10YR 5/3 dry. Loam texture, without large size particles. Non sticky, and non plastic. Moderate, medium sub angular blocky structure. Very hard when dry, and firm when wet. Many medium pores, and many medium roots. Many medium, reddish mottling. Very dry layer; Clear smooth boundary with underlying horizon. The pH is 7.0; and the cation exchange capacity is 20.5 milliequivalents per 100 grams of soil. The base saturation percentage is high, with Ca^{++} being the most abundant cation. The organic matter content is 3.3%.

- B1t horizon (20 to 60 cm):
  Grayish red, 2.5YR 4/2 when wet, and 2.5YR 4/3 dry. Loam texture, with 1% of volume occupied by large particles of about 2 cm in diameter. Non sticky, and non plastic. Moderate angular blocky structure. Very hard when dry, and firm when wet. Many medium size pores, and fine roots. Hard Plow pan between 20 to 30 cm. Common medium size reddish mottling. Dry horizon, of Clear, smooth boundary with underlying horizon. The pH is 7.9, and the cation exchange capacity is 15 milliequivalent per 100 grams of soil. The organic matter content is 1.5%.

- B2t horizon (60 to 80 cm):
  Grayish red, 2.5YR 5/2 when wet; and 2.5YR 5/4 dry. Clay loam texture, with many large particles of about 2 to 4 cm in diameter (approximately 60 % of soil volume). The large particles are of iron oxide concretions (Plinthite). Slightly sticky, and non plastic. Structureless; Very hard when dry, and firm when wet. Few fine pores, and very few fine roots. Many, coarse reddish mottling. Slightly wet layer. The pH is 8.2; and the cation exchange capacity is 20.5 milliequivalents per 100 grams of soil. The organic matter content is 0.7%.

- B3 horizon (80 to 120 cm):
  Grayish red, 2.5YR 4/2 wet; and 2.5YR 5/3 dry. Sandy Loam texture. Many large particles of about 4 cm in diameter, composed of iron concretion and gravel. Non sticky, and non plastic. Structureless, hard when dry, and firm when wet. Many coarse reddish mottling; wet layer.

Figure

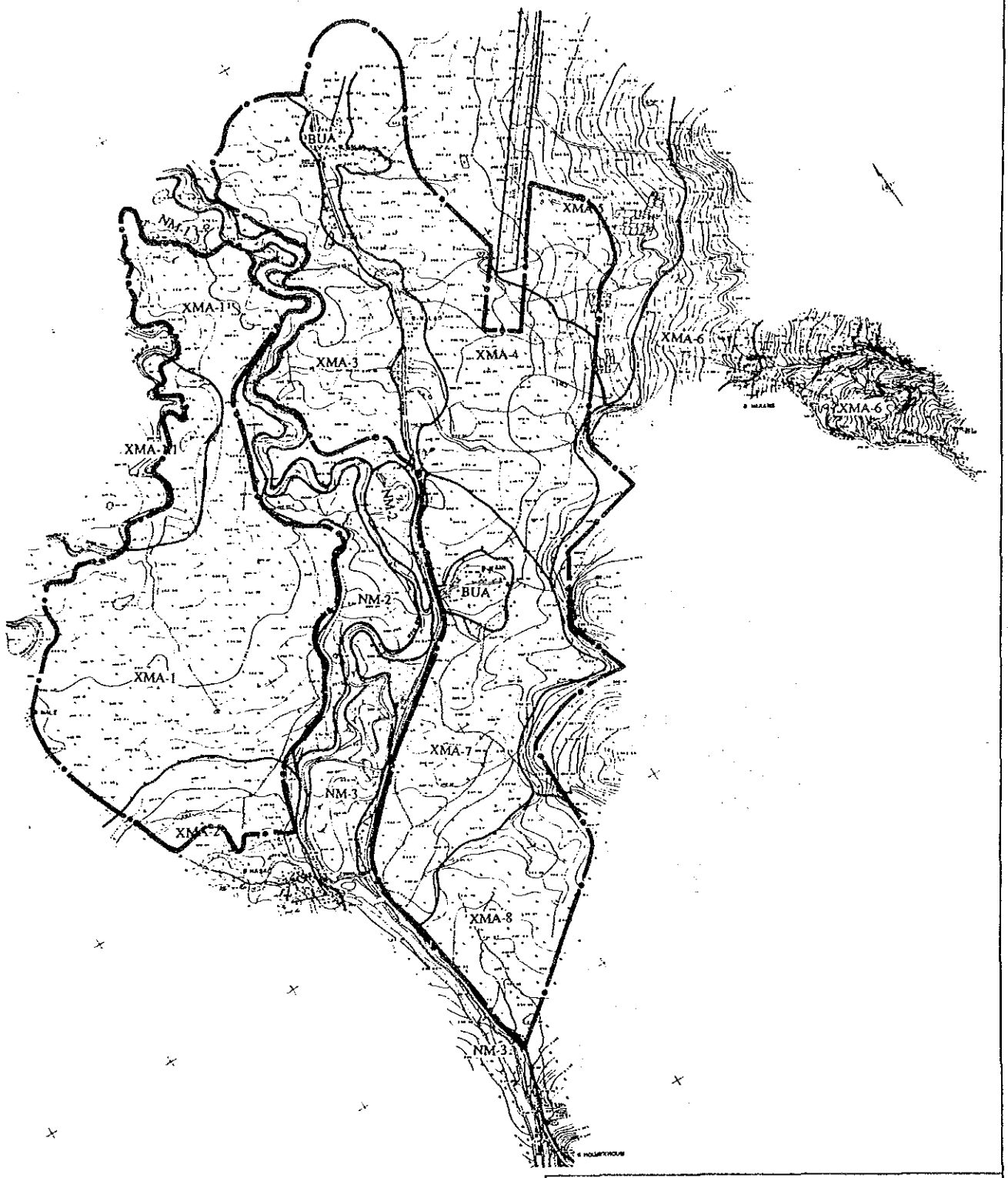

Fig. FA-1 Mapping Land Unit in Xai Model Area

THE LAO PEOPLE'S DEMOCRATIC REPUBLIC MINISTRY OF AGRICULTURE AND FORESTRY
AGRICULTURAL DEVELOPMENT PROJECT TO CONTROL SLASH AND BURN CULTIVATION IN OUDOMXAY PROVINCE
NIPPON KOEI CO., LTD. CONSTRUCTION PROJECT CONSULTANTS, INC.

