

Appendix-B
AGRICULTURE

**BASIN-WIDE BASIC IRRIGATION AND DRAINAGE
MASTER PLAN STUDY
IN
THE KINGDOM OF CAMBODIA**

FINAL REPORT

APPENDIX-B AGRICULTURE

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CHAPTER B 1 PRESENT CONDITIONS

B1.1 Ream Kon Rehabilitation Sub-project Area

B1.1.1 Soils and Land Suitability

The soils distributed in the sub-project area are examined based on the reconnaissance level soil map prepared in the Mater Plan Stage of the present Study, in which soils are classified at soil sub-unit level following the FAO/UNESCO classification system.

The sub-project area is entirely covered with Gleyic Luvisol (LVg). The soil has fine textured layers in the entire profile (LiC~HC) and the effective soil depth is deep. The surface soils have acid reaction (pH) and moderate to high soil fertility, judged from moderate total nitrogen, moderate to high cation exchange capacity (CEC) and high exchangeable potassium.

The soil is classified as moderately suitable for rice production and marginal suitable for upland crops production according to the FAO classification system (Framework for Land Evaluation, FAO, 1976).

B1.1.2 Present Land Use

The present land use of the sub-project area is paddy field under different irrigation statuses. Accordingly, the land use of the area has been classified based on current irrigation statuses into 2 sub-categories of: i) supplemental irrigation paddy field and ii) rainfed paddy field (including field under rainfed condition). There exist no paddy fields under normal irrigation condition in the area. The present land use of the area is estimated as follows;

Present Land Use of the Sub-project Area

Land Use Sub-category	Area & Proportion		
	(ha)	(%)	(%)
Normal Irrigation Paddy Field	-	-	-
Supplemental Irrigation Paddy Field	50	2	-
Rainfed Paddy Field	1,970	98	-
Paddy Field Total	2,020	100	93
Right-of-ways	150	-	7
Sub-project Area	2,170	-	100

As shown in the table, irrigation water supply conditions in the sub-project area are very poor and the paddy fields under rainfed conditions account for 98% of the total fields in the area. The paddy fields under supplemental irrigation are limited to 50 ha, while pump irrigation for early wet season rice cultivation is practiced commonly as stated earlier.

B1.1.3 Agro-demography and Land Holding

Agro-demographic and land holding features in the project communes (major communes located in the sub-project area) estimated based on the Commune Survey on Crops & Livestock, 2003, MAFF.

When assuming that number of farm households is accounted by number of crop producing households, farm households in the communes are calculated at 82% of the total households and none-farm households are estimated at 18%. 91% of the farm households (crop producing

households) are producing wet season rice. Average family size is 5.1 members as follows;

Agro-demographic Features in the Project Communes in 2003

Items	Average 1/	Range 1/
% of Farm Households to Total Households	82%	67 – 98%
% of None Farm Households (No. of none crop producing households)	18%	2 – 33%
% of Farm Households Producing Wet Season Rice	91%	76 – 99%
Average Family Size (in 2005, SEILA Data Base)	5.1	4.9 – 5.4

1/: Average & range of Prey Svay, Chrey & Kear Commune

Source: Commune Survey on Crops & Livestock, 2003, MAFF & SEILA Commune Data Base, 2005

The access to data/information on land tenure was rather limited. However, the Commune Survey provides some information on the land tenure and holding statuses as shown below.

Land Holding Features of the Project Communes in 2003

Indicator	Average 1/	Range 1/
% of Landless Households	18%	2 – 33%
% of Farm Households with Holding Size Less Than 10a	27%	4 – 38%
% of Farm Households with Holding Size More Than 3ha	55%	33 – 80%

1/: Average & range of Prey Svay, Chrey & Kear Commune

Source: Commune Survey on Crops & Livestock, 2003, MAFF

Almost all the farm households in the communes appear to have some farmland. From the rice cropped area in wet season, average holding size of paddy field per farm household is roughly estimated at 2.2ha as shown in Table B1.1-1. Proportion of land holding households having less than 0.1ha is calculated at 27% and the same of more than 3ha is at 55%.

The number of landless households calculated at 18% of the total households is nearly equal to the number of none crop producing households. Therefore, the landless figure might represent non-farm households domiciling in the sub-project area, especially in urban areas and number of landless farm households might be limited.

B1.1.4 Crop Production

(1) General

The present agricultural conditions in the sub-project area have been studied based on the results of interview survey with the major project commune offices (major communes located in the sub-project area), village chiefs and DAO Moung Ruessei, statistic data of DAO and PDA and findings of the field survey by the Study Team. The summary sheet of the statistic data on the major communes are presented in Table B1.1-2, B1.1-3 and B1.1-5 to B1.1-9 and the results of interview surveys are presented in Attachment B1.1-1 and B1.1-2.

Rice production is the most important agricultural activities in the sub-project area and it is estimated that about 91% of farm households in the project communes had engaged in wet season rice cultivation in 2003. The rice production in the area is characterized by low and unstable productivity under rainfed conditions by a single cropping of rice in wet season under both direct sowing and transplanting method. Further, prolonged rice cultivation season continuing from April to January with the cultivation of both early wet and wet season rice and with the cultivation of rice varieties of different growth durations of early to late and traditional farming practices adapted to the agro-climatic conditions are other characteristics of the rice production in the area.

However, rice cultivation in the early wet season by way of pump irrigation along irrigation canals and drains is practiced to a certain extent. Dry season rice cultivation is practiced in extremely limited extent outside of the sub-project area. Further, cultivation of upland crop (mungbeans) is practiced to a negligible extent in paddy fields in the area.

(2) Cropping Season and Variety

Rice cropping seasons in the area are: i) early wet season from April to July under direct sowing and ii) wet season from May/July to November/January under direct sowing and July/September to November/January under transplanting. The early wet season rice is generally grown supplemented by pump irrigation as stated earlier.

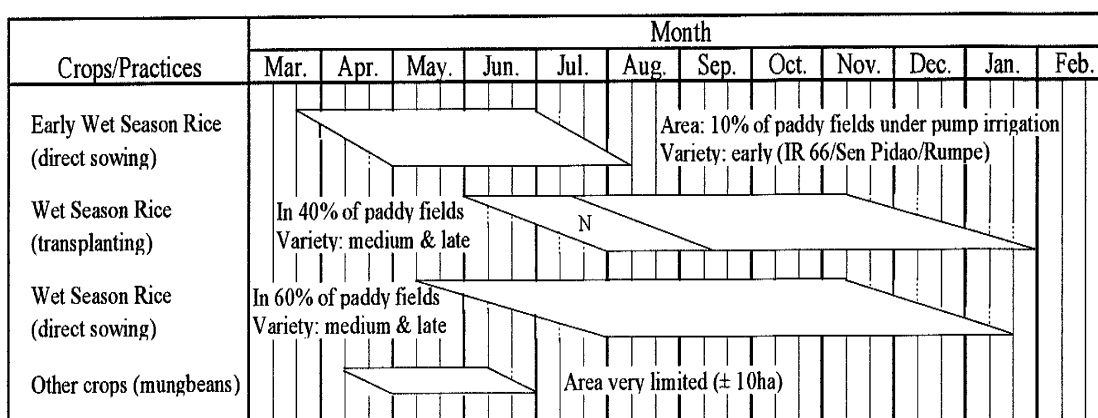
In the area, a number of rice varieties are cultivated and cropping seasons vary substantially depending on varieties grown. Traditional local varieties other than those selected by CARDI are called by local names and same varieties might be named differently depending on locations. Currently cropped traditional local varieties appear to have been selected by farmers in the past and have some characteristics suited to local agro-climatic conditions such as tolerance to drought and inundation. Major varieties grown in the area are as follows;

Major Varieties Grown in the Sub-project Area

Season	Growth Duration	Variety
Early Wet Season	Early	IR 66, Sen Pidao, Rumpe
Wet Season	Medium	Phka. Khney, Phka Rumdoul, Phka Rumchang, Somali, Riang Chey, Neang Khon
	Late	CAR 4, CAR 6, Komping Puoy, Neang Mine

(3) Cropping Calendar and Pattern

The prevailing cropping calendar in the area estimated based on the interview survey results (Attachment B1.1-1 & B1.1-2) is illustrated as shown in the following figure.



Prevailing Cropping Calendar in Paddy Fields: Ream Kon Sub-project Area

A single cropping of wet season rice under rainfed condition is a prevailing cropping pattern, while a double cropping of early wet season rice and wet season rice is also carried out in about 10% of the paddy fields in the area. The prevailing planting method of rice is direct sowing in the area. About 60% of rice cropped areas in wet season and all rice cropped areas in early wet season are cultivated under direct sowing method. Cultivation of other crops than rice in paddy fields is extremely limited at present. The prevailing cropping patterns in the area

are estimated as shown in the following table.

Prevailing Cropping Patterns in the Sub-project Area

Cropping Pattern	Area
Single cropping of wet season rice	Predominant pattern; in 90% of the area
Double cropping of rice (early wet season - wet season)	In about 10% of the area; mostly in supplemental irrigation fields

(4) Cropped Area

The current cropped areas of rice and other crops in the sub-project area have been estimated based on the various data and information and the findings of the field survey as presented in Table B1.1-4 and as summarized below.

Estimated Cropped Area & Cropping Intensity in the Sub-project Area

Cropping Season	Irrigation Status	Cropped Area			Cropping Intensity (%)
		Rice		Other Crops 2/	
		Area (ha)	Intensity (%)		
Early Wet Season	Pumping 1/	200	10	10ha	10
Wet Season	Supplemental	50	2	-	2
	Rainfed	1,970	98	-	98
Annual	-	2,220	110	10ha	110

1/: Including most of supplemental irrigation field 2/: Muungbeans

Source: JICA Study Team

As shown in the table, the cropping intensity of rice is estimated at 10% in early wet season and 100% in wet season. The overall annual cropping intensity in the paddy fields is estimated at 110% including upland crops.

(5) Yield and Production

Yields of paddy in the sub-project area are estimated on the basis of the statistic data of PDA/DAO and SEILA Data Base, the results of interview surveys (Attachment B1.1-1), Socio-economic Survey and Inventory Survey by JICA as shown in Table B1.1-10 and as summarized in the following table.

Estimated Paddy Yield Level in the Sub-project Area (ton/ha)

Irrigation Status	Early Wet Season	Wet Season	
	Direct Sowing	Direct Sowing	Transplanting
Supplemental Irrigation 1/	2.5	1.5	2.2
Rainfed Condition	-	1.0	1.7

1/: Including pump irrigation in early wet season.

Source: JICA Study Team

The current yield levels of paddy in wet season under rainfed condition are estimated at 1.0 ton/ha in direct sowing and 1.7 ton/ha in transplanting. Under supplemental irrigation, paddy yields are estimated at 1.5 ton/ha and 2.2 ton/ha, respectively for direct sowing and transplanting. Early wet season rice yield is estimated at 2.5 ton/ha under pump irrigation. A current yield of upland crop (mungbeans) is estimated at 0.5 ton/ha.

On the basis of the estimated cropped areas and yields, the production of paddy in the area is estimated as shown in Table B1.1-11 and summarized in the following table.

Estimated Paddy Production in the Sub-project Area

Irrigation Status	Cropped Area & Production of Paddy (ha & ton)						Annual Production
	E. Wet Season		Wet Season				
	Direct Sowing		Direct Sowing		Transplanting		
	Area	Production	Area	Production	Area	Production	
Pump Irrigation	200	500	-	-	-	-	500
Supplemental Irrigation	-	-	30	44	20	45	89
Rainfed Condition	-	-	1,182	1,340	788	1,182	2,522
Total	200	500	1,212	1,384	808	1,227	3,111

Source: JICA Study Team

As shown, the current paddy production in the sub-project area is estimated at 500 tons in early wet season, 2,610 tons in wet season and 3,110 tons annually. The annual production volume of upland crop (mungbeans) in the area is estimated at 5 ton.

(6) Prevailing Farming Practices

Some specific features of rice farming practices in the area are:

- Prevailing of direct sowing method (60%) to transplanting method (40%) for planting in wet season rice is estimated based on the results of interview surveys as shown in Table B1.1-4. While, early wet season rice is solely cultivated under direct sowing method,
- Prevailing of mechanical land preparation (65%) to land preparation by draft animal (35%) as shown in Table B1.1-5,
- High seeding rate in direct sowing (120 to 150 kg/ha), partly aiming at suppressing weed growth by sowing densely, and
- Cultivation of both improved and local varieties of medium and late growth duration in wet season.

B1.1.5 Crop Production in Upland Fields

Compared with rice production, production of upland crops is extremely limited in the sub-project area as shown in Table B1.1-6 and summarized below.

Cropped Area of Major Upland Crops in the Project Communes

Crops	Area		Crops	Area	
	(ha)	(%)		(ha)	(%)
Seat Potato	18	9	Corn	7	4
Cassava	12	6	Vegetables	136	68
Groundnut	13	7	Others	2	1
Mungbeans	12	6	Total	200	100

Source: MAFF & DAO Mounng Ruessei

As shown in the table, cropped areas of upland crops in the project communes are about 1% of annual rice cropped area of some 15,000ha in the communes. Major upland crop is sweat potato followed by groundnut, mungbeans and cassava. Annual cropped area of vegetables is estimated at 136ha. Major vegetables include chili, watermelon, cucumber, pumpkin, gourd, string beans and leafy vegetables. Main cropping season of upland crops and vegetables in upland fields is wet season.

Fruit trees grown in the communes are extremely limited and major fruits are pineapple and banana as shown in Table B1.1-7.

B1.1.6 Farm Machinery and Equipment

The inventory on farm machinery and equipment in the project communes is presented in Table B1.1-8 and summarized in the following table.

Inventory of Farm Machinery in the Project Communes in 2007

Tractor	Hand Tractor	Water Pump	Engine Thresher	Tractor Attachment	
				Plow	Harrow
21	478	213	20	18	12

Source: DAO Moung Ruessei

The number of hand tractors in the communes is substantial and mechanical land preparation work is prevailing practices, partly because of larger land holding size per farm household compared with sub-project areas in other provinces. The number of water pumps, appeared to be used for supplemental water supply to paddy fields, when rainfall in wet season is insufficient, is also substantial in the communes

B1.1.7 Livestock

Livestock sub-sector is an important agricultural activity for farm economy and provides an essential source of draft power and manure for farming in the sub-project area. Accordingly, a substantial number of animals and poultry are raised in the area and majority of farm families hold some kind of animals as shown in Table B1.1-9 and as summarized below.

Livestock Population & Holding Status in the Project Communes in 2003

Item	Cattle	Buffalo	Pig	Animal Unit	Poultry
Population	10,511	789	2,357	10,641	47,787
Holding Size/Family	1.6	0.1	0.4	1.6	7.4

Source: Commune Survey on Crops & Livestock, 2003, MAFF

From the table, an average holding size of cattle, buffalo and pig in 2003 in the communes is calculated at 1.6, 0.1 and 0.4 heads per farm household, respectively, equivalent to animal units of 1.6 in total. The holding size of poultry is calculated at 7.4 per farm family. However, as the statistic figures include livestock & poultry hold by commercial farms, an actual holding size per farm is lower than the said estimates.

B1.1.8 Post-harvest and Marketing

Threshing of paddy in home yard by engine thresher or hiring service is prevailing in the sub-project area. After threshing, paddies except for those kept for family consumption are generally marketed without drying soon after harvest partly because of insufficient drying space and no drying yard. Paddies for family consumption are sun dried in a home yard and stored below the elevated floor.

Prevailing marketing channels of paddy in the area are marketing of field dry paddy to village collectors or rice millers at village level. In the former channel, at the first place, farmers sell paddy to the local collectors who himself are quite often farmers who do that kind of business as side activities. The local collectors market paddy to the wholesalers or to the rice millers. The wholesalers sell rice further to the traders/large scale wholesalers in/from Phnom Penh or

other provinces, who export or market some products to Viet Nam or Thai buyers. Other crops produced in the area are mostly sold in market at village level. Because of limited market volume by individual farmers, farmers have little bargaining power in price setting in general.

Major constraints for paddy marketing identified through the Socio-economic Survey are unstable market prices of paddy followed by low market prices of paddy as is the case in other sub-project areas as shown in Attachment B1.1-3 and summarized below.

Paddy Marketing Constraints Reported by Sample Farmers

	Constraint
Most Serious Constraint	Unstable market prices of paddy/rice
2 nd Serious Constraint	Low market prices of paddy/rice
3 rd Serious Constraint	Limitation of market of paddy/rice

Source: Socio-economic Survey by the JICA Study team, 2007

Major constraints reported by the rice millers in the project district are: i) price competition with Viet Nam buyers, ii) mainly purchasing sun-dried paddy because of no drying facility and failing completion with Viet Nam and Thai buyers who accept field dried paddy (wet paddy), iii) price fluctuation and iv) limited capital to buy in bulk after harvest and store. The results of the interview survey with rice millers in the project district are presented in Attachment B1.1-4.

