of rice is still very low level around 1.2 ton/ha on average. The main reason why the farmers seek for rice cultivation is to attain self-sufficiency in food and also rice cultivation is still the most reliable industry in the area. However, most of field has no stable irrigation water supply and proper drainage resulting in drought or flood damage sometimes.

2.3.2 Rice

(1) Cropping pattern

i) Land use

According to the present land use survey, the present land use in the Study Area was classified as given in Table IV-13 and summarized as follows:

(Unit: ha)

Land use categories	Kandal Stung	%	Tonle Bati	%	Total	%
Villages,roads,etc	1,500	13.2	400	5.8	1,900	10.4
Rainfed wet season rice	7,300	64.6	5,100	73.9	12,400	68.1
Wet season uplandcrops	300	2.7	50	0.7	350	1.9
Cattle grazing,unused	2,200	19.5	1,350	19.6	3,550	19.5
Gross area	11,300	100.0	6,900	100.0	18,200	100.0

The most of the farm land is devoted to the wet season rice cultivation, about 7,300 ha or 65 % of gross land area in Kandal Stung and about 5,100 ha or 74 % in Tonle Bati Study Area, respectively. Out of 18,200 ha of the total Study area, 12,400 ha are used for rice field as seen above.

ii) Cropping season

The varieties of rice cultivated are highly related to the seasons as described in the section of rice ecosystem. The cultivated area of rice by season in the Study Area collected through the district offices is given in Tables IV-14 ,and IV-15.

a. Farmers grow early rice at the onset of the wet season around April-May depending on the arrival of rainfall, transplant during May, and harvest in August-September. The early rice is about 5 % of the total planted area of rice in the Study Area. This type of rice is sometimes damaged due to drought during August when some dry spell takes place. The varieties used for this rice are usually improved varieties of around 110 days of growth duration.

b. The medium rice is the main type in the Study Area, approximately 75 % of the total planted area of rice in Tonle Bati Study Area, and 60 % in Kandal Stung Study Area. The medium rice is usually sown to nursery around May to June, and after one month of nursery period, transplanting to the main field is carried out. The varieties used for the medium rice is 120 to 150 days of growth duration from sowing to harvesting, and the varieties are more or less photoperiod sensitive. They flower during mid October to mid November. Harvesting of the medium rice is carried out during October to November in Kandal Stung study area, and mid November to December in Tonle Bati study area, respectively.

c. The late rice is grown on the field where the land flooded usually deeper than the field for medium rice. The late rice is sown June to July and harvested during December to February. The varieties used for this type are photoperiod sensitive and flower mid October to mid November with growth duration of 150 to 180 days. The planted area under this type of rice is estimated at about 35 % and 20 % in Kandal Stung and Tonle Bati Study Area, respectively.

d. There are two types of dry season rice in the Study Area. The ordinary dry season rice is grown with irrigation from lake or pond, after harvesting of medium rice, usually sown during November to December and harvested in March to April. The planted area for this type is very limited mainly due to shortage of irrigation water. The other type of dry season rice is called receding rice which is transplanted after the water of lake or pond receded. The area of the receding rice is in the Study Area is very limited, but outside the eastern part of the Tonle Bati Study Area, there are bout 600 ha of this type of rice with irrigation from Tonle Bati Lake.

The present cropping pattern is clarified based on the results of land use survey and the data on the ratio of planted area by season obtained from the district offices. The clarified present cropping pattern is given in the following table and illustrated in Fig. IV-6 and Fig. IV-7.

Season	Kandal Stung	Tonle Bati	Total
Early	300	300	600
Medium	4,600	4,100	8,700
Late	2,700	1,000	3,700
Dry season	0*	30	30
Total planted area	7,600	5,430	13,030
Total field area	7,300	5,100	12,400
Cropping intensity	104 %	106 %	105 %

* The data not available.

The cropping intensity is 104 and 106 % for Kandal Stung and Tonle Bati Study Area, respectively.

(2) Farming practices

Rice cultivation is rather extensively practised by farm family level. Usually wet nursery is prepared by plowing in two times and harrowing under submerged condition with area of about 1/5-1/10 of the main field to be planted. The best levelling is required and make raised seed bed of 1 to 1.2 m of width. The seed is soaked for 24 hours in the pond water, incubated for around 36 to 48 hours in the closed place up to root of rice seed elongates about 2 cm, and sown to the seed bed with rate of 50 to 60 kg per ha of main field. Before transplanting, plowing is done usually under submerged condition but depend on availability of irrigation water, and followed by harrowing, and transplanting. Spacing of transplanting is about 20 cm x 20 cm. The farmers use farmyard manure as basal dose and chemical fertilizers such as Urea of 20 kg/ha and Compound (16:20:0) of 80 kg/ha on average, and apply Urea in split application of two to three times. Plant protection is usually not required because of low damages by insects and disease. Farmers rarely apply chemicals, especially for brown plant hoppers in March to April. The other insects found in the Study Area are green plant hopper, gall midge, etc. Harvesting is done by manual using sickle and threshing usually by beating at the home yard. Some farmers use treadle threshers for improved varieties due to low shattering characteristics. The threshed paddy is well dried under the sun and stored to granary of each farm household. The transplanting and harvesting works are done in labour exchange system. The inputs requirement for present farm operation is summarized in Table IV-16.

(3) Yield of rice

The data on yield of rice in the Study Area was collected from District Offices of Kandal Stung and Bati, interviews to farmers, and IRRI-Cambodia Project. The yield of rice is still very low level at about 1.2 to 1.5 ton/ha on average. The yield varies largely depending on the varieties, rate of application of fertilizers, planting seasons, and conditions

of irrigation and soils. Among these factors, farmers always complain of shortage of irrigation water and less availability of fertilizers in time. The results obtained from IRRI-Cambodia Project in Kandal Stung and Takeo provinces also indicate almost the same level of rice yield of 1.2 to 2.4 ton/ha for rainfed lowland rice. According to the results of interviews to farmers in the Study area, it varies from 0.9 to 2.4 ton/ha. More than 2.5 ton/ha of yield is usually obtained for dry season rice with full irrigation.

(4) Production of rice in the Stady Area

The rice production by season in the Study Area is roughly estimated based on the data on cultivated area and the average unit yield of 1.2 ton/ha for rainfed lowland rice, 3.0 ton/ha for dry season rice as follows:

Season	Kandal Stung Area		Tonle Bati Are		Total	
	Area (ha)	Production (ton)	Area (ha)	Production (ton)	Area (ha)	Production (ton)
Early	300	360	300	360	600	720
Medium	4,600	5,520	4,100	4,920	8,700	10,440
Late	2,700	3,240	1,000	1,200	3,700	4,440
Dry Season	0*	0	30	90	30	90
Total	7,600	9,120	5,430	6,570	13,030	15,690

* The data not available.

The total production of rice in the Study Area is estimated at about 15,690 t in 1993.

2.3.3 Other Crops

Crops grown in the Study Area other than rice are sugar palm, maize, cassava, sweet potato, vegetables and some perennial crops. Almost all of farmers grow banana, mango, guava, cocos, etc. in their home gardens. Those planted area and the number of sugar palm tree collected from District offices are shown in Table IV-17. Beside these crops sugar palm tree plays important role in farm income during the dry season. Sugar palm tree is usually planted along the band of rice field, but the majority of tree is found on the sandy soils along the old river levees where the productivity of rice is rather low. The number of sugar palm tree and sugar production in the Study Area is shown in Table IV-18. As seen in the table, Sugar Palm trees are concentrated to several communes especially in Kandal Stung Study Area. The production of sugar is about 25 kg/tree/year. Vegetables were not commonly grown in the area but recently some farmers have started to grow vegetables and mushroom for marketing. Other crops are mostly consumed within the area.

2.3.4 Livestock

Livestock raising is quite important activities for the farmers in the Study Area. Most farmers keep cattle, pig and poultry. The cattle is raised for draught power for field preparation and transportation by cart and for manures. Pig and poultry are mostly for sale to market. The number of livestock in Kandal Stung District from 1979 to 1990, and 1993 are shown in Table IV-19 and IV-20, respectively. As seen in the Tables, the number of cattle in the Kandal Stung District substantially increased from about 6,000 in 1979 to 31,200 heads in 1993, more than five times and pig increased about 1,000 heads to 10,700 heads. The number of animals per family in the Study Area is estimated as shown in Table IV-21 and Table IV-22 in Kandal Stung and Tonle Bati Study Area, respectively. The number of draught cattle per family in the Kandal Stung Study Area is estimated at about 1.7 heads, and that in Tonle Bati Study Area is 1.3 heads, so the average number of yoke (one pair of cattle) per family in the Study Area is

estimated at 0.8 and 0.6 for Kandal Stun and Tonle Bati Study Area, respectively. As seen in the Tables, families in more than half number of communes are suffering from shortage of draught animals at present, but it is estimated based on the existing total number of cattle in the areas, that in few years later when the cattle under 3 years old at present will become old enough to supply power, almost all of families will have sufficient draught cattle in the area. Cattle raising is still primitive. They are mostly fed crop residues and household leftovers, in particular, grass for cattle becomes short in common in the dry season. The farmers usually store rice straw at harvesting time for feeding throughout a year. The most problem for livestock raising is disease control. The Government has made effort to mitigate animal disease with vaccination program especially to prevent Hemorrhagic septicaemia, Anthrax, Black leg and Foot and mouth disease, but still the coverage is not sufficient mainly due to lack of facilities, equipment and medicines and shortage of veterinary staff. According to the district offices about 10 to 30 heads of cattle die of disease (Hemorrhagic septicaemia, Anthrax, etc.) in each district in a year. Pigs and poultry has been damaged by disease such as Swine fever, Newcastle, etc. but no vaccination services by the Government has been launched. The coverage of vaccination program in Kandal Stung and Tonle Bati districts are shown in Table IV- 23. The covered area(by commune) is changed every year and the rate of vaccination of the selected area is still very low. According to veterinarians in district offices, the major problems and constraints for the vaccination are shortage of vaccines, lack of equipment such as cold store, syringe and means of transportation, and ignorance of some farmers who doesn't like to vaccinate animals.

2.3.5 Fishery

Fisheries activity in the Study Area is mostly done with cast net, traps, or scoop net in the rivers, small streams, canals, ponds and lakes wherever they can access to catch naturally propagated fishes. Small beach seines are used in Tonle Bati Lake in the dry season. The precise data concerning the amount of fish caught in the Study Area are not available. According to the Reappraisal Report for Prek Thnot Multipurpose Project, the average consumption of fish is about 18 kg/capita/year. The fish caught in the Study Area is consumed by family and some surplus is sold to market. The farmers make dried and smoked fish, fermented and salted fishes , and some of them are sold also in the small shops in the villages. Once UNICEF tried to promote fish culture in Kandal Stung Study Area in the flame of Family Food Production program, but not lasted long mainly due to difficulties beyond the farmers' capacity such as scarce water source especially in the dry season and severe flooding in 1991. Fish culture is not observed in and around the area at present except fishing on the naturally propagated ones.

2.3.6 Agricultural Production

Agriculture is the basic industry in the Study Area. Almost all families are depending on the agriculture and agro-base industry. Rice is the staple food and the main agricultural product, followed by other minor crops such as maize, cassava, sweet potato, and some vegetables. The total planted area of lowland rice in 1993 is estimated at about 7,600 ha in Kandal Stung Study Area, and 5, 430 ha in Tonle Bati Study Area, respectively. The total production of rice is estimated at about 15,690 t (in paddy). The area for other crops is quite small compared with that of rice, about 300 ha and 50 ha in Kandal Stung and Tonle Bati Study Areas, respectively.

The remarkable crop other than rice in the Study Area is sugar palm tree, they collect sap from the tree and make sugar. The number of tree is estimated at about 40,000 and 7,600 in Kandal Stung and Tonle Bati Study Areas, respectively. The estimated amount of sugar production is about 1,190 t/year. The sugar production is recognized as one of important economic element in the Study Area. According to socio-economic survey in the Study Area, approximately a half of the family in Kandal Stung Study Area grow sugar palm in between rice plots and elevated lands.

Beside the crop cultivation, livestock raising plays very important role in farmers' economy. The cattle is raised for the purpose of draught power for farm operation, while pigs and poultry are mostly raised for marketing purpose.

Total production of rice, palm sugar and number of livestock raised by the Study Area in 1993 are as shown below:

Items	Kandal Stung Stady Area	Tonle Bati Study Area	Total
Paddy (t)	9,120	6,570	15,690
Sugar (t)	1,000	190	1,190
Cattle (head)	16,240	9,530	25,770
Pig (head)	7,320	4,130	11,450
Poultry (head)	64,000	27,500	91,500

The gross production value of the above agricultural production at farm gate is estimated as follows:

Items	Kandal Stung	Tonle Bati	Total	Price	Value	Value	%
		(1,000Riel)	(Mill. Riel)	(US$)			
Paddy(t)	9,120	6,570	15,690	400	6,276	2,853	62
Sugar(t)	1,000	190	1,190	800	952	433	10
Cattle(head)	2,400	1,430	3,830	260	996	453	10
Pig(head)	11,000	6,200	17,200	80	1,376	625	14
Poultry(head)	96,000	41,250	137,250	3	412	187	4
Total				10,012	4,551	100	

Note; The annual production of animals is estimated as assumption based on the total number of animals, applying 15 %, 150 % and 150 % for cattle, pig and poultry, respectively.

As seen in the above table, about 62 % of annual farm production value is depended on rice cultivation, while livestock contribute about 28 % of the total production in the Study Area.

2.4 Farm Household Economy in Study Area

2.4.1 Land Holding and Family Size

The average land holding size by household is 1.2 ha and 1.3 ha for Kandal Stung and Tonle Bati Study Area, respectively as shown in Table IV-24. According to the result the average family size in Kandal Stung and Tonle Bati Study Areas are 6.0 person/family, out of which about 2.5 persons are adult per family.

2.4.2 Farm Household Economy

(1) Food balance of farm household

A rough analysis on food balance for the average size of family in the Study Area was made based on the results of sample survey. The requirement of rice consumption is calculated at 310 kg/capita/year(paddy) on the basis of target set by the Government at present:

Area cultivated	1.2	ha
Average unit yield	1.2	t/ha
Production	1,440	kg (paddy)
Consumption	1,860	kg/family (310 kg x 6 person/family in paddy)
Balance	- 420	kg

The result indicates that the families having less than around 1.5 ha of rice field are suffering from shortage of rice at present.

(2) Income base

The the Study Area's main economy base is rice cultivation, but the production is not sufficiently high mainly due to irrigation water deficit and shortage of inputs and improved techniques. The farmers are at present earning income basically from rice cultivation , but a majority of farmers maintains their living supplemented by other incomes, livestock, sugar, wages, etc. The following table shows major types of income source of farm household categorized.

	Income source category	Kandal Stung Study Area		Tonle Bati Study Area	
		No.	%	No.	%
1	Rice cultivation only	5	7	1	2
2	Rice and livestock	6	8	27	66
3	Rice , livestock and other crop	10	13	0	0
4	Rice, livestock and other off-farmincome	44	58	7	17
5	Rice and other off-farm income	11	14	6	15
	Total	76	100	41	100

As shown above, livestock raising fairly contributes to farm income. In Kandal Stung Study Area, only 28 % of farmers are full-time farmer, while 68 % in Tonle Bati Study Area. About 58 % of total farm household in Kandal Stung Study Area ern their income from rice, livestock and off farm activities, while in Tonle Bati Study Area, rice and livestock type of farming is the main income source for 66 % of the total farm household.

(3) Income and expenditures

The present farm income for the typical categories of farm household is estiamted based on the result of farm household survey as presented in Table IV-25. The net income of farm household in Kandal Stung Study Area is estiamted at about US$ 290 and 220 for farming and off farm activities, respectively and totaled at US$ 510. Net farm household income in Tonle Bati Study Area is estimated at about US$ 200 from farming activities only. About 37 % of the gross income in Kandal Stung Study Area is derived from off-farm income consisting of salaries, wages earned by labour work and remittance from their family working in Phnom Penh or abroad. About 80 % of the gross farm income is derived from rice production in Tonle Bati Study Area.

The living expenses are consisted of food, fuel, house, cloth, health, culture, education, child care, communication and transportation as shown in Table IV-26. The distribution of living cost by items are summarized as follow:

(Unit: %)

Items	Kandal Stung	Tonle Bati
Food	56	52
Fuel	3	7
House	6	8
Cloth	8	13
Health	8	6
Culture	1	4
Education	2	5
Child care	4	3
Transportation	12	2

As seen above, expense for food is 56 and 52 % of the total income in Kandal Stung and Tonle Bati Study Area, respectively.

The estimated results of income and expenditures for farm household in the area are summarized as follows:

(Unit: US$)

Items		Kandal Stung Paddy/livestock/off farm	Tonle Bati Paddy/Livestock
1	Gross income	600	300
1)	Farm income	380	300
2)	Off-farem income	220	0
2	Gross Outgo	600	300
1)	Production cost	90	100
2)	Living expenses	510	200
3	Net reserve (1-2)	0	0

The total annual living expenses of the average farm household in Kandal Stung and Tonle Bati Study areas are estimated at about US$ 510 and 200 as shwon in Table IV-26. The study on farm budget makes it clear that farm economy for the typical farmers in both Kandal Stung and Tonle Bati Study Areas remains on the subsistance level.