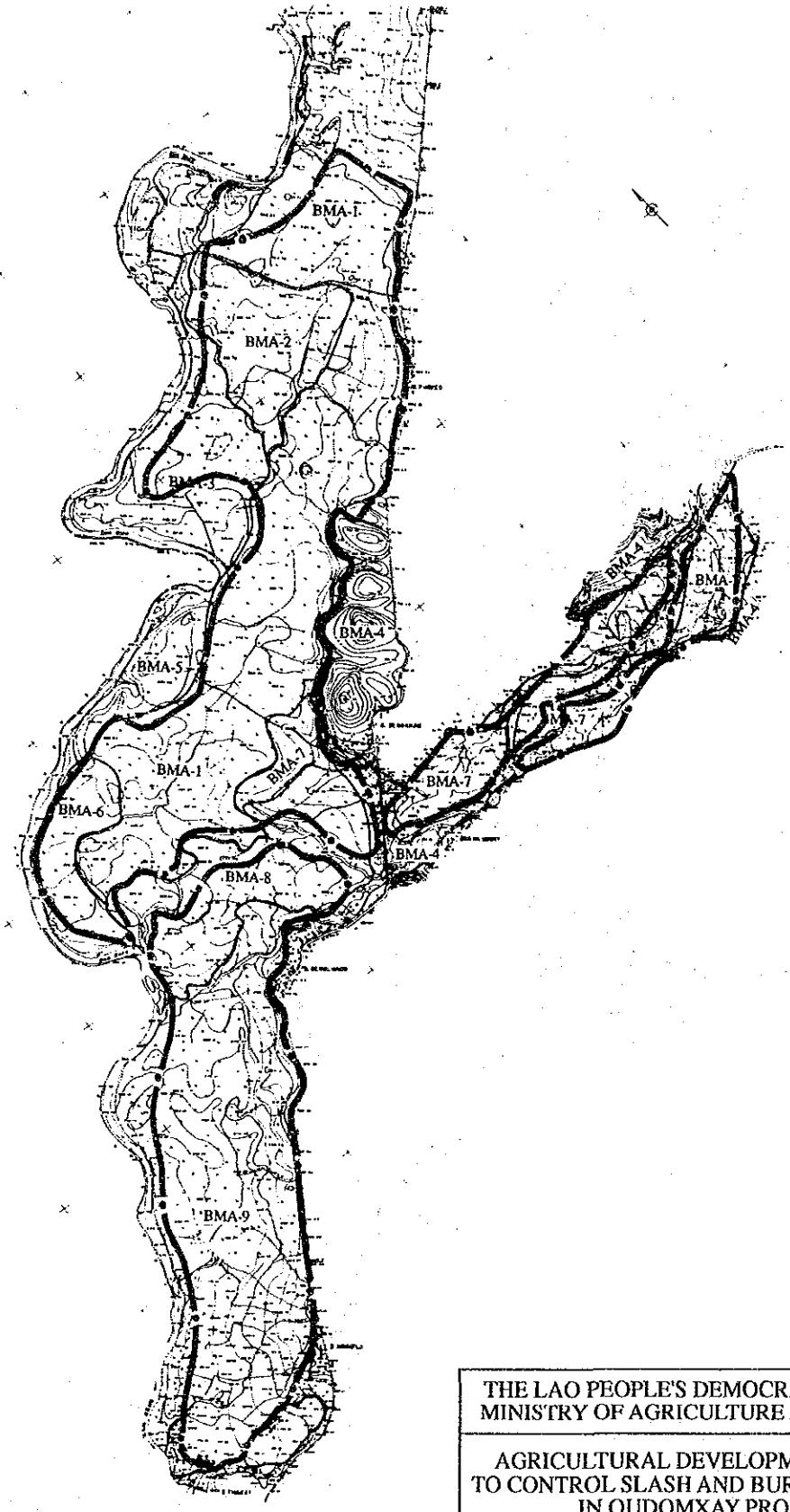

Fig. FA-2 Mapping Land Unit in Beng Model Area

THE LAO PEOPLE'S DEMOCRATIC REPUBLIC MINISTRY OF AGRICULTURE AND FORESTRY
AGRICULTURAL DEVELOPMENT PROJECT TO CONTROL SLASH AND BURN CULTIVATION IN OUDOMXAY PROVINCE
NIPPON KOEI CO., LTD. CONSTRUCTION PROJECT CONSULTANTS, INC.

