Part II Feasibility Study

E.5 PRESENT CONDITION OF THE STUDY AREA

E.5.1 Soil and Land Use

(1) Soil

The specific soil survey for the Study Area has not been conducted so far. Based on the Soil Map (1:500,000) obtained from LUMO, MAFF, the Study Area comprises three major soil units, namely Brown Alluvials, Alluvials and Cultural Hydromorphics. (See Figure E.5.1.)

These three soil units are not major constraints for agricultural production. The two alluvial soil units covering more than 90 % of the Study Area are rather productive ones in Cambodia. Their distributions in the Study Area and the general characteristics of those soil units are as follows;

1. *Brown Alluvials : 2,000 ha (33%)*
   These coarser-textured soils are distributed along the Mekong River banks. They are economically quite significant and have different production potential from the finer-textured slake-water alluvials.
2. *Alluvials : 3,990 ha (65%)*
   The fresh-water alluvial deposits are geologically recent deposits of effluents in which pedological processes of soil formation have not proceeded enough to make significant pedological horizon differentiation.
3. *Cultural Hydromorphics : 140 ha (2%)*
   This soil have a thin, artificially compacted, impermeable horizon resulting from development into rice fields. While these soils are classified on the basis of recent cultural usage, the shallow impermeable compacted layer of the soil has an overriding effect on the physical and production characteristics of these soils.

(Note; Area measurement data are based on the Soil Map scaled up to 1:50,000.)

Based on the field survey, the Brown Alluvials seem to be narrower than the map indication and the Cultural Hydromorphics seem to be distributed more broadly to the east part of the Study Area. Field survey also reveals that acid sulfate soil, which is occasionally observed in the tropic and becomes one of the agricultural constraints, is not distributed in the Study Area.

(2) Land Use

Land use in the Study Area is classified into following six categories; farmland, reservoir /inundated forest, waste/grass/bush land, river/lake, residential land and road/canal. According to the field survey and the topographic map (1:10,000), the present land use map is drawn and the areas of each land use category are measured. (See Table E.5.1 and Figure E.5.2 and E.5.3.)

Farmland has the largest occupation, 3,565 ha; 58 % of the Study Area. Secondly, waste/ grass/bush land represents 18 %; 1,127 ha. Those two categories possess three fourth of the total Study Area.

The distribution of those land use categories primarily depends on the land elevation, in other words, flooding period. Low land areas usually receive longer period of flood than high land areas so intensive land use is impossible. Low land areas mainly include waste/grass /bush land, river/lake, reservoir/inundated forest, and the part of farmland for dry season recession paddy. The land below 8-meter height occupies 64 % of the Study Area. On the other hand, high land areas are used intensively, such as residential land, orchards and some upland crop farmland.

Among the six categories, waste/grass/bush land, the second largest distribution, includes some farmland, shrubs and unutilized areas but they are unified as this one land category because their distribution is very complicated. Usually, this land use category corresponds to the land between 6 to 8-meter height, which receives 2 to 4-month flood period.

Most of the reservoir/inundated forest is surrounded by artificial dike and the natural vegetation in reservoir is abundant. The stored floodwater in reservoir is usually utilized for irrigation of dry season recession paddy. The vegetation in reservoir supplies fire woods for village people and also provides the fish habitats during inundated period. Thus the reservoir is multipurpose. Recently, inundated forest seems to decrease gradually by the cutting for fire woods collection and the clearing for the development of new farmland, although the statistical data are not available.

The land use of farmland is furthermore classified into four sub-categories by farming. Details are described in the next chapter.

E.5.2 Agriculture

(1) Agricultural Land Use

Based on the field survey, there is a general relationship between agricultural land use and land elevation in the Study Area, as follows;

Land Elevation (m)	Main Agricultural Land Use
> 9	Orchard, Upland crops
9-8	Upland crops, Irrigation paddy
8-6	Rainfed paddy, Recession paddy
< 6	Recession paddy

In the Study Area, there are more than 3,500 hectares of farmland, which represent 58 % of

the whole Study Area. They are classified into four major agricultural land use categories, namely recession paddy (dry season paddy utilizing flood recession water); 1,622 ha, irrigation paddy (wet season paddy with supplemental irrigation) + upland crops; 817 ha, rainfed paddy (wet season paddy with only rainfed water); 1,052 ha and orchard; 74 ha. (See Figure E.5.2, E.5.4 and Table E.5.2.)

