Table X-8 Net Production value - [1]

Description	Without Project	With Project	Increment
1. Planted Area (ha)			
Irrigated Paddy			
- Rainy season		1,655	1,655
- Dry season		490	490
Rainfed Paddy			
- Rainy Season	1,850		-1,850
Upland Crops			
- Rainy Season Paddy			
Peanut	15		-15
- Dry Season Peanut		495	495
2. Unit Yield (ton/ha)			
- Irrigated Paddy - Rainy Season		4.0	4.0
- Dry Season		4.5	4.5
- Rainfed Paddy - Rainy Season	1.5		-1.8
- Upland Crops			
- Rainy Season Rice			
- Rainy Season Peanut (unshelled)	0.5		-0.6
- Dry Season Peanut (unshelled)		2.5	2.5
3. Crop Production (ton)			
- Irrigated Paddy			
- Rainy Season		6,620	6,620
- Dry season		2,205	2,205
-Rainfed Paddy - Rainy Season	2,775		-3,330
- Upland Crops			
- Upland Rice			
- Rainy Season Peanut	7.5		-9.0
- Dry Season Peanut		1,237.5	1,237.5

4. Unit Price (US$/ton)	Financial Price (US$)			Economic Price (US$)		
	Rainy Season		Dry Season	Rainy Season		Dry Season
	WOP	WP	WP	WOP	WP	WP
Paddy	142.0	142.0	155.0	226.2	226.2	226.2
Peanut	228.5	—	228.5	203.6	—	203.6
5. Gross Production (:000US$)	Financial Value			Economic Value		
	Rainy Season		Dry Season	Rainy Season		Dry Season
	WOP	WP	WP	WOP	WP	WP
Paddy	394.05	940.04	341.775	627.705	1,497.444	498.771
Peanut	1.714	—	282.769	1.527	—	251.955
6. Unit Production Cost (US$/ha)	Financial Cost			Economic Cost		
	Rainy Season		Dry Season	Rainy Season		Dry Season
	WOP	WP	WP	WOP	WP	WP
Paddy	215.0	361	342	144	286	238
Peanut	148	—	2,760	99	—	204
7. Total Production Cost (US$.000)						
Paddy	397.75	597.455	167.580	266.40	473.33	116.62
Peanut	2.220	—	136.620	1.485	—	100.98
8. Net Production Value						
Paddy	-3.7	342.585	174.195	361.305	1,024.114	382.151
Peanut	-0.508	—	146.149	0.042	—	150.975
Total	-4.206	342.585	320.344	361.347	1,024.114	533.126

	Financial Cost	Economic Cost
9. Benefit	+667.135	1,195.893

Description \ Year	4th	5th	6th	7th	8th
	1st ~3rd year, Construction Period				
1. Without Project					
1) Rainfed Paddy (1850 ha)					
Unit yield (t/ha)	1.5	1.5	1.5	1.5	1.5
Gross Production (ton)	2,775	2,775	2,775	2,775	2,775
Gross Production Value (US$.000)	627.705	627.705	627.705	627.705	627.705
Gross Production Cost (US$.000)	266.400	266.40	226.40	266.40	266.40
Net Production Value (US$.000)	361.305	361.305	361.305	361.305	361.305
2) Rainfed Peanut (15 ha)					
Unit Yield	0.5	0.5	0.5	0.5	0.5
Gross Production	7.5	7.5	7.5	7.5	7.5
Gross Production Value	1.527	1.527	1.527	1.527	1.527
Gross Production Cost	1.485	1.485	1.485	1.485	1.435
Net Production Value	+0.042	0.042	0.042	0.042	0.042
3) Total Net Production Value	+361.347	361.347	361.347	361.347	361.347
2. With Project					
1) Rainy Season Paddy (1655 ha)					
Unit Yield	2.5	3.0	3.5	3.8	4.0
Gross Production	4,137.5	4,965.0	5,792.5	6,289.0	6,620.0
Gross Production Value	935.903	1,123.083	1,310.150	1,422.572	1,497.444
Gross Production Cost	473.33	473.33	473.33	473.33	463.33
Net Production Value	462.573	649.753	836.820	949.242	1,024.114
2) Dry Season Paddy (490 ha)					
Unit Yield	2.5	3.0	3.5	4.0	4.5
Gross Production	1,225.0	1,470	1,715	1,960	2,205
Gross Production Value	277.095	332.514	387.933	443.352	498.771
Gross Production Cost	116.62	116.62	116.62	116.62	116.62
Net Production Value	160.475	215.894	271.313	336.732	382.151
3) Dry Season Peanut (495 ha)					
Unit Yield	1.5	1.8	2.0	2.2	2.5
Gross Production	742.5	891	990	1,089	1,237.5
Gross Production Value	151.173	181.408	201.564	221.700	251.955
Gross Production Cost	100.98	100.98	100.98	100.98	100.98
Net Production Value	+50.193	80.428	100.584	120.74	150.975
4) Total Net Production Value	673.241	946.075	1,208.717	1,396.714	1,557.24
3. Benefit	+311.894	584.826	847.37	1,035.367	1,195.893

Table X-10 Financial Crop Benefit Stream

Description \ Year	1~3	4th	5th	6th	7th	8th
1. Without Project	Construction					
1) Rainfed Paddy (1850 ha)	Period					
Unit yield (t/ha)		1.5	1.5	1.5	1.5	1.5
Gross Production (ton)		2,775	2.775	2,775	2,775	2,775
Gross Production Value (US$.000)		394.05	394.05	394.05	394.05	394.05
Gross Production Cost (US$.000)		397.75	397.75	397.75	397.75	397.75
Net Production Value (US$.000)		-3.70	-3.7	-3.7	-3.7	-3.7
2) Rainfed Peanut (15 ha)						
Unit Yield		0.5	0.5	0.5	0.5	0.5
Gross Production		7.5	7.5	7.5	7.5	7.5
Gross Production Value		1.714	1.714	1.714	1.714	1.714
Gross Production Cost		2.220	2.220	2.220	2.220	2.220
Net Production Value		-0.506	-0.506	-0.506	-0.506	-0.506
3) Total Net Production Value		-4.206	-4.206	-4.206	-4.206	-4.206
2. With Project						
1) Rainy Season Paddy (1655 ha)						
Unit Yield		2.5	3.0	3.5	3.8	4.0
Gross Production		4,137.5	4,965.0	5,792.5	6,289	6,620
Gross Production Value		587.525	705.030	822.535	893.038	940.040
Gross Production Cost		597.455	597.455	597.455	597.455	597.455
Net Production Value		-9.930	+107.575	225.080	295.583	342.585
2) Dry Season Paddy (490 ha)						
Unit Yield		2.5	3.0	3.5	4.0	4.5
Gross Production		1,225	1,470	1,715	1,960	2,205
Gross Production Value		189.875	227.850	265.825	303.800	341.775
Gross Production Cost		167.58	167.58	167.58	167.58	167.58
Net Production Value		22.295	60.27	98.245	136.22	174.198
3) Dry Season Peanut (495 ha)						
Unit Yield		1.5	1.8	20	2.2	2.5
Gross Production		742.5	891	990	1,089	1,237.5
Gross Production Value		169.661	203.593	226.215	248.837	282.769
Gross Production Cost		136.62	136.62	136.62	136.62	136.62
Net Production Value		33.041	66.973	89.595	112.217	146.149
4) Total Net Production Value		+45.406	234.818	412.920	544.020	662.932
3. Benefit		49.612	239.024	417.126	548.226	667.138

Table X-11

Agricultural Benefit in 1999 in 1991 Constant Price

	Financial (US$.000)					Economic (Unit : .000US$)			
	Cropping Area (ha)	Gross Production Value	Production Cost	Net Production Value	Benefit	Gross Production Value	Production Cost	Net Production Value	Benefit
1. Without Project									
Rainfed Paddy	1,850	394.05	397.75	-3.7		627.705	266.40	361.305	
Rainfed Peanut	15	1.714	2.22	-0.506		1.527	1.485	0.042	
Total	1865	395.76	399.97	-4.206		629.232	267.885	361.347	
2. With Project Irrigated Paddy									
Rainy Season	1,655	940.04	597.455	342.585		1,497.444	473.33	1,024.114	
Dry Season	490	341.775	167.58	174.198		498.771	116.62	382.151	
Irrigated Peanut									
Dry Season	495	282.769	136.62	146.149		251.955	100.98	150.975	
Total	2,640	1,564.584	901.655	662.932	587.992	2,248.17	690.93	1,557.24	1,195.093

Table X-12 Economic Price of Paddy

(Unit : forecasted price in 1991 constant term)

Description	Unit	Economic price/ton
1) IBRD projection price in 2000 in 1985 constant price (white, milled, 5% broken, FOB Bangkok)	US$	197 <:1
2) Converted to 1991, constant price <:1	US$	318.2
3) Freight and Insurance <2 (Bangkok – Savannakhet)	US$	+27.0
4) Value (CIF Savannakhet)	US$	345.2
5) Port Handling charge and Bagging	US$	+6.8
6) Transportation Cost from Rice Mill to Savannakhet		+2.2
Price of Milled rice at rice mill <3		354.2
Conversion from rice to Paddy (rice/paddy = 0.65)		230.2
Milling charge <5		-14.3
Value of Bran		+11.8
Handling and transportation cost from Farm to rice Mill		-1.5
Economic Farmgate Price of Paddy		226.2

<:1 IBRD, Revision of primary commodity Price Forecasts, October 1991. The IBRD estimated price in 1985 constant US$ was adjusted by a factor of 1.4869 (M uv) to 1988 constant Price

2. Unit price/cost for the transportation. Handling and other charge were estimated based on the New Tariff Rate, WFF, October,1991.

3. Conversion factor from paddy to rice : 65%

Table X-13 Export Parity Price of Peanut in 2000

(Unit : Projection price in 1991 constant term)

Description	Unit	Economic price/ton
1) F.O.B. US Gulf in 1991 < : 1	US$	277.0
2) Freight and Insurance < : 2 (Savannakhet - Bangkok - US. Gulf)		-66.5
3) Value F.O.B. Savannakhet		210.5
4) Port Handling Charge and Bagging		-3.5
5) Transportation Cost from Project Site to Savannakhet		-2.2
6) Transportation Cost from Farm Gate to Market		-1.2
7) Economic Farm Gate Price		203.6

Source : 1. IBRD, Reversion of primary commodity Price Forecasts, October 1991.

The IBRD, estimated price in 1985 constant US$ was adjusted by a factor of 1.4869 (Muv) to 1991 constant price.
Since the Price of Peanut is not given in IBRR forecast. a price more than 15% of soybean was assumed way as the estimation of IFAD,.
Soybeam : 241 $ in 1991 constant price

2. Transportation and other charges were estimated based on the New Tariff Rate, WFF, October 1991.

Table X - 14 Economic Price of Fertilizer

Items	Unit	Value/ton
F.O.B. N.W. Europe in 1991 Price (Urea, 46% of N)	US$	176.0
Freight and Insurance < : 1 (Palenbang - Bangkok - Savannakhet)	US$	+61
Value CIF, Savannakhet	US$	237
Port Handling charge	US$	+4.0
Storage, Distribution and Handling	US$	+7.3
Transportation Cost from Savannakhet to Project Site	US$	2.2
Handling and transportation cost from Market to Farmgate	US$	1.2
Economic Farm Gate Price	US$	252.0
F.O.B. US. Gulf in 1991, Price (DAP)	US$	177.0
Freight and Insurance (US Gulf - Bangkok - Savannakhet)	US$	+665
Value (CIF Savannakhet)	US$	243.5
Port Handling charge and Bagging	US$	+4.7
Storage, Distribution and Handling	US$	+7.3
Transportation Cost from Savannakhet to Project Site	US$	+2.2
Handling and transportation cost from Market to Farm gate	US$	+1.2
Economic Farm Gate Price	US$	259
FOB Vancouver in 1991 price (Postassium chloride)	US$	109
Freight and Insurance (Vancouver - Bangkok - Savannakhet)	US$	+66.5
Value CIF Savannakhet	US$	+175.5
Port handling charge and Bagging	US$	+4.7
Storage, Distribution and Handling	US$	+7.3
Transportation Cost from Handling	US$	+2.2
Handling and transportation cost from Farmgate to Market	US$	+1.2
Economic Farm Gate Price	US$	191.00

Source 1) IBRD, Revision of primary commodities price Forecasts, October, 1991

The IBRD estimated price in 1985 constant price US$ is adjusted by a factor of 1.4869 (Muv) to 1991 constant price.

2) Unit price for various expenditures estimated based on New Tariff Rate W. FF. October 1991.