B1.1.9 Agricultural Extension Services

The present statuses of agricultural extension services in the sub-project area are discussed from the view point of the same in the project district, Moug Ruessei District, and the sub-project area specific activities.

(1) Agricultural Extension Services in the Project District

(a) Institutions

The government institutions involved in agricultural support services at the province level is PDA Battambang. The PDA is a provincial level agricultural agency under the provincial government and is an agency responsible for agricultural development and provision of agricultural supporting services at province, district, commune and village levels. The PDA is composed of 6 technical offices and two planning/administrative offices. The PDA has its branch offices at district level called District Agricultural Office (DAO).

The district agricultural Office covering the sub-project area is DAO Moug Ruessei. The DAO has three sections of agronomy, extension and livestock. However, staffing of the office is limited to 10 in total and extension activities of the office appear to be very limited.

International and bilateral cooperation organization having activities in the district include is EU. Major NGO having agricultural sector support activities is KRDA .

(b) Extension Services

The government extension services at the sub-project area level (commune & village) are basically to be provided by DAO under the support and guidance of PDA. Major agricultural extension activities in the province provided are programs under NCCD (decentralization program after SEILA) by the government and activities under donors and NGOs. However,

current services by the government appear to be extremely limited due primarily to financial constraints.

Under the new extension system, the recruiting and deployment of Village Agricultural Extension Agent (VAA) at each village is planned by the end of 2008. The introduction of farmer-to-farmer extension is envisaged under the system.

(2) Current Extension Activities in the Project Communes

Major agricultural support activities operated in the project communes are activities under ECOSORN and provision of quality rice seeds and extension of improved farming practices. Major activities under NCCD in the project communes (Chrey, Prey Svay, Kear) include irrigation canal rehabilitation and road rehabilitation/construction.

B1.1.10 Seed and Farm Inputs Supply

The predominant rice seed supply system in Cambodia is illustrated as follows;

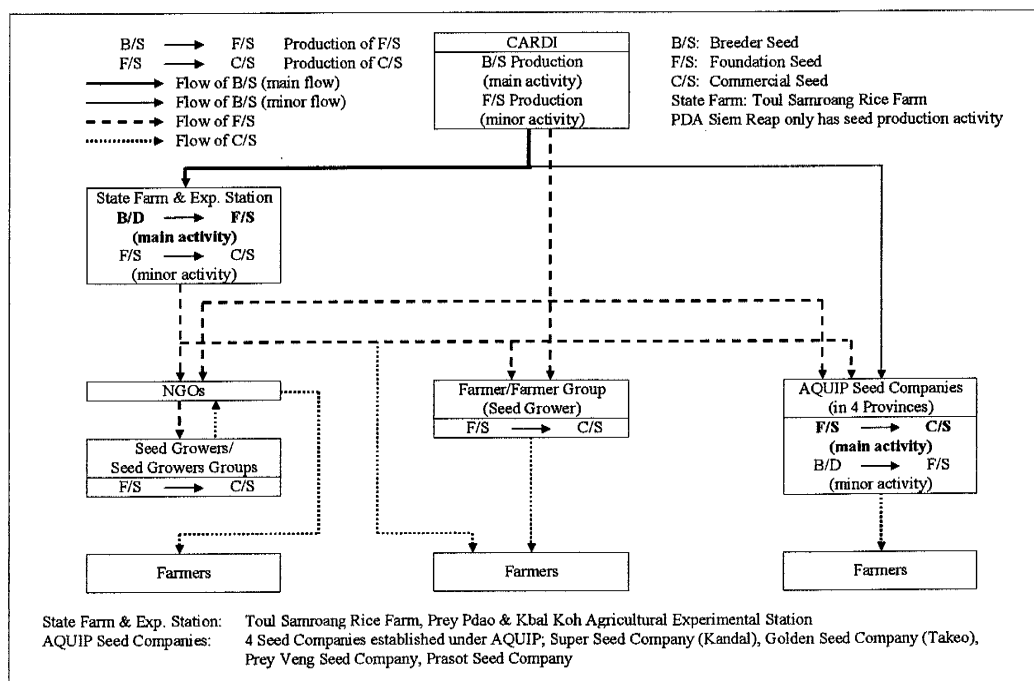


Figure Current Predominant Rice Seed Production & Supply System in Cambodia

Common channel of quality seed supply in and around the sub-project area is through provision of seed under support programs of PDA/DAO, donors or others. Commercial seed suppliers in the area are farm inputs suppliers in district centers (Moung Ruessei) but their supply volume is limited.

Predominant seed source of rice is self-multiplied seeds (products of previous season) followed by seeds exchange with other farmers in the area. Demand for quality seeds appears to be low at present. In contrast to such situation, the results of the Socio-economic Survey (Attachment B1.1-5) indicate no serious constraints for quality seed procurement in the sub-project area as shown in the following table.

Seed Supply Conditions in the Sub-project Area

Enquiry	Reponses (200 sample farmers)
Seed Source of Rice	Own products: 74%; exchange with others: 11%
Frequency of Seed Replacement	Once per 3 cropping: 72%; once per over 4 cropping: 28%
Procurement of Wanted Seed	Easy: 74%; difficult./not possible 24%
Procurement of Quality Seed	Easy: 62%; difficult/not possible: 48%
Price of Quality Seed	Too expensive: 4%; acceptable: 31%

Source: Socio-economic Survey by the JICA Study team, 2007

In upland crops production, quality seeds are seldom used and major seed sources are: i) seeds procured at local markets and ii) own products. Prevailing seed sources of vegetables are also seeds procured at local markets and own products. However, vegetable seeds imported from Thailand and Vietnamese are commonly used for intensive vegetable production.

Production of upland crops and vegetables in Cambodia is still limited. However, production of those seeds is carried out by Chamkaleu Seed Production Farm, Khbar Koh Agricultural Experimental Station and CARDI. Main upland crops seed produced by them include soybeans, mungbeans, maize, groundnut and some vegetables seeds.

For the expansion of upland crops production, seed multiplication within the sub-project area should better be envisaged under the strengthening of agricultural extension activities.

Farm input supplies in the area are mostly carried out by dealers in district centers and local markets at commune or district level. The results of the Socio-economic Survey (Attachment B1.1-5) indicate existing of no serious constraints for fertilizer procurement except for price.

B1.1.11 Rural Credit

The deployment of ACLEDA Bank and MFIs is rapidly expanding in the country and Battambang Province in recent years. Major formal rural credit operators in the project district include ACLEDA Bank and PRASAC MFI. The numbers of branch (province level) and sub-branch offices (district level) of ACLEDA Bank in the project province (Battambang) and district are as follows;

Deployment of Branch & Sub-branch Offices of ACLEDA

Institute	Branch Offices	Sub-branch Offices	Project District
ACLEDA	2 in province	10 in province	1 sub-branch office

Source: ACLEDA Bank Plc

The sub-branch office of ACLEDA Bank is located in Moung Commune neighboring to the project communes. In addition, there deployed a district office of PRASAC MFI in the commune. The terms and conditions of micro credit (farm credit & small-scale industry) of ACLEDA Bank are as follows;

Terms & Conditions for Farm Credit of ACLEDA Bank

Institute	Credit Period & Interest rate		Conditions
ACLEDA	6 months < R.500,000; interest 3.0%/month	12 months >R.500,000 interest: 3.0%/month	Provision of collateral & approval of commune council

Source: ACLEDA Bank Plc., Branch Office

Further, a local NGO (KRDA) is providing micro credit services in the district. However,

non-institutional credit providers such as money lenders, rice millers, farm input suppliers and relatives or friends might continue to be an important source of rural credit.

The results of the Socio-economic Survey on farm credit conducted in the sub-project area are presented below.

Results of Socio-economic Survey on Farm Credit in the Sub-project Area

Enquiry	Proportion by Reponses	Sample No.
Access to farm credit	Easy: 58%; difficult: 8%, not received: 35%	26
Amount of credit	Sufficient: 54%; insufficient: 8%; not received: 38%	26
Timing of provision	In time: 54%; delayed: 12%; not received: 35%	26
Procedures for credit application	Easy: 12%; difficult: 46%, not received: 42%	26

Source: Socio-economic Survey in the sub-project area by the JICA Study Team, 2007

B1.1.12 Agricultural Cooperatives

The formation of agricultural cooperatives is promoted by MAFF/PDA in the country with the support of NGOs. The number of cooperatives formed in Battambang Province and the project district is as follows;

No. of Agricultural Cooperatives in Province & Moug Ruessei District (2008)

Province	Project District	Project Communes
32 cooperatives	4 cooperatives	3 cooperatives (Chrey & Ta Loas Commune)

However, the statuses of cooperatives in the district are still at an infant level and no cooperative activities such as procurement, shipment & selling activities are carried out. The total members of the 4 cooperatives in the district are 170 and 43 members per cooperatives on average. An average capital of the cooperatives is very limited to Riel 1,200,000.-. One cooperative in Chery Commune operates saving & credit services to members.

B1.1.13 Current Capacity to Pay

For the estimation of the current capacity-to-pay, farm economic analyses on typical farms were made based on the crop budget analyses on the current crop production (Table B1.1-12 & B1.1-13) and the results of the Socio-economic Survey conducted in 2007.

(1) Typical Farms

Almost all the paddy fields in the sub-project area (98% of total) are categorized into rainfed paddy fields. Accordingly, depending on prevailing rice cultivation systems in wet season, two typical farms having rainfed paddy field, one farm practicing direct sowing and the other practicing transplanting, are selected.

On the basis of the average holding size of paddy fields per farm family estimated in the section B1.1.3, the typical farms for the present farm economic analysis are defined as shown in the following table.

Typical Farms for Analyses

Type	Irrigation Status	Planting Method 1/	Holding Size 2/
Type A	Rainfed paddy field	Transplanting	2.2 ha/family
Type B	Rainfed paddy field	Direct Sowing	2.2 ha/family

1/: Planting method in wet season 2/: holding size of paddy field assumed

(2) Current Capacity to Pay

The present farm economy of the typical farms are estimated based on the results of the Socio-economic Survey and the crop budget as shown in Table B1.1-14 and as summarized below.

Item		Amount (Riel 1,000.-)	
		Type A	Type B
Gross Incomes	Rice Production	4,614	2,920
	Other Farm Incomes	630	630
	Non-farm Income	2,060	2,060
	Total Income	7,304	5,610
Expenditures	Production Costs of Farm Products	2,735	2,253
	Other Expenditures	4,000	3,600
	Total Expenditures	6735	5,853
Net Surplus		569	-243

1/: Assuming other farm income & non-farm income are same in both cases

As shown in the table, the current farm economy of the typical farm A (transplanting) indicate net surplus (capacity to pay) of Riel 569,000 or 8% of the total income. While, the typical farm B (direct sowing) indicates net deficit of Riel 243,000 or 4% of the income.

B1.1.14 Results of Socio-economic Survey

Under the present Study, the agro-economic survey aiming at identifying problems and constraints for irrigated farming, activities implemented for improvement of rice productivity by farmers and expectations for improvement of farming activities have been carried out in the sub-project area under the Socio-economic Survey conducted in the Study.

The results of the Socio-economic Survey carried out aiming at identifying problems and constraints for farming, activities implemented for improvement of rice productivity by farmers and expectations for improvement of farming activities are presented in a narrative manner in Table B1.1-15. Major constraints in rice farming identified are low paddy yield and irrigation water shortage even in wet season. Farmers expectations for farming and physical works (irrigation/drainage) are **productivity improvement of wet season rice and adequate irrigation water supply in wet season**, respectively. The detail results of the Survey are presented in Attachment B1.1-3. The results of the Survey on farming practices, farm input supply and marketing are presented in Attachment B1.1-5.

B1.2 Por Canal Rehabilitation Sub-project Area

B1.2.1 Soils and Land Suitability

The soil distribution in the sub-project area is similar to that in the Ream Kon sub-project area and the entire sub-project area is distributed with Gleyic Luvisol (LVg). The characteristics of the soil are explained in the section B1.1.1.

The soil is classified as moderately suitable for rice production and marginal suitable for upland crops production according to the FAO classification system (Framework for Land Evaluation, FAO, 1976).

B1.2.2 Present Land Use

The present land use of the sub-project area is paddy field under different irrigation statuses. Accordingly, the land use of the area has classified according to current irrigation statuses into 2 sub-categories of: i) supplemental irrigation paddy field and ii) rainfed paddy field (including field under rainfed condition). There exist no paddy fields under normal irrigation condition in the area. The present land use of the area is estimated as follows;

Present Land Use of the Sub-project Area

Land Use Sub-category	Area & Proportion		
	(ha)	(%)	(%)
Normal Irrigation Paddy Field	-	-	-
Supplemental Irrigation Paddy Field	100	5	-
Rainfed Paddy Field	1,970	95	-
Paddy Field Total	2,070	100	93
Right-of-ways	160	-	7
Sub-project Area	2,230	-	100

As shown in the tables, irrigation water supply conditions in the sub-project area are very poor and the paddy fields under rainfed conditions account for 95% of the total fields in the area.

B1.2.3 Agro-demography and Land Holding

Agro-demographic and land holding features in the project communes (major communes located in the sub-project area) estimated based on the Commune Survey on Crops & Livestock, 2003, MAFF are presented as follows;

Agro-demographic Features in the Project Communes in 2003

Items	Average 1/	Range 1/
% of Farm Households to Total Households	77%	67 – 95%
%. of None Farm Households (No. of none crop producing households)	23%	5 – 33%
% of Farm Households Producing Wet Season Rice	81%	68 – 97%
Average Family Size (in 2005, SEILA Data Base)	5.2	5.0 – 5.4

1/: Average & range of Kear, Ta Loas & Kakaoh Commune

Source: Commune Survey on Crops & Livestock, 2003, MAFF & SEILA Commune Data Base, 2005

By assuming that number of farm households is accounted by number of crop producing households, farm households in the area is calculated at 77% of the total households and none-farm households are estimated at 23%. 81% of the farm households (crop producing households) are producing wet season rice. Average family size is 5.2 members.

The access to data/information on land tenure was rather limited. However, the Commune Survey provides some information on the land tenure and holding statuses as follows;

Land Holding Features of the Project Communes in 2003

Indicator	Average 1/	Range 1/
% of Landless Households	23%	5 – 33%
%. of Farm Households with Holding Size Less Than 10a	16%	2 – 34%
% of Farm Households with Holding Size More Than 3ha	61%	33 – 90%

1/: Average & range of Kear, Ta Loas & Kakaoh Commune

Source: Commune Survey on Crops & Livestock, 2003, MAFF

As shown in the table, almost all the farm households in the communes appear to have some farmland. From the rice cropped area in wet season, average holding size of paddy field per

farm household is roughly estimated at 2.4ha as shown in Table B1.2-1. Proportion of land holding households having less than 0.1ha is calculated at 16% and the same of more than 3ha is at 61%.

The number of landless households calculated at 23% of the total households is nearly equal to the number of none crop producing households. Therefore, the landless figure might represent non-farm households domiciling in the sub-project area, especially in urban areas and number of landless farm households might be limited.

B1.2.4 Crop Production

(1) General

Rice production is the most important agricultural activities in the sub-project area and it is estimated that about 81% of farm households in the project communes had engaged in wet season rice cultivation in 2003. As is the case in the Ream Kon sub-project area, the rice production in the area is characterized by low and unstable productivity under rainfed conditions and by a single cropping of rice in wet season under both direct sowing and transplanting method. Further prolonged rice cultivation season continuing from April to January with the cultivation of both early wet and wet season rice and with the cultivation of rice varieties of different growth durations of early to late and by traditional farming practices are other characteristics of the rice cultivation.

However, rice cultivation in the early wet season by way of pump irrigation along irrigation canals and drains is practiced to a substantial extent. Dry season rice cultivation is practiced in extremely limited extent outside of the sub-project area. Further, cultivation of other crops than rice in the paddy fields in the area was not reported.

The summary sheet of the statistic data on the major communes are presented in Table B1.2-2 to B1.2-3 and B1.2-5 to B1.2-9 and the results of interview surveys are presented in Attachment B1.1-1 and B1.1-2.

(2) Cropping Season and Variety

Rice cropping seasons in the area are similar to those in the Ream Kon Sub-project area and consist of : i) early wet season from April to July/August under direct sowing and ii) wet season from May/July to November/January under direct sowing and August/September to December/January under transplanting. The early wet season rice is generally grown supplemented by pumping irrigation as stated earlier.