The area of recession paddy occupies 45 % of total farmland and it is exclusively distributed to the land under 8-meter height and most fields are under 6-meter height. This category is normally situated around reservoir, which provides supplemental irrigation water, although stored floodwater is sometimes not enough. Fields are usually cropped only once a year because of flood in wet season and lack of water after harvesting paddy.

In the area of irrigation paddy + upland crops category, both two kind of crops are cultivated and double/triple cropping are somewhat conducted. This category occupies about 23 % of total farmland and most of the land is situated above 8-meter height. This category is mainly distributed around the residential land along the Mekong and has a wide variety of crops because the farmers can easily obtain irrigation water by pumping up from the Mekong and the existing colmatage canal. Some farmers also irrigate paddy by pumping in the beginning of wet season when it rains sporadically. On the other hand, in the villages of Vihearsour, upland crops are cultivated just around the houses and limited for home consumption use due to the difficulty of securing irrigation water.

The area of rainfed paddy is distributed to only two eastern communes, Vihearsour and Sanlung, and 30 % of total farmland correspond to this category. In those two communes, rainfed paddy is the main farming activity. The farmland of this category usually does not receive floodwater, or if receives, the flood period is very short, so recession paddy is generally impossible.

Orchard is mainly cultivated for home consumption on the levee of the Mekong in the western part of the Study Area and around the houses in the eastern part. The planted area is very small, 74 ha, which represents only 2 % of total farmland.

Some of the swamps, reservoirs and lakes are also used for lotus and mat grass (*Scirpus grossus L. f.* and *Cyperus difformis*) field but those areas can neither be clarified nor be measured. They are included in the three categories; lake/river, reservoir/inundated forest and waste/grass/bush land.

(2) Crops

According to the analysis of a interviewing survey, called Rural Socio-Economic Survey, 491 farmers out of 500 have paddy field and the average paddy field area is 0.92 ha. (See Table E.5.3.)

In the progress report III, it mentioned that there were 475 farmers among 500 interviewees and the analysis was based on 475 farmers. But further analysis reveals that (1) there are no interviewees without farming activities, and (2) there are nine farmers who own no paddy field but they have upland field (0.2-0.7 ha) and six of them practice tenant farming for paddy. Some 22 interviewees earn more money from fishing activity than from farming activity but all of them actually practice farming. Consequently, 500 interviewees are all included for the analysis of agriculture section in this report. (See Table E.5.4.)

About half of interviewed farmers practice both dry and wet season paddy based on the result of the Rural Socio-Economic Survey. Farmers practicing only dry season paddy occupy about 30% and those who practice only wet season paddy occupy about 20%. In Prek Tamerk and Prek Ampil, farmers who practice only dry season paddy are dominant, 64% and 71%. On the other hand, farmers who practice only wet season paddy are dominant in Sanlung, 88%. Farmers who practice both dry and wet season paddy are common in Vihearsour, 84%. In Puk Reusei, there are three types of paddy practicing farmers to some extent, each type occupies 26 to 39%. (See Table E.5.5.)

The analysis of the Rural Socio-Economic Survey reveals that 20 upland crops are practiced in the Study Area. Generally, upland crops farming are more common during dry season than during wet season. In dry season, 17 upland crops are cultivated by 144 farmers and 137 farmers of them are in Prek Tamerk and Puk Reusei. Mat grass is the most popular crop and practiced by 62 farmers. Mungbean is the second one, cultivated by 21 farmers. Tomato, watermelon and chili are followings but all of them are practiced by less than 10 farmers. In wet season, only 9 upland crops are cultivated by 85 farmers and 54 farmers of them are in Puk Reusei. Sesame is the most popular crop and practiced by 33 farmers. Cassava and maize are the following crops, practiced by 14 and 10 farmers, respectively.