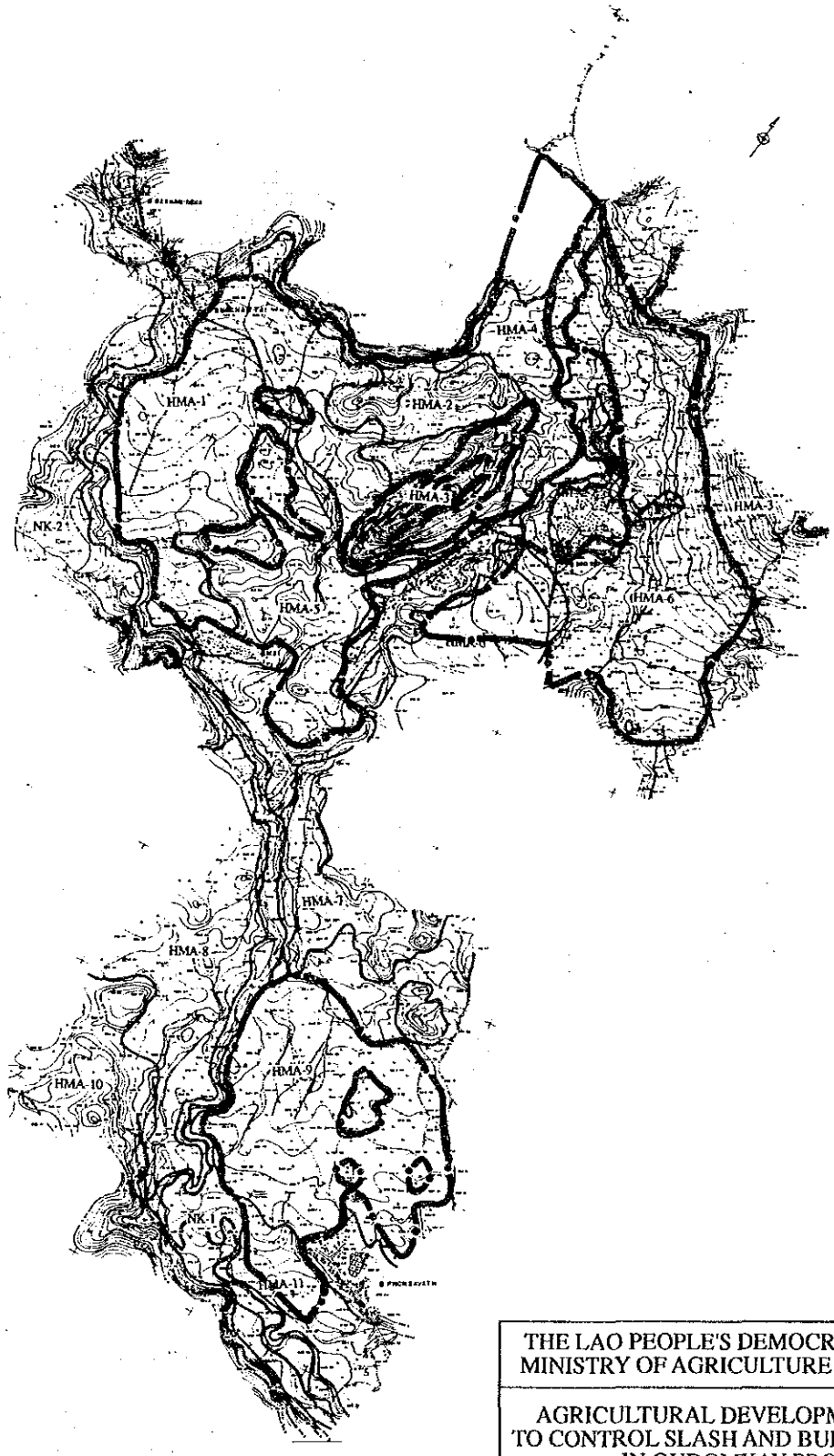

Fig. FA-3 Mapping Land Unit in Hun Model Area

THE LAO PEOPLE'S DEMOCRATIC REPUBLIC MINISTRY OF AGRICULTURE AND FORESTRY
AGRICULTURAL DEVELOPMENT PROJECT TO CONTROL SLASH AND BURN CULTIVATION IN OUDOMXAY PROVINCE
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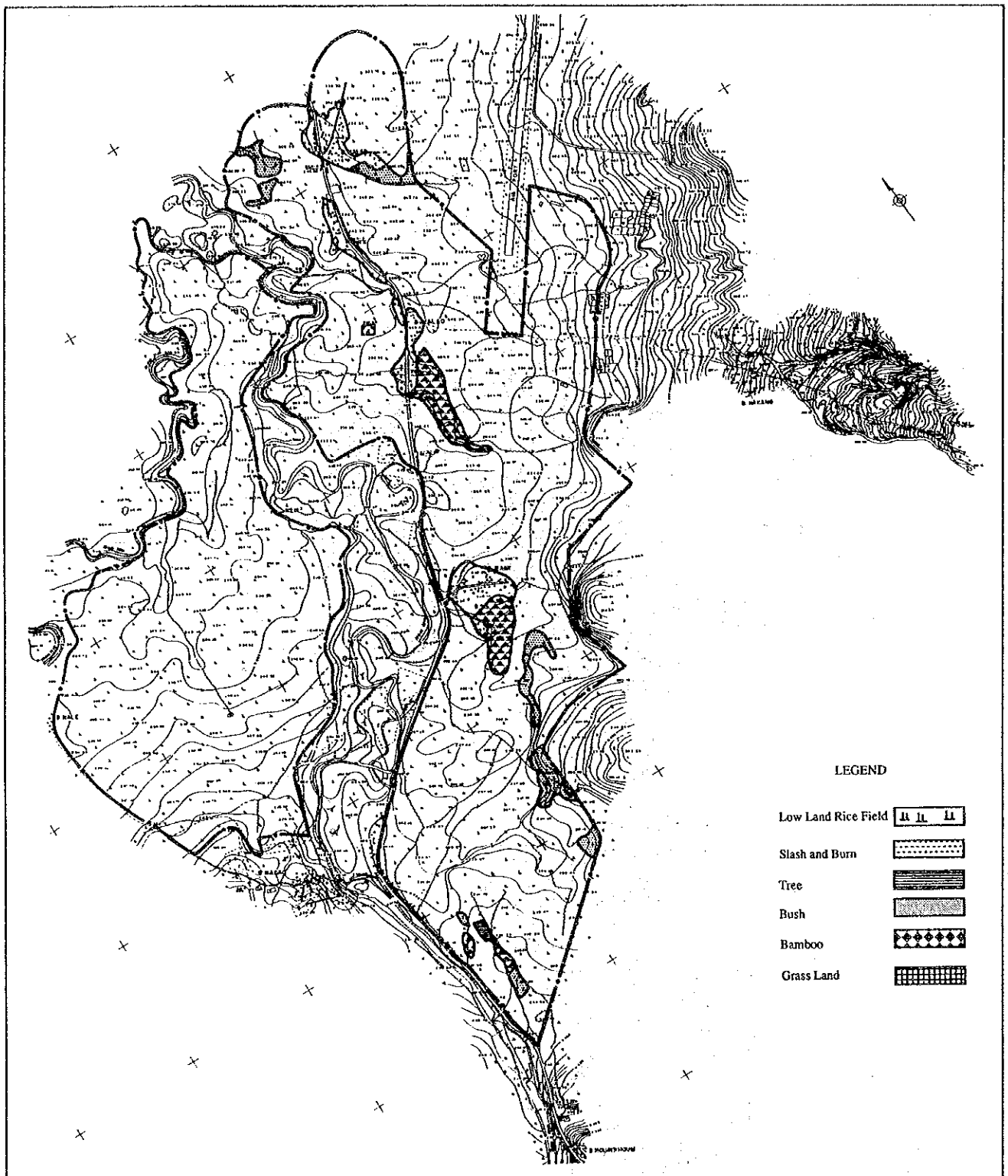

Fig. FA-4 Present Land Use in Xai Model Area

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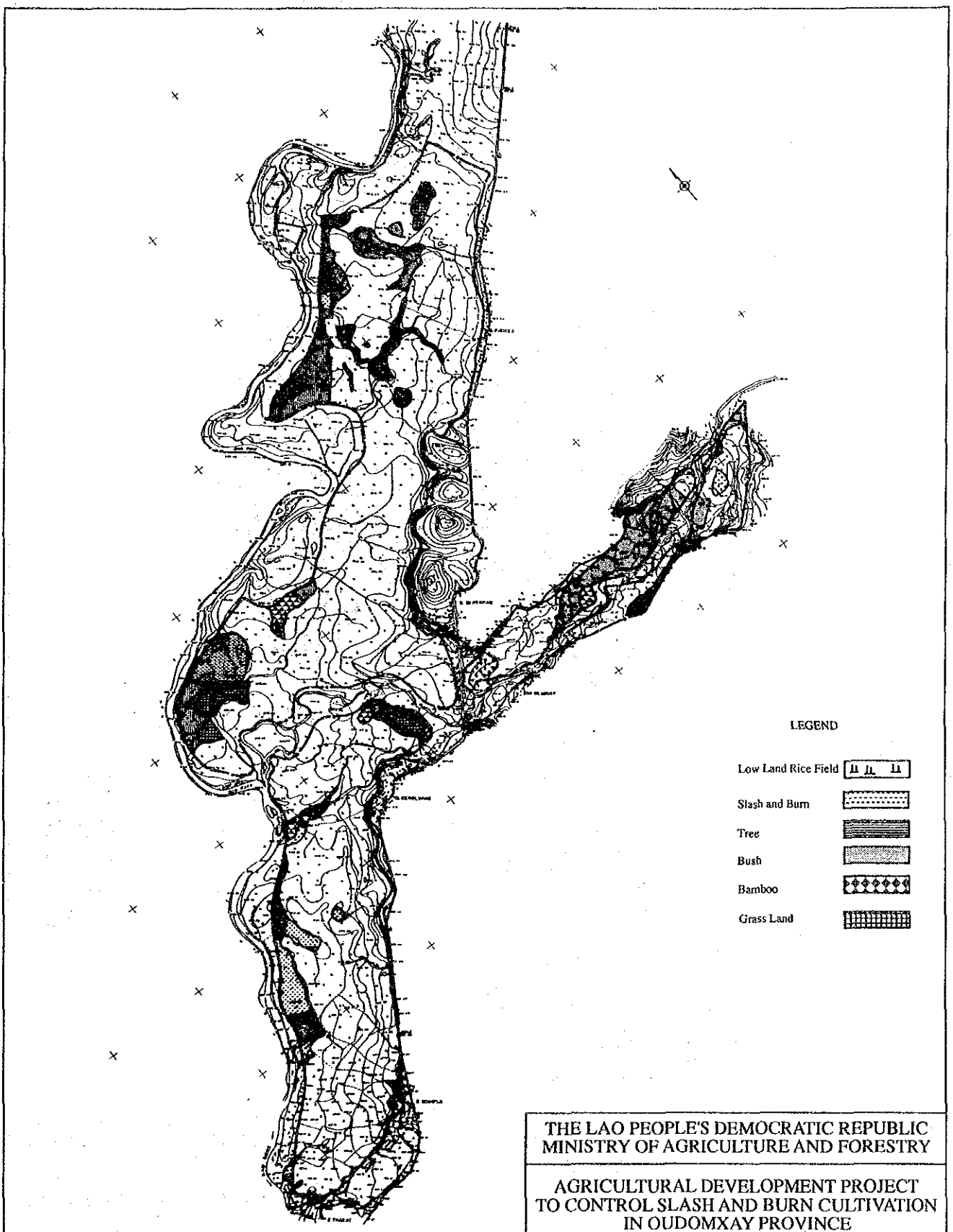