Table X - 15 Economic Price of Diazinon and Seven

Items	Unit	Diazinon	Seven
1) Value C.I.F. Savannakhet < : 1	US$	2,475	233.0
2) Port Handling Charge	US$	+4.7	+4.7
3) Storage, Distribution and Handling	US$	+7.3	+7.3
4) Transportation cost from Vieriane to project site < : 2	US$	+2.2	+2.2
5) Handling and transportation cost from Market to Savannakhet	US$	+1.2	+1.2
6) Economic Farm Gate Price	US$	2,485	2,315

Source 1) Unit prices or costs were obtained from MAF

2) Unit cost for various expenditures were estimated based on the New Tariff Rate, W.F.F. October 1991

Table X-16 Economic Production Cost and Benefit

(Unit: US$)

Year in Order	Year	Benefit	Project Cost				Return	NPV	
			Capital Cost	O/M Cost	Replace-ment cost	Total		Discount rate 8%	9%
1	1993	—	509,000			509,000	-509,000	-509,000	-509,000
2	1994	—	4,425,500			4,425,500	-4,425,500	- 3,793,981	3,726,271
3	1995	—	4,880,400			4,880,400	-4,880,400	-3,874,061	3,767,668
4	1996	311,894	1,947,700	29,255		1,976,955	-1,665,061	-1,223,820	1,178,863
5	1997	584,826		29,255		29,255	555,571	378,344	361,121
6	1998	847,370		29,255		29,255	818,115	515,412	487,596
7	1999	1,035,367		31,639		31,639	1,003,728	585,173	549,039
8	2000	1,195,897		31,639		31,639	1,164,258	628,699	584,458
9	2001	1,195,897		31,639		31,639	1,164,258	582,129	535,559
10	2002	1,195,897		33,427		33,427	1,162,470	539,051	490,562
11	2003	1,195,897		33,427		33,427	1,162,470	498,700	451,038
12	2004	1,195,897		33,427		33,427	1,162,470	461,501	413,839
13	2005	1,195,897		33,427	345,000	378,427	817,470	300,829	266,495
14	2006	1,195,897		33,427		33,427	1,162,470	395,240	347,579
15	2007	1,195,897		33,427		33,427	1,162,470	366,178	319,679
16	2008	1,195,897		33,427		33,427	1,162,470	339,441	292,942
17	2009	1,195,897		33,427		33,427	1,162,470	313,867	268,531
18	2010	1,195,897		33,427		33,427	1,162,470	290,618	246,444
19	2011	1,195,897		33,427		33,427	1,162,470	269,693	225,519
20	2012	1,195,897		33,427		33,427	1,162,470	249,931	206,920
21	2013	1,195,897		33,427		33,427	1,162,470	231,332	190,645
22	2014	1,195,897		33,427		33,427	1,162,470	213,894	174,371
23	2015	1,195,897		33,427	345,000	378,427	817,470	138,970	112,811
24	2016	1,195,897		33,427		33,427	1,162,470	183,670	146,471
25	2017	1,195,897		33,427		33,427	1,162,470	169,721	134,846
26	2018	1,195,897		33,427		33,427	1,162,470	156,933	123,222
27	2019	1,195,897		33,427		33,427	1,162,470	145,309	113,922
28	2020	1,195,897		33,427	243,080	276,507	919,390	106,649	82,745
29	2021	1,195,897		33,427		276,507	1,162,470	124,384	95,323
30	2022	1,195,897		33,427		276,507	1,162,470	115,085	87,185
31	2023	1,195,897		33,427		276,507	1,162,470	106,959	80,382
32	2024	1,195,897		33,427		276,507	1,162,470	99,042	73,745
33	2025	1,195,897		33,427	345,000	378,427	817,470	64,482	47,577
34	2026	1,195,897		33,427		33,427	1,162,470	84,913	62,064
35	2027	1,195,897		33,427		33,427	1,162,470	78,623	56,945
36	2028	1,195,897		33,427		33,427	1,162,470	72,799	52,243
37	2029	1,195,897		33,427		33,427	1,162,470	67,407	47,928
38	2030	1,195,897		33,427		33,427	1,162,470	62,413	43,972
39	2031	1,195,897		33,427		33,427	1,162,470	57,790	40,337
40	2032	1,195,897		33,427		33,427	1,162,470	53,474	37,199
41	2033	1,195,897		33,427		33,427	1,162,470	49,545	33,944
42	2034	1,195,897		33,427		33,427	1,162,470	45,876	31,151
43	2035	1,195,897		33,427	345,000	378,427	817,470	29,877	20,092
44	2036	1,195,897		33,427		33,427	1,162,470	39,331	26,219
45	2037	1,195,897		33,427		33,427	1,162,470	36,417	24,054
46	2038	1,195,897		33,427		33,427	1,162,470	33,720	22,068
47	2039	1,195,897		33,427		33,427	1,162,470	31,222	20,230
48	2040	1,195,897		33,427		33,427	1,162,470	28,909	18,574
49	2041	1,195,897		33,427		33,427	1,162,470	23,724	17,040
50	2042	1,195,897		33,427		33,427	1,162,470	24,412	15,112
51	2043	1,195,897		33,427		33,427	1,162,470	22,949	14,298
52	2044	1,195,897		33,427		33,427	1,162,470	21,249	13,150
53	2045	1,195,897		33,427		33,427	1,162,470	19,675	12,071
								+54,699	-1,062,523

EIRR $\frac{9-r}{1} = \frac{1,062,523}{-1,062,523 - 54,699} = 0.95$

$r = 8.05\%$

In case of Cost 10% increased

$8-r = \frac{-885,387}{-885,387 - 699,335} = 0.55$

$r = 7.45\%$

In case of Benefit 10% decreased

$8-r = \frac{890,857}{-890,857 + 533,117} = 0.62$

$r = 7.38\%$

Table X-17 Farm Budget

Items (Farm Land, Unit : ha)	1.0 ha Farm		1.5 ha Farm		2.0 ha Farm	
	WOP	WP	WOP	WP	WOP	WP
1. Operated Area - Paddy Field	1.0	1.0	1.5	1.5	2.0	2.0
2. Planted Area						
a. - Rainfed Paddy	0.8	—	1.2	—	1.6	—
- Irrigated paddy	—	0.89	—	1.34	—	1.79
b. - Rain season	—	0.28	—	0.44	—	0.57
c. - Dry season	0.2	—	0.3	—	0.4	—
d. - Rainfed Peanut	—	0.29	—	0.45	—	0.58
e. - Irrigated Peanut						
Sub total						
Rainy season	1.0	0.89	1.5	1.34	2.0	1.79
Dry season	—	0.57	—	0.89	—	1.15
3. Gross Production						
a (ton)	1.20	—	1.80	—	2.40	—
b	—	3.56	—	5.36	—	7.16
c	—	1.26	—	1.98	—	2.565
d	0.10	—	0.15	—	0.20	—
e		0.725		2.225		2.875
4. Gross Production Value						
a (US$)	170.4	—	255.6	—	340.8	—
b	—	505.52	—	761.12	—	1,016.72
c	—	195.30	—	306.90	—	397.575
d	22.85	—	34.275	—	45.7	—
e	—	165.662	—	508.412	—	656.938
Sub total	193.25	866.482	289.875	1,576.432	386.5	2,071.233
5. Production Cost						
a (US$)	1,720		258.0		344.0	
b	—	321.29	—	483.74	—	464.19
c	—	95.76	—	150.48	—	194.94
d	29.6	—	44.4	—	59.2	—
e		80.04		124.20		160.08
Sub total	201.6	497.09	302.4	758.42	403.2	1,001.21
6. Net Production Value of Farm						
Without Project	-8.35		-12.525		-16.5	
With Project		369.392		818.012		1,070.012
7. Income from non-project <:1						
Agricultural Income	30.0	35.71	35.71	50.0	35.71	71.42
Livestock	24.3	21.42	21.42	28.57	35.71	42.86
Non-Agriculture	42.8	21.43	35.70	35.70	35.70	35.70
8. Total of Farm Income	+88.75	447.95	+80.135	932.282	90.62	1,220.02
9. Return of family						
man-day/year	124.8	175.93	187.2	268.7	249.6	354.5
US$	124.8	156.94	187.2	239.034	249.6	316.112
10. Tax (5% of Rainy season paddy)	8.52	25.276	12.78	38.056	17.04	50.836
11. Irrigation water charge	—	41.61	—	66.405	—	83.79
12. Household Expenditure						
Food expenditure for own farm <:2	156.2	156.2	242.82	242.82	315.24	315.24
Production cost of non-project area crops	21.43	21.43	—	—	5.0	5.0
Other expenditure	7.15	7.15	2.15	2.15	4.3	4.3
13. Disposable Income (US$)						
Gross Farm Income	116.45	526.332	174.675	1,057.046	233.10	1,386.342
Gross Over all Income	205.20	604.89	267.335	1,171.282	340.22	1,536.132
Disposable Income	+11.9	353.224	9.585	821.851	-1.36	1,076.966

<:1 Based on farm survey
<:2 Family size : 5, 7, 9 P/Fa, Annual consumption of paddy per capita: 330 kg
<:3 Based on farm survey

Table X - 18 Change of Farm Budget

(Unit: US$)

Description Farm Size	Farm Gross Income	Total Gross Income	Farm Expense	Disposable Income
Without Project				
1.0 ha	116.45	205.2	193.3	+11.9
1.5 ha	174.675	267.335	257.75	+9.585
2.0 ha	233.10	340.22	341.58	-1.36
With Project				
1.0 ha	526.332	604.89	251.666	353.224
1.5 ha	1,056.046	1,171.316	349.431	821.851
2.0 ha	1,386.112	1,536.132	459.166	1,076.966

Note : Detail data shown Table X-17.

ANNEX X I

MASTER PLAN

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Abbreviation of Measurement

mm	:	millimeter
cm	:	centimeter
m	:	meter
km	:	kilometer
cm^2	:	square centimeter
m^2	:	square meter
ha	:	hectare
km^2	:	square kilometer
cm^3	:	cubic centimeter
ℓ	:	liter
kℓ	:	kiloliter
m^3	:	cubic meter
MCM	:	million cubic meter
g	:	gram
kg	:	kilogram
t	:	ton
v	:	volt
A	:	ampere
W	:	watt
kW	:	kilowatt
kWh	:	kilowatt hour
MW	:	megawatt
%	:	percent
°C	:	degrees centigrade
s	:	second
min	:	minute
h	:	hour
kip	:	Lao Kip
US$	:	U.S. Dollar
¥	:	Japanese Yen

Abbreviation

Lao PDR	:	Lao People's Democratic Republic
MAF	:	Ministry of Agriculture and Forestry
MCTPC	:	Ministry of Communication, Transport, Post and Construction
DEPFIC	:	Department of Economic Planning, Finance and International Cooperation
DI	:	Department of Irrigation
DAF	:	Department of Agriculture and Forestry
DCTPC	:	Department of Communication, Transport, Post and Construction
IIM	:	Institute of Irrigation and Microhydropower
EOJ	:	Embassy of Japan
JICA	:	Japan International Cooperation Agency
ADB	:	Asian Development Bank
FAO	:	Food and Agriculture Organization
IBRD (WB)	:	International Bank for Reconstruction and Development
MC	:	Mekong Committee
The Team	:	JICA Study Team
NEM	:	New Economic Mechanism
GDP	:	Gross Domestic Product
S/W	:	Scope of Work
M/S	:	Masterplan Study
F/S	:	Feasibility Study
O/M	:	Operation and Maintenance
P.	:	Province
D.	:	District
B.	:	Ban
H.	:	Houay

CHAPTER 1 INTRODUCTION

1-1 Background of the Study

The area of Lao PDR is 236,800 km^2. It is an inland country bordered to the east by Vietnam, to the north by Myanmar and China, to the west by Thailand, and to the south by Kampuchea. The population in 1990 was estimated at 4,170,000 and the population density was 17.6 persons/km^2.

Lao PDR established a social democracy system in December 1975, but recently, it tries to keep friendly relations, not only with eastern countries, but also with the western developed countries and ASEAN countries, in order to develop its economic situation. It has diplomatic relations with 66 countries and had 24 embassies in 1988.

The economic policy has been reformed to the western system, based on the NEM issued at the Fourth Party Conference held in October 1988. For example, centralization, subsidy system and bureaucracy are being excluded from the state enterprises, while independence and activation are being promoted. Every economic sector is being developed according to the methods of national capitalism, in order to improve production. As a result, training and the introduction of foreign techniques are being promoted, private ownership of agricultural lands is being permitted according to the farmer's ability and, the liberation of the rice market in order to increase productivity, policies preferring cooperative systems are being revised to consider individual rights, and the market shall determine production. A new tax system that will promote production and marketing is being studied, and a law on foreign investment was proclaimed in July 1988.

The GDP per capita of Lao PDR is extremely low at about 180 US$ (1988). Agriculture covers 60% of the GDP according to the estimation of the World Bank, it also employs 70% of the working populace (15 ~ 64 years old) which is 42% of the total population as of 1986. In 1986, according to the FAO estimation, the cultivated area was 900,000 ha, pasture area was 800,000 ha, and the forest area was 13,100,000 ha. According to the above statements, agriculture and forestry are the main industries. However, their development is extremely slow.

In the 1980's, rice production in Lao PDR exceeded one million tons. It reached 1.44 million tons in 1986 and self-sufficiency in rice production was declared. Severe drought in 1987, however, caused a 17% decrease from the previous year's production and a shortage of 220 thousand tons of paddy for domestic consumption. Furthermore, decrease in rice production continued in 1988 due to flood and drought.

From these conditions, the Government of Lao strived to improve the agricultural structure so as to exploit agricultural potentials, and worked to change the individual self-sufficient agricultural system to a marketable one. In the 2nd Five-Year Plan (1986 ~ 1990), very important attention was concentrated on the 1). achievement of self-sufficience in food, decrease in imports (excluding food), the promotion of production and export, 2). development of transportation and communication, 3). and the development of human resources. In the plan, 34.7% of the investment plan is allocated to agriculture in which 18% is distributed to irrigation.

The basic policies of the agricultural development of the Lao Government are as follows;

(1) To Establish a relationship between the Government and the farmers by shifting from a bureaucratic system to a supportive and serviceable system, and to make the farmers understand production, marketing and regional characteristics.

(2) To introduce Technology

a) To shift from a self-sufficient agriculture to marketing agriculture

b) To solve the problems concerning water (effective use of water resources, protection from flood and erosion)

c) To introduce bio-technology

d) To improve the roads, facilities and machineries

e) To develop forestry

f) To train the farmers

(3) To promote the production plan and to implement the investment and services necessary to it.

(4) To gain the support of all agricultural development sectors.

(5) To effectively accept international cooperation.

The targets of agricultural development are:

(1) To expand agricultural dimensions by making use of natural, land and labour resources.

(2) To improve the agricultural structure by means of ① breaking away from a production structure which relies principally on rice cultivation and individual self-sufficiency, ② developing agriculture in all fields (cereals, cash crops, industrial plants, livestock and forestries), ③ harmonizing the agricultural structure of forestry and livelihood, ④ developing rural agro-industry, ⑤ promoting positive forestry-related activities in order to preserve the environment, farming, livestock breeding and living conditions, ⑥ and by combining experiences and traditions with modern technology.

Various models will be proposed, in order to achieve these targets.

In spite of its location and self-sufficiency in rice production, the province of Savannakhet is still underdeveloped. The Government of Lao PDR has requested the cooperation of the Japanese Government to carry out a master plan study and a feasibility study on the top priority project in Savannakhet Province. In response to the request, the Government of Japan sent the preliminary survey team of JICA to Lao PDR on August 7, 1990. The Scope of Work for the study and the Minutes of the Meeting were agreed upon and signed on August 15, 1990. The study commenced on November 12, 1990.

1-2 Objectives of the Study

The objectives of the study are as follows:

(1) To formulate a master plan for the Integrated Agricultural Rural Development Project in Savannakhet Province, in which comprehensive water resources development programs are to be reviewed and developed,

and possible agricultural rural development projects are to be identified and evaluated.

(2) To carry out a feasibility study on the top priority project of the master plan.