Based on the communal statistics obtained from district agriculture office, thirteen upland crops are cultivated in the communes concerned. Among them, chili has the largest planted area, 118 ha, but more than 40 % of planted area, 48 ha, is in Prek Ampil which occupies only 3 % of the Study Area. (See Table E.5.6.)

(3) Farming Practices

Irrigation water availability and flood condition determine cropping season in the Study Area. Irrigation paddy + upland crops area along the Mekong usually does not have flood or has only gentle flood. Moreover irrigation water is available all year round by pumping up from the Mekong. So cropping intensity is very high, more than 300 % in some fields. Those areas are basically more than 8-meter height.

Most areas of recession paddy lying around reservoirs receive severe flood and the lower field has the longer flood period. In accordance with floodwater recession, farmers start to transplant paddy seedlings and supplemental irrigation water is supplied from reservoirs by gravity. Sometimes the stored water is not enough for growth period so farmers pump up

water from lower water source such as Boeng Phtea by traditional manual irrigation, rohat/snaich, or mobile pumps. Generally, recession paddy area is single cropping.

Rainfed paddy areas in the eastern part of the Study Area are situated on more than 8-meter height so the flood condition is almost same as that of irrigation paddy + upland crops areas. One of the big differences between the two areas is irrigation water availability. Since there is no permanent water source like the Mekong, the cropping intensity in this area is usually less than 100 %.

In Puk Reusei, half of both paddy and upland crops practiced farmers sell their farm product. In Prek Tamerk and Sanlung, farmers selling paddy are less than 20%, this means that most farmers in these two communes cultivate paddy for self-consumption. But farmers who sell upland crops are more than 50%. On the other hand, it becomes the contrary in Vihearsour and Prek Ampil. In these two communes, farmers tend to sell paddy but cultivate upland crops for self-consumption. (See Figure E.5.5.)

Based on the analysis of the Rural Socio-Economic Survey, self-keeping paddy seed is customarily used for nursery. Farmers who renew paddy seed are very few and it is estimated less than 10%. (See Figure E.5.6.)

Farming practices of wet and dry season paddy are obtained from the Rural Socio-Economic Survey. In wet season, the average amount of seed for nursery is 120 kg/ha and this figure is almost same among 5 communes. In dry season, it is 134 kg/ha but the figure ranges 127 – 170 kg/ha. (See Table E.5.7 and E.5.8.)

Urea is the only fertilizer applied commonly in both wet and dry season. In wet season, it is commonly used in three communes along the Mekong, namely Prek Tamerk, Puk Reusei and Prek Ampil. The average amount of application ranges 84 – 181 kg/ha. In dry season, 90% of farmers (324/365) use urea as a whole, in particular, the using rate in Vihearsour rises up from 34% in wet season to 77%. The average amount of application ranges 90 – 181 kg/ha.

Agricultural chemicals are not used customarily and about one fourth of the farmers apply them in wet season. But the number of used farmers increases to 50% in dry season. Methyl parathion and mevinphos are two common insecticides in both wet and dry season. Usually, farmers get farming information such as the application method of fertilizer and agricultural chemicals from neighbors (452/500) and extension officers (272/500).

For wet season paddy, farmers usually conduct land preparation between June to July and transplant seedlings between July and August. Harvesting season varies from October to December because the growth period depends on the planted variety. On the other hand, each farming practice for dry season paddy is generally conducted in accordance with the

recession of floodwater. So the period of each farming practice becomes one-month longer. Generally, land preparation is conducted between October to December, transplanting is between November to January, and harvesting is between February to April. (See Table E.5.9.)

According to the analysis of the Rural Socio-Economic Survey, 274 farmers have their own draft animal and the average number of animal per family is 2.3 heads. Tractor is not extended at all except for one farmer in Puk Reusei. Thresher is mainly distributed in Puk Reusei, 58 machines out of 62. As for hand sprayer and mobile pump, 55 farmers have them, which represents 11 % of all. (See Table E.5.10 and E.5.11.)