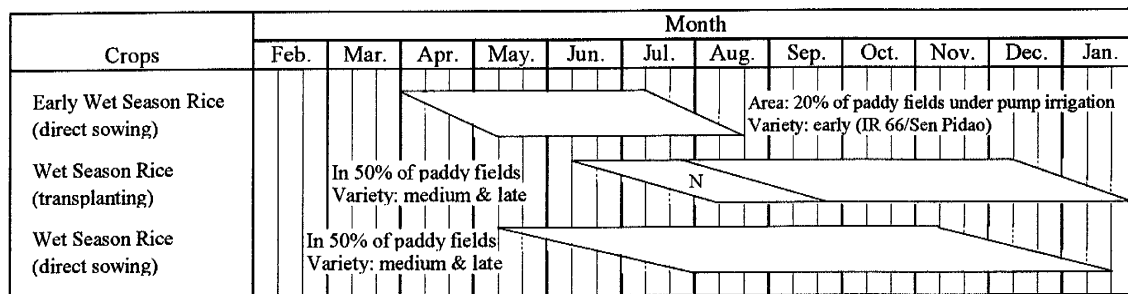
In the area, a number of rice varieties are cultivated and cropping seasons vary substantially depending on varieties grown. Major varieties grown in the area are as follows;

Major Varieties Grown in the Sub-project Area

Season	Growth Duration	Variety
Early Wet Season	Early	IR 66, Sen Pidao
Wet Season	Medium	Phka Khney, Riang Chey, Sen Chey, Srov Sor
	Late	Komping Puoy, CAR 4, CAR 6, , Neang Khon

(3) Cropping Calendar and Pattern

The prevailing cropping calendar in the area estimated based on the interview survey results (Attachment B1.1-1 & B1.1-2) is illustrated as shown in the following figure.



Prevailing Cropping Calendar in Paddy Fields: Por Canal Sub-project Area

A single cropping of wet season rice under rainfed condition is a prevailing cropping pattern, while a double cropping of early wet season rice and wet season rice is estimated to be carried out in about 20% of the paddy fields in the area. About 50% of rice cropped areas in wet season are grown by direct sowing method and early wet season rice is exclusively cultivated under direct sowing method. Cultivation of other crops than rice is not practiced in the paddy fields in the area. The prevailing cropping patterns in the area are estimated as shown in the following table.

Prevailing Cropping Patterns in the Sub-project Area

Cropping Pattern	Area
Single cropping of wet season rice	Predominant pattern; in 80% of the area
Double cropping of rice (early wet season - wet season)	In about 20% of the area; Mostly in supplemental irrigation fields

(4) Cropped Area

The current cropped areas of rice and other crops in the area have been estimated based on the various data and information and the findings of the field survey as presented in Table B1.2-4 and as summarized below.

Estimated Cropped Area & Cropping Intensity in the Sub-project Area

Cropping Season	Irrigation Status	Cropped Area			Cropping Intensity (%)
		Rice		Other Crops	
		Area (ha)	Intensity (%)		
Early Wet Season	Pumping 1/	410	20	-	20
Wet Season	Supplemental	100	5	-	5
	Rainfed	1,970	95	-	95
Sub-total		2,070	100	-	100
Annual	-	2,480	120	-	120

1/: Including most of supplemental irrigation paddy field

Source: JICA Study Team

As shown in the table, the cropping intensity of rice is estimated at 20% in early wet season and 100% in wet season. The overall annual cropping intensity in the paddy fields is estimated at 120%.

(5) Paddy Yield and Production

Yields of paddy in the sub-project area are estimated on the basis of the statistic data of

PDA/DAO and SEILA Data Base, the results of interview surveys, Socio-economic Survey and Inventory Survey by JICA as shown in Table B1.2-10 and as summarized as follows;

Estimated Paddy Yield Level in the Sub-project Area (ton/ha)

Irrigation Status	Early Wet Season	Wet Season	
	Direct Sowing	Direct Sowing	Transplanting
Supplemental Irrigation 1/	2.5	1.5	2.2
Rainfed Condition	-	1.0	1.7

1/: Including pump irrigation in early wet season.

Source: JICA Study Team

The current yield level of paddy in wet season under rainfed condition is estimated at 1.0 ton/ha in direct sowing and 1.7 ton/ha in transplanting. Under supplemental irrigation, paddy yields are estimated at 1.5 ton/ha and 2.2 ton/ha, respectively for direct sowing and transplanting. Early wet season rice yield is estimated at 2.5 ton/ha under pumping irrigation.

On the basis of the estimated cropped areas and yields, the production of paddy in the area is estimated as shown in Table B1.2-11 and summarized in the following table.

Estimated Paddy Production in the Sub-project Area

Irrigation Status	Cropped Area & Production of Paddy (ha & ton)						Annual Production
	E. Wet Season		Wet Season				
	Direct Sowing		Direct Sowing		Transplanting		
	Area	Production	Area	Production	Area	Production	
Pump Irrigation	410	1,025	-	-	-	-	1,025
Supplemental Irrigation	-	-	50	75	50	110	185
Rainfed Condition	-	-	985	985	985	1,675	2,660
Total	410	1,025	1,035	1,060	1,035	1,785	3,870

Source: JICA Study Team

As shown, the current paddy production in the sub-project area is estimated at 1,020 tons in early wet season, 2,850 tons in wet season and 3,870 tons annually.

(6) Prevailing Farming Practices

Some specific features of rice farming practices in the area are:

- Similar proportion of direct sowing method (50%) and transplanting method (50%) for planting in wet season rice is estimated based on the results of interview surveys as shown in Table B1.2-4. While, early wet season rice is solely cultivated under direct sowing method,
- Prevailing of mechanical land preparation (62%) to land preparation by draft animal (38%) as shown in Table B1.2-5,
- High seeding rate in direct sowing (120 to 150 kg/ha), partly aiming at suppressing weed growth by sowing densely, and
- Cultivation of both improved and local varieties of medium and late growth duration in wet season.

B1.2.5 Crop Production in Upland Fields

Compared with rice production, production of upland crops is extremely limited in the sub-project area as shown in Table B1.2-6 and summarized below.

Cropped Area of Major Upland Crops in the Project Communes

Crops	Area		Crops	Area	
	(ha)	(%)		(ha)	(%)
Mungbeans	10	7	Corn	6	4
Sweat Potato	10	7	Vegetables	107	70
Cassava	9	6	Others	1	1
groundnut	8	5	Total	151	100

Source: MAFF & DAO Moung Ruessei

As shown in the table, cropped areas of upland crops in the project communes are about 1% of annual rice cropped area of some 14,000ha in the communes. Major upland crops are mungbeans and sweat potato followed by cassava, groundnut and corn. Annual cropped area of vegetables is estimated at 107ha. Major vegetables include string beans, watermelon, cucumber, pumpkin and leafy vegetables. Main cropping season of upland crops and vegetables in upland fields is wet season.

Fruit trees grown in the communes are extremely limited and major fruits are pineapple and banana as shown in Table B1.2-7.

B1.2.6 Farm Machinery and Equipment

The inventory on farm machinery and equipment in the project communes is presented in Table B1.2-8 and summarized in the following table.

Inventory of Farm Machinery in the Project Communes in 2007

Tractor	Hand Tractor	Water Pump	Engine Thresher	Tractor Attachment	
				Plow	Harrow
32	304	109	40	28	19

Source: DAO Moung Ruessei

The number of tractors and hand tractors in the communes is substantial and mechanical land preparation work is prevailing practices, partly because of larger land holding size per farm household compared with sub-project areas in other provinces. The number of water pumps, appeared to be used for supplemental water supply to paddy fields, is rather limited.

B1.2.7 Livestock

Livestock sub-sector is an important agricultural activity for farm economy and provides an essential source of draft power and manure for farming in the sub-project area. Accordingly, a substantial number of animals and poultry are raised in the area and majority of farm families hold some kind of animals as shown in Table B1.2-9 and as summarized below.

Livestock Population & Holding Status in the Project Communes in 2003

Item	Cattle	Buffalo	Pig	Animal Unit	Poultry
Population	9,370	847	2,984	9,792	24,495
Holding Size/Family	1.3	0.1	0.4	1.4	3.4

Source: Commune Survey on Crops & Livestock, 2003, MAFF

From the table, an average holding size of cattle, buffalo and pig in 2003 is calculated at 1.3, 0.1 and 0.4 heads per farm household, respectively, equivalent to animal units of 1.4 in total. The holding size of animals in the communes is substantially lower than other sub-project areas. The holding size of poultry is limited at 3.4 per farm family.

B1.2.8 Post-harvest and Marketing

Threshing of paddy in home yard by engine thresher or hiring service is prevailing in the sub-project area as is in the Ream Kon area. After threshing, paddies except for those kept for family consumption are generally marketed without drying soon after harvest partly because of insufficient drying space and no drying yard. Paddies for family consumption are sun dried in a home yard and stored below the elevated floor.

Prevailing marketing channel of paddy in the area is similar to the same in the Ream Kon area and village collector is a main market destination. Major constraints for paddy marketing identified through the Socio-economic Survey are unstable market prices of paddy followed by low market prices of paddy as is the case in other sub-project areas as shown in Attachment B1.2-1 and summarized below.

Paddy Marketing Constraints Reported by Sample Farmers

	Constraint
Most Serious Constraint	Unstable market prices of paddy/rice
2 nd Serious Constraint	Low market prices of paddy/rice
3 rd Serious Constraint	Unstable market prices of livestock

Source: Socio-economic Survey by the JICA Study team, 2007

Major constraints reported by the rice millers in the project district are discussed in the section B1.1.8 and the results of the interview survey with rice millers in the project district are presented in Attachment B1.1-4.

B1.2.9 Agricultural Extension Services

(1) Agricultural Extension Services in the Project District

(a) Institutions

The government institutions involved in agricultural support services at the province level is PDA Battambang as discussed in the section B1.1.9. The PDA has its branch offices at district level called District Agricultural Office (DAO). The district agricultural Office covering the sub-project area is DAO Moug Ruessei. The DAO has three sections of agronomy, extension and livestock. However, staffing of the office is limited to 10 in total and extension activities of the office appear to be very limited as discussed earlier in the said section.

(b) Extension Services

The government extension services at the sub-project area level (commune & village) are basically to be provided by DAO under the support and guidance of PDA. Major agricultural extension activities in the province provided are programs under NCCD (decentralization program after SEILA) by the government and activities under donors and NGOs as discussed in the section B1.1.9. However, current services appear to be extremely limited due primarily to financial constraints.

(2) Current Support Activities in the Project Communes

Current major agricultural support program operated in the project communes include activities by ECOSORN. In addition, agricultural support activities under NCCD are also implemented by DAO/PDA to a limited extent.

In the Chrey Commune, quality rice seeds have been supplied under ECOSORN aiming at improvement of rice production in the commune. Major activities under NCCD in the project communes (Ta Loas, Chrey, Kear) include irrigation canal rehabilitation and road rehabilitation/construction.

B1.2.10 Seed and Farm Inputs Supply

The predominant rice seed supply system in Cambodia is illustrated in the section B1.1.10.

Common channel of quality seed supply in and around the sub-project area is through provision of seed under support programs of donors or others. Commercial seed suppliers in the area are farm inputs suppliers in district centers but their supply volume is limited.

Predominant seed source of rice is self-multiplied seeds (products of previous season) followed by seeds exchange with other farmers in the area. Further, seed replacement frequency is also low and demand for quality seeds is negligibly low at present. In contrast to such situation, the results of the Socio-economic Survey (Attachment B1.2-2) indicate no serious constraints for quality seed procurement in the Target as follows;

Seed Supply Conditions in the Target Area

Enquiry	Reponses (200 sample farmers)
Seed Source of Rice	Own products: 74%; exchange with others: 14%
Frequency of Seed Replacement	Once per 3 cropping: 73%; once per over 4 cropping: 27%
Procurement of Wanted Seed	Easy: 63%; difficult/not possible: 37%
Procurement of Quality Seed	Easy: 58%; difficult/not possible: 42%
Price of Quality Seed	Too expensive: 30%; acceptable: 23%

Source: Socio-economic Survey by the JICA Study team, 2007

In upland crops production, quality seeds are seldom used and major seed sources are: i) seeds procured at local markets and ii) own products. Prevailing seed sources of vegetables are also seeds procured at local markets and own products. However, vegetable seeds imported from Thailand and Vietnamese are commonly used for intensive vegetable production under irrigation. For the expansion of upland crops production, seed multiplication within the sub-project area should better be envisaged under the strengthening of agricultural extension activities.

Farm input supplies in the area are mostly carried out by dealers in district centers and local markets at commune or district level. The results of the Socio-economic Survey (Attachment B1.2-2) indicate existence of no serious constraints for fertilizer procurement except for price.

B1.2.11 Rural Credit

Major formal rural credit operators in the project district include ACLEDA Bank and PRASAC MFI as discussed in the section B1.1.11. The sub-branch offices of ACLEDA Bank and PRASAC MFI are located in Moung Commune neighboring to the project communes.

B1.2.12 Agricultural Cooperatives

The number of agricultural cooperatives formed in Battambang Province and the project district is 32 and 4, respectively, as discussed in the section B1.1.12. However, the statuses of cooperatives in the district are still at an infant level and no cooperative activities such as procurement, shipment & selling activities are carried out. One cooperative in Chery

Commune operates saving & credit services to members.

B1.2.13 Current Capacity to Pay

For the estimation of the current capacity-to-pay, farm economic analyses on typical farms were made based on the crop budget analysis on the current crop production in paddy fields (Table B1.1-12) and the results of the Socio-economic Survey by the Study Team in 2007.

(1) Typical Farms

Almost all the paddy fields in the sub-project area (95% of total) are categorized into rainfed paddy fields. Accordingly, depending on prevailing rice cultivation systems in wet season, two typical farms having rainfed paddy field, one farm practicing direct sowing and the other practicing transplanting, are selected as is the case in the Ream Kon Sub-project Area.

On the basis of the average holding size of paddy fields per farm family estimated in the section B1.2.3, the typical farms for the present farm economic analysis are defined as shown in the following table.

Typical Farms for Farm Economic Analysis

Type	Irrigation Status	Planting Method 1/	Holding Size 2/
Type A	Rainfed paddy field	Transplanting	2.4 ha/family
Type B	Rainfed paddy field	Direct Sowing	2.4 ha/family

1/: Planting method in wet season 2/: holding size of paddy field assumed

(2) Current Capacity to Pay

The present farm economy of the typical farms are estimated based on the crop budget analyses and the results of the Socio-economic Survey as shown in Table B1.1-14 and as summarized below.

Present Farm Economy 1/

Item		Amount (Riel 1,000.-)	
		Type A	Type B
Gross Incomes	Rice Production	5,738	3,890
	Other Farm Incomes	1,120	1,120
	Non-farm Income	1,980	1,980
	Total Income	8,838	6,990
Expenditures	Production Costs of Farm Products	3,575	3,049
	Other Expenditures	3,670	3,670
	Total Expenditures	7,245	6,719
	Net Surplus	1,593	271

1/: Assuming other farm income, non-farm income & other expenditures are same in both cases

As shown in the table, the current farm economy of the typical farm Type A (transplanting) indicate net surplus (capacity to pay) of Riel 1,593,000 or 18% of the total income and the same of the Type B (direct sowing) indicates net surplus of Riel 271,000 or 4 % of the income. The net surplus of the Type B is about 17% of the same of the Type A. In both cases, the current capacity to pay is limited attributed mainly to low productivity of paddy under rainfed condition.

B1.2.14 Results of Socio-economic Survey

The results of the Socio-economic Survey are presented in a narrative manner in Table B1.2-12. Major constraints in rice farming identified are low paddy yield and irrigation water shortage even in wet season. Farmers expectations for farming and physical works (irrigation/drainage) are **productivity improvement of wet season rice and adequate irrigation water supply in wet season**, respectively. The detail results of the Survey are presented in Attachment B1.2-1. The results of the Survey on farming practices, farm input supply and marketing are presented in Attachment B1.2-2.

B1.3 Damnak Ampil Rehabilitation Sub-project Area

B1.3.1 Soils and Land Suitability

The soils distributed in the sub-project area are examined based on the reconnaissance level soil map prepared in the Master Plan Stage of the present Study, in which soils are classified at soil sub-unit level following the FAO/UNESCO classification system. According to the map, the sub-project area is entirely covered with the association of Gleyic Acrisol and Plinthic Acrisol (ACG/ACp).