2.5 Agricultural Supporting Services in Study Area

2.5.1 District Agricultural Office

The agricultural supporting services are usually extended through two channels of the Government organizations with some supports by NGO's. One is from each central department passing through provincial level to district agricultural office as contact point to farmers. The other is through agricultural or rural development centre operated by Department of Agronomy. The former channel is mostly used for services such as FFP program, cattle vaccination program, and general information by MAFF. The later is for agricultural support services such as technical demonstration and guidance, input supply, rural credit and community development, but the area covered by the centre is very limited as covering several villages of a few communes. The Government institutions directly concerned to the Kandal Stung Study Area is agricultural office of Kandal Stung District of Kandal Province and Kandal Stung Rural Development Centre, while Tonle Bati Study Area receives support services by agricultural office of Bati District of Takeo Province, and Tonle Bati Agricultural Development Centre. The organization and staffing of agricultural offices of Kandal and Takeo

Provinces are given in Table IV-27 and IV-28, and the staffing of agricultural office of Kandal Stung and Bati Districts are as shown below:

Section	Engineer	Assitant Enginner	Agent	Worker	Total
(1)Kandal Stung District					
Chief of Office	0	1	0	0	1
Vice chief of office	0	1	0	0	1
Administration	0	0	2	0	2
Hydrology	0	1	4	0	5
Agronomy	0	0	3	0	3
Veterinary	0	0	2	0	2
Material	0	0	3	0	3
Total	0	3	14	0	17
(2)Bati District					
Chief of Office	0	1	0	0	1
Vice chief of office	0	1	0	0	1
Administration	0	1*	0	0	1*
Hydrology	0		0	2	2
Agronomy	0	1*	0	0	1*
Veterinary	0	1	0	0	1
Material	0	0	4	0	4
Total	0	4	4	2	10

* The work is covered by one staff.

Ther are assigned no staff of engineer class and insufficient number of staff to execute effective agricultural extension work in the both offices.

2.5.2 Agricultural Extension and Input Supply

Agricultural extension work in the Study Area was started since 1986 by the Tonle Bati Agricultural Development Centre (TBADC) in Tonle Bati Study Area and in 1991 by Kandal Stung Rural Development Centre (KSRDC) in Kandal Stung Study Area under the Department of Agronomy. The covered area for agricultural extension by KSRDC is about 375 families in 12 villages in 3 communes. Most of activities are concentrated to community development through small scale agricultural credit. The TBADC was established in 1986 in collaboration with the Department of Agronomy and WCC. WCC transfered the supporting activitiy to HEKS in December 1993. The main objectives of the centre is to distribute irrigation water to the area of about 6,000 ha in cooperation with District Agricultural Office and distribution of farm inputs. The extension work was started in 1992 including such activities as rural credit, operation of demonstration plot to show farming techniques for fertilizer application and improved varieties, as well as community development such as repairing of rural road, digging wells, and education of teachers of primary school.

The branch of CCAM of Kandal Province is supplying fertilizers and chemicals to the Kandal Stung district area through a store house located in Siem Reap village, just out side the Southeast end of Kandal Stung Study area. Kandal Stung district has no store facility to keep fertilizers and chemicals. Fertilizers and chemicals are also sold in Svay Minh market in Kandal Stung Study area and at some small retail shops along Road No.2 as the private channel. The Tonle Bati Agricultural Development Centre sells fertilizers and chemicals as the Government channel retailers for Tonle Bati Study area. Fertilizers are also available in Samrang Yang market located at south end of the Tonle Bati Study area. Bati district office has no store to keep fertilizers and chemicals.

2.5.3 Agricultural Credit

The Agricultural Development Centre in Tonle Bati Study Area (TBADC) and Rural Development Centre in Kandal Stung Study Area (KSRDC) run a small schemes for rural credit covering some parts of the Study Area. KSRDC started small rural credit schemes by formulating credit-use groups based on the rice bank as the core activity, utilizing the rice supplied by WFP. The areas covered by the scheme during 1990 to 1993 were 6 villages in Tropieng Weng, 5 villages in Thmey and 1 village in Trea. KSRDC organised farmers' groups to be responsible for repayment of borrowed credits. The interest rate is decided by the group members at about 3 to 7 % per month in most cases. The groups organised were 18, comprising 616 families in total, and the all covered area is outside Kandal Stung project area. The main items other than rice covered by credit are materials for palm sugar production, initial fund for livestock raising and home vegetable gardens. TBADC started credit services from 1992 and covered 2 villages, 120 families. They took same procedure to organise farmers' group through which credits are disbursed and repaid. According to data obtained through TBADC, the major items for the credit by group members are summarised as follows:

Purposes	Tropieng Elk Village				RA Sang Village			
	Man(%)		Women(%)		Man(%)		Women(%)	
Vegetable garden	11	(31)	9	(39)	0	(0)	0	(0)
Pig	10	(29)	7	(30)	16	(48)	20	(91)
Palm sugar*	3	(9)	1	(4)	0	(0)	0	(0)
Sales	11	(31)	5	(22)	17	(52)	2	(9)
Cow	0	(0)	1	(4)	0	(0)	0	(0)
Total	35	(100)	23	(100)	33	(100)	22	(100)

* To procure materials such as bamboo ladder, container, fuel wood.

The items of activities covered by the credit are mostly for home vegetable garden, home yard pig raising and operation of small shops in the villages. No significant differences of credit between male and female members were observed. The observed constraints by the Centres for carrying on the credit services are shortage of well trained extension staff, shortage of veterinary care for pigs, poultry and shortage of planting materials, etc.

There is no other formal credit system for farmers other than described above. There exists an informal credit system, farmers who become short of rice for home consumption especially for transplanting time to before harvesting time borrow paddy from relatives or neighbours and repaid in labour force or in paddy after harvesting. In case of borrowing from relatives mostly without interest, but the interest rate is around 100 % for 6 months in case borrowing from lenders.

2.5.4 Agro-processing and Marketing in Study Area

(1) Processing

The most important agro-processing activity in the Study Area is rice milling. There are privately owned rice mills in the villages. The number of rice mill in each commune in the Study Area is given in Table IV-29. As seen in the table, about a half number of villages have rice mills in their villages. Most of rice mills have been installed in recent 2 to 3 years. This phenomenon may be relating to the application of the free market system for farm products, especially rice. Through interview to villagers about processing of rice at present almost all villagers use rice mill for milling rice, instead of pounding method. The milling charge is about 100 Riel/kg (paddy), or if rice bran given to the miller no other charge is necessary. There roughly two types of rice mills are found in the area, one is composed of one dehuller with one steel type whitening system, and the other is composed of only one

steel huller one-pass type. The former has about 400 kg/hr of processing capacity, the latter has about 150 kg/hr of capacity (out put) on an average. The recovery rate of the milling is about 60-62 % according to the millers. The both types of milling machine are operated with 16 to 18 horse power of diesel engine. These engine and machine are imported mainly from China and Thailand, some milling machines are manufactured in Phnom Penh, and spare parts are available in Phnom Penh.

Sugar production from sugar palm is also important agro-processing in the Study Area. Usually sugar production is carried out in the dry season. The gathered sap from the tree is reduced to sugar by boiling in the cast iron pan over a slow fire for two to three hours located at their home. About 25 kg/tree of sugar can be produced during one season. The income from sugar palm is important subsidiary income of farmers.

The farmers catch fish in the canals, rivers and ponds and some of surplus are processed to dried and smoked fish, salted fish and fermented fish, kept for home consumption and also sold at small retail market in villages.

(2) Marketing of agricultural products

At present the marketing of farm products in the area is under free marketing system. Usually farmers sell their products, especially paddy, pigs and poultry whenever cash required, to the middleman who are visiting individual farmer. No organization has been established to trade farm products, and the farmer has less power to negotiate with the middleman on the prices of products.

3. AGRO-ECONOMIC CONDITIONS IN PRIORITY DEVELOPMENT AREA

3.1 Agricultural Production in Priority Development Area

3.1.1 Crops and Cropping Pattern

(1) Land use and crops

The data on the present land use in and around the Priority Development Areas obtained through the district agricultural offices are as shown in Tables IV-30 and IV-31, and summarised as follows:

	Kandal Stung area		Tonle Bati area	
Land use	(ha)	(%)	(ha)	(%)
1. Agricultural land:	1,840	70	1,460	80
Rice field	1,793	69	1,452	79
Double cropping	93	4	8	0
Single cropping	1,700	65	1,444	79
Upland crops	47	2	9	1
2. Shrubs	132	5	34	2
3. Forest	26	1	0	0
4. Villages	171	7	304	17
5. Others	447	17	27	2
6. Total	2,616	100	1,825	100

The most of the land is used for agriculture especially for rice cultivation, 69 % and 80 % of the total land area, while the area for upland crops is 1.8 % and 0.5 % in and around the Kandal Stung and Tonle Bati Priority Development Areas, respectively. The upland crops grown in the area are vegetables such as green beans, leafy vegetables, cucumbers, sweet potato, maize, and cassava in the home garden or on the slightly higher land which is unsuitable for rice cultivation.

(2) Cropping pattern

The varieties of rice cultivated in the area are highly related to the seasons. The planted area of rice by season in and around the Priority Development Areas collected through the district offices is given in Tables IV-32, and IV-33, and summarised as shown below:

	Kandal Stung area		Tonle Bati area	
Crop	(ha)	(%)	(ha)	(%)
Dry season rice*	0	0	513	9
Early rice	122	6	433	8
4-month rice	1,133	56	3,170	58
6-month rice	771	38	1,345	25
Total planted	2,026	100	5,461	100

* The dry season rice in Tonle Bati area is mostly of receding rice out side the Priority Development Area.

a. The early rice is about 6 % and 8 % of the total planted area of rice in the Kandal Stung and Tonle Bati Priority Development Areas, respectively. The varieties used for this rice are usually improved varieties of around 110 days of growth duration. The most of farmers grow medium or late rice after harvesting of the early rice.

b. The medium (4-month varieties) rice is the main type in and around the Priority Development Areas, 56 % of the total planted area of rice in Kandal Stung Priority Development Areas, and 58 % in Tonle Bati Priority Development Areas. The varieties used for the medium rice is 120 to 150 days of growth duration from sowing to harvesting, and the varieties are more or less photoperiod sensitive. Harvesting of the medium rice is carried out during October to November in Kandal Stung Priority Development Areas, and mid November to December in Tonle Bati Priority Development Areas, respectively.

c. The late rice (6-month varieties) is grown on the field where the land flooded usually deeper than the field for medium rice. The late rice is sown June to July and harvested during December to February. The varieties used for this type are photoperiod sensitive and flower mid October to mid November with growth duration of 150 to 180 days. The planted area under this type of rice is estimated at 38 % and 25 % in Kandal Stung and Tonle Bati Priority Development Areas, respectively.

d. There are two types of dry season rice in and around the area. The ordinary dry season rice is grown with irrigation from lake or pond, after harvesting of medium rice, usually sown during November to December and harvested in March to April. The planted area for this type is very limited mainly due to shortage of irrigation water. The other type of dry season rice is called receding rice which is transplanted after the water of lake or pond receded. The receding rice is not found in the Priority Development Area.

The present cropping pattern in the Priority Development Area is clarified based on the present land use and the above mentioned data on the ratio of planted area by season. The total rice field in the Priority Development Areas is defined as 1,950 ha and 1,600 ha in Kandal Stung and Tonle Bati Priority Development Areas, respectively The clarified present cropping pattern is given in the following table and illustrated in Fig. IV-8 and Fig. IV-9.

(Unit : ha)

Season	Kandal Stung Priority Development Area	Tonle Bati Priority Development Area
Early*	120	130
Medium	1,170	1,120
Late	780	480
Dry season	0	0
Total planted area	2,070	1,730
Total rice field area	1,950	1,600
Cropping intensity	106 %	108 %

3.1.2 Farming Practices

Rice cultivation is rather extensively practised by farm family level. The prevailing farming practices in the Priority Development Area are basically same as clarified in the master plan study area. The level of farm inputs is in almost same level of that in master plan area on average, and transplanting and harvesting works are mostly done in labour exchange system. Input requirements for the present farming practices are given in Table IV-34.

3.1.3 Crop Yield and Production

(1) Yield and production of rice

As shown in Tables IV-32 and IV-33, the average yield of rice for 1993-94 crop season is 1.3 and 1.7 ton/ha in and around Kandal Stung and Tonle Bati Priority Development Areas, respectively. According to the results of farm household survey conducted by the present study on the Priority Development Areas, it varies from 0.5 to 3.0 ton/ha, and 1.5 and 1.4 ton/ha on the weighted average in Kandal Stung and Tonle Bati Priority Development Area, respectively. All the results show the yield of rice in and around the Priority Development Area is still low level on an average.

The rice production by season in the Priority Development Areas is roughly estimated based on the cultivated area and the average unit yield of 1.4 ton/ha for rainfed lowland rice as follows:

Season	Kandal Stung Area		Tonle Bati Area	
	Area (ha)	Production (ton)	Area (ha)	Production (ton)
Early	120	170	130	180
Medium	1,170	1,640	1,120	1,570
Late	780	1,090	480	670
Total	2,070	2,900	1,730	2,420

The total production of rice (paddy) in the Priority Development Area is estimated at 2,900 and 2,420 tons in Kandal Stung and Tonle Bati Priority Development Area for 1993-94 crop season, respectively.

(2) Other crops

Crops grown in and around the Priority Development Areas other than rice are sugar palm, maize, cassava, sweet potato, vegetables and some perennial crops. Almost all of farmers grow banana, mango, guava, cocos, etc. at their home gardens. The planted area of upland crops in and around the Kandal Stung Priority Development Area are shown in Table IV-35. The number of sugar palm tree and sugar production in and around the Priority Development Area is shown in Table IV-36. As seen in the table, Sugar Palm trees are concentrated to several communes especially in Kandal Stung area. The average number of sugar palm tree is 1.8 and 0.2 tree/household in Kandal Stung and Tonle Bati Priority Development Areas, respectively. According to the farm household survey, there are very few farmers producing palm sugar recently in the Priority Development Area mainly due to low price of sugar and high risk of accident for collecting sugar sap on the tree. Vegetables were not commonly grown in the area but recently some farmers have started to grow vegetables and mushroom for marketing. Other crops are mostly consumed within the area.

3.1.4 Livestock and Fisheries

(1) Livestock raising

Livestock raising is a quite important activity for the farmers in and around the Priority Development Areas. Most farmers keep cattle, pig and poultry. The number of livestock in and around the Priority Development Areas collected through district offices is shown in Tables IV- 37 and IV-38. Number of animals in the Priority Development Areas is estimated based on the average number of animals per household and the number of household in the areas as shown below:

Priority Develop't Area	Kandal Stung				Tonle Bati			
No. of household*	2,170				1,140			
Livestock	Draught	Cattle**	Pig	Poultry	Draught	Cattle**	Pig	Poultry
No. /household(head)	1.0	1.4	0.5	4.2	2.2	3.0	1.2	7.8
Total No.(head)	2,170	3,040	1,090	9,110	1,370	3,420	1,370	8,890
No./household, Master Plan area (head)	1.6	4.2	1.1	10.0	1.2	3.2	0.9	5.7

* The no. of household is esitmated based on the average area/household and total area of rice filed in each priority development area.

** Total of cattle.

The number of animals per household in the Kandal Stung Priority Development Area are rather smaller than those of Kandal Stung Master Plan Area, while those in Tonle Bati Priority Development Area are mostly same as the level of the Tonle Bati Master Plan Area. The number of draught cattle per family in Kandal Stung Priority Development Area is estimated at about 1.0 head, and that in Tonle Bati Priority Development Area is 2.2 heads, so the average number of yoke (one pair of cattle) per family is estimated at 0.5 and 1.1 for Kandal Stung and Tonle Bati Priority Development Area, respectively. As seen in the Tables IV-37 and IV-38, families in more than half number of villages in Kandal Stung area are suffering from shortage of draught animals at present. In the field preparation season, the farmers keeping no cattle need to hire draught cattle for their field preparation and pay in paddy or labour for transplanting rice at the rate of two days transplanting work to one morning ploughing. The most problem for livestock raising is shortage of feed and disease control.

(2) Fisheries

Fisheries activity in and around the Priority Development Areas is mostly done with cast net, traps, or scoop net in the rivers, small streams, canals, ponds and lakes wherever they can access to catch naturally propagated fishes. The farmers make dried and smoked fish, fermented and salted fishes , and some of them are sold also in the small shops in the villages. Fish culture is not observed in and around the Priority Development Areas at present except fishing on the naturally propagated ones.

3.1.5 Agro-processing

The most important agro-processing activity in and around the Priority Development Areas is rice milling. The most of villagers polish their rice using rice polish in their villages. The number of rice mill in each village in and around the Priority Development Area is given in Table IV-39. As seen in the table, about 90 % of villages have rice mills in their villages. Most of rice mills have been installed in recent 2 to 3 years. The recovery rate of the milling is about 60-62 % according to the millers.

Palm sugar production is also important agro-processing in the Master Plan Study area, but shares small part of agricultural activity in the Priority Development Areas according to farm household survey and data obtained through district offices as described in the preceding section of crop production. Usually sugar production is carried out in the dry season. The gathered sap from the tree is reduced to sugar by boiling in the cast iron pan over a slow fire for two to three hours located at their home yard. About 25 kg/tree of sugar can be produced during one season.

The farmers catch fish in the canals, rivers and ponds and some of surplus are processed to dried and smoked fish, salted fish and fermented fish, kept for home consumption and also sold at small retail market in villages.

3.1.6 Marketing of Agricultural Products and Inputs

At present the marketing of farm products in the area is under free marketing system. Usually farmers sell their products, especially paddy, pigs and poultry whenever cash required, to the middleman who are visiting individual farmer. No organization has been established to trade farm products in and around the Priority Development Areas. The most important products in the areas is rice. The farmers usually sell the rice (paddy) to the middle man for cash, or barter paddy for daily necessities such as salt and sugar brought by the middle man.

The branch of CCAM of Kandal Province is supplying fertilizers and chemicals to Kandal Stung District area through a store house located in Siem Reap village, just out side the Southeast end of Kandal Stung Priority Development Area. Kandal Stung District office has no store facility to keep fertilizers and chemicals. Fertilizers and chemicals are also sold in Svay Minh market located in Kandal Stung Priority Development Area and at some small retail shops along Road No.2 as the private channel. The Tonle Bati Agricultural Development Centre sells fertilizers and chemicals as the Government channel retailers for Tonle Bati Priority Development Area. Fertilizers are also available in Samrang Yang market located about 4 km South of the Tonle Bati Priority Development Area. Bati district office has no store to keep fertilizers and chemicals. No credit sale system of fertilizers is found in the areas.

