

***Appendix-D***  
***AGRICULTURE***

**THE STUDY  
ON  
COMPREHENSIVE AGRICULTURAL DEVELOPMENT  
OF  
PREK THNOT RIVER BASIN  
IN  
THE KINGDOM OF CAMBODIA**

**FINAL REPORT  
Volume-VI: Appendixes for Master Plan  
Appendix-D  
Agriculture**

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## APPENDIX-D: AGRICULTURE

### Chapter D-1 The Target Area

#### D-1.1 Soils

##### (1) General

For the present soil study, the reconnaissance soil investigations in the Target Area were made by using the soil map (original scale: 1/100,000) prepared by CNMC, the soil map (scale: 1/50,000) prepared in 2005 based on UNDP (original scale: 1/250,000) and the soil study reports by CARDI (Cambodian Agricultural Research and Development Institute) as reference materials. The field reconnaissance survey was carried out employing the 1:100,000 topographic maps as a base map and observations of 42 soil profiles at 39 soil auger sites and 3 natural soil profiles were made. The representative soil profiles were described at 7 test pits and 2 natural soil profiles. Soil samples for conventional laboratory tests were taken from 6 sites and undisturbed soil samples for analyzing soil physical properties were taken at 3 sites distributed with the representative soils in the Target Area.

The soil laboratory tests were carried out on the following properties by sub-letting to the local consultant.

#### Laboratory Test Items

Chemical Properties	
pH	Available Phosphate (Av.-P)
Total Nitrogen (T-N)	Exchangeable Cations (Ca, Mg, K, Na)
Total Carbon (T-C)	Cation Exchangeable Capacity (CEC)
Total Phosphate (T-P)	
Physical Properties	
Particle Size Analysis	Moisture Content
Bulk Density	Specific Gravity

##### (2) Soil Distribution and Characteristics

The soils distributed in the Target Area are classified following the FAO classification system applied in the CNMC (Cambodian National Mekong Committee) soil map and classified at soil phase level by considering soil properties important for agriculture such as surface soil texture and effective soil depth. The soils in the Area are classified into six soil types of Gleyic Acrisol Medium Textured Phase (Soil Taxonomy: Ultisols), Gleyic Acrisols Medium to Fine Textured Phase, Gleyic Acrisol Coarse Textured Phase, Plinthic Acrisols (Ultisols) and Dystric Leptosol (Entisols) as shown in Figure D.1.1.1. The distributions of the soils in the Area are shown in the following table.

#### Soil Distribution in the Target Area

Soil Type	Distribution	
	(ha)	(%)
Gleyic Acrisol Medium Textured Phase (GA <sub>m</sub> )	55,410	53
Gleyic Acrisol Medium to Fine Textured Phase (GA <sub>f</sub> )	10,750	10
Gleyic Acrisol Coarse Textured Phase (GA <sub>c</sub> )	1,460	1
Plinthic Acrisols (PA)	28,580	27
Dystric Leptosol (DL)	9,000	9
Total	105,200	100

Soils found in the Target Area are almost exclusively having medium textured (SL) surface layers underlain with finer textured sub-soils, however, the distribution of limited extent of soils with fine or coarse textured surface soils are also identified. The distributions and characteristics of the soils are discussed in the following sections. The results of the soil analysis are presented in Table D.1.1.1.

(a) Gleyic Acrisol Medium Textured Phase (mapping symbol: GAm)

The soils are distributed most extensively in the Target Area and mostly used as paddy fields. Their distribution accounts for 55,410 ha or 53 % of the Area. The soils correspond to Prey Khmer Soil according to the classification system of CARDI. The soils are developed on the old and recent alluvial terraces and have medium textured surface layer (SL) underlain with finer sub-surface layer (SL to SCL) and fine textured sub soils (SCL to SC). The surface soils are highly weathered and have weak cohesion capacity because of leaching out of cementing materials as base, organic matter and silica. Accordingly, the soils are 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 poor soil fertility judged from low total nitrogen, carbon and phosphate content, low cation exchange capacity (CEC) and exchangeable K, Ca and Mg. The bulk density and specific gravity of the surface soils are 1.83 and 2.62 (g/cm<sup>3</sup>), respectively. The descriptions of the typical soil profiles are presented in Attachment 1.

(b) Gleyic Acrisol Medium to Fine Textured Phase (mapping symbol: GAf)

The soils are mostly distributed on flood plains along the Prek Thnot River and partly found in the eastern part of the Target Area to a limited extent and the lands distributed with the soils are almost entirely used as paddy fields. Their distributions account for 10,750 ha or 10 % of the Area. The soils correspond to Prey Khmer Soil (fine textured phase) according to the classification system of CARDI. The soils are developed on the old alluvial terraces and have medium to fine textured surface layer (SL~SCL/CL) underlain with finer sub-surface layer (SCL) and fine textured sub soils (SC to C). The surface soils are highly weathered and have weak cohesion capacity because of leaching out of cementing materials as base, organic matter and silica. Accordingly, the soils are friable when moist and 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 to neutral reaction (pH) and poor to moderate soil fertility depending on location, judged from low to moderate cation exchange capacity (CEC) and low to moderate exchangeable K, Ca and Mg. The bulk density and specific gravity of the surface soils are 1.43 and 2.62 (g/cm<sup>3</sup>), respectively. The descriptions of the typical soil profiles are presented in Attachment 1.

(c) Gleyic Acrisol Coarse Textured Phase (mapping symbol: GAc)

The distribution of the soils is limitedly found along the Ou Krang Ambel River and the lands distributed with the soils are almost entirely used as paddy fields. Their distribution accounts for 1,460 ha or 1 % of the Area. The soils are developed on the old alluvial terraces and have coarse textured surface layer (S~LS) underlain with finer sub-surface layer (SL~SCL) and fine textured sub soils (SCL to SC). The surface soils are highly weathered and have weak cohesion capacity because of leaching out of cementing materials as base, organic matter and silica. Accordingly, the soils are extremely friable when moist and very easy to crush by fingers. The surface soils of the representative profiles have slightly acid reaction (pH) and poor soil fertility judged from very low total nitrogen content, low cation exchange capacity (CEC) and low exchangeable K, Ca and Mg. The effective depth of the soils is deep and no plinthite layer is encountered within 100 cm from the surface. The soils may correspond to Prey Khmer Soil (fine textured phase) according to the classification system of CARDI. The descriptions of the typical soil profiles are presented in Attachment 1.



(d) Plinthic Acrisol (mapping symbol: PA)

The soils are extensively distributed in the slightly elevated central and north eastern part of the Target Area. The lands distributed with the soils are partly used as paddy fields and the greater parts are left unused as shrub land and grass land with scattered shrub. Their distribution accounts for 28,580 ha or 27 % of the Area. The soils are developed on the old alluvial terraces and have medium textured surface layer (SL) underlain with finer sub-surface layer (SL~SCL). The soils are characterized with the existence of plinthite layers in the sub soils. The surface soils are highly weathered and have weak cohesion capacity because of leaching out of cementing materials as base, organic matter and silica. Accordingly, the soils are very friable when moist and very easy to crash by fingers. The effective depth of the soils is depending on the occurrence of the plinthite layers and moderate in general (around 50cm or more). However, the depth to plinthite layers is variable depending on location. The soils may correspond to Prateah Lang Soil according to the classification system of CARDI. The description of the typical soil profiles is presented in Attachment 1. The surface soils of the representative profiles have acid to slightly acid reaction (pH) and poor soil fertility judged from low cation exchange capacity (CEC) and low exchangeable K, Ca and Mg. The bulk density and specific gravity of the surface soils are 1.84 and 2.60 (g/cm<sup>3</sup>), respectively.

(e) Dystric Leptosol (mapping symbol: DL)

The soils are found in the low mountains and their slopes in the southern and eastern parts of the Target Area. The use of the lands distributed with the soils are mostly categorized as forest or shrub land. Their distributions account for 9,000 ha or 9 % of the Area. The soils have shallow effective depth and left unused as shrub or forest.

## D-1.2 Land Suitability for Crop Production

### (1) Methodologies

The land suitability classification of the Target Area for annual crop production has been made by applying simplified method of the system proposed in the Framework for Land Evaluation (FAO, 1976). However, an additional suitability class is introduced to differentiate coarse textured soils from others. Areas distributed with coarse textured soils are defined as critical (C). It is considered not relevant to classify those soils as not suitable since the areas are almost used for paddy fields. The criteria applied in the land suitability classification are presented in Table D.1.2.1

### (2) Land Suitability

The results of the land suitability classification of the soils in the Target Area are presented in Table D.1.2.2 and summarized in the following table.

**Land Suitability Classification of the Soils in the Target Area**

Soil Type	Land Suitability Classes	Distribution	
		(ha)	(%)
Gleyic Acrisol Medium Textured Phase (GAm)	S3	55,410	53
Gleyic Acrisol Medium to Fine Textured Phase (GAf)	S2	10,750	10
Gleyic Acrisol Coarse Textured Phase (GAc)	S3C	1,460	1
Plinthic Acrisols (PA)	S3	28,580	27
Dystric Leptosol (DL)	N	9,000	9
Total		105,200	100

As shown in the table, 10% of the Target Area (distributed with Gleyic Acrisol Fine to Medium Textured Phase) are classified as moderately suitable (S2) for crop production, 80% of the Area (distributed with Gleyic Acrisol Medium Textured Phase and Plinthic Acrisols) as marginally suitable (S3), 1% of the Area (distributed with Gleyic Acrisol Coarse Textured Phase) as critical (S3C) and 9% of the Area (distributed with Dystric Letosol) as non-suitable (N).

### D-1.3 Agro-climatic Conditions

#### D-1.3.1 General

Climate in Cambodia is characterized by tropical monsoons, having distinct rainy and dry spells (periods). The south-western monsoon predominates from May to November bringing about the rainy season with about 90% of annual rainfall precipitated and the dry season last from November/December to April. However, the start of rainy season fluctuates annually and the rainfall in the initial period of the rainy season, end of April to June, is not stable, which largely affects the commencing of land preparation for rice cultivation annually. Further, the same in November is also unstable.

#### D-1.3.2 Agro-climatic Conditions in the Target Area

The agro-climatic conditions of the Target Area are characterized by the length of the rainy and dry spells. Basically, the rainy spells last for six months from May to October and the dry spells continue also for five months from December to April. Rainfall distribution in November is very unstable regardless of mean monthly rainfall of over 100 mm in the month. The rainfall distribution from May to August fluctuates annually to a substantial degree, which presents a serious constraint for the stabilization of rainfed rice cultivation in the Area. Rainfall before and after the dry season, in April and November, sometimes exceeds 100mm, while the same in the rest of the dry season from December to March is extremely limited.

Sunshine hours in and around the Area are longer in the dry season varying from 8.3 hours in April to 8.7 hours in January and the same in the rainy season is 5.6 hours in September to 6.1 hours in June. Agro-climatic features observed in and around the Target Area are presented in Table D.1.3.1.

### D-1.4 Agro-demography and Land Tenure & Holding

#### D-1.4.1 Agro-demographic Features

Among 5 project districts in the Target Area, one district, Chbar Mon District, is defined as urban area and the rest 4 districts are defined as rural area. Similarly, among 44 project communes in the Area, all 5 communes in Chamber Mon District are classified as urban and the rest 39 communes are as rural area. Naturally, there exist some different features among communes in rural and urban areas.

The agro-demographic features of the project communes in the Target Area identified based on the Commune Survey on Crops & Livestock, 2003, MAFF and village-wise data of SEILA Commune Data Base 2004 are presented in Table D.1.4.1 and summarized in the following table.

**Agro-demographic Features of the Project Communes in the Target Area**

Items	Features
No. of Households (total)	62,100
No. of Farm Households (No. of crop producing households)	55,847
% of Farm Households to Total Households	90 %
% of None Farm Households (No. of none crop producing households)	10 %
% of Farm Households Producing Rice	100 %
Total Population	340,784
Average Family Size	5.4
Working Population (15 ~ 64 years old)	198,176
Working Population/ Household (15 ~ 64 years old)	3.1

*Source: Commune Survey on Crops & Livestock, 2003, MAFF & SEILA Commune Data Base, 2004*

When assuming that number of farm households is accounted by number of crop producing households, farm households in the Target Area account for 90% of the total households and none-farm households are estimated at 10% of the total. 100% of farm households (crop producing households) are producing rice. Average family size is 5.4

members and working population is estimated at 3.1 persons/ household.

Such features in 5 urban communes and 39 rural communes in the Target Area are presented in Table D.1.4.1 and summarized in the following table.

**Agro-demographic Features of Urban and Rural Communes**

Items	Urban	Rural
% of Farm Households to Total Households	68 %	93 %
Average Family Size	5.3	5.4
Working Population/ Household (15 ~ 64 years old)	3.3	3.6

*Source: Commune Survey on Crops & Livestock, 2003, MAFF & SEILA Commune Data Base, 2004*

As shown, the proportion of farm households in the urban communes is estimated at as low as about 68% compared with the same of 93% in the rural communes.

#### **D-1.4.2 Land Tenure and Land Holding**

##### (1) Land Issues in Cambodia<sup>1</sup>

In Cambodia, land tenure ship and administration structures have changed several times and all the farm lands operated collectively by villagers during the previous political regime were allocated to individual villagers in 1989 with the policy movement toward a free market system. The government reintroduced land ownership rights are as follows;

- Land for domicile: To be provided for ownership by the provincial committee or municipality; size up to 2,000m<sup>2</sup>
- Possession land: State land allocated to farmers to manage and for use for exploitation; size up to 5 ha
- Concession land: Right to occupy land for large scale crop production that would contribute to the national economy; size greater than 5 ha

However, because of increasing trend of illegal ownership of larger land, land concentration and land disputes, the government issued a new land law in 2001, in which maximum land size for ownership is no longer limited and land concessions for large scale crop production could be provided for up to 10,000 ha.

In Cambodia, “rehabilitation from civil war” and “transition from communist system to capitalism system” proceeded at the same time. These trends have had a big impact on local people’s right and access to community forests, rivers, lakes, ponds and farming land that are the foundation of rural livelihood of farmers and created a number of agricultural landless households, the poorest people in rural area, although all the farmers had allocation of farm land in 1989. The size of farm land allocated to individuals is reported to be depending on the size of farm lands in a village and the number of villagers in the village.

The landlessness is increasing at an alarming rate due primarily to the population growth, health problems, indebtedness and land grabbing. Although the estimates on the proportion of household without agricultural land or agricultural landless household vary depending on sources of estimates, it is estimated at 10 % of the total households in the Target Area in Commune Crop & Livestock Survey, 2003, MAFF.

Other major land issues in the country include land disputes and projects affected people as follows;

- Land continues to be the prime source of conflict in Cambodia. The nature of land disputes and the parties involved vary from place to place. Many dispute causes were filed by farmers or villagers and the major defendants were members of the local authorities and armed forces.
- Since the government declared that the right of way is state public land in 1999, the government does not compensate people living on the right of way, except of costs

<sup>1</sup> This section was prepared based on “Land Issue Study in Cambodia, CEDAC & JVC, 2005”

for resettlement, immovable buildings/assets and fruit trees when the project affected people legally possessed or occupied land and legally built the property. The declaration considered that all people living on the right of way are state land grabbers, even though people settled in the areas settle before the declaration.

(2) Land Tenure and Land Holding in the Target Area

The access to data/information on land tenure was rather limited in the present Study. However, the Commune Survey on Crops & Livestock, 2003, MAFF and SEILA Data Base, 2004 provides some information on the land tenure and holding statuses as shown in Table D.1.4.1 and summarized in the following table.

**Land Tenure & Holding Features of the Project Communes in the Target Area**

Indicator	Features
No. of Households (total)	62,100
No. of Farm Households (No. of crop producing households)	55,847
No. of None Farm Households (No. of none crop producing households)	6,253 <sup>1/</sup>
No. of Landless Households	
Total Paddy Field in Project Communes	39,688 ha
Average Paddy Field Holding Size per Farm Household	0.71 ha
% of Farm Households with Holding Size Less Than 0.1ha	4 %
% of Farm Households with Holding Size More Than 3ha	2 %
% of Landless Households	10%

<sup>1/</sup>: 41 % in Chbar Mon District categorized as urban area in SEILA Data Base

Source: Commune Survey on Crops & Livestock, 2003, MAFF & SEILA Data Base 2004

As shown in the table, when assuming that number of farm households is accounted by number of crop producing households, all the farm households in the Target Area appear to have some farmland and average holding size of paddy field per farm household is estimated at 0.71ha. Proportion of land holding farm households having less than 0.1ha is calculated at 4% and the same of more than 3ha is at 2%, which might indicate that evenly distributed land holding statuses are still maintained in the Area after the land allocation in 1989.

The number of landless households (No. of none crop producing households) reported in the Commune Survey on Crops & Livestock, 2003, MAFF calculated at 10% of the total households. The figure, however, appears to include non-farm households domiciling in urban areas and actual number of landless farmers can not be estimated.

Holding size of upland field is rather limited in the Area and estimated based on the results of the Socio-economic Survey<sup>2</sup> as follows;

**Holding Status of Upland Field of Sample Farmers <sup>1/</sup>**

Land Type	No. of Respondent		Total Area	Average per	
	No.	%		Respondent	Sample
Upland Field for Field Crop Prod.	83	42%	28.8	0.35	0.14
Upland Field for Fruit Production	41	21%	9.7	0.24	0.05
Total	-	-	38.5	-	0.19

<sup>1/</sup>: Socio-economic Survey by the JICA Study team, 2005; sample No. 200

The result of the Socio-economic Survey indicates that 99% of the sample farmers in the Target Area are owner operator and tenancy arrangement of farm land is seldom practiced as shown below.

**Land Tenure Status of Sample Farmers**

Land Tenure Status	No. of respondent	Proportion
Owner Operator	197	98.5 %
Owner-cum-tenant or -sharecropper	3	1.5 %
	200	100 %

Source: Socio-economic Survey by the JICA Study team, 2005

<sup>2</sup> Socio-economic Survey conducted by the JICA Study Team in September 2005

## Chapter D-2 Present Agriculture

### D-2.1 Present Land Use

The present land use of the Target Area has been studied by applying 1/50,000 topographic maps (produced from SPOT images 1996 & 1997) as base maps and by updating information presented in the maps with the interpretation of 1/40,000 air-photographs taken in 2004, field ground truth survey and the irrigation inventory survey made by the JICA Study Team. For the preparation of present land use map, GIS has been used. The land use in the Area have been categorized into seven categories of: i) paddy field, ii) upland field, iii) forest, iv) grass & shrub land, v) settlement/industrial land, vi) others and vii) water surface. The present land use map is presented in Figure D.2.1.1 and the area extents of individual categories of lands are estimated as shown in the following table.

**Present Land Use of the Target Area**

Land Use Category	Area	%	Land Use Category	Area	%
Paddy Field <sup>1/</sup>	42,780	40.7	Settlement/Industrial Land	7,110	6.8
Upland Field	820	0.8	Others	1,180	1.1
Forest	2,120	2.0	Water Surface	800	0.8
Shrub & Grass Land	50,390	47.9	Total	105,200	100

<sup>1/</sup>: Gross area

As shown in the table, the area extent of the project target land use category of paddy field is 42,780 ha consisting of irrigated field and rainfed field. The descriptions of major land use categories are as follows;

#### Paddy Field (Gross Area: 42,780 ha or 41 % of the Target Area)

This category of land is the primary target area of the present study accounting for 42,780 ha in gross or 41 % of the Target Area and includes irrigated paddy field, supplementary irrigated paddy field in rainy season and rainfed paddy field. The distribution of irrigated paddy field is depending on surface water resources availability and mainly located close to the Roleang Chery Regulator and along the north and south Hun Sen main canals. The gross area of paddy field include paddy field, right of ways and some other categories of land such as settlement and shrub/grass land because of limitation in mapping of scattered small scale distributions of such land uses. The net area of paddy field in the Area is estimated at 41,500 ha, 97% of gross area<sup>3</sup>, in the present study as follows;

$$\text{Net area} = \text{gross area} \times 97 \% = 42,780 \text{ ha} \times 0.97 \approx 41,500 \text{ ha}$$

The present agricultural development plans are to be formulated on this paddy field area, although there exists some difference in paddy field areas between the result of the land use study and the statistic data.

The irrigated field is located within the command area of irrigation system capable of supplying irrigation water. However, irrigable area in dry season is extremely limited. The supplementary irrigated paddy field is located in the command area of irrigation systems and has access to irrigation water supply only in rainy season. Irrigated paddy fields in the Area are almost exclusively used for rice cultivation and upland crop cultivation is extremely limited.

Rainfed paddy field is the largest land use type within the paddy field in the Target Area and extensive distributions of the same are found in the northern and southern parts of the Target Area located away from the Prek Thnot River. Rainfed paddy fields in the Area are used for a single cropping of rice in rainy season, however,

<sup>3</sup> With the use of GIS system and recent air-photographs, paddy field area was measured precisely.

because of unstable rainfall distribution and cultivation of traditional varieties, productivities are limited.

#### Upland Field (820 ha or 0.8 % of the Target Area)

The distribution of upland fields is basically limited to the surrounding of settlement areas and their extent is also limited to 820 ha or 0.8% of the Area. The land is primarily used for cultivation of upland crops to a limited extent and major crops grown include vegetables and mungbeans.

#### Forest (2,120 ha or 2.0 % of the Target Area)

Limited extent of forest is found in the low mountainous areas in the southern end of the Target Area and the area extent is 2,120 ha or 2.0% of total.

#### Grass & Shrub Land (50,390 ha or 48 % of the Target Area)

Grass land with scattered shrub and shrub land is the largest land use category in the Area and extensively distributed in the north eastern part, the northern part and the low mountainous areas in the Area. The area extent is 50,390 ha or 48% of the Area and The shrub land in the north eastern part of the Area is controlled by the Kampong Speu Provincial Department of Forestry for watershed conservation purpose.

#### Settlement/Industrial Land (7,110 ha or 6.8 % of the Target Area)

This category of land include village or urban settlement areas and industrial land and account for 7,110 ha or 6.8% of the Target Area. Located close to the capital, the land use conversion from farmland (paddy field) to industrial or settlement area was substantial in the past and such conversion will continue in the future. Especially, the expansion of industrial areas is remarkable along the national road No. 3, 4, 42 and 51. The current area extent of an industrial area in the Area is estimated at 650 ha.

#### Others (1,180 ha or 1.1% of the Target Area)

This land use category include right of ways as roads & canals, barren land and undistinguishable lands.