Gleyic Acrisol (ACg) has medium to fine textured surface layer (SL~LiC) underlain with finer textured sub soils (LiC to HC). In medium textured soil, surface soils are highly weathered and have weak cohesion capacity because of leaching out of cementing materials as base, organic matter and silica. The medium textured soil is very friable when moist and quite easy to crush by fingers. The effective depth of the soils is deep and no plinthite layer is encountered within 100 cm from the surface. The surface soils of the representative profiles have acid reaction (pH) and low to moderate soil fertility judged from moderate total nitrogen, moderate to low cation exchange capacity (CEC) and high exchangeable potassium.

Plinthic Acrisol (ACp) generally has medium textured surface layer (SL~L) underlain with finer textured sub soils. Surface soils are highly weathered and have weak cohesion capacity because of leaching out of cementing materials as base, organic matter and silica. The soils are very friable when moist and quite easy to crush by fingers. The effective depth of the soils is deeper than 80cm and plinthite layers are encountered in sub-soils at different depth. The surface soils of the representative profiles have acid reaction (pH) and low soil fertility judged from moderate total nitrogen, low cation exchange capacity (CEC) and moderate exchangeable potassium.

The soil is classified as marginally suitable both for rice and upland crops production according to the FAO classification system (Framework for Land Evaluation, FAO, 1976).

B1.3.2 Present Land Use

The present land uses of the sub-project are exclusively paddy fields under different irrigation statuses. Accordingly, the land uses of the areas are classified depending on current irrigation statuses into 2 sub-categories of: i) supplemental irrigation paddy field and ii) rainfed paddy field (including fields under rainfed condition) as shown in the following table.

Present Land Use of the Sub-project Area

Land Use Sub-category	Area		
	(ha)	(%)	(%)
Normal Irrigation Paddy Field	-	-	-
Supplemental Irrigation Paddy Field	500	21	-
Rainfed Paddy Field	1,930	79	-
Paddy Field Total	2,430	100	93
Right-of-ways	180	-	7
Sub-project Area	2,610	-	100

As shown in the tables, irrigation water supply conditions in the sub-project are better compared with other sub-project areas and the paddy fields under supplemental irrigation and rainfed conditions account respectively for about 21% and 79% of the total paddy fields.

B1.3.3 Agro-demography and Land Holding

Agro-demographic and land holding features in the project communes (major communes located in the sub-project area) estimated based on the Commune Survey on Crops & Livestock, 2003, MAFF are presented as follows;

Agro-demographic Features in the Project Communes in 2003

Items	Average 1/	Range 1/
% of Farm Households to Total Households	89%	88 – 90%
% of None Farm Households (No. of none crop producing households)	11%	10 – 12%
% of Farm Households Producing Wet Season Rice	100%	100%
Average Family Size (in 2005, SEILA Data Base)	5.3	5.1 – 5.5

1/: Average & range of Trapeang Chong & Snam Preah Commune

Source: Commune Survey on Crops & Livestock, 2003, MAFF & SEILA Commune Data Base, 2005

When assuming that number of farm households is accounted by number of crop producing households, farm households in the area is calculated at 89% of the total households and none-farm households are estimated at 11%. All the farm households (crop producing households) are producing wet season rice. Average family size is 5.3 members.

The access to data/information on land tenure was rather limited. However, the Commune Survey provides some information on the land tenure and holding statuses as shown in the following table.

Land Holding Features of the Project Communes in 2003

Indicator	Average 1/	Range 1/
% of Landless Households	11%	10 – 12%
% of Farm Households with Holding Size Less Than 10a	8%	0 – 15%
% of Farm Households with Holding Size More Than 3ha	15%	12 – 18%

1/: Average & range of Trapeang Chong & Snam Preah

Source: Commune Survey on Crops & Livestock, 2003, MAFF

As shown in the table, almost all the farm households in the communes appear to have some farmland. From the rice cropped area in wet season, average holding size of paddy field per farm household is roughly estimated at 1.2ha as shown in Table B1.3-1. Proportion of land holding households having less than 0.1ha is calculated at 8% and the same of more than 3ha is at 15%.

The number of landless households calculated at 11% of the total households is nearly equal to the number of none crop producing households. Therefore, the landless figure might

represent non-farm households domiciling in the sub-project area, especially in urban areas and number of landless farm households might be limited.

B1.3.4 Crop Production

(1) General

The present agricultural conditions of the sub-project area have been studied on the basis of the results of interview survey with the major project commune offices, village chief and DAO Bakan, statistic data of DAO and PDA and findings of the field survey by the Study Team. The summary sheet of the statistic data on the major communes are presented in Table B1.3-2, B1.3-3 and B1.3-5 to B1.3-9 and the results of the interview surveys are presented in Attachment B1.3-1 and B1.1-2.

Rice production is the most important agricultural activities in the sub-project area and it is estimated that wet season rice cultivation was practiced by about 100% of farm households in 2003. Rice production in the area is characterized by low and unstable productivity under rainfed conditions. Further, prolonged rice cultivation season continuing from July/August to November/December with the cultivation of rice varieties of different growth durations of medium to late and traditional farming practices are other characteristics of the rice production in the area.

Rice cultivation in dry season by pumping irrigation is practiced in a limited extent. No other crops are cultivated in the paddy fields in the area.

(2) Cropping Season and Variety

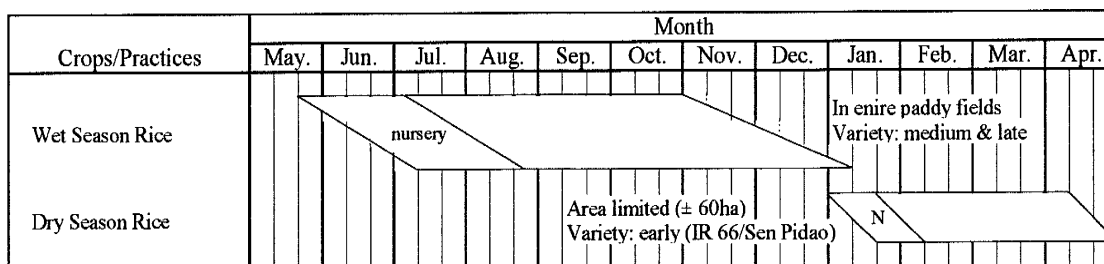
Rice cropping season in the area is almost exclusively wet season from July/August to November/December. Dry season rice cultivation is practiced from January/February to April in a limited extent. In the area, a number of rice varieties are cultivated and cropping seasons vary substantially depending on varieties grown. Major varieties grown are as follows;

Major Varieties Grown in the Sub-project Area

Season	Growth Duration	Variety
Wet Season	Medium	Phka. Rumdoul, Phka Khney, Phka Mulis, Somali
	Late	Neang Pong, CAR 4, CAR 7, CAR 9, Kang Threung
Dry Season	Early	IR, Sen Pidao

(3) Cropping Calendar and Pattern

The prevailing cropping calendar in the area estimated based on the interview survey results (Attachment B1.3-1 & B1.1-2) is illustrated as shown in the following figure.



Prevailing Cropping Calendar in Paddy Fields: Damnak Ampil Sub-project Area

As stated earlier, a single cropping of wet season rice is an almost exclusive cropping pattern in the area as an extent of dry season rice cultivation is limited. Cultivation of other crops in paddy fields was not reported.

(4) Cropped Area

The current cropped areas of rice and other crops in the area have been estimated on the basis of various data and information and the findings of the field survey as presented in Table B1.3-4 and as summarized below.

Estimated Cropped Area & Cropping Intensity in the Sub-project Area

Cropping Season	Cropped Area (ha)		Cropping Intensity (%)
	Rice	Other Crops	
Wet Season	2,430	-	100
Dry Season	60	-	2
Annual	2,490	-	102

Source: JICA Study Team

As shown in the table, the cropping intensity of rice is estimated at 100% in wet season and only at 2% in dry season. The annual cropping intensity in the paddy fields is estimated to be 102% including dry season rice.

(5) Paddy Yield and Production

Yields of paddy in the sub-project area are estimated based on the statistic data of PDA/DAO and SEILA Data Base, the results of interview surveys, Socio-economic Survey and Inventory Survey by JICA as shown in Table B1.3-10 and B1.3-11 and summarized as follows;

Estimated Paddy Yield & Production in the Sub-project Area

Irrigation Status	Yield Level		Cropped Area		Production
	Wet Season	Dry Season	Wet Season	Dry Season	
Under Rainfed Condition	1.5 t/ha	-	1,930 ha	-	2,895 ton
Supplemental Irrigation 1/	2.0 t/ha	2.5 t/ha	500 ha	60 ha	1,150 ton
Total	-	-	2,430 ha	60 ha	4,045 ton

1/: Including pumping irrigation in dry season.

The current yield level of paddy in wet season is estimated at around 1.5 ton/ha under rainfed condition and 2.0 ton/ha in wet season under supplemental irrigation and 2.5 t/ha in dry season under pumping irrigation. Current production of paddy in the area is estimated at 3,900 tons in wet season, 150 tons in dry season and 4,050 tons annually.

(6) Prevailing Farming Practices

Some specific features of rice farming practices in the area are:

- Prevailing of transplanting method ($\pm 92\%$) to direct sowing method as shown in Table B1.3-5,
- Prevailing of land preparation by draft animal ($\pm 80\%$) to land preparation by tractor ($\pm 20\%$) as shown in Table B1.3-5, and
- Cultivation of both improved and local varieties of medium and late growth duration.

B1.3.5 Crop Production in Upland Fields

Compared with rice production, production of upland crops is extremely limited in the sub-project area as shown in Table B1.3-6 and summarized below.

Cropped Area of Major Upland Crops in the Project Communes

Crops	Area		Crops	Area	
	(ha)	(%)		(ha)	(%)
Sugar Cane	163	51	Mungbeans	12	4
Corn	36	11	Vegetables	15	5
Groundnut	13	4	Others	67	21
Cassava	12	4	Total	318	100

Source: DAO Bakan

As shown in the table, cropped areas of upland crops in the project communes are less than 4% of annual rice cropped area of some 8,400ha in the communes. Major upland crop is sugar cane followed by corn, groundnut, mungbeans, and cassava. Annual cropped area of vegetables is estimated at 15ha. Major vegetables include cucumber, pumpkin, string beans and egg plant. Main cropping season of upland crops and vegetables in upland fields is wet season.

Fruit trees grown in the communes are extremely limited and major fruit trees are banana and orange as shown in Table 4.3.2-7.

B1.3.6 Farm Machinery and Equipment

The inventory on farm machinery and equipment in the project communes is presented in Table B1.3-8 and summarized in the following table.

Inventory of Farm Machinery in the Project Communes in 2007

Tractor	Hand Tractor	Water Pump	Engine Thresher	Rice Mill	
				Small	Big
11	70	445	29	247	7

Source: PDA Pursat

The number of hand tractors in the communes is substantial, however, land preparation work by draft animal is still prevailing practices. The number of water pumps, appeared to be used for supplemental water supply to paddy fields when rainfall in wet season is insufficient, is large in the communes. The number of rice mills appears to be more than sufficient for milling demand because marketing of paddy is commonly carried out in the form of unhusked rice.

B1.3.7 Livestock

Livestock sub-sector is an important agricultural activity for farm economy and provides an essential source of draft power and manure for farming in the sub-project area. Accordingly, a substantial number of animals and poultry are raised in the area and majority of farm families hold some kind of animals as shown in Table B1.3-9 and as summarized below.

Livestock Population & Holding Status in the Project Communes in 2003

Item	Cattle	Buffalo	Pig	Animal Unit	Poultry
Population	13,601	6,310	10,507	20,021	219,872
Holding Size/Family	1.3	0.6	1.0	1.9	20.8

Source: Commune Survey on Crops & Livestock, 2003, MAFF

From the table, an average holding size of cattle, buffalo and pig in 2003 is calculated at 1.3, 0.6 and 1.0 heads per farm household, respectively, equivalent to animal units of 1.9 in total. The holding size of poultry is calculated at 20.8 per farm family. However, as the statistic figures include livestock & poultry hold by commercial farms, an actual holding size per farm is lower than the said estimates.

B1.3.8 Post-harvest and Marketing

Use of engine thresher provided by hiring service is prevailing threshing method of paddy in the sub-project area. After threshing, paddies except for those kept for family consumption are generally marketed without drying soon after harvest partly because of insufficient drying space and no drying yard. Paddies for family consumption are sun dried in a home yard and stored.

According to the results of the Socio-economic Survey, prevailing marketing channels of paddy in the area are marketing of field dry paddy to village rice millers followed by rice millers in commune centers. A main marketing destination of other crops is also markets at village level. Because of limited market volume by individual farmers, farmers have little bargaining power in price setting in general.

Major constraints for paddy marketing identified through the Socio-economic Survey are unstable market prices of paddy followed by low market prices of paddy as is the case in other sub-project areas as shown in Attachment B1.3-2 and summarized below.

Paddy Marketing Constraints Reported by Sample Farmers

	Constraint
Most Serious Constraint	Unstable market prices of paddy/rice
2 nd Serious Constraint	Low market prices of paddy/rice
3 rd Serious Constraint	Limitation of market of paddy

Source: Socio-economic Survey by the JICA Study team, 2008

Major constraints reported by the rice millers in the project district are similar to those reported by rice millers in Moug Ruessei District and include: i) price competition with Viet Nam buyers, ii) no drying facility or insufficient drying spaces and failed completion with Viet Nam and Thai buyers who accept field dried paddy (wet paddy), iii) unstable price influenced by demand in Viet Nam and iv) poor management and limited activity of the Pursat Rice Millers Association. The results of the interview survey with rice millers in the project district are presented in Attachment B1.3-3. In Pursat Province, large scale rice storage with extensive drying yard is established for cooperative use of member rice millers by the Federal Rice Millers Association. However, the use of the storage is reported to be rather limited due mainly to difficulty in procuring of paddy in bulk.

B1.3.9 Agricultural Extension Services

The present statuses of agricultural support services in the sub-project area are discussed from the view point of the same in the project district, Bakan District, and the sub-project area specific support activities.

(1) Agricultural Extension Services in the Project District

(a) Institutions

The government institutions involved in agricultural support services at the province level is PDA Pursat. The PDA is a provincial level agricultural agency under the provincial government and is an agency responsible for agricultural development and provision of agricultural supporting services at province, district, commune and village levels. The PDA is composed of 6 technical offices and two planning/administrative offices. The PDA has its branch offices at district level called District Agricultural Office (DAO).

The district agricultural Office covering the sub-project area is DAO Bakan. The DAO has two sections of agronomy and livestock. However, staffing of the office is limited to 6 in total and extension activities of the office appear to be very limited.

International organizations having agricultural activities in the district include EU (SLPP: livestock sub-sector activities) and FAO (food security program). Several local NGOs are involved in agricultural sector support activities.

(b) Extension Services

The government extension services at the sub-project area level (commune & village) are basically to be provided by DAO under the support and guidance of PDA. Major agricultural extension activities provided in the province are programs under NCCD (decentralization program after SEILA) by the government and activities under donors and NGOs. However, current services appear to be extremely limited due primarily to financial constraints.

Under the new extension system at village level in which the deployment of Village Agricultural Extension Agent (VAA) at each village is planned, recruiting of VAA from Village Livestock Agent (VLA) or key farmers has been carried out in the province and project district.

(2) Current Support Activities in the Project Communes

Current major agricultural support program operated in the project communes include activities by NGOs; Ox-Farm (livestock, rice bank, canal maintenance, farm credit) and livestock activities by local NGOs. Major activities under NCCD in the project communes (Tropeang Chong, Snam Preah) include irrigation canal rehabilitation and road rehabilitation.

B1.3.10 Seed and Farm Inputs Supply

The predominant rice seed supply system in Cambodia is illustrated in the section B1.1.10.

Primary source of quality seed supply in and around the sub-project areas is provision of seed under support programs of PDA/DAO, donors or others. Commercial seed suppliers are farm inputs suppliers in district center (Bakan) but their supply volume is limited as is the case in Moung Ruessi.

According to the results of the Socio-economic Survey, predominant seed source of rice is self-multiplied seeds (products of previous season) followed by seeds exchange with other farmers in the areas. Further, seed replacement frequency is also low and demand for quality

seeds appears to be low at present. In contrast to such situation, the Survey results indicate no serious constraints for quality seed procurement in the sub-project areas as follows;

Seed Supply Conditions in the Sub-project Areas

Enquiry	Reponses (200 sample farmers)
Seed Source of Rice	Own products: 57%; exchange with others: 20%
Frequency of Seed Replacement	Once per 3 cropping: 79%; once per over 4 cropping: 23%
Procurement of Wanted Seed	Easy: 100%; difficult/not possible: 0%
Procurement of Quality Seed	Easy: 83%; difficult/not possible: 17%
Price of Quality Seed	Too expensive: 30%; acceptable: 23%; not purchased: 47%

Source: Socio-economic Survey by the JICA Study team, 2008

Farm input supplies in the project district are mostly carried out by dealers in district centers and local markets at commune or district level.