3.1.7 Agricultural Production

Rice is the staple food and the main agricultural product, followed by other minor crops such as maize, cassava, sweet potato, and some vegetables. The total planted area and production of lowland rice in 1993 is estimated at about 2,070 ha and 2,900 ton in Kandal Stung Priority Development Area, and 1,730 ha and 2,420 ton in Tonle Bati project area, respectively. The area for other crops is negligible small compared with that of rice, less than 50 ha and 10 ha in Kandal Stung and Tonle Bati Priority Development Areas, respectively.

The major crop other than rice in the Priority Development Area is sugar palm tree. The number of tree is estimated at about 3,900 and 230 in Kandal Stung and Tonle Bati Priority Development Areas, respectively. The estimated amount of sugar production is about 100 and 10 tons/year in Kandal Stung and Tonle Bati Priority Development Area, respectively. The sugar production is recognised as one of important economical elements in the Master Plan area, but has not large share of production in the Priority Development Areas.

Beside the crop cultivation, livestock raising plays very important role in farmers' economy. The cattle is raised for the purpose of draught power for farm operation, while pigs and poultry are mostly raised for marketing purpose.

The estimated production of rice, palm sugar and number of livestock in the Priority Development Areas for 1993-94 crop year are as shown below:

Items	Kandal Stung Area	Tonle Bati area
Paddy (ton)	2,900	2,400
Sugar (ton)	100	10
Cattle (head)	3,000	3,400
Pig (head)	1,100	1,400
Poultry (head)	9,100	8,900

The gross production value of the above agricultural production at farm gate is estimated as follows:

Item	Production		Unit Price	Value					
	Kandal Stung	Tonle Bati		Kandal Stung			Tonle Bati		
			(1,000R)	(MR)	(1000US$)	(%)	(MR)	(1000US$)	(%)
Paddy(ton)	2,900	2,400	400	1,160	468	(77)	960	384	(74)
Sugar(ton)	100	10	600	60	24	(4)	6	2	(0)
Cattle(head)	450	510	260	117	47	(8)	133	53	(10)
Pig(head)	1,650	2,100	80	132	53	(9)	168	67	(13)
Popultry(heaad)	13,700	13,400	3	41	13	(3)	40	16	(3)
Total				1,510	608	(100)	1,307	522	(100)

Note; The annual production of animals is estimated as assumption based on the total number of animals, applying 15 %, 150 % and 150 % for cattle, pig and poultry, respectively.

As seen in the above table, 77 % of annual farm production value depend on rice cultivation, while livestock contribute about 20 % of the total production in the Kandal Stung Priority Development Area. In Tonle Bati Priority Development Area rice cultivation contributes 74 % , and livestock produces 26 % of the production, respectively.

3.2 Farm Household Economy in Priority Development Area

3.2.1 Land Tenure and Land Holding

The present land use data in and around the Priority Development Area collected through the district offices are as shown in Table IV-30 and Table IV-31. According to the data, about 70 % of land in the Kandal Stung area is devoted to the agricultural land of which 97 % is rice field. In Tonle Bati area, about 80 % of the total area is agricultural land and of which 99 % is rice field. The average agricultural land per farm household is 0.9 ha and 1.4 ha in Kandal Stung and Tonle Bati Priority Development Area, respectively. According to the farm household survey most of the farmers in the Priority Development Area have their own land even though the land title registration is not completed yet, and any tenant farmers who are renting farmland from the landowner could not be observed in the survey. The distribution of rice field holding area by farmers obtained through the household survey in each Priority Development Area is as shown below:

Holding size(ha)	Kandal Stung		Tonle Bati	
<0.5	30	25(%)	7	16(%)
0.5<1.0	48	40	7	16
1.0<1.5	29	24	19	44
1.5<2.0	11	9	8	19
2.0<	3	2	2	5
Total	121	100	43	100

The holding area of rice field by farmers in the Kandal Stung Priority Development Area is rather smaller, 65 % of farmers' holding areas are less than 1.0 ha, while in Tonle Bati area, 63 % of farmers are holding rice field of 1.0 <2.0 ha.

3.2.2 Farm Household Economy

In order to grasp the economic condition of the farm family in the Priority Development Areas, farm household survey was carried out for 128 and 68 households in Kandal Stung and Tonle Bati area, respectively.

(1) Food balance of farm household

According to the household survey , the average family size of household is 5.6 and 6.0 persons in Kandal Stung and Tonle Bati Priority Development Areas, respectively. A rough analysis on food balance for the average size of family in the Priority Development Areas was made based on the data obtained so far as follows:

Project area	Master plan area	Kandal Stung	Tonle Bati
Area cultivated(ha)	1.2	0.9	1.4
Average yield(ton/ha)	1.2	1.4	1.4
Production(kg)	1,440	1,260	1,960
Consumption(kg)	1,860	1,740	1,860
Balance(kg)	- 420	- 480	+ 100

The rice production in the Kandal Stung Priority Development Area is still insufficient for their food while in Tonle Bati Priority Development Area it fulfils almost their consumption only. According to food balance analysis for individual household surveyed, about 80 % and 70 % of households in Kandal Stung and Tonle Bati area, respectively are suffered from shortage of rice for their own consumption.

(2) Income Base

The main economy base is rice cultivation in the Priority Development Areas, but the production is not sufficiently high mainly due to irrigation water dificit and shortage of inputs and improved techniques. The farmers in the areas are earning income basically from rice cultivation, but a majority of farmers maintains their life supplemented by other incomes, livestock, sugar, wages, etc. as shown in Table IV-40. The following table shows major types of income source of farm household categorized.

	Income source category	Kandal Stung area		Tonle Bati area	
		No.	%	No.	%
1	Rice cultivation only	7	6	5	11
2	Rice and livestock	16	14	24	55
3	Rice, livestock and other crop	13	11	0	0
4	Rice, livestock and other off-farm incom	57	48	13	30
5	Rice and other off-farm income	25	21	2	5
	Total	118	100	44	100

In Kandal Stung area, only 31% of farmers are full-time farmer, while 66% in Tonle Bati area. About 69% of total farms household in Kandal Stung area earn their income from rice, livestock and off-farm activities, while in Tonle Bati area, rice and livestock type of farming is the main income source for 66% of the total farm household.

(3) Income and Expenditures of Farm Household

i) Farm Household Income

The present farm income for the typical categories of farm household is based on farm-income and off farm income as described above, and estimated based on the result of farm household survey as presented in Tables IV-41. The gross income in Kandal Stung area is estimated at about US$ 370 and 160 for farming and off farm activities, respectively and totalled at about US$ 530. The gross farm household income in Tonle Bati area is estimated at about US$ 570 and US$ 30 from farming activities and off farm-income, respectively. About 33 % of the gross income in Kandal Stung area is derived from off-farm income consisting of salaries, wages earned by labour work and

remittance from their family working in Phnom Penh or abroad. About 95% of the gross farm income is derived from farming activity in Tonle Bati area.

ii) Farm Household Expenditures

The living expenses are consisted of food, fuel, house, cloth health, education, communication and transportation as shown in Table IV-42. The distribution of living cost by items are summarized as follow:

(Unit: %)

Items	Kandal Stung	Tonle bati
Food	69	76
House	2	0
Cloth	6	5
Health	12	10
Education	7	7
Transportation	1	1
Others	3	1

As seen above, expense for food is 69 and 76 % of the total expenses in Kandal Stung and Tonle Bati area, respectively.

The estimated balance of income and expenditures for farm household in the area are summarizxed as follows:

	Items	Kandal Stung Paddy/livestock/off farm	Tonle Bati Paddy/Livestock
1	Gross income	530	600
1)	Farm income	370	570
2)	Off-farm income	160	30
2	Gross Outgo	530	600
1)	Production cost	50	80
2)	Living expenses	480	520
3	Net reserve (1-2)	0	0

The total annual living expenses of the average farm household in Kandal Stung and Tonle Bati study areas are estimated at about US$ 530 and 600. The study on farm budget makes it clear that farm economy for the typical farmers in both Kandal Stung and Tonle Bati areas remains on the subsistence level.

3.3 Agricultural Supporting Services in Priority Development Area

3.3.1 Agricultural Extension Services

(1) Kandal Stung Priority Development Area

At present any noteworthy agricultural extension work is executed in Kandal Stung Priority Development Area, other than by district agricultural office. In May 1944 MCC (NGO) has phased down their activity for rural credit covering three villages in Roluos commune by one worker. In 1991 Kandal Stung Rural Development Centre (KSRDC) was established under the Department of Agronomy with cooperation of WVI, but their activity has been covering 375 families in 12 villages in 3 communes in South-west part of the district outside the Priority Development Area and concentrated to community mobilization

through small scale agricultural credit and income generation activities. No agricultural support services are extended to the Priority Development Area by NGOs at present.

(2) Tonle Bati Priority Development Area

Agricultural extension work by TBADC is to distribute irrigation water to the area of about 6,000 ha (including the Priority Development Area) in cooperation with District Agricultural Office and distribution of farm inputs. The extension work was started in 1992 as pilot village project including such activities as rural credit, operation of demonstration plot to show farming techniques for fertilizer application and improved varieties, as well as community mobilization such as repairing of rural road, digging wells, and education of teachers of primary school. From the end of 1993, HEKS has taken over the cooperation and continuing at present. The staff and major facilities and equipment of the centre are as follows:

Staff/facility	Number/area/spec.
Staff:	
Chief of Centre	(vacant)
Deputy chief	Engineer (agronomy)
Assistant engineer	3 agronomy, 1 hydrology
Agent	2
Tractor operator	3
Security	1
Facility and equipment:	
Rice field	8 ha
Compound	2.5 ha
Storage cum garage	242 m^2 x 1
Office cum meeting hall	240 m^2 x 1
Staff quarter cum dormitory	84 m^2 x 1
Tractor	60 HP x 4
Power tiller	10 HP x 3
Attachment for tractors	LS
Motor cycle	7

The centre has to cover extension work for about 2,800 households, 34 villages in 5 communes of about 6,000 ha by 4 extension workers, but due to shortage of staff and budget, it is limited to covering the selected 4 pilot villages in 4 communes at present.

3.3.2 Agricultural Credit

KSRDC started a small rural credit scheme in 1990, and the covered area by 1993 were 6 villages, but outside the Kandal Stung Priority Development Area. TBADC started credit services from 1992 and covered 2 villages, 120 families as the trial cases outside the Priority Development Area, also.

3.3.3 Agricultural Input Supply

They took procedure to organise farmers' group through which credits are disbursed and repaid. According to data obtained through TBADC, the major items for the credit by group members are mostly for home vegetable garden, home yard pig raising and operation of small shops in the villages. No significant differences of purpose of credit between male and female members were observed. The observed constraints by the Development Centres for

carrying on the credit services are shortage of well trained extension staff, shortage of veterinary care for pigs, poultry and shortage of planting materials, etc.

There is no other formal credit system for farmers other than described above, and the informal credit system is existing in the areas.

4. AGRICULTURAL DEVELOPMENT PLAN IN STUDY AREA

4.1 National Agricultural Development Policy

The agricultural sector is recognized as the highest priority sector in the national reconstruction program. The productivity of the sector, on which about 85% of the national population (8.8 million) rely on, is still low due to the lack of rural infrastructure and agricultural production technology, while there is considerable potential for increasing as well as diversifying agricultural production in Cambodia. For the purpose of increasing productivity of agriculture and thus improving living standard, the Government has taken effective efforts in the sector as adoption of granting land ownership rights, free market and decontrol of prices of products to provide more incentives to producers. Realization of the sector's potential, an improvement is necessary in the access of farmers to agricultural inputs, such as fertilizers, pesticides, seeds and agricultural credit. The sector is also required to be improved and expanded in the supporting infrastructure such as irrigation, flood control and drainage facilities, rural roads, and to be strengthened in the delivery of basic support services, such as research and extension services, not only to promote production but also to improve life of rural people.

Agriculture in Cambodia is mostly dominated by rainfed rice cultivation. Although irrigation development can greatly increase cropping intensity and total agricultural production, a lack of capital accumulation has long limited the irrigated area. Since irrigation development requires a rather large investment and accruement of benefit is often delayed, the Government has intended to promote to begin with a cost-effective and quick-responding small scale development as a model scheme where sustainable and self reliant agriculture is achieved. The model scheme can work as a show-case that displays the effects of agricultural and rural infrastructure development, strengthened agriculture support services and rural life improvement and community development.

4.2 Agricultural Development Constraints in the Study Area

4.2.1 Needs and Problems

The farmer's needs and major problems, expectation for the future agricultural and rural development were surveyed by a interview to farmers, regarding the rural life especially during the dry season, farming activities, and farmer's living condition at present. According to the results of survey, about 80% of the farmers pointed out deficit of drinking and irrigation water in the dry season, about 60 % and 100 % of farmers in Kandal Stung and Tonle Bati Study Areas pointed out shortage of chemical fertilizers, respectively. Most of farmers in Tonle Bati Study Area showed the necessity of rice seed of HYV. Regarding the living conditions, all of farmers in Tonle Bati Study Area complained about shortage of food, and that in Kandal Stung Study Area was about 50 %. Other major needs and constraints in the area are shortage of health services, school houses, and so on. The results of farmer's interview survey are summarised as shown in Table IV-43.

4.2.2 Agricultural Development Constraints in the Study Area

Most of the constraints which are crucial to profitable and sustainable agricultural development in the Study Area are due to insufficient agricultural services, beside fundamental element of irrigation water deficit. Major constraints to further development of agriculture are summarized as follows:

(1) Irrigation water deficit

The farmers are suffering from shortage of irrigation water for cultivating rice even in the wet season particularly in the beginning of the wet season. The farmers in the Study Area are eager for growing rice at least two crops a year but due to irrigation deficit constraint, at present, two crops of rice cultivation is paractised in the very limited area. It is essential to improve irrigation water supply to develop and stabilize the agriculture in the Study Area.

(2) Insufficient agricultural inputs supply

Availability of certified seeds is very limited. Farmers are using their own seeds of local varieties. Most of these varieties are low yielding, but compelled to use. These local varieties are rather adaptable to local micro-environments and alleviate the risks because of their tolerance to adverse conditions such as drought. Photoperiod sensitive varieties with different flowering stage are also used to spread the transplanting and harvesting periods in order to mitigate labour shortage. The shortage of improved seeds is the major constraints for increasing rice production.

Shortage of agricultural inputs such as fertilizers, chemicals are also major constraints at present in the area. Timely and stable supply of farm inputs with reasonable prices are required to attain stabilized and sustainable agricultural production.

(3) Lack of supporting services and improved techniques

Despite the fact that the existing rice fields in the Study Area have a large potential of increasing crop yields especially rice, no packages of farming techniques have been developed, for which field trials of rice varieties, appropriate planting time and fertilizer practices suited to the differences in the physical conditions are indispensable. Since there is no basis of researched techniques, credible extension services for increase in crop production as well as life improvement for farmers could not be provided sufficiently by the offices concerned for proper and profitable farm management.

The present support services such as agricultural extension, rural credit, inputs supply system, marketing of agricultural products, are not functioning well mainly due to lack of qualified manpower, facilities, appropriate techniques as well as budget. The effective extension and supporting services are inevitable to attain full exploitation of agricultural development in the Study Area. Present complicated extension systems are necessary to be improved, and strengthened in manpower, techniques and facilities. A formal credit system is also necessary to be introduced to enable farmers access to stable availability of farm inputs.

4.3 Proposed Agricultural Development Plan in Study Area

4.3.1 Development Target

Reflecting the development need and the national development policy, the development objectives for the agricultural development plan in the Master Plan recognized are (i) to raise farmer's income level through enhancement of agriculture, especially rice and livestock productions, by efficient utilization of the land and water development potential in the area, (ii) to contribute to regional need to increase rice production with the aim of achieving self-sufficiency in rice in the Study Area, and (iii) to raise living standard and improve rural peoples life through generating farm income and extension of living techniques. The practical targets set up for the above objectives are as follows:

(1) Self sufficiency in food

In line with the national development plan, to supply rice of 310 kg in paddy for consumption.

(2) Income generation

In line with national development plan, to pull up the present level of about 1.12 million Riels(US$ 509 equivalent) of total annual farm household income to nearly 3.0 million(US$ 1,360 equivalent) or more than 2.5 times of the present level, or 10 % increase a year.

(3) Cost for food

The ratio of expenses for food (Engel's coefficient) to be less than 50 % of the total farmer's living expenditures, and remain net reserve about 10 % of income.

4.3.2 Basic Development Concepts

Two alternatives are taken for agricultural development in the Study from the view points of the availability of irrigation water, i.e.:

a. With Prek Thnot Reservoir and

b. Without Prek Thnot Reservoir

Under the without Prek Thnot Reservoir, the irrigation water depends only on the run- of-the Prek Thnot river and the amount of the water is very limited especially in the dry season. On the other hand, no limitation of irrigation water is expected throuhgout the year under the with Prek Thnot Reservoir. The Study Area is divided into several development schemes and the conditions of each scheme are summarized as follows:

Water source alternatives	Name of Scheme	Availability of irrigation water
1. With Prek Thnot Reservoir:		
(a) Regulated water by Reservoir	Kandal Stung Scheme Saba Scheme Kouk Krasang Scheme Kouk Pring Scheme Tonle Bati Scheme Chamtali Scheme Trakiet Scheme	Water is available all year round
(b) No water available by Reservoir	Trapeang Chak Scheme	Rainfed only. Irrigation development is not envisaged in this Master Plan due to topographical condition.
2. Without Prek Thnot Reservoir:		
(c) Run-of-the river only	Kandal Stung Scheme	Water from the river can be used for irrigation from May to December, but irrigation water is very limited during January to March.
(d) Run-of-river plus local regulation pond	Saba Scheme Tonle Bati Scheme	Water from the river can be used for irrigation from May, and some parts can be irrigated using the regulated water during dry season, but water is short in March.

The basic agricultural development concepts are formulated according to the above two main alternatives.