(3) To transfer knowledge to the counterpart personnel of Lao PDR through on-the-job-training in the course of the study.

1-3 Study Area

The study area covers the following parts of the Savannakhet Province: Khanthabouly, Champhone, Songkhone, Outhomphone, Saybouly, Atsaphanthong districts, the right bank of Xe Banghiang located to the west of Xe Douangmala in Songbouly district, and the catchment area on the right bank of Xe Bangfai located to the west of route No. 13.

1-4 Policy and Scope of the Study

1-4-1 Policy of the Study

Agriculture is a key industry in Lao PDR and its development is very important to raise the economy of Lao PDR. The Lao Government, therefore, has attached importance to agriculture in its last economic development plans which was aimed at self-sufficiency in rice production. As previously stated, the plans succeeded and self-sufficiency was achieved in 1986. Although rice production has decreased in 1987 and 1988 due to drought and flood, it has almost recovered in 1990 indicating that self-sufficiency will be achieved again in the very near future.

Aside from concentrating on the establishment of rice production that will not be easily influenced by natural disasters and one that will correspond with population increase, recently, the Government of Lao aims to improve the marketing, diversified, modernized and integratedly developed agricultural structures. However, the technology used in farming organizations and facilities, marketing, irrigation, post-harvest treatment, livestock and processing of traditionally self-consumptive mono-cultural agriculture, which is dependent on natural conditions, are underdeveloped.

For the successful improvement of the agricultural structure, therefore, a harmonized development in all fields has to be formulated.

The most serious factor which impedes agricultural development is lack of funds and technology. Lao PDR is concerned, not only with the high economic growth of Japan, but also with the technical developments of agriculture, its key industry, especially concentrating on the complete development of the marketing structure, organization, irrigation and diversified agricultural structures. In order to discover the technical methods suitable to Lao PDR through Japanese techniques, it is necessary to open Lao's economy, to establish a free policy, and to train engineers.

The Study Team decided the following approach with due consideration to the above mentioned items.

1) A Development Harmonized in all Fields

As previously mentioned, a basic agricultural development shall be conducted in all fields, and an agricultural structure, which has not been experienced by leaders nor farmers, shall be established.

Development will not be totally effective unless it is applied in all the related fields. For example, the improvement of productivity would be useless unless the marketing systems, transportation systems and farming technology are also developed.

Therefore, a study will be carried out so as to implement harmonious development in all fields (diversified agriculture, marketing systems, production increase, livestock, fishery, etc.).

2) Formulation of a Feasible Plan

Although the area is wide, the implementation of an unfeasible plan would render it useless. A feasible plan will be formulated taking into consideration the scale of the local budget and the actual results of the foreign aids.

A study will be made, therefore, to enable the effective implementation of the plan on a wide area with small investments.

3) Understanding the Rural Socio-structure

The ties of the village communities in Lao PDR are strong. It is, therefore, important to study and understand the rural socio-structure, government policy, farmers' needs and the past agricultural systems, and to establish a plan which is familiar with the farmers.

4) Irrigation

Many of the irrigation facilities in the study area, with the exception of the pumping systems, are used to supply water during the dry season. Therefore, irrigation for a stabilized production during the rainy season will be studied.

1-4-2 Scope of Work

The flow chart of the study is shown in Fig. 1-1. The study is composed of two (2) phases.

1) Phase I

A master plan for the integrated agricultural development will be formulated in this phase. The priority of the projects formulated in the master plan will be studied.

2) Phase II

A feasibility on the master plan's top priority project will be carried out.

CHAPTER 2 OUTLINE OF THE STUDY AREA

2-1 Topography and Soil

2-1-1 Topography

The study area is a semi-plain extending from the southwest foothill of Annam Massifs to the Mekong river. It has a width of 120 km from east to west, a length of 150 km from north to south and an average elevation of 200m. The topography of this area is a little complicated with meandering Xe Bangfai and Xe Banghiang rivers, small to medium streams, several basins, a lot of valleys and the alluvial plain of Xe Bangfai Downstream basin. The topographical map is shown in Fig. 2-1.

2-1-2 Soil

The study area is mainly classified into two areas, one of which is a residual soil area with the mother materials of weathered parent rocks, and the other is a transported soil area by the river action of the Mekong river system.

These soil layers are generally several meters thick. The clay in the soil is assumed to be Kaolinite. The contents of the clay, having the physical moving effect of rainfall, is generally low in the surface layer of middle to highland areas, and very low especially in steep areas with low vegetation. The rainfall effect causes not only the movement of clay, but serious soil erosion followed by gully which are seen in a lot of places in the area. There is very little corrosion and organic matter in infertile or steep highland areas, but a lot is observed in the basins of low land areas.

Therefore, the soil of the study area is not generally fertile but physically good and cultivable. It has high potentials for production increase through appropriate soil management.

According to the classification of FAO/UNESCO, the soils in the study area are classified into the following 5 groups. The soil map is shown in Fig. 2-2.

(1) Orthic Acrisols

They are distributed in the slope or hilly areas with high elevation and well drained conditions. The surface horizon is sandy with low developed soil structure and is easily eroded to gully by rainfall. Soil fertility is low. Argillic horizon accumulated with clay covers the next horizon.

(2) Ferric Acrisols

These soils are distributed from the top to the foot of the undulating hills with medium elevation. The contents of the clay in the surface horizon is less than that of Orthic Acrisols and the sandy horizon is thick because of low vegetation. The horizon sequence is the same as in Orthic Acrisols. The ground water level is about 5 m. Some of the areas contain laterite.

(3) District Gleysols

These soils are distributed in the lowland areas along the Mekong river. The formation of the soil is greatly affected by the Mekong river. The soil is fertile enough with loams containing water.

(4) Other Lowland Soils

These soils are distributed in the lowland basin and valley basin areas. The parent material of the soil is clay which is drained from the back mountainous areas. The formation of the soil is greatly affected by flood and ground water level. There are several kinds of soil found in this area, and they are Gleysols, Acrisols and Fluvrsols. These soils are generally structured from heavy clay and are very fertile.

(5) Highland soils

These soils are distributed in the high and dry land areas. They have thin layers with some gravels and are very erosive owing to the steep slopes.

2-1-3 Vegetation

The vegetation of the study area is divided into 3 categories: forest, shrub and marsh.

(1) Forests: These areas are composed of dry deciduous forests, located in the highland areas with an elevation ranging between 140 to 180 m. Dipterocarpaceae dominates the forest and the big-tall trees which form sparse woods with shrubs (Strychnos Spp, Randia Spp) and grass. The forests near the villages are mostly covered with young trees and shrubs because of deforestation. All of them are natural forests.

(2) Shrubs: These areas are composed of various kinds of trees, bamboos and grasses adjacent to the existing cultivated areas.

(3) Wetland and marsh: These areas are located in the lower areas of the existing cultivated areas. These areas are covered with graminacae sp. grasses, reeds, Coba (Zizania Latifolia Turcz), etc.

2-2 Land Use

2-2-1 Present Land Use

The rainy season rice cultivation has been carried out for a long time and it dominates the farming activities in the study area. The rainfed paddy field has an elevation ranging from 140 to 170 m, and it is shaped like a basin. In Xeno, the elevation of the rainfed paddy fields is 180 m, and these fields are used for rice cultivation during the rainy season. In the dry season, paddy cultivation is carried out by flood recession cultivation in the shallow areas of the marsh or the reservoir. In some areas (such as the foot of the valley, etc.) with plenty of spring water or the lowland areas, dry season paddy is cultivated through small to medium scale irrigation systems. Furthermore, various kinds of field crops are grown in the rainfed paddy fields along the small and medium size rivers. However, the total cultivated area of field crops in the dry season is very low, showing a low utilization percentage of rainfed paddy fields, even including dry season paddy. The rainfed paddy fields are also used as grazing land in the dry season.

The drainage conditions in the lower basin of Xe Banghiang is bad and is left undeveloped.

The highland areas adjacent to the rainfed paddy fields lead to the forest where a village, a road, banana and vegetable gardens can be found. There are small slash and burn fields in the highland areas around the villages. Most of these fields are cultivated only to cover the poor harvest of paddy. Shifting slash and burn cultivation has not been observed in this area. The crops for slash and burn fields are upland rice, corn, beans, cotton and groundnut, etc., and the use of the fields is limited up to 4 years.

There are orchards along route No.9, which is located in the suburbs of Savannakhet, where coconuts, longans, litchi and banana, are planted.

The forest areas are located in the higher areas of the rainfed paddy field. The area has broad leaved trees forming natural forests with a capacity of 90 m^3/ha. However, the capacity of the area with good trees is now gradually decreasing. Only 35~40% of the total forest area is left. Only the logs with a breast diameter of more than 60 cm are lumbered, however, the losses are quite big because of poor equipment and roads. Considerable amounts of forest production such as cardamom, lacquer, resin and rattan, etc. are gathered. The forest areas around the villages have been deforested, and at present, it has become an area for firewood collection. These areas are also natural grazing areas.

The surface water of the ponds, reservoirs and the marshes are very important to the environment and are used for inland fishery.

2-2-2 Characteristics of the Present Land Use

The characteristics of the present land use in the study area are summarized below.

(1) The cultivated lands are mainly rainfed paddy fields and mono-culture is implemented in the paddy during the rainy season. Lowland and highland areas with no water resources are not cultivated.

(2) Planting in rainfed paddy fields in the dry season is very limited because of poor water resources. The lands are rarely used for cultivation, they are mainly used for pasture.

(3) Except for some orchards in the higher lands than rainfed paddy fields, the number of cultivated lands are few because of the following factors:

- 4 months dry season with high temperature
- Poor water retentivity of the sandy soil leading to drought and erosion in the rainy season

(4) The forest areas are composed of natural broad leaved trees and has a very high capacity. These areas are also blessed with plenty of special forest products, some of which are utilized for animal grazing. Recently, these areas are deforested resulting in the decrease of the number of big trees and the increase in the number of young trees and bushes around the village.

(5) Ponds and reservoirs are traditionally used for inland fishery.

(6) The village areas and main roads are located in areas with more than 140 m elevation.

The present land use is summarized below and Table 2-1 shows the present land use according to district.

Kind of land	Area (ha)	Ratio (%)	Reference
Rainfed paddy field	86,072	98.1	100.0%
Paddy, double cropping field	1,679	1.9	
Total paddy field	87,751	97.2	100.0%
Upland field	2,493	2.8	
Cultivated land	90,244	7.5	100.0%
Forest and other lands	1,109,856	92.5	
Total	1,200,100	100.0	

2-2-3 Geology

The study area is located in the eastern end of Korat plateau and the geology is mesozoic. The parent rocks are mainly composed of sand stone, shale and siltstone. The soil layers are several to more than 10 m thick. Furthermore, the soil layer in some places contains gravel layers of laterite or hard pan.

On the other hand, the lower basin and plain of Xe Bangfai river and the middle basin of Xe Banghiang river are covered with deep alluvium which are rich in clay.

2-3 Meteorology and Hydrology

2-3-1 Climate

The study area has a tropical climate which is dominated by the south-west monsoon. The monsoon, carrying moisture from the Indian Ocean, brings heavy rainfall between mid-May and mid-October. The north-east monsoon between November and mid-February brings cool air from Siberia and mainland China.

The annual rainfall in Savannakhet varies between 1000mm and 1650mm in 1967 ~ 1989. The average depth is about 1400mm. The average depth in Xeno is about 1700mm.

The annual average temperature is about 26°C and the monthly temperature ranges from 21°C to 30°C.

The relative humidity ranges from 75% to 82% during the rainy season and 64% to 68% in other periods. Table 2-1 summarizes the pan evaporation, mean wind velocity and sunshine hours at Savannakhet.

2-3-2 Meteo-hydrological Data

Meteorology and Hydrology Department, the Ministry of Agriculture and Forestry is responsible for the management of all stations in LAO PDR.

At present, 16 meteorological stations and 20 hydrological stations are in operation for the project area and Thailand.

Table 2-2 shows the lists, station's code numbers, station's name, location, datum level, etc.

2-3-3 Flow Regime

The Xe Banghiang and Xe Bangfai rivers which pass through Savannakhet and Khammouane provinces are the large tributaries of the Mekong river.

The Xe Banghiang basin has a catchment of 19,600km^2 and occupies most of Savannakhet province through which it flows westwards before joining Mekong river at Khemarat. The Keng Done and Keng Tangane falls are situated in the Xe Banghiang's meandering downstream reach. The Xe Champhone and Xe Xangxoy rivers are large tributaries which join the main river through the Xe Noy river, about 15km upstream of Keng Done.

The Xe Bangfai is a medium-sized tributary of Mekong river, with a catchment area of 9,470km^2. It is located on the left bank of Mekong and joins the opposite Nakorn Phanom, in northeastern Thailand, some 55km downstream of Thakhek. The lower basin of the Xe Bangfai, downstream from the Xe Bangfai bridge, is subject to overflow during the flood season.

The flow regimes of Xe Banghiang river at B. Keng Done and Xe Bangfai river at the bridge are listed on Table 2-3.

2-3-4 Flood

Flood occurs mostly during the south-west monsoon season, from May to September. Flood in the study area can be classified into the following two types:

- Seasonal floods of Mekong river which affected the Xe Bangfai plain directly
- Flash floods from main tributaries

The seasonal floods occur from the end of July to early September, when the south-westerly monsoon wind blows, after strong continuous rain for several days or storm rainfall for 2 or 3 days. The flash floods occur mostly in the Xe Banghiang, Xe Bangfai, Xe Champhone and other tributaries.

(1) Xe Bangfai basin

The lower Xe Bangfai flooding area is affected by the water level of Mekong river during the south-east monsoon season from the middle of May to October.

The following table shows the maximum water levels of main flood years between 1970 and 1984 at Xe Bangfai bridge.

Flood Maximum Water Level (Xe Bangfai bridge)

Year	Date	Xe Bangfai Max. W.L. (m)
1970	27 Aug.	+144.66
1972	31 Jul.	+144.45
1974	30 Aug.	+144.38
1975	3 Sep.	+144.70
1978	12 Aug.	+144.40
1984	18 Aug.	+144.15

Fig. 2-2 shows the hydrographs of the above years, showing the flooding levels varying between 135.00 and 145.00 m E.L. with consecutive more than one month of 140m elevation. Fig. 2-3 shows the flooding area in the Xe Bangfai lower basin with a total area of about 30,000ha.