B1.3.11 Rural Credit

The deployment of ACLEDA Bank and MFIs is rapidly expanding in the country and Pursat Province in recent years. Formal rural credit operators in the project district include ACLEDA Bank, PRASAC and Hattha Kaksekar Ltd. The numbers of branch (province level) and sub-branch offices (district level) of ACLEDA Bank operated in the project province (Pursat) and district are as follows;

Deployment of Branch & Sub-branch Offices of ACLEDA & AMRET

Institute	Branch Offices	Sub-branch Offices	Project District
ACLEDA	2 in province	7 in province	1 branch & 1 sub-branch office

Source: DAO Bakan

The branch and sub-branch office in the district are located in Tropeang Chong and Ou Ta Pomg Commune, respectively neighboring to the project communes. In addition, there deployed 2 district offices of Hattha Kaksekar and 1 sub-branch office of PRASAC in and around the project communes. The terms and conditions of micro credit (farm credit & small-scale industry) of PRASAC MFI are similar to those of ACLEDA Bank as follows;

Terms & Conditions for Farm Credit of PRASAC MFI

Institute	Credit Period & Interest rate	Conditions
PRASAC MFI	4 ~ 12 months interest 3.0%/month	Provision of collateral & approval of commune council

Source: ACLEDA Bank Plc., Branch Office

However, non-institutional credit providers such as money lenders, rice miller, farm input suppliers and relatives or friends might continue to be an important source of rural credit.

B1.3.12 Agricultural Cooperatives

The formation of agricultural cooperatives is promoted by MAFF/PDA in the country with the support of NGOs. The number of cooperatives formed in Pursat Province and the project district is as follows;

No. of Agricultural Cooperatives in Province & Bakan District (2008)

Province	Project District	Project Communes
12 cooperatives	3 cooperatives	No cooperatives formed

However, the statuses of cooperatives in the district are still at an infant level and no

cooperative activities such as procurement, shipment & selling activities are carried out. The total members of the 3 cooperatives in the district are 131 and 44 members per cooperatives on average. An average capital of the cooperatives is very limited to Riel 1,500,000.-.

B1.3.13 Current Capacity to Pay

For the estimation of the current capacity-to-pay, farm economic analyses on typical farms were made based on the crop budget analyses on the current crop production in paddy fields (Table B1.1-12) and the results of Socio-economic Survey by the Study Team in 2008.

(1) Typical Farms

Paddy fields in the sub-project area are categorized into rainfed field (79% of total) and supplemental irrigation paddy field (21%). Accordingly, farm families having rainfed paddy field and supplemental irrigation paddy field were selected as typical farms for the present farm economic analyses.

On the basis of the average holding size of paddy fields per farm family estimated in the section B1.3.3, the typical farms for the farm economic analyses are defined as shown below.

Typical Farms for Analysis

Type	Irrigation Status	Holding Size 1/
Type A	Rainfed paddy field	1.2 ha/family
Type B	Supplemental irrigation	1.2 ha/family

1/: holding size of paddy field assumed

(2) Current Capacity to Pay

The present farm economy of the typical farms are estimated based on crop budget analyses and the results of the Socio-economic Survey as shown in Table B1.1-14 and as follows;

Present Farm Economy 1/

Item		Amount (Riel 1,000.-)	
		Type A	Type B
Gross Incomes	Rice Production	1,980	2,640
	Other Farm Incomes	1,119	1,119
	Non-farm Income	1,916	1,916
Total Income		5,015	5,675
Expenditures	Production Costs of Farm Products	1,423	1,590
	Other Expenditures	3,400	3,400
	Total Expenditures	4,823	4,990
Net Surplus		192	685

1/: Assuming other farm income, non-farm income & other expenditures are same in both cases

As shown in the table, the current farm economy of the typical farm Type A (rainfed) indicate net surplus (capacity to pay) of Riel 192,00 or 4% of the total income and the same of the Type B (supplemental irrigation) indicates net surplus of Riel 685,000 or 12 % of the income. In both cases, the current capacity to pay is limited attributed mainly to small land holding size and low productivity of paddy under insufficient water supply or rainfed condition.

B1.3.14 Results of Socio-economic Survey

The results of the Socio-economic Survey are presented in a narrative manner in Table

B1.3-12. Major constraints in rice farming identified are low paddy yield and irrigation water shortage in dry season. Farmers expectations for farming and physical works (irrigation/drainage) are **productivity improvement of wet season rice and adequate irrigation water supply in wet season**, respectively. The detail results of the Survey are presented in Attachment B1.3-2. The results of the Survey on farming practices, farm input supply and marketing are presented in Attachment B1.3-4.

B1.4 Wat Loung Rehabilitation Sub-project Area

B1.4.1 Soils and Land Suitability

The soils distributed in the sub-project area are similar to the same in the Damnak Ampil sub-project area as the areas are located adjacently. The entire sub-project area is distributed with the association of Gleyic Acrisol and Plinthic Acrisol (ACG/ACp). The characteristics of the soils are explained in the section B1.3.1. The soil association is classified as marginally suitable both for rice and upland crops production according to the FAO classification system (Framework for Land Evaluation, FAO, 1976).

B1.4.2 Present Land Use

The present land uses of the sub-project are exclusively paddy fields under different irrigation statuses. Accordingly, the land uses of the areas are classified depending on current irrigation statuses into 2 sub-categories of : i) supplemental irrigation paddy field and ii) rainfed paddy field (including fields under rainfed condition) as follows;

Present Land Use of the Sub-project Area

Land Use Sub-category	Area		
	(ha)	(%)	(%)
Normal Irrigation Paddy Field	-	-	-
Supplemental Irrigation Paddy Field	130	5	-
Rainfed Paddy Field	2,590	95	-
Paddy Field Total	2,720	100	93
Right-of-ways	200	-	7
Sub-project Area	2,920	-	100

As shown in the tables, irrigation water supply conditions in the sub-project are very poor and the paddy fields under rainfed conditions account for about 95% of the total paddy fields in the area.

B1.4.3 Agro-demography and Land Holding

Agro-demographic and land holding features in the project communes (major communes located in the sub-project area) estimated based on the Commune Survey on Crops & Livestock, 2003, MAFF are presented as follows;

Agro-demographic Features in the Project Communes in 2003

Items	Average 1/	Range 1/
% of Farm Households to Total Households	90%	88 – 94%
% of None Farm Households (No. of none crop producing households)	10%	6 – 12%
% of Farm Households Producing Wet Season Rice	100%	100%
Average Family Size (in 2005, SEILA Data Base)	5.2	5.1 – 5.5

1/: Average & range of Trapeang Chong, Snam Preah & Khnar Totueng Commune

Source: Commune Survey on Crops & Livestock, 2003, MAFF & SEILA C commune Data Base, 2005

When assuming that number of farm households is accounted by number of crop producing households, farm households in the area is calculated at 90% of the total households and none-farm households are estimated at 10%. All the farm households (crop producing households) are producing wet season rice. Average family size is 5.2 members.

The access to data/information on land tenure was rather limited. However, the Commune Survey, MAFF provides some information on the land tenure and holding statuses as shown in the following table.

Land Holding Features of the Project Communes in 2003

Indicator	Average 1/	Range 1/
% of Landless Households	10%	6 – 12%
%. of Farm Households with Holding Size Less Than 10a	6%	0 – 15%
% of Farm Households with Holding Size More Than 3ha	16%	12 – 20%

1/: Average & range of Trapeang Chong & Snam Preah

Source: Commune Survey on Crops & Livestock, 2003, MAFF

As shown in the table, almost all the farm households in the communes appear to have some farmland. From the rice cropped area in wet season, average holding size of paddy field per farm household is roughly estimated at 1.4ha as shown in Table B1.4-1. Proportion of land holding households having less than 0.1ha is calculated at 6% and the same of more than 3ha is at 16%.

The number of landless households calculated at 10% of the total households is nearly equal to the number of none crop producing households. Therefore, the landless figure might represent non-farm households domiciling in the sub-project area, especially in urban areas and number of landless farm households might be limited.

B1.4.4 Crop Production

(1) General

Rice production is the most important agricultural activities in the sub-project area and it is estimated that wet season rice cultivation was practiced by about 100% of farm households in 2003. As is the case in the Damnak Ampil sub-project area, rice production in the area is characterized by low and unstable productivity under rainfed conditions. Further, prolonged rice cultivation season with the cultivation of rice varieties of different growth durations of medium to late and traditional farming practices are other characteristics of the rice production in the area.

Rice cultivation in dry season by pump irrigation is practiced in a limited extent. Further, vegetable production in dry season is also practiced in paddy fields, basically under rainfed conditions. The summary sheet of the statistic data on the major communes are presented in Table B1.4-2, B1.4-3 and B1.4-5 to B1.4-9 and the results of the interview surveys are presented in Attachment B1.3-1 and B1.1-2.

(2) Cropping Season and Variety

Rice cropping season in the area is similar to the same in the Damnak Ampil Sub-project Area and is almost exclusively wet season from July/August to November/January. Dry season rice cultivation is practiced from December to April/May in a limited extent. In the area, a number

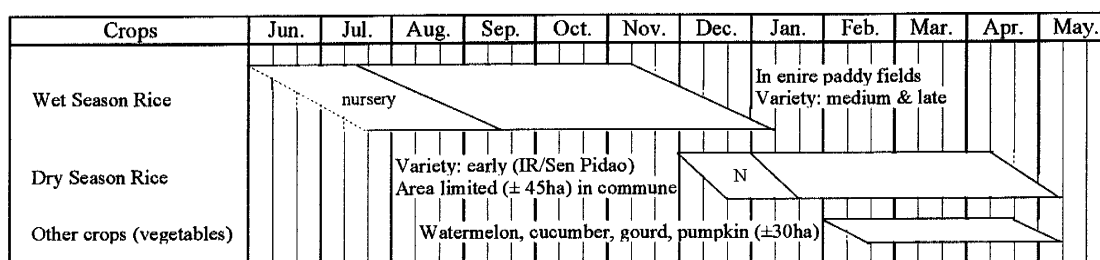
of rice varieties are cultivated and cropping seasons vary substantially depending on varieties grown. Major varieties grown are as follows;

Major Varieties Grown in the Sub-project

Season	Growth Duration	Variety
Wet Season	Medium	Phka. Rumdoul, Phka Khney, Phka Mulis, Somali
	Late	Neang Pong, CAR 4
Dry Season	Early	IR, Sen Pidao

(3) Cropping Calendar and Pattern

The prevailing cropping calendar in the area estimated based on the interview survey results (Attachment B1.3-1 & B1.1-2) is illustrated as shown in the following figure.



Prevailing Cropping Calendar in Paddy Fields: Wat Loun Sub-project Area

As stated earlier, a single cropping of wet season rice is an almost exclusive cropping pattern in the area because an extent of dry season rice cultivation is extremely limited. Cultivation of other crops such as watermelon, cucumber, gourd and pumpkin in paddy fields is practiced in dry season in limited extent as shown in the figure.

(4) Cropped Area

The current cropped areas of rice and other crops in the area have been estimated based on the basis of various data and information and the findings of the field survey as presented in Table B1.4-4 and as summarized below.

Estimated Cropped Area & Cropping Intensity in the Sub-project Area

Cropping Season	Cropped Area (ha)		Cropping Intensity (%)
	Rice	Other Crops 1/	
Wet Season	2,720	-	100
Dry Season	45	30	3
Annual	2,765	30	103

1/: Watermelon & cucumber

Source: JICA Study Team

As shown in the table, the cropping intensity of rice is estimated at 100% in wet season. The overall annual cropping intensity in the paddy fields is estimated to be 103% including rice and other crops grown in the dry season.

(5) Yield and Production

Yields of paddy in the sub-project area are estimated based on the statistic data of PDA/DAO and SEILA Data Base, the results of interview surveys, Socio-economic Survey and Inventory Survey by JICA as shown in Table B1.4-10 and B1.4-11 and as summarized in the following.

Estimated Paddy Yield & Production in the Sub-project Area

Irrigation Status	Yield Level		Cropped Area		Production
	Wet Season	Dry Season	Wet Season	Dry Season	
Under Rainfed Condition	1.5 t/ha	-	2,590 ha	-	3,885 tons
Supplemental Irrigation 1/	2.0 t/ha	2.5 t/ha	130 ha	45 ha	373 tons
Total	-	-	2,720 ha	45 ha	4,258 tons

1/: Including pumping irrigation in dry season.

The current yield level of paddy in wet season is estimated at around 1.5 ton/ha under rainfed condition and 2.0 ton/ha in wet season under supplemental irrigation and 2.5 ton/ha in dry season under pumping irrigation. Current production of paddy in the area is estimated at 4,150 tons in wet season, 110 tons in dry season and 4,260 tons annually. Current yields of vegetables are estimated at watermelon 5.5 ton/ha and cucumber 6.0ton/ha based on the results of crop budget surveys conducted by the Study Team. The production volume of the crops is estimated at some 170 tons.

(6) Prevailing Farming Practices

Some specific features of rice farming practices in the area are:

- Prevailing of transplanting method ($\pm 92\%$) to direct sowing as shown in Table B1.4-5,
- Prevailing of land preparation by draft animal ($\pm 80\%$) to land preparation by tractor ($\pm 20\%$) as shown in Table B1.4-5, and
- Cultivation of both improved and local varieties of medium and late growth duration.

B1.4.5 Crop Production in Upland Fields

Compared with rice production, production of upland crops is extremely limited in the sub-project area as shown in Table B1.4-6 and summarized below.

Cropped Area of Major Upland Crops in the Project Communes

Crops	Area		Crops	Area	
	(ha)	(%)		(ha)	(%)
Sugar Cane	165	57	Mungbeans	15	5
Corn	40	14	Vegetables	15	5
Groundnut	16	6	Others	23	8
Cassava	15	5	Total	289	100

Source: DAO Bakan

As shown in the table, cropped areas of upland crops in the project communes are about 2% of annual rice cropped area of some 11,800ha in the communes. Major upland crop is sugar cane followed by corn, groundnut, mungbeans and cassava. Annual cropped area of vegetables is estimated at 15ha. Major vegetables include watermelon, cucumber, pumpkin, string beans and egg plant. Main cropping season of upland crops and vegetables in upland fields is wet season.

Fruit trees grown in the communes are extremely limited and major fruit trees are banana and orange as shown in Table B1.4-7.

B1.4.6 Farm Machinery and Equipment

The inventory on farm machinery and equipment in the project communes is presented in

Table B1.4-8 and summarized in the following table.

Inventory of Farm Machinery in the Project Communes in 2007

Tractor	Hand Tractor	Water Pump	Engine Thresher	Rice Mill	
				Small	Big
13	118	600	38	274	9

Source: PDA Pursat

The number of hand tractors in the communes is substantial; however, land preparation work by draft animal is still prevailing practices. The number of water pumps, appeared to be used for supplemental water supply to paddy fields when rainfall in wet season is insufficient, is also substantial in the communes. The number of rice mills appears to be more than sufficient for milling demand because marketing of paddy is commonly carried out in the form of unhusked rice.

B1.4.7 Livestock

Livestock sub-sector is an important agricultural activity for farm economy and provides an essential source of draft power and manure for farming in the sub-project area. Accordingly, a substantial number of animals and poultry are raised in the area and majority of farm families hold some kind of animals as shown in Table B1.4-9 and as summarized below.

Livestock Population & Holding Status in the Project Communes in 2003

Item	Cattle	Buffalo	Pig	Animal Unit	Poultry
Population	11,344	4,393	9,128	15,989	205,232
Holding Size/Family	1.3	0.5	1.1	1.9	24.2

Source: Commune Survey on Crops & Livestock, 2003, MAFF

From the table, an average holding size of cattle, buffalo and pig in 2003 is calculated at 1.3, 0.5 and 1.1 heads per farm household, respectively, equivalent to animal units of 1.9 in total. The holding size of poultry is calculated at 24.2 per farm family. However, as the statistic figures include livestock & poultry hold by commercial farms, an actual holding size per farm is lower than the said estimates.

B1.4.8 Post-harvest and Marketing

Prevailing threshing method is by engine thresher of hiring service followed by pedal thresher and manual threshing in the sub-project area. After threshing, paddies except for those kept for family consumption are generally marketed without drying soon after harvest partly because of insufficient drying space and no drying yard. Paddies for family consumption are sun dried on plastic sheet in a home yard and stored.

According to the results of the Socio-economic Survey, prevailing marketing channels of paddy in the area are marketing of field dry paddy to rice millers in commune centers followed by collectors at village level. A main marketing destination of other crops is markets at village level. Because of limited market volume by individual farmers, farmers have little bargaining power in price setting in general as is the case in other sub-project areas.