#### Water Surface (800 ha or 0.8 % of the Target Area)

This land use category includes the Prek Thnot river, other rivers and ponds/reservoirs in the Area.

## **D-2.2 Rice Production**

### **D-2.2.1 General**

Rice production is the most important agricultural activities in the Target Area and nearly 100% of farm households are engaging in rainy season rice cultivation. However, those producing dry season rice are rather limited and according to SEILA Data Base the area extent of dry season rice is about 3% of the total paddy field reflecting water supply constraints in dry season in the Area. The rice production in the Area could be characterized by low and unstable productivity in rainfed fields and prolonged rice cultivation season continuing from May to January with the cultivation of rice varieties of different growth durations of early to late. Further, traditional farming practices adapted to the agro-climatic conditions in the Area is another characteristic of the rice production in the Area.

### **D-2.2.2 Cropping Season and Variety**

Cropping seasons in the Area are generally defined into two seasons of rainy season and dry season. The rainy season, predominant cropping season, lasts from May to October and the dry season is from November to April. Statistically, rainy season rice is defined as rice planted from May to October and dry season rice is rice planted from November to April. However, from the actual cropping seasons of rice, rice cropping season could better be differentiated into: i) early rainy season rice planted from April/May to June in irrigated area, ii) rainy season rice planted from July to September both in rainfed and irrigated area and iii) dry season rice planted from January to February in irrigated area.

Rice varieties in Cambodia are classified into photosensitive early rice, medium rice and late rice cultivated in rainy season and non-photo sensitive rice cultivated both in dry and rainy season. Current predominant rice variety grown in the Target area is medium rice in rainy season and non-photosensitive early rice in dry or early rainy season.

However, 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 cultivated 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 drought tolerance and tolerance to inundation.

Rice breeding in Cambodia was initiated by CIAP (Cambodia-IRRI-Australian Project) and followed by CARDI. Under the breeding program, a number of rice varieties were released through pure line selections of local varieties in the country. Based on the selections, promising rice varieties such as CAR 4, CAR 6, CAR 11, Santepheap 3, Phka Rumduol and Rieng Chey were released by CARDI. Cross breeding was also introduced and non-photo sensitive promising early rice varieties of Sen Pidao, IR Kesar and Kru are released and their cultivation area is expanding especially in dry season or early rainy season in irrigated areas. Other non-photo-sensitive early varieties common in the Target Area include IR 66 and IR 36 grown mostly in dry season or early rainy season. Major varieties released by CARDI with their characteristics and varieties grown commonly in the Area and are listed in Table D.2.2.1.

### **D-2.2.3 Cropping Calendar and Pattern**

The cropping calendar and patterns in the paddy fields in the Target Area are studied by categorizing the fields based on irrigation water supply conditions into three of categories of paddy field: i) irrigated paddy field, ii) supplementary irrigated paddy field in rainy season and iii) rainfed paddy field.

#### **(1) Irrigated Paddy Field**

In the irrigated paddy field, double cropping of rice is practiced under irrigation. Rainy season rice cultivation under irrigation in the entire area and dry or early rainy season rice cultivation in a part of the field because of the limitation of irrigation water supply. Cropping calendar in the area is diversified depending on locations affected by the seasonal availability of irrigation water supply, while the prevailing cropping season of rainy season rice (from transplanting to harvest) is July/August to November/December with medium variety. Cropping calendars of dry season rice and early rainy season rice is January/February to April/May and April ~ June to July ~ September, respectively. The former is found in Chbar Mon, Samraong Tong and Kong Pisei district in Kampong Speu and the latter is practiced in Chbar Mon and Samraong Tong. Further, double cropping of early variety of rice is also practiced to a limited extent in the Target Area. The prevailing cropping calendar and patterns in the field is illustrated in Figure D.2.2.1.

Cultivation of upland crops and vegetables in the paddy fields is extremely limited and is mostly practiced from June to August in the early rainy season before cultivation of rainy

season rice. Vegetable cultivation under irrigation is also practiced to a limited extent mostly in dry season from November to April.

(2) Supplementary Irrigated Paddy Field

Single cropping of rainy season rice is exclusive cropping pattern in the supplementary irrigated paddy field and prevailing cropping calendar is May ~ July/August to November ~ January as shown in Figure D.2.2.1. Prevailing variety in the field is medium variety, while early variety is also grown in case when start of cultivation delays due to irrigation water supply and rainfall distribution. Cultivation of upland crops and vegetables are practiced only to a negligible extent in the early rainy season from May to July.

(3) Rainfed Paddy Field

Similar to the supplementary irrigated area, single cropping of medium or late variety of rice is a cropping pattern in the rainfed field in the Target Area. Prevailing cropping calendar is June/July ~ December/January as shown in Figure D.2.2.1. Predominant variety is medium variety and cultivation of late variety becomes less common except in areas suffering from seasonal inundation in the early dry season of December

#### D-2.2.4 Cropped Area and Production in the Project Communes

Aiming at obtaining basic reference data on rice production in the Target Area, rice production features in the project communes<sup>4</sup> have been examined based on SEILA Commune Data Base, crop statistics of MAFF and PDAs.

(1) Cropped Area and Cropping Intensity

Cropped area and cropping intensity of rice in the project communes are estimated based on SEILA Commune Data Base from 2002 to 2004 as shown in Table D.2.2.2 and as summarized in the following table.

**Cropped Area & Cropping Intensity in Project Communes**

Item	Cropped Area	Cropping Intensity <sup>1/</sup>
Cropped Area Cropping Intensity in Rainy Season	38,705 ha	100 %
Cropped Area in Dry Season	1,139 ha	3 %
Annual Cropped Area & Cropping Intensity	39,865 ha	103 %

<sup>1/</sup>: Total paddy field: 38,881 ha

Source: Shown in Table D.2.2.2

As shown in the table, the overall cropping intensity of rice in the rice fields in the project communes is estimated at 100 % in rainy season, only at 3 % in dry season and 103 % annually. However, it was found from the water balance study made by the Study Team that the cultivation of dry or early rainy season rice in the Area might be practiced under strict water shortage conditions

(2) Paddy Yield and Production

Yield and production of paddy in the project communes are estimated on the basis of the statistic data of MAFF and PDAs as shown in Table D.2.2.3 and as summarized in the following table.

**Paddy Yield & Production in Project Communes**

Communes	Average Paddy Yield (ton/ha)				Production (1000ton)
	To Cropped Area		To Harvested Area		
	Rainy Season	Dry Season	Rainy Season	Dry Season	
Communes in Kp. Speu <sup>1/</sup>	1.4	2.4	1.7	2.6	38.0
Communes in Kandal <sup>2/</sup>	1.8	2.8	1.9	2.8	17.2
All Project Communes <sup>3/</sup>	1.6	2.4	1.7	2.4	62.7

<sup>1/</sup>: Average of 2003/04 – 2004/05; <sup>2/</sup>: 2000/01 – 2003/04; <sup>3/</sup>: 2003/04

Source: Shown in Table D.2.2.3

<sup>4</sup> Communes wholly or partly located in the Target Area



Paddy yield levels in the project communes are estimated at in the range of 1.4 ~ 1.8 ton/ha in rainy season and 2.4 ~ 2.8 ton/ha in dry season to cropped area and the same to harvested area is at 1.7~1.9 ton/ha and 2.6~2.8 ton/ha, respectively for rainy season and dry season as shown in the table. Such average rice yields are overall average of irrigated and rainfed fields in case of rainy season.

Annual production of paddy in the communes in Kampong Speu and Kandal is reported at 38,000 ton (average of 2003/04 to 2004/05) and 17,000 ton (average of 200/01 to 2003/04), respectively and 62,700 ton in total in 2003/04 crop year.

#### D-2.2.5 Crop Losses

Because of unstable rainfall distribution and limitation of water resources for irrigation, rice production in the Target Area remains unstable and serious crop losses in rainy season 2004/05 due mainly to severe drought are reported as shown in Table D.2.2.4 and as summarized in the following table.

**Rice Crop Losses in 2004/05 and Normal Years in the Project Communes**

Causes	2004/05 Rainy Season		2003/04 Rainy Season (Normal Year)	
	Area Completely Destroyed	Proportion to Cropped Area	Area Completely Destroyed	Proportion to Cropped Area
Drought	12,396 ha	36 %	295 ha	1 %
Flood	0 ha	-	710 ha	2 %
Pest & Disease	0 ha	-	148 ha	0.4 %
Total	12,396 ha	36 %	1,153 ha	3 %

As shown in the table, losses of rice plants caused by drought in 2004/05 rainy season was very serious and reportedly about 36% of cropped areas suffered from complete losses.

#### D-2.2.6 Prevailing Farming Practices

##### (1) Prevailing Farming Practices

Prevailing farming practices in the Target Area by cropping season and land use category are presented in Table D.2.2.5 and briefly described in the following.

##### Land Preparation

Land preparation is done by a pair of draft animal. Prevailing practices are 2 plowing & 1 harrowing, however, performance of land leveling appears to be insufficient.

##### Variety, Seed Sources & Replacement, Nursery

Cultivation of photosensitive local varieties is prevailing in rainy season while cultivation of non-photosensitive improved early varieties is almost exclusively carried out in early rainy and dry season. Major varieties in rainy season include Chamar Prom and Riang Chey and the same in dry season is IR 66, IR 36 and Sen Pidao. Primary seed sources are own products of a previous season and use of quality or certified seed is very limited. Frequency of seed replacement is depending on farmers but once per 4 croppings or more is common practice.

Seeding rate is high at 45 to 100 kg/ha and seedling age for transplanting is 1 to 2 months for local varieties and 1 month for early variety, although largely affected by water availability in a field or rainfall distribution.

##### Transplanting

Transplanting is randomly done at planting distance of 20x 20 to 30 x 30 cm. 2 to 3 plants per hill or more is common practice.

### Fertilization

Fertilization of urea and DAP is commonly practiced. A total dosage is around 150 to 200 kg/ha in an irrigated field and around 100 to 150 kg/ha in a rainfed field, although substantial differences among farmers. Top dressing of urea is also common practices.

### Harvesting

Harvesting is carried out manually with sickle and after sun drying in a field and threshing is usually done manually and partly by using engine thresher.

### Straw

Cattle raising is commonly practiced by farmers in the Area and rice straw is fed to cattle. Preparation of manure is also common practices.

#### (2) SRI in and around the Target Area

Modified SRI (System of Rice Intensification) was initially introduced in the Target Area in Kampong Speu Province by the guidance of CEDAC (Centre d'Etude de Développement Agricole). Basic farming practices specific to the modified SRI are: i) use of raised bed for nursery, ii) transplanting of a single seedling, iii) regular or line planting and iv) keeping rice field under nearly upland conditions up to flowering (seldom applied in irrigated field in the country).

In 2005, areas applied the modified SRI in rainfed paddy fields in Kampong Speu Province expanded largely through the collaborated guidance of PDA and CEDAC. The area extent of rainfed rice cultivation applying a part of SRI practices in the province is as follows;

#### **Area Introduced Modified SRI in Kampong Speu in 2005/06 Cropping Season**

District	No. of Villages	No. of Farmers	Cropped Area	Land Use
Chbar Mon	2	25	5 ha	Irrigated field
Samraong Tong	27	178	35 ha	Mostly irrigated field
Kong Pisei	36	925	486 ha	Rainfed paddy field
Other Districts (2)	116	1,672	814 ha	Rainfed paddy field

Source: PDA Kampong Speu

In most cases, SRI practices applied in the cultivation are transplanting of young seedling, single plant per hill and regular or line planting and water management system of SRI is not practiced.

#### **D-2.2.7 Post-harvest and Processing**

##### (1) Post-harvest and Processing

As described in the prevailing farming practices, manual operation of harvesting and threshing after sun drying in a field is common practices although mechanical threshing by a engine thresher is being introduced. After sun drying in home yards, paddy is stored in home for family consumption or marketing. Storage of rice in farm household before consumption or marketing and marketing of rice is almost exclusively in the form of paddy (dry unhusked rice).

Rice milling for family consumption is carried out at a small rice miller operated in a village. Prevailing arrangement of rice milling in the Area is free milling in stead of surrendering rice bran to a rice miller.

Rice milling facilities in the Target Area are mostly small scale rice milling units and are operated at village level mainly for rice milling for family consumption. Distribution of such rice mills in the project communes is inventoried as shown in Table D.2.2.6.

Existence of 1,164, 263 and 1,427 small scale rice mills are reported in the project communes in Kampong Speu, Kandal and in total, respectively. Rice milling capacities of such rice mills are mostly in the range of 200 to 500 kg of paddy/hour. Current rice milling capacity in the Target Area is far larger than milling demand for family consumption in the Area.

In addition to such small scale rice mills, medium to large scale rice mills in the project communes is reported to be 44, 23 and 67, respectively in Kampong Speu, Kandal and overall. In such rice mills, commercial operation of procurement and processing is practiced. Among such millers, large scale commercial rice procurement and processing (milling) is operated by several large scale rice millers. Such large scale rice millers include Kasekam Angkhor and a rice mill at Prey Roka village in Angk Snuol District, Kandal and a rice mill in Chbar Mon, Kampong Speu. Kasekam Angkhor has a large scale rice mill factory with factory space of 3,840m<sup>2</sup>. The firm is procuring specified varieties of organic rice under contract growing arrangement with farmers in Kandal, Kandal, Takeo and Kompot provinces. Rice milling capacity of the rice mill in Prey Roka village is 3.3 – 3.5 ton/hour and solely procuring and processing IR varieties of rice for logistic supply to the military and police sector.

The results of the questionnaire survey on farming practices, post-harvest and marketing issues are presented in Attachment 2. The results on post-harvest issues are summarized in the table below.

**Prevailing Post-harvest Practices in the Target Area <sup>1/</sup>**

Practices	Reponses of Sample Farmers
Threshing	Manual threshing: 97%
Drying of Paddy	Sun drying 100%
Paddy Storage	Wooden or bamboo container: 81%
Maximum Paddy Storage Period	8.7 months in average

<sup>1/</sup>: Results of questionnaire survey on 200 sample farmers by the JICA Study Team

## (2) Post-harvest Losses

Substantial post-harvest losses in rice production in the Area occur in many instances including: i) at harvesting, ii) after harvesting during field drying and transport from a field to home yard for threshing, iii) at threshing and iv) at storage. In food balance study on rice of the food security office, 13% of paddy productions are estimated as post-harvest losses and seed requirements for food security analysis.

The results of the questionnaire survey on post-harvest losses are shown in Attachment 2 and summarized in the following table.

**Dominant Post-harvest Losses in the Target Area <sup>1/</sup>**

Post-harvest Practices	Proportion of Sample Farmers	
	Most Dominant Losses	Second Dominant Losses
Harvesting	35%	23%
Field Drying	3%	9%
Threshing	50%	23%
Winnowing	2%	23%
Storage	2%	7%
Other Practices	9%	17%

<sup>1/</sup>: Results of questionnaire survey on 200 sample farmers by the JICA Study Team

### D-2.2.8 Weaknesses of Rice Production in the Target Area

Aiming at overviewing rice production in the Target Area, the weaknesses on the same, which should duly be addressed in the present development plan, are enumerated in the followings.

- Unstable and low productivity of rice primarily attributed to limited and unstable availability of water because of limitation of available water resources and unstable rainfall distribution,
- With the limited availability of water resources, rainfed rice cultivation with poor and unstable productivity remaining as a mainstay in farming activities,

- Prevailing farming practices characterized by use of traditional varieties, continuous use of self produced seeds, aged seedlings, random planting, limited application of fertilizer, inadequate post-harvest practices, etc., presenting serious problems attributed to low productivity,
- Single cropping of rice and annual low land use intensity at nearly 100% and extremely limited production of upland crops,
- Farmers preference for medium or late traditional varieties resulted in prolonged cropping season, higher water requirements and a single cropping of rice almost the entire paddy fields. Release of promising early and medium varieties by CARDI providing chances to improve such situations, but realization of curtailing cropping season still limited; and
- Substantial extents of land use conversion from rice fields to industrial or settlement areas mainly along the National Roads.

### D-2.3 Food Balance

The food balances of rice in the project communes in the past 3 years are studied applying the method adopted in the food balance study of MAFF to obtain rough idea on food supply conditions in the communes. However, depending on the sources of statistic data, substantial discrepancies on food balances are noticed. To keep consistency with the rice production figures in the preceding sections, the present food balance study has been made based on the statistic figures of the project PDAs. The results on food balance by project communes are presented in Table D.2.3.1 and the summary result is shown in the following table.

**Food Balance of Paddy in the Project Communes**

Crop Year	Production (ton)	Food Balance of Paddy (ton)	Proportion (%) <sup>1/</sup>
2002 – 2003	45,160	- 20,510	45
2003 – 2004	62,720	- 11,510	25
2004 – 2005	46,950	- 21,000	45
Average	51,610	- 17,680	38

<sup>1/</sup>: Proportion of deficits to requirements

Source: Shown in Table 2.3.1

As shown in the table, roughly 38% of deficits to the requirements in the communes are estimated on average. The average deficit of some 17,680 tons of rice corresponds to about 32,000 tons of paddy, which is about 62% of the average annual production volume of 51,610 as follows;

$$\begin{aligned} & \text{Rice deficit } 17,680\text{ton}/0.64(\text{rice recovery rate})/0.87(1- 0.13/\text{post-harvest losses} + \text{seed}) \\ & \cong \text{Paddy deficit } 32,000 \end{aligned}$$

The said paddy deficit of 32,000 tons is currently required to suffice requirements of rice in the communes or paddy production increase of 62% from the current level of 51,600 tons to 83,600 tons is required to suffice the same. For reference purpose, food balance result by district is presented in Table D.2.3.2.

### D-2.4 Production of Other Crops

Compared with rice production, productions of other crops such as upland crops, vegetables and fruits are extremely limited in the Target Area as shown in Table D.2.4.1, D.2.4.2 and D.2.4.3 and summarized in the following table.

**Cropped Area of Other Crops in Project Communes in 2003**

Crops	Area (ha)			Fruits	Area(ha)
	Rainy Season	Dry Season	Annual		
Upland Crops	668	30	698	Banana	359
- Mungbeans	341	0	341	Mango	292
- White Corn	63	0	63	Coconut	290
- Groundnut	76	7	83	Jack Fruit	129
- Others	188	23	211	Milk Fruit	63
Vegetables	556	350	907	Others	151
Total	1,224	380	1,604	Total	1,284

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

As shown in the table, cropped areas of upland crops and vegetables are extremely limited

to about 4 % of an average annual rice cropped area of 39,900 ha. Major upland crop is mungbeans followed by groundnut. Major vegetables include water melon, cucumber, string beans and morning glory. Annual cropped area of vegetables exceeds the same of upland crops, which means the extreme limitation of upland crops production in the Target Area. However, from field survey, the cropped area of vegetables appears to be over estimated because cropped areas by individual farmers are very limited. Major fruit trees found in the Area are banana, mango and coconut, although the planted area as a whole is limited.

Cultivation of upland crops, especially of mungbeans, is mainly practiced in rainy season in scattered upland fields around villages or sloping lands and in the early rainy season in paddy fields to a negligible extent. However, cultivation of upland crops after harvesting of paddy in dry season is also observed. Mungbeans cultivation in paddy fields is carried out under non-tillage system. Variety is a local variety and cultivation is extensive with very limited farm inputs (fertilizer) application. Productivity of upland crops in the Area is low and yield level of mungbeans is estimated at less than 0.5 ton/ha.

Vegetable cultivation is mainly practiced in home garden, upland & irrigated paddy fields close to Roleang Chrey Regulator, Krang Ampil Commune having spring water supply and along the natural levee of the Prek Thnot River. In irrigated areas close to Roleang Chery Regulator, good quality vegetable production is promoted by Peri-urban Agriculture Centre (PUAC) Kampong Speu, a Cambodian NGO supported by a Belgian NGO. Major activities of the organization include marketing of high quality vegetables to Phnom Penh and farmer training on vegetable production.

The production of upland crops and vegetables in 2003 is presented in Table D.2.4.1 and D.2.4.2. As shown in the tables, mungbeans production is reported at 700 tons in the project communes.

Sugar palm commonly found in the entire Target Area, especially in the northern and southern part of the Area, is regarded as an industrial crop of important farm income source. The harvesting season of the palm is dry season and palm saps are usually processed into palm sugar or palm wine. The palm is usually planted in a scattered manner on the bound of paddy fields.

## D-2.5 Livestock

Livestock sub-sector is an important agricultural activity for farm economy and a substantial number of animals and poultry are raised in the project communes as shown in Table D.2.5.1 and as summarized below.

**Livestock Population & Holding Status in the Project Communes**

Item	Cattle	Cow	Draft Cattle	Pig
Population	123,436	40,405	48,713	51,406
Holding Size/Farm	2.3	0.7	0.9	1.0
% of Household <sup>1/</sup>	63 %	-	-	26 %

<sup>1/</sup>: Proportion of households holding subject animal to total households

Source: Commune Survey on Crops & Livestock, 2003, MAFF & SEILA Commune Data Base, 2004

From the table, an average holding size of cattle, cow, draft cattle and pig is calculated at 2.3, 0.7, 0.9 and 1.0 heads per farm household, respectively, equivalent to animal units of 4.2 in total. The holding size of poultry is calculated at 8.1 per farm. However, as the statistic figures include livestock & poultry hold by commercial farms, an actual holding size per farm is lower the said estimates. Farm households having livestock are rather limited and cattle/buffalos and pigs are raised by 63% and 26% of farm households, respectively.

Commercial livestock farms of pig and poultry are operated to a substantial extent in and around the Target Area of Kampong Speu Province. The number and scale of such farms are as shown in the following table.

### No. of Commercial Livestock Farms in Kampong Speu

Farm	Number	Farming Size (heads)
Pig Farm	22	200 ~ 2,000
Poultry Farm	47	3,000 ~ 100,000

Source: PDA Kampong Speu

Production figures of livestock in the Area were not available since the transaction of live animals and poultry is common. There exist 4 slaughter houses in the Area. The number of animals slaughtered in such facilities is reported by PDAs as follows;

### No. of Animals Processed in Slaughter Houses in the Target Area in 2004

Slaughter House	Cow (per Year)	Pig (per Year)
Chamber Mon	360	5,100
Kong Pisei	324	600
Angk Snell	1,500	2,420
Kandal Stueng	280	440

Source: PDA Kampong Speu & Kandal

Land preparation for paddy cultivation is mostly done by draft animals in the Area and as a whole number of draft animals appear to be enough to carry out such works as shown in the following table.