(2) Xe Champhone basin

The following table shows the maximum water levels of the Xe Champhone river in the years 1976 to 1988 at Kengkok and Khemarat.

Year	Date	Max. W.L. (m) (Kengkok)	Max. W.L. (m) (Khemarat)
1976	7, Aug.	+137.70	+130.28
1977	8, Sep.	+137.71	+125.92
1978	17, Aug.	+141.24	+128.78
1979	26, Sep.	+137.68	+126.42
1980	8, Sep.	+137.90	+130.36
1981	11, Aug.	+137.56	+129.73
1982	27, Sep.	+137.64	+124.66
1983	11, Oct.	+136.11	+123.16
1984	4, Aug.	+137.66	+124.95
1985	12, Aug.	+137.78	+126.81
1986	29, Aug.	+137.60	+124.91
1987	11, Sep.	+137.20	+125.65
1988	5, Aug.	+138.08	+123.83

Fig. 2-4 shows the hydrographs of the years 1985 to 1988 at Kengkok and Khemarat, illustrating that the water levels of the rivers around Kengkok reach 130.0m to 135.0m E.L. in the south-west monsoon season. Therefore, the lower areas of Kengkok are facing a serious problem of drainage. The year 1988 has the lowest rice production among the recent years due to flood, showing a demand for drainage countermeasure for the areas with 137.0m and 138.0m E.L.

Table 2-3 Flow Regime of Xe Banghiang and Xe Bangfai

Xe Banghiang (cu.m/sec)

Year	Max.	High	Medium	Low	Drought	Min.	Average
1960			(Lack of some data)				
1961	6,360.00	1,130.00	176.00	53.00	4.00	0.00	964.18
1962	4,950.00	666.00	146.00	66.10	3.70	1.00	572.83
1963	5,440.00	911.00	107.00	47.20	3.70	0.20	647.72
1964	7,070.00	538.00	167.00	41.80	4.00	0.00	666.91
1965	2,250.00	466.00	111.00	65.20	3.70	0.20	333.88
1966	3,970.00	376.00	148.00	42.70	2.70	0.00	448.52
1967	4,100.00	375.00	116.00	48.10	4.00	1.00	417.98
1968	7,540.00	277.00	89.20	39.10	2.30	1.00	418.24
1969	4,930.00	117.00	451.00	40.90	1.60	0.20	475.54
1970	4,220.00	185.00	619.00	44.00	1.00	0.20	490.85
1971	5,760.00	170.00	840.00	55.30	3.60	0.00	624.69
1972			(Lack of some data)				
1973	2,790.00	107.00	550.00	47.20	5.40	0.00	435.48
1974			(Lack of some data)				
1975	4,710.00	192.00	476.00	52.60	2.80	0.00	546.56
1976	4,020.00	131.00	371.00	31.90	4.80	0.00	337.49
1977	3,150.00	62.20	190.00	31.90	4.60	1.00	268.92
1978			(Lack of some data)				
1979			(Lack of some data)				
1980			(Lack of some data)				

Xe Bangfai (cu.m/sec)

Year	Max.	High	Medium	Low	Drought	Min.	Average
1973	2,990.00	653.00	104.00	39.80	25.70	22.80	441.41
1974	3,220.00	556.00	94.60	30.20	26.90	25.70	497.04
1975	3,320.00	522.00	97.30	31.80	26.90	25.40	515.34
1976	3,190.00	569.00	89.40	34.50	30.00	29.20	446.55
1977	2,870.00	265.00	42.00	32.20	27.50	26.60	246.74
1978			(Lack of some data)				
1979	2,780.00	300.00	68.20	30.80	17.00	15.00	380.97
1980	2,760.00	273.00	50.30	25.10	19.10	17.90	243.87
1981	3,000.00	589.00	111.00	26.60	19.90	17.60	420.82
1982	1,850.00	393.00	53.20	31.40	17.70	16.70	278.22
1983	1,190.00	263.00	39.10	24.60	19.30	17.20	151.35
1984	3,140.00	411.00	116.00	28.00	18.60	16.70	427.44
1985			(Lack of some data)				
Average	2,755.45	435.82	78.65	30.45	22.60	20.98	368.16

2-4 Society

In 1975, after the formation of the republic of the people's socialism, Lao Government has made an effort to promote the industrial development, based on agriculture.

The Three Year Middle Term Plan (1978 - 1980), the First Five Year Development Plan (1981 - 1985), and the Second Five Year Development Plan (1986 - 1990) made a steady progress, but the self-sufficiency in rice production, which is the staple food, is still not in a good situation.

The present structure of the Lao Government is shown in Fig 2-6.

On the other hand, the administrative organizations of each province have an agricultural department. The structures of the study area provinces; Savannakhet and Khammouane, are shown in Fig. 2-7 and 2-8.

2-4-1 Population

The population of Lao PDR in 1990 was approximately 4,170 thousand. The rate of increase of the population in 1990 was approx. 2.9%, and in the past 5 years similar trend shows.

The population changes in the past 5 years of each district in Savannakhet Province are shown in Table 2-5. The population in 2000 is estimated using the statistic method on the past 5 years data.

The estimated labor population of each Savannakhet district is shown at Table 2-6.

2-4-2 Education

The education system in Lao PDR is controlled by the Ministry of Education and Sports. As for the provinces, it is controlled by the Department of Education and Sports of each province.

The general education system comprises 5 years of primary school, (children enter at the age of six), 3 years of secondary school and 3 years of higher secondary school. The number of schools, teachers and students in

each district of Savannakhet Province and Nongbok of Khammouane Province are shown in the Table 2-7.

The system of compulsory education is not established. The primary school entrance rate is 75%, secondary school is 12% and higher secondary schools is 3%.

Songbouly District has the highest number of schools per capita in Savannakhet Province, and is also higher than national average. However, the primary school entrance rate in Savannakhet Province is less than the national average. The same rate was observed in other school levels.

2-4-3 Medical System

The medical system in Lao PDR is controlled by the Ministry of Health. The number of hospitals, doctors, nurses and beds in each district in Savannakhet in 1990 are shown in Table 2-8. The number of hospitals and dispensaries are considerably lower than that of the national average.

The highest cause of death is by malaria, and the next diseases are parasitic infections, diarrhea, bronchitis and indefinable diseases.

2-4-4 Systems of Agricultural Support and Extension

The authorities of agricultural experimentation and research are as follows:

Sarakham Rice Crop Research Center
Hadokheo Agricultural Experiment Station
Agricultural Research Center

The collection of local species of paddy, upland crops, and the adaptation of improved species are carried out at these research centers.

On the other hand, at the Thasano Seed Farm in Savannakhet province, paddy is planted during the rainy season, and paddy, maize and beans are planted during the dry season. There are 7 employees (6 men and 1

woman) on this farm. The detailed activities of the farm are mentioned in 2-6 Agriculture.

Agricultural extension is predominantly executed by the provincial department of agriculture, who goes around to the rural areas, and undertakes extension activities such as giving advises. The number of agricultural extension technicians by district are shown as follows:

District	No. of Technicians	District	No. of Technicians
(Khammouane P.)			
Nongbok	15	Songbouly	0
		Songkhone	28
(Savannakhet P.)		Atsaphanthong	30
Saybouly	8	Others	28
Outhompkone	8		
Khanthabouly	6	Savannakhet Total	123
Champhone	15		

According to an oral survey, the extension workers do not have a very good reputation in spite of their efforts. The reasons are as follows:

① Inadequate transportation and road conditions for the workers
② Insufficient budget for the extension activities
③ lack of fertilizers and chemicals for agricultural extension

2-4-5 Land Ownership

Land is basically owned by the government. Therefore, it is necessary to have permission from the government to use the lands. However, it is possible to hand over one's land to others by cash. In this case, it does not have an official price, and the settlement is made by discussion between the persons concerned.

The reclamation is in a licence system, though preference is given to cultivation of river beds and petty farmers' cultivation.

2-4-6 Tax System

The amount of tax imposed depends on one's harvested crop, and the tax is basically paid by paddy. The grades of harvested crop are as follows:

Grade	Harvested Volume (t)	Tax (kg/ha)
I	3.5 ~ 4.0	160
II	2.5 ~ 3.5	140
III	2.0 ~ 2.5	120
IV	less than 2.0	100

In case of a decrease in the production by disaster, etc., there is a system of tax reduction by damages. The tax reduction is as follows:

less tha 30% of decrease in production	no tax reduction
30 ~ 50%	20% reduction
50 ~ 75%	50% reduction
more than 50%	tax exemption

The taxation of savannakhet in the past 5 years is as follows:

Items	1986	1987	1988	1989	1990
Upland paddy field (ha)	9,952	9,952	7,309	8,001	8,110
Rainfed field (ha)	82,209	82,209	75,882	82,227	82,227
Total harvest (t)	210,082	231,142	81,973	247,644	238,230
Tax for paddy (t)	8,360	9,507	4,212	8,185	8,185
Tax for cash (10^3 kip)	292,600	427,815	210,600	532,025	572,950
Tax reduction area (ha)					
Reclaimed paddy field	1,019	1,019	709	709	1,053
Re-reclaimed paddy field	660	660	8,148	1,562	1,562
Irrigated paddy field	824	824	813	920	920

Data source: Tax Office, Savannakhet

2-4-7 Farmers' Organization

In 1978, the Government of Lao PDR set a production target of 1,000,000 tons of unhulled rice and promote agricultural collectivization and cooperation. According to the statistic data of Lao's, the number of farmers' cooperatives and cooperative members in the past are as follows:

Year	No. of cooperatives	No. of Members	Year	No. of cooperatives	No. of Members
1978	1,365	54,800	1983	2,114	86,515
1979	2,626	86,525	1984	2,546	140,079
1980	1,420	66,687	1985	3,184	163,188
1981	1,343	63,254	1986	3,420	170,261
1982	1,952	84,459			

The past condition of organization in Savannakhet Province is as follows:

1978	56	Cooperatives
1979	158	Cooperatives
1982	7	Cooperatives (having no effect, they decreased)
1987	631	Cooperatives (due to reeducation for leaders, they increased)
1990	0	Cooperatives

As indicated above, as of 1990, the cooperatives have completely disappeared. Moreover, according to a survey, there are no longer any cooperatives, with the exception of a few cooperatives in the provinces of Houaphanh, Champassack and Xiengkhuang. The main reasons behind the disappearance of these cooperatives are as follows:

① the cooperative leaders were elected from the farmers by voting, however, both leaders and members did not have a good understanding of the cooperatives.

② the farmers distrusted the cooperatives because they had no information on the accounts.

③ They cannot choose their own farming hours.

④ There were too many regulations in the cooperatives.

⑤ Dissatisfaction with the tax system.

⑥ Dissatisfaction with the distribution of rewards.

Currently, instead of the cooperatives, agricultural supporting authorities for the construction of irrigation facilities and O/M, in a style of enterprise, are being established in each province.

2-5 Agro-economy

2-5-1 Agricultural Production

The economy of the study area is dependent on agriculture. 90% of the labor population belongs to agriculture. The main products in the study area are rice, sweet potatoes, maize, mongo beans, soybeans, peanuts, tobacco, cotton, sugarcane and spices. Vegetables are planted on a small scale at the fields where water is accessible. According to the basic data, the paddy harvested in Savannakhet Province in 1990 was 236,000 tons from 87,121 ha. This rice production corresponds to 15.6% of the total rice production in the whole country, and is the highest. The rice production per capita in Savannakhet Province was 368 kg. However, according to the data of the Department of Planning, the surplus rice was only 10 tons, which will be insufficient in case of emergencies like floods and droughts. The volume of rice produced in each district is shown in Table 2-9.

Rice production relies mostly on rainfed single crop paddy fields, which covered 78,915 ha (91.9%). The upland paddy fields covered 6,925 ha (8.1%). The irrigated paddy fields were only 1,281 ha.

Forestry is an important industry in Savannakhet Province. Forests account for 75% of the whole area and produces not only general timber but also teaks and red sandalwoods. The volume of felling in 1990 was 41.5 million m^3, and the exported lumber was 25 million m^3. The felling is in the licence system. Tax imposes 25US$ on teaks, 250US$ on red sandalwoods.

2-5-2 Farmers' Economy

Farmers' paddy field holding in Savannakhet Province ranges from 0.6 ha to 1.7 ha, and 1.0 ha on average.

The Gross Domestic Production (GDP) in Savannakhet Province in 1990 was 124 million US$, 178US$ per capita. Agricultural section covers 87% of GDP. Crop production covers 39% of the agricultural section, livestock production 57% and forestry 4%. Industry covers 8% of the GDP, and mining 53% of the industry section. The detailed data are shown in Table 2-10.

It was difficult to completely analyze the agricultural income of each farmers due to a peculiarity in farm management. In addition to the available data by the district, the farmers' income is estimated, assuming that 20% of the total heads of animals are sold every year, by converting buffaloes and cattles into U.T.B. and pigs and poultries into unit. The income from forestry is omitted due to lack of data. According to this estimation, average net income is only 300 US$ per farmers' house, but it seems that there are other sources of income such as forestry. The results of the estimation are shown in Table 2-11.

2-5-3 System of Farming Finance

Farming capital is poor, however, there is an agricultural loan system for the farmers who appears promising. The interest is 0.5~45%, the upper-limit of the low interested loan is 500US$, and the term of payment is 10 years. However, in order to apply for a loan, it is necessary to present documentations for property estimation, repaying plan and repaying compensation. It is difficult for farmers, who need the funds, to repay with high interests. Most farmers, who need low interest loan, fail the documents screening. At present, the problems of insufficient funds and repaying compensation are not fully solved, the fund cooperation is not effectively done.

2-5-4 Im-export and Marketing Price of Agricultural Products

Most of the condiments and processed agricultural products are imported from neighboring countries. The payment in 1990 for the main imported products was 2,229,250US$; 444,500US$ for milk, 510,000US$ for sugar, 274,750US$ for condiments and 1,000,000US$ for others.

The main exported products are woods and their processed products are valued at 1,730,920US$, buffaloes and cattles at 2,034,785US$ which includes animals valued at 1,150,658US$ are imported from Vietnam and directly exported to Thailand.

The scale of the domestic market is small. The selling prices of the agricultural products and animals, therefore, repeats the same pattern every year. For example, the price of rice rises from June to August during the lower rice supply season, and then falls with the increase of the supply. The seasonal price changes of the main agricultural products and animals are shown in Fig. 2-9.