Major constraints for paddy marketing identified through the Socio-economic Survey are unstable market prices of paddy followed by low market prices of paddy as is the case in other sub-project areas as shown in Attachment B1.4-1 and summarized below.

Paddy Marketing Constraints Reported by Sample Farmers

	Constraint
Most Serious Constraint	Unstable market prices of paddy/rice
2 nd Serious Constraint	Low market prices of paddy/rice
3 rd Serious Constraint	Unstable market prices of livestock

Source: Socio-economic Survey by the JICA Study team, 2007

Major constraints reported by the rice millers in the project district are discussed in the section B1.3.8 and the results of the interview survey with rice millers in the project district are presented in Attachment B1.3-3.

B1.4.9 Agricultural Extension Services

(1) Agricultural Extension Services in the Project District

(a) Institutions

The government institutions involved in agricultural support services at the province level is PDA Pursat as discussed in the section B1.3.9. The PDA has its branch offices at district level called District Agricultural Office (DAO). The district agricultural Office covering the sub-project area is DAO Bakan. The DAO has two sections of agronomy and livestock. However, staffing of the office is limited to 6 in total and extension activities of the office appear to be very limited as discussed earlier in the said section.

(b) Extension Services

The government extension services at the sub-project area level (commune & village) are basically to be provided by DAO under the support and guidance of PDA. Major agricultural extension activities provided in the province are programs under NCCD (decentralization program after SEILA) by the government and activities by NGOs as discussed in the section B1.3.9. However, current services appear to be extremely limited due primarily to financial constraints.

(2) Current Support Activities in the Project Communes

Current major agricultural support program operated in the project communes include activities by NGOs; Ox-Farm (livestock, rice bank, canal maintenance, farm credit) and livestock activities by local NGOs. Major activities under NCCD in the project communes (Tropeang Chong, Snam Preah) include irrigation canal rehabilitation and road rehabilitation.

B1.4-10 Seed and Farm Inputs Supply

Primary source of quality seed supply in and around the sub-project areas is provision of seed under support programs of PDA/DAO, donors or others. Commercial seed suppliers are farm inputs suppliers in district center (Bakan) but their supply volume is limited as is the case in Moung Ruessi.

According to the results of the Socio-economic Survey (Attachment B1.4-2), predominant seed source of rice is self-multiplied seeds (products of previous season) followed by seeds exchange with other farmers in the areas. Further, seed replacement frequency is also low and demand for quality seeds appears to be low at present. In contrast to such situation, the Survey results indicate no serious constraints for quality seed procurement in the sub-project areas as

shown in the following table.

Seed Supply Conditions in the Sub-project Areas

Enquiry	Reponses (200 sample farmers)
Seed Source of Rice	Own products: 79%; exchange with others: 16%
Frequency of Seed Replacement	Once per 3 cropping: 43%; once per over 4 cropping: 57%
Procurement of Wanted Seed	Easy: 79%; difficult/not possible: 21%
Procurement of Quality Seed	Easy: 54%; difficult/not possible: 46%
Price of Quality Seed	Too expensive: 27%; acceptable: 14%; not purchased: 59%

Source: Socio-economic Survey by the JICA Study team, 200

Farm input supplies in the project district are mostly carried out by dealers in district centers and local markets at commune or district level.

B1.4.11 Rural Credit

Major formal rural credit operators in the project district include ACLEDA Bank, PRASAC MFI and Hattha Kaksekar as discussed in the section B1.3.11. The sub-branch offices of ACLEDA Bank, PRASAC MFI and Hattha Kaksekar are located in the project communes (Tropeang Chong & Boeng Khnar).

B1.4.12 Agricultural Cooperatives

The number of agricultural cooperatives formed in Pursat Province and the project district is 12 and 3, respectively, as discussed in the section B1.3.12. In the project communes, there formed 2 cooperatives. However, the statuses of the cooperatives are still at an infant level and no cooperative activities such as procurement, shipment & selling activities are carried out.

B1.4.13 Current Capacity to Pay

For the estimation of the current capacity-to-pay, farm economic analysis on typical farms was made based on the results of the Socio-economic Survey and the crop budget analysis on the current crop production in paddy fields (Table B1.1-12 & B1.1-13).

(1) Typical Farms

Paddy fields in the sub-project area are categorized into rainfed and supplemental irrigation paddy fields, although the former is representing 95% of total. Accordingly, farm families having rainfed paddy field and supplemental irrigation paddy field were selected as typical farms for the present farm economic analyses.

On the basis of the average holding size of paddy fields per farm family estimated in the section B1.4.3, the typical farms for the present farm economic analysis are defined as shown in the following table.

Typical Farms for Analysis

Type	Irrigation Status	Holding Size 1/
Type A	Rainfed paddy field	1.4 ha/family
Type B	Supplemental irrigation	1.4 ha/family

1/: holding size of paddy field assumed

(2) Current Capacity to Pay

The present farm economy of the typical farms are estimated based on the results of the Socio-economic Survey and the crop budget as shown in Table B1.1-14 and as follows;

Present Farm Economy

Item		Amount (Riel 1,000.-)	
		Type A	Type B
Gross Incomes	Rice Production	2,310	3,080
	Other Farm Incomes	1,100	1,100
	Non-farm Income	1,690	1,690
	Total Income	5,100	5,870
Expenditures	Production Costs of Farm Products	1,598	1,793
	Other Expenditures	2,870	2,870
	Total Expenditures	4,468	4,663
Net Surplus		632	1,207

1/: Assuming other farm income, non-farm income & other expenditures are same in both cases

As shown in the table, the current farm economy of the typical farm Type A (rainfed) indicate net surplus (capacity to pay) of Riel 632,000 or 12% of the total income and the same of the Type B (supplemental irrigation) indicates net surplus of Riel 1,207,000 or 20% of the income. The current capacity to pay of the Type B farm under supplemental irrigation is 190% of the same of the Type A farm under rainfed condition.

B1.4.14 Results of Socio-economic Survey

The results of the Socio-economic Survey are presented in a narrative manner in Table B1.4-12. Major constraints in rice farming identified are low paddy yield and irrigation water shortage even in wet season. Farmers expectations for farming and physical works (irrigation/drainage) are **productivity improvement of wet season rice and adequate irrigation water supply in wet season**, respectively. The detail results of the Survey are presented in Attachment B1.4-1. The results of the Survey on farming practices, farm input supply and marketing are presented in Attachment B1.4-2.

B1.5 Wat Chre Rehabilitation Sub-project Area

B1.5.1 Soils and Land Suitability

The soils distributed in the sub-project area are similar to the same in the Damnak Ampil and Wat Loung sub-project areas as the areas are located adjacently. The entire sub-project area is distributed with the association of Gleyic Acrisol and Plinthic Acrisol (ACG/ACp). The characteristics of the soils are explained in the section B1.3.1. The soil association is classified as marginally suitable both for rice and upland crops production according to the FAO classification system (Framework for Land Evaluation, FAO, 1976).

B1.5.2 Present Land Use

The present land uses of the sub-project are exclusively paddy fields under different irrigation statuses. Accordingly, the land uses of the areas are classified depending on current irrigation statuses into 2 sub-categories of : i) supplemental irrigation paddy field and ii) rainfed paddy field (including fields under rainfed condition) as follows;

Present Land Use of the Sub-project Area

Land Use Sub-category	Area		
	(ha)	(%)	(%)
Normal Irrigation Paddy Field	-	-	-
Supplemental Irrigation Paddy Field	60	6	-
Rainfed Paddy Field	1,030	94	-
Paddy Field Total	1,090	100	93
Right-of-ways	80	-	7
Sub-project Area	1,170	-	100

As shown in the tables, irrigation water supply conditions in the sub-project are very poor and the paddy fields under rainfed conditions account for about 94% of the total paddy fields in the area.

B1.5.3 Agro-demography and Land Holding

Agro-demographic and land holding features in the project communes (major communes located in the sub-project area) estimated based on the Commune Survey on Crops & Livestock, 2003, MAFF are presented as follows;

Agro-demographic Features in the Project Communes in 2003

Items	Average 1/	Range 1/
% of Farm Households to Total Households	93%	89 – 95%
% of None Farm Households (No. of none crop producing households)	7%	5 – 11%
% of Farm Households Producing Wet Season Rice	97%	91 – 100%
Average Family Size (in 2005, SEILA Data Base)	5.4	5.2 - 5.7

1/: Average & range of Boeng Khnar, Me Tuek & Ou Ta Paong Commune

Source: Commune Survey on Crops & Livestock, 2003, MAFF & SEILA Commune Data Base, 2005

When assuming that number of farm households is accounted by number of crop producing households, farm households in the area is calculated at 93% of the total households and none-farm households are estimated at 7%. 97% of the farm households (crop producing households) are producing wet season rice. Average family size is 5.4 members.

The access to data/information on land tenure was rather limited. However, the Commune Survey provides some information on the land tenure and holding statuses as shown in the following table.

Land Holding Features of the project Communes in 2003

Indicator	Average 1/	Range 1/
% of Landless Households	7%	5 – 11%
% of Farm Households with Holding Size Less Than 10a	2%	0 – 5%
% of Farm Households with Holding Size More Than 3ha	18%	8 - 29%

1/: Average & range of Boeng Khnar, Me Tuek & Ou Ta Paong Commune

Source: Commune Survey on Crops & Livestock, 2003, MAFF

As shown in the table, almost all the farm households in the communes appear to have some farmland. From the rice cropped area in wet season, average holding size of paddy field per farm household is roughly estimated at 1.6ha as shown in Table B1.5-1. Proportion of land holding households having less than 0.1ha is calculated at 2% and the same of more than 3ha is at 18%.

The number of landless households calculated at 7% of the total households is nearly equal to the number of none crop producing households. Therefore, the landless figure might represent

non-farm households domiciling in the sub-project area, especially in urban areas and number of landless farm households might be limited.

B1.5.4 Crop Production

(1) General

Rice production is the most important agricultural activities in the sub-project area and it is estimated that wet season rice cultivation was practiced by about 97% of farm households in 2003. As in the case in the Damnak Ampil and Wat Loung sub-project areas, rice production in the area is characterized by low and unstable productivity under rainfed conditions and by a single cropping of rice in wet season under transplanting method. Further, prolonged rice cultivation season continuing from June to January with the cultivation of rice varieties of different growth durations of medium to late and traditional farming practices are other characteristics of the rice production in the area.

Rice cultivation in early wet and dry season is not practiced because of unavailability of irrigation water. The summary sheet of the statistic data on the major communes are presented in Table B15-2, B1.5-3 and B1.5-5 to B1.5-9 and the results of the interview surveys are presented in Attachment B1.3-1 and B1.1-2.

(2) Cropping Season and Variety

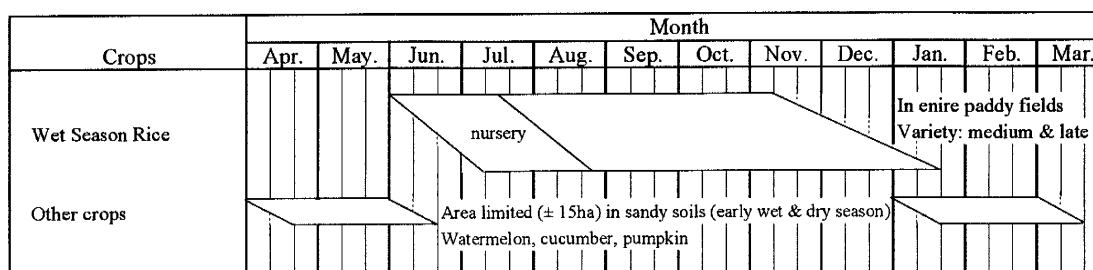
Rice cropping season in the area is similar to those in the Damnak Ampil and Wat Loung Sub-project Areas and is wet season and rice plants are grown from July/August to November/January in rainfed fields. In the area, a number of rice varieties are cultivated and cropping seasons vary substantially depending on varieties grown. Major varieties grown are as follows;

Major Varieties Grown in the Sub-project Area

Season	Growth Duration	Variety
Wet Season	Medium	Phka. Rumdoul, Phka Khney, Phka Mulis
	Late	Neang Pong, Phka Sla

(3) Cropping Calendar and Pattern

The prevailing cropping calendar in the area estimated based on the interview survey results (Attachment B1.3-1 & B1.1-2) is illustrated as shown in the following figure.



Prevailing Cropping Calendar in Paddy Fields: Wat Chre Sub-project Area

As stated earlier, a single cropping of wet season rice is an exclusive cropping pattern in the area. Cultivation of other crops such as watermelon, cucumber and pumpkin in paddy fields is

practiced both early wet and dry season in the area though in limited extent as shown in the figure.

(4) Cropped Area

The current cropped areas of rice and other crops in the area have been estimated on the basis of various data and information and the findings of the field survey as presented in Table B1.5-4 and as summarized below.

Estimated Cropped Area & Cropping Intensity in the Sub-project Area

Cropping Season	Cropped Area (ha)		Cropping Intensity (%)
	Rice	Other Crops 1/	
Wet Season	1,090	-	100
Early Wet Season	-	15	1.4
Dry Season	-	15	1.4
Annual	1,090	30	103

1/: Watermelon & cucumber

Source: JICA Study Team

As shown in the table, the cropping intensity of rice is estimated at 100% in wet season. The overall annual cropping intensity in the paddy fields is estimated to be 103% including other crops grown in the early wet and dry season.

(5) Paddy Yield and Production

Yields of paddy in the sub-project area are estimated on the basis of the statistic data of PDA/DAO and SEILA Data Base, results of interview surveys, Socio-economic Survey and Inventory Survey by JICA as shown in Table B1.5-10 and B1.5-11 and as summarized below.

Estimated Paddy Yield & Production in the Sub-project Area

Irrigation Status	Yield Level		Cropped Area		Production
	Wet Season	Dry Season	Wet Season	Dry Season	
Under Rainfed Condition	1.5 t/ha	-	1,030 ha	-	1,545 tons
Supplemental Irrigation	2.0 t/ha	-	60 ha	-	120 tons
Total	-	-	1,090 ha	-	1,665 tons

The current yield level of paddy in wet season is estimated at around 1.5 ton/ha under rainfed condition and 2.0 ton/ha under supplemental irrigation. Current annual production of paddy in the area is estimated at 1,670 tons.

Current yields of vegetables are estimated at watermelon 5.5 ton/ha and cucumber 6.0ton/ha based on the results of crop budget surveys conducted by the Study Team. The production volume of the crops is estimated at some 170 tons.

(6) Prevailing Farming Practices

Some specific features of rice farming practices in the area are:

- Prevailing of transplanting method ($\pm 90\%$) to direct sowing method as shown in Table B1.5-5 (results of the interview survey with a commune office),
- Prevailing of land preparation by draft animal ($\pm 60\%$) to land preparation by tractor ($\pm 40\%$) as shown in Table B1.5-5, and
- Cultivation of both improved and local varieties of medium growth duration.

B1.5.5 Crop Production in Upland Fields

Compared with rice production, production of upland crops is extremely limited in the sub-project area as shown in Table B1.5-6 and summarized below.

Cropped Area of Major Upland Crops in the Project Communes

Crops	Area		Crops	Area	
	(ha)	(%)		(ha)	(%)
Corn	11	10	Vegetables	34	32
Sweet Potato	9	8	Watermelon	24	22
Mungbeans	9	8	Others	9	13
Cassava	8	7	Total	109	100

Source: DAO Bakan

As shown in the table, cropped areas of upland crops in the project communes are less than 1% of annual rice cropped area of some 12,000ha in the communes. Major upland crop is corn followed by sweet potato and mungbeans. Annual cropped area of vegetables is estimated at 34ha and the same of watermelon is at 24ha in the communes. Major vegetables include cucumber and pumpkin. Main cropping season of upland crops and vegetables in upland fields is wet season.

Fruit trees grown in the communes are extremely limited as shown in Table B1.5-7.

B1.5.6 Farm Machinery and Equipment

The inventory on farm machinery and equipment in the project communes is presented in Table B1.5-8 and summarized in the following table.

Inventory of Farm Machinery in the Project Communes in 2007

Tractor	Hand Tractor	Water Pump	Engine Thresher	Rice Mill	
				Small	Big
42	177	454	65	247	10

Source: PDA Pursat

The number of tractors and hand tractors in the communes is substantial; however, land preparation work by draft animal is more common compared with the same by machinery. The number of water pumps, appeared to be used for supplemental water supply to paddy fields when rainfall in wet season is insufficient, is also substantial in the communes. The number of rice mills appears to be more than sufficient for milling demand because marketing of paddy is commonly carried out in the form of unhusked rice.