### Works Done by Draft Animals in Project Communes in 2004

Project Communes in	Rice Field <sup>1/</sup>	No. of Draft Animals	Capability <sup>2/</sup>
Kampong Speu	29,521 ha	39,570	40,000
Kandal	10,167 ha	9,143	10,000
Total	39,688 ha	48,713	50,000

<sup>1/</sup>: SEILA Commune Data Base 2004 <sup>2/</sup>: Land preparation capability: > 1.0 ha per season per head

## D-2.6 Inland Fishery

### (1) Fish Production

Rice and fish are the traditional staple foods of the Cambodian diet and many rural households subsist on a combination of agricultural and fishing activities. Therefore, by supporting freshwater fisheries, inland water resources or surfaces play a critical role in rural livelihoods by providing opportunities for rural households to:

- Diversify their livelihood activities and thereby insure against the risk of agricultural failures;
- Optimize their labor resources among different livelihood activities during different seasons;
- Access an income-generating activity with very little capital investment and no land, and
- Maintain/improve nutrition, as fresh and possessed fish represent a significant source of protein.

In the Target Area, inland fisheries are the 3<sup>rd</sup> important sub-sector (within the agriculture sector) following the crop and livestock sub-sector in rural economy, although figures on the production volume was not available because majority of freshwater fish catch in the Area is from capture fisheries (harvesting of wild fish stocks). However, the role of aquaculture in fish production appears to be increasing.

According to the Agricultural Statistics 2004-2005, inland fish catch of the project provinces are as follows;

### Inland Fish Catch in Fishing Season 2003-2004 (unit: ton)

Project Province	Inland Fish Catch			Fish Catch Total
	By Fishing Families	By Commercial	In Fields	
Kampong Speu	400	0	1,000	1,400
Kandal	14,000	10,100	13,000	37,100

Source: Agricultural Statistics, 2004-2005, Statistics Office, MAFF

Parts of Kandal Province outside of the Target Area are located in the main inland fisheries zones and the above fish catch figures mostly come from those zones and not form the Target Area. However, the reported statistics are typically based on planned figures rather than estimates based on actual catches and the figures appear to be indicative inland fish catch & production figures.

In the Target Area, fishing activities in natural water surfaces are allowed from October to June and the closed period is from July to September. However, main fishing season is October to November. Most fish catches are consumed domestically either as fresh fish or processed products such as dried fish, fish paste (prahok) and fish source (tuk tery). Common species of fish caught include common carp, silver carp, silver barb, sneak head, *Hypsibarbus pierrei* and *Trichogaster pectoralis*. Fishing lots are not established in the Target Area.

(2) Freshwater Fish Culture

The Fisheries Office of PDA Kampong Speu has fish breeding facilities and efforts to introduce freshwater fish culture in the Target Area have been made although still at the threshold level. Freshwater culture in the Area is carried out both in small ponds or ponds and rice fields. In Kampong Speu Province, the existence of 150 small fish ponds in Vosai District and the development of 40 small fish ponds in Kong Pisei in 2006 are reported by PDA. Kinds and number of breeding facilities of the Offices and owned privately are as follows;

**Fish Breeding Facilities in & around the Target Area**

Project Province	Hatchery	Breeding Pond	Fingering Production
Kampong Speu	3 (PDA)	8 (6PDA & 2 private)	± 2.0 million in 2005
Kandal	1 (project)	0	-

Source: PDA Kampong Speu & Kandal

Fish fingering production capacities of those breeding facilities are reported to be 3 to 4 million in Kampong Speu.

In the Target Area, freshwater fish culture appears to be still in an initial stage, although development of small fish ponds and fish cultures in rice field are reported. However, JICA has started Freshwater Aquaculture Improvement & Extension Project (FAIEX) in February 2005 in 4 provinces including Kampong Speu and started corporation with Fisheries Office of the province as explained in the section 3.7. Further, a commercial scale fish farm was recently constructed close the Roleang Chrey Regulator.

Needs for diversification of income sources as well as improvement of nutritional condition could be addressed through the introduction of freshwater fish culture in the Target Area, especially directed to farmers at marginal status. The main freshwater aquaculture strategies in Cambodia include: i) fattening juvenile fish for market, ii) stocking surplus fish in order to speculate on market prices, iii) small-scale, low input fish-raising for food security purposes.

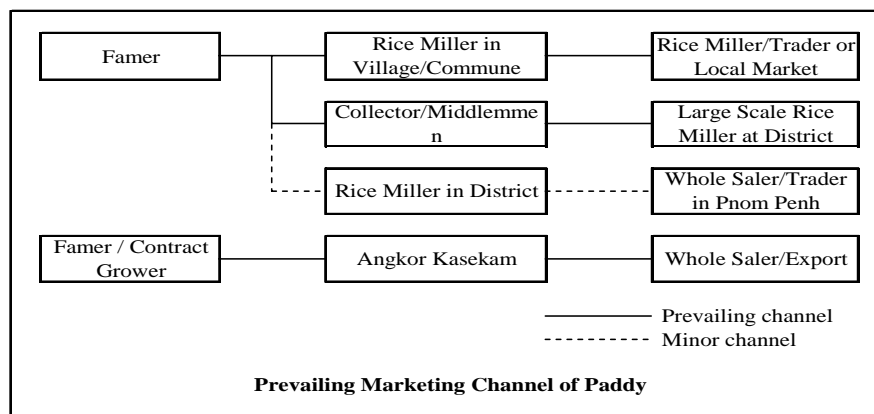
**D-2.7 Marketing**

**D-2.7.1 Rice Marketing**

(1) Marketing Volume and Channel

As the Target Area is rice deficit area as a whole and holding size of rice field is estimated at around 0.7 ha per farm, marketing volume of rice is estimated to be limited. Therefore, marketing volumes of rice in the Target Area appear to be limited. The result of the Socio-economic Survey presented in Table D.2.7.1 indicates that an average volume of paddy marketed is calculated at 1,180 kg per those marketed and 670 kg per a sample farmer. However, the same result also indicates that the marketed volumes of paddy account for 34% of total products and 55% of the sample farmers (184) reported marketing of paddy. Marketing of rice in the Area is carried out almost exclusively in the form of paddy (dry unhuksed rice). Marketing timing of rice appears to be depending on individual farmers. However, common timing is when cash is needed followed by when price is high.

The prevailing marketing channels of paddy in the Area identified through the Socio-economic Survey, information provided by PDAs and rice millers and field survey by the Study Team are illustrated in the following figure.



As shown in the figure, the area specific marketing channel is the marketing under the contract growing with Angkor Kasekam Roongreung Co., Ltd. Located in Angk Snuol.

Another notable marketing system reported in the Target Area is a paddy mortgage system between farmers and rice millers. In the system, a farmer can deposit his products (paddy) at a warehouse of rice miller without paying storage charge under the condition that he shall sell his products to the miller and that he is free for the timing of selling of his products. Such a system appears to be a transaction quite an advantage to farmers, however, according to agricultural agencies, there appears to be unfair practices involved in measuring and other stages by a miller. The Open Paddy Market (OPM) Project of JICA has been introducing OPM Paddy Mortgage System in the pilot projects.

(2) Market Prices

Seasonal fluctuations of market prices of paddy are common phenomenon in the Target Area and in Cambodia as well since cultivations of photosensitive varieties of rice prevail. Generally, paddy prices are lowest from January to February just after the peak harvesting season and highest from September to October before the harvesting season. Further, price differences of about 50~100 riel/kg between local medium/late varieties and improved early varieties (IR varieties) are also reported in the Area Seasonal and varietal differences of paddy prices in the Target Area are reported as follows;

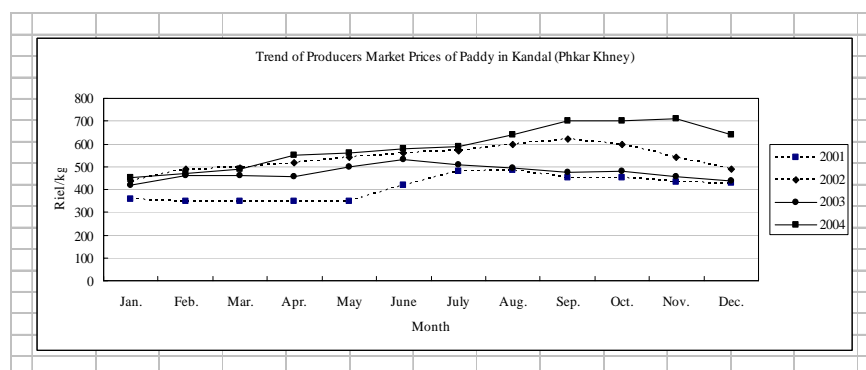
**Seasonal Differences of Paddy Prices in the Target Area in 2004/2005 (unit: riel/kg) <sup>1/</sup>**

Variety	a. Jan. ~ Feb.	b. Sep.	Differences (b – a)
Local (medium/late)	590	700	110
Early Variety (IR)	550	620	70

<sup>1/</sup>: Farm gate prices of local varieties of paddy Source: Rice millers in the Target Area

Such price differences between varieties reflect consumers preference for local varieties to improved varieties. Consumers preference for local varieties is because of favorable taste and aroma of those compared with improved varieties. As common practices in irrigated area, farmers grow local varieties in rainy season for family consumption and improved varieties for marketing in the early rainy or dry season.

The past trends of paddy prices from 2001 to 2004 in the Target Area could be estimated based on the producers market prices of paddy in Kandal and Takeo as shown in Table D.2.7.2 and below.





The noticeable feature in the past price trend of paddy is price increase in the last quaternary of 2004 and general trend of price hike from July/August to October.

Paddy and rice market prices in Cambodia are largely affected by the import demands of Vietnam and Thailand, especially by those of Vietnam. The 2004 rainy season rice production in neighboring countries and Cambodia as well were badly affected by severe drought and the paddy & rice prices in Cambodia stabilized at higher level because of persistent demand from the two countries.

Because of limited market volume by individual farmers and purchase prices of paddy determined by buyers (rice miller or their agent collector/middleman) on the basis of the wholesale market in Phnom Penh, farmers have little bargaining power in price setting.

Major constraints for paddy marketing identified in the present Study through the Socio-economic Survey are low market price of paddy and unstable market price followed limitedly by limitation of market for paddy.

### (3) AMIS

The target provinces of the on-going Agricultural Market Information System (AMIS) Project financed by ADB will be expanded from current 12 provinces to 15 provinces from 2006 and the project operation will start in Kampong Speu Province from 2006.

#### **D-2.7.2 Marketing of Other Agricultural Products**

Both production and, therefore, marketing volumes of other crops are rather limited in the Target Area. Common marketing destinations of upland crops are local markets followed by middlemen/collector and the same of vegetables are local markets followed by markets in district centers.

In stead, substantial number of animals and poultry are marketed as estimated from the population of those in the Area. Common market destinations of animal and poultry are collector/middleman followed by village markets and markets in district centers. There are 4 slaughter houses in and around the Target Area as shown in Table D.2.2.6.

#### **D-2.7.3 Agro-processing**

A noticeable agro-processing in the Area is palm sugar production operated at household level. Although, any data on production volumes was inaccessible palm sugar production is one of important income sources in the Area.

#### **D-2.7.4 Marketing Facilities**

The distribution of 17 village markets, 15 commune level markets and 4 district level markets are reported as shown in Table D.2.2.6. Among such markets, the 4 district level markets are having important functions as marketing places of farm inputs and vegetables distributed from wholesale markets in Phnom Penh. The local level markets, village and commune markets are functioning as destination markets of agricultural products in the Target Area. Wholesale market of rice, vegetables and upland crops are established in Phnom Penh.

## **Chapter D-3      Agriculture Support Services**

### **D-3.1    Agricultural Support Institutions**

#### **D-3.1.1   Government Institutions**

The government institutions involved in agricultural support services include MAFF at central level and Provincial Department of Agriculture (PDA) in Kampong Speu and Kandal Province at province level. Because of the decentralization policy in the country, government sector providers of such services at field level are PDA of individual provinces. The organization structures of MAFF and PDA Kampong Speu and Kandal are shown respectively in Figure. D.3.1.1, D.3.1.2 and D.3.1.3.

##### **(1)    MAFF**

As the central agency, MAFF is the primary ministry responsible for agricultural development and is mandated to plan, implement and monitor & evaluate agricultural development and agricultural support services in the country. Agricultural departments and programs within the ministry focus mainly on crop, livestock and fisheries development, agro-processing, research and education, extension and technical services. However, with the introduction of the decentralization policy, the primary functions of the Ministry in the field of agricultural support are to establish policy framework, to formulate and manage programs, to supervise and monitor/evaluate programs implementation.

Among a number of departments of MAFF, Dept. of Agronomy & Agricultural Land Improvement (DAALI), Agricultural Extension (DAE), Fisheries and Animal Health & Production are the agencies responsible for agricultural supporting services related with the present Study. DAALI is a technical agency responsible for crop sub-sector technology development, seed production, plant protection and soil management & improvement. DAE is a central agency mandated to extension services, farming system development and farmer organizations. Department of Fishery and Animal Health & Production are agencies for technical development and provision of support services on respective sectors. Agricultural marketing issues are handled by Agricultural Marketing Office of Department of Planning & Statistics.

Central Agricultural Research and Development Institute (CARDI) is placed under the jurisdiction of the Ministry as one of public institutions. The provincial level agricultural agency of PDA is technically under the jurisdiction of the Ministry as shown in the organization of the Ministry shown in Figure D.3.1.1.

The most serious technical weakness of the related departments appears to be the limited accessibility to information on actual agricultural and agro-economic conditions at provincial, district and field levels.

##### **(2)    PDA**

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. As shown in Figure D.3.1.2 and D.3.1.3, PDA Kampong Speu is composed of six technical offices and two planning/administrative offices and PDA Kandal is of six technical offices and three planning/administrative offices. Total number of staffs including district level staffs is 269 and 331, respectively in Kampong Speu and Kandal.

Major functions of Agronomy Office of PDA include technology development, seed production and plant protection and the same of Extension Office are provision of extension services and human resources development. Animal Health Office has functions

of provision of veterinary services, technology development and extension services and the same of Fishery Office are fish fry and fingerling production, technology development and extension services. Major functions of technical offices of PDAs are explained in Table D.3.1.1. The current major project activities of Agronomy Offices are as follows;

#### **Current Major Project Activities of Agronomy Offices**

<b>Agronomy Office</b>	<b>Project</b>	<b>Extension Activities</b>
Kampong Speu	APIP/LWF	IPM (3 non- project districts)
	WVC	IPM (1 non-project district)
	CIDA	RFV (rice-fish-vegetable system) (Kong Pisei & 4 non-project districts)
Kandal	APIP	IPM (Kandal Stueng, Angk Snuol, etc.)
	FAO	IPM (Kandal Stueng, etc.)

*Source: PDA Kampong Speu & Kandal*

PDA has its branch offices at district level called District Agricultural Office (DAO). In the Target Area of the present Study, 3 DAOs in Kampong Speu and 2 DAOs in Kandal are deployed as shown below.

#### **DAOs & Their Staffs in the Target Area**

<b>Kampong Speu</b>		<b>Kandal</b>	
<b>DAO</b>	<b>No. of Staffs</b>	<b>DAO</b>	<b>No. of Staffs</b>
Chbar Mon	10	Kandal Stueng	10
Samraong Tong	11	Angk Snuol	11
Kong Pisei	11		

*Source: PDA Kampong Speu & Kandal*

The organization set-ups of DAOs are illustrated in Figure D.3.1.4. The amount and sources of development budget in 2005 of PDA Kampong Speu are shown in the following table.

#### **Development Budget of PDAs in 2005 (unit: US\$) <sup>1/</sup>**

<b>Source</b>	<b>Kampong Speu</b>	
	<b>Amount</b>	<b>Proportion</b>
Central Government	183,000	62%
Project Budget	110,210	38%
- CAAEP II	48,760	
- APIP	24,450	
- SEILA	30,000	
- UNICEF	7,000	
<b>Total</b>	<b>293,210</b>	<b>100%</b>

<sup>1/</sup> *Converted by applying 1US\$ = 4,000 riel;*

As shown, the allocation of project budget from MAFF accounts for 38% of the total development budget in Kampong Speu.

### **D-3.1.2 International Organizations and NGOs**

A number of international and bilateral cooperation organizations are involved in agricultural sector support activities in and around the Target Area as shown in Table D.3.1.2, list of the international and bilateral cooperation organizations and their major agricultural activities in the project provinces. Some of important activities or programs closely related with the present study are discussed in the section 3.7.

Similarly, a number of NGOs are involved in agricultural sector support activities in and around the Target Area as shown in Table D.3.1.3, list of NGOs and their major agricultural activities in the project provinces. The activities of a NGO (CEDAC) closely related with the present study are discussed in the section 3.7.

### **D-3.2 Agricultural Research**

The institutional set-up of the agricultural research and technology development activities in Cambodia is composed of the central institute for crop sector research (Cambodian Agricultural Research and Development Institute/CARDI) and the state farms and

experimental stations belong to DAALI of MAFF as illustrated in Figure D.3.1.1.

#### (1) CARDI

CARDI is a semi-autonomous, leading agricultural research and technology development public institute under the jurisdiction of MAFF and its core purpose is to improve the living standards of Cambodian farmers through agricultural research, technology development and technology transfer. The institute is located close to the Target Area along the National Road Route 3.

CARDI was originally established as the central rice research institute under CAIP (Cambodia, Australia and IRRI Project). However, in 1999, the Institute was reestablished as a semi-autonomous institute to offer leadership and innovation in the application of agricultural research and development to direct and enhance Cambodia's agricultural future. The national mandates given to CARDI consist of;

- Management and leadership of all research activities to enhance agricultural development,
- Conducting applied research (including agricultural economics) and technology transfer,
- Delivering services to support implementation and rehabilitation of agricultural development project,
- Development of human resources in the agricultural field, and
- Cooperation with relevant research institutions, both national and international.

To meet the said national mandates, CARDI currently establishes six research programs or units of: i) plant breeding, ii) agronomy & farming system, iii) soil & water sciences, iv) plant protection, v) agricultural engineering as indicated in Figure D.3.1.1. In addition, the institute has Training & Information Center for training and technology transfer purposes.

One of the important functions of CARDI has been rice seed development and production and the Institute has been established as a national provider of rice genetic resources, breeder seed and foundation seed. A number of quality rice seeds developed or selected by CARDI have been released by the Varietal Recommendation Committee of Cambodia. Among the same, promising rice varieties of Sen Pdao (non-photo sensitive early rice) and Phka Rumduol & Rieng Chey (photo sensitive medium variety) for the Target Area are included.

Further, under the scheme called "Effect of Integrated Crop Management for Rice Field Improvement" supported by ACIAR, rice demonstration fields are being operated by CARDI in Samraong Tong and Angk Snuol District.

The institute should be placed as a technical resource agency for the pilot project under the present study and close collaboration and cooperation should be sought during the pilot project operation.

#### (2) Other Research and Technology Development Institutions

Other agricultural research and technology development institutes under DAALI of MAFF include Prey Pdao and Kbal Koh Experimental Stations and Toul Samroang Rice Seed Farm and Chamkaleu Seed Production Farms. The major mandate of the Stations and Farms are adaptive technology development and seed production.

The Prey Pdao Experimental Station is located in Angk Snuol District of the Target Area. The organization set-up of the Station is composed of Production, Research and Administration Sections and major functions are rice seed production, adaptive research and demonstration activities as stated earlier. The staffing and facilities of the Station are shown in the following table.

### **Staffing and Major Facilities of Prey Pdao Station**

Position	No.	Facilities	No./Area
Staff		Facilities/land	
Director (acting)	1	Irrigated rice field	7 ha
Deputy Director	1	Office	1
Section Chief	2	Accommodation	1
Staffs	4	Storehouse	1
Total	8	Tractor	1

*Source: Prey Pdao Station*

Seed production in 2004 and major activities in 2005 of the Station are as follows;

#### **Seed Production & Major Activities of Prey Pdao Experimental Station**

Seed Production (2004)	Rainy season 7.7 ton Dry season 11.6 ton
Farmer Training (compost preparation)	2 courses (2005)
Demonstration Plots (use of compost)	6 plots (2005)
Duck Culture in Rice Fields	4 plots (plan, 2005)

The Station could be nominated as a technical support institute for the operation of the pilot project under the present Study.

### **D-3.3 Agricultural Extension**

#### **D-3.3.1 Institutional Set-up for Agricultural Extension**

The national mandate for agricultural extension in Cambodia is placed with Department of Agricultural Extension (DAE) and Agricultural Extension Offices (AEO) of PDA in provinces. Although extension staffs in provinces and districts and district level Agricultural Offices (DAO) for extension have been deployed and financial and reporting systems are in place to an insufficient degree, the establishment of the extension system is yet to be envisaged and the provision of extension services to farming communities are extremely limited due primarily to financial constraints of the country. In other words, the delivery system of extension services to farmers are still in their infancy and a fully functioning national extension system does not exist.

The establishment of the national agricultural extension system was envisaged under CAAEP I (1998-2000) and the institutional set-up for agricultural extension system to be established in the country was designed as shown in Figure D.3.3.1. Some key components or concepts envisaged in the system are as follows;

- The system aims to apply Farming System Research & Development (FSRD) approaches to identify priority needs for programs through Agro-Ecosystems Analysis (AEA) or other processes and to create close links between research and extension,
- Extension activities at provincial and district level and farmer to farmer transfer of information and extension are envisaged in the system and much of transferring of information to all farmers are to be achieved through farmer to farmer links,
- Formation of multidisciplinary or holistic teams at district level to provide extension services, and
- Links at the field operational level between extension, research and farmers are to be formed.

The target provinces of the present Study, Kampong Speu and Kandal, are among 14 provinces where CAAEP II activities are being introduced, however, the envisaged extension system has not been fully introduced and applied yet in the target provinces.

In the proposed extension system, district level staffs have essential functions on field level extension activities as shown in the envisaged technology transfer role of the district level agriculture staffs<sup>5</sup> illustrated in Figure. D.3.3.2.