2-5-5 Marketing

The marketing structure of Savannakhet Province is under-developed due to the self-sufficient agricultural systems and the socialistic economic structure used in the past. As a result of the past agricultural structure, agro-industries, infrastructure of production and transportation, introduction of cash crops, and marketing structure are under-developed.

The marketing activities are concentrated during the dry season when the road conditions are favorable for the middlemen. They are stagnant during the rainy season. The farmers, therefore, sell almost all of the products at the cheapest season, and it motivates farmers' towards production.

2-6 Present Agricultural Conditions

The agricultural characteristics in the study area are enumerated below.

- Family management, considerably low investment and unstabilized rain-fed agriculture ruins the farm economy.
- The farmers' main objective is to stabilize their living conditions. The workers and the producers are both considered as consumers. the farmers cannot distinguish family budget from operation budget.
- Production market is small and prices are unstable. These are the factors that make the farmers lose their will to produce.
- The average cultivation ratio, rain-fed paddy ratio and irrigation ratio in the study area are 7.5%, 97% and 1.9%, respectively.

(1) Present conditions of rice production

Low elevated areas experience flood damages every year while high elevated areas experience drought damages. The damages inflicted by drought and floods in the study area in the year 1987 and 1988 were enormous. The economy of the study area has not yet recovered from these damages.

Upland rice and floating rice are beneficial crops in areas with unfavorable geographical conditions. However the yield, at 1.5 tons/ha, is lower than that of the other paddies.

The damages inflicted by floods are shown in Table 2-12.

(2) Input of Agricultural Chemicals, Fertilizers and Seeds

There are only few fertilizers, agricultural chemicals and high yield seeds in the study area necessary to production development. Chemical fertilizers are only used in nurseries and vegetable gardens, and only few agricultural chemicals are used in high quality vegetables. Most of the high yield varieties have poor resistance to flood and the amount of varieties produced is not enough.

Although seeds are sold in Thasano seed farm, distribution is not properly conducted due to lack of transportation.

Fertilizers and agricultural chemicals are generally sold in the Agricultural Enterprise. The results of the Thasano seed farm seed distribution are shown in Table 2-13.

(3) Agricultural and Rural Support System

A plan that will support farming funds, develop irrigation, and prevent livestock epidemic will be formulated.

The objectives, however, cannot be easily obtained due to the following reasons.

a) Shortage of development funds and technical experts

b) Small domestic market and unstable prices

c) Large regional differences due to delay in rural road improvement

d) The release of farming funds take time

e) Under-developed organizational support

Due to the shortage of funds, only few projects are being implemented.

(4) Standard Volume of Agricultural Works

There is no standard established for agricultural works. According to the data of the agricultural department, the whole family works in the rain-fed paddies, and the amount of work conducted is 1.8/couple, which is about 250 days/year. There are about 2.0 temporarily hired workers for 7 to 10 days in other fields during the harvest season. The total number of working days is 60 days. The planting ratio is shown in Table 2.

(5) Fruit trees and Vegetable Cultivation

Banana and coconuts are planted in areas with an elevation of 150 m, while longan, sugar apples and jujube are planted in areas with an elevation of 150~200 meters. Coffee and pepper are planted in high lands.

Different kinds of trees are planted in order to reduce damages. The building of a producing district is slow. As a result a) technological management stagnates, b) low economic effect due to the delay in the

introduction of improved seeds, and c) the development of the market is slow.

These impeding factors have not been solved and development is not furthered in spite of existing development reserve.

Vegetables are exchanged for cash during the dry season. However, due to the delay in the reclamation of the domestic market, the farmers are only involved in the marketing of watermelons. Moreover, the farmers only cultivate the crops indicated by the Thai dealers. As a result, the prices are not stabilized and the farmers lose their will to produce.

(6) Industrial Crops

Cotton and pepper production, which is planted for family consumption, has considerably decreased due to delay in seed renewal and long term domestic seeding. The cropping standard is shown in Table 2-14.

(7) Use of Draft Animals and Livestock Production

Manpower and animals are both used in cultivation. The annual working days of the water buffalo is approximately 60 days/1.5 ha of rain-fed paddy. The average rental fee of the draft animals is 1,500 kip/day/head. Agricultural works, however, are conducted in groups, and labor charges are not being paid.

(8) Rice Consumption

According to the data of the Planning Department, the minimum amount of rice required is 360 kg/person/year. On the other hand, the data of the Agricultural Department was calculated based on the unofficial age classification data.

The results showed that there is enough rice to cover the required amount. However, there are no extra amounts due to the damages inflicted by drought and flood.

(9) Cropping standard slightly differs every year according to the disparity in the amount of rainfall. The planting rate of the upland crops changes every year according to the specifications of the dealers of the agricultural

crops. This condition causes the prices to remain low and technology to remain underdeveloped.

The present planting conditions are shown in Fig. 2.

(10) Livestock Breeding and Livestock Prices

Livestock breeding is indeed important because the animals can be exchanged for cash. Livestock and draft animals are both important sources of protein. The animals are left to graze in the fields for the whole year. The number of animals hardly increase and the death rate of the young animals is high due to feed shortage during the dry season. The effects of vaccination has increased and training is being conducted to increase the number of staff.

(11) Consumption of Livestock and fish Production

Meat consumption is estimated from the number of animals butchered. Although there were no available data on fish consumption, the interviews conducted in Pakbo farm enabled us to estimate fish consumption.

Aside from the abattoir records, several animals are also butchered during ceremonial occasions. However, there are no data on the specific number of animals killed during these occasions. The estimated meat consumption of the study area is 2 kg/person/year.

(12) Inland Fishery

A full scale inland fishery is not implemented in the study area. Although breeding in the existing small dams and marshes can be improved, due to the following reasons, it is still underdeveloped.

- Shortage of fishing materials (fishing nets and boats)
- New fries escape the marshes and dams which overflow during the rainy season
- Fish production is small and prices are high

The Development Potential of Inland fishery in the study area is shown in Table 2.

(13) Mineral, Forestry and Processing Industry

The study area is also involved with minerals and rock salts, aside from forestry and other related industries. The area is only involved with the production of lots of undiscovered resources because the scale of the domestic lumber industry and rock salt refinery is small. Recently, there is a growing concern for the depletion of lumber resources. It is, therefore, desirable to construct a processing industry as the source of the farmers subsidiary income. The materialization of this concept is once again hindered by lack of funds and technical experts.

2-7 Irrigation and Drainage

2-7-1 Existing Irrigation Farming

Similar to the rest of Lao PDR, agriculture in the study area depends largely upon rainfed paddy cultivation in the rainy season. Under specific climatic and topographic conditions, the rainfed agriculture in the area has the following constraints;

- Damage by drought in drought year
- Damage by flood in flood year
- Insufficiency of water for both domestic and agricultural use in the dry season

In the Second Five-Year Plan (1986 ~ 1990), the Lao PDR government declared the aim to 'Stabilize and increase the rice production and crop diversification' for the agricultural sector. In accordance with the above target, the provincial government has made efforts to achieve such target with the following solution to the constraints:

(1) Pumping irrigation from the Mekong and the Xe Bangfai river for dry season paddy cultivation.

(2) Storage of water by reservoirs or river channels for both dry season cultivation and domestic use.

(3) Flood gate for both flood control in the rainy season and storage of water in the dry season.

Distribution facilities are only found in the medium scale pump irrigation projects along the Mekong or the Xe Bangfai river. In the other small scale project areas, there are no permanent structures of canal but small ditches are constructed annually by the farmers. Other than these, manual watering in vegetables gardening or direct provision of water for paddy fields by small pump are very common in the area. Supplementary irrigation is only found in pump irrigation project areas in drought years, which shows that planned supplementary irrigation is not so common in the area. Under limited budget and technology, the provincial government is

concentrating on low cost irrigation agriculture with farmers participation in the first stage of irrigation development.

2-7-2 Water Rights

At present, the law or regulations for the water rights are not enacted in Lao PDR.

In theory, natural water, such as rivers, lakes, ponds and ground water, belongs to the nation and, therefore, every one possesses equal right to it. The utilization of water in each village is determined by the farmers through a village leader. When the interest of water use affects more than two villages, discussions are carried out among the village leaders with the officials from the sub-district or district.

2-7-3 Existing Irrigation Facilities

There are 4 types of facilities in the study area, and the total number of facilities is shown below.

Type	Number
Reservoir	17
Weir	12
Pump	7
Flood gate	13
Total	49

(1) Reservoir

Existing reservoirs are further subclassified into 4 types under the site and utilization conditions.

(a) Reservoirs in floody area

The reservoirs of this type are mostly found in lowland floody areas with an elevation of 130 ~ 135 m above M.S.L. around Xe Champhone river basin. The dikes constructed from laterite soils are 1,000 ~ 4,000

m long and 5 ~ 10 m high. The reservoir area is of 100 ~ 200 ha. The construction work is done by the farmers and the construction period is 3 months to 1 year.

The utilization purposes of the reservoir are;

- Dry season paddy cultivation and vegetable garden in and around the reservoir.
- Domestic use, animal use and fishing.

Transplantation of seedling is carried out according to the reduction of water depth (Flood Recession Cultivation). After the transplantation, timely irrigation of the paddy field is required by small pumps. For the vegetable garden filled with cucumber, beans and corn, manual watering is very common. Only dry season cultivation is practicable in this area owing to annual inundation in the rainy season. There are 6 reservoirs of this type in the study areas.

(b) Reservoir in non-floody areas

Reservoirs in Bungva and Nongtao (Khanthabouly district) are constructed in non-floody areas with simple and permanent canal structures in the fields maintained by the farmers. There are no canals in the farm, and plot to plot irrigation is applied. Dry season paddy growing with gravity irrigation is partly observed in addition to seasonal rainfed paddy cultivation. There are 4 reservoirs of this type in the study area.

(c) Reservoir in highland area

Two (2) reservoirs in H. Po and H. Makngao (Champone district) are constructed in highland forest areas located close to each other with an elevation of 150 ~ 160 m above M.S.L. These reservoirs are used in transmigration purposes. Those transmigrants are supposed to live on cattle raising and fishing. There are no irrigation facilities such as canals, only dikes and spillways. For domestic use and vegetable garden, water is available around the lakes.

The H. Makngao reservoir was constructed in 1987 and 40 families have transmigrated. They raise cattle and fishing. They cleared a little

rainfed paddy field in the forest, however, the yields are very low and the damages caused by rodents give the farmers problems. A trial project for raising 100 heads of cattle is being carried out around H. Po reservoir by the Department of Livestock. There are 2 reservoirs of this type in the study area.

(d) Small reservoir for domestic use

Reservoir of this type are very small (2 ~ 10 ha) and is only for domestic use and manual watering of vegetable gardens. There are 5 reservoirs of this type in the study area.

Total irrigable areas through all the reservoirs mentioned above is estimated at 1,410 ha in the dry season and 560 ha in the rainy season. (supplementary irrigation) The total reservoir area will be 3,035 ha. However, according to the interview with the farmers, the actual irrigation area depends on rainfall conditions, rice production, price of rice, farmers' intention and availability of labour. The actual irrigation area is estimated at about 70% of the above figures.

Irrigable area and reservoir area by reservoir type are summarized in the table below.

Type of Reservoir	Number	Irrigable Area (ha)		Reservoir Area (ha)
		Dry Season *	Wet Season	
(a) Reservoir in floody area	6	1,050	-	2,490
(b) Reservoir in non-floody area	4	260	450	350
(c) Reservoir in highland area	2	40	110	150
(d) Small Reservoir	5	60 **	3	45
Total	17	1,410	563	3,035

Note * Irrigable area; Actual irrigation area is estimated at 70% of the above figures.

** Pump irrigation of Koutchap (Nongbok district)

(2) Weir

The existing weirs were constructed after 1986, and most of these were built during the last 2 or 3 years (1988 ~ 1990). There are 12 weirs in the study area. These weirs are very simple stop-log type with reinforced concrete structure, a height of 4 ~ 5 m and a width of 20 ~ 30 m. Stop-logs are lined, in between with 10 cm thick of clay to stop water leakage and raise up the water level. The stop-logs are 1 m long for easy handling. The construction work is carried out by the association of benefiting farmers. Materials such as cement, reinforcement bars, gravel and transportation, through technical advice, are provided by the staffs of the provincial irrigation division. The construction period is 3 ~ 6 months.

The operation of the stop-logs is carried out by the farmers themselves by conducting discussions headed by a village leader. The stop-logs are taken out and a sand sluiceway is opened in the rainy season. To store water for the dry season, stop-logs are set at the end of the rainy season. The stopped water is stored in the river channel 3 ~ 5 km upstream and is intended for domestic use and manual watering of vegetable gardens along the river. There are some areas where the wells dry out at the end of the dry season, therefore, the stored river water is also very important as the vellagers' drinking water. However, the storage capacity of water is limited because almost all rivers dry up in the dry season, and only 3 ~ 5 ha of paddy irrigation is carried out.

Weirs in H. Kok (Songkhone district), Kengkok Bok and H. Chelamong (Atsaphanthong district) can not irrigate by gravity but by pump because of topographical conditions. Furthermore, because of the limited amount of stored water, unbalanced use of water by the villagers will cause a need for discussion.

The total area to be irrigated by the existing weirs for paddy cultivation in the dry season reaches 83 ha according to the interview survey shown below. However, the average actual irrigation area is estimated at 70% of the above figure.

Irrigation Area by the Existing Weirs

Weir	District	Dry Season Paddy Irrigation Area (ha)
H. Sikhai	Saybouly	50
H. Lahang	Atsaphanthong	7
H. Mong	Songkhone	6
H. Nokkok	Champhone	20
Total		83

Dry season paddy irrigation has not been conducted through the other 8 existing weirs. However, based on the storage capacity, the irrigable areas in the dry season is estimated at 3 ~ 5 ha per weir. The total areas the 12 existing weirs are estimated at 108 ha in the dry season and 510 ha in the rainy season as summarized below.

Irrigable Area by 12 Weirs

	Number of Weir	Irrigable Area (ha)	
		Rainy Season	Dry Season
Existing Weir	12	510	108

In addition to the above mentioned 12 permanent weirs constructed under the support of the province, there are a lot of temporary weirs built by the farmers. These temporary weirs are made of soil, bush wood and straw, etc., and constructed within a day annually at the end of the rainy season. There are no records about the temporary earth weirs, but, the number of those weirs is estimated to be big and its utilization is considered very useful.