(1) Agricultural development

Rice is proposed as the main crop in the future cropping pattern, because rice is the staple food and farmers are traditionally rice cultivators, and the area is still facing shortage of rice. Double cropping of rice during the wet season is basically introduced but depend on the availability of irrigation water. Crop diversification with cash crops such as vegetables, feed crops for promotion of livestock raising are also introduced for increasing cash income and raising living standard of farmers. These proposed cropping patterns are formulated taking into account the availability of irrigation water, say, irrigated and non irrigated areas. Recommended farming practices are basically based on full use of animal power taking into consideration the present conditions in the Study Area. In the long term, however, mechanization of farming may be necessary especially for improving soils on the old elevated levee and timely cultivation of crops. Chemical fertilizers application is recommended for the proposed farming practices because of the poor soil fertility in the Study Area. Minimum use of pesticides is also recommended as one of means to avoid disastrous damages by pests if necessary. It is also recommended to establish IPM system through research by the national research institutes in collaboration with the agricultural extension system.

(2) Agro-industry and marketing development

Agro-industry will be considered in relation to the marketing system. The main product will be rice in the area so that milling of rice will be the main processing activity in the future. The marketing of rice is usually in the form of paddy and the milling activity is mostly for home consumption in the area. These activities are handled by small scale private sector under the free market system. The existing milling capacity of rice mills in the area is estimated at over the required milling capacity even around year

of 1999. The marketing system for agricultural inputs is very weak at present. It is proposed to establish a supply system of farm inputs through present government channel by strengthening the Agricultural Development Centres. The main commodities produced and marketed are pig and poultry and palm sugar beside rice.

At present there is no farmers' organization for marketing activities such as agricultural cooperatives in the Study Area. The products are usually sold at the farm gate to the middleman. Accordingly, the farmers have to sell those products without systematic negotiation of prices. It is recommended to promote farmers organization for marketing activity such as agricultural cooperatives, by transferring the function and facilities of marketing and input supply of the Agricultural Development Centres to the farmers organization in the future.

(3) Agricultural support services strengthening

The agricultural support services is to cover the whole Study Area not only for the irrigation development area but also for the area left without irrigation development.

There exist some constraints relevant to the present agricultural supporting system as described in the preceding sections. In order to cope with the prevailing constraints, a comprehensive supporting services are needed, consisting of rural credit, training program for farmers as well as extension workers, supply of farm inputs and seeds of improved varieties, together with appropriate farming techniques suitable for the agricultural conditions in the Study Area. The development concept is first of all to activate the existing Agricultural Development Centre in Tonle Bati Study Area, and Rural Development Centre in Kandal Stung Study Area. The Kandal Stung Study Area covers about 11,300 ha in gross which is rather large to be covered by the existing one centre so that one more development centre is proposed to be established beside the activation of the existing one. Operation plan of the centres will be formulated taking into consideration the cooperation with each district office, relevant research stations, development centres and other project such as IRRI-Cambodia Project. and also the various activities regarding the life improvement in the Study Area. The operation plan includes strengthening of extension system, improvement of input supply system, trial and demonstration work, introduction of improved crop and seed multiplication, etc. as well as agricultural and life improvement extension work.

(4) Farmers' organization development

The major function of farmers' organization is to carry out various activities related to marketing, operation and management of irrigation facilities and rural infrastructures, rural life improvement, community organizasion development, as well as promotion of agricultural production. The development plan is formulated taking into consideration of improving and strengthening the existing farmers groups and organizations. Formulation of the plan also includes the farmers participation from the project planning to implementation, so that motivation of the farmers toward the successful operation of the various program activities created by the project as well as operation and maintenance of facilities implemented by the project would be enhanced.

4.3.3 Proposed Cropping Pattern

(1) Basic principles

The proposed cropping patterns are formulated on the basis of the following basic principles which govern the selection of crops and cropping seasons to be introduced under the project condition:

i)With Prek Thnot Reservoir

a. In the wet season , 100 % of irrigable land would be cultivated with rice of which 20 % be still of local varieties.

b. In the dry season , 50 % of land be cultivated with improved rice varieties and the remaining 50 % be cultivated with upland crops under irrigated condition.

ii)Without Prek Thnot Reservoir

a. In the wet season, 100 % of irrigable land would be cultivated with rice of which 20 % be of local varieties.

b. In the dry season, 50 % of land be for improved varieties of rice, 30 % for upland crops such as maize, soybeans and vegetables, and the remaining 20 % in fallow.

c. The cropping period is staggered due to availability of labour and irriagtion water.

(2) Selection of crops

The most promising crops are selected in view of the above mentioned principles and the results of investigation on the natural and social conditions in the project area. Since rice has been a base of farming and economic activities and supply of staple food, and the farmers in the area have long experienced in rice cultivation, rice remains as the main food crops. The rice varieties to be introduced are high-yielding varieties with early to medium growth duration of about 120 to 150 days, photo period insensitive. Maize and soybeans are selected for the main secondary crops in the dry season, in connection with the promotion of livestock production especially pig and poultry. Some vegetables such as Chinese cabbage, cabbage, green string beans, kale, etc. are considered to be introduced as cash crops in the dry season. Greengrams, groundnut, sesame, sweet potato may also be introduced in the dry season.

(3) Land suitability

The land suitabilities in the Study Area for rice and other upland crops are classified as shown in Table IV-44 based on the results of soil and land use survey given in ANNEX II, and the proposed land use in the Study Area are summarized in the following table. As seen in the Table IV-44, present wetland rice areas are mostly suitable for wetland rice and other upland crops cultivation under irrigated condition, and will be able to satisfy the area for the proposed land use plan. No substantial change in land use is taken into account between the present and the future uses.

(unit: ha)

Land use categories	Kandal Stung	%	Tonle Bati	%	Total	%
1.Present*:						
Villages,roads,etc	1,500	13.2	400	5.8	1,900	10.4
Rainfed wet season rice field	7,300	64.6	5,100	73.9	12,400	68.1
Wet season uplandcrops field	300	2.7	50	0.7	350	1.9
Cattle grazing,unused	2,200	19.5	1,350	19.6	3,550	19.5
Gross area	11,300	100.0	6,900	100.0	18,200	100.0
2.With Prek Thnot Reservoir:						
Villages,roads,etc	1,500	13.3	400	5.8	1,900	10.4
Irrigated rice field	4,200	37.2	4,200	60.9	8,400	46.2
Rainfed wet season rice field	3,100	27.4	900	13.0	4,000	22.0
Wet season uplandcrops field	300	2.7	50	0.7	350	1.9
Cattle grazing,unused	2,200	19.5	1,350	19.6	3,550	19.5
Gross area	11,300	100.0	6,900	100.0	18,200	100.0
3.Without Prek Thnot Reservoir:						
Villages,roads,etc	1,500	13.3	400	5.8	1,900	10.4
Irrigated rice field	1,950	17.3	1,600	23.2	3,550	19.5
Rainfed wet season rice field	5,350	47.3	3,500	50.7	8,850	48.6
Wet season uplandcrops field	300	2.7	50	0.7	350	1.9
Cattle grazing,unused	2,200	19.5	1,350	19.6	3,550	19.5
Gross area	11,300	100.0	6,900	100.0	18,200	100.0

*The present land use is based on Table IV-44.

(4) Proposed cropping pattern

In due consideration of the above basic principles and given conditions which is mainly governed the irrigation water availability, the proposed cropping patterns are formulated for the two alternative conditions. The main aim of the proposed cropping pattern is to stabilize wet season rice crop, and then to introduce dry season rice crop about 50 % of the irrigated area, and also to introduce upland crops especially for livestock promotion, depending on the availability of water. The area of mixed cultivation of maize and soybeans are about 38 % of the irrigated area together with about 12 % of vegetables for the with Prek Thnot Reservoir condition. For the without Prek Thnot Reservoir condition, mixed cultivation of soybeans and maize, and vegetables are about 15 % , respectively. As the result, cropping intensities for each alternative are 200 % and 180 %, respectively. The details are given in Table IV-45 and illustrated in Figs. IV-10, and summarized as below.

i) With Prek Thnot Reservoir condition

The proposed cropping pattern for about 8,400 ha of irrigated area of Kandal Stung (4,200 ha) and Tonle Bati (4,200 ha) is as follows:

Crops	Wet season		Dry season	
	(%)	(ha)	(%)	(ha)
Rice:	100	8,400	50	4,200
Early dry season rice			50	4,200
Early wet season rice	50	4,200		
Medium wet season rice	30	2,520		
Medium local var. of rice	20	1,680		
Maize & soybeans			38	3,192
Vegetables			12	1,008
Total crop intensity	100	8,400	100	8,400

The total area of wet season rice would be 8,400 ha and the dry season rice area, 4,200 ha. The mixed culture of maize and soybeans would be about 3,200 ha, and the area for vegetables about 1,000 ha. About 3,100 ha and 900 ha of rainfed rice field is left without irrigation development in Kandal Stung and Tonle Bati area, respectively (see proposed land use plan also).

ii) Without Prek Thnot Reservoir condition

The proposed cropping pattern for total area of 3,550 ha of Kandal Stung (1,950 ha) and Tonle Bati (1,600 ha) irrigation development areas are as follows:

Crops	Wet season		Dry season	
	(%)	(ha)	(%)	(ha)
Rice:	100	3,550	48	1,700
Early dry season rice			48	1,700
Early wet season ric	50	1,775		
Medium wet season	30	1,065		
Medium local var. o	20	710		
Maize & soybeans			14	510
Vegetables			14	510
Total crop intensity	100	3,550	77	2,720

The total area of the wet season rice would be 3,550 ha and that of dry season would be 1,700 ha. The area for upland crops of maize and soybeans is about 510 ha and that of vegetables also about 510 ha, respectively. The rest of about 5,350 and 3,500 ha of existing rainfed rice field in Kandal Stung and Tonle Bati Study Area, respectively, would be remained as it is (see proposed land use plan also).

4.3.4 Proposed Farming Practices

Proper farming practices are essential for realising the full exploitation of agricultural potential in the project area. It is necessary to introduce new high-yielding varieties or hybrid seed with appropriate use of fertilizers and agro-chemicals along with the supply of irrigation water and institutional support services. The present farming practices prevailing in the project area are basically applied to the proposed practices such as animal power for soil preparation and transportation, manual operation for transplanting and harvesting, wet nursery system and ordinary transplanting method, etc. Although farm mechanization has various advantages such as speedy and smooth farming, emancipation from laborious work, etc. It requires large investment for the individual farmer, and research, experiment and guidance services for proper farm mechanization, etc. Taking into consideration these requirements and present circumstances, rapid introduction of full mechanization is not practicable in the area, but the some mechanization is necessary especially for chemical application, threshing rice, shelling maize and groundnut, etc.

Regarding plant protection, proper application of chemicals will become necessary for safe and effective control of insects and diseases taking into account the selection of

attractive agro-chemicals. The minimum use of pesticides is recommended to avoid disastrous damages by pests if necessssary with introduction of the environmentally sound practices by using selected chemicals such as Fenitrothion, Buprofezin, Dithiocarbamate, Benomyl, etc. The farmers should choose the chemicals through consultation with the Agricultural Development Centres and services. It is recommended to apply those under the guidance of the agricultural extension worker. It is recommended to organize the integrated pest management system for protection of the crops as well as the environmental conservation in the area.

The inputs and labour requirement for the proposed farming practices for each crop are summarized in Table IV-46. The staggering period for farm operation is determined based on the farm labour balance between the requirement for the proposed practices and the available family labour especially at the season of peak labour requirement and the available labour force. The average available labour force for farming for each house hold is estimated at 2.0 persons.

Proper management of livestock is essential to promote livestock production in the Study Area. The most of farmers are feeding animals with residues and byproducts of rice crops, and the animals are mostly freely roaming in and around the living areas, especially pig and poultry. This raising method makes very difficult not only to keep clean living environment of rural people, to promote home gardening, but also to keep animals in healthy condition. It is recommended to produce secondary crops for feed and construct proper houses for animals to manage feeding effectively and for better health condition of animals. Beside improvement of feed and houses, it is also essential to promote disease control of animals by extension of veterinary services such as vaccination and breeding of healthy animals.

4.3.5 Anticipated Crop Yield and Production

The present yield of crops in the project area is rather low level mainly due to lack of irrigation water, shortage of farm inputs, and low level of supporting services to supply farming techniques and materials. After implementation of the project, the yield of crops would be substantially increased and stabilized through getting accustomed to irrigation farming practices accompanied by agricultural support services. The increase of yield without the project is considered to be insignificant. The research results obtained by the IRRI-Cambodia Project were carefully referred for setting the target yield of rice as shown in Table IV-47. The target yield of crops at the full development stage is assumed as shown below:

(Unit : t/ha)

Crop		Present	Without irrigation*	With irrigation
Rice	Local varieties	1.2	2.5	3.0
	High Yielding Var.	-	-	4.0
Maize & beans(mixed)				
	Maize	1.2	1.5	3.0
	Soybeans	1.0	1.0	2.0
Groundnut		0.7	0.7	1.5
Mungbeans		0.6	0.6	1.0
Sesame		0.5	0.5	1.2

Notes: Yield for rice is in dried paddy, maize and groundnut for shelled grain. Maize and soybeans are grown as mixed crop. * Yield of without irrigation condition is assumed under the condition covered by agricultural support services.

Most of the farmers in the Study Area are not familiar yet with new varieties of crops and farming practices to be introduced such as proper fertilization, plant protection, and water management. In order to attain the projected target yield as earlier stage as

possible by applying the proposed farming practices, it is essential to improve and strengthen the present agricultural supporting services in keeping pace with the implementation of the infrastructural development. It would not take so long time to enable the farmers to sufficiently manage the operation of the irrigation facilities and to attain the projected target yield in success, because some of farmers in the area are rather familiar with the selected crops even for the new varieties. It is estimated at about 5 years of build-up period after completion of the project works and starting the proper agricultural support services.

The anticipated annual rice production at the full target level in the area are estimated as given in Table IV-48 and summarized as shown below:

		Net area(ha)	Planted area (ha)	Production (t)
1.	With Prek Thnot Reservoir condition			
1.1	Irrigation development area			
	Kandal Stung	4,200	6,300	24,360
	Tonle Bati	4,200	6,300	24,360
	Subtotal	8,400	12,600	48,720
1.2	Non irrigation development area			
	Kandal Stung	3,100	3,224	8,060
	Tonle Bati	900	984	2,460
	Subtotal	4,000	4,208	10,520
1.3	Study area total	12,400	16,808	59,240
2.	Without Prek Thnot Reservoir condition			
2.1	Irrigation development area			
	Kandal Stung	1,950	2,850	11,010
	Tonle Bati	1,600	2,400	9,280
	Subtotal	3,550	5,250	20,290
2.2.	Non irrigation development area			
	Kandal Stung	5,350	5,564	13,910
	Tonle Bati	3,500	3,740	9,350
	Subtotal	8,850	9,304	23,260
2.3	Studyarea total	12,400	14,554	43,550

As seen in above table, the anticipated rice production in the area at full target stage for the with Prek Thnot Reservoir condition is estimated at 59,240 t, while that for without Prek Thnot Reservoir condition is estimated at 43,550 t. The present rice production in the whole Study Area is estimated at about 15,600 t, and the increment of rice production by the project is expected at about 43,600 and 27,950 t for the with and without alternatives, respectively.

Anticipated production of the secondary crops such as maize and soybeans is estimated as given in Table IV-49, and summarized as follows:

	Kandal Stung		Tonle Bati		Total	
	Planted area	Prod.	Planted area	Prod.	Planted area	Prod.
	(ha)	(t)	(ha)	(t)	(ha)	(t)
1. With Prek Thnot Reservoir						
Maize	1,596	4,788	1,596	4,788	3,192	9,576
Soybeans	1,596	2,394	1,596	2,394	3,192	4,788
Vegetables	504	5,040	504	5,040	1,008	10,080
2. Without Prek Thnot Reservoir						
Maize	270	810	240	720	510	1,530
Soybeans	270	405	240	360	510	765
Vegetables	270	2,700	240	2,400	510	5,100

With Prek Thnot Reservoir condition, the expected production of the secondary crops is estimated at about 9,600 t of maize, 4,800 t of soybeans and about 10,000 t of vegetables. Without Prek Thnot Reservoir condition, the production is estimated at 1,500 t of maize, 800 t of soybeans and 5,100 t of vegetables respectively.

4.3.6 Anticipated Livestock Production

About 30 % of maize and soybeans produced in the project area is proposed to be fed to pig and poultry. These maize and soybeans are considered to bring about substantial increment newly produced by the project, beside the feed for the existing livestock production. The anticipated production of livestock is estimated as the increased production of pig which is very common animals in the Study Area. The requirement of feed to raise 50 kg of pig is estimated at about 250 kg of coarse grains. The expected increased production of pig in the Study Area is estimated as follows:

	Grains for fed*	Total no of pig	Incleased no of pig per household**
	(t)	(head)	(head)
1. With Prek Thnot Reservoir			
Kandal Stung	2,150	8,600	2.5
Tonle Bati	2,150	8,600	2.6
Total	4,300	17,200	
2. Without Prek Thnot Reservoir			
Kandal Stung Priority Development Area	360	1,440	0.7
Tonle Bati Priority Development Area	320	1,280	1.1
Total	680	2,720	

* About 30 % of production of maize and soybeans.

** Number of household included in irrigation development area is about 3,500 and 3,320 in Kandal Stung and Tonle Bati area, under with Prek Thnot Reservoir condition. Those for without condition, 2,170 and 1,140 in Kandal Stung and Tonle Bati area, respectively.

With Prek Thnot Reservoir condition, the increased number of pig would be about 17,200 heads, while without Prek Thnot Reservoir condition, it is estimated at bout 2,700 heads in the Study Area. The average annual production of pig per household in the Study Area at present is about 2 heads and 1.4 heads in Kandal Stung and Tonle Bati Study Area, respectively. In the irrigation development area under the with Prek Thnot Reservoir condition, the average number of pig increased per household is counted at about 2.5 heads in Kandal Stung Study Area, and about 2.6 heads in Tonle Bati Study

Area respectively. Without Prek Thnot Reservoir condition, the increased number of pig per household is estimated at about 0.7 heads in Kandal Stung Study Area, 1.1 heads in Tonle Bati Study Area, respectively.