Fig. FA-5 Present Land Use in Beng Model Area

THE LAO PEOPLE'S DEMOCRATIC REPUBLIC MINISTRY OF AGRICULTURE AND FORESTRY
AGRICULTURAL DEVELOPMENT PROJECT TO CONTROL SLASH AND BURN CULTIVATION IN OUDOMXAY PROVINCE
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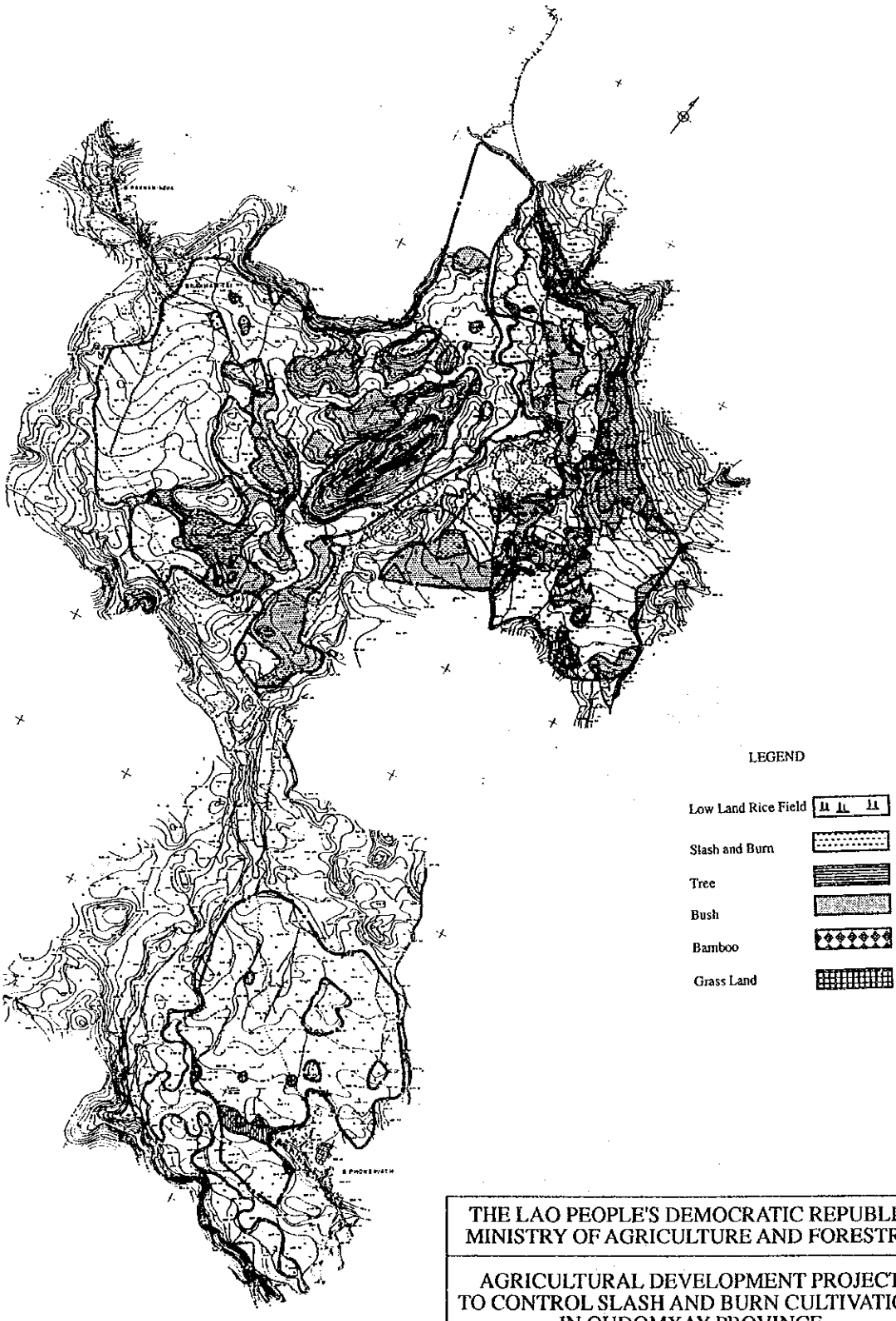

Fig. FA-6 Present Land Use in Hun Model Area

THE LAO PEOPLE'S DEMOCRATIC REPUBLIC
MINISTRY OF AGRICULTURE AND FORESTRY

AGRICULTURAL DEVELOPMENT PROJECT
TO CONTROL SLASH AND BURN CULTIVATION
IN OUDOMXAY PROVINCE

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ANNEX-FB
RURAL SOCIO-ECONOMY

ANNEX-FB RURAL SOCIO-ECONOMY

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1. INTRODUCTION

This ANNEX presents the results of rural socio-economic survey in the three model areas. The objectives of the survey are (i) to collect information on brief history of the villages, settlement pattern, population, family size, land and livestock holdings, local organization, division of labor, women's role in agriculture, and living condition; and (ii) to know the farmers' opinions, needs and their problems on agricultural and rural development towards better living conditions in relation to discontinuation of slash-and-burn cultivation in the model areas. The data used in this report were obtained through the rural socio-economic survey and each district office.

The rural socio-economic investigation was carried out, basically by two methods: one is overall survey of the present conditions in the form of interview to the village leaders and of observation, and the other is benchmark survey of farmers by using questionnaire. Twenty-five (25) villages with 178 families were sampled for the benchmark survey. Out of them, 23 villages with 158 families are related directly or indirectly to the development project of the model areas.