(3) Pump

Existing pump irrigation systems are used mainly for paddy cultivation during the dry season. Temporary pumping up during the rainy season is done in drought year. The planned supplementary irrigation in the rainy season is not common in the area. There are 7 pumping facilities and they are divided into 2 types as shown below.

Type of Pump	Irrigable Area per Site (ha)	Number of Project
Floating Pump	20 ~ 30	5
Inclined Pump	300 ~ 500	2

Each floating type of pumping facility is 5 ~ 10 years old and 3 of 5 facilities are not in use because they are out of order. Medium scale projects of inclined pump are planned for Muang Khao (Thakhek district) and Tonhen (Saybouly district) where the total irrigation area is 890 ha as shown below.

Existing Medium Scale Pump Irrigation Project

Project	Water Source	District	Construction Year	Irrigable Area in Dry Season (ha)
Muangkhao	Mekong	Thakhek	1987	340
Tonhen	Xe Bangfai	Saybouly	1990	550

(4) Flood gate

Existing flood gates are mainly constructed at the river-mouth of the branches flowing into Xe Bangfai river in both Nongbok and Saybouly districts. The construciton of the flood gates are intended for:

- Flood control in the rainy season
- Storing water in river channels in the dry season

In the lower basin of the Xe Bangfai, there are annually flooded areas caused by the backwater of the Mekong river from August to September. Considerable number of fields are protected by regulating water, and in October the gates are closed to store water in the river channels for dry season paddy cultivation by pump irrigation.

There are 13 flood gates, four of which are not in use due to damage.

One gate can control about 100 ha of flooding area and store water for about 50 ha of dry season paddy irrigation. Total controllable and irrigable areas by flood gates are summarized below.

Number of Flood Gate	13 (4 gates are damaged)
Flood Control Area	1,000 ha
Irrigable Area in Dry Season	420 ha

All the existing irrigation facilities are listed in Table 2-16 and their locations are shown in Fig.-2-13. The total irrigable areas are 2,938 ha during the dry season and 2,383 ha during the rainy season and 1,000 ha of flood control areas and they are summarized below.

Total Irrigable Area by Existing Facilities

Type	Number	Rainy Season Irrigable Area (ha)	Flood Control Area (ha)	Dry Season Irrigable Area (ha)
Reservoir	17	563	-	1,410
Weir	12	510	-	108
Pump	7	1,310	-	1,000
Flood Gate	13	-	1,000	420
Total	49	2,383	1,000	2,938

2-7-4 Organization of Provincial Irrigation Division

(1) Irrigation Division of Agriculture and Forestry Department in Savannakhet Province

There are 2 deputy chiefs under the irrigation division. The division is subdivided into 2 services, management and technical services. There are 5 staffs in the management service, 12 engineers and 17 technicians in the technical service, totaling 37 staffs. The technical service has 4 sections namely survey/design, operation/maintenance, construction and zone, however, the staffs of the construction section hold the positions of zone section concurrently. 12 of the districts of Savannakhet province are divided into 6 zones and 2 staffs (one engineer and one technician) from the province and 6 technicians from the districts are allocated to each zone for construction and maintenance of facilities. Khanthabouly district, as an

exception, is under the direct support of the province. The organization chart of Irrigation Division is shown in Fig.-2-14.

(2) Irrigation Division of Agriculture and Forestry Department in Khammoune Province

The irrigation division has one division chief, one deputy chief, 8 engineers and 14 technicians, totaling 24 staffs. The division is subdivided into 5 sections namely survey/design, construction, pump, operation/maintenance and supporting district. The staffs of supporting district section are allocated to 6 districts and are working with the technicians of the districts for construction and maintenance. The organization chart of irrigation division is shown in Fig.-2-15.

2-7-5 Construction of Irrigation Facilities

(1) Irrigation project

The implementation of the irrigation projects is broadly divided into two categories according to project scales.

Project Scale	Medium Project	Small Project
Irrigation Area	200 ~ 500 ha	50 ~ 200 ha
Budget	Government (MAF)	Province
Finance	Government and External Assistance	Province and NGO Assistance
Construction	Irrigation Construction Enterprise	Farmer
Supervision	Irrigation Dept. of MAF and Province	Provincial Irrigation Division
Construction Method	Construction by heavy equipment	Manual work

(2) Irrigation Construction Enterprise

The main construction enterprises in Lao PDR with heavy equipment and experiences/capability of large scale irrigation projects are the following 4 enterprises.

1. State Enterprise Construction Irrigation No. 1
2. State Enterprise Construction Irrigation No. 2
3. Irrigation Construction Enterprise, Savannakhet
4. Irrigation Construction Enterprise, Thakhek

The 2 state enterprises above belong to MAF, and they are involved in most medium to large scale projects in the whole country. The other 2 provincial enterprises belong to each province, respectively, engaging in the projects in each province. There are other provincial construction enterprises belonging to Champasak or Bolykhamsay provinces, however, there is much difference between the above 4 enterprises and the provincial ones in experience/capability and availability of heavy construction equipment.

(3) Irrigation Construction Enterprise, Savannakhet

This enterprise belongs to the province and was established in 1987. The running budget is managed under a self-supporting accounting system similar to other enterprises. Main works undertaken are provincial construction projects contracting not only with the Agricultural Department of irrigation projects but also with the Construction Department of road projects. There are 160 staffs in all, including engineers. Heavy equipment such as bulldozers, motorgraders, dump trucks, backhoes and tank lorries are available in the enterprise, some are provided by the Government.

(4) Small Scale Irrigation Company

2 Small Scale Irrigation Companies belonging to Champhone and Atsaphanthong district, were established in 1989. These companies do not own construction equipment and are managed with minimum staff under a self-supporting accounting system. The company employs necessary technicians and labourers on project basis engaging mainly in management of facilities and procurement of farm inputs shown below.

Small Scale Irrigation Company, Atsaphanthong's activities in Tonhen Pump Irrigation Project (Saybouly district)

1. Contract with MAF
   - Pump installation
   - Construction of concrete structure and base
   - Maintenance of canals
   - Training farmers for dry season paddy cultivation
2. Contract with the beneficial farmers
   - Provision of irrigation water (pump operation)
   - Collection of electricity charges
   - Procurement of fertilizers (300 kg/ha) and chemicals

2-7-6 Operation and Maintenance

(1) O/M

O/M of all provincial facilities is already transferred to each district. The operations of existing weirs and flood gates are easily handled by farmers with periodic visits of district staffs. The operation of pumping facilities is, however, being operated by district staffs. The provinces are aiming at transferring the responsibility of O/M to the farmers by holding trainings on O/M of pumps, canal systems and structures. For medium scale projects, technical level-up of district staffs are also required. The training course for the technicians is often held by the Ministry.

There are no completely organized irrigation water users' group. However, there are practical farmers' groups, headed by a village leader, for O/M of small weirs or dams. In Tonhen Pump Irrigation Project, for example, there is a program to organize 120 benefiting farmers and to divide them into 12 groups (10 farmers per group) with one leader for each group. The 12 selected leaders will be tained step by step.

(2) Water charge

At present, a concept of water charge is collected from the electric charges of pump operation. Electric charges in both provinces of Savannakhet and Khammouane are 17 kip/kwh for domestic use and 12.5 kip/kwh for irrigation purpose as of 1990. For example, in Nake Pump Irrigation Project the water charge (electric charge) for the dry season paddy in 1989/90 was 19,000 kips per ha. According to the actual operation results of Nake Project, total water requirement is estimated at 1,627 mm (See Nake Pump Irrigation Project below).

Nake Pump Irrigation Project

Specification of Pump	:	70 kw, D=300 mm
Irrigated Area	:	24 ha
Total Electricity	:	36,480 kwh
Total Electric charge	:	460,000 kips
Unit Price	:	12.5 kip/kwh
Total Pump-up Volume	:	390,600 cubic m
Pump-up Volume per ha	:	16,275 cubic m/ha

2-7-7 Constraints

(1) Budgetary and technical limitation

Under the conditions of budgetary limitation and present technical level, irrigation facilities have to be inevitably cheap and simple.

(2) Supplementary irrigation

More stable and increasing production of rainfed paddy cultivation can be expected by planned supplementary irrigation. There are almost no facilities which can provide planned supplementary irrigation except for the pumping facilities.

(3) Water management

Effective irrigation can only be achieved with water control facilities and technique/knowledge of management. However, both of them are inadequate. There is an example in a pumping irrigation project in which the terminal fields are unable to receive adequate water due to insufficient field canals. Thus, the farmers, owning such fields, are not willing to be charged for water payment with the same electric charge. In order to distribute water equally, an adequate field canal system is indispensable.

(4) Farming practice with irrigation

At present, 150 day local variety is grown in the dry season irrigation area. Saving water will be possible with the introduction of improved varieties. Effect of irrigation will be doubled through suitable farming practice and by building a good relationship between the extension workers and irrigation staff.

2-8 Rural Infrastructure

2-8-1 Outline

The social infrastructural conditions (roads, electricity, water supply, airport, riverport, telecommunication, transportation, school and hospital) in the study area are being developed at present.

Since the study area has plenty of water resources, farming areas, forest, mineral resources, the biggest population in the whole province and is located in a strategic position connecting Vietnam-Lao-Thailand, its development will contribute a lot to Lao PDR agriculture and economy.

However, the very poor agro-infrastructural conditions hinder agricultural development. Therefore, agro-infrastructural development is considered as the most important section in the Project. The existing infrastructural conditions are shown in Fig. 2-16.

2-8-2 Roads

(1) Route No.13

Route No.13 is the main and the longest road in Lao PDR from Luangprabang to Champasak. It was constructed during the French colonization in the 1930's. With the exception of the roads in the outskirts of the cities, route No. 13 was not improved due to civil wars and shortage of funds.

The reconstruction project of route No. 13 was planned by the Government, and was conducted by the Ministry of Communication, Transportation, Post and Construction (MCTPC) in 1983. The improvement project of south zone route No. 13 will start from route No. 11 of Savannakhet up to B. Lak 35 and B. Xe Banghiang. The total road length is about 250 km and the project cost is estimated at 20 million US$ (World Bank Loan).

The South Zone Improvement Project commenced in 1988, and entails 10 m widening for asphalt pavement. The project will be completed in

1995. At present, road foundation and surface embankments are being constructed.

The Route No. 13 Improvement Project is generally supervised by MCTPC, and the South Zone route No.13 Improvement Project is being conducted by the State Enterprise of south zone route No. 13. The activities of the State Enterprise are construction of drainage facilities, O/M works, equipment maintenance, road improvement and contract work management. There are 320 workers (including 16 engineers) and a total of 70 heavy construction equipment.

Traffic in route No. 13 is about 300 cars per day. The vehicles constitute 67% trucks, 23% buses, 10% pick-ups and others, and the total annual traffic is about 100,000 vehicles per year. The main line of route No. 13 will be opened for public use and this is considered as a great contribution to the economic development of Lao PDR.

(2) Route No. 9

Route No. 9 is paved with asphalt (penetration construction method) and runs from Savannakhet to B. Shaiden with a total road length of about 256 km. Route No. 9 is an international road. The construction of the road was conducted by the government of Lao PDR in 1979 with the assistance of the Soviet Union, Vietnam, Hungary, Bulgaria, Czechoslovakia and France. It was completed in 1985.

The main objectives involved in the improvement of route No. 9 are to obtain economic development in Lao PDR and Vietnam, and to maintain friendly relations between the two countries. A new route was constructed to connect route No. 9 with the Kengkabao Riverport, and this route was named route No. 9 - A.

The total construction cost of route No. 9 was 5,000 million Lao kips and 52 million Soviet roubles, and the total amount received from various countries was about 3,000 million kips. There are 5 big bridges and 202 culverts and small bridges between the border of Vietnam (B. Shaiden) and Kengkabao Riverport. The asphalt pavement of the road is 7 m wide, and the total width of the road is 15 m.

The surface road condition of route No. 9 is very poor with only simple asphalt pavement. The road is almost impassable. The road surface

damages are caused by insufficient embankment of sub-base course and frequent passage of over-loaded trucks.

At present, road rehabilitation is being carried out and the cost might reach 300 million kips. The working period is planned until June 1991. However, yearly repair is necessary in order to maintain favorable road conditions.

The O/M of route No. 9 are the responsibilities of the MCTPC and the government. There are 320 workers (including 10 engineers, 30 mechanics, 90 operators), and 85 heavy equipment. However, 55% of the equipment are in need of repair.

The traffic conditions of route No. 9 is about 420 cars per day. Traffic is mainly caused by 89% trucks, 4% buses, 3% pick-ups and 3% heavy trucks and others.

The main imports from Vietnam are cement (1,100,000 tons), reinforced bars (9,800,000 tons) oil, lumber, ceramics, cattle and others. The products exported to Vietnam are gypsum and lumber. The goods from Vietnam passes through Lao to Thailand.

(3) Route No. 11

Route No. 11 is the responsibility of the provincial government. The pavement is lateritic, and the road starts from Savannakhet to B. Lak 35, B. Kengkok and B. Lahanam Thong. The total road length is about 85 km. The provincial government operates and maintains route No. 11. However, due to very limited budget, the road condition is poor, especially the route of B. Kengkok and B. Lahanam Thong where passage is impossible during the rainy season.

The traffic in route No. 11 is mainly caused by approximately 50~150 recycled truck buses per day.