#### **D-3.3.2 Extension Method**

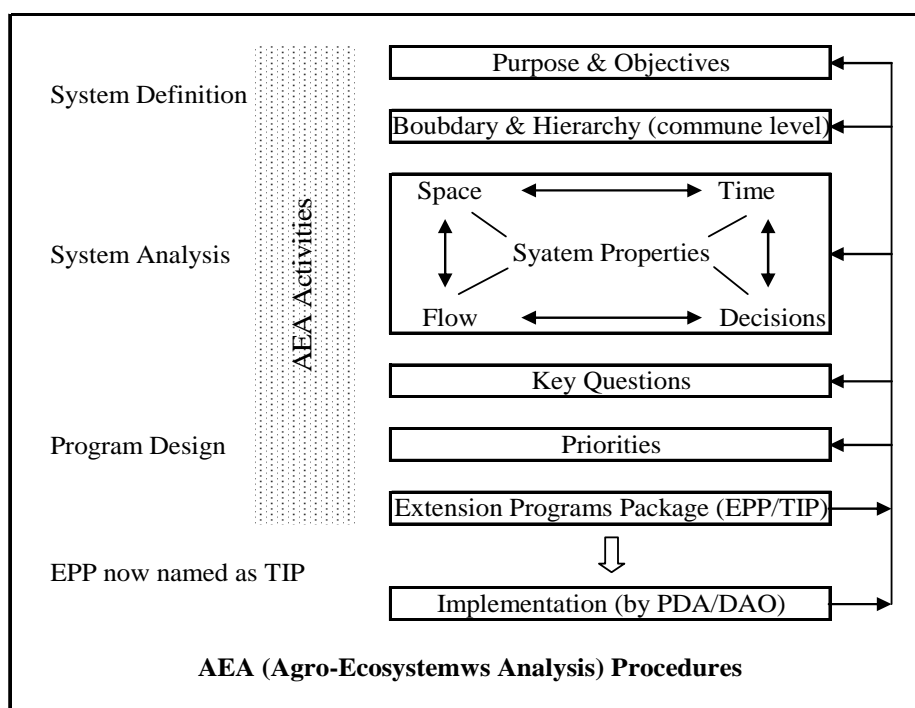
The approaches for the provision of agricultural extension services or the extension

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<sup>5</sup> Source: Guidelines for Agricultural Extension in Cambodia, August 2000, CAAEP

method envisaged in the extension system discussed in the section 3.3.1, which are currently being introduced in the project provinces and other 5 provinces covered by CAAEP II, include AEA at the commune level as a participatory needs assessment methodology for planning agricultural extension and development programs for implementation under the Commune Agricultural Plan (CAP) with SEILA funding. AEA has been implemented in over 200 communes in 14 provinces, and its use is now endorsed under the current MAFF policy.

AEA is conducted by multidisciplinary teams from relevant government departments and local stakeholders such as commune councils and farmers. It proceeds in a series of stages, interspersed with short breaks over a period of a month or more, as shown in Table D.3.3.1. The procedures for AEA are illustrated in the following figure<sup>6</sup>.



As shown in the figure, the final output of AEA is the formulation of EPP (Extension Programs Package; currently called as TIP/Technical Implementation Procedures) to be implemented in a target commune. In the Target Area, AEA under CAAEP II were implemented in 17 communes out of the 44 project communes as follows;

**Project Communes Covered by AEA under CAAEP II**

Kampong Speu		Kandal	
District	No. of AEA Communes	District	No. of AEA Communes
Chbar Mon	1	Kandal Stueng	-
Samraong Tong	7	Angk Snuol	4
Kong Pisei	5	Total	17

Source: DAE & CAAEP II

The priority needs for agricultural development supports identified in AEA conducted by DAE, PDAs and CAAEP II in the project communes are presented in Table D.3.3.2. Some priority support programs identified through AEA have been implemented to a pilot degree in the project districts.

<sup>6</sup> Source: IEA for Irrigation System Development (ISAEA), 2005, CAAEP II

### D-3.3.3 Provincial Extension Agencies

Within the agencies mandated to provide agricultural extension services, those actually involved in such services are PDAs, their district level offices of DAOs and their staffs. Those practical extension agencies are weakly established in various meanings.

#### (1) Staffing and Deployment of Agricultural Extension Workers

Staffing of Agricultural Extension Office (AEO) of PDA and deployment of Agricultural Extension Workers (AEWs) in the project provinces are as follows;

#### Staffing & Deployment of AEWs

Office	AEW			SMS <sup>1/</sup>
	Crop	Livestock	Total	
Kampong Speu				
AEO	4	3	7	2
DAO Chbar Mon	1	1	5	
DAO Kong Pisei	1	1	5	
DAO Samraong Tong	2	2	5	
Other DAOs	n.a.	n.a.	23	
Total	-	-	45	2
Kandal				
AEO	6	-	6	2
DAO Kandal Stueng	3	2	5	
DAO Angk Snuol	3	2	5	
Other DAOs	n.a.	n.a.	30	
Total	-	-	41	2

<sup>1/</sup>: Subject Matter Specialist

Source: PDA Kampong Speu & Kandal

Among the said AEWs, those involved in fulltime project activities are 16 for CAAEP II and 12 for SEILA in Kampong Speu and 16 for CAAEP II in Kandal.

#### (2) Activities of Project AEOs

The envisaged extension activities of AEOs are reported to be;

- Implementation of AEA under CAAEP II,
- Demonstration activities on crops & livestock, and
- Farmer training through meeting/course, field day & field visit.

However, because of constraints on operational funds for extension activities, the provision of extension services through the implementation of projects of donors and NGOs are primary activities of AEOs. Current such extension activities of AEOs carried out under project supports are as follows;

#### Current Major Project Extension Activities of AEO

AEO	Project	Extension Activities
Kampong Speu	CAAEP II	AEA in 20 communes Staff training, formation of agr. cooperatives
	SEILA	Farmer training, demonstration (all districts)
Kandal	CAAEP II	AEA in 30 communes Farmer training, demonstration, study tour
	SEILA	Village livestock agent training
		Cow bank

#### (3) Village Livestock Agent (VLA)

In the Target Area, farmer veterinary & extension services providers called Village Livestock Agent (VLA) are deployed as shown in the following table.

#### VLA's Deployed in the Target Area

Kampong Speu				Kandal		
Chbar Mon	Samraong Tong	Kong Pisei	Province	Angk Snuol	Kandal Stueng	Province
20	57	37	400	20	66	338

Source: PDA Kampong Speu & Kandal

Those VLAs were trained for about a month before qualification under support programs of donors/NGOs and SEILA. The proportion of VLAs still engaging in such services in Kampong Speu is reported to be around 70 to 80% by PDA.

#### **D-3.4 Seed Production and Supply**

Although National Seed Strategy Document was drafted under APIP, the introduction the national seed policy and seed production and certification system has not been realized in Cambodia because legislative processes for the introduction is yet to be performed. Current predominant rice seed production and supply system in Cambodia is illustrated in Figure. D.3.4.1. As shown in the figure, main rice seed production system consists of: i) production of breeder seed (B/S) by CARDI, ii) production of foundation seed (F/S) by State Farms, CARDI and Agricultural Experimental Station and iii) commercial seed (certified seed) production by seed producers and seed growers. However, because of the limitation of demand for quality seed, it could not be assessed that quality seed production and supply system has been established in the country as a whole. Further, due to lack of the national seed policy and seed production and certification system, seed inspection and certification is implemented arbitrary by individual seed producers and quality seeds produced usually called commercial seed (C/S).

As indicated in the current predominant rice seed production and supply system in Figure D.3.4.1, major quality seed producers in the country include: i) CARDI, ii) State Farms and Agricultural Experimental Stations of DAALI, iii) 4 seed companies established under AQIP (Agricultural Quality Improvement Project) and iv) seed growers/seed growers groups. In and around the Target Area, Prey Pdao Agricultural Experimental Station in Angk Snuol District to a limited extent and Super Seed Company in Kandal Stueng to a large extent are producing certified seed for distribution to dealers, farmers or else. Certified seed production of the Station in 2004 was about 20 tons and the same of the Company was about 400 tons. Major varieties produced in the former were IR 66, Sen Pidao and CAR 4 and products were mainly distributed to individual farmers and partly to NGOs and GTZ project. Major variety produced by the Company is Pkha Rumduoul, Riang Chey, IR 66 and Sen Pidao and major distribution destinations are seed dealers, NGOs, government projects and individual farmers.

Marketed volume of produced seeds of the Company in 2004 was reported to be around 75% of total products or 300 tons only because of rather limited demand for certified seeds. Such limited market for quality seed forced the Company to reduce seed production plan to about 200 tons in 2005. Commercial or certified seed prices of CARDI and Seed Companies are Riel 1,500/kg irrespective of varieties (retail price of Seed Companies is Riel 1,600/kg).

Common channel of quality seed supply in and around the Target Area is through provision of seed under contract growing with Kasekam Angkhor and under support programs of donors or others. Commercial seed suppliers in the Area are farm inputs suppliers in district centers but their supply volume are limited.

Predominant seed source of rice is self-multiplied seeds (products of previous season) followed by seeds exchange with other farmers in the Target 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 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: 72%; exchange with others: 23%
Frequency of Seed Replacement	Once per 3 cropping: 46%; once per over 4 cropping: 54%
Procurement of Wanted Seed	Easy: 91%; difficult: 9%
Procurement of Quality Seed	Easy: 53%; difficult/not possible: 47%
Price of Quality Seed	Too expensive: 41%; acceptable: 54%

*Source: Socio-economic Survey by the JICA Study team, 2005*

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.

Production of upland crops and vegetables in Cambodia is still limited. However, upland crops seed production is carried out by Chamkaleu Seed Production Farm and CARDI started to produce upland crops seed. Main upland crops seed produced by the farm is beans and the same of CARDI is beans and maize.

#### D-3.5 Farm Inputs Supply

Supply sources of chemical fertilizers and agro-chemicals in Cambodia solely depend on import commodities since no fertilizer and agro-chemical industries have been established. Since the introduction of privatization of farm inputs import, major role in the same is undertaken by a private sector. Major importers and distributors of farm inputs in the country include a government public institution, Agriculture Input Company (AIC; fertilizer). Major origins of such commodities are Thailand and Vietnamese.

Serious problem in farm inputs supply in the country is distribution (marketing) of chemical fertilizers and agro-chemicals of poor quality. The fertilizer and agro-chemical standardization has been introduced in Cambodia, however, no system to effectuate the standardization is yet to be established. Establishment of such system including inspection and certification of such commodities is urgently required.

Farm input supplies in the Target Area are mostly carried out by dealers in district centers and local markets at commune or district level. Group purchasing of fertilizer is seldom practiced in the Area, however, introduction of such purchasing arrangement by 2 farmer cooperatives in the Area is reported.

The results of the Socio-economic Survey (Attachment 2) indicate the existing of no serious constraints for procurement of fertilizer except for price as follows;

#### Fertilizer Supply Conditions in the Target Area

Enquiry	Reponses (200 sample farmers)
Frequency of Wanted Fertilizer	Easy: 90%; difficult: 10%
Supply Timing of Fertilizer	In time: 87%; delayed: 13%
Fertilizer Price	Too expensive: 81%; acceptable: 19%

*Source: Socio-economic Survey by the JICA Study team, 2005*

#### D-3.6 Farm Credit

Formal banking financial system for farm credit is limited in Cambodia and some institutions called, "Micro Finance Institution (FMI)", having credit services are operating farm credit services to farmers or rural people. Such institutions operating in and around the Target Area include ACLEDA Bank (NGO involved in rural credit established as a bank), PRASAC and Vision Fund. Further, several NGOs providing micro credit services in the project provinces include FLD (Farmer Livelihood Development), PNKS (Ponlen Ney Kdey Sangkum/Light of Hope) and Enfant & Development. However, non-institutional credit providers such as rice miller, farm input suppliers and relatives or friends might be a mainstay in financing in the Area. The results of the Socio-economic Survey on farm credit are as follows;

### Results of Socio-economic Survey on Farm Credit

Enquiry	Reponses (200 sample farmers)
Access to Farm Credit	Easy: 45%; difficult: 36%, not received: 19%
Amount of Credit	Sufficient: 59%; not sufficient: 22%; not received: 19%

*Source: Socio-economic Survey by the JICA Study team, 2005*

#### D-3.7 Major On-going Agricultural Support Programs/Schemes

Current on-going major agricultural support programs or schemes operated in the Target Area and their main activities are as follows;

##### (1) CAAEP II

Project Title	Cambodia Australia Agriculture Extension Project II
Financing Agency	AusAID
Executing Agency	MAFF & PDA of 14 provinces (Kampong Speu, Kandal, others)
Project Period	2001 ~ 2006
Project Cost	AUS\$ 18.9 million (≅ US\$ 10 million)

CAAEP II is the second phase project of CAAEP which was implemented aiming at the establishment of agricultural extension system in Cambodia and the primary objective of the phase II project is the development of extension method to be introduced under the system and practical introduction of the method at province, district and commune levels. The proposed extension method is the formulation of TIP (Technical Implementation Procedures; formally called EPP/Extension Programs Package) through AEA as discussed earlier in the section 3.3.

In the Target Area, AEAs were conducted in 17 communes out of the 44 project communes. The current stage of AEA in most of the target communes is the formulation of agricultural extension programs for the identified priority needs. Such extension programs formulated are to be implemented in 2006 in 6 provinces (not yet decided). However, some of extension programs have been executed as a pilot operation as follows;

#### Pilot Extension Programs Implemented under CAAEP II

Program	Target Province
Vegetable Production	Kandal,
FWUC Empowerment	Battambang, Modndolkiri
Early Rainy & Dry Season Rice Production	Kandal, Modndolkiri, Kampong Cham

*Source: CAAEP II*

AEAs conducted in the project communes are at the final stage for program formulation as stated earlier. The results of AEAs to date, key questions & priority rating and TIPs (priority extension subjects), in the project communes are presented in Table D. 3.3.2 and 3.7.1.

##### (2) CEDAC (Centre d'Etude de Development Agricole)

CEDAC is a research and development NGO specialized in the field of ecological agriculture and rural development. The Center was set up in 1997 by Cambodians with initial support from GRET (a French NGO). The mission of the Center is to work towards "the improvement of the well being of small farmers and consumers by promoting ecological agriculture and building up capacity of farmer organizations and other stakeholders". Current staff number of CEDAC is around 130 consisting of full-time staff and field-based staff and it is operating in 14 provinces from the central and 7 field offices.

The major development activities of the Center include the dissemination of SRI (System of Rice Intensification) and formation and empowerment of farmer & community-based organization, especially FWUC (Farmer Water User Community).

SRI has been introduced in 20 provinces including the project provinces of Kampong Speu and Kandal and total the number of farmers applying SRI for their rice production is

roughly estimated at 50,000 by the Center. In Cambodia, SRI is practiced both in irrigated and rainfed paddy fields and area extent is larger in the latter. In Kampong Speu, rainfed rice cultivation applying a part of SRI practices expanded largely in 2005 as discusses in the section 2.2.6.

Another CEDAC activity closely related with the present Study is the formation and empowerment of FWUC. Such activities are currently operated in the project areas of the ADB financed North Western Irrigation Project. Further, the Center is providing agricultural extension activities under the financial support of NGOs. For example, the Center is providing technical (consultancy) services in Stueng Chinta Irrigation and Rural Infrastructure Project implemented under ADB financing by MOWRAM/PDORAM. The agricultural extension and FWUC formation/empowerment components of the Project is financed by AFD and GRET (French NGO) and CEDAC are involved as implementing organization of such support services.

### (3) APIP (Agricultural Productivity Improvement Project)

Project Title	Agricultural Productivity Improvement Project
Financing Agency	IBRD
Executing Agency	MAFF
Project Period	1998 ~ 2005
Project Cost	US\$ 35.1 million (base cost)

The executing agency of the project is MAFF and the project components cover 7 departments of the ministry including DAALI and Dept. of Animal Health & Production and Fisheries. The major project components consist of seed production, IPM, plant protection, soil management, farming system improvement and institutional strengthening of MAFF.

The major activities under the seed production component include: i) drafting of National Seed Strategy Document and ii) establishment of National Seed Quality Control Unit and legislation of seed related laws and regulations. Although the Strategy Document was drafted and the Center was established, the introduction the national seed policy and seed production and certification system has not been realized in Cambodia because legislative processes for the introduction is yet to be performed.

IPM has been implemented in Kampong Speu and Kandal as a component of the National IPM Project. Other major components of the project are: i) establishment of soil laboratory, ii) strengthening of State Farms, iii) agricultural statistic establishment and capacity building of MAFF staff.

### (4) AQIP

Project Title	Agricultural Quality Improvement Project
Financing Agency	AusAID
Executing Agency	MAFF & PDA, MRD & PDRD, MWVA & PDWVA
Project Period	2000 ~ 2005
Project Cost	AUS\$ 15 million (≈ US\$ 8.1 million)

AQIP is the bilateral cooperation project and implemented by a consultant firm contracted with AusAID. The project aims at contributing to the national food security, improvement of agricultural productivity and increase of added value of agricultural products through rice seed production, improvement of post-harvest technology, improvement of marketing of vegetables and fruits, irrigation rehabilitation and human resources development.

The most essential project component of the project is the rice seed production scheme. The scheme envisages establishing seed companies in 4 provinces including Kandal Province and to develop quality rice seed production and supply system within the province. The targeted 4 seed companies have already been established as follows;

### Seed Companies Established by AQIP

Province	Company Established
Kandal	Super Seed Company
Takeo	Golden Seed Company
Prey Veng	Prey Veng Seed Company
Svay Rieng	Prasot Seed Company

The seed production in the scheme is carried out by the seed growers farmer groups formed under the scheme. Such seed growers farmer group is called Seed Growers Community and organized in each province. The organizational set-up of the Community consists of village, commune and district level seed growers community which are formed into the Community at province.

Super Seed Company in Kandal is located in the project district of Kandal Stueng District. Seed production of the Company in 2004 was as shown in the following table.

### Seed Production & Supply of Super Seed Company in 2004

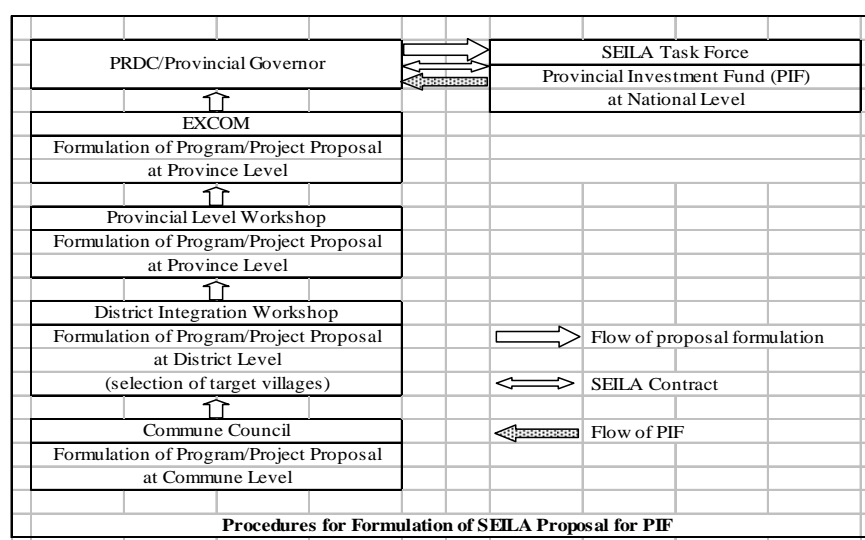
Production	Marketed Volume	Major Varieties Produced
400 ton	300 ton	Pkha Rumduoul, Riang Chey, IR 66, Sen Pidao

The most serious and detrimental constraint for the seed production scheme was the limitation of demand or market of quality seeds in the past. However, the demand for quality seed of farmers increased in 2005 and about 75 to 80% of seeds produced by the 4 Seed Companies (1,362 ton) were sold to farmers or seed dealers. The remaining 20 to 25% are distributed to NGOs or projects. According to AQIP, the merging of the 4 Seed Companies into a business entity is scheduled to be in September or October in 2006 and Unsaid will continue to support the seed production scheme until the end of January, 2008.

#### (5) SEILA

SEILA is a national poverty reduction program started from 1996 and aims also at the promotion of decentralization policy through the empowerment of local government. The phase I of the program was implemented from 1996 to 2000 and the current phase II is from 2001 to 2005. For the program, a number of donor agencies such as UNDP, WFP, IBRD, IFAD, England and other donors have been providing financial support. The target groups of the program are poor villages defined as SEILA villages.

Both the project provinces have extension programs implemented by using SEILA fund. The procedures for the formulation of program/project proposal for SEILA fund are composed of 3 workshops held at different hierarchy level of local authorities of: i) commune level workshop, ii) District Integrated Workshop and iii) provincial workshop for formulation of provincial proposal. The provincial proposal is then reviewed and final overall proposal at provincial level is formulated at EXCOM (Executing Committee) as shown in the following figure.



The procedures are bottom-up ones and ensure involvement local authorities at district and commune levels and communities at commune and village levels; which will produce ownership of all stakeholders toward proposed programs/projects. PIF will be an important and promising fund sources for agricultural support services strengthening by the provincial authorities.

#### (6) IPM (Integrated Pest Management)

Aiming at supporting the National IPM Project of MAFF being executed by DAALI, a number of international and bilateral cooperation agencies and NGOs have been implementing IPM schemes throughout a country. Such institutions include DANIDA, IBRD, FAO, CIDA and several NGOs.

The common objectives of such IPM schemes are:

- Improvement of planning, implementing and management capabilities of MAFF and NGOs for IPM farmer training,
- Improvement of farmers knowledge and capability on plant protection and reduction of agro-chemical use, and
- Finding solutions to farming problems through FFS (Farmer Field School) and other extension activities follow.

Main activity of IPM is to hold FFS for one cropping season and train farmer trainers through the FFS and support the farmer trainers for their farmer to farmer training activities to follow.

IPM have been implemented under APIP and by CIDA, FAO and NGOs in the project districts.

#### (7) SLPP

Project Title	Smallholder Livestock Production Program
Financing Agency	European Union
Executing Agency	Dept. of Animal Health & Production, MAFF
Target Provinces	Kampong Speu, Takeo, Kampong Chang, Pursat
Project Period	April 2005 ~ March 2010 (5 years)
Project Cost	€ 5.0 million

SLPP is a newly commenced livestock sub-sector project covering the project province of Kampong Speu. The overall project objective is to reduce poverty and food insecurity in rural areas by increasing the rate of growth of livestock GDP. The project envisages solving problems underlain in low productivity and returns from livestock production in Cambodia; poor animal health, poor technical capacity in local communities and inequitable and inefficient markets. Smallholder livestock producers represent the primary beneficiaries of the project. Other key stakeholders include Village Livestock Agents, Department and Office of Animal Health and Production, commune councils, private sector traders and other intermediaries, and local NGOs.