2. POPULATION AND ETHNIC GROUPS

2.1 Population

According to benchmark survey of the selected 158 families, population composition in the model areas is as follows:

(Unit: %)

Area/Age Group	0-15	16-30	31-45	46-60	61-
Xai Model Area	47	24	12	11	6
Beng Model Area	46	25	14	11	4
Hun Model Area	45	26	15	9	5
Average	46	25	13	11	5

Note: Details are in Table FB-4.

The population structure is very young that 46% of total population is under 15 year-old, while only 5% of the population is above 61 year-old. The male-female ratio is 48 to 52 on an average.

2.2 Family Size and Labor Force

The households consist of either a nuclear family or an extended family. Family size varies from a minimum of 2 to a maximum of 16 persons with an average of 7. Average family size by ethnic group of Lao Loum and Lao Theung is 7.6 and 6.8, respectively (see Table FB-5).

In order to get the data on labor force in total and in agriculture, 66, 46 and 46 families in Xai, Beng and Hun areas, respectively, were exampled. Total and agricultural work force, and these percentage in each model areas are as follows:

(Unit: person)

	Population (a)	Total Work Force (b)	Agricultural Work Force (c)	(b)/(a) x 100	(c)/(b) x 100
Xai	482	228	189	47%	83%
Beng	397	166	147	42%	90%
Tun	303	143	128	47%	90%
Total/Average	1,182	537	464	45%	86%

Note: Those who work are categorized as labor force regardless of their ages and sexes. This table is prepared on the basis of Table FB-5.

In Xai, Beng and Hun areas, 47%, 42% and 47% of the population can be categorized as labor force, respectively. On an average, 45% of total population is estimated as labor force. The percentage of labor force who is engaged in agriculture is 83 in Xai area, 90 in

Beng and Hun areas with an average of 86%. Xai area is located around the center of provincial capital so that it provides the opportunity of non-agricultural employment such as trade and public service.

As seen in Table FB-1 total population is 4,356, 3,015, and 3,535 in Xai, Beng and Hun areas, respectively. Using the above percentages of total and agricultural work force, the number of total and agricultural work force is estimated and summarized as follows:

(Unit: person)

	Population	Total Work Force	Agricultural Work Force
Xai	4,356	2,047	1,699
Beng	3,015	1,266	1,139
Hun	3,535	1,661	1,495

2.3 Ethnic Groups in Model Area

As seen in Table FB-1, Lao Loum are dominated in Xai and Beng areas, while Lao Theung is the majority in Hun area. In general, Lao Loum is engaged in lowland rice cultivation, and in contrast Lao Theung largely depend their livelihood on upland rice by slash-and-burn cultivation.

Lao Loum is generally Buddist, although some sub-ethnic group such as Tai Dam (Na Kang in Xai area) is animist (see Table FB-3). They are usually lowland rice cultivators and settle in the sedentary villages near rivers. Lao Theung is animist and originally lived in the midland of mountain areas. As far as model areas are concerned, they are engaged in upland rice farming with lowland rice cultivation, hunting and gathering, and live in the new-sedentary villages.

3. SETTLEMENT OF VILLAGES IN MODEL AREA

3.1 Village Categories: Old and New

The villages in the model areas are classified into two categories of the settlement history, say: old village which settled before 1970, and new village which was established after 1970 in or near the present place. Lao Loum villages generally have long history more than 100 years, while those of Lao Theung have newly settled within the last 10 to 20 years.

	Xai		Beng		Hun		Total	
	Old	New	Old	New	Old	New	Old	New
Lao Loum	5	1	6	0	2	0	13	1
Lao Theung	0	1	0	1	0	4	0	6
Lao Sung	0	0	0	0	0	0	0	0
Mix	2	0	0	0	0	1	2	1
Total	7	2	6	1	2	5	15	8

Note: Old : villagers settled in or near present place before 1970
New : villagers settled in or near present place after 1970

Lao Loum villages in Xai model area, except Na Kang which settled from near border on Vietnam within the last 10 years because of land scarcity in that area, are old ones.

Almost all Lao Loum villages in Beng model area were previously located beside the Beng river. Around 1975, the villagers changed village location along the National Road in order to avoid flood damage, and to access to public services and market. These villages form the center of the Beng district.

There are four Lao Theung villages in Hun model area. Around 1970, these Lao Theung was settled in the area under the government's instruction and with their own wills, after Lao Loum people escaped from that area to other provinces due to war events. Some Lao Theung families returned to the old original villages, due to limited land for cultivation, because Lao Loum people came back after the war ceased. However, many of Lao Theung remain in the new village enjoying better living conditions in terms of easy access to public services and market.

3.2 Village Categories and Cultivated Land

Average holding size of rice field in new and old villages is estimated as shown below, based on Tables FB-1 and FB-2.

(Unit: ha)

	New Villages		Old Villages	
	Total	per Family	Total	per Family
Lowland rice field	123.1	0.20	727.0	0.57
Upland rice field	503.2	0.80	173.6	0.14

The farmer in new villages cultivates smaller area of lowland rice field, and larger area of upland rice field as compared to the farmer in old villages, because old villages already occupied lowland rice field which was easily terraceable land before new villages were established.

3.3 Village Size

The village size in terms of number of families by ethnic groups is summarized as follows:

(Unit: number)

		<49	50 - 99	100 - 149	>150	Total
Xai	LL	1	2	2	1	6
	LT	1	-	-	-	1
	Mix	1	1	-	-	2
Beng	LL	-	6	-	-	6
	LT	-	1	-	-	1
	Mix	-	-	-	-	0
Hun	LL	-	2	-	-	2
	LT	-	1	2	1	4
	Mix	-	1	-	-	1
Total		3	14	4	2	23

Note: This table is prepared on the basis of district offices' data

As seen in the above table, there are no great differences in village size between two ethnic groups, although the size of Lao Theung village is usually smaller than that of Lao Loum in Oudomxay province as a whole. About 60% of the villages in number is medium size which consist of 50 to 99 families.

In general, Lao Theung villages are small consisting of less than 49 families, and large villages of Lao Theung appeared exceptionally in Hun area, because some small villages had been amalgamated when they settled down from the mountain areas.

4. LAND TENURE SYSTEM AND LAND HOLDING

4.1 Land Tenure System

Land is officially the property of the state, and the people have the usufruct right of land, but no right of buying and selling the land. However, customary land tenure system still exists in the study area, and varies greatly in different categories of land, namely, lowland and upland.

4.1.1 Customary Tenure System of Lowland

In the case of lowland rice field, purchase and renting of lands are observed in the model areas. The original right of land acquisition becomes a right of property, and such a right is usually transferred by inheritance. The Tai Lao family is matrilineal, and the youngest daughter with the husband usually inherits the land and family house. The Tai Dam family is essentially partrilineal and the eldest son generally inherits the land.

4.1.2 Customary Tenure System of Upland

The territories of each village are well-defined by the surrounding villages. Most villages have certain rules on the forests concerning cutting trees, grazing livestock, slash-and-burn cultivation, and other activities. For those who break the rules, the village committee gives a warning at first time, but they will be fined, if the violation is continued.