During field survey, 20 farmers were directly interviewed and data of both flood and cropping periods were obtained. (This interviewing is completely different from the Rural Socio-Economic Survey.) The data of land elevation were estimated from the topographic map. It shows that upland crops are generally cultivated on the land higher than 8-meter and floodwater comes up to almost 9-meter height land. It seems that floodwater comes quickly and recedes slowly. Paddy cropping is adjusted in accordance with the recession of floodwater. (See Table E.5.12.)

(4) Production and Yield

It is difficult to estimate the paddy production in the Study Area accurately because there is no production statistics by commune. The statistics of planted and damaged areas of paddy by commune are available but the communal production is estimated by multiplying the district average yield and communal harvested area together. In wet season paddy of 1995, the district average paddy yields of early, medium and late variety are 3.0, 2.5 and 2.7 tons/ha, respectively. The yield of 1994/95 dry season paddy in Ksach Kandal varies from 3.51 to 3.84 tons/ha by variety types. (See Table E.5.13.)

Based on the Rural Socio-Economic Survey, the average yields of paddy by cropping season are calculated. The yields of dry season paddy vary from 2.26 to 3.30 ton/ha. There is a tendency that the yield of only dry season cropping (3.17 ton/ha) is higher than that of both dry and wet season cropping (2.77 ton/ha). On the other hand, the yields of wet season paddy vary from 1.27 to 2.93 ton/ha. Same as dry season paddy, there is a tendency that the yield of only wet season cropping (2.18 ton/ha) is higher than that of both dry and wet season cropping (1.42 ton/ha). The yields of wet season paddy in Sanlung and Vihearsour are lower than the yields of other communes because the major varieties differ. (See Table E.5.5.)

The yields of upland crops are also calculated from the data of Rural Socio-Economic Survey. Generally, those figures seem to be exaggerated because some figures are bigger than the district average yield, sometimes more than eight times. (See Table E.5.14.)

(5) Livestock

Livestock plays a great role for rural people in terms of labor, income generation and food supply. Large animals such as cattle and buffaloes are generally used for farming labor. Those animal labors are indispensable for farming because agricultural machines are still not extended at all. They are usually used for plowing, harrowing, hauling and so on. They also provide organic natural fertilizer; manure.

According to the statistics, cattle are common in three communes along the Mekong but inland two communes have a lot more buffaloes than riverside communes. Pigs and chickens are popularly raised in all five communes. (See Table E.5.15.)

Based on the Rural Socio-Economic Survey, 274 farmers have their own draft animal, which represents 55% of all. The average raising heads ranges from 2.1 to 2.4. Pigs are important sub-income sources for rural people so they are more popular in four communes except for Prek Ampil. In particular, 24 farmers out of 25 raise pigs in Sanlung. Except for pigs, medium animals like sheep and goat are not observed in the Study Area. Most interviewed farmers are also breeding chickens but ducks are not common. They are usually raised to supply eggs and meat for home consumption. (See Table E.5.10.)

(6) Women in Agricultural Activities

Based on the analysis of Rural Socio-Economic Survey, there are 520 female full-time farm labors and 435 female part-time farm labors in 500 interviewed families. It indicates that every household has 1.04 full-time and 0.87 part-time female farm labors, respectively. The figures of male farm labors are 1.50 and 0.48, respectively. This implies that female labor is basically supplementary for male labor. Although the interviewed farm number is small, female labors occupy more than half of total labor force in Sanlung. (See Table E.5.16.)

For a housewife, farming is the most time-consuming task. The initial analysis of Rural Socio-Economic Survey shows that a housewife works for farm for 4 hours and 51 minutes per day on the average, which occupies 40 % of daily working hours; 12 hours. (See Figure E.5.7.)