(4) Rural roads

The rural road networks in and around the study area are about 520 km in total length, and they are under the responsibility of the provincial government. However, almost all rural roads are seriously damaged, many bridges are broken, and 80% of the rural roads are impassable in the rainy

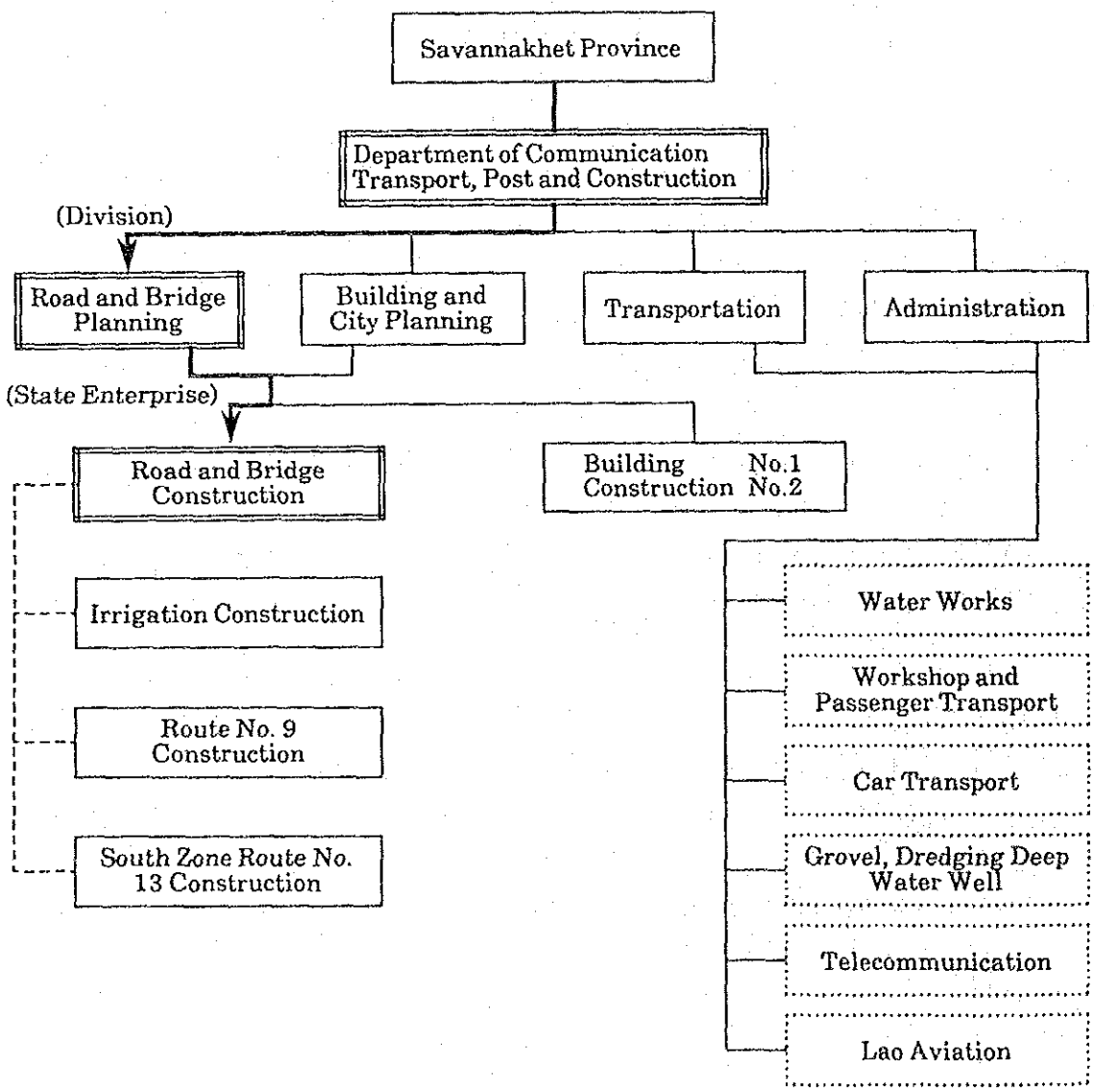
season. There are 55 bridges to be reconstructed and 21 bridges to be newly constructed. The roads in need of immediate repair are about 55% (290 km) long.

Traffic in these roads is about 10~30 cars per day. Rural road improvement is, therefore, inevitable for the rural development of the study area.

a. Rural roads O/M organization

The O/M of the rural roads in Savannakhet province are supervised by the Department of Communication, Transportation, Post and Construction (DCTPC). The organization is shown below.

Rural Road O/M Organization



b. O/M budget

The budget for the O/M of the rural roads is as follows:

Year	Actual Budget (Million kips)	Actual Budget (Million kips)
1985	20	20
1986	22	22
1987	31	31
1988	46	60
1989	50	200
1990	250	300
1911		400

The O/M budget includes staff allowance, purchase of materials and survey expenses. The actual O/M budget is 250 million kips in 1990, and the roads can be improved up to 20~40 km. The rural road improvement plan, which will start in 1991, will cover Savannakhet to Kengkabao (40 km) and B. Lak 35 to Kengkok (15 km).

2-8-3 Electricity

The electric supply of the study area is supervised by the Ministry of Industry. Electricity in Savannakhet city before 1973, was provided by the diesel power plant. A 22 kv electric power cable is wired across the Mekong river from Mukudahan (Thailand), extending electricity to the study area. The existing 22 kv power line in the Savannakhet province provides electricity to Khanthabouly, Champhone, Outhomphone and Atsaphanthong. The rural electrification plan for the study area is shown in Fig. 2-16, and the main power cable line systems are shown in Fig. 2-17.

The electric charges are 17 kip/kwh in Savannakhet city (1990), and 10 kip/kwh in Vientiane. The electricity purchased from Thailand is about 8 kip/kwh.

At present, 95% of Savannakhet city is electrified while other cities and districts rely on private generators.

The Savannakhet Electric State Enterprise has its own electric generator for emergency use (750 kw×2 sets, 400 kw×2 sets).

Blackout happens once or twice a week in Savannakhet city.

The electric condition is shown below.

Electrification Achievement (kWh)

Year	From Thailand	Diesel Generation	Private sector	Government Office and Public Use	Household Consumption	Electricity Loss
1985	13,684,194	27,763	6,228,622	624,533	3,875,009	2,983,793
1986	13,753,430	31,080	7,083,704	716,287	3,388,755	2,596,764
1987	14,465,667	4,730	7,742,753	528,271	3,466,068	2,733,305
1988	15,895,310	29,860	6,834,100	424,797	5,793,836	2,872,437
1989	18,131,180	11,280	7,722,323	432,253	6,927,482	3,060,402
1990 (until June)	10,230,200	3,800	4,264,560	213,410	4,643,400	1,112,630

2-8-4 Water Supply

a. Savannakhet city water supply

The city water supply facilities were constructed with the assistance of France from 1973 to 1975. At present, the water treatment volume is about 1,000 m^3/day with intake pumps 37 kW×3 units, water conveyance pumps 75 kW×3 units, and conveyance pipes ϕ500~200 mm. The water supply ratio is about 65% in the city.

The water supply achievement is as follows:

Description	Unit	1985	1986	1987	1988	1989	until September 1990
Water Supply Volume	m^3	1,981,705	2,134,169	2,337,065	2,722,981	2,756,154	3,007,723

Description	Unit	1985	1986	1987	1988	1989	until September 1990
Effective Water Supply Volume	m^3	1,749,899	1,714,073	2,055,879	2,399,032	2,434,539	2,528,541
Number of Supply per House	House	2,963	3,222	3,479	3,777	4,274	4,826
Water Supply Population	Person	16,971	18,265	19,550	21,040	23,525	26,285
Total Population in Savannakhet	Person	44,383	45,572	46,794	48,047	49,335	50,656

The organization of the State Enterprise of Water Works is under the jurisdiction of the DCTPC. It has many branch offices and water supply facilities in Xeno (200 Houses), Donghen (120 Houses), Pakxong (97 Houses), Phine, Sepone, B. Xok and B. Tatdet. The total number of staff is 97 and the annual budget was 130 million kips in 1990.

The water charges are imposed through different rate systems; 35 kip/m^3 for household use, 55 kip/m^3 for government use, 65 kip/m^3 for industrial use and 150~200kip/m^3 for rural use.

The city water consumption increases every year and is assumed to exceed the capacity of the water works within the next 3~4 years (the maximum water supply plan for the year 2000 is about 4,716,000 m^3/year, and the estimated water consumption will be 4,200,000 m^3 for 1991.) The sudden increase in the city population and the increase in the number of factories and residential areas are the main reasons for the increase in water demand. At present, the improvement and expansion of the water facilities precede all other water works.

b. Domestic Water Supply

The villages in the study area depend on shallow wells, springs, small streams and swamps for their water supply. The shallow wells are about 10~15 m deep and they usually dry up during the dry season. The

villagers have to work hard to secure water from the swamps and small streams during the dry season. Well water samples were taken from 11 important villages and water quality analysis was made in Vientiane. The water analysis data are shown in Table 2-17.

2-8-5 Riverport

Savannakhet riverport carries out its duties concerning the transportation of goods, materials and passengers between Lao and Thailand satisfactorily. At present, through trading, Lao, Thailand and Vietnam share amiable relations. The volume of trades between these countries are increasing every year.

The main goods traded from Vietnam are cement, reinforced bars, scraps, timber, ceramics, groceries and cattles, while oil, garments provisions, fertilizers, machineries and spare parts are transported from Thailand.

The new route No. 9 has been opened and is located in Kengkabao riverport, which is 28 km to the north of Savannakhet. However the water level of Mekong River drops during the dry season, especially from November to April, making traveling to Vientiane difficult for some years. The annual transportation rate of Savannakhet riverport is shown in Table 2-18.

2-8-6 Airport

In recent years, the economy of Lao has developed and as a result, the number of passengers who avail with the air services exceed the number of air transportation available. The State Enterprise of Lao Aviation has 3 aircrafts (AN4-Antonov 24) for domestic use.

The total number of passengers in 1990 was 8,891 from Vientiane to Savannakhet and Pakse, 8,541 from Savannakhet to Vientiane, and 943 from Savannakhet to Pakse. The number of passengers increases to 20~30% every year.

The citizens of Lao and the foreigners are required to carry travel permits when traveling within the country either by air, bus or boat. The permit can be obtained from the police station.

Savannakhet airport facilities were constructed in the 1960's, and at present, all facilities, including the aircrafts, require rehabilitation. The length of the runway is 1,800 m.

2-8-7 Telecommunication

The State Enterprise of Telecommunication is under the jurisdiction of the Savannakhet administration, but actual activities are under the direct supervision of the head office of MCTPC in Vientiane. The telephone service in Savannakhet is in poor condition and there are only 210 lines within the city. Telegrams are used during emergencies. The development of the telecommunication system all throughout Lao is being planned by the Government of Japan.

In 1990, telegram utilization was about 152,000 words and the cost of domestic telegrams was 60 kip/word and 5 US$/word for cablegrams.

Mails are not generally distributed. There are 600 post office boxes in big cities. In 1990, the annual domestic correspondence had about 43,000 letters and 46,000 letters for overseas correspondence.

2-8-8 Transportation

The Savannakhet bus company is directly controlled by the DCTPC, and as an independent public corporation, it also transports passengers to Vientiane, Pakse and Vietnam (Hanoi, Hue, Danang). The Enterprise has 28 busses (70 persons/bus). There are also privately owned buses (formerly trucks) and tricycles in the main cities mainly used to transport passengers and cargo to the rural areas. However, these privately owned vehicles cannot operate during the rainy season, because of poor rural road conditions.

The annual number of passengers of the privately owned vehicles covers 20~30% of the total number of passengers.

The transportation business of the Enterprise is shown below.

Passenger Transport 1990

Route	Distance from Savanna-khet	Hours	Fuel Consump-tion	Bus fee	Times / Month	Total Passengers per year 1990
	km	h	ℓ	kip		
Sha dieng (Vietnam border)	256	7	180	1600	31	44,074
Sepone	210	5	150	1300	31	6,060
Phin	175	4	130	1200	31	(–)
Phalon	100	2.5	80	900	31	(–)
Donghen	75	2	60	700	31	(–)
Nahang Noy	100	3	80	800	31	19,626
Ban Veun	85	3	70	500	31	22,014
Kengkobao	50	1.5	50	500	15	4,120
Phoummachedy	55	2	50	500	30	33,613
Kengkok	55	2	50	500	30	12,250
Lahakhok	80	3	60	700	30	18,030
Songbouly	100	3.5	80	800	36	39,975
Pakxong	75	3	70	800	31	11,237
Tha Pasoum	100	3.5	80	900	14	8,925
Xe Banhieng	100	4	80	900	15	(–)
Tha Panthong	159	3	130	1200	15	3,492
Sakhum	90	2.5	80	800	15	(–)
Dong Tha	70	2.5	80	700	15	1,550
Total of Savannakhet province						224,966
Pakse	250	5	190	2,000	51	35,690
Thakek	145	5.5	100	1,400	29	32,920
Vientiane	500	15	420	6,000	30	1,640
Vientiane to Pakse	750	18	610	8,000	30	573
Total of outside Savannakhet						70,823

Route	Distance from Savanna-khet	Hours	Fuel Consump-tion	Bus fee	Times / Month	Total Passengers per year
	km		ℓ	kip		
Hanoi	920	2 days	780	13,200	1	530
Hue	400	14 h	320	5,800	4	(–)
Danang	540	17 h	450	7,800	4	544
Total of outside Savannakhet						1,074

※(–) : The total number of passengers were not counted in this route.

The Annual Changes of in the Total Number of Passengers

Description	1987	1988	1989	1990
In Savannakhet Province	388,221	312,404	273,872	224,966
Around Savannakhet City	0	0	2,623	6,755
Outside Savannakhet	0	0	18,640	70,823
Abroad	0	0	713	1,074
Total	388,221	312,404	295,848	303,618

The Changes in Car Registration in Savannakhet Province

Item	1984	1985	1986	1987	1988	1989	1990	Total
Motorbike, 50cc	33	37	42	133	782	324	352	1,703
Motorbike, more than 65cc	38	42	90	529	2,181	1,258	789	4,927
Ordinary cars and pick ups	84	54	33	76	233	265	223	968
Truck and bus	45	31	45	126	386	311	223	1,167
Grand total								8,765

CHAPTER 3 BASIC DEVELOPMENT CONCEPT

3-1 Basic Development Concept Policy

3-1-1 Factors that Impede Agricultural Development

The study area has a self-sufficient agriculture which is mainly focused on rice production. Production, however, is totally controlled by natural conditions. The marketing systems and facilities are very poor, and the farmers' economy and the rural economy are greatly affected by drought or flood. For example, the number of livestock in the study area has extremely decreased in 1989 and 1990 due to the 1987 and 1988 drought and flood. This only shows how week the farmers' economy is against natural conditions.

The potentials of the study area for agricultural production is high considering that it is blessed with a good location and rich natural resources.

The main factors that impede agricultural development are:

(1) Shortage of Investment

There is very little investment in the area to exploit the abundant natural resources. At present, investment is limited and the agricultural condition is in a vicious circle indicating shortage of investment - low productivity - poverty.