4.4 Marketing and Price Prospects

The area is located in the suburbs of Phnom Penh and densely populated with high increase rate. It is expected that a considerable rice demand will be continued under these circumstances, and the considerable demand of livestock production will be also expected especially for markets to Phnom Penh in view of change in diet for food of high proteins and increase in population.

The prospective prices of farm output and inputs were estimated based on the World Bank's forecasts on price prospects for rice, maize, soybeans, chemical fertilizers and agro-chemicals. The present and the estimated prospective economic prices at farm gate are as shown below:

Commodities	Present prices US$/t (Riel/kg)		Prospective prices (US$/t)
Paddy	182	400	207
Maize	218	480	147
Soybenas	400	880	283
Chinese cabbage	318	700	164
Urea	218	480	261
15-15-15	264	580	-
Muriate of potash		-	241
Pesticides	511	1,125	221

4.5 Agricultural Benefit

The anticipated agricultural production value increased by the project is evaluated as the agricultural benefit of the project under with and without Prek Thnot Reservoir conditions. The increased agricultural production value per ha is estimated as the unit incremental benefit by the projcet as shown below.

(Unit: US$/ha)

	With Prek Thnot Reservoir		Without Prek Thnot Reservoir	
	Irrigation	Non irrigation	Irrigation	Non irrigation
Incremental value				
Kandal Stung	1,557	183	1,261	183
Tonle Bati	1,557	183	1,326	183

Source: Tables IV-50.

Based on the above unit incremental value, the total incremental value is estimated for the each alternative area as follows.

	With Prek Thonot Reservoir			Without Prek Thnot Reservoir		
	Irrigation	Non irrigation	Total	Irrigation	Non irrigation	Total
Incremental value (US$/ha)						
Kandal Stung	1,557	183		1,261	183	
Tonle Bati	1,557	183		1,326	183	
Project area (ha)						
Kandal Stung	4,200	3,100	7,300	1,950	5,350	7,300
Tonle Bati	4,200	900	5,100	1,600	3,500	5,100
Incremental value (1,000 US$)						
Kandal Stung	6,539	567	7,106	2,459	979	3,438
Tonle Bati	6,539	165	6,704	2,122	641	2,763
Total	13,078	732	13,810	4,581	1,620	6,201

Under with Prek Thnot Reservoir condition, the anticipated agricultural benefit is estimated at about US$ 13.1 million, and US$ 0.7 million for irrigation development area and non irrigation development area, respectively. Under without Prek Thnot Reservoir condition, the anticipated agricultural benefit is estimated at about US$ 4.6 million, and US$ 1.6 million for irrigation development area and non irrigation development area, respectively.

The economic agricultural benefit for the irrigation development area uner without Prek Thnot Reservoir condition, the incremental benefit is estimated at US$ 2.1 million and US$ 1.8 milion for Kandal Stung and Tonle Bati areas, respectively. The total agricultural benefit is estimated at about US$ 3.9 million for the irrigation development area as shown in Table IV-52.

4.6 Farm Household Economy

In order to evaluate the project feasibility from farmers' household economy, typical household budget were prepared for the future 4 development alternatives, i.e. irrigation development area and non irrigation development area for with and without Prek Thnot Reservoir conditions as shown below:

1. With Prek Thnot Reservoir:	Irrigation area		Non Irrigation area	
	Kandal Stung	Tonle Bati	Kandal Stung	Tonle Bati
Gross income	2,561	2,732	776	798
Production cost	360	390	135	148
Net income	2,201	2,342	641	650
Living expenses	1,364	1,364	641	650
Net reserve	837	978	0	0
2. Without Prek Thnot Reservoir:	**Irrigation area**		**Non Irrigation area**	
	Kandal Stung	Tonle Bati	Kandal Stung	Tonle Bati
Gross income	1,635	2,640	776	798
Production cost	158	233	135	148
Net income	1,477	2,407	641	650
Living expenses	1,364	1,364	641	650
Net reserve	113	1,043	0	0

Source: Table IV-50

In the irrigation area under the with or without Prek Thnot Reservoir conditions, the net income of the household is sufficient to pay more than US$ 1,360 of annual living expenses, and will have considerable capacity to pay. While in the non irrigation area of Kandal Stung, the household will get farm income about 1.5 times of the total income (farm income plus off-farm income) of about US$ 530/year at present. The household in Tonle Bati of non irrigation area will gain about 1.3 times of present household income of about US$ 600. In the non irrigation area, the household may be necessary to earn off-farm income in the future to improve their life.

4.7 Agricultural Supporting Services Development Plan

4.7.1 Development Concept

(1) Objectives of support services

The objectives of the agricultural support services in the Stury Area is to extend necessary assistance to the farmers based on the following principles to attain the agricultural development objectives proposed under the project:

a. to identify problems, to look for solutions, to solve the problems identified, and to monitor and evaluate the results,

b. to acquire sufficient knowledge, insight and skills in order to reach the agricultural development objectives,

The main agricultural development components proposed are to raise crop and livestock productions in order to increase farm household income and to enable the farmers to enjoy the improved rural life with full use of the facilities constructed under the project. The area to be covered by the agricultural support services is not limited to the irrigation development area but to the whole Study Area.

The proposed supporting services comprises (i) the agricultural technical extension, (ii) agricultural inputs and equipment supply, rural credit supply and agricultural insurance system (iii) operation and maintenance of irrigation and drainage system and provided rural infrastructures such as road and domestic water supply. The supporting services also extend to the field of rural life improvement.

(2) Organization strengthening

There exist various constraints relevant to the present agricultural supporting system. In order to cope with the prevailing constraints, a comprehensive supporting service system is needed through effective staffing and facilities provided, and which consists of rural credit, training for farmers as well as extension workers, supply of farm inputs and quality seed of improved varieties together with appropriate farming techniques suitable for the agricultural conditions in the Study Area. The development plan includes the activation of the existing Agricultural Development Centre in Tonle Bati area, and Rural Development Centre in Kandal Stung area. The Kandal Stung Centre covers about 11,300 ha which is rather large to provide the services effectively so that establishment of one more agricultural development centre is proposed beside the activation of the existing centre.

(3) Operation of support services

Operation plan of the centres is formulated taking into consideration the cooperation and coordination with each district office, relevant research stations,

development centres and other project such as IRRI-Cambodia Project and also the various activities regarding the life improvement in the Study Area. The Government has started an improvement plan of agricultural extension system from the national level to commune level. According to the improvement plan, the new Department of Extension will be established under MAFF and be responsible for agricultural extension work through provincial, district and each commune levels with providing agricultural extension workers.

In this Master Plan, it is proposed that the agricultural supporting services at the initial stage in the project area will be carried out by the Agricultural Development Centres which will be operated directly under the management of the Department of Extension. And afterward, operation of the Agricultural Development Centres with sufficient qualified extension workers and facilities will be transferred to the management under each district office. The proposed operation system of the Agricultural Development Centres for agricultural services are illustrated in Fig. IV-11.

4.7.2 Agricultural Extension

The proposed agricultural extension services will be provided mainly for food (rice) and some other secondary crops and livestock raising mainly pig, poultry and cattle for draft power, through provision of trained extension personnel, vehicles and equipment and office buildings to be constructed.

(1) Extension activities

Key points for emphasis in agricultural extension are summarized as follows:

i) Introduction of improved varieties:

Introduction of the improved and recommendable varieties selected through the experiments by agricultural research stations as well as IRRI project activities. Execution of simple trials and demonstration cultivation of the introduced varieties in the Stury Area to confirm suitability to conditions of the area.

ii) Supply of planting materials:

Multiplication and supply of extension seed of the introduced varieties required by the farmers. The multiplication will be carried out by the contracted leading farmers' field.

iii) Demonstration and guidance on cultivation techniques:

Demonstration and guidance for cultivation of crops such as improved nursery management, kind, rate, timing and method of application of fertilizers and pesticides, pest surveillance, communal rat control, water management including irrigation and drainage.

iv) Extension on livestock production:

Education of farmers on potentials and methods of keeping animals for better production, improved nutrition and disease control, housing construction, and basic breeding guidelines,

v) Strengthening of vaccination service:

Vaccination for the animals will be extended using animal health mobile unit organized in the agricultural development centres, and

vi) Monitoring and evaluation

Monitoring and evaluation of the results obtained through the agricultural services activities should be executed for further feed back to improvement of the agricultural support services activities.

(2) Proposed staffing for agricultural extension

The proposed Agricultural Development Centres will be the base for the agricultural extension work in the project area, and the covering area of each centre, name of commune, number of villages, number of families are summarized as follows:

Agricultural Development Centre	GrossArea	Covered Communes	No.of Village	No. of Family	Proposed No. of Field worker
	(ha)	(No.)			
1. Kandal Stung No. 1		Trapieng Veng	4	354	1
(Existing)		Tbeng	2	135	1
		Thmey	5	259	1
		Trea	9	783	2
		Prek Roka	4	645	2
Sub total	5,600	(5)	24	2,131	7
2. Kandal Stung No. 2		Anlong Romeat	6	451	1
(Newly proposed)		Spean Thmar	8	512	1
		Rolous	3	353	1
		Preas Puth	5	356	1
		Kong Noy	4	222	1
		Teang	6	345	1
		Bakou	7	612	2
		Kok Trop	9	716	2
Sub total	5,700	(8)	48	3,567	10
3. Tonle Bati		Champey	7	797	2
(Existing)		Put Sar	11	1,350	3
		Kraing Thnung	3	356	1
		Kandeong	3	228	1*
		Trapieng Sap	1	97	1*
Sub total	6,900	(5)	25	2,828	9
Total	18,200	(18)	97	8,526	26

The required number of field extension worker is estimated based on the following assumptions:

i) The number of family to be covered by one field extension worker are proposed to be about 300 to 400 at the maximum.

ii) The farmers group to be covered by one field worker is assumed at about 10 to 16, and one farmers group is composed of about 25 to 30 farm households.

iii) The working day for field worker are:

a. Visit one group twice a month,
b. Visit two groups a day,
c. Field working days per week are 4 days,
d. Training and study for worker himself for 2 days a week,

The proposed number of field extension worker to be assigned for each agricultural development centre and their specialities are summarized as follows:

Specialities	Kandal Stung No.1	Kandal Stung No.2	Tonle Bati	Total
Rice/Secondary crops	2	6	6	14
Horticultural crops	2	2	2	6
Livestock/Veterinary	3	2	2	5
Total	7	10	10	27

Beside the filed workers listed above, subject matter specialists for rice, secondary crops and livestock/veterinary are required for each Agricultural Development Centre.

(3) Facilities and equipment

The facilities and equipment for agricultural extension work are required for both activities of field and office works. The Agricultural Development Centres serve as the home base of the field extension workers. The community hall established in each commune will be the field office of the field worker and will be used for training of farmers, and residence for the worker will be provided near the community hall. The training of farmers group will be mostly carried out at the community hall. The offices, buildings and facilities required to be provided are summarized as follows:

	Facilities and Equipment	Quantity
1.	In Agricultural Development Centre:	
	Office space for subject matter specialists	3 specialists in each centre
	4WD vehicle	3 for each centre
	Minibus(20 persons)	1 for each centre
	Mobile extension unit vehicle(4WD) with audio visual equipment and veterinary service	1 in each centre
	Cold storage for vaccine (solar energy)	1 in each centre
	Copy/printing machine	1 in each centre
	Personal Computers with printer	1 set in each centre
	Residence	1 residence for each specialist
	Trial cum demonstration farm	1 ha for each centre
	Electricity supply	1 in each centre
	Portable generator for community hall	2 for each centre
	Farm machinery for demonstration	1 set of machanized rice farming for each centre
2.	In Community Hall	
	Office space for field worker	1~3 persons
	Motor cycle	1 for each worker
	Residence	1 for each worker
	Store space for equipment	1 space in each hall
	Trial farm	0.1 ha
	Life improvement training facilities	1 set

4.7.3 Agricultural Input Supply System

The basic concept for the proposed supply system of agricultural inputs required is to improve the existing supply system of the Government channel by the Central Company of Agricultural Material (CCAM), basically. The key points for the improvement are:

a. to supply inputs required to the whole project area by CCAM through the Agricultural Development Centres,

b. to strengthen the storage and handling capacity of Agricultural Development Centres to meet the requirement,

c. command area of one storage to be constructed is about 2,000 ha of field,

The amount of fertilizers and agro-chemicals required for command area of each Agricultural Development Centre are as follows:

Agricultural Development Centre	Command area (ha)	Inputs	Requirement (t)
		Fertilizers(ton)	Chemicals(lit.)
1. Kandal Stung No.1	2,700	1,000	11,000
2. Kandal Stung No.2	4,340	1,500	17,000
3. Tonle Bati	5,700	2,000	23,000

Base for estimation:

i) Command area is estimated on the basis of 1.2 and 1.3 ha/family in Kandal Stung and Tonle Bati area, respectively.

ii) Requirement of fertilizers and chemicals is 350 kg/ha and 4 litre/ha on average, respectively.

iii) The storing capacity of storage is for one crop season for each area.

The number of storage required for each Agricultural Development Centre is one (1), two (2) and three (3) for Kandal Stung No. 1, Kandal Stung No. 2 and Tonle Bati, respectively.

The proposed input supply system forms one of sections of the Agricultural Development Centre. CCAM is responsible for handling of materials, i.e. loading and unloading, transportation to the store and stacking of materials, and individual farmer receives and carries those by ox-cart to his home from the storehouse.

Staffing required for operation of the section and each storage are summarized as follows:

Staff	Requirement
Section Chief	1 in each centre
Store house manager	1 in each store
Clerks	2 in each store
Store keeper	2 in each store

4.7.4 Agricultural Credit Services and Insurance

(1) Credit Services

The MAFF(Department of Extension) is proposed to be the implementing institution of the credit program, and the Agricultural Development Centre will be the contact point to the borrowers. For the implementing the credit progarm, it is important to motivate the farmers by informing and discussing on the credit system with them. And the program should be implemented and funded based on the request by the farmers where the credit is really needed. The following kind and categories of activities to be covered by the credit taking into consideration of the experiences observed through NGOs activities in the area:

-Rice for home consumption, especially during planting time to before harvesting,

-Small amount of investment for income-generating activities such as livestock raising, home vegetable garden, small business, etc. and

-Inputs for farming especially for fertilizres and improved seed.

The proposed credit system is a kind of "small farmers development credit" or "credit for poor. The borrowers should be limited to the poor only, but not for the rather rich farmers. In the right of experiences by NGOs such as WVI and WCC in the area, the borrowers should be organized into solidarity groups that provide mutual support and be responsible for repayment. The size of one group will be about 10 to 15 members. The credit should be channelled through the groups for delivery and repayment, assisted by the agricultural and rural improvement extension workers of the Agricultural Development Centres.

For the sustainable and effective operation of the program, some strategies and activities by the implementing institution should carefully be considered; adequate and appropriate training and preparation of borrowers, assurance of subsequent loans upon repayment of old loans, effective savings mobilization, etc.

(2) Insurance

It is recommended to implement an agricultural insurance system by the Government as a public policy measure to promote general welfare among the people or

the sector, as a kind of social insurance to ensure security and risk-taking in agriculture. Along with success of the proposed credit services and community development in a sense of mutual aid, effective mobilization of savings, formation of fund, sufficient institutional capacity of implementation, then the fund can be used for mutual aid or mutual insurance when some members of them suffered from crop losses, etc.

4.7.5 Agro-industry and Marketing Development

Agro-industry development is necessary to be considered in relation to the marketing system. The main product under with project condition will be rice. Rice milling will be the main processing activity in the future also. The present rice processing activity and marketing system was carefully studied. The free marketing system has been applied and processing and marketing of rice is mostly handled by private sector. The marketing of rice is usually in the form of paddy and milling of rice is mainly for home consumption in the Study Area. The number and capacity of rice mill existing in the Study Area was surveyed. According to the study, the existing capacity of rice mills is estimated at about 9,000 and 10,000 t/year (out put) for Kandal Stung and Tonle Bati area, respectively (see ANNEX-VI). The milling capacity required in the future is roughly estimated based on the following assumptions:

i) Consumption per capita in future; 162 kg/year in rice (Government target)

ii) Population and paddy consumption in future

(1,999 year with annual population growth rate of 2.8 %);

Kandal Stung Study Area 26,120 x 1.15=30,000
30,000 person x 162 kg/year=49,000t/year

Tonle Bati Study Area 15,500 x 1.15=17,800
17,800 person x 162 kg/year=2,900 t/year

iii) Existing milling capacity;

Kandal Stung area 9,000 t/year
Tonle Bati area 10,000 t/year

As seen in above, the existing capacity of rice mill in the area is already over the estimated requirement for around 1999. Therefore, no additional rice mill is considered to be required in the near future.

It is recommended to promote farmers organisation for marketing activities such as agricultural cooperatives, by transferring the function and facilities of marketing and inputs supply of the Agricultural Development Centres to the farmers organization in the future along with the progress of toperation capacity of farmers.

4.7.6 Farmers' Organization

The basic concept for development of farmers' organization is to carry out various supporting activities through the proposed Agricultural Development Centres, related to operation and management of irrigation facilities and rural infrastructures, rural life improvement, and community development, as well as promotion of agricultural production. There is no effective farmers' organization in the Study Area at present. The following are the anticipated groups to be established:

a. Water users' association (irrigation water)
b. Drinking water supply group (wells)
c. Small farmers' credit group
d. Cultivation techniques study group

e. Life improvement leading group
f. FHH/women's group

(1) Water users' association (irrigation water)

Water users' group as the beneficiaries at the end will be established for operation and management of on farm irrigation facilities and be integrated to the water users' association. The formulation of the group is designed based on the proposed layout of the irrigation systems and water sources. Preferably, one water users' group is formulated at one quaternary canal level consisting of 7-10 families on average. One water users' association is instituted by organizing the groups of one irrigation block which cover about 400 ha on average.