Major project activities include:

- Institutional capacity building for Dept. of Animal Health & Production,
- Improvement of rural animal health services through training, certification and expansion of Village Livestock Agent (VLA),
- Introduction and implementation of a national system of animal disease surveillance and monitoring,
- Improvement of animal health through demonstration and extension services,
- Improvement of livestock feed regimes,
- Linking producers with local markets, and
- Improvement of meat processing, storage and marketing.

(8) FAIEX

Project Title	Freshwater Aquaculture Improvement & extension Project
Financing Agency	JICA
Executing Agency	Dept. of Fisheries, MAFF
Target Provinces	Kampong Speu, Takeo, Kampong Chang, Pursat
Project Period	February 2005 ~ February 2010 (5 years)
Project Cost	JPY 550 million (≒US\$ 5 million)

FAIEX was recently started with the objectives of improvement of freshwater fish culture in the target provinces. The objectives of the project are the improvement of small-scale freshwater fish culture technologies and extension of the technologies to rural communities and development of a fish culture extension network in rural areas.

Major project activities envisaged are:

- Trainings of staffs of Fisheries Office of PDA, farmers and small-scale fish seed producers,
- Farmer assistance by provision of guidance and fingerling & equipment,
- On-station & on-farm trials, and
- Enhancement of community pond management through participatory management of fish-refuge ponds by promoting formation of “fish-refuge communities” in villages.

The activities of FAIEX are commenced in February 2005 and the small-scale aquaculture extension program and the community pond management program are being implemented in Kampong Speu and other 3 provinces. In the Target Area, the small-scale aquaculture extension program is introduced in Veal Commune of Kong Pisei District.

## **Chapter D-4      Problems and Constraints in Agricultural Development**

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 presented in Table D.4.1.1 and Attachment 3, major problems and constraints in agricultural development in the Target Area, which should duly be addressed in the present Study in an integrated manner, have been studied by sub-sector wise into crop, livestock and inland fishery sub-sector. Further, problems and constraints in crop sub-sector, a leading sub-sector in the agriculture in the Target Area, have been discussed by categorizing issues into: i) agronomic or technical issue, ii) agro-economic and farm economic issues, iii) marketing issues and iv) agricultural support services and institutional issues.

### **D-4.1    Crop Sub-sector**

#### **(1)    Agronomic or Technical Issues**

The captioned issues in this text include the aspects of production and post-harvest. The primary agronomic constraint is the unstable and low productivity of rice in the Area adversely affected by various factors. Major problems or constraints and proposed development directions to be taken are discussed as follows;

- Primary constraint that is attributed to the unstable and low productivity of rice is limited and unstable availability of water because of limitation of available water resources. 85% of the total rice fields in the Area are under rainfed conditions characterized by poor and unstable productivity. Further, 14% of the total is rice fields with rainy season supplemental irrigation where only a single cropping of rice is ensured; which should be addressed through the development and efficient utilization of available water resources to an extent possible. The priority target of the present Study will be the stabilization of rainy season rice production through the expansion of command area of supplemental irrigation by way of water resources development and efficient use.
- With the limited availability of water resources in the Area, rainfed rice cultivation with poor and unstable productivity will remain as a mainstay in the future farming activities and majority of farmers in the Area will continuously have to face hardship occurring periodically; which should be addressed through the testing and introduction of any approaches having possibility to mitigate such situations. To this regard, promising results of modified SRI obtained in rainfed fields in and around the Target Area should be tested and disseminated if satisfactory resulted.
- Prevailing farming practices characterized by use of traditional varieties, continuous use of self produced seeds, aged seedlings, random planting, limited application of fertilizer, inadequate post-harvest practices, etc., 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 support services introduced in a well integrated manner and implemented in a farmer participatory manner (because of financial constraints of government institutions). Further, such situations will be improved through the introduction of contract growing or partnership arrangement between farmers and a commercial sector.
- Single cropping of rice is almost exclusive cropping pattern in the Area and annual land use intensity or cropping intensity as a whole is as low as nearly 100%. Further, production of upland crops is extremely limited in the Area; which should be addressed by envisaging crop diversification in the Area to a possible extent. Chances for introduction of upland crops or vegetables appear to exist in the early rainy season by shifting current cropping season of rice toward the middle to late rainy season by growing early or medium variety of rice.
- Farmers preference for medium or late traditional varieties brings about prolonged cropping season, higher water requirements and only a single cropping of rice almost entire rice fields in the Area. The release of promising early and medium varieties by CARDI is providing chances to improve such situations, but the realization of curtailing cropping season is still limited; which should be addressed through the strengthening of agricultural support services

introduced in a well integrated manner, although a number of factors to be tackled are involved in circumstances where such practices prevail.

- Substantial extents of land use conversion from rice fields to industrial or settlement areas occur mainly along the National Roads.

## (2) Agro-economic and Farm Economic Issues

Problems on the captioned issues are closely related with low and unstable productivity of crop sub-sector and, therefore, with agronomic or technical issues as follows;

- Because of limited land holding size and irrigation water resources availability, farm economic situations of majority of farm households are at marginal level; which should be addressed through the intervention for productivity improvement as discussed earlier in agronomic or technical issue.
- However, such situations might be most serious with land less households, women headed households and farm households with land holding size of less than 0.1 ha. Based on SEILA Data Base 2004 and statistics of MAFF such families account respectively for about 10%, 19% and 4% of total families in the project communes; which should better be addressed through the income generating approaches introduced by a farmer group basis. The primary target groups of the approaches will be poor farm households as stated above.

## (3) Marketing Issues

As the Target Area as a whole is a rice deficit area as discussed and production volume of most of individual farmers is limited due to limited holding size and productivity. Therefore, marketing volumes of rice appears to be limited. However, the result of the Socio-economic Survey indicate about 55% of the respondents marketed paddy in the past one year and the total marketed volume was about 34% of the total products.

- Major paddy marketing constraints identified in the present Study are low market price of paddy and unstable market price as discussed in the section 2.7; which could be addressed by ways of: i) production of quality products through improvement of farming practices, ii) formation of farmer groups and seeking for possibilities to introduce contract growing or partnership arrangement as an economic activity of the groups and iii) provision of market information to farmer groups as an activity of extension services; although chances to intervene in marketing issues under the present Study will be limited because of the spatial limitation of the Target Area.

## (4) Agricultural Support Services and Institutional Issues

Major constraints on this issues appears to be financial constraints, implementation of support activities in less coordinated manner and lack of ownership by PDAs on such activities carried out by donors and NGOs as follow.

- In the Target Area, agricultural support activities have been implemented by a number of donor agencies and NGOs or by the support of them. For the efficient use of such resources and responding well toward actual beneficiaries needs, coordinated implementation of such activities is to be envisaged; which could be envisaged through the establishment of a standing coordination body at province level under the guidance of MAFF (DAE/DAALI) and leading donors in the Area.
- Because of financial constraints of PDAs for development activities, current agricultural extension or support services are basically limited to those supported by donor agencies. Possibly, such situation might have resulted in lack of program ownership by PDAs and formulation and implementation of programs poorly reflecting area specific or target group specific needs and needs identified by PDAs; which should be addressed through the intensification of coordination as stated above and the further involvement of PDAs/DAOs from the stage of program formulation.
- Because of financial constraints of PDAs and existing limitation in supports by donor agencies, efficient utilization of available resources is yet to be seriously sought; which to be addressed through empowerment of extension personnel, further promotion of farmers participatory approach (farmer-to-farmer extension and farmer-led trial) and introduction of extension services operated by a farmer group.
- The strengthening of agricultural support services introduced in a well integrated manner and



implemented in a farmer participatory manner should be sought as stated earlier.

## **D-4.2 Livestock and Inland Fisheries Sub-sector**

### **D-4.2.1 Livestock Sub-sector**

The livestock sub-sector is the second important economic activity of farm households in the Target Area. In addition, draft cattle are primary sources of labor for land preparation and transport of farm products. However, livestock husbandry in the Area is still in the stage of rather less intensive and the sub-sector faces unstable and low productivity. Major constraints for the development of the livestock sub-sector include problems in animal health, raising practices, genetic resources and feed supply as follows;

- Primary constraint reported by PDAs is animal/poultry losses cause by diseases due to insufficient veterinary services coverage; this to be addressed through strengthening of animal health services through envisaging the involvement of farmers in the delivery of services as currently promoted.
- Less intensive or poor livestock raising practices are also current serious constraints to be addressed immediately in the sub-sector.
- Other constraints are the lack of comprehensive study on livestock development potential in the environment of the Target Area including investigation on improvement of genetic resources and feed supply conditions as well as animal health issues; as an approach to address to this issue, the execution of the comprehensive study on the sub-sector development is proposed in the present Study.

### **D-4.2.2 Inland Fisheries Sub-sector**

In the Target Area, inland fisheries are the 3<sup>rd</sup> important sub-sector (within the agriculture sector) following the crop and livestock sub-sector in rural economy. Needs for diversification of income sources as well as improvement of nutritional condition of farmers could be addressed through the introduction of freshwater fish culture in the Area, especially for those at marginal status. The main freshwater aquaculture strategies in Cambodia include: i) fattening juvenile fish for market, ii) stocking surplus fish in order to sell at favorable market prices, iii) small-scale, low input fish-raising for food security purposes.

However, freshwater fish culture appears to be still in an initial stage in the Target Area, which appears to be the primary constraint for the development of inland fisheries sub-sector, although the development of small fish ponds and fish cultures in rice field is reported. Further, JICA started a freshwater fish culture project in Kampong Speu and other three provinces. The approaches to be introduced in the present Study are to initiate efficient use of water surfaces/ponds utilized for irrigated agriculture development and to envisage diversifying income sources through the introduction of small-scale freshwater culture in the Area.

## Chapter D-5 Agricultural Development Concepts

### D-5.1 Approaches for the Formulation of Agricultural Development Plan

On the basis of the comprehensive study on the present conditions, development constraints and proposed directions to be taken, the basic approaches for the formulation of the agricultural development plan under the present Master Plan have been set as follows;

- Demarcating paddy fields in the Target Area as the priority area for the present agricultural development plan, since in terms of agricultural development potential, paddy fields are the land use category with the largest potential in the Area,
- The primary objective of the present Master Plan for the comprehensive agricultural development is productivity improvement of both irrigated and rainfed rice to improve supply-demand balance of rice within the Target Area,
- Accordingly, the development priority is placed on rice production through the development and efficient use of existing water resources and the stabilization and improvement of productivity of rice,
- Comprehensive development approaches by placing the priority in rice production (crop sub-sector) and by seeking materialization of development potentials to an extent possible in livestock and inland fisheries sub-sectors are envisaged, and
- Agriculture based income generation components are envisaged within the context of comprehensive agricultural development. Accordingly, income generating components of crop, livestock and inland fisheries sub-sector directed to marginal farmers are planned within the scope of income generation. Candidate activities including small scale livestock development, fruit production promotion, small scale inland fisheries and other promising activities will be accommodated in the income generation plan of the present Master Plan.

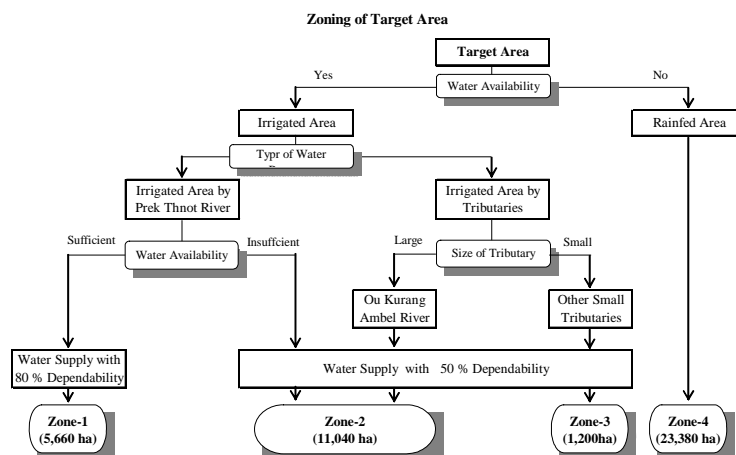
### D-5.2 Zoning of Target Area

The Target Area exhibits diversity in terms of water availability and land use. In view of this situation, it is inadvisable to simply apply a uniform development approach plan to such large area. Instead, zoning of the Target Area is recommendable as an appropriate approach, especially for crop sub-sector, which is a main income source for farmers in the Target Area. The Master Plan for comprehensive agricultural development should be thus formulated by applying zone based approach.

The zoning map is prepared in the following three steps.

- Preparation of assessment map on land use
- Preparation of assessment map on irrigated area by the Prek Thnot River and water harvesting. In case of irrigated area by the Prek Thnot River, it is divided into 80% dependable area and 50% dependable area considering the maximum use of the North Main Canal and the South Main Canal which have been almost excavated so far.
- Overlaying of these assessment maps to delineate the rainfed area.

As the results of zoning, the Target Area is divided into the four zones: i) Zone-1 5,710ha, ii) Zone-2 11,210ha, iii) Zone-3 600ha and iv) Zone-4 23,980ha. The procedures for the zoning are shown below:



### D-5.3 Present and Without-Project Agricultural Development Conditions in the Target Area

The present and without-project<sup>7</sup> agricultural development conditions in the Target Area have been assumed based on: i) the findings of the present agricultural study, ii) the results of the Irrigation Inventory Survey, iii) the results of water balance study and iv) the statistic data of SEILA, MAFF and PDAs as shown together with the with-project condition in Table D.5.3.1 and D. 5.3.2 and as follows;

#### (1) Land Use and Irrigation Status

The land use and irrigation status of the Target Area in each zone and the overall Area are summarized as follows;

#### Assumptions on the Present and Without-Project Agricultural Development Statuses (net area; ha)

Zone	Land Use	Irrigation Status	Present/ Without-Project	With-Project	Increment
Zone-1	Paddy Field	Irrigated <sup>1/</sup>	500	500	0
		Supplemental <sup>2/</sup>	3,490	5,160	1,670
		Rainfed	1,720	-	-1,720
		Sub-total	5,710	5,660	-50
	Right of Ways		-	50	50
	Total		5,710	5,710	0
Zone-2	Paddy Field	Irrigated <sup>1/,3/</sup>		(3,200)	0
		Supplemental <sup>2/</sup>	1,710	11,040	9,330
		Rainfed	9,500	-	-9,500
		Sub-total	11,210	11,040	-170
	Right of Ways		-	170	170
	Total		11,210	11,210	0
Zone-3	Paddy Field	Supplemental <sup>2/</sup>	600	1,200	600
		Rainfed	600	-	-600
		Total	1,200	1,200	0
Zone-4	Paddy Field	Rainfed	23,380	23,380	0
Overall	Paddy Field	Irrigated <sup>1/</sup>	500	500	0
		Supplemental <sup>2/</sup>	5,800	17,400	11,600
		Rainfed	35,200	23,380	-11,820
		Sub-total	41,500	41,280	-220
	Right of Ways		-	220	220
	Total		41,500	41,500	0

<sup>1/</sup>: Irrigated paddy field; irrigation water available for double cropping of rice

<sup>2/</sup>: Supplementary irrigated paddy field in rainy season; water supply only for rainy season

<sup>3/</sup>: Area irrigable in early rainy season is 3,200ha by 50% dependability

As shown in the table, it is assumed that the paddy fields in the Area are 41,500ha (net area) in total and categorized into: irrigated paddy field of 500ha or 1% of total, supplementary irrigated field of 5,800ha or 14% and rainfed paddy field of 35,200ha or 85%.

#### (2) Cropped Area and Cropping Intensity

The cropped area and cropping intensity in the Area are estimated by zone based on the present land use as shown in Table D.5.3.2 and summarized below.

#### Present/Without-Project Cropped Area & Intensity of Rice in the Target Area

Zone	Early Rainy Season		Rainy Season		Annual	
	Area (ha)	C.I. (%)	Area (ha)	C.I. (%)	Area (ha)	C.I. (%)
Zone-1	500	9	5,710	100	6,210	109
Zone-2	-	-	11,210	100	11,210	100
Zone-3	-	-	1,200	100	1,200	100
Zone-4	-	-	23,380	100	23,380	100
Overall	500	1	41,500	100	42,000	101

CI: Cropping intensity

<sup>7</sup> Without-project conditions before the functional failure of the Roleang Chery Regulator

As shown, the cropped area in early rainy season is extremely limited to about 1% of the total paddy fields because of the limitation of water resources in the season and a single cropping of rainy season rice is an exclusive cropping pattern in the Area. Double cropping is assumed to be practiced in an area of 9% or 500ha of Zone-1.

### (3) Crop Yields

Current yield levels of paddy in each category of rice field in the Target Area have similarly been estimated based on the statistic data of SEILA, MAFF, PDAs, the results of the questionnaire survey and information provided by PDAs as shown in Table D.5.3.3 and as summarized as follows;

**Yield Levels under Present and Without-Project Conditions**

Crop	Cropping Season		
	Early Rainy	Rainy	
	Present/Without	Present	Without
Early Rice	2.40	-	-
Medium Rice (irrigated ) <sup>1/</sup>	-	2.10	2.10
Medium Rice (rainfed)	-	1.20	1.50
Upland Crops <sup>2/</sup>	0.45	-	-

<sup>1/</sup>: Medium rice under supplemental irrigation

<sup>2/</sup>: Upland crops represented by mungbeans

### (4) Crop Production

Present paddy productions in the Target Area are estimated for individual categories of rice fields on the basis of the cropped areas and estimated yields as shown in Table D.5.3.2 and as summarized in the following table.

**Estimated Present Paddy Productions in the Target Area (unit: ton)**

Zone	Early Rainy	Rainy	Annual
Zone-1	1,200	10,443	11,643
Zone-2	-	14,991	14,991
Zone-3	-	1,980	1,980
Zone-4	-	28,056	28,056
Total	1,200	55,470	56,670

As shown, the current paddy production in the Target Area is estimated at 55,500 tons in rainy season, 1,200 tons in dry season and 56,700 tons annually.

## D-5.4 Development Concepts

The development concepts composed of development objectives, strategies and basic development plan or concepts have been studied by sub-sector wise into crop-sub-sector, livestock sub-sector and inland fisheries sub-sector.

### D-5.4.1 Crop Sub-sector

In accordance with the basic development directions addressing to problems and constraints for crop sub-sector development discussed in the section 4.1, the basic development plan or development concepts for the primary target sub-sector have been established for each zone as follows;

#### D-5.4.1.1 Basic Agricultural Development Plan in Zone-1

##### (1) Development Objectives

The development approach in Zone-1 is the irrigated agriculture development aiming at: i) improvement of productivity and increased production of rice and ii) improvement of land use intensity; through the development and efficient utilization of water resources of the Prek Khnot River and the introduction of double cropping of irrigated rice to an extent possible with available irrigation water supply.

## (2) Development Strategies

The strategies established for the attainment of the said development objectives include:

- Improvement of productivity and increased production of rice is envisaged through the introduction of: i) a double cropping of early rice to a limited extent and a single cropping of medium rice in rainy season in the rest of the project area as shown in the proposed cropping pattern illustrated in Figure D.5.4.1 and ii) improved farming and irrigation practices formulated on the basis of current farming practices which representing to a certain extent capabilities of farming communities, farming constraints and farmers expectations,
- Improvement of productivity and increased production of rice is envisaged through the introduction of improved farming practices supported by the strengthening of agricultural support services of farmer participatory concept,
- Introduction of water saving rice cultivation availing expansion of irrigation beneficiary areas to an extent possible through the efficient utilization of valuable water resources, and
- Envisaging the introduction of upland crops/vegetable production in about 5% of the project area in early rainy season to increase land use intensity and promote crop diversification.

## (3) Basic Agricultural Development Plan

The basic agricultural development plan in Zone-1 indicated by cropping pattern and cropping intensity; which are planned in accordance with the results of water balance and irrigation study and the development strategies discussed earlier; target yields and crop production plan are proposed as shown in Table D.5.4.1 and Figure D.5.4.1 and explained as follows;

### (a) Proposed Cropping Pattern and Intensity

The proposed cropping pattern in Zone-1 is illustrated in Figure D.5.4.1 and summarized in the following table.

**Proposed Cropping Pattern & Intensity**

Early Rainy Season		Rainy Season		Annual	
Crop	Area (Intensity)	Crop	Area (Intensity)	Crop	Area (Intensity)
Early Rice	500ha ( 9%)	Early Rice	500ha (9%)	Early Rice	1,000ha (18%)
		Medium Rice	5,160ha (91%)	Medium Rice	5,160ha (91%)
Upland Crops	280ha ( 5%)			Upland Crops	280ha ( 5%)
Total	780ha (14%)		5,660ha (100%)		6,440ha (114%)

### (b) Target Crop Yields

The target crop yields under the development plan are set as shown in Table D.5.3.3 and the following table in comparison with the present yield levels.

**Target Yields and Present Yield Levels**

Crop	Early Rainy Season			Crop	Rainy Season		
	Yield (t/ha)				Yield (t/ha)		
	Target	Present	Increment		Target	Present	Increment
Early Rice	3.30	2.40	0.90	Early Rice	3.30	-	-
Upland Crops	0.70	0.45	0.25	Medium Rice	3.00	2.10	0.90

*Upland crops represented by mungbeans; medium rice under supplemental irrigation*

The yield increases of 0.9 ton/ha in early rice, 0.9 ton/ha in medium rice and 0.25 ton/ha in upland crops are envisaged under the plan.

### (c) Proposed Farming Practices

The proposed farming practices of rice are presented in Table D.5.4.2. Major improvements envisaged from the current prevailing practices are: i) proper land leveling & preparation, ii) use of quality seed, iii) raised nursery bed, iv) planting of young seedling, v) regular planting, vi) reduced no. of plants per hill, vii) fertilization (increased & timely application including compost or cow dung), viii) introduction of proper

on-farm water management & water saving culture, ix) intensified weeding and x) improvement of post-harvesting practices.

(4) Agricultural Support Services Required

The agricultural support services required for the promotion of adoption of proposed farming practices and for attaining the project target cropping pattern, cropping intensity and crop yields at an earlier stage are as shown in the following table.

**Required Agricultural Support Services**

Activity	Program Required
Field Extension Programs	Plot & area demonstration, adaptability test, seed multiplication
Farmer/Farmer Group Training Programs	Training program, farmer field school, study tour, village extension agent training & deployment
Mass Guidance/Workshop	Mass guidance/workshop
Farmer-to-farmer Extension Support <sup>1/</sup>	Farmer-to-farmer extension support
Staff Empowerment	Staff training, study tour

<sup>1/</sup>: Provision of support for farmer-to-farmer extension by village extension agents

As shown in the table, the introduction of village extension agents like VLA (Village Livestock Agent) is envisaged as farmer-to-farmer extension providers.