Unlike lowland rice field, swiddens are considered to be village property rather than individual one. The villagers have equal usufruct right for the fallow forest land to be used for slash-and-burn cultivation, but the right on certain place terminates when field is left fallow. Swiddens are allocated to each farmer through negotiation among villagers under the control of the village committee. The land allocation is based on the number of family member of each farmer. In this case, every farmer can propose the location of land where family heads desire to use for cultivation. Individual field is clearly determined, and any disputes are settled before any clearing work takes place.

4.2 Land Holding

4.2.1 Farming Systems

There exist the following three main farming systems in the region.

(a) Lowland rice cultivation
(b) Upland rice cultivation (slash-and-burn cultivation)
(c) Combination of (a) and (b)

As seen in Table FB-2, many Lao Loum villages in Xai area belong to item (a). Although some villages in Beng area such as Beng Kham and Beng Louang belong to item (a), other villages can be categorized as item (c).

Lao Theung farmers in Hun area also practice lowland rice cultivation, but their main agricultural activity is slash-and-burn cultivation. On the other hand, the economic activity of Lao Loum in Hun area is mainly dependent on lowland rice production. There are no pure shifting cultivators who belong to item (b) in the three model areas.

4.2.2 Land Holding Size

The average land holding size of lowland and upland field in each model area and by ethnic group is estimated as shown below, based on Tables FB-1 and FB-2.

(Unit: ha)

Land Category	Model Area		
	Xai	Beng	Hun
Lowland rice field	0.53	0.50	0.31
Upland rice field	0.07	0.27	0.73
Total	0.60	0.77	1.04

(Unit: ha)

Land Category	Ethnic Group	
	Lao Loum	Lao Theung
Lowland rice field	0.58	0.18
Upland rice field	0.11	0.85
Total	0.69	1.03

The holding size of lowland rice field of Lao Theung is very small as compared to that of Lao Loum, and upland field of Lao Theung family is larger than that of Lao Loum. Above two tables also show that the total cultivated land per family tends to be larger when the farmers are engaged mainly in upland farming, but to be smaller when they are engaged mainly in lowland rice cultivation.

Fig. FB-1, which is drawn up from Table FB-2, shows that the area of slash-and-burn cultivation per family is, by and large, inverse relation to that of rice field. The more rice field is available, the less slash-and-burn cultivation is practiced.

4.2.3 Land Distribution

The land distribution in each model area is as follows:

Farm Size (ha)	Xai		Beng		Hun	
	No. of Families (%)	Cultivated Land (%)	No. of Families (%)	Cultivated Land (%)	No. of Families (%)	Cultivated Land (%)
0.0 - 0.49	24	5	0	0	2	1
0.5 - 0.99	20	13	20	11	19	11
1.0 - 1.49	36	41	43	38	48	43
1.5 - 1.99	15	27	26	31	20	25
over 2.0	5	14	11	20	11	20

The above table shows that the land distribution in Xai area is distorted as compared with those of Beng and Hun areas.

According to the village leaders interviewed, there are about 10 to 40% of farmers who have no lowland rice field even in Lao Loum villages. The farmers generally try to avoid the segmentation of their land by inheritance if their land is already so very small that some of their children are not possible to hold lowland rice field at all. As a result, they have to practice slash-and-burn cultivation for surviving.

Limited lowland rice field in Lao Theung villages is shared among the farmers according to their family size, as seen in Hun area. For example, there are 126 families in Somphon village which is divided into 6 Nuay (village unit), and about 9 ha of lowland rice field is shared in farming with one-year cycle. This means that each Nuay can use the lowland rice field once in six years. It may be said from these situations that the farmer in this area have a great need for opening of new rice field whenever and wherever it is possible.

5. LIVESTOCK HOLDING

5.1 Holding Number of Livestock

A farmer raises 3 buffalos, 2 cattle, 2 pigs, and 16 poultry on an average as shown below, although the number of livestock per farmer varies among the villagers and between villages.

(Unit: number)

	Xai	Beng	Hun	Average
Buffalo	2.1	3.7	2.9	2.9
Cattle	1.9	3.1	0.4	1.8
Pig	1.3	3.1	2.0	2.1
Poultry	14.7	21.8	11.1	15.9

Note: Details are in Table FB-5.

Lao Loum farmers generally keep animals more than Lao Theung, as seen in the following table (see Table FB-7).

(Unit: number)

	Buffalo	Cattle	Pig	Poultry
Lao Loum	3.3	2.7	2.7	18.4
Lao Theung	2.3	0.3	1.2	8.4

5.2 Percentage of Sold Livestock

The percentage in number of sold livestock to the total number in the model areas in 1991 is estimated based on the interviews with 158 farmers and summarized in the following table:

(Unit: %)

	Xai	Beng	Hun
Buffalo	7	8	7
Cattle	8	13	25
Pig	50	48	36
Poultry	24	9	20

Note: Details are in Table FB-8.

As seen in the above table, 7 or 8% of buffalo was sold in the model areas. Sold number of cattle and poultry in the total number is not more than 25%. More than one-thirds of pig was sold in Hun area, while about 50% of pig was sold in Xai and Beng areas.

5.3 Raising Method

The farmers in the model areas keep various kind of livestock in a traditional manner. Livestock is generally pastured in the forest in the rainy season, and also in rice field

after harvest in the dry season. Lao Theung villages are often fenced and they raise livestock outside the villages. Free grazing requires fencing of cultivated field both upland and lowland in order to protect crops from the depredation by animals.

5.4 Raising Purpose

The buffalo is quite important for lowland rice cultivators, because it provides draft power for rice field preparation. Other livestock plays an important role as an insurance in such a way that the farmers can sell their livestock in order to buy food in the case of food shortage.

6. SLASH-AND-BURN CULTIVATION

Slash-and-burn cultivation is characterized by a rotational system of upland fields between relatively shorter periods of cropping and longer periods of fallowing. The fallow period of Lao Loum farmers in the foothills is generally shorter than that of Lao Theung farmers in the mountain areas. There is, however, no great difference in slash-and-burn cultivation practices between Lao Loum and Lao Theung who settle in lowland areas.

In the model areas, the land is generally cultivated for one year with fallow period of 4 to 5 years. Limited available land per farm family and the present government policy for the forest areas has brought about shortening of the fallow period so that the fallow period could not be long enough for restoring soil fertility. More than 5 years of fallow period is needed in order to maintain soil fertility for sustainable cultivation of rice, but in reality it is impossible to do so due to land scarcity in the foothills.

The farmers in Xai area cultivate relatively large lowland rice field with better opportunity for non-farm employment and good access to Xai market so that very few farmers practice slash-and-burn cultivation. On the other hand, most of farmers particularly Lao Theung are slash-and-burn cultivators in Hun area, because they have quite small lowland rice field. About half of Lao Loum farmers practice slash-and-burn cultivation in Beng area.

Many people realize that there is no sufficient forest for slash-and-burn cultivation around their villages. Almost all farmers are keen to stop this type of farming because of hard work with low yielding. Irrigation development and land clearing are the most important preconditions for this end (see Table FB-9).