The proposed water users' association is composed of 1-chairman, 1-secretary, 1-treasurer, 1-water master and 4-ditch tenders. The main activities of the association are clearing and maintenance of irrigation and drainage canals below tertiary irrigation blocks, and scheduling of water delivery within the control area. It is recommended to start activities of organization of the groups by participation of the farmers from the planning stage of the project. The water users' association will receive technical guidance and instructions through the Agricultural Development Centres.

(2) Drinking water supply group

The principles for formulation of drinking water supply group are as follows:

a. One users' group for one well,
b. To prepare proposal for well construction, and implement the well by assistance from the life improvement section of the Agricultural Centres,
c. To be responsible for appropriate use and maintenance of the facilities.

(3) Small farmer's credit group

The principles for formulation of small farmer's credit group are as follows:

a. The group will be responsible for disburse and repayment of the credit,
b. To prepare proposal for formulation of the credit group to apply loans for farm inputs, pig and poultry raising, materials for home gardening, retail shops and small business, etc.

The system which has been carried out by the existing Agricultural Centres cooperated with NGOs will be taken into account for organizing the credit groups. It is proposed that the credit services will be taken care by the supply and marketing section of the Agricultural Development Centres.

(4) Cultivation techniques study group

For effective extension of crop production techniques to the farmers, it is recommended to formulate a farmers' study group for cultivation techniques. The member of the group will be leading farmers and the main activities of the group will be to introduce improved vaireties and techniques and to demonstrate to other farmers under the guidance of the extension workers, and to help extension workers as the grass root coordinator for the agricultural extension work in the area.

(5) Life improvement leading group

For establishment of the better rural life, it is essential to motivate the co-operative activities of the peoples in a community. It is proposed to organize life improvement leading groups for effective life improvement extension work. The size of one group is of about 20 members having common objectives to improve their rural life. The group will be formulated through meetings or participation to the field workshops concerned to their life improvement. And as a goal, the group will become to have their own opinions and to raise recommen-dations to the rural life improvement extension work.

(6) FHH/women's group

Khmer Women Association is considered as vehicles to promote grass roots organization of women. The activity of women's organization will be effective especially for extension of life improvement in views of hygiene and health in their home life. The organization will be effective for small farmers' credit scheme such as home gardening and raising of pig and poultry. Establishment of FHHs group is necessary to extend special care by the Agricultural Development Centres for life improvement extension as well as to promote agricultural productions.

4.7.7 Strengthening of Agricultural Development Centre

All of the proposed agricultural support services will be extended through the proposed Agricultural Development Centre . The proposed organization of the Agricultural Development Centre is as shown in Fig. IV-11. Each centre will be composed of 5 sections, i.e. Agricultural Extension, Supply and Marketing, Life Improvement, Operation and Maintenance, and Administration. Each section has a section chief with the staff and facilities proposed for each service activity.

The staffing and facilities proposed for each Centre are summarized below:

(1) Kandal Stung No.1 Centre

This centre covers Southern part of Kandal Stung Study Area in which irrigation development project will not be implemented neither under with Prek Thnot Reservoir nor under with Prek Thnot Reservoir mainly due to geographical condition. There exists a Rural Development Centre operated under the Department of Agriculture cooperated with WVI. This centre will be improved and reactivated with provision of staff and facilities. The proposed command area of field by this centre is about 2,700 ha, composed of 5 communes, i.e. Trapieng Veng, Tbeng, Thmey, Trea and Prek Roka, and 2,131 families at present. The proposed organization and staff are given in the following table:

Section	Staffing
1. Administration	1- General manager
	1- Section chief
	1- Clerk
	1- Accountant
	1- Typist
	5- Vehicle drivers
	3- Office boy
	2- Security
2. Agricultural extension	1- Section chief
	3- Subject matter specialist (1 is section chief out of 3)
	7- Field extension worker
	2- Machinary operator
3. Life improvement extension	1- Section chief (Specialist)
	3- Life improvement worker
4. Supply and Marketing	1- Section chief
	1- Store house manager
	2- Clerks
	2- Store keeper
5. Operation and Maintenance	1- Assistant civil engineer
	2- Maintenance work supervisor
	2-Machinery operator

(2) Kandal Stung No.2 Centre

This centre is proposed to be newly established with provision of staff and facilities to cover Northern part of Kandal Stung Study Area in some part of which irrigation development project will be implemented under the condition of without Prek Thnot Reservoir, and almost entire area will be covered with irrigation development under with condition of Prek Thnot Reservoir. The proposed command area of farm land by this centre is about 4,340 ha, composed of 8 communes, i.e. Anlong Romeat, Spean Thmar, Rolous, Preas Puth, Kong Noy, Teang, Bakou and Kok Trop, 3,567 families at present. The proposed organization and staff are given in the following table:

Section	Staffing
1. Administration	1- General manager
	1- Section chief
	1- Clerk
	1- Accountant
	1- Typist
	5- Vehicle drivers
	3- Office boy
	2- Security
2. Agricultural extension	1- Section chief
	3- Subject matter specialist (1 is section chief out of 3)
	10- Field extension worker
3. Life improvement extension	1- Section chief (Specialist)
	5- Life improvement worker
4. Supply and Marketing	1- Section chief
	2- Store house manager
	4- Clerks
	4- Store keeper
5. Operation and Maintenance	1- Sector Chief (Canal system manager)
	2- Maintenance work supervisor
	2- Machinary operator
	2- Ditch tender

(3) Tonle Bati Agricultural Development Centre

The exiting Centre is proposed to be improved with provision of staff and facilities to cover the Tonle Bati Study area in some part of which irrigation development project will be implemented under the condition of without Prek Thnot Reservoir, and almost entire area will be covered by irrigation development under with Prek Thnot Reservoir. The proposed command area of this centre is about 5,700 ha, composed of 5 communes, i.e. Champey, Put Sar, Kraing Thnung, Kandeong and Trapieng Sap, 2,828 families. The proposed organization and staff are given in the following table:

Tonle Bati Centre:

Section	Staffing
1. Administration	1- General manager
	1- Section chief
	1- Clerk
	1- Accountant
	1- Typist
	5- Vehicle drivers
	3- Office boy
	2- Security
2. Agricultural extension	1- Section chief
	3- Subject matter specialist (1 is section chief out of 3)
	10- Field extension worker
3. Life improvement extension	1- Section chief (Specialist)
	6- Life improvement worker
4. Supply and Marketing	1- Section chief
	3- Store house manager
	6- Clerks
	6- Store keeper
5. Operation and Maintenance	1- Canal system manager
	2- Maintenance work supervisor
	2- Machinary operator
	2- Ditch tender

The staffing and facilities proposed for each Centre are summarized in Table IV-55.

5. AGRICULTURAL DEVELOPMENT PLAN IN PRIORITY DEVELOPMENT AREA

5.1 Proposed Agricultural Development Plan

5.1.1 Basic Development Concepts

Reflecting the development need and the national development policy, the development objectives for the agricultural development plan in the Master Plan recognized are (i) to raise farmer's income level through enhancement of agriculture, especially rice and livestock productions, by efficient utilization of the land and water development potential in the area, (ii) to contribute to regional need to increase rice production with the aim of achieving self-sufficiency in rice in the Master Plan Study area, and (iii) to raise living standard and improve rural peoples life through generating farm income and extension of living techniques.

The basic development concepts of agricultural development plan for the Priority Development Areas basically follow to the above mentioned development objectives clarified in the Master Plan Study.

5.1.2 Proposed Cropping Pattern

(1) Basic principles

The planned irriagtion development in the Priority Development Areas is basically without Prek Thnot Reservoir condition. The proposed cropping patterns are formulated on the basis of the following basic principles which govern the selection of crops and cropping seasons to be introduced under the project condition:

a. In the wet season, 100 % of irrigable land would be cultivated with rice of which 20 % be of local varieties.

b. In the dry season, 50 % of land be for improved varieties of rice, 30 % for upland crops such as maize, soybeans and vegetables, and the remaining 20 % in fallow.

c. The cropping period is staggered due to availability of labour and irrigation water.

(2) Selection of crops

Since rice has been a base of farming and economic activities and supply of staple food, and the farmers in the area have long experienced in rice cultivation, rice remains as the main food crops. The rice varieties to be introduced are high-yielding varieties with early to medium growth duration of about 120 to 150 days, photo period insensitive. Maize and soybeans are selected for the main secondary crops in the dry season, in connection with the promotion of livestock production especially pig and poultry. Some vegetables such as Chinese cabbage, cabbage, green string beans, kale, etc. are considered to be introduced as cash crops in the dry season. Greengrams, groundnut, sesame, sweet potato may also be introduced in the dry season.

(3) Proposed cropping pattern

In due consideration of the above basic principles the proposed cropping patterns are formulated for the Priority Development Areas. The main aim of the proposed cropping pattern is to stabilize wet season rice crop, and then to introduce dry season rice crop to some extent of the irrigated area, and also to introduce upland crops especially for livestock promotion. The mixed cultivation of maize and soybeans is also considered for the irrigated area together with vegetables.

The proposed cropping pattern for Kandal Stung Priority Development Area (1,950 ha) and Tonle Bati Development Area (1,600 ha) are formulated based on the above mentioned concepts as shown in Table IV-56 and Fig. IV-10 and summarized as follows:

Kandal Stung area(1,950 ha):

Crops	Wet season		Dry season	
	(%)	(ha)	(%)	(ha)
Rice:	100	1,950	46	900
Early dry season rice			46	900
Early wet season rice	50	975		
Medium wet season rice	30	585		
Medium local var. of rice	20	390		
Maize & soybeans			14	270
Vegetables			14	270
Total crop intensity/area	100	1,950	74	1,440

The total area of the wet season rice would be 1,950 ha and that of dry season would be 900 ha. The area for upland crops of maize and soybeans is about 270 ha and that of vegetables also about 270 ha, respectively. The cropping intensity for wet season and dry season and dry season is 100% and 74%, respectively.

Tonle Bati area(1,600 ha):

Crops	Wet season		Dry season	
	(%)	(ha)	(%)	(ha)
Rice:	100	1,600	50	800
Early dry season rice			50	800
Early wet season rice	50	800		
Medium wet season rice	30	480		
Medium local var. of rice	20	320		
Maize & soybeans			15	240
Vegetables			15	240
Total crop intensity/area	100	1,600	80	1,280

The total area of the wet season rice would be 1,600 ha and that of dry season would be 800 ha. The area for upland crops of maize and soybeans is about 240 ha and that of vegetables also about 240 ha, respectively. The cropping intensity for wet season is 100% and 80%, respectivity.

5.1.3 Proposed Farming Practices

It is necessary to introduce new high-yielding varieties or hybrid seed with appropriate use of fertilizers and agro-chemicals along with the supply of irrigation water and institutional support services. The present farming practices prevailing in the project area are basically applied to the proposed practices such as animal power for soil preparation and transportation, manual operation for transplanting and harvesting, wet nursery system and ordinary transplanting method, etc. Some mechanization is necessary especially for chemical application, threshing rice, shelling maize and groundnut, etc.

Regarding plant protection, proper application of chemicals will become necessary for safe and effective control of insects and diseases. The minimum use of pesticides is recommended to avoid disastrous damages by pests if necessary with introduction of the environmentally sound practices by using selected chemicals such as Fenitrothion, Buprofezin, Dithiocarbamate, Benomyl, etc. The farmers should choose the chemicals through consultation

with the Agricultural Development Centres and services. It is recommended to apply those under the guidance of the agricultural extension worker. It is recommended to organize the integrated pest management system for protection of the crops as well as the environmental conservation in the area.

The inputs and labour requirement for the proposed farming practices for each crop are summarized in Table IV-46. The staggering period for farm operation is determined based on the farm labour balance between the requirement for the proposed practices and the available family labour especially at the season of peak labour requirement and the available labour force. The available labour force for farming for each house hold is estimated at 2.5 persons on average.

Proper management of livestock is essential to promote livestock production in the study area. It is recommended to produce secondary crops for feed and construct proper houses for animals to manage feeding effectively and for better health condition of animals. Beside improvement of feed and houses, it is also essential to promote disease control of animals by extension of veterinary services such as vaccination and breeding of healthy animals.

5.1.4 Anticipated Crop Yield and Production

The present yield of crops in the Priority Development area is rather low level mainly due to lack of irrigation water, flooding and poor drainage, shortage of farm inputs, and low level of supporting services to supply farming techniques and materials. After implementation of the project, the yield of crops would be substantially increased and stabilized through getting accustomed to irrigation farming practices accompanied by agricultural support services. The increase of yield without the project is considered to be insignificant. The research results obtained by the IRRI-Cambodia Project were carefully referred for setting the target yield of rice as shown in Table IV-47. The target yield of crops at the full development stage is assumed as shown below:

(Unit : t/ha)

Crop	Present	Without irrigation*	With irrigation
Rice Local varieties	1.2	2.5	3.0
High Yielding Var.	-	-	4.0
Maize & beans(mixed)			
Maize	1.2	1.5	3.0
Soybeans	1.0	1.0	2.0
Groundnut	0.7	0.7	1.5
Mungbeans	0.6	0.6	1.0
Sesame	0.5	0.5	1.2

Notes: Yield for rice is in dried paddy, maize and groundnut for shelled grain. Maize and soybeans are grown as mixed crop. * Yield of without irrigation condition is assumed under the condition covered by agricultural support services.

Most of the farmers in the area are not familiar yet with new varieties of crops and farming practices to be introduced such as proper fertilization, plant protection, and water management. In order to attain the projected target yield as earlier stage as possible by applying the proposed farming practices, it is essential to improve and strengthen the present agricultural supporting services in keeping pace with the implementation of the infrastructural development. It would not take so long time to enable the farmers to sufficiently manage the operation of the irrigation facilities and to attain the projected target yield in success, because some of farmers in the area are rather familiar with the selected crops even for the new varieties. It is estimated at about 5 years of build-up period after completion of the project works and starting the proper agricultural support services.

The anticipated annual rice production at the full target level in the area are estimated as given in Table IV-57 and summarized as shown below:

Irrigation Development Area	Net area (ha)	Planted area (ha)	Production (t)
Kandal Stung	1,950	2,850	11,010
Tonle Bati	1,600	2,400	9,280

As seen in above table, the anticipated rice production in the area at full target stage is estimated at 11,010 t and 9,280 t for Kandal Stung and Tonle Bati Priority Development Area, respectively. The present rice production in the each area is estimated at about 2,900 t and 2,400 t, respectively. The increment of rice production by the project is expected at about 8,100 t and 6,900 t for each area, respectively.

Anticipated production of the secondary crops such as maize and soybeans is estimated as given in Table IV-57, and summarized as follows:

	Kandal Stung		Tonle Bati	
	Planted area	Production	Planted area	Production
	(ha)	(t)	(ha)	(t)
Maize	270	810	240	720
Soybeans	270	405	240	360
Vegetables	270	2,700	240	2,400

The expected production of the secondary crops in Kandal Stung area is estimated at about 810 t of maize, 405 t of soybeans and about 2,700 t of vegetables. The expected production secondary crops in Tonle Bati area is estimated at 720 t of maize, 360 t of soybeans and 2,400 t of vegetables respectively.

5.1.5 Anticipated Livestock Production

About 30 % of maize and soybeans produced in the project area is proposed to be fed to pig and poultry. The anticipated production of livestock is estimated as the increased production of pig which is very common animals in the study area. The requirement of feed to raise 50 kg of pig is estimated at about 250 kg of coarse grains. The expected increased production of pig in the study area is estimated as follows:

	Grains for fed*	Total no of pig	Increased no.of pig per household**
	(t)	(head)	(head)
Kandal Stung	360	1,440	0.7
Tonle Bati	320	1,280	1.1

* About 30 % of production of maize and soybeans.

** Number of household included in priority development area is about 2,170 and 1,140 in Kandal Stung and Tonle Bati area, respectively.

The increased number of pig would be about 1,440 heads in Kandal Study Priority Development Area, 1,280 heads in Tonle Bati Priority Development Area, respectively. The average annual production of pig per household in the Priority Development Area at present is about 0.8 heads and 1.8 heads in Kandal Stung and Tonle Bati area, respectively. In the irrigation development area the average number of pig increased per household is counted at about 0.7 heads in Kandal Stung area, and about 1.1 heads in Tonle Bati area, respectively.

5.2 Agricultural Benefit

The anticipated agricultural production value increased by the project is evaluated as the agricultural benefit of the project. The increased agricultural production value per ha is estimated as the unit incremental benefit by the project for the Priority Deveropment Areas as shown below:

	Incremental benefit	
	Kandal Stung	Tonle Bati
Unit increment (US$/ha)	1,261	1,326
Project area (ha)	1,950	1,600
Total increment (1000 US$)	2,459	2,122

The anticipated agricultural benefit is estimated at about US$ 2.5 million, and US$ 2.1 million for Kandal Stung and Tonle Bati Priority Development Area, respectively(refer to Table IV-50).

The economic agricultural benefit for the Priority Development Area under without Prek Thnot Reservoir condition, the incremental benefit is estimated at US$ 2.1 million and US$ 1.8 million for Kandal Stung and Tonle Bati areas, respectively as shown in Table IV-52.

5.3 Farm Household Economy

In order to evaluate the project feasibility from farmers' point of view in the Priority Development Areas, typical farm household budget were assessed for the with and without project conditions as follows:

	Without project		With project	
	Kandal Stung	Tonle Bati	Kandal Stung	Tonle Bati
Gross income	550	600	1,635	2,640
Production cost	50	80	158	233
Net production value	480	520	1,477	2,407
Living expenditure	480	520	1,364	1,364
Balance	0	0	113	1,043

Note: Refer to Table IV-54, also.

As seen above, the income increased by the project is expected as about 3 times in Kandal Stung Area, and more than 4 times of the present total income respectively. The expenditures for living would be expected at the target of about 3 million Riel or US$1,364 , and some reserve would be expected.