B1.5.7 Livestock

Livestock sub-sector is an important agricultural activity for farm economy and provides an essential source of draft power and manure for farming in the sub-project area. Accordingly, a substantial number of animals and poultry are raised in the area and majority of farm families hold some kind of animals as shown in Table B1.5-9 and as summarized below.

Livestock Population & Holding Status in the Project Communes in 2003

Item	Cattle	Buffalo	Pig	Animal Unit	Poultry
Population	9,547	5,049	8,460	14,828	51,925
Holding Size/Family	1.3	0.7	1.2	2.1	7.3

Source: Commune Survey on Crops & Livestock, 2003, MAFF

From the table, an average holding size of cattle, buffalo and pig in 2003 is calculated at 1.3, 0.7 and 1.2 heads per farm household, respectively, equivalent to animal units of 2.1 in total. The holding size of poultry is calculated at 7.3 per farm family. However, as the statistic figures include livestock & poultry hold by commercial farms, an actual holding size per farm is lower than the said estimates.

B1.5.8 Post-harvest and Marketing

Prevailing threshing method is by engine thresher of hiring service followed by pedal thresher in the sub-project area. After threshing, paddies except for those kept for family consumption are generally marketed without drying soon after harvest partly because of insufficient drying space and no drying yard. Paddies for family consumption are sun dried on plastic sheet in a home yard and stored.

According to the results of the Socio-economic Survey, the prevailing marketing channel of paddy in the area is marketing of field dry paddy to village markets followed by village collectors. Because of limited market volume by individual farmers, farmers have little bargaining power in price setting in general as is the case in other sub-project areas.

Major constraints for paddy marketing identified through the Socio-economic Survey are unstable market prices of paddy followed by low market prices of paddy as is the case in other sub-project areas as shown in Attachment B1.5-1 and summarized below.

Paddy Marketing Constraints Reported by Sample Farmers

	Constraint
Most Serious Constraint	Unstable market prices of paddy/rice
2 nd Serious Constraint	Low market prices of paddy/rice
3 rd Serious Constraint	Unstable market prices of livestock

Source: Socio-economic Survey by the JICA Study team, 2008

Major constraints reported by the rice millers in the project district are discussed in the section B1.3.8 and the results of the interview survey with rice millers in the project district are presented in Attachment B1.3-3

B1.5.9 Agricultural Extension Services

(1) Agricultural Extension Services in the Project District

(a) Institutions

The government institutions involved in agricultural support services at the province level is PDA Pursat as discussed in the section B1.3.9. The PDA has its branch offices at district level called District Agricultural Office (DAO). The district agricultural Office covering the sub-project area is DAO Bakan. The DAO has two sections of agronomy and livestock. However, staffing of the office is limited to 6 in total and extension activities of the office appear to be very limited as discussed earlier in the said section.

(b) Extension Services

The government extension services at the sub-project area level (commune & village) are basically to be provided by DAO under the support and guidance of PDA. Major agricultural extension activities provided in the province are programs under NCCD (decentralization

program after SEILA) by the government and activities by NGOs as discussed in the section B1.3.9. However, current services appear to be extremely limited due primarily to financial constraints.

(2) Current Support Activities in the Project Communes

Major activities under NCCD in the project communes (Boeung Khnar) include irrigation canal rehabilitation and road rehabilitation. In addition, agricultural support activities are operated by local NGOs.

B1.5-10 Seed and Farm Inputs Supply

Primary source of quality seed supply in and around the sub-project areas is provision of seed under support programs of PDA/DAO, donors or others. Commercial seed suppliers are farm inputs suppliers in district center (Bakan) but their supply volume is limited as is the case in the other sub-project areas.

According to the results of the Socio-economic Survey (Attachment B1.5-2), predominant seed source of rice is self-multiplied seeds (products of previous season) followed by seeds exchange with other farmers in the areas. Further, seed replacement frequency is low and demand for quality seeds appears to be low at present. In contrast to such situation, the Survey results indicate no serious constraints for quality seed procurement in the sub-project areas as shown in the following table.

Seed Supply Conditions in the Sub-project Areas

Enquiry	Reponses (200 sample farmers)
Seed Source of Rice	Own products: 78%; exchange with others: 18%
Frequency of Seed Replacement	Once per 3 cropping: 50%; once per over 4 cropping: 50%
Procurement of Wanted Seed	Easy: 68%; difficult/not possible: 32%
Procurement of Quality Seed	Easy: 56%; difficult/not possible: 44%
Price of Quality Seed	Too expensive: 24%; acceptable: 8%; not purchased: 68%

Source: Socio-economic Survey by the JICA Study team, 200

Farm input supplies in the project district are mostly carried out by dealers in district centers and local markets at commune or district level.

B1.5.11 Rural Credit

Major formal rural credit operators in the project district include ACLEDA Bank, PRASAC MFI and Hattha Kaksekar as discussed in the section B1.3.11. The sub-branch office of ACLEDA Bank is located in the project commune (Ou Ta Pong).

B1.5.12 Agricultural Cooperatives

The number of agricultural cooperatives formed in Pursat Province and the project district is 12 and 3, respectively, as discussed in the section B1.3.12. In the project commune (Boeng Khnar), there formed 2 cooperatives. However, the statuses of the cooperatives are still at an infant level and no cooperative activities such as procurement, shipment & selling activities are carried out.

B1.5.13 Current Capacity to Pay

For the estimation of the current capacity-to-pay, farm economic analysis on typical farms was

made based on the crop budget analysis on the current crop production in paddy fields (Table B1.1-12 & B1.1-13) and the results of the Socio-economic Survey by the Study Team conducted in 2007.

(1) Typical Farms

Paddy fields in the sub-project area are categorized into rainfed and supplemental irrigation paddy fields, although the former is representing 94% of total. Accordingly, farm families having rainfed paddy field and supplemental irrigation paddy field were selected as typical farms for the present farm economic analyses.

On the basis of the average holding size of paddy fields per farm family estimated in the section B1.5.3, the typical farms for the present farm economic analysis are defined as shown in the following table.

Typical Farms for Analyses

Type	Irrigation Status	Holding Size 1/
Type A	Rainfed paddy field	1.6 ha/family
Type B	Supplemental irrigation	1.6 ha/family

1/: holding size of paddy field assumed

(2) Current Capacity to Pay

The present farm economy of the typical farms are estimated based on the results of the Socio-economic Survey and the crop budget as shown in Table B1.1-14 and summarized in the following table.

Present Farm Economy

Item		Amount (Riel 1,000.-)	
		Type A	Type B
Gross Incomes	Rice Production	2,640	3,520
	Other Farm Incomes	290	290
	Non-farm Income	1,740	1,740
	Total Income	4,670	5,550
Expenditures	Production Costs of Farm Products	1,540	1,762
	Other Expenditures	2,460	2,460
	Total Expenditures	4,000	4,222
Net Surplus		670	1,328

1/: Assuming other farm income, non-farm income & other expenditures are same in both cases

As shown, the current farm economy of the typical farm Type A indicate net surplus (capacity to pay) of Riel 670,000 or 14% of the total income and the same of the Type B indicates Riel 1,328,000 or 24% of the income. The current capacity to pay of the Type B farm under supplemental irrigation is 198% of the same of the Type A farm under rainfed condition.

B1.5.14 Results of Socio-economic Survey

The results of the Socio-economic Survey are presented in a narrative manner in Table B1.5-12. Major constraints in rice farming identified are low paddy yield and irrigation water shortage in dry season. Farmers expectations for farming and physical works (irrigation/drainage) are **productivity improvement of wet season rice and adequate irrigation water supply in wet season**, respectively. The detail results of the Survey are

presented in Attachment B1.5-1. The results of the Survey on farming practices, farm input supply and marketing are presented in Attachment B1.5-2.

B1.6 Lum Hach Rehabilitation Sub-project Area

B1.6.1 Soils and Land Suitability

The soils distributed in the sub-project area are examined based on the reconnaissance level soil map prepared in the Mater Plan Stage of the present Study, in which soils are classified at soil sub-unit level following the FAO/UNESCO classification system.

According to the map, the soils distributed in the sub-project area are classified into 3 soil types (sub-units) as follows:

Soil Distribution in Lum Hach Sub-project Area

Soil Sub-unit	Distribution	Land Suitability Class	
		For Rice	For Upland Crops
Gleyic Acrisol (ACg)	56%	S3	S3
Plinthic Acrisol (ACp)	38%	S3	S3
Dystric Fluvisol (FLd)	6%	S2	S2/S3

Gleyic Acrisol (ACg) has medium to fine textured surface layer (SL~LiC) underlain with finer textured sub soils (LiC to HC). In medium textured soil, surface soils are highly weathered and have weak cohesion capacity because of leaching out of cementing materials as base, organic matter and silica. The effective depth of the soils is deep and no plinthite layer is encountered within 100 cm from the surface.

Plinthic Acrisol (ACp) generally has medium textured surface layer (SL~L) underlain with finer textured sub soils. The soils are very friable when moist and quite easy to crash by fingers. The effective depth of the soils is deeper than 80cm and plinthite layers are encountered in sub-soils at different depth.

Gleyic Acrisol (ACg) and Plinthic Acrisol (ACp) are classified as marginally suitable both for rice and upland crops production and Dystric Fluvisol (FLd) is moderately suitable for rice production and moderate to marginally suitable for upland crops production according to the FAO classification system (Framework for Land Evaluation, FAO, 1976).

B1.6.2 Present Land Use

The present land uses of the sub-project are exclusively paddy fields under different irrigation statuses. Accordingly, the land uses of the areas are classified depending on current irrigation statuses into 2 sub-categories of : i) supplemental irrigation paddy field and ii) rainfed paddy field (including fields under rainfed condition) as follows;

Present Land Use of the Sub-project Area

Land Use Sub-category	Area		
	(ha)	(%)	(%)
Normal Irrigation Paddy Field	-	-	-
Supplemental Irrigation Paddy Field	200	6	-
Rainfed Paddy Field	3,120	94	-
Paddy Field Total	3,320	100	93
Right-of-ways	250	-	7
Sub-project Area	3,570	-	100

As shown in the tables, irrigation water supply conditions in the sub-project are very poor and the paddy fields under rainfed conditions account for about 94% of the total paddy fields in the area.

B1.6.3 Agro-demography and Land Holding

Agro-demographic and land holding features in the project communes (major communes located in the sub-project area) estimated based on the Commune Survey on Crops & Livestock, 2003, MAFF are presented as follows;

Agro-demographic Features in the Project Communes in 2003

Items	Average 1/	Range 1/
% of Farm Households to Total Households	98%	95 - 100%
% of None Farm Households (No. of none crop producing households)	3%	0 - 5%
% of Farm Households Producing Wet Season Rice	-	100%
Average Family Size (in 2005, SELLA Data Base)	4.5	4.4 - 4.5

1/: Average & range of Anhchanh Rung, Pech Changvar & Popel Commune

Source: Commune Survey on Crops & Livestock, 2003, MAFF & SELLA Commune Data Base, 2005

When assuming that number of farm households is accounted by number of crop producing households, farm households in the area is calculated at 98% of the total households and none-farm households are estimated at 2%. 98% of the farm households (crop producing households) are producing wet season rice. Average family size is 4.6 members.

The access to data/information on land tenure was rather limited. However, the Commune Survey provides some information on the land tenure and holding statuses as shown in the following table.

Land Holding Features of the Project Communes in 2003

Indicator	Average 1/	Range 1/
% of Landless Households	3%	0 - 5%
% of Farm Households with Holding Size Less Than 10a	0%	0%
% of Farm Households with Holding Size More Than 3ha	2%	0 - 3%

1/: Average & range of Anhchanh Rung, Pech Changvar & Popel

Source: Commune Survey on Crops & Livestock, 2003, MAFF

As shown in the table, almost all the farm households in the communes appear to have some farmland. From the rice cropped area in wet season, average holding size of paddy field per farm household is roughly estimated at about 1.4ha as shown in Table B1.6-1. Proportion of land holding households having less than 0.1ha is calculated at 1% and the same of more than 3ha is at 1%, which suggest rather even land holding status in the sub-project area compared with the holding statuses in other sub-project areas.

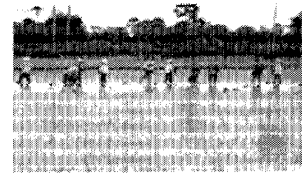
The number of landless households calculated at 2% of the total households is nearly equal to the number of none crop producing households. Therefore, the landless figure might represent non-farm households domiciling in the sub-project area, especially in urban areas.

B1.6.4 Crop Production

(1) General

The present agricultural conditions of the sub-project area have been studied on the basis of the results of interview survey with the major project commune offices and DAO Boribo,

statistic data of DAO and PDA and findings of the field survey by the Study Team. The summary sheet of the statistic data on the major communes are presented in Table B1.6-2, B1.6-3 and B1.6-5 to B1.6-8 and the results of the interview surveys are presented in Attachment B1.6-1 and B1.1-2.



Rice production is the most important agricultural activities in the sub-project area and it is estimated that wet season rice cultivation in 2003 was practiced by about 98% of farm households. Rice production in the area is characterized by low and unstable productivity under rainfed conditions or nearly rainfed conditions in coarse textured soils because of unstable and limited water supply and by a single cropping of rice under transplanting method. Further, prolonged rice cultivation season continuing from May/June to October/December with the cultivation of rice varieties of different growth durations of early to late and traditional farming practices are other characteristics of the rice production in the area. Rice cultivation in the early wet and dry season is not practiced currently. The cultivation of vegetables in paddy field in dry season is reported, however, an area extent is limited.

(2) Cropping Season and Variety

Rice cropping seasons in the sub-project area is similar to those in the sub-project areas in the Pursat River Basin and is wet season and rice plants are grown from July/August to November/December in paddy fields under rainfed conditions. A number of rice varieties are cultivated and cropping seasons vary substantially depending on varieties grown. Major varieties grown in the area are as follows;

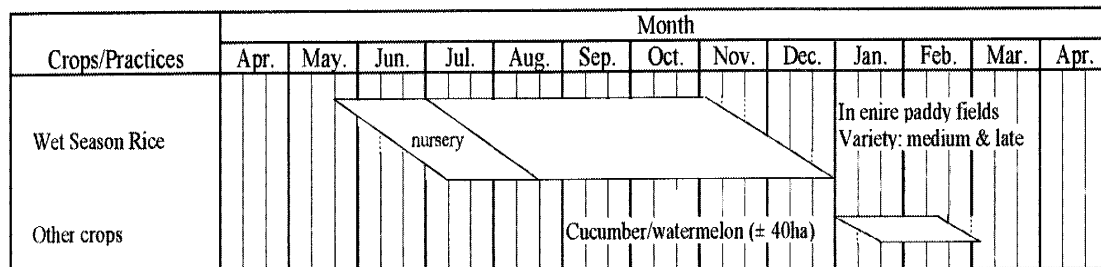
Major Varieties Grown in the Sub-project Area

Season	Growth Duration	Variety
Wet Season	Early	Sen Pidao
	Medium	Phka Rumduol, Phka Samley, Phka Sla
	Late	CAR 4, Neang Sor

Source: JICA Study Team

(3) Cropping Calendar and Pattern

The prevailing cropping calendar in the area estimated based on the interview survey results (Attachment B1.6-1 & B1.1-2) is illustrated as shown in the following figure.



Prevailing Cropping Calendar in Paddy Fields: Lum Hach Sub-project Area

As stated earlier, a single cropping of wet season rice is an exclusive current cropping pattern in the area.

(4) Cropped Area

The current cropped areas of rice and other crops in the area have been estimated based on the basis of various data and information and the findings of the field survey as presented in Table B1.6-4 and as summarized below.

Estimated Cropped Area & Cropping Intensity in the Sub-project Area

Cropping Season	Cropped Area (ha)		Cropping Intensity (%)
	Rice	Other Crops 1/	
Wet Season	3,320	-	100
Dry Season	-	40	1
Annual	3,320	40	101

1/: Watermelon & cucumber

Source: JICA Study Team

As shown in the table, the cropping intensity of rice is estimated at 100% in wet season. The overall annual cropping intensity in the paddy fields is estimated to be 101% including other crops grown in dry season.

(5) Crop Yield and Production

Yields of paddy in the sub-project area are estimated on the basis of the statistic data of PDA/DAO and SEILA Data Base, the results of interview surveys, Socio-economic Survey and Inventory Survey by JICA as shown in Table B1.6-9 and B1.6-10 and as summarized in the following table.