(2) Insufficient Marketing System

Due to the past self-supporting agricultural system, the marketing system is poor and its development is hampered by inadequate roads and storage facilities. The farmers lose their volition because the farm-gate prices of the agricultural products are controlled by middlemen.

It is difficult to shift to marketing agriculture and to contribute to the national economy because of the inadequate conditions of the marketing systems, the rural roads, post harvest facilities and the market informations.

(3) Shortage of Agricultural Production Inputs

The study area is blessed with natural resources. However, the soils are sandy and not very fertile, except for areas regularly visited by floods. Productivity, therefore, does not increase without suitable supply of inputs. Chemical fertilizers are expensive because they are not produced in the country and their import is limited. According to the farmers' economic survey, only 42 out of 126 farmers have applied fertilizers or preventive chemicals.

(4) Insufficient Irrigation Facilities and their Maintenance

The ratio of the irrigated area in Savannakhet Province has been crawling sideways since 1985, and is extremely increasing in Khammouane Province since 1988. Both ratios, however, are still within the national average ratio.

With the exception of the pumping systems, the existing irrigation facilities only contribute to the supply of domestic and livestock water in the dry season and do not supply irrigation water during the rainy season. By studying again the operation, water management, canal systems, etc., the functions of the existing facilities will increase.

(5) Poor Road Conditions

The maintenance of rural roads between villages, villages and highways, and villages and important facilities is inadequate. Transportation is almost impossible during the rainy season. There are many difficult traffic points in the dry season due to broken bridges. The farmers cannot chose the delivery period of the products. The farmers, therefore, complain about poor road conditions because they hinder the marketing and transportation of necessary agricultural inputs.

(6) Inadequate Post-Harvest Facilities

Paddies are stored in store-houses built in each farmer's house yard. Much loss is gained, therefore, from damages caused by rainfall leaks and rodents. Furthermore, these storehouses do not have enough storage capacity.

(7) Inadequate Extension Service System

Owing to the traditional self-supporting agricultural system, the farmers have not experienced an improved agricultural structure such as diversified, marketing and modernized agriculture. In order to achieve the improvement of the agricultural structure, extension service systems, including training of farmers and the supply of inputs and information, will have to be fully strengthened. The average number of farmers commanded by one district extension worker in the study area is 770. There are no agricultural research institutes nor agro-industries.

3-1-2 The Basic Development Policy

(1) Target Year

The economy of Laos has improved favorably, if not quickly. It is advisable not to aim for a rapid development and a target which is too lofty to realize. Based on this point, feasible medium and small sized projects will be studied, and the foundation of the agricultural development will be established first. Therefore, the year 2010, a medium term development plan, will be the target year of the study.

(2) A Stabilized Rice Production which will Correspond with Population Increase

At present, rice production is greatly influenced by natural conditions. However, it will correspond with the population estimated for the year 2010, by improving the agricultural structures of irrigation, input, farming technology, agricultural land expansion and storage systems.

(3) Improvement of the Agricultural Structure

Shifting from a self-supporting agriculture to a marketable one is the most important agricultural policy in Lao PDR and the most important target of the Study. In order to achieve this target, the diversification of agriculture, the marketing and the service system will have to be improved.

(4) A Harmonized Integrated Agricultural Development

The basic structure of marketable agriculture is totally different from self-supporting agriculture. This study, therefore, will equally develop the

facilities, technology and the organization for productivity, marketing, farming, extension and living conditions.

It is also important to maintain harmony with the natural environment, social structure and economic structure.

(5) The Development of Diversified Agriculture and the Establishment of a Chief Producing District

In marketable agriculture, it is necessary to make use of the potential characteristics of each area for the development of diversified agriculture. This will also increase the income of the farmers. Cash crops, industrial crops, livestock, fishery, and agricultural processing are studied according to the potentials of each area.

Diversified agriculture is planned with due consideration of the establishment of a chief producing district. The advantages in establishing a chief producing district are as follows:

a) Improvement of the quality of the agricultural products

The quality of the agricultural products can be improved by selecting the crops suitable to the natural conditions of the area, and by concentrated guidance on farming and cultivation.

b) Economic Production Cost

Cooperative works and reasonable operations are possible through group works.

c) Improvement of Marketing

The market can be easily developed if high quality crops are collected.

(6) Development of Irrigation and Drainage

The development of the operation and maintenance of the irrigation and drainage systems is important in order to increase agricultural productivity and diversification. By means of a feasible scale, a study on the use of the water resources in the study area can be made.

According to the past data, floods brought more damages than droughts. By constructing large flood control dams, drainage pumping stations and

dikes, flood control becomes possible for a long term. This study, however, concentrates on a middle term development plan.

(7) Development of Rural Roads

Transportation is the most important element in the improvement of input supply, dispersion, and marketing structure. The rural roads will be developed, therefore, and their operation and maintenance will be studied.

(8) Improvement of the Farmers' Living Environment

A study on transportation and communication, electricity, local water supply, education, health and sanitation and the preservation of the greeneries will be made, because they are essential to the improvement of the farmers' living conditions.

(9) To Propagate the Project by the Construction of the Pilot Project

The study area is very wide and basic improvements on the agricultural structure will be introduced. The propagation of agricultural development will take time and will be costly, and successful results can only be achieved through trial and error. The construction of the pilot project is, therefore, recommendable and will be studied.

3-1-3 The Policy for the Materialization of Agricultural Development

Integrated agricultural development consists of 3 fields. The improvement of the marketing structure, increase of productivity and the improvement of the farmers' living conditions. Each field is developed through hardware and software development. Every field in the study area is underdeveloped. Development can only be effective if it is implemented equally in all fields. However, the study area is too wide and has varied conditions to develop a pattern. The following approach for the materialization of the agricultural development concept, therefore, are recommendable for an effective development.

(1) Zone Development and Establishment of Agricultural Supporting Centers

Taking into consideration the conditions of the administrative boundaries (district), location, arable land, water resources and communication, the study area is divided into several zones. An agricultural supporting center is established in each zone as the marketing and the farmers' organization's base.

(2) Construction of Pilot Projects

Even if a single zone is divided, it would still be too wide to develop. A pilot project composed of a center with a suitable scale and few projects which will develop land productivity and agro-infrastructure will be constructed in all zones. The former will be used as a base and the latter as a model for zone development.

(3) Advantage of Zone Development

The study area covers a very wide area of about 12,000 km^2. It aims to equally conduct development in all fields, within a medium term of 20 years, with limited investment.

The development of the softwares such as marketing and the farmers' organization, can be carried out by the Government and the farmers through trial and error. Development cannot be achieved by funds. The team recommends the establishment of an agricultural supporting center as a base for the development of the software. It also recommends to divide the area into zones under the control of the centers, and to develop these zones through the centers.

The advantage of zone development are as follows:

(1) Realization of an Equal Agricultural Development

The study area is too wide to implement an equal agricultural development. An elaborate development can be possible by zone division and the establishment of the centers.

(2) Exploitation of Regional Potentials

The study area is very wide and each area has varied characteristics. By zone division, the exploitation of the potentials of each area and the formulation of development projects can be conducted easily.

(3) Easy Development of the Organizations

The centers will function as the core of the organizations, and it will develop larger organizations by mixing with other centers.

(4) Strengthening the Effect of Demonstration

Although the development of the hardware in the pilot project is only limited to some parts of the zone, the establishment of a center will affect all zones. It will be accelerated, therefore, to a higher level in the zone. The improvement of a wide area will also affect other zones. This will benefit wide areas with small investments.

3-2 Agro-economic Development Concept

The study area is estimated to have high potentials for agricultural development

It is necessary to achieve rice production increase which will be in accordance with population increase by using this area as a rice supplying base. It is also important to achieve a steady increase in the farmers' income. The project, therefore, aims to achieve self-sufficiency in rice production and aims to more than triple the present amount of agricultural production.

3-2-1 Rice Production Plan

The rice production plan is estimated according to the estimated population and the annual consumption per capita.

The population of Lao PDR in 2010 is estimated at 6,240 thousand by means of the widely used logistic curve estimation method.

The individual rice consumption rate is 160 kg in Myanma and Bangladesh, 155 kg in Thailand, and 150 kg in Indonesia, Philippines and Sri Lanka. The consumption rate of tha people of Laos, Vietnam and Cambodia is higher than Thailand and Myanma at 180kg. Diet will improve 20 years later, and taking this into consideration, the amount of

rice consumption per capita was estimated at 170 kg. Assuming that the amount of polished rice is 60%, the amount of loss is 7.9%, the amount of paddy seed is 7.1% consumption per capita is estimated at 330 kg, and the national consumption is estimated at approximately 2,064 thousand tons.

According to the data taken the last 5 years on national rice production ratio, the largest paddy production ratio of the study area is 18%. If production and the marketing structure would be improved in 2010, and if the study area would produce 20% of the national rice production, the target production of the study area will be 412 thousand tons.

3-2-2 Vegetables and Cereals Production Plan

To improve the farmers' economy in the year 2010, it is necessary to introduce cash crops which will promote the agricultural market. Taking the likes of the neighboring countries into consideration, the following crops will be recommended; peanuts, cassava, mongo beans, vegetables, tobacco, cotton, sugarcane, spices, fruits, etc. An irrigated upland field of 10,000 ha will be constructed in the dry season, and 5,000 ha of land will be reclaimed. Upland crops will be cultivated in these areas.

3-3 Land Use Development Concept

3-3-1 Land Resources Potential

As previously mentioned in 2-1, the use of the study area for cultivation purposes is sufficiently possible based on the studies on surface geology, soil and vegetation. The 4 types of soil in the study area have more than 1 m of effective soil, and these soils do not contain gravel and pan. Vegetation was also found to be normal.

However, cultivation of areas with more than 200 m E.L. is difficult owing to steep topography. Orthic Acrisols and Ferric Acrisols occupying the middle and highland areas are sandy soils with low water retentivity which is easily affected by drought and erosion. Therefore, the construction of normal upland fields are not suitable for these areas, but orchard or irrigation paddy fields, are suitable. The middle and low land areas tend to

suffer from flood damages in the rainy season, the development of field crop areas, at present, is therefore, not advisable. The soil potential productivity classification is summarized below (Table 3-1, Fig. 3-2).

Land Category	Land Use	Land Capability Class *1	Area (ha)
Dissected isolated hills. erosion surface and mountains	Paddy field	Ⅳ g p f n a *2	112,100 (9%)
	Normal upland field	Ⅳ g p (W) f n a s e	
	Land under permanent cultivation	Ⅲ g p (W) f n a s e	
High terraces of plestocene deposit	Paddy field	Ⅲ 1 f n a	194,100 (16%)
	Normal upland field	Ⅳ (W) e	
	Land under permanent cultivation	Ⅲ t w (W) f n e	
High ravine terraces old alluvium	Paddy field	Ⅲ 1 t n a	445,500 (38%)
	Normal upland field	Ⅳ (W) e	
	Land under permanent cultivation	Ⅲ t w (W) f n e	
Lower terraces of semi recent alluvium	Paddy field	Ⅲ n	340,300 (20%)
	Normal upland field	Ⅳ (W)	
	Land under permanent cultivation	Ⅲ w n	
Lawland plane at recent alluvium	Paddy field	Ⅲ n a	208,000 (17%)
	Normal upland field	Ⅳ w (W) a	
	Land under permanent cultivation	Ⅳ w a	
			1,200,100

Remarks
*1 Symbol mark 4 is unsuitable land.
*2 g p .....*etc.* is limiting factor. Showed the Table 3-1.

3-3-2 Land Use Strategy

Agriculture in the study area has been developed through the rainfed paddy cultivation, the only dominating crop. The rainfed paddy field is one of the effective utilization systems of water resources during the rainy season. However, due to frequent drought and rough management its producing capacity cannot be improved. The study area, however, is considered as the largest rice producing area in Lao and is also expected to play a role in crop diversification and livestock development for the improvement of trade balance and increase of farmers' income.

The land utilization plan in the study area should be made with due consideration of the natural resources, agricultural production, existing forest development, etc. described below.

(1) Paddy field: Utilization of alluvial plains, basins and some parts of the hilly areas. Development of double cropping paddy field with suitable water resources.

- Rainy season : Local variety (HYV in hilly area)
- Dry season : Double cropping paddy, field crop with irrigation, fallow land

(2) Land under permanent Cultivation : Utilization of hilly areas, some parts of basins and alluvial plains. Water will be stored for domestic and irrigation use. Development of fruit and industrial (Oil, etc.) trees.

(3) Normal upland field : Utilization is limited to some parts of the hilly areas with good topographical conditions. Land reclamation with adequate attention for erosion. Crops should have a high coverage of land and rotation should be implemented. Store water for domestic and irrigation use. Recommended crops : forage crops, pulses, millet, maize, cotton, sesame, vegetables.

(4) Basins, alluvial plains are mainly used for paddy fields (partly used for upland fields in the dry season).

(5) Hilly areas are mainly used for orchards or pasture. Paddy fields will be constructed only in areas with enough water resources. The use of the forests and pasture will be considered important.

(6) Mountain areas will be afforested.

(7) The overall cultivation ratio should be less than 30%.

3-4 Agricultural Development Plan

3-4-1 Agricultural Support and Marketing Structure Development Plan

Organizations that will enable the smooth implementation of the formulation of the production plan, construction of infrastructure and its O/M, supply of agricultural inputs, marketing of products, collection and analysis of marketing informations, rice polishing, storage, livestock, processing, trust and credit, extension, training, improvement of living conditions, etc. will be established. These organizations will easily adapt to rural customs and traditions, will be managed democratically and will be strengthened by substantial equity capital and the farmers' participation in the project.

The present agricultural support comes from the government. There are marketing organizations, and they are controlled by middlemen. The reason why the price of rice is unfavorable to the farmers is their weak organizational ability. It is important to establish a price formation structure so as to uplift the farmers' will to produce.

Repeated trial and error are necessary in order to achieve the improvement in the agricultural structure, especially in diversified agriculture. Excellent leaders and farmers' voluntary participation are, therefore, necessary. It is, therefore, desirable that the organization, investments, operation and management will be conducted by the farmers themselves. The excessive protections of the Government ① obstruct farmers' independence and positive participation, ② make accumulation of capital impossible, ③ cause inefficiency, and many failures. However, on the other hand, it is difficult to contribute to national economy without the direct or indirect protection of the government and the farmers cannot cope with the drastic changes in the directives given by the Government.

If the management of the organization will be handed over to the farmers in the future, it is advisable to let the Government carry out