5.4 Agricultural Supporting Services Development Pian

5.4.1 Development Concept

(1) Objectives of support services

The objectives of the supporting services proposed for the Priority Development Area follow to the development concepts formulated under the Master Plan Study.

The proposed supporting services comprises (i) the agricultural technical extension, (ii) agricultural inputs and equipment supply, rural credit supply and agricultural insurance

system (iii) operation and maintenance of irrigation and drainage system and provided rural infrastructures such as road and domestic water supply, and marketing facilities, and (iv) the supporting services also extend to the filed of rural life improvement.

(2) Organization strengthening

The development plan includes the activation of the existing Agricultural Development Centre for Tonle Bati Priority Development Area, and newly establishment of the Kandal Stung Priority Development Area, respectively.

(3) Operation of support services

As proposed in the Master Plan, the agricultural supporting services at the initial stage in the Priority Development Area will be carried out by the Agricultural Development Centres which will be operated directly under the management of the Department of Extension. And afterward, operation of the Agricultural Development Centres with sufficient qualified extension workers and facilities will be transferred to the management under each district office. The proposed operation system of the Agricultural Development Centres for agricultural services are illustrated in Fig. IV-11.

5.4.2 Agricultural Extension

The proposed agricultural extension services will be provided mainly for food (rice) and some other secondary crops and livestock raising mainly pig, poultry and cattle for draft power, through provision of trained extension personnel, vehicles and equipment and office buildings to be constructed.

(1) Extension activities

Key points for emphasis in agricultural extension are summarized as follows:

a. Introduction of improved varieties:
b. Supply of planting materials:
c. Demonstration and guidance on cultivation techniques:
d. Extension on livestock production:
e. Strengthening of vaccination service:
f. Monitoring and evaluation

(2) Proposed staffing for agricultural extension

The Agricultural Development Centres will be the base for the agricultural extension work in the Priority Development Area, and the covering area of each centre, name of commune, number of villages, number of families are summarized as follows:

Agricultural Development Centre	GrossArea	Covered Communes	No.of Village	No. of Family	Proposed No. of Field worker
	(ha)	(No.)			
1. Kandal Stung No. 2		Anlong Romeat	5	359	1
(Newly proposed)		Rolous	3	353	1
		Preas Puth	5	356	2**
		Kong Noy	3	176	1*
		Teang	2	183	1*
		Bakou	6	535	2
		Kok Trop	2	208	2**
Total	2,400	(7)	26	2,170	7
2. Tonle Bati		Champey	2	305	1*
(Existing)		Put Sar	1	103	1*
		Kraing Thnung	5	667	2**
		Kandeong	1	65	2**
Total	1,830	(4)	9	1,140	3

The required number of field extension worker is estimated based on the following assumptions:

i) The number of family to be covered by one field extension worker are proposed to be about 300 to 400 at the maximum.

ii) The farmers group to be covered by one field worker is assumed at about 10 to 16, and one farmers group is composed of about 25 to 30 farm households.

iii)The working day for field worker are:

a. Visit one group twice a month,

b. Visit two groups a day,

c. Field working days per week are 4 days,

d. Training and study for worker himself for 2 days a week,

The proposed number of field extension worker to be assigned for each agricultural development centre and their specialities are summarized as follows:

Specialities	Kandal Stung No.2	Tonle Bati
Rice/Secondary crops	3	1
Horticultural crops	2	1
Livestock/Veterinary	2	1
Total	7	3

Beside the field workers listed above, subject matter specialists for rice/secondary crops horticulturel crops and livestock/veterinary are required for each Agricultural Development Centre.

(3) Facilities and equipment

The facilities and equipment for agricultural extension work are required for both activities of field and office works. The Agricultural Development Centres serve as the home

base of the field extension workers. The community halls proposed to be established Anlong Romeat, Bakon, Kong Nory, Roluous Preahputh in Kandal Stung Priotiry Development Area, Kreing Thnong and Champey communes in Tonle Bati Priority Development Area, respectively. These halls will be the field office of the field worker and will be used for training of farmers, and residence for the worker will be provided near the community hall. The training of farmers group will be mostly carried out at the community hall. The offices, buildings and facilities to be provided are Described in detail in Annex VI, and summarized as follows:

	Facilities and Equipment	Quantity
1.	In Agricultural Development Centre:	
	Office space for subject matter specialists (one of them is section chief)	3 specialists in each centre
	4WD vehicle	3 for each centre
	Minibus(20 persons)	1 for each centre
	Mobile extension unit vhicle(4WD) with audio visual equipment and veterinary service	1 in each centre
	Cold storage for vaccine (solar energy)	1 in each centre
	Copy/printing machine	1 in each centre
	Personal Computer with printer	1 set in each centre
	Residence	1 residence for each specialist
	Trial cum demonstration farm	1 ha for each centre
	Electricity supply	1 each centre
	Portable generator for community hall	2 for each centre
	Farm machinery for demonstration	1 set of machanized rice farming for each centre
2.	In Community Hall:	
	Office space for field worker	1~3 persons
	Motor cycle	1 for each worker
	Residence	1 for each worker
	Store space for equipment	1 space in each hall
	Trial farm	0.1 ha

5.4.3 Agricultural Input Supply System

The basic concept for the proposed supply system of agricultural inputs required is to improve the existing supply system of the Government channel by the Central Company of Agricultural Material (CCAM), basically. The key points for the improvement are:

a. to supply inputs required to each Priority Development Area by CCAM through the Agricultural Development Centres,

b. to strengthen the storage and handling capacity of Agricultural Development Centres to meet the requirement,

The amount of fertilizers and agro-chemicals required for each Priority Development Centre are as follows:

PriorityDevelopment Area	Command area (ha)	Impts	Requirement (t)
		Fertilizers (t)	Chemicals (lit.)
Kandal Stung	1,950	700	7,800
Tonle Bati	1,600	600	6,400

Base for estimation:

i) Requirement of fertilizers and chemicals is 350 kg/ha and 4 litre/ha on average, respectively.

ii) The storing capacity of storage is for one crop season for each area.

The required capacity of storage is 700 t of fertilizers and 7.8 kl of chemicals for Kandal Stung and 600 t of fertilizers and 6.4 kl of chemical for Tonle Bati Priority Development Areas, respectively. The detailes of strage is described in Annex VI.

The proposed input supply system forms one of sections of the Agricultural Development Centre. CCAM is responsible for handling of materials, i.e. loading and unloading, transportation to the store and stacking of materials, and individual farmer receives and carries those by ox-cart to his home from the storehouse.

Staffing required for operation of the section and each storage are summarized as follows:

Staff	Requirement
Section Chief	1 in each centre
Store house manager	1 in each store
Clerks	2 in each store
Store keeper	2 in each store

5.4.4 Agricultual Credit Services and Insurance

(1) Credit Services

The MAFF(Department of Extension) is proposed to be the implementing institution of the credit program, and the Agricultural Development Centre will be the contact point to the borrowers. For the implementing the credit progarm, it is important to motivate the farmers by informing and discussing on the credit system with them. And the program should be implemented and funded based on the request by the farmers where the credit is really needed. The following kind and categories of activities to be covered by the credit taking into consideration of the experiences observed through NGOs activities in the area:

-Rice for home consumption, especially during planting time to before harvesting,

-Small amount of investment for income-generating activities such as livestock raising, home vegetable garden, small business, etc. and

-Inputs for farming especially for fertilizres and improved seed.

The proposed credit system is a kind of "small farmers development credit" or "credit for poor. The borrowers should be limited to the poor only, but not for the rather rich farmers. In the right of experiences by NGOs such as WVI and WCC in the area, the borrowers should be organized into solidarity groups that provide mutual support and be responsible for

repayment. The size of one group will be about 10 to 15 members. The credit should be channelled through the groups for delivery and repayment, assisted by the agricultural and rural improvement extension workers of the Agricultural Development Centres.

For the sustainable and effective operation of the program, some strategies and activities by the implementing institution should carefully be considered; adequate and appropriate training and preparation of borrowers, assurance of subsequent loans upon repayment of old loans, effective savings mobilization, etc.

(2) Insurance

It is recommended to implement an agricultural insurance system by the Government as a public policy measure to promote general welfare among the people or the sector, as a kind of social insurance to ensure security and risk-taking in agriculture. Along with success of the proposed credit services and community development in a sense of mutual aid, effective mobilization of savings, formation of fund, sufficient institutional capacity of implementation, then the fund can be used for mutual aid or mutual insurance when some members of them suffered from crop losses, etc.

5.4.5 Agro-processing

The main product under with project condition will be rice. Rice milling will be the main processing activity in the future also. The present rice processing activity and marketing system was carefully studied. The free marketing system has been applied and processing and marketing of rice is mostly handled by private sector. The marketing of rice is usually in the form of paddy and milling of rice is mainly for home consumption in the area. According to the number of rice mill existing in the area, milling capacity is estimated at about 4.1 t/hr and 3.0 t/hr (out put) for Kandal Stung and Tle Bati area, respectively. The milling capacity required in the future is roughly estimated based on the following assumptions:

i) Consumption per capita in future; 162 kg/year in rice (Government target)

ii) Population and rice consumption in future

(1,999 year with annual population growth rate of 2.8 %);
Kandal Stung area: 2,170 x 5.6 x 1.15=14,000person
14,000person x 162 kg/year=2,300 t/year
Tonle Bati area: 1,140 x 6.0 x 1.15=7,900 person
7,900 person x 162 kg=1,300 t/year

iii) Working capacity (out put);

Kandal Stung area 4.1 t/hr x 200 days/year x 4 hr/day=3,300 t/year
Tonle Bati area 3.0 t/year x 200 days/year x 4 hr/day=2,400 t/year

As seen above, the existing capacity of rice mill in the area is already over the estimated requirement for around 1999. Therefore, no additional rice mill is proposed under the project.

5.4.6 Farmers' Organization

The basic concept for development of farmers' organization is to carry out various supporting activities through the proposed Agricultural Development Centres, related to operation and management of irrigation facilities and rural infrastructures, rural life improvement, and community development, as well as promotion of agricultural production. There is no effective farmers' organization in the Priority Development Area at present. The following are the anticipated groups to be established:

a. Water users' association (irrigation water)

b. Drinking water supply group (wells)
c. Small farmers' credit group
d. Cultivation techniques study group
e. Life improvement leading group
f. FHH/women's group

(1) Water users' association (irrigation water)

The number of water users association in the Kandak Study Priority Development Area will be 5 in total, and one federation off the association will be established. The water users' association will receive technical guidance and instructions through the Agricultural Development Centres.

(2) Drinking water supply group

The principles for formulation of drinking water supply group are as follows:

a. One users' group for one well,
b. To prepare proposal for well construction, and implement the well by assistance from the life improvement section of the Agricultural Centres,
c. To be responsible for appropriate use and maintenance of the facilities.

The water users group is coincided with the numbers of well, say about 1 or 2 group in each village.

(3) Small farmer's credit group

The principles for formulation of small farmer's credit group are as follows:

a. The group will be responsible for disburse and repayment of the credit,
b. To prepare proposal for formulation of the credit group to apply loans for farm inputs, pig and poultry raising, materials for home gardening, retail shops and small business, etc.

One groups will be consisted of 10 to 15 farmers on average. It is proposed that the credit services will be taken care by the supply and marketing section of the Agricultural Development Centres.

(4) Cultivation techniques study group

For effective extension of crop production techniques to the farmers, it is recommended to formulate a farmers' study group for cultivation techniques. The member of the group will be leading farmers and the main activities of the group will be to introduce improved varieties and techniques and to demonstrate to other farmers under the guidance of the extension workers, and to help extension workers as the grass root coordinator for the agricultural extension work in the area. One study group will be consisted of about 20 persons and be established one in each commune.

(5) Life improvement leading group

For establishment of the better rural life, it is essential to motivate the co-operative activities of the peoples in a community. It is proposed to organize life improvement leading

groups for effective life improvement extension work. The size of one group is of about 20 members having common objectives to improve their rural life. One group in each commune will be established. The group will be formulated through meetings or participation to the field workshops concerned to their life improvement. And as a goal, the group will become to have their own opinions and to raise recommen-dations to the rural life improvement extension work.

(6) FHH/women's group

Khmer Women Association is considered as vehicles to promote grass roots organization of women. The activity of women's organization will be effective especially for extension of life improvement in views of hygiene and health in their home life. The organization will be effective for small farmers' credit scheme such as home gardening and raising of pig and poultry. Establishment of FHHs group is necessary to extend special care by the Agricultural Development Centres for life improvement extension as well as to promote agricultural productions.

5.4.7 Strengthening of Agricultural Development Centre

All of the proposed agricultural support services will be extended through the proposed Agricultural Development Centre . The proposed organization of the Agricultural Development Centre is as shown in Fig. IV-11. Each centre will be composed of 5 sections, i.e. Agricultural Extension, Supply and Marketing, Life Improvement, Operation and Maintenance, and Administration. Each section has a section chief with the staff and facilities proposed for each service activity to cover the Priority Development Area only.

The staffing and facilities proposed for each Centre are summarized below:

(1) Kandal Stung No.2 Centre

This centre is proposed to be newly established with provision of staff and facilities to cover Kandal Stung Priority Development Area in almost entire area will be covered with irrigation development. The proposed command area of farm land by this centre is about 1,950 ha(rice field), composed of 7 communes, i.e. Anlong Romeat, Rolous, Preas Puth, Kong Noy, Teang, Bakou and Kok Trop, 2,170 families at present. The proposed organization and staff are given in the following table:

Kandal Stung No.2 Centre:

Section	Staffing
1. Administration	1- General manager
	1- Section chief
	1- Clerk
	1- Accountant
	1- Typist
	5- Vehicle drivers
	2- Office boy
	2- Security
2. Agricultural extension	1- Section chief
	3- Subject matter specialist (1 is section chief out of 3)
	7- Field extension worker
3. Life improvement extension	1- Section chief (Specialist)
	3- Life improvement worker
4. Supply and Marketing	1- Section chief
	1- Store house manager
	2- Clerks
	2- Store keeper
5. Operation and Maintenance	1- Section chief (Canal system manager)
	2- Maintenance work supervisor
	2- Machinery operato
	1- Farm machinery mechanic
	2- Machinery operator
	2- Ditch tender

(2) Tonle Bati Agricultural Development Centre

The existing Centre has been operated to cover the Tonle Bati Study Area of about 5,700 ha. The proposed strengthening of this centre is only for the Priority Development Area (1,830 ha ingres, in which 1,600 ha will be covered by irrigation development). The proposed objective area is composed of 4 communes, i.e. Champey, Put Sar, Kraing Thnung, Kandeong, 1,140 families at present. The proposed organization and staff are given in the following table.

Tonle Bati Centre:

Section	Staffing
1. Administration	1- General manager
	1- Section chief
	1- Clerk
	1- Accountant
	1- Typist
	5- Vehicle drivers
	2- Office boy
	2- Security(1 is at present)
2. Agricultural extension	1- Section chief(1 is at present)
	3- Subject matter specialist (1 is section chief out of 3)
	3- Field extension worker
3. Life improvement extension	1- Section chief (Specialist)
	2- Life improvement worker
4. Supply and Marketing	1- Section chief
	1- Store house manager
	2- Clerks
	2- Store keeper
5. Operation and Maintenance	1- Canal system manager
	2- Maintenance work supervisor(1 is at present)
	1- Farm machinery mechanic
	2- Farm machinery operator
	2- Ditch tender

The staffing and facilities proposed for each Centre are summarized in Table IV-58.

Tables

Table IV-1 Land Use of Cambodia

Item	Area ('000ha)	Share %
I. Natural Areas	13,829	76
A. Forest	12,300	68
1. Mainly evergreen forest	6,293	
a. Broad leafed forest	6,283	
Dense broad leafed forest	4,816	
Flooded evergreen forest	362	
Mangrove forest	61	
Mosaic evergreen or deciduous forest and secondary vegetal formations	529	
Mosaic of flooded forest, swampy vegetation, follow land	157	
Secondary vegetal formations	358	
b. Pine forest(Pmerkusii)	10	
2. Deciduous forest	6,007	
B. Other Vegetation	1,529	8
Thickets	96	
Scrub, brushwood	103	
Grass savannah	129	
Grassland susceptible to flooding	823	
Swampy vegetation	379	
II. Cultivated Areas	3,785	21
Paddy field	1,377	
Paddy field with palm trees	1,309	
Mosaic of upland crops and second vegetal formation	839	
Mosaic of field crops and fruit garden/rural area in the lowland	174	
Plantation (rubber)	85	
III. Other Land Usage	539	3
Bare land and sandy bank	52	
Open water areas, rivers	488	
Total	18,153	

Source : Reconnaissance Land Use Map of Cambodia, Mekong Secretariat, 1991.