(5) Development Plan

On the basis of the proposed main canal system in Zone-1, the agricultural development plans in the zone are formulated as “Irrigated Agriculture Improvement Model Project”, Upper North Main Canal Irrigated Agricultural Improvement Project” and “Upper South Main Canal Irrigated Agricultural Improvement Project” as discussed in Chapter D6.

**D-5.4.1.2 Basic Agricultural Development Plan in Zone-2**

(1) Development Objectives

The development approach in Zone-2 is the irrigated agriculture development aiming at: i) improvement of productivity and increased production of rice and ii) improvement of land use intensity; through the development and efficient utilization of water resources of the Prek Khnot River and the introduction of double cropping of irrigated rice to an extent possible with available irrigation water supply.

(2) Development Strategies

The strategies established for the attainment of the said development objectives in Zone-2 are similar to the case of Zone-1 and include:

- Improvement of productivity and increased production of rice is envisaged by the introduction of: i) early rice to a limited extent in early rainy season once in 2 years in accordance with the result of water balance study (irrigable at 50% dependability) and a single cropping of medium rice in the entire area in rainy season as shown in the proposed cropping pattern illustrated in Figure D.5.4.1 and ii) improved farming and irrigation practices,
- Improvement of productivity and increased production of rice is envisaged through the introduction of improved farming practices supported by the strengthening of agricultural support services of farmer participatory concept,
- Introduction of water saving rice cultivation availing expansion of irrigation beneficiary areas to an extent possible, and
- Envisaging the introduction of upland crops/vegetable production in about 5% of the project area in early rainy season to increase land use intensity and promote crop diversification.

(3) Basic Agricultural Development Plan

The basic agricultural development plan in Zone-2 indicated by cropping pattern and cropping intensity; which are planned in accordance with the results of water balance and irrigation study and the development strategies discussed earlier; target yields and crop production plan are proposed as shown in Table D.5.4.1 and Figure D.5.4.1 and explained as follows;

(a) Proposed Cropping Pattern and Intensity

The proposed cropping pattern in Zone-2 is illustrated in Figure D.5.4.1 and summarized in the following table.

**Proposed Cropping Pattern & Intensity**

Early Rainy Season		Rainy Season		Annual	
Crop	Area (Intensity)	Crop	Area (Intensity)	Crop	Area (Intensity)
Early Rice	1,600ha (14%)			Early Rice	1,600ha ( 14%)
		Medium Rice	11,040ha (100%)	Medium Rice	11,040ha (100%)
Upland Crops	550ha (5%)			Upland Crops	550ha ( 5%)
Total	2,150ha (19%)		11,040ha (100%)		13,190ha (119%)

(b) Target Crop Yields

The target crop yields under the development plan are set as shown in Table D.5.3.3 and the following table in comparison with the present yield levels.

**Target Yields and Present Yield Levels**

Early Rainy Season			Rainy Season				
Crop	Yield (t/ha)			Crop	Yield (t/ha)		
	Target	Present	Increment		Target	Present	Increment
Early Rice	3.30	-	-	Early Rice	-	-	-
Upland Crops	0.70	0.45	0.25	Medium Rice	2.80	2.10	0.70

*Upland crops represented by mungbeans; medium rice under supplemental irrigation*

The yield increase of 0.7 ton/ha in medium rice and 0.25 ton/ha in upland crops are envisaged under the plan.

(c) Proposed farming practices

The proposed farming practices for rice are presented in Table D.5.4.2. Major improvements envisaged from the current prevailing practices are similar to those proposed for Zone-1.

(4) Agricultural Support Services Required

The agricultural support services required for the promotion of adoption of proposed farming practices and for attaining the project target cropping pattern, cropping intensity and crop yields at an earlier stage are similar to the case of Zone-1 as follows;

**Required Agricultural Support Services**

Activity	Program Required
Field Extension Programs	Plot & area demonstration, adaptability test, seed multiplication
Farmer/Farmer Group Training Programs	Training program, farmer field school, study tour, village extension agent training & deployment
Mass Guidance/Workshop	Mass guidance/workshop
Farmer-to-farmer Extension Support <sup>1/</sup>	Farmer-to-farmer extension support
Staff Empowerment	Staff training, study tour

<sup>1/</sup>: Provision of support for farmer-to-farmer extension by village extension agents

(5) Development Plan

On the basis of the proposed main canal system in Zone-2, the agricultural development plans in the zone are formulated as “Lower North Main Canal Irrigated Agricultural Improvement Project”, “Lower South Main Canal Irrigated Agricultural Improvement Project” and Ou Krang Ambel Irrigated Agricultural Improvement Project” as discussed in Chapter D6.

**D-5.4.1.3 Basic Agricultural Development Plan in Zone-3**

(1) Development Objectives

The development approach in Zone-2 is the water harvesting irrigated agriculture development aiming at: i) improvement of productivity and increased production of rice and ii) improvement of land use intensity; through the development and efficient utilization of water resources.

(2) Development Strategies

The strategies established for the attainment of the said development objectives in Zone-3 are similar to the cases of Zone-1 and Zone-2 and include:

- Improvement of productivity and increased production of rice is envisaged through the introduction of improved farming and irrigation practices,
- Improvement of productivity and increased production of rice is envisaged by the strengthening of agricultural support services of farmer participatory concept,
- Introduction of water saving rice cultivation availing expansion of irrigation beneficiary areas to an extent possible, and
- Envisaging the introduction of upland crops/vegetable production in about 5% of the project area in early rainy season to increase land use intensity and promote crop diversification.

(3) Agricultural Development Plan

The basic agricultural development plan in Zone-3 indicated by cropping pattern and cropping intensity; which are planned in accordance with the results of water balance and irrigation study and the development strategies discussed earlier; target yields and crop production plan are proposed as shown in Table D.5.4.1 and Figure D.5.4.1 and explained as follows;

(a) Proposed Cropping Pattern and Intensity

The proposed cropping pattern in Zone-3 is illustrated in Figure D.5.4.1 and summarized in the following table.

**Proposed Cropping Pattern & Intensity**

Early Rainy Season		Rainy Season		Annual	
Crop	Area (Intensity)	Crop	Area (Intensity)	Crop	Area (Intensity)
		Medium Rice	1,200ha (100%)	Medium Rice	1,200ha (100%)
Upland Crops	60ha (5%)			Upland Crops	60ha (5%)
Total	60ha (5%)		1,200ha (100%)		1,260ha (105%)

(b) Target Crop Yields

The target crop yields under the development plan are set as shown in Table D.5.3.3 and the following table in comparison with the present yield levels.

**Target Yields and Present Yield Levels**

Early Rainy Season				Rainy Season			
Crop	Yield (t/ha)			Crop	Yield (t/ha)		
	Target	Present	Increment		Target	Present	Increment
Upland Crops	0.70	0.45	0.25	Medium Rice	2.80	2.10	0.70

*Upland crops represented by mungbeans; medium rice under supplemental irrigation*

The yield increase of 0.7 ton/ha in medium rice and 0.25 ton/ha in upland crops are envisaged under the plan.

(c) Proposed farming practices

The proposed farming practices for early and medium rice are presented in Table D.5.4.2. Major improvements envisaged from the current prevailing practices are similar to those proposed for Zone-1 and Zone-2.

(4) Agricultural Support Services Required

The agricultural support services required for the promotion of adoption of proposed



farming practices and for attaining the project target cropping pattern, cropping intensity and crop yields at an earlier stage are as shown in the following table.

**Required Agricultural Support Services**

Activity	Program Required
Field Extension Programs	Plot & area demonstration, adaptability test, seed multiplication
Farmer/Farmer Group Training Programs	Training program, farmer field school, study tour, village extension agent training & deployment
Mass Guidance/Workshop	Mass guidance/workshop
Farmer-to-farmer Extension Support <sup>1/</sup>	Farmer-to-farmer extension support
Staff Empowerment	Staff training, study tour

<sup>1/</sup>: Provision of support for farmer-to-farmer extension by village extension agents

(5) Development Plan

The agricultural development plans in Zone-3 are formulated as “Water Harvesting Irrigated Agricultural Improvement Project” as discussed in Chapter D6.

**D-5.4.1.4 Basic Agricultural Development Plan in Zone-4**

The study on the development approaches directed to Zone-4, rainfed paddy fields, is ambitious ones and will present a number of controversial issues. However, for the attainment of the present Master Plan target of improvement of agricultural productivity in the Target Area, the improvement of rainfed agriculture should duly be sought through the integrated interventions of agronomic, extension and farmer organizational approaches.

(1) Development Objectives

The development approach in Zone-4 is the improvement of rainfed agriculture aiming at the productivity increase and increased production of rice in the zone.

(2) Development Strategies

The strategies established for the attainment of the said development objectives in Zone-4 include:

- Improvement of productivity and increased production of rice is envisaged by the introduction of improved farming practices; in this regards, the expansion of modified SRI in Kampong Speu Province as stated earlier and promising results obtained in the SRI fields as shown in Table D.5.3.3 indicate the possibility for the attainment of the objectives,
- Improvement of productivity and increased production of rice supported by the strengthening of agricultural support services is envisaged (the approach for strengthening include training and deployment of village agriculture agents),
- Envisaging the introduction of upland crops/vegetable production in early rainy season to a very limited extent in a pilot scale as a trial step for crop diversification in the future,
- In the present Study, the development intervention is formulated as “Rainfed Agriculture Improvement Project”, and
- The proposed intervention is the strengthening of agricultural support services in the zone implemented by MAFF/PDA in collaboration with NGOs and supported by experts.

(3) Agricultural Development Plan

The agricultural development plan in Zone-4 indicated by cropping pattern and cropping intensity, target yield and crop production plan are established in accordance with the said development strategies as shown in Table D.5.4.1 and Figure D.5.4.1 and explained as follows;

(a) Proposed Cropping Pattern and Intensity

The proposed cropping pattern in Zone-4 is illustrated in Figure D.5.4.1 and summarized in the following table.

### Proposed Cropping Pattern & Intensity

Early Rainy Season		Rainy Season		Annual	
Crop	Area (Intensity)	Crop	Area (Intensity)	Crop	Area (Intensity)
		Medium Rice	23,380ha (100%)	Medium Rice	23,380ha (100%)
Upland Crops	230ha (1%)			Upland Crops	230ha (1%)
Total	230ha (1%)		23,380ha (100%)		23,610ha (101%)

#### (b) Target Crop Yields

The target crop yields under the development plan are set as shown in Table D.5.3.3 and the following table in comparison with the without-project yield.

#### Target Yields and Present Yield Levels

Early Rainy Season				Rainy Season			
Crop	Yield (t/ha)			Crop	Yield (t/ha)		
	Target	Present	Increment		Target	Without <sup>I/</sup>	Increment
Upland Crops	0.45	-	-	Medium Rice	2.00	1.50	0.50

<sup>I/</sup>: Present yield level 1.2 t/ha;

Upland crops represented by mungbeans

The yield increase of 0.5 ton/ha from the without-project and 0.8 ton/ha from the present level are envisaged under the plan.

#### (c) Proposed farming practices

The proposed farming practices are presented in Table D.5.4.2. Major improvements from the current prevailing practices envisaged are: i) proper land leveling & preparation, ii) heightening of bound, iii) use of quality seed, iv) raised nursery bed, v) planting of young seedling, vi) regular planting, vii) reduced no. of plants per hill, viii) fertilization (increased & timely application including compost or cow dung), ix) intensified weeding and x) improvement of post-harvesting practices. Major improvements from the current prevailing practices envisaged are similar to those proposed for Zone-1 to 3. However, the introduction of the modified SRI disseminated in Kampong Speu, which is covering most of the said proposed farming practices, is proposed after further adaptability test and accommodating site specific requirements in farming practices.

#### (4) Agricultural Support Services Required

The agricultural support services required for the promotion of adoption of proposed farming practices and for attaining the project target at an earlier stage are as follows;

#### Required Agricultural Support Services

Activity	Program Required
Field Extension Programs	Plot & area demonstration, adaptability test, seed multiplication
Farmer/Farmer Group Training Programs	Training program, farmer field school, study tour, village extension agent training & deployment
Mass Guidance/Workshop	Mass guidance/workshop
Farmer-farmer Extension Support <sup>I/</sup>	Farmer-farmer Extension Support
Staff Empowerment	Staff training, study tour

<sup>I/</sup>: Provision of support for farmer-farmer

Agricultural support services required in the Zone-4 development are similar to those for other zones, however, intensive and farmer participated deliveries of such services will be essential for the attainment of the target productivity improvement in the zone.

#### (5) Development Plan

The proposed development intervention in the zone is the strengthening of agricultural support services implemented by MAFF/PDA in collaboration with NGOs and supported by experts and formulated as "Rainfed Agriculture Improvement Project" as discussed in Chapter D6.

#### **D-5.4.2 Livestock Sub-sector**

##### **(1) Development Objectives**

The development concepts for the livestock sub-sector have been established with the aims of: i) stabilization of livestock productivity through the improvement of veterinary services and raising practices, ii) introducing income generating opportunities for marginal farmers and iii) formulation livestock development plan on long term basis based on the comprehensive study on the development of the sub-sector in and around the target Area.

##### **(2) Development Strategies**

The development strategies for the sub-sector under the present Study have been established in accordance with the basic development directions addressing to problems and constraints for the sub-sector development discussed in the section 4.2 as follows

- Primary development constraints in the sub-sector are animal/poultry losses or high mortality rate cause by diseases due to insufficient veterinary services coverage and poor livestock raising practices. Strengthening of animal health and extension services through the involvement of farmers in the delivery of services as Village Livestock Agent (VLA) as currently introduced in the Target Area is to be envisioned for the stabilization of productivity. The approaches are to be formulated as “Veterinary Services Strengthening and Livestock Raising Improvement Project”.
- Small scale income generation oriented livestock sub-sector development efforts directed to marginal farmers are accommodated in the income generation components in the present Master Plan. Conceivable schemes will include: i) village chick/hen management, ii) cow bank and iii) other promising activities successfully introduced by NGOs or donor agencies.
- For the enhancement of livestock productivity in the Target Area, the integrated implementation of improvement of genetic resources, development of feed resources and improvement of veterinary services are considered essential. As the sub-sector is a main income source of farming communities, the development of the sub-sector will be a primary target sub-sector in the long term agricultural development in the Area. However, the overall investigations on present conditions, development potentials and approaches for development are yet to be made. In the present Master Plan, therefore, the execution of the study for the formulation of the livestock sub-sector development plan is envisaged in the short-medium term development plan as “Livestock Sub-sector Development Study”. The long term plan is to be formulated based on the study.

##### **(3) Development Plan**

The development plans proposed for the livestock sub-sector in the Target Area include “Veterinary Services Strengthening and Livestock Raising Improvement Project” and “Livestock Sub-sector Development Study”. Details of the plans are discussed in Chapter D6.

#### **D-5.4.3 Inland Fisheries Sub-sector**

##### **(1) Development Objectives**

The development approaches and concepts for the inland fisheries sub-sector have been established with the aims of: i) efficient utilization of existing water surfaces or water surfaces developed under the present irrigation development plan and creating of common fund of water users communities of the subject water surfaces and ii) introducing small scale fish culture to provide marginal farmers with income generating opportunities.

##### **(2) Development Strategies**

The development strategies for the sub-sector under the present Study have been established in accordance with the basic development directions addressing to problems and constraints for the sub-sector development discussed in the section 4.2 as follows

- For the utilization of valuable existing or newly developed water surfaces, the development of

community based inland fish culture is envisaged in the water surfaces used for irrigation development. Target areas of the development are reservoirs or ponds for the small scale irrigation development projects of the present Study and the groups of beneficiaries (FWUCs) of irrigation development who are responsible for O&M of irrigation systems will be the target groups. Returns from the development are to be utilized as a source of fund required for O&M of irrigation systems. The approaches are to be formulated as “Community Based Inland Fisheries Development Project”, and

- The dissemination of small scale fish culture with aims of providing income generating opportunities for marginal farmers and of supporting improvement of nutritional status of such target groups is envisaged as a fishery sub-sector income generating component accommodated in “Income Generation Project for Marginal Farmers”.

### (3) Development Plan

The development plans proposed for the inland fisheries sub-sector include “Community Inland Fisheries Development Project”. Details of the plan are discussed in Chapter D6.

## **D-5.4.4 Income Generation for Marginal Farmers**

### (1) Development Objectives

The poverty reduction is the primary development goal of Cambodia and National Poverty Reduction Strategy (NPRS) dictates the improvement of agriculture sector and the enhancement of assistance to farmer as the backbone of poverty reduction, which could be achieved through the strengthening of agriculture sector through the improvement of productivity and diversification of farming.

The main objective of this development intervention, enhancement/introduction of income generation activities targeted to marginal farmers, is to increase farm income of marginal farmers and to improve the level of food security, thereby contribute to human security and reduce vulnerability of target groups. The project aims to achieve this by promoting income diversification of the target groups.

### (2) Development Strategies

The development intervention envisages achieving/approaching to the said development objective by employing the extension mechanisms including employment of group oriented approach by forming of small farmer organizations, “Learning by Doing” concept through the operation of Integrated Farmer Field School (IFFS) and provision of credit for improvement of current farming activities or introduction of new farming activities selected by target groups. The mechanisms have been successfully introduced under SPFS of FAO and such innovative extension approaches through IFFS has demonstrated the importance of a participatory and sustained support to farmers in order to stabilize their agricultural production. The development strategies involved in the project include:

- Target group of the project are poor farmers who belong to the poorest and most vulnerable group in the Target Area. In the present study, landless farm households, women headed households and farm households with less than 0.1 ha of land are tentatively selected as target groups. These households are formed into a group of farmers sharing a common production interest,
- Responding to farmers needs, the project envisages introducing participatory community micro-project approaches which could be more responsive to the communities needs and will be the better and practical way to solve the problem of farmers,
- The lessons learned from the past similar projects indicate that lack of capital is one of the main constraints to improve rural poor farmers’ livelihood and saving and credit activities have played a very important role to sustain the project activities at grass roots level. The project accommodates such credit provision as a core component for sustaining farmers activities to improve and diversify their farm incomes, and
- Employment of participatory extension approach through IFFS.

(3) Development Plan

The development plan for income generation support purpose is formulated as “Income Generation Project for Marginal Farmers”. Details of the plan are discussed in Chapter D6.

**D-5.4.5 Institutional and Agricultural Support Services Strengthening**

(1) Development Objectives

The objective of the present Master Plan is productivity improvement of both irrigated and rainfed rice to improve supply-demand balance of rice within the Target Area. From the crop sub-sector development constraints faced in the Area, strengthening of agricultural support services and improvement of irrigation water management will be essential in order to ensure the attainment of project targets at an early stage.

The present development intervention is proposed as a technical cooperation project with the objectives of: i) establishment of an institutional set-up responsible for the promotion of agricultural productivity improvement centering on rice in the Target Area at an initial stage of the Master Plan, ii) development and extension of improved and sustainable farming technologies on rice production to enhance productivity of the primary agriculture activity in the Area, iii) development and extension of irrigation water management and O&M technologies and practices for sustaining the irrigation systems in the Area and iv) formation and empowerment of Farmer Water Users Group (FWUG) and Farmer Water Users Community (FWUC) and other farmers organizations.

(2) Development Strategies

For the attainment of the objectives stated above, the development strategies of the Project are set as follows;

- Insufficient coordination and collaboration between MAFF and MOWRAM appears to be one of essential constraints for the irrigated agricultural development in the Target Area. The development intervention aims at the establishment of coordination and collaboration body at central and project level to tackle with such sustained constraint for the development under the support of the foreign donor, and
- Establishing the Project Management Unit or Project Office for the project implementation organized by staffs of MAFF/PDA and MOWRAM/ PDOWRAM in the Area as an institute responsible for the integrated & collaborative activities of MAFF & MOWRAM.

(3) Scope of the Intervention

The Project is formulated as a technical cooperation project for the period of 5 years and the project purpose is to establish an institution responsible for the agricultural productivity improvement, Project Management Unit or Project Office, and to strengthen agricultural support services provided through the Project Office. The envisioned major activities include: i) institutional strengthening, ii) improvement of irrigated and rainfed rice production system with farmers participation, iii) establishment of village extension agents (VEAs), iv) introduction of proper water management & O&M system and v) capacity building of farmer organization.

## Chapter D-6 Agricultural Development Plan

### D-6.1 Crop Sub-sector Development Plan

#### D-6.1.1 Zone-1 Development Project

Based on the irrigation study, the irrigation statuses of the 3 irrigation projects in zone-1 have been planned as follows;

**Planned Irrigation Status of Projects in Zone-1**

Project	Irrigated Area in Cropping Season	
	Early Rainy	Rainy
Irrigated Agriculture Improvement Model Project	285ha	570ha
Upper North Main Canal Irrigated Agriculture Improvement Project	215ha	2,210ha
Upper South Main Canal Irrigated Agriculture Improvement Project	-	2,880ha

#### D-6.1.1.1 Irrigated Agriculture Improvement Model Project

##### (1) Land Use

As discussed in the section 5.4.1 and the section above, the with- and without-project land use and irrigation status of the Project are as follows;

**Land Use & Irrigation Status under With- & Without-Project (ha)**

Land Use	Irrigation Status	Present/ Without-Project	With-Project	Increment
Paddy Field	Irrigated <sup>1/</sup>	575	570	- 5
	Sub-total	575	570	- 5
Right of Ways		-	5	5
Total		575	575	0

<sup>1/</sup>: Irrigated paddy field; irrigation water available for double cropping of rice

As shown, basically no improvement in the irrigation status from the present or without-project condition is expected under the Project.

##### (2) Proposed Cropping Pattern

The proposed cropping pattern and planned cropping intensity of the project are as shown in Figure D.6.1.1 and Table D.6.1.1 and as summarized below.

**Proposed Cropping Pattern & Intensity**

Early Rainy Season			Rainy Season			Annual		
Crop	Area (Intensity)		Crop	Area (Intensity)		Crop	Area (Intensity)	
Early Rice	285ha	(50%)	Early Rice	285ha	(50%)	Early Rice	570ha	(100%)
			Medium Rice	285ha	(50%)	Medium Rice	285ha	(50%)
Upland Crops	30ha	(5%)				Upland Crops	30ha	(5%)
Total	315ha	(55%)		570ha	(100%)		885ha	(155%)

Under the project, a planned annual rice cropping intensity is 150% and no increase of the intensity from the present level of 150% is expected.