Estimated Paddy Yield & Production in the Sub-project Area

Irrigation Status	Yield Level		Cropped Area		Production
	Wet Season	Dry Season	Wet Season	Dry Season	
Under Rainfed Condition	1.2 t/ha	-	3,120 ha	-	3,744 tons
Supplemental Irrigation	2.0 t/ha	-	200 ha	-	400 tons
Total	-	-	3,320 ha	-	4,144 tons

The current yield level of paddy in wet season is estimated at around 1.2 ton/ha under rainfed condition and 2.0 ton/ha under supplemental irrigation. Current annual production of paddy in the area is estimated at 4,140 tons.

Current yield of other crops are estimated at watermelon 6.0ton/ha and cucumber 5.5 ton/ha based on the results of crop budget surveys conducted by the Study Team. The production volume of the crops is estimated at some 230 tons.

(6) Prevailing Farming Practices

Farming practices of rice in the sub-project area are characterized by: i) cultivation of improved variety (Phka Rumduol) commonly practiced, ii) transplanting exclusively employed for planting and iii) prevailing of land preparation by draft animal to mechanical land preparation.

B1.6.5 Crop Production in Upland Fields

Compared with rice production, productions of upland crops are extremely limited in the sub-project area as shown in Table B1.6-5 and summarized below.

Cropped Area of Major Upland Crops in the Project Communes

Crops	Area		Crops	Area	
	(ha)	(%)		(ha)	(%)
Vegetables	86	55	Sesame	8	5
Cassava	20	13	Mungbeans	7	4
Sweet Potato	19	12	Others	4	3
Groundnut	12	8	Total	156	100

Source: DAO Boribo

As shown in the table, cropped areas of upland crops in the project communes are about 2% of annual rice cropped area of some 8,000ha in the communes. Major upland crop is corn followed by sweet potato and cassava. Annual cropped area of vegetables is estimated at 86ha in the communes as shown in the table. Major vegetables include cucumber, leafy vegetables, string beans, pumpkin, watermelon and gourd. Main cropping season of upland crops and vegetables is wet season from April/May to November/December.

Fruit trees grown in the communes are extremely limited as shown in Table B1.6-6.

B1.6.6 Farm Machinery and Equipment

The inventory on farm machinery and equipment in the project communes is presented in Table B1.6-7 and summarized in the following table.

Inventory of Farm Machinery in the Project Communes in 2007

Tractor	Hand Tractor	Water Pump	Engine Thresher	Rice Mill	
				Small	Big
0	57	68	13	180	0

Source: PDA Kampong Chhnang

Land preparation works by draft animal are predominant practices in the area. The number of rice mills appears to be more than sufficient for milling demand because marketing of paddy is commonly carried out in the form of unhusked rice.

B1.6.7 Livestock

Livestock sub-sector is an important agricultural activity for farm economy and provides an essential source of draft power and manure for farming in the sub-project area. Accordingly, a substantial number of animals and poultry are raised in the area and majority of farm families hold some kind of animals as shown in Table B1.6-8 and as summarized in the following table.

Livestock Population & Holding Status in the Project Communes in 2003

Item	Cattle	Buffalo	Pig	Animal Unit	Poultry
Population	7,554	8,101	11,368	16,363	62,816
Holding Size/Family	1.3	1.4	2.0	2.9	11.0

Source: Commune Survey on Crops & Livestock, 2003, MAFF

From the table, an average holding size of cattle, buffalo and pig in 2003 is calculated at 1.3, 1.4 and 2.0 heads per farm household, respectively, equivalent to animal units of 2.9 in total. The holding size of poultry is calculated at 11 per farm family. However, as the statistic figures include livestock & poultry hold by commercial farms, an actual holding size per farm is lower than the said estimates.

B1.6.8 Post-harvest and Marketing

Different from other sub-project areas, manual threshing is prevailing in the sub-project area followed by use of engine thresher under hiring service. After threshing, paddies except for those kept for family consumption are generally marketed without drying soon after harvest partly because of insufficient drying space and no drying yard. Paddies for family consumption are sun dried on plastic sheet in a home yard and stored.

According to the results of interview with the project commune office (Anchang Rung), the prevailing marketing channel of paddy in the area is marketing of field dry paddy to village collectors. The local collectors market paddy to wholesalers or to rice millers. However, because of limited holding size of paddy field and low productivity of paddy, market surplus of paddy in the area is limited and farmers have little bargaining power in price setting in general as is the case in other sub-project areas.

Major constraints for paddy marketing identified through the Socio-economic Survey are unstable market prices of paddy followed by low market prices of paddy as is the case in other sub-project areas as shown in Attachment B1.6-2 and summarized below.

Paddy Marketing Constraints Reported by Sample Farmers

	Constraint
Most Serious Constraint	Unstable market prices of paddy/rice
2 nd Serious Constraint	Low market prices of paddy/rice
3 rd Serious Constraint	Low market prices of livestock

Source: Socio-economic Survey by the JICA Study team, 2008

The number of sizable rice miller in the project district is limited to one, which has a medium capacity rice mill of milling capacity of paddy 1ton/hour. Major constraints reported by the rice miller are: i) difficulty to procure sun dried paddy because field dried paddies are procured by Viet Nam buyers and ii) no drying facility to dry wet paddies. The results of the interview survey with rice millers in the project district are presented in Attachment B1.3-3.

B1.6.9 Agricultural Extension Services

(1) Institutions

The government institutions involved in agricultural support services at the province level is PDA Kampong Chhnang. The PDA is a provincial level agricultural agency under the provincial government and is an agency responsible for agricultural development and provision of agricultural supporting services at province, district, commune and village levels. The PDA is composed of 6 technical offices and two planning/administrative offices. The PDA has its branch offices at district level called District Agricultural Office (DAO).

The district agricultural Office covering the sub-project area is DAO Boribo. The DAO has three sections of agronomy, extension & agricultural legislation and livestock. However, staffing of the office is limited to 7 in total and extension activities of the office appear to be very limited.

International and bilateral cooperation organizations having activities in the district include EU (SLPP: livestock sub-sector activities), FAO and ADB (in Tonle Sap area). Major NGOs involved in agricultural sector support activities are World Vision, CEDAC and New Human.

(2) Extension Services

The government extension services at the sub-project area level (commune & village) are basically to be provided by DAO under the support and guidance of PDA. Major agricultural extension activities in the province provided are programs under NCCD (decentralization program after SEILA) by the government and activities under donors and NGOs. However, current services appear to be extremely limited due primarily to financial constraints.

In Cambodia, a new extension system at village level was introduced in 2008. Under the system, the deployment of Village Agricultural Extension Agent (VAA) at each village is targeted by recruiting from Village Livestock Agent (VLA) or key farmers. In the project district (Boribo), 73 VAAs were recruited for 64 villages in the district. The introduction of farmer-to-farmer extension is envisaged under the system.

(3) Current Support Activities in the Project Communes

Current major agricultural support program operated in the project commune (Anchanh Rung) include demonstrations of improved rice farming practices by PDA/DAO. The program is operated by 15 farmers and a total size of demonstration plots is 2.1 ha. In addition, agricultural support activities by NGOs include integrated farming scheme of New Human, food for work program of WFP and home garden scheme of CEDAC.

Major activities under NCCD in the project communes (Anchanh Rung, Phsar) are road construction and animal vaccination.

B1.6.10 Seed and Farm Inputs Supply

The predominant rice seed supply system in Cambodia is illustrated in the section B1.1.10.

Common channel of quality seed supply in and around the sub-project area is through provision of seed under support programs of PDA/DAO, donors or others as is the case in other sub-project areas. Commercial seed suppliers are farm inputs suppliers in district center but their supply volume is limited because of limited demand

According to the results of the Socio-economic Survey (Attachment B1.6-3), predominant seed source of rice is self-multiplied seeds (products of previous season) followed by seeds exchange with other farmers in the areas. Further, seed replacement frequency is low and demand for quality seeds appears to be very low at present. In contrast to such situation, the Survey results indicate no serious constraints for quality seed procurement in the sub-project area as follows;

Seed Supply Conditions in the Sub-project Areas

Enquiry	Reponses (200 sample farmers)
Seed Source of Rice	Own products: 83%; exchange with others: 10%
Frequency of Seed Replacement	Once per 3 cropping: 46%; once per over 4 cropping: 54%
Procurement of Wanted Seed	Easy: 82%; difficult/not possible: 12%
Procurement of Quality Seed	Easy: 54%; difficult/not possible: 46%
Price of Quality Seed	Too expensive: 18%; acceptable: 14%; not purchased: 68%

Source: Socio-economic Survey by the JICA Study team, 200

B1.6.11 Rural Credit

The deployment of ACLEDA Bank and MFIs is rapidly expanding in the country and Kompong Chhnang Province in recent years. Formal rural credit operators in the project district include ACLEDA Bank, PRASAC MFI, Credit MFI and Cambodian Entrepreneur Building Limited. The numbers of branch (province level) and sub-branch offices (district level) of ACLEDA Bank in the project province and district are as follows;

Deployment of Branch & Sub-branch Offices of ACLEDA

Institute	Branch Offices	Sub-branch Offices	Project District
ACLEDA	1 in province	7 in province	1 sub-branch office

Source: ACLED Bank Plc

The sub-project office in the district is located in Ponley Commune neighboring to the project communes. In addition, district offices of PRASAC, Credit MFI and Cambodian Entrepreneur Building Limited are also established in the commune.

The terms and conditions of micro credit (farm credit & small-scale industry) of Credit MFI are similar to those of ACLEDA Bank and PRASAC MFI as follows;

Terms & Conditions for Farm Credit of Credit MFI

Institute	Credit Period & Interest Rate	Conditions
Credit MFI	4 ~ 12 months < R.4,000,000; interest 3%/month	Collateral & approval of commune council (no collateral below R. 800,000.-)

Source: Credit MFI, Boribo Office

Further, NGOs such as World Vision are providing micro credit services in the district. However, non-institutional credit providers such as money lenders, rice miller, farm input suppliers and relatives or friends might continue to be an important source of rural credit.

The results of the Socio-economic Survey on farm credit conducted in the area are as follows;

Results of Socio-economic Survey on Farm Credit in the Lum Hach Sub-project Area

Enquiry	Proportion by Reponses	Respondents No.
Access to farm credit	Easy: 38%; difficult: 21%, not received: 40%	42
Amount of credit	Sufficient: 43%; insufficient: 19%; not received: 38%	42
Timing of provision	In time: 29%; delayed: 29%; not received: 43%	42
Procedures for credit application	Easy: 21%; difficult: 31%, not received: 48%	42

Source: Socio-economic Survey in the sub-project area by the JICA Study Team, 2007

B1.6.12 Agricultural Cooperatives

The formation of agricultural cooperatives in Kompong Chhnang Province is still limited and only 4 cooperatives are formed in the province. No cooperatives are formed in the project district as shown below.

Agricultural Cooperatives in Kompong Chhnang

District	Major Activities
Kompong Tralach	Rice production, saving & credit
Tuek Phos	Saving & credit
Rolea Bier	Cooperatives of agricultural products traders

Source: PDA Kompong Chhnang

B.16.13 Current Capacity to Pay

For the estimation of the current capacity-to-pay, farm economic analysis on typical farms was made based on the crop budget analysis on the current crop production in paddy fields (Table B1.1-12 & B1.1-13) and the results of the Socio-economic Survey by the Study Team.

(1) Typical Farms

Paddy fields in the sub-project area are categorized into rainfed and supplemental irrigation paddy fields, although the former is representing 94% of total. Accordingly, farm families having rainfed paddy field and supplemental irrigation paddy field were selected as typical farms for the present farm economic analyses.

On the basis of the average holding size of paddy fields per farm estimated in the section B1.6.3, the typical farms for the present farm economic analysis are defined as follows;

Typical Farms for Analyses

Type	Irrigation Status	Holding Size 1/
Type A	Rainfed paddy field	1.4 ha/family
Type B	Supplemental irrigation	1.4 ha/family

1/: holding size of paddy field assumed

(2) Current Capacity to Pay

The present farm economy of the typical farms are estimated based on the results of the Socio-economic Survey and the crop budget as shown in Table B1.1-14 and as follows;

Present Farm Economy

Item		Amount (Riel 1,000.-)	
		Type A	Type B
Gross Incomes	Rice Production	1,848	2,618
	Other Farm Incomes	550	550
	Non-farm Income	570	570
	Total Income	2,968	3,738
Expenditures	Production Costs of Farm Products	1,422	1,616
	Other Expenditures	1,280	1,280
	Total Expenditures	2,702	2,896
Net Surplus		266	842

1/: Assuming other farm income, non-farm income & other expenditures are same in both cases

As shown in the table, the current farm economy of the typical farm Type A indicate net surplus (capacity to pay) of Riel 266,000 or 9% of the total income and the same of the Type B indicates net surplus of Riel 842,000 or 23% of the income.

B1.6.14 Results of Socio-economic Survey

The results of the Socio-economic Survey are presented in a narrative manner in Table B1.6-11. Major constraints in rice farming identified are low paddy yield and irrigation water shortage in dry season. Farmers expectations for farming and physical works (irrigation/drainage) are **productivity improvement of wet season rice and adequate irrigation water supply in wet season**, respectively. The detail results of the Survey are presented in Attachment B1.6-2. The results of the Survey on farming practices, farm input supply and marketing are presented in Attachment B1.6-3.

CHAPTER B 2 AGRICULTURAL DEVELOPMENT CONCEPT

B2.1 Constraints for Agricultural Development and Proposed Development Directions

The primary agronomic constraint common in all the sub-project areas is unstable and low productivity of rice adversely affected by various factors and the primary physical constraint common is insufficient water supply, even in wet season. On the basis of the findings discussed in the preceding chapters and the results of the Socio-economic Survey on farming constraints, improvement measures and expectations as discussed earlier, major problems and constraints in agricultural development in the sub-project areas, which should duly be addressed in the present Study in an integrated manner, have been enumerated and conceivable development directions are discussed in the followings.

- Primary constraint that is attributed to the unstable and low productivity of rice is limited and unstable availability of water because of limitation of irrigation water supply. Most rice fields in the six sub-project areas are under rainfed conditions. Further, supplemental irrigation in wet season is exclusive current irrigation status even in the irrigated fields;

which should be addressed through the development and efficient utilization of available water resources to an extent possible.

- Single cropping of rice is a prevailing cropping pattern in the sub-project areas and annual land use intensities or cropping intensities in paddy fields are limited to 100 to 120%. Further, production of upland crops in paddy fields is negligibly limited;

which should be addressed by introducing rice and upland crops/vegetables cultivation in the early wet and dry season within the availability of irrigation water resources. However, field based technology development and extension activities are essential for the promotion of upland crops production in paddy fields.

- Prevailing traditional farming practices are also serious problems attributed to low productivity. However, a number of factors are involved in circumstances where such practices prevail;

which should be addressed through the strengthening of agricultural extension services introduced in a well integrated manner.

- Extensive traditional direct sowing is prevailing rice cultivation method in the sub-project areas of Ream Kon and Por Canal. Compared with transplanting method, yield levels of paddy in direct sowing are reported to be 0.5 to 1.0 ton/ha lower;

which should be addressed by the technology development for productivity improvement of direct sowing and the extension of results/findings of the development to farming communities. Technical development activities for direct sowing are been carried out by BRAND (Battambang Rural Area Nurture and Development Project), JICA. The results/findings of the same should better be verified at farmers levels and disseminated in the sub-project areas.

- In the current post-harvest operations in the sub-project areas, marketing of field dried

paddy (wet paddy) is commonly practiced because of insufficient drying spaces and no drying facilities at village level. Further, farmers' practical knowledge on the importance of post-harvest practices appears to be limited. As a result, rice millers without drying facilities (dryer) in the project districts are placed in the disadvantageous position in the competition with traders from neighboring countries. Production increase expected under the with-project condition might invite marketing competition with other producing areas in future and product quality will become an important issue for marketing.

As an initial step toward the improvement of post-harvest operations and product quality, the construction of drying yard and storage facility should better be considered under the sub-project on a pilot basis.

B2.2 Development Strategies

The basic development strategies established for the agricultural development in all the sub-project areas are as follows;

- Productivity improvement and production increase of rice is targeted through the introduction of irrigated farming and increase of annual cropping intensity within the availability of irrigation water supply,
- Improvement of productivity and increased production of rice is envisaged through the introduction of improved farming practices supported by the strengthening of agricultural extension services,
- Envisaging the introduction of upland crops/vegetables production under irrigation in the early wet and dry season to an extent practical by sharing available irrigation water with rice production to increase land use intensity and promote crop diversification,
- Strengthening of agricultural extension services accommodated as a project component for extension of improved farming practices and dissemination of upland crops/vegetables production, and
- Current planting methods of rice, transplanting and direct sowing in the subject areas, will be maintained in the future as such planting methods have been employed by farmers dictated by their land holding sizes and availability of labor forces and alternation of planting methods will be impractical.