Weeding is the most labor consuming work among various work items of slash-and-burn cultivation. Main weed is Ageratum conyzoides (Nya Kew in Laotian) which grows well in relatively fertile field, but overfarming and repeated fires are likely to encourage growth of grasses (e.g., Imperata cylindrica).

7. HUNTING, FISHING AND COLLECTING

Hunting, fishing and collecting are also important activities, for farmers to supplement their subsistence economy through the activities. The frequency of these activities in each model area (a) and by ethnic group (b) is as follows:

(a) (Unit: %)

	Hunting			Fishing			Collecting		
Model Area	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Xai	3	23	74	6	55	39	60	17	23
Beng	7	43	50	40	42	18	76	21	3
Hun	5	56	39	18	58	24	55	38	7
Average	5	41	54	21	52	27	64	25	11

(b) (Unit: %)

Ethnic	Hunting			Fishing			Collecting		
Group	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Lao Loum	3	32	65	27	47	26	56	25	19
Lao Theung	9	57	34	13	46	41	62	31	7

Note: The percentage is calculated by the number of farmers who belongs to categories of (1), (2) and (3) in total numbers within an area or ethnic group.
(1): quite often, (2): sometimes, (3): never
Source: Benchmark Survey, details are shown in Table FB-10.

The percentage of the farmers, who never practice hunting, fishing and collecting, in Xai area is higher than those in Beng and Hun areas. On an average, 89%, 73%, and 46% of the farmers is engaged in collecting, fishing, and hunting, respectively. The order of importance among them can be summarized as Collection > Fishing > Hunting. Lao Loum people are found of and familiar with fishing rather than hunting, but for Lao Theung in reverse.

Many farmers interviewed pointed out that the natural resources such as wild animals and plants in the forests and rivers tend to decrease within recent one or two decades due to population increase and deforestation.

8. VILLAGE ORGANIZATIONS

8.1 Water Users' Associations

The existing irrigation systems can be divided into two types: one is a small-scale traditional brushwood weir constructed by users themselves, and the other is a medium-size with permanent concrete weir constructed by the joint effort of users, authorities, and/or by financial assistance from the Lao Quaker Services (NGO).

The chief of water users association is appointed by the village committee or elected by the villagers in Lao Loum villages. The chief is the most respected person among villagers, and his task is the annual repair of the weirs and canals. For this, each village and family has to send labor force, depending on the area of irrigated rice field. Lao Theung villages have no specific organization for water use.

Two-thirds of 108 families interviewed noticed the existence of water problem, and according to them, the main reasons for the problem are insufficient amount of water and its uneven distribution.

There are no strict rules and water fee in the case of traditional system. Therefore, the farmers often ignore the rules of water management in order to direct it into their own fields. It is unlikely to take place in the system with permanent concrete weir.

Although irrigation water is used by individual farmers, the maintenance and operation of the system require group action. It should be noted here that traditional associations could not cope with larger scale of a modern irrigation system without the establishment of the village and supra village level organizations defining the right and duty of the members.

8.2 Farmers' Organization

Village based collectives, which aimed at group work in farming and the distribution of products, existed until 1986 or so. Recently, however, there are no farmers' organizations established in the model areas under the government arrangement other than village committee, village unit (Nuay) and women's union. The farmer's organization aiming at economic or social activities is also not formulated yet in the model areas as well as in the province.

8.2.1 Village Committee

The village committee has a political structure composed of a Village Chief and his Council. The chief is elected by villagers and recognized by the government authorities. His task is to govern the village, to settle conflicts such as irrigation water distribution, crop damage by animals, etc. and to collect government taxes. Most of villages has Rice Storage (Sang Kao) which has function of storing paddy collected as taxes, supplying food for village guests, and function of rice bank from which villagers would borrow paddy in time of needs and repay the next year (see section of agricultural credits).

8.2.2 Village Unit (Nuay)

Most of the villages related to the model areas are divided into several Nuay, each consisting of 10 to 15 families in general. The chief of Nuay is appointed by the village chief. The main activities of Nuay are cooperation in the form of labor exchange and mutual aid in farming and living among farmers of a Nuay and some time between Nuays.

8.2.3 Women's Union

Every woman who is more than 18 years-old (in the case of woman who already married, more than 16 years-old) can become the member of the women's union. The member fee is five Kip per month for women who are getting salary and one Kip per month for women of farm family. In the case of Beng district, population of women who can be the member is 5,194 in total. However, actual number of women with membership is only 286. The activities of the unions are generally low, because the union had more political character in the past. Therefore, re-organization of the union is requested so as to promote more economic and social activities of the women under the introduction of the New Economic Mechanism (NEM). Recently, some new trials are being made by Lao Women Union with an assistance of Lao Quaker service, which include the promotion of appropriate technology to lighten workload of the women, cotton cultivation, establishment of village rice bank, etc.

8.3 Traditional Labor Exchange System

The basic unit of production is the small family farm which is operated primarily by own labor. Hiring labor is not common in the model areas (see Table FB-11). However, when it takes place, the daily wage in agriculture can be paid in 10 kg of rice or cash ranging from Kip 500 to 1,500.

Labor exchange is carried out among the group of blood ties and neighbors at the peak periods of planting, harvesting, threshing and transportation. Land clearing and fencing are made by their own family labor (see Table FB-12). Burning of fallow lands is usually carried out by several families together when they have the field in a lot.

Weeding is carried out by labor exchange among Lao Theung farmers, probably because weeds are major constraint to increase in productivity of slash-and-burn cultivation, requiring heavy input of labor to control.

9. WOMEN'S ROLE IN RURAL SOCIETY

There is rigid custom in responsibility on some tasks for men and women. Men's tasks include house building, land clearing, hunting, caring of large size livestock (e.g., buffalo and cattle), and so forth. On the other hand, women have main responsibility for cooking, child care, milling rice, water fetching, collecting firewood and forest products, caring of small size livestock (e.g., pig and poultry), although their children often help them (see Table FB-13).

Women enjoy the right to vote for the election of village head, and also participate in decision-making of village meeting. However, they tend to hesitate to speak out their opinions in the public place.

Women have relatively more work to do and work much longer hours than men. Women's tasks are incessant because the demands for domestic works continue all year round.

Fifty farmers were interviewed about (a) who keeps money and (b) who decides what use it for. These results are as follows:

(a) (Unit: number)

	Na Kang Lao Loum	Thin Lao Loum	Done Xai Lao Theung	Houay La Lao Theung	Phonsavat Lao Loum
Husband	-	-	6	2	-
Wife	7	10	4	8	10
Both	3	-	-	-	-

(b) (Unit: number)

	Na Kang Lao Loum	Thin Lao Loum	Done Xai Lao Theung	Houay La Lao Theung	Phonsavat Lao Loum
Husband	1	1	4	6	1
Wife	-	2	1	-	2
Both	9	7	5	4	7

Lao Loum women keep money and take part in the decision-making of its utilization, while those of Lao Theung seem to have less power on this domain. Marketing activities are the responsibility of women in Lao Loum, but for men in Lao Theung society.

10. LIVING CONDITION

10.1 Domestic Water

Main water source for domestic use is river in Hun and Xai areas. The people also enjoy the benefit of piped water in Xai and Beng areas (see Table FB-14). Most of Lao Loum people drink boiled water, but few Lao Theung people boil water for drinking.