##### (3) Target Crop Yields

The target crop yields under the development plan are set as shown in Table D.5.3.3 and the following table in comparison with the present yield levels.

**Target Yields and Present Yield Levels**

Crop	Early Rainy Season			Crop	Rainy Season		
	Yield (t/ha)				Yield (t/ha)		
	Target	Present	Increment		Target	Present	Increment
Early Rice	3.30	2.40	0.90	Early Rice	3.30	-	-
Upland Crops	0.70	0.45	0.25	Medium Rice	3.00	2.10	0.9

*Upland crops represented by mungbeans; medium rice under supplemental irrigation under with-project*

(4) Crop Production Plan

The cropped area and crop production under the with-project and without-project are shown in Table D.6.1.1 and summarized in the following table.

**Annual Cropped Area & Crop Production under With & Without-project**

Crop	Item	Without Project	With Project	Increment <sup>1/</sup>	
				Area/Prod.	%
1. Early Rainy Season Rice	- Cropped Area (ha)	285	285	0	-
	- Production (ton) 2/	684	941	257	38
2. Rainy Season Rice	- Cropped Area (ha)	575	570	-5	-
	- Production (ton) 2/	1,208	1,796	588	49
3. Rice Total	- Cropped Area (ha)	860	855	-5	-
	- Production (ton) 2/	1,892	2,736	845	45
4. Upland Crops	- Cropped Area (ha)	30	300	0	-
	- Production (ton) 2/	40	47	7	-

<sup>1/</sup>: Increment in % to without-project    <sup>2/</sup>: Paddy production

The paddy production increase of some 850 tons or the paddy production of 145% of the present/without-project level at full development is envisaged under the project.

(5) Agricultural Support Programs

The implementation and cost schedule of the agricultural support programs required for attaining the project target at an earlier stage are shown in Table D.6.1.2. The total estimated direct costs for such programs are estimated at about US\$ 23,000 as follows;

**Estimated Direct Costs for Support Programs**

Activity	Estimated Cost (US\$)
Field Extension Programs	13,900
Farmer/Farmer Group Training Programs	3,160
Mass Guidance/Workshop	220
Support Fund for Extension Staff <sup>1/</sup>	3,960
Provision of Transportation Means	1,200
Total	22,530

<sup>1/</sup>: Provision of support for farmer-farmer extension & field staff

**D-6.1.1.2 Upper North Main Canal Irrigated Agriculture Improvement Project**

(1) Land Use

As discussed in the section 5.4.1 and 6.1.1, the with- and without-project land use and irrigation status of the Project are as shown in the following table.

**Land Use & Irrigation Status under With- & Without-Project (ha)**

Land Use	Irrigation Status	Present/ Without-Project	With-Project	Increment
Paddy Field	Irrigated <sup>1/</sup>	215	215	0
	Supplemental <sup>2/</sup>	1,345	1,995	650
	Rainfed	670	-	-670
	Sub-total	2,230	2,210	-20
Right of Ways		-	20	20
Total		2,230	2,210	0

<sup>1/</sup>: Irrigated paddy field; irrigation water available for double cropping of rice

<sup>2/</sup>: Supplementary irrigated paddy field in rainy season; water supply only for rainy season

As shown, the increase of supplementary irrigated area of 650ha from the present and without-project level is planned in the Project.

## (2) Proposed Cropping Pattern

The proposed cropping pattern and planned cropping intensity of the project are as shown in Figure D.6.1.1 and Table D.6.1.1 and as summarized below.

### Proposed Cropping Pattern & Intensity

Early Rainy Season			Rainy Season			Annual		
Crop	Area (Intensity)		Crop	Area (Intensity)		Crop	Area (Intensity)	
Early Rice	215ha	(10%)	Early Rice	215ha	(10%)	Early Rice	430ha	(20%)
			Medium Rice	1,995ha	(90%)	Medium Rice	1,995ha	(90%)
Upland Crops	110ha	(5%)				Upland Crops	110ha	(5%)
Total	325ha	(15%)		2,210ha	(100%)		2,535ha	(115%)

Under the project, a planned annual rice cropping intensity is 110% and no increase of the intensity from the present level of 110% is expected.

## (3) Target Crop Yields

The target crop yields under the development plan are set as shown in Table D.5.3.3 and the following table in comparison with the present yield levels.

### Target Yields and Present Yield Levels

Early Rainy Season				Rainy Season			
Crop	Yield (t/ha)			Crop	Yield (t/ha)		
	Target	Present	Increment		Target	Present	Increment
Early Rice	3.30	2.40	0.90	Early Rice	3.30	-	-
Upland Crops	0.70	0.45	0.25	Medium Rice	3.00	1.5~2.1	0.9~1.5

*Upland crops represented by mungbeans; medium rice under supplemental irrigation under with-project*

## (4) Crop Production Plan

The cropped area and crop production under the with-project and without-project are shown in Table D.6.1.1 and summarized in the following table.

### Annual Cropped Area & Crop Production under With & Without-project

Crop	Item	Without Project	With Project	Increment <sup>1/</sup>	
				Area/Prod.	%
1. Early Rainy Season Rice	- Cropped Area (ha)	215	215	0	-
	- Production (ton) 2/	516	710	194	38
2. Rainy Season Rice	- Cropped Area (ha)	2,230	2,210	-20	-
	- Production (ton) 2/	4,281	6,695	2,414	56
3. Rice Total	- Cropped Area (ha)	2,445	2,425	-20	-
	- Production (ton) 2/	4,797	7,404	2,607	54
4. Upland Crops	- Cropped Area (ha)	20	110	90	-
	- Production (ton) 2/	27	171	144	-

<sup>1/</sup>: Increment in % to without-project 2/: Paddy production

The paddy production increase of some 2,600 tons or the paddy production of 154% of the present/without-project level at full development is envisaged under the project as shown in the table.

## (5) Agricultural Support Programs

The implementation and cost schedule of the agricultural support programs required for attaining the project target at an earlier stage are shown in Table D.6.1.2. The total estimated direct costs for such programs are estimated at about US\$ 42,000 as follows;



### Estimated Direct Costs for Support Programs

Activity	Estimated Cost (US\$)
Field Extension Programs	18,170
Farmer/Farmer Group Training Programs	5,600
Mass Guidance/Workshop	440
Support Fund for Extension Staff <sup>1/</sup>	13,320
Staff Empowerment	1,500
Provision of Transportation Means	2,900
Total	41,930

<sup>1/</sup>: Provision of support for farmer-farmer extension & field staff

#### D-6.1.1.3 Upper South Main Canal Irrigated Agriculture Improvement Project

##### (1) Land Use

As discussed in the section 5.4.1 and 6.1.1, the with- and without-project land use and irrigation status of the Project are as follows;

##### Land Use & Irrigation Status under With- & Without-Project (ha)

Land Use	Irrigation Status	Present/ Without-Project	With-Project	Increment
Paddy Field	Supplemental <sup>1/</sup>	1,855	2,880	1,025
	Rainfed	1,050	-	-1,050
	Sub-total	2,905	2,880	-25
Right of Ways		-	25	25
Total		2,915	2,915	0

<sup>1/</sup>: Supplementary irrigated paddy field in rainy season; water supply only for rainy season

As shown, the increase of supplementary irrigated area of 1,025ha from the present and without-project level is planned in the Project.

##### (2) Proposed Cropping Pattern

The proposed cropping pattern and planned cropping intensity of the project are as shown in Figure D.6.1.1 and Table D.6.1.1 and as summarized below.

##### Proposed Cropping Pattern & Intensity

Early Rainy Season			Rainy Season			Annual		
Crop	Area (Intensity)		Crop	Area (Intensity)		Crop	Area (Intensity)	
			Medium Rice	2,880ha	(100%)	Medium Rice	2,880ha	(100%)
Upland Crops	140ha	(5%)				Upland Crops	140ha	(5%)
Total	140ha	(5%)		2,880ha	(100%)		3,020ha	(105%)

Under the project, a planned annual rice cropping intensity is 100% and no increase of the intensity from the present level of 100% is expected.

##### (3) Target Crop Yields

The target crop yields under the development plan are set as shown in Table D.5.3.3 and the following table in comparison with the present yield levels.

##### Target Yields and Present Yield Levels

Early Rainy Season				Rainy Season			
Crop	Yield (t/ha)			Crop	Yield (t/ha)		
	Target	Present	Increment		Target	Present	Increment
Upland Crops	0.70	0.45	0.25	Medium Rice	3.00	1.5~2.1	0.9~1.5

*Upland crops represented by mungbeans; medium rice under supplemental irrigation under with-project*

##### (4) Crop Production Plan

The cropped area and crop production under the with-project and without-project are shown in Table D.6.1.1 and summarized in the following table.

### Annual Cropped Area & Crop Production under With & Without-project

Crop	Item	Without Project	With Project	Increment <sup>1/</sup>	
				Area/Prod.	%
1. Rainy Season Rice	- Cropped Area (ha)	2,905	2,880	-25	-
	- Production (ton)	5,471	8,640	3,170	58
2. Upland Crops	- Cropped Area (ha)	10	140	130	-
	- Production (ton)	13	235	222	-

<sup>1/</sup>: Increment in % to without-project

The paddy production increase of some 3,200 tons or the paddy production of 158% of the present/without-project level at full developed is envisaged under the project as shown in the table.

#### (5) Agricultural Support Programs

The implementation and cost schedule of the agricultural support programs required for attaining the project target at an earlier stage are shown in Table D.6.1.2. The total estimated direct costs for such programs are estimated at about US\$ 54,000 as shown in the following table.

#### Estimated Direct Costs for Support Programs

Activity	Estimated Cost (US\$)
Field Extension Programs	25,080
Farmer/Farmer Group Training Programs	6,880
Mass Guidance/Workshop	660
Support Fund for Extension Staff <sup>1/</sup>	16,560
Staff Empowerment	1,500
Provision of Transportation Means	3,200
Total	53,880

<sup>1/</sup>: Provision of support for farmer-farmer extension & field staff

### D-6.1.2 Zone-2 Development Project

#### D-6.1.2.1 Lower North Main Canal Irrigated Agriculture Improvement Project

##### (1) Land Use

As discussed in the section 5.4.1, the with- and without-project land use and irrigation status of the Project are as follows;

#### Land Use & Irrigation Status under With- & Without-Project (ha)

Land Use	Irrigation Status	Present/ Without-Project	With-Project	Increment
Paddy Field	Supplemental <sup>1/</sup>	550	1,390	840
	Rainfed	850		-850
	Sub-total	1,400	1,390	-10
Right of Ways			10	10
Total		1,400	1,400	0

<sup>1/</sup>: Supplementary irrigated paddy field in rainy season; water supply only for rainy season

As shown, the increase of supplementary irrigated area of 840ha from the present and without-project level is planned in the Project.

##### (2) Proposed Cropping Pattern

The proposed cropping pattern and planned cropping intensity of the project are as shown in Figure D.6.1.1 and Table D.6.1.3 and as summarized below.

### Proposed Cropping Pattern & Intensity

Early Rainy Season			Rainy Season			Annual		
Crop	Area (Intensity)		Crop	Area (Intensity)		Crop	Area (Intensity)	
Early Rice <sup>1/</sup>	200ha	(14%)				Early Rice	200ha	(14%)
			Medium Rice	1,390ha	(100%)	Medium Rice	1,390ha	(100%)
Upland Crops	70ha	(5%)				Upland Crops	70ha	(5%)
Total	270ha	(5%)		1,390ha	(100%)		1,660ha	(119%)

<sup>1/</sup>: Area irrigable for early rice in early rainy season by 50% dependability is 400ha; 50% (200ha) allocated annually for project planning purpose

Under the project, a planned annual rice cropping intensity is 114% and an increase of 14% from the present level of 100% is expected.

#### (3) Target Crop Yields

The target crop yields under the development plan are set as shown in Table D.5.3.3 and as follows in comparison with the present or without-project yield.

#### Target Yields and Present Yield Levels

Early Rainy Season				Rainy Season			
Crop	Yield (t/ha)			Crop	Yield (t/ha)		
	Target	Present	Increment		Target	Without	Increment
Early Rice	3.30	-	-	Early Rice	-	-	-
Upland Crops	0.70	0.45	0.25	Medium Rice	2.80	1.5~2.1	0.7~1.3

Upland crops represented by mungbeans; medium rice under supplemental irrigation under with-project

#### (4) Crop Production Plan

The cropped area and crop production under the with-project and without-project are shown in Table D.6.1.3 and summarized in the following table.

#### Annual Cropped Area & Crop Production under With & Without-project

Crop	Item	Without Project	With Project	Increment <sup>1/</sup>	
				Area/Prod.	%
1. Early Rainy Season Rice	- Cropped Area (ha)		200	200	-
	- Production (ton) <sup>2/</sup>		660	660	-
2. Rainy Season Rice	- Cropped Area (ha)	1,400	1,390	-10	-
	- Production (ton) <sup>2/</sup>	2,430	3,892	1,462	60
3. Rice Total	- Cropped Area (ha)	1,400	1,590	190	-
	- Production (ton) <sup>2/</sup>	2,430	4,552	2,122	87
4. Upland Crops	- Cropped Area (ha)	10	70	60	-
	- Production (ton) <sup>2/</sup>	22	109	87	-

<sup>1/</sup>: Increment in % to without-project <sup>2/</sup>: Paddy production

The paddy production increase of some 2,100 tons or the paddy production of 187% of the present/without-project level at full development is envisaged under the project as shown in the table.

#### (5) Agricultural Support Programs

The implementation and cost schedule of the agricultural support programs required for attaining the project target at an earlier stage are shown in Table D.6.1.4. The total estimated direct costs for such programs are estimated at about US\$ 24,000 as follows;

### Estimated Direct Costs for Support Programs

Activity	Estimated Cost (US\$)
Field Extension Programs	11,310
Farmer/Farmer Group Training Programs	5,090
Mass Guidance/Workshop	330
Support Fund for Extension Staff <sup>1/</sup>	5,520
Staff Empowerment	500
Provision of Transportation Means	1,600
Total	24,350

<sup>1/</sup>: Provision of support for farmer-farmer extension & field staff

#### D-6.1.2.2 Lower South Main Canal Irrigated Agriculture Improvement Project

##### (1) Land Use

As discussed in the section 5.4.1, the with- and without-project land use and irrigation status of the Project are as shown in the following table.

##### Land Use & Irrigation Status under With- & Without-Project (ha)

Land Use	Irrigation Status	Present/ Without-Project	With-Project	Increment
Paddy Field	Supplemental <sup>1/</sup>		6,750	6,750
	Rainfed	6,880		-6,880
	Sub-total	6,880	6,750	-130
Right of Ways			130	130
Total		6,880	6,880	0

<sup>1/</sup>: Supplementary irrigated paddy field in rainy season; water supply only for rainy season

As shown, the full upgrading of rainfed paddy fields to supplementary irrigated fields of 6,750ha is planned in the Project.

##### (2) Proposed Cropping Pattern

The proposed cropping pattern and planned cropping intensity of the project are as shown in Figure D.6.1.1 and Table D.6.1.3 and as summarized below.

##### Proposed Cropping Pattern & Intensity

Early Rainy Season			Rainy Season			Annual		
Crop	Area (Intensity)		Crop	Area (Intensity)		Crop	Area (Intensity)	
Early Rice <sup>1/</sup>	1,000ha	(15%)				Early Rice	1,000ha	(15%)
			Medium Rice	6,750ha	(100%)	Medium Rice	6,750ha	(100%)
Upland Crops	330ha	(5%)				Upland Crops	330ha	(5%)
Total	1,330ha	(20%)		6,750ha	(100%)		8,080ha	(120%)

<sup>1/</sup>: Area irrigable for early rice in early rainy season by 50% dependability is 400ha; 50% (200ha) allocated annually for project planning purpose

Under the project, a planned annual rice cropping intensity is 115% and an increase of 15% from the present level of 100% is expected.

##### (3) Target Crop Yields

The target crop yields under the development plan are set as shown in Table D.5.3.3 and the following table in comparison with the present or without-project yield levels.

##### Target Yields and Present Yield Levels

Early Rainy Season				Rainy Season			
Crop	Yield (t/ha)			Crop	Yield (t/ha)		
	Target	Present	Increment		Target	Without	Increment
Early Rice	3.30	-	-	Early Rice	-	-	-
Upland Crops	0.70	0.45	0.25	Medium Rice	2.80	1.5	1.3

Upland crops represented by mungbeans; medium rice under supplemental irrigation under with-project

(4) Crop Production Plan

The cropped area and crop production under the with-project and without-project are shown in Table D.6.1.3 and summarized in the following table.

**Annual Cropped Area & Crop Production under With & Without-project**

Crop	Item	Without Project	With Project	Increment <sup>1/</sup>	
				Area/Prod.	%
1. Early Rainy Season Rice	- Cropped Area (ha)		1,000	1,000	-
	- Production (ton) <sup>2/</sup>		3,300	3,300	-
2. Rainy Season Rice	- Cropped Area (ha)	6,880	6,750	-130	-
	- Production (ton) <sup>2/</sup>	10,320	18,900	8,580	83
3. Rice Total	- Cropped Area (ha)	6,880	7,750	870	13
	- Production (ton) <sup>2/</sup>	10,320	22,200	11,880	115
4. Upland Crops	- Cropped Area (ha)	80	330	250	-
	- Production (ton) <sup>2/</sup>	89	513	424	-

<sup>1/</sup>: Increment in % to without-project <sup>2/</sup>: Paddy production

The paddy production increase of some 12,000 tons or the paddy production of 215% of the present/without-project level at full development is envisaged under the project as shown in the table.

(5) Agricultural Support Programs

The implementation and cost schedule of the agricultural support programs required for attaining the project target at an earlier stage are shown in Table D.6.1.4. The total estimated direct costs for such programs are estimated at about US\$ 113,000 as follows;

**Estimated Direct Costs for Support Programs**

Activity	Estimated Cost (US\$)
Field Extension Programs	48,020
Farmer/Farmer Group Training Programs	20,140
Mass Guidance/Workshop	1,430
Support Fund for Extension Staff <sup>1/</sup>	34,560
Staff Empowerment	3,000
Provision of Transportation Means	5,700
Total	112,850

<sup>1/</sup>: Provision of support for farmer-farmer extension & field staff

**D-6.1.2.3 Ou Krang Ambel Irrigated Agriculture Improvement Project**

(1) Land Use

As discussed in the section 5.4.1, the with- and without-project land use and irrigation status of the Project are as follows;

**Land Use & Irrigation Status under With- & Without-Project (ha)**

Land Use	Irrigation Status	Present/ Without-Project	With-Project	Increment
Paddy Field	Supplemental <sup>1/</sup>	1,160	2,900	1,740
	Rainfed	1,770		-1,770
	Sub-total	2,930	2,900	-30
Right of Ways			30	30
Total		2,930	2,930	0

<sup>1/</sup>: Supplementary irrigated paddy field in rainy season; water supply only for rainy season

As shown, the increase of 1,740ha of supplementary irrigated fields is planned and the area extent of the irrigated field expands to 2,900ha from the present 1,160ha in the Project.

(2) Proposed Cropping Pattern

The proposed cropping pattern and planned cropping intensity of the project are as shown in Figure D.6.1.1 and Table D.6.1.3 and as summarized below.

### Proposed Cropping Pattern & Intensity

Early Rainy Season			Rainy Season			Annual		
Crop	Area (Intensity)		Crop	Area (Intensity)		Crop	Area (Intensity)	
Early Rice <sup>1/</sup>	400ha	(14%)				Early Rice	400ha	(14%)
			Medium Rice	2,900ha	(100%)	Medium Rice	2,900ha	(100%)
Upland Crops	150ha	(5%)				Upland Crops	150ha	(5%)
Total	550ha	(19%)		2,900ha	(100%)		3,450ha	(119%)

<sup>1/</sup>: Area irrigable for early rice in early rainy season by 50% dependability is 400ha; 50% (200ha) allocated annually for project planning purpose

Under the project, a planned annual rice cropping intensity is 114% and an increase of 14% from the present level of 100% is expected.

#### (3) Target Crop Yields

The target crop yields under the development plan are set as shown in Table D.5.3.3 and the following table in comparison with the present or without-project yield levels.

#### Target Yields and Present Yield Levels

Early Rainy Season				Rainy Season			
Crop	Yield (t/ha)			Crop	Yield (t/ha)		
	Target	Present	Increment		Target	Without	Increment
Early Rice	3.30	-	-	Early Rice	-	-	-
Upland Crops	0.70	0.45	0.25	Medium Rice	2.80	1.5~2.1	0.7~1.3

Upland crops represented by mungbeans; medium rice under supplemental irrigation under with-project

#### (4) Crop Production Plan

The cropped area and crop production under the with-project and without-project are shown in Table D.6.1.3 and summarized in the following table.

#### Annual Cropped Area & Crop Production under With & Without-project

Crop	Item	Without Project	With Project	Increment <sup>1/</sup>	
				Area/Prod.	%
1. Early Rainy Season Rice	- Cropped Area (ha)		400	400	-
	- Production (ton)		1,320	1,320	-
2. Rainy Season Rice	- Cropped Area (ha)	2,930	2,900	-30	-
	- Production (ton)	5,091	8,120	3,029	59
3. Rice Total	- Cropped Area (ha)	2,930	3,300	370	13
	- Production (ton)	5,091	9,440	4,349	85
4. Upland Crops	- Cropped Area (ha)	20	150	130	-
	- Production (ton)	27	233	207	-

<sup>1/</sup>: Increment in % to without-project

The paddy production increase of some 4,300 tons or the paddy production of 185% of the present/without-project level at full development is envisaged under the project.

#### (5) Agricultural Support Programs

The implementation and cost schedule of the agricultural support programs required for attaining the project target at an earlier stage are shown in Table D.6.1.4. The total estimated direct costs for such programs are estimated at about US\$ 49,000 as follows;

#### Estimated Direct Costs for Support Programs

Activity	Estimated Cost (US\$)
Field Extension Programs	20,570
Farmer/Farmer Group Training Programs	9,750
Mass Guidance/Workshop	660
Support Fund for Extension Staff <sup>1/</sup>	12,240
Staff Empowerment	1,500
Provision of Transportation Means	4,200
Total	48,920

<sup>1/</sup>: Provision of support for farmer-farmer extension & field staff

### D-6.1.3 Zone-3 Development Project

#### D-6.1.3.1 Water Harvesting Irrigated Agriculture Improvement Project

##### (1) Land Use

As discussed in the section 5.4.1, the with- and without-project land use and irrigation status of the Project are as follows;

**Land Use & Irrigation Status under With- & Without-Project (ha)**

Land Use	Irrigation Status	Present/ Without-Project	With-Project	Increment
Paddy Field	Supplemental <sup>1/</sup>	600	1,200	600
	Rainfed	600		-600
Total		1,200	1,200	0

<sup>1/</sup>: Supplementary irrigated paddy field in rainy season; water supply only for rainy season

As shown, the increase of 600ha of supplementary irrigated fields is planned in the Project.