E.5.3 Agricultural Supporting System

(1) Agricultural Extension Service

There are eleven officers in District Agriculture Office located in Knong, Prek Tamerk. It has four sections and two sections, namely "Agronomy Section" and "Animal Production & Health Section", are related to the agricultural extension service in the Study Area. "Agronomy Section" had four staffs two years ago but two of them went out for training and

they did not come back after its completion. The vacancy is still not yet filled up. Nowadays, both sections have two staffs each. (See Figure E.5.8.)

At present, the office tries to hold a meeting/seminar for commune staff every month at the office. There were four meetings/seminars during the last six months (Jan - Jun, 1997) and eight meetings/seminars in last year. Usually, the meeting/seminar is consisted of two parts; general subject and specific subject. The director conducts the former one and the staffs of "Agronomy Section" conduct the latter one. Due to the limited budget, there is no training material for attendants such as brochure/textbooks and only the oral lecture is given.

Two staffs of the "Animal Production & Health Section" prevent the spread of diseases of cattle, buffaloes and pigs with injection. The medicines are distributed through the provincial office. During the last six months (Jan - Jun, 1997), they gave injections to 5 cattle, 12 buffaloes and 94 pigs. They also control the 18 slaughterhouses in the district by monitoring the number of slaughtered animals and collecting tax.

There are some short-term training courses for the district staff by the provincial government but they are not held periodically but sporadically.

(2) Post-Harvest, Processing and Marketing

Because of prevailing of subsistence farming in the Study Area commercial basis post-harvest activities have not been encouraged excluding small-scale village-based 43 rice mills. Milling machines are operated by oil because of absence of electricity in the Area. Milling charge is 250 Riels per 10 kg of paddy.

Mat manufacturing is popularly observed particularly in the villages along the Mekong River. Raw materials for mat making are rush and mat grass, and manufactured by one pair of women on home industry-basis. Merchants come from Phnom Penh to purchase mats from villagers and some of them are exported Thailand etc. Mat is 1.2 x 2.1 m in size and price varies depending its quality from 5 US$ to 10 US$ each. A pair of women can make two mats a day.

Some other agricultural processing such as noodle, tobacco, dried chili, sesame cake and smoked fish are made but all of these activities is small-scale and negligible in the district and Study Area.

There are three local markets in Ksach Kandal, Prek Tamerk, Vihearsour and Svay Romeat. Excluding fattening pigs and ducks marketed to Phnom Penh, most crop surplus are sold to these local markets and consumed in the district because of subsistence farming. Crops are transported to the markets mainly by motorcycle and bicycle.

(3) Agricultural Credit

Because of absence of institutional credit systems in Cambodia most agricultural credit have been provided by local traders acting as moneylenders charging high interest rates. Therefore, NGOs like GRET, UNCEF, ACLEDA etc. have worked for the rural credit sector. In particular, GRET, French NGO, covers province of Kandal, Kompong Speu, Prey Veng by establishing a number of village banks since 1991.

In the Study Area, GRET has provided rural credit for 615 borrowers, corresponding to only 3% of the total households in the district, and averaging loan size of 35 US$ per borrower. Borrowing or lending money between relatives and neighbors are still prevailing in Ksach Kandal. These 615 borrowers requested a short-term credit, which can be lent in the condition of 4% of interest rate per month and 5 to 10 month's repayment period and 150,000 Riels in maximum in one time.

Before starting credit, GRET surveys solidarity of village people through the training to explain the GRET's credit system and borrower's duty and then borrowers are required to set up group which is composed of five households headed by one chief. This group forms the guarantee system relying on a collective liability under the leadership of one chief. Repayment must be monthly basis and in cash, and its rate in the district is reported 100% due to this system.

E.6 DEVELOPMENT PLAN

E.6.1 Land Use

(1) Basic Concept

As mentioned in the previous chapter, both floodwater and elevation restrict the present land use conditions. Those two factors limit the physical availability of land, namely, on the ground or under water. The land use situation always changes in accordance with floodwater level. In this study, the control/protection of the flood from the Mekong is not considered and that means the Study Area still receives the effect of floodwater. In consequence, the present land use situation will not change drastically.