(Unit: %)

	River	Well	Pipe Water	Rain
Xai	41	25	28	6
Beng	18	23	57	2
Hun	64	20	4	4

10.2 Fertility and Mortality

Malaria and Diarrhea are the main diseases in the region. The levels of both fertility and infant mortality seem to be very high. Regardless of the age, ten women in each model area were interviewed to know about the number of child birth and death. Significant number of children die at a young age, and infant mortality rate is 35% in Na Kang (Xai, Lao Loum), 42% in Houay La (Beng, Lao Theung), 36% in Phonsavat (Hun, Lao Loum), and 37% on an average, as shown below.

	Na Kang	Houay La	Phonsavat	Total
No. of birth	72	59	75	206
No. of death	25	24	27	77
Infant mortality rate (%)	35	42	36	37

10.3 Housing

The majority of households interviewed have no latrine and electricity supply. In general, Lao Loum houses are constructed of wood, while Lao Theung houses are made of bamboo. Grass and bamboo are the source of thatching for Lao Theung houses, but a tin roof is not rare in Lao Loum villages. The space under the floor of house is used for storage of firewood, farm implements and as animal shed. Lao Loum keeps a wooden mortar and traditional weaving implement under the floor.

10.4 Road Condition

Peoples' opinions concerning road condition are summarized in the following table:

(Unit: number)

Model Area	Good	Not Good
Xai	31	4
Beng	32	2
Hun	6	30

Most people in Xai and Beng model areas are satisfied with road condition, but more than 80% of the farmers in Hun area complains about it, because there is no all-weather road between the district center and the villages.

10.5 Firewood

Lao Theung collects firewood after burning of the swiddens and harvesting, while Lao Loum collects firewood several times for a year. Withered tree from conserved forest and dried wood used for fencing are also used for cooking. Collecting firewood is female task in both ethnic groups.

10.6 Education

Forty families were interviewed about the formal education of family members. The average years of formal education by age groups and sex are as follows:

(Unit: year)

	Model		6 - 15		16 - 30		31 - 45		46 - 60		61 -	
Village	Area	Ethnic	M	F	M	F	M	F	M	F	M	F
Thin	Xai	LL	2.0	2.1	7.2	4.2	9.0	1.6	3.8	0.5	0	0
Done Xai	Xai	LT	1.3	0.6	3.8	0.6	4.0	1.0	3.5	0	0	0
Houay` La	Beng	LT	1.6	0.3	5.3	1.6	4.6	0.9	1.5	0	0	0
Ponsavat	Hun	LL	3.3	2.7	9.0	7.6	6.8	3.8	4.7	1.0	2.0	0

Note: LL = Lao Loum LT = Lao Theung
M = Male F = Female

As seen in the above table, education level of Lao Loum is higher than that of Lao Theung, and male has longer formal education than female in both ethnic groups.

10.7 Handicraft

Cloth and bag are weaved by the women of Lao Loum and Lao Theung respectively, while basket making is male's responsibility. These handicrafts are mainly produced for family use, and have minor importance in an income-generation. Lao Loum women have the tradition of weaving cotton cloth for their own use, but manufactured cheap clothes imported from Thailand and China is apt to discourage this activities in recent years.

10.8 Food Consumption

Glutinous rice is the main staple food for both Lao Loum and Lao Theung. On the average, one family consumes 117 kg of polished rice, 8 kg of livestock meat, 2.5 kg of wild animal meat, 6 kg of fish, 23 kg of wild vegetable and 7 kg of fruit per month. The people obtain wild food through the activities of collecting, fishing and hunting which also serve functions as supplementing farm production and income especially during hardship periods. For example, the amount of wild animal meat makes up 24% of total meat consumption.

10.9 Family Expenditure

Two-thirds of Lao Loum farmers think that they belong to the middle class, while more than half of Lao Theung regard themselves as poor farmers (see Table FB-15). Family expenditure of the half number of farmers interviewed has exceeded the income (see Table FB-16), although very few people fell into big debt. The following table shows the sum and composition of family expenditure.

(Unit: Kip 1,000)

	Xai (LL)		Beng (LL)		Hun (LL)		Hun (LT)	
Item	Amount	(%)	Amount	(%)	Amount	(%)	Amount	(%)
Clothes	59	(19)	49	(19)	43	(24)	29	(24)
Foods	118	(37)	82	(31)	53	(29)	33	(28)
Health	38	(17)	36	(14)	26	(14)	24	(20)
Education	12	(4)	19	(7)	9	(5)	6	(5)
Transportation	26	(8)	22	(8)	14	(8)	6.5	(5)
Taxes	10	(3)	9	(3)	11	(6)	6.5	(5)
Others	52	(17)	46	(18)	26	(14)	15	(13)
Total	315		263		182		120	

Note: Details are shown in Table FB-17.

Lao Theung in Hun area spend a small sum of money as compared to Lao Loum. A significant portion is spent on clothes and foods. The families spend 12% to 20% of total expenditure as health care.

They need cash for purchasing supplemental food and clothes, medical care, transportation, education, ceremonies, hired labor, agricultural tax, and so forth.

10.10 Existence of Female-head-families

It should be also noted that female-head-families exist in almost all villages in the model areas. The percentage of female-head-families varies from 0 to 11 with an average of 6, according to the interview to 17 village leaders. The families and their farming are supported by the village unit (Nuay) and blood ties.

11. CONSTRAINTS TO AGRICULTURAL DEVELOPMENT

The farmers in the model areas are characterized by subsistence-oriented agriculture rather than market-oriented. They know that the local market is small and unstable. Obtaining sufficient food to meet family needs is the main objective of the farmers in general, and of Lao Theung in particular.

Under the condition of high fluctuation of agricultural production caused by pests and disease and natural hazards, the farmers are likely to give the highest priority to the risk aversion over profit maximization, because they have limited capacity to bear risk.

From the farmers' point of view, serious constraints to increase in agricultural production can be summarized as follows:

	Crop Production	Livestock Production
1.	pests and disease	pests and disease
2.	water shortage in lowland field poor soil of upland field	lack of budget for purchasing
3.	difficulty in control of animals	limited grassland

Although the stabilization of agricultural production is the basis of sustainable livelihood, pests and disease often jeopardize the stable production of crop and livestock.

Almost all farmers who practice slash-and-burn cultivation are keen to stop this type of agriculture because of hard and incessant work with low yielding (see Table FB-9). However, it is not easy task for them because they don't have enough irrigation water and rice field. In other words, the shortage of rice field with lack of irrigation water is the most serious obstacle to stop slash-and-burn cultivation for lowland settlers. It is obvious that irrigation development with new land clearing is the most important precondition towards this end.

Lowland farmers cultivate small area of rice field, 0.5 ha/family on an average, mainly because the availability of arable land and irrigation water are absolutely limited. On the other hand, the upland rice field is relatively large and its size is mainly depending on the availability of family labor for clearing lands and weeding. Hence, the major constraints to more rice production are land and water in lowland, and labor in upland.