##### (2) Proposed Cropping Pattern

The proposed cropping pattern and planned cropping intensity of the project are as shown in Figure D.5.4.1 and Table D.6.1.5 and as summarized below.

**Proposed Cropping Pattern & Intensity**

Early Rainy Season			Rainy Season			Annual		
Crop	Area (Intensity)		Crop	Area (Intensity)		Crop	Area (Intensity)	
			Medium Rice	1,200ha	(100%)	Medium Rice	1,200ha	(100%)
Upland Crops	60ha	(5%)				Upland Crops	60ha	(5%)
Total	60ha	(5%)		1,200ha	(100%)		1,260ha	(105%)

<sup>1/</sup>: Area irrigable for early rice in early rainy season by 50% dependability is 400ha; 50% (200ha) allocated annually for project planning purpose

Under the project, a planned annual rice cropping intensity is maintained to the present level of 100%.

##### (3) Target Crop Yields

The target crop yields under the development plan are set as shown in Table D.5.3.3 and the following table in comparison with the present or without-project yield levels.

**Target Yields and Present Yield Levels**

Early Rainy Season				Rainy Season			
Crop	Yield (t/ha)			Crop	Yield (t/ha)		
	Target	Present	Increment		Target	Without-Project	Increment
Upland Crops	0.70	0.45	0.25	Medium Rice	2.80	1.5~2.1	0.7~1.3

Upland crops represented by mungbeans; medium rice under supplemental irrigation under with-project

##### (4) Crop Production Plan

The cropped area and crop production under the with-project and without-project are shown in Table D.6.1.3 and summarized in the following table.

**Annual Cropped Area & Crop Production under With & Without-project**

Crop	Item	Without Project	With Project	Increment <sup>1/</sup>	
				Area/Prod.	%
1. Rainy Season Rice	- Cropped Area (ha)	1,200	1,200	0	-
	- Production (ton) <sup>2/</sup>	2,160	3,360	1,200	56
2. Upland Crops	- Cropped Area (ha)	10	60	50	-
	- Production (ton) <sup>2/</sup>	5	93	88	-

<sup>1/</sup>: Increment in % to without-project <sup>2/</sup>: Paddy production

The paddy production increase of some 1,200 tons or the paddy production of 156% of the present/without-project level at full development is envisaged under the project as shown in the table.



(5) Agricultural Support Programs

The implementation and cost schedule of the agricultural support programs required for attaining the project target at an earlier stage are shown in Table D.6.1.6. The total estimated direct costs for such programs are estimated at about US\$ 11,500 as follows;

**Estimated Direct Costs for Support Programs**

Activity	Estimated Cost (US\$)
Field Extension Programs	4,440
Farmer/Farmer Group Training Programs	3,060
Support Fund for Extension Staff <sup>1/</sup>	3,000
Staff Empowerment	1,000
Total	11,500

<sup>1/</sup>: Provision of support for farmer-farmer extension & field staff

**D-6.1.4 Zone-4 Development Project**

**D-6.1.4.1 Rainfed Agriculture Development Project**

(1) Land Use

As discussed in the section 5.4.1, the with- and without-project land use and irrigation status of the Project are as follows;

**Land Use & Irrigation Status under With- & Without-Project (ha)**

Land Use	Irrigation Status	Present/ Without-Project	With-Project	Increment
Paddy Field	Rainfed	23,380	23,380	0

No change in an area extent of rainfed paddy fields is planned under the project.

(2) Proposed Cropping Pattern

The proposed cropping pattern and planned cropping intensity of the project are as shown in Figure D.5.4.1 and Table D.6.1.5 and as summarized below.

**Proposed Cropping Pattern & Intensity**

Early Rainy Season			Rainy Season			Annual		
Crop	Area (Intensity)		Crop	Area (Intensity)		Crop	Area (Intensity)	
			Medium Rice	23,380ha	(100%)	Medium Rice	23,380ha	(100%)
Upland Crops	230ha	(1%)				Upland Crops	230ha	(1%)
Total	230ha	(1%)		23,380	(100%)		23,610	(101%)

Under the project, a planned annual rice cropping intensity is maintained to the present level of 100%.

(3) Target Crop Yields

The target crop yields under the development plan are set as shown in Table D.5.3.3 and the following table in comparison with the present or without-project yield levels.

**Target Yields and Present Yield Levels**

Early Rainy Season				Rainy Season			
Crop	Yield (t/ha)			Crop	Yield (t/ha)		
	Target	Present	Increment		Target	Without-Project	Increment
Upland Crops	0.45	-	-	Medium Rice	2.00	1.50	0.5

*Upland crops represented by mungbean*

4) Crop Production Plan

The cropped area and crop production under the with-project and without-project are shown in Table D.6.1.3 and summarized in the following table.



### Annual Cropped Area & Crop Production under With & Without-project

Crop	Item	Without Project	With Project	Increment <sup>1/</sup>	
				Area/Prod.	%
1. Rainy Season Rice	- Cropped Area (ha)	23,380	23,380	0	-
	- Production (ton) <sup>2/</sup>	35,070	47,760	11,690	33
2. Upland Crops	- Cropped Area (ha)		230	230	-
	- Production (ton) <sup>2/</sup>		104	104	-

<sup>1/</sup>: Increment in % to without-project <sup>2/</sup>: Paddy production

The paddy production increase of some 12,000 tons or the paddy production of 133% of the without-project level at full development is envisaged under the project as shown in the table.

#### (5) Agricultural Support Programs

The proposed Project is a development intervention aiming at strengthening of agricultural support services in Zone-4 for attaining the project target at an earlier stage. The Project is to be executed by MAFF/PDA in collaboration with NGOs and supported by a consultant team. The project activities are shown in the form of PDM as presented in Table 6.1.7. The implementation schedule and cost estimate of the project are shown in Table D.6.1.8 and D.6.1.9. The total estimated costs for the project are estimated at about US\$ 2,479,000 as follows;

#### Estimated Costs for Support Programs

Activity	Estimated Cost (US\$)
Direct Program Costs	
Field Extension Programs	49,490
Farmer/Farmer Group Training Programs	49,040
Mass Guidance/Workshop	2,750
Support Fund for Extension Staff <sup>1/</sup>	175,800
Staff Empowerment	7,500
Provision of Transportation Means	19,000
Farmer group Formation/Empowerment	96,000
Sub-total	399,580
Indirect Cost (Consultant Services Cost)	2,079,000
Total	2,479,000

<sup>1/</sup>: Provision of support for farmer-farmer extension & field staff

#### D-6.1.5 Overall Agricultural Development Features under the Master Plan

##### (1) Overall Agricultural Development Features

The overall crop sub-sector agricultural development features of the Master Plan are presented in Table D.6.1.10 and summarized the following table.

#### Overall Agricultural Development Features under the Master Plan

Zone	Annual Paddy Production <sup>1/</sup>	Without Project	With Project	Increment	
				Area/Prod.	% <sup>2/</sup>
Zone-1	Cropped Area (ha)	6,210	6,160	-50	-
	Production (ton)	12,159	18,780	6,621	54
Zone-2	Cropped Area (ha)	11,210	12,640	1,430	13
	Production (ton)	17,841	36,192	18,351	103
Zone-3	Cropped Area (ha)	1,200	1,200	0	-
	Production (ton)	2,160	3,360	1,200	56
Zone-4	Cropped Area (ha)	23,380	23,380	0	-
	Production (ton)	35,070	46,760	11,690	33
Overall	Cropped Area (ha)	42,000	43,380	1,380	3
	Production (ton)	67,230	105,092	37,862	56

<sup>1/</sup>: Cropped area & production of paddy <sup>2/</sup>: Increment in % to without-project

As indicated in the table, the characteristic of the present crop sub-sector Master Plan is defined as production increases of paddy of about 38,000 ton that are realized through the productivity improvement of paddy with no major increase in cropped areas as envisaged in the objective of the Plan. Such productivity improvement is attributed to the

improvement of irrigation statuses in Zone-1, Zone-2 and Zone-3 with increase of supplementary irrigated areas of 11,600ha and is envisaged through improvement of rice production system in Zone-4. Major features of the Master Plan are as tabulated below.

#### Major Features of Master Plan

Feature	Present/Without	With	Increment
Irrigated Field (ha) <sup>1/</sup>	500	500	0
Supplementary Irrigated Field (ha)	5,800	17,400	11,600
Rainfed Field (ha)	35,200	23,380	-11,820
Overall Paddy Yield (ton/ha)	1.6	2.4	0.8

<sup>1/</sup>: Irrigated field by 80% dependability

#### (2) Food Balance

The future food balance of rice in the Target Area under the Master Plan (with-project condition) and the without-project condition has been examined with the following assumptions.

#### Assumptions for Food Balance Study in the Target Area

Condition	The irrigated and rainfed agriculture improvement plans in the Master Plan are implemented as scheduled in the implementation plan. The full development in terms of production is attained in 2020.
Condition	No change in rice production level in the Area from the present level is assumed in future.
Requirements	Per capita consumption of rice: 143 kg as indicated in Table D.6.1.13.
in Target Area	As estimated in Table D.6.1.11.
in Future	As estimated in Table D.6.1.12.

The result of the study is indicated in Table D.6.1.13 and summarized below.

#### Food Balance Study in the Target Area

Year		Rice Sufficiency Rate	
		With-project	Present/Without-project
2005	Present Status	-	68%
	Final Year of Medium Term <sup>1/</sup>	93%	55%
	Full Development year <sup>2/</sup>	93%	50%

<sup>1/</sup>: Final year of the Master Plan period

<sup>2/</sup>: Full development stage attained of the agricultural improvement plans

As shown in the tables, the self-sufficiency of rice in the Target Area, basic target envisaged in the Master Plan, is nearly attained in 2015 in the final year of the Master Plan, which is markedly compared with the same of 55% under the present/without-project condition.

### D-6.2 Livestock Sub-sector Development Plan

#### D-6.2.1 Veterinary Services Strengthening and Livestock Raising Improvement Project

##### (1) Project Objective and Approaches

The captioned project has been formulated with the aims of stabilization of livestock productivity in the Target Area through the improvement of veterinary services and livestock raising practices.

For attaining the said objective, the development approaches taken is to recruit new Village Livestock Agents (VLAs) or empower existing VLAs in each village as providers of animal health and livestock extension services for strengthening of animal health and extension services in the project area. However, target districts of SLPP are excluded from the target area of the project because similar activities are planned under SLPP.

### (3) Project

The project plans to recruit new Animal Health Agents (VLAs) or empower existing VLAs as provider of animal health and livestock extension services at village level.

Target Area: Chbar Mon, Samraong Tong & Kong Pisei District  
(Target districts of SLPP are excluded from the Project)

Target Group: Existing VLAs and VLA candidates in the project target area  
Total No. of target groups: 500 (1 each from project villages)  
New VLAs: 400 & existing VLAs: 100

Project Period: 5 years (2008 ~ 2012)

Executing Agency: Department of Animal Health & Production, MAFF

Implementation Agency: PDA Kampong Speu & Kandal

### (4) Project Components

Major project components include:

- Training of trainer (training of PDA/DAO staffs)
- New VLA training course
- Refresher training of existing VLAs
- Provision of veterinary equipment
- Field demonstration on improved livestock raising at selected villages
  - 100 villages ( $\pm$  20% of project villages)
  - Subject: Pig fattening & chick & hen management (tentative)

The project logical framework is presented in the form of PDM in Table D.6.2.1.

### (5) Implementation and Cost Schedule

The implementation and estimated cost schedules of the project are shown in Table D.6.2.2 and D.6.2.3. The project cost is estimated at US\$ 314,000.-

## **D-6.2.2 Livestock Sub-sector Development Study**

### (1) Project Objective

For the enhancement of livestock productivity in the Target Area, the integrated implementation of improvement of genetic resources, development of feed resources and improvement of veterinary services are considered essential. The proposed development study aims at formulating an integrated livestock sub-sector development plan in the Target Area for a medium and long term development scope. The long term plan is to be formulated based on the study.

The development study is to be implemented by a well experienced foreign consultant so as to ensure the quality of outputs and formulation of practical development plans.

### (2) Scope of the Study

The main scopes of the study include: i) identification of present conditions and development constraints & potential, ii) study on integrated livestock development concepts and iii) formulation of integrated development plans, as follows;

- Identification of present conditions (population, genetic resources, feed resources, production, raising practices & system, diseases, marketing, processing, support system & activities, private sector,
- Identification of development constraints & potential,
- Study on integrated livestock development concepts,
- Formulation of integrated development plan, and
- Cost estimate & project evaluation.

The project logical framework is presented in the form of PDM in Table D.6.2.4.

### (4) Executing Agency and Study Period

Executing Agency: Department of Animal Health & Production, MAFF

Study Period: 12 months (2008)

(5) Implementation Schedule and Cost Estimate

The implementation schedule and cost estimate are shown in Table D.6.2.2. The cost of the Study is roughly estimated at US\$ 1.41 million.

### D-6.3 Inland Fisheries Sub-sector Development Plan

#### D-6.3.1 Community Inland Fisheries Development Project

(1) Project Objective and Approaches

The development approaches have been established with the aim of promoting of inland fish culture in the water surfaces for Water Harvesting Irrigated Agriculture Improvement Project and with the aim of raising common fund of water users communities responsible for the O&M of the subject irrigation system.

The development approaches of the project have been established as follows;

- Project target areas are ponds for “Water Harvesting Irrigated Agricultural Improvement Project” of the present Study and the groups of beneficiaries (FWUGs) of irrigation development will be the target groups, and
- Prior to the start of development activities, detailed inventory survey on a target pond is essential to clarify whether any current water uses, water and fishing rights and other rights do or do not conflict with the present development intervention.

(2) Project

In the project, the development of community based inland fish culture is envisaged in the water surfaces used for irrigation development. Returns from the development are to be utilized as a source of fund required for O&M of irrigation systems.

Target Ponds (Ponds free from flooding throughout a year): 49 ponds

Size Distribution of Target Ponds: in total of 49 ponds

Micro-scale (0.4 - 3.0ha)	Small-scale (3.6 - 10.3ha)	Medium-scale (11.5 - 34.3ha)	Large-scale (57.6-111.4ha)
3	27	16	3

Target Groups: FWUGs (FWUCs) of target ponds

Executing Agency: Department of Fisheries, MAFF

Implementation Agency: PDA Kampong Speu & Kandal

Project Period: 5 years with 1 year pilot operation (2008 ~ 2013)

(3) Project Components

Major project components include:

- Initial technical guidance
- Provision of fingerings
- Provision of fishing net & boat
- Periodical field guidance by PDA/DAO staffs

The project logical framework is presented in the form of PDM in Table D.6.3.1.

(4) Implementation Schedule and Cost Estimate

The project implementation schedule and cost estimates are presented in Table D.6.3.2 and D.6.3.3, respectively. The project cost is estimated at US\$ 344,000.-.

### D-6.4 Income Generation Project for Marginal Farmers

#### D-6.4.1 Project Objective

The main objective of this development intervention, enhancement/introduction of income generation activities targeted to marginal farmers, is to increase farm income of marginal farmers and to improve the level of food security as discussed in the section 5.4.4. The project aims to achieve this by promoting income diversification of the target groups. The overall project features and framework is illustrated in Figure 6.4.1.

## D-6.4.2 Project

### (1) Target Groups

Target groups of the schemes are marginal farmers who are poor and most vulnerable group for food insecurity in the Target Area and land less households, households with holding size less than 0.1ha and women headed households are tentatively defined as target households (actual target groups to be selected in the preparatory stage of the project). As similar projects have been implemented in or around the Target Area by SPFS, SEILA and NGOs, the project target groups are tentatively set to be 20% of the said households or 4,200 households as follows;

**Estimated Number of Marginal Farmers & Target Groups <sup>1/</sup>**

Target Households <sup>1/</sup>	Kampong Speu	Kandal	Target Area
Land Less Farmers	3,995	2,258	6,253
Households with Holding Size < 0.1ha	1,110	868	1,978
Women Headed Families	8,478	3,539	12,017
Total	13,583	6,665	20,248
Target Groups ( $\pm 20\%$ ;) )	2,800	1,400	4,200

<sup>1/</sup>:Marginal households in the project communes

Source: SEILA Data Base 2004 & Source: Commune Survey on Crops & Livestock, 2003, MAFF

### (2) Project Components

Project is to be implemented in 2 stages of preparatory and operation stage as explained as follows;

#### (a) Preparatory Stage

- Inventory survey (selection of target groups and villages),
- Preparation of Annual Work Plan,
- Preparation of scheme lists & guidelines, and
- Field staffs (PDA/DAO/NGOs staffs) training; trainer training.

#### (b) Project Operation Stage

- PRA at village level,
- Farmer group (Self-help Group) formation of members having similar intention or preference toward income generating activities,
  - Membership: 30 members & 3 sub-groups of 10 members
  - Selection of a scheme to be introduced by a group
  - Board member: President, vice president & treasurer
  - Training program for board members
- IFFS (Integrated Farmer Field School) curriculum development,
- IFFS (including a study plot or scheme operation) at target villages,
- Provision of credit for farm inputs, seedlings, farm tools, fingerling, animal and poultry etc. depending on schemes selected and beneficiaries needs, and
  - Credit amount US\$50/member (depending on schemes selected),
  - Credit provision & revolving arrangement
- Monitoring & evaluation.

#### (c) Conceivable Candidate Schemes

- Village Chick & Hen Management Scheme,
- Fish Culture Scheme in Rice Field,
- Fruit Seedling Production Scheme,
- Small-scale Fish Culture Scheme,
- Small scale livestock production (pig raising etc.),
- Fruit production, and
- Mushroom production with local inputs.

The project logical framework is presented in the form of PDM in Table D.6.4.1.

- (3) Project Period (2009 ~ 2013)  
Pilot operation phase: 1 year (2009)  
Operation phase: 4 years (2010 ~ 2013)

(4) Project Implementation

The proposed arrangement for the project is as follows;

Project Executing Agency: MAFF

Project Implementation Agency: PDAs/NGOs

Collaboration & Partnership:

MRD, CDC, VDC, SPFS, SLPP, FAIEX, CAAEP II, other stakeholders and related projects in and around the Target Area

#### **D-6.4.3 Implementation and Cost Schedule**

The implementation and cost schedules are shown in Table D. 6.4.2. The cost estimates for some candidate schemes are shown in Table D.6.4.3 and D.6.4.4. The overall cost is estimated at US\$566,000.-.

#### **D-6.5 Institutional and Agricultural Support Strengthening Project**

##### **D-6.5.1 Project Objectives**

The project is proposed as a technical cooperation project with the objectives of: i) establishment of an institutional set-up for the promotion of agricultural improvement centering rice in the Target Area, ii) development and extension of improved and sustainable farming technologies on rice production, iii) development and extension of irrigation water management and O&M technologies and practices and iv) formation and empowerment of water users groups (FWUG/FWUC) and other farmers organizations as discussed in the section 5.4.5.

The institutional set-up component include: i) establishment of Standing Coordination Committee and Task Force Team at a central level, ii) establishment and empowerment Project Office in the Target Area and iii) capacity building of local authorities.

##### **D-6.5.2 Project**

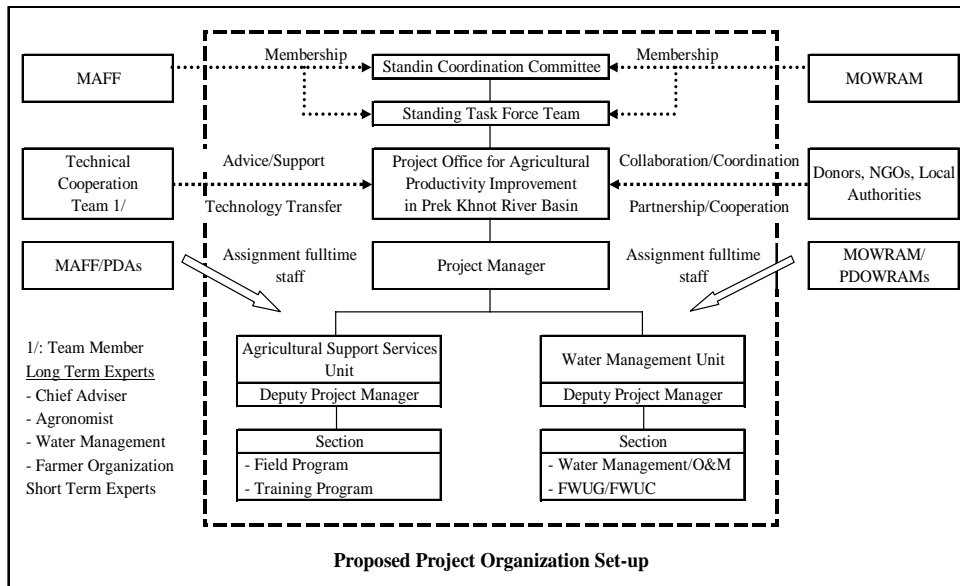
The Project is formulated as a technical cooperation project for the period of 5 years and the project purpose is to establish an institution responsible for the agricultural productivity improvement, Project Office, and to strengthen agricultural support services provided through the Project Office. The project major activities include: i) institutional strengthening, ii) improvement of irrigated rice & rainfed production system with farmers participation, iii) establishment of village extension agents (VEAs, iv) introduction of proper water management & O&M system and v) capacity building of farmer organizations.

Target Area: The Target Area (Kampong Speu & Kandal Province)

Project Period: 5 years (2009 ~ 2014)

Executing Agency: MAFF/MOWRAM

The proposed organization set-up of the Project Office is as illustrated in the following.



The project logical framework is presented in the form of PDM in Table 6.5.1.

### D-6.5.3 Implementation and Cost Schedule

The project implementation schedule and cost estimate are shown in Table D.6.5.2 and D.6.5.3, respectively. The project cost is estimated at US\$ 2,440,000-.

### D-6.6 Overall Implementation and Cost Schedules for Agricultural Development Projects

The overall implementation and cost schedules for the agricultural development projects under the Master Plan are shown in Table D.6.6.1.