Table IV-2 Land Area and Population

Names of provincial and municipal bodies	Land area km^2	Populatic the midst of1990 (thousand)(2)	Density pers/ km^2	Administrative bodies in 1990			Population in the midst of 1991 (thousand)	Density pers/ km^2
				District Precinct	commune municipal district	Hamlet Zone		
Total number throughout the country	181,035 (1)	8,568	47	153	1,545	12,603	8,807	49
I-Plain region	25,069	4,632	185	58	688	6,151	4,763	190
1-Phnom Penh	267	478	1,790	7	74	488	491	1,840
2-Kandal	3,591	867	241	10	149	1,092	892	248
3-Kompong chhnam	9,799	1,371	140	15	171	1,642	1,410	144
4-Svay Rieng	2,966	374	126	6	80	690	385	130
5-Prey Veng	4,883	862	177	11	116	1,132	886	181
6-Takeo	3,563	680	191	9	98	1,107	699	196
II-Tonle Sap Lake region	67,668	2,528	37	45	426	3,642	2,598	38
1-Kompong thom	13,814	486	35	7	81	711	499	36
2-Siem Reap	15,271	595	39	13	108	910	612	40
3-Banteay Meanchey	9,937	426	43	7	59	535	438	44
4-Battambang	10,433	513	49	7	65	475	527	51
5-Pursat	12,692	225	18	4	44	418	231	18
6-Kompong chhnang	5,521	283	51	7	69	593	291	53
III-Costal region	17,237	554	32	16	146	670	569	33
1-Kompong Som	868	68	78	3	21	74	69	79
2-Kompot	5,209	453	87	7	95	475	466	89
3-Koh Kong	11,160	33	3	6	30	121	34	3
IV-Piateau and mountain region	68,061	854	13	34	285	2,140	877	13
1-Kompong Speu	7,017	436	62	7	87	1,260	448	64
2-Preah Vihear	13,788	89	6	6	49	198	91	7
3-Swng Treng	11,092	50	5	4	34	122	52	5
4-Rattanakiri	10,782	58	5	7	49	229	59	6
5-Mondulkiri	14,288	20	1	5	21	79	21	2
6-Kratie	11,094	201	18	5	45	252	206	19

Notes : (1) Including 3000Km2 of Tonle Sap area

(2) Figures depends on the result of census issue at the end of 1980 and considers the rate of annual increase of 2.8%

Source : Statistics Book, 1980-1991, Ministry of Planning

Table IV-3 Population of Cambodia

Unit : 000 pers

Name of Provinces	1981		1986		1987		1988		1989		1990		1991	
and cities	Total	female	Total	female	Total	female	Total	female	Total	female	Total	female	Total	female
Total number throughout the country	6,682	3,590	7,672	4,122	7,882	4,237	8,107	4,356	8,334	4,478	8,568	4,603	8,807	4,732
I-Plain regions	3,613	1,948	4,148	2,236	4,265	2,299	4,384	2,363	4,507	2,430	4,632	2,497	4,763	2,568
1-Phnom Penh city	329	181	428	237	440	244	452	250	465	258	478	265	491	272
2-Kandal	720	391	776	420	798	432	820	444	844	456	867	469	892	482
3-Kompong cham	1,070	569	1,228	653	1,262	671	1,298	690	1,334	709	1,371	729	1,410	750
4-Svay Rieng	292	161	335	185	345	190	354	195	364	201	374	206	385	212
5-Prey Veng	672	360	772	413	794	425	816	437	838	449	862	461	886	475
6-Takeo	530	286	609	328	626	337	644	347	662	357	680	367	699	377
II-Tonle Sap lake region	1,971	1,052	2,263	1,208	2,322	1,242	2,391	1,277	2,458	1,312	2,528	1,350	2,598	1,387
1-Kompong Thom	379	200	435	230	447	237	460	243	473	250	486	257	499	264
2-Siem Reap	477	252	548	289	563	297	563	297	579	305	595	314	612	323
3-Banteay Meanchey	-	-	-	-	-	-	403	212	414	218	426	224	438	230
4-Battambang	719	381	825	437	844	449	485	259	499	266	513	273	527	281
5-Pursat	175	96	201	111	207	114	212	117	218	120	225	124	231	127
6-Kompong chhnang	221	123	254	141	261	145	268	149	275	153	283	158	291	162
III-Costal region	432	234	496	269	509	276	524	284	538	292	554	299	569	308
1-Kompong Som	53	29	61	34	62	34	64	36	65	36	68	37	69	39
2-Kompot	354	191	406	219	417	225	429	231	441	238	453	244	466	251
3-Kob Kong	25	14	29	16	30	17	31	17	32	18	33	18	34	19
IV-Plateau and mountain region	666	356	765	409	786	420	808	432	831	444	854	457	877	469
1-Kompong speu	340	184	390	211	401	217	412	223	424	229	436	236	448	242
2-Preah Vihear	69	37	80	42	82	43	84	44	87	46	89	47	91	48
3-Stung Treng	39	21	45	24	46	25	48	25	49	26	50	27	52	32
4-Rattanakiri	45	24	52	28	53	29	55	30	56	30	58	31	59	28
5-Mondulkiri	16	8	18	9	19	9	19	10	19	10	20	10	21	10
6-Kratie	157	82	180	95	185	97	190	100	196	103	201	106	206	109

Source : Statistics Book 1980-1991, Ministry of Planning

Table IV-4 Labour Force in Cambodia by Province and City

(Unit : 000 person)

Names of provinces and cities	Number of people in 1980	Divided		
		Under the age of labour	Within the age of labour	Over the age of labour
Total	6,590,374	3,091,773	3,113,026	385,575
1-Phnom Penh	324,236	154,580	153,309	16,347
2-Kandal	710,332	323,404	339,324	47,604
3-Kampong Cham	1,054,809	501,725	472,621	80,463
4-Svay Rieng	287,898	141,905	131,837	14,156
5-Prey Veng	662,945	323,253	302,541	37,151
6-Takeo	523,250	234,265	259,601	29,384
7-Kompong Thom	373,672	175,558	176,960	21,154
8-Siem Reap	470,577	224,188	224,563	21,826
9-Banteay Meanchey	-	-	-	-
10-Battambang	708,937	333,807	336,420	38,710
11-Pursat	172,794	77,756	87,651	7,387
12-Kompong Chnang	217,727	95,749	110,467	11,511
13-Kompong Som	51,883	24,931	24,681	2,271
14-Kompot	348,739	167,258	163,155	18,326
15-Koh Kong	25,185	11,938	12,055	1,192
16-Kompong Speu	335,353	151,428	166,977	16,948
17-Preah Vihear	68,490	32,920	31,642	3,928
18-Stung treng	38,723	18,009	18,280	2,434
19-Rattanakiri	44,461	18,950	23,224	2,287
20-Mondul kiri	15,363	5,149	8,718	1,496
21-Kratie	155,000	75,000	69,000	11,000

Result of on December 31st, 1980

Male from 16 to 60 years of age female from 16 to 55 years of age

Source: Statistics Book 1980-1991, Ministry of Planning.

Table IV-5 (1/4) Gross Domestic Producct by Industrial Origin, at Current Prices (Millions of Riels)

	1987	1988	1989	1990	1991
Agriculture	42,707	109,548	113,200	291,080	618,448
Crops & Rubber	24,130	83,579	71,400	171,080	311,279
Rice	12,567	62,279	46,900	92,213	144,137
Other Crops & Rubber	11,563	21,300	24,500	78,867	167,142
Livestock	11,129	16,748	29,400	81,356	204,667
Fishing	4,724	6,245	9,400	28,234	63,487
Forestry	2,724	2,976	3,000	10,409	39,015
Industry	20,618	30,132	41,300	73,881	177,260
Mining and Quarrying	1,563	1,953	2,500	3,125	4,688
Manufacturing	10,610	15,806	23,000	40,000	90,600
Electricity and Water	522	588	600	2,156	6,973
Construction	7,924	11,785	15,200	28,600	75,000
Services	35,564	55,879	92,800	229,829	601,057
Transport and Communications	3,228	4,224	6,500	22,547	43,154
Whole sale and Retail Trade	14,039	28,498	46,100	96,287	288,861
Hotels and Restaurants	130	155	400	1,889	5,668
Government Administration, Education and Health	3,559	5,733	9,300	28,296	62,484
Home Ownership	7,535	8,870	15,500	40,919	92,762
Other Services	7,073	8,400	15,000	39,890	108,128
GROSS DOMESTIC PRODUCT	98,889	195,559	247,300	594,790	1,396,765
Memo Items :					
Average Official Exchange Rate (Riel/US$)	100	142	194	407	711
Nominal GDP (US$ mil)	988.9	1377.2	1274.7	1461.4	1964.5
GDP/Capita (US$)	127	170	153	171	223

Source : Cambodia, Agenda for Rehabilitation and Reconstruction 1992, World Bank.

Table IV-5 (2/4) Gross Domestic Product by Industrial Origin, at Constant Prices (Millions of Riels)

	1987	1988	1989	1990	1991
Agriculture	106,805	106,163	113,200	112,184	131,528
Crops & Rubber	57,863	67,208	71,400	65,317	82,303
Rice	37,373	42,706	46,900	44,262	49,418
Other Crops & Rubber	20,490	24,502	24,500	21,055	32,885
Livestock	35,449	25,212	29,400	31,076	31,422
Fishing	9,407	9,966	9,400	12,355	13,510
Forestry	4,086	3,777	3,000	3,435	4,292
Industry	31,727	40,926	41,300	40,291	43,742
Mining and Quarrying	2,066	2,273	2,500	2,750	3,025
Manufacturing	13,636	17,977	23,000	22,000	23,500
Electricity and Water	566	612	600	541	467
Construction	15,459	20,064	15,200	15,000	16,750
Services	69,340	94,446	92,800	94,540	105,034
Transport and Communications	6,252	6,505	6,500	6,411	7,000
Whole sale and Retail Trade	27,391	48,516	46,100	45,000	50,758
Hotels and Restaurants	255	264	400	734	996
Government Administration, Education and Health	6,943	9,760	9,300	10,995	10,980
Home Ownership	14,700	15,100	15,500	15,900	16,300
Other Services	13,800	14,300	15,000	15,500	19,000
GROSS DOMESTIC PRODUCT	207,873	241,535	247,300	247,015	280,304
Real GDP Growth Rate (Percent)		16.2	2.4	-0.1	13.5

Source : Cambodia, Agenda for Rehabilitation and Reconstruction 1992, World Bank.

Table IV-5 (3/4) Implicit Price Deflators

	1987	1988	1989	1990	1991
Agriculture	40.0	103.2	100.0	259.5	470.2
Crops & Rubber	41.7	124.4	100.0	261.9	378.2
Rice	33.6	145.8	100.0	208.3	291.7
Other Crops & Rubber	56.4	86.9	100.0	374.6	508.3
Livestock	31.4	66.4	100.0	261.8	651.3
Fishing	50.2	62.7	100.0	228.5	469.9
Forestry	66.7	78.8	100.0	303.0	909.0
Industry	65.0	73.6	100.0	183.4	405.2
Mining and Quarrying	75.6	85.9	100.0	113.6	155.0
Manufacturing	77.8	87.9	100.0	181.8	385.5
Electricity and Water	92.1	96.1	100.0	398.9	1493.0
Construction	51.3	58.7	100.0	190.7	447.8
Services	51.3	59.2	100.0	243.1	572.2
Transport and Communications	51.6	64.9	100.0	351.7	616.5
Whole sale and Retail Trade	51.3	58.7	100.0	214.0	569.1
Hotels and Restaurants	51.0	58.7	100.0	257.4	569.1
Government Administration, Education and Health	51.3	58.7	100.0	257.4	569.1
Home Ownership	51.3	58.7	100.0	257.4	569.1
Other Services	51.3	58.7	100.0	257.4	569.1
GROSS DOMESTIC PRODUCT	47.6	81.0	100.0	240.8	498.3
Annual Change (Percent)		70.2	23.5	140.8	106.9

Source : Cambodia, Agenda for Rehabilitation and Reconstruction 1992, World Bank.

Table IV-5 (4/4) Shares of Real GDP by Sector

	1987	1988	1989	1990	1991
Agriculture	51.4	44.0	45.8	45.4	46.9
Crops & Rubber	27.8	27.8	28.9	26.4	29.4
Rice	18.0	17.7	19.0	17.9	17.6
Other Crops & Rubber	9.9	10.1	9.9	8.5	11.7
Livestock	17.1	10.4	11.9	12.6	11.2
Fishing	4.5	4.1	3.8	5.0	4.8
Forestry	2.0	1.6	1.2	1.4	1.5
Industry	15.3	16.9	16.7	16.3	15.6
Mining and Quarrying	1.0	0.9	1.0	1.1	1.1
Manufacturing	6.6	7.4	9.3	8.9	8.4
Electricity and Water	0.3	0.3	0.2	0.2	0.2
Construction	7.4	8.3	6.1	6.1	6.0
Services	33.4	39.1	37.5	38.3	37.5
Transport and Communications	3.0	2.7	2.6	2.6	2.5
Whole sale and Retail Trade	13.2	20.1	18.6	18.2	18.1
Hotels and Restaurants	0.1	0.1	0.2	0.3	0.4
Government Administration, Education and Health	3.3	4.0	3.8	4.5	3.9
Home Ownership	7.1	6.3	6.3	6.4	5.8
Other Services	6.6	5.9	6.1	6.3	6.8
GROSS DOMESTIC PRODUCT	100.0	100.0	100.0	100.0	100.0

Source : Cambodia, Agenda for Rehabilitation and Reconstruction1992, World Bank.

Table IV-6 (1/4) Main Products Exported

	Unit	1980	1985	1986	1987	1988	1989	1990
Total value of export	,000 Roubles.$	1,006.0	17,726.9	25,303.4	27,144.3	32,489.9	44,249.5	34,728.2
Cotton	ton	225	168	182	433	252	210	155.7
Rubber	,000 ton	1.4	14.1	23.4	25.2	26.7	32.9	23.8
Cartyre	,000 Tires	...	2.2	5.5	4.0	2.9	3.5	5.3
Slippers	,000 Pairs	...	60.3	...	30.0	300.0	700.0	170.0
Timber	,000 km^3	...	18.1	26.5	24.7	52.6	91.1	96.9
Tabacco leaves	,000 ton	...	1.1	1.5	0.6	0.05	0.4	0.3
Pepper	ton	...	...	...	31.6	13.6	90.0	49.0
Green bean	ton	...	...	...	...	...	...	500.0
Soy bean	,000 ton	...	6.2	8.6	10.0	...	16.3	13.7
Corn	,000 ton	...	4.7	9.8	6.7	18.6	15.4	5.5
Lacquer	,000 ton	...	7.0	229.0	141.0	99.0	50.0	...
Ceroma wood	,000 ton	...	...	...	...	0.6	0.5	...

Source : Statistics Book 1980-1991, Ministry of Planning

Table IV-6 (2/4) Main Products Imported

	Unit	1980	1985	1986	1987	1988	1989	1990
Total value	,000 Roubles. $	1,330	96,235.2	119,402.2	12,256.8	126,898.9	134,941.5	115,352.8
Husked rice	,000 ton	...	...	...	19.15	5.66	...	...
Condensed milk	,000 ton	1,597	1,384	...	1,665	1,437	...	...
Sugar	,000 ton	...	1.01	...	794	1.04	...	...
Beer	,000 Bottles	...	1,631	...	198	93.4	...	...
Various kinds of cloths	,000 m	5,418	1,321	16,020	13,358	13,976	15,122	13,259.2
Mosquito net	,000 m	356	1,158	879	943	280	...	...
Cotton thread	,000 m	...	...	1,490	3,150	1,500	928	295.5
Cement	,000 ton	0.179	6.5	22.1	28.4	21.9	23.3	17.2
Fuel	,000 ton	77.576	164.8	144.1	117.6	116.9	187.6	205.9
In which								
Gasoline	,000 ton	12.608	37.6	34.7	24.7	19.8	96.9	16.6
KO	,000 ton	2.608	13.0	18.0	6.9	13.9	12.3	31.2
Diesel	,000 ton	34.607	72.5	62.1	49.7	99.2	97.6	106.2
FO	,000 ton	27.122	38.5	26.5	32.4	32.5	61.4	39.4

Source : Statistics Book 1980-1991, Ministry of Planning

Table IV-6 (3/4) Exportation & Activities

	Export products	Unit	1991 Quantity	1991 VAL/1,000US$	1992 Quantity	1992 VAL/1,000US$
	TOTAL	US$		71,300		51,343
1	Natural rubber	ton	30,548	18,652	27,826	12,610
2	Timber	m^3	259,779	24,634	296,492	25,072
3	Soy beans	ton	49,110	9,889	9,740	2,053
4	Sesame	-	3,549	1,213	827	249
5	Corn	-	26,410	2,345	6,150	567
6	Tabacco leaves	-	1,482	2,219	119	168
7	Fishery products	-	2,468	1,571	2,475	1,394
8	Lotus grains	-	483	247	300	150
9	Kapok fiber	-	123	130	206	191
10	Kenaf fiber	-	1,000	212	700	147
11	Rotin	-	707	244	545	209
12	Strychnos nux vomica L	-	128	29		
13	Cashew nut	-	219	156	369	236
14	Dry chilly	-	30	33		
15	Cattle skin	-	183	77	262	130
16	Cattle	TETES	804	82	791	86
17	Scent wood	ton	70	40	2,451	32
18	Black pepper	-			40	24
19	Car tyre	COMP.	3,456	270		

Source : Department of Foreign Trade, Ministry of Commerce

Table IV-6 (4/4) Importation

Imported products	Unit	1991		1992	
		Quantity	VAL/1,000US$	Quantity	VAL/1,000US$
TOTAL	US$		259,404		345,660
1 Consumption commodity	-		13,756		27,150
2 Rice	ton	15,050	3,231	16,570	2,815
3 Rice grain	-	3,000	450		
4 Wheat	-	3,000	495		
5 Flour	-	11,651	2,518	732	186
6 Sugar	-				
7 Cloth	M	21,010,171	12,606	22,738,272	13,453
8 Soft drink	Boxes	433,687	2,584	1,124,063	6,213
9 Beer	-	2,032,138	14,829	2,333,084	15,268
10 Cigaret	-	136,842	17,466	368,458	34,460
11 Vine	bottle			31,440	157
12 Tape recorder	PGS	45,135	2,179	28,702	1,184
13 TV	-	25,791	7,253	13,989	2,847
14 Videocorder	-	18,988	4,603	16,057	3,123
15 Refrigerators	-	520	109	957	247
16 Air conditioner	-	1,591	562	2,367	954
17 Steel	ton	2,200	787	27,067	8,419
18 Motor cycle	PGS	122,611	32,856	146,556	33,266
19 Car	-	1,847	4,965	5,462	22,334
20 Cement	ton	115,306	7,980	232,679	13,965
21 Fuel	-	5,512	1,538	36,110	9,687
22 Fuel	-	72,293	20,980	161,137	38,010
23 Fuel	-	67,261	16,986	154,413	37,133
24 Fuel	-	24,786	3,429	40,000	5,000
25 Fuel	-			2,165	554
26 Medecine	US$		6,950		5,116

Source : Department of Foreign Trade, Ministry of Commerce