The floodwater usually covers most of the Study Area at the peak of flood. According to the hydrological analysis, the peak water levels of 1/2 and 1/10 return period at Chrouy Changvar, Phnom Penh, are 8.83 and 9.97 meters, respectively. The land below 9-meter height occupies more than 85 % of the Study Area so the majority of the Study Area is covered with floodwater once every two-year. (See Table E.5.2)

In addition to the above-mentioned preconditions, the construction/rehabilitation of agricultural infrastructures such as farm roads, reservoir dikes and canals are planned. Those infrastructures do not convert the basic land use category into others because the primary functions of those facilities are not the prevention of flood but they can vary flooding period in the areas concerned.

Taking those matters into consideration, basic concepts of land use for agricultural development are derived as follows;

- The basic land use conditions will not be changed drastically because floodwater comes every year even after the development of planned agricultural infrastructures.
- By the construction/rehabilitation of planned agricultural infrastructure, flooding itself could not be prevented. However flooding period could be somewhat controlled because planned farm roads also have secondary function as floodwater protection/retention dikes. (It is possible to make the flow of floodwater into farmland late for harvesting wet season crops and also to retain floodwater longer.) Therefore, flood damage of crops will be reduced in rainfed paddy, upland crops and orchard areas.
- The development of new farmland is limited only in the waste/grass/bush land.
- The vegetation of reservoir/inundated forests will be conserved because those areas have important multi-functions such as supplying firewood for rural people and providing fish habitat and hatchery, not only at present but also in the future.

(2) Land classification

Since this study aims to enhance agricultural production, land classification is applied to only farmland occupying 58% of the whole area.

From the viewpoint of rainfed paddy in the Study Area, 8 and 9-meter height contours become distinctive levels. As mentioned previously, the peak water levels of 1/2 and 1/10 return period at Phnom Penh, are 8.83 and 9.97 meters, respectively. Usually, wet season paddy height is between 0.8 to 1.2 meters (1994 Research Report, "Section 2. Rice Varietal Improvement", CIAP) so if the average height of wet season paddy is supposed about 1 meter, the rainfed paddy field below 8-meter height is likely to flood over and receive flood damage once every two-year, statistically. This paddy field area is classified as frequent flood damage zone. As the same way, the rainfed paddy field above 9-meter height is unlikely to receive flood damage only once every ten-year. This paddy field area is classified as scarce flood damage zone. (See Table E.6.1, E.6.2 and E.6.3.)

Same method is applied to the irrigation paddy + upland crops area and orchard. Generally, irrigation paddy can be harvested before floodwater comes so it rarely receives the flood damage. On the other hand, upland crops sometimes receive flood damage because their fields are distributed on the relatively lowland and the cropping seasons of most crops start in accordance with rainfall, mostly in May. In this case, the fields of upland crops and orchard below 9-meter height are classified as frequent flood damage zone and the fields above 10-meter height are classified as scarce flood damage zone. (See Table E.6.1 and E.6.2.)

As for recession paddy fields, there are no water volume differences based on land elevation because the recession of floodwater gradually starts from the highland to lowland and there is only time lag between the high and low fields. Usually, receding floodwater is used for initial water requirement for paddy growth. After the completion of floodwater recession, it needs supplementary irrigation to get good harvest because it slightly rains in this season.

If the reservoir dikes are rehabilitated, the volume of stored water increases enough to irrigate the recession paddy area. There may be local irrigation water shortage caused by the disproportion of water distribution from reservoirs to fields, especially in the field far from the reservoirs. However, the stored water volume will be secured as a whole. Consequently, in the recession paddy area, there are no big differences related to the field location/elevation.

If the farm road conditions will be improved and the flood flow into the recession paddy area will be delayed in the future, upland crops could be cultivated to some extent before flooding. In this case, the non-flooding period becomes an important index of land. In the Study Area, the cropping period of wet season upland crops generally starts in May/June and ends before

flooding. If the flood comes in September, 3 to 4 months of cropping period is secured for crop growth. But if it comes in August, it makes cropping period short, 2 to 3 months. In accordance with the length of available cropping period, the recession paddy area is classified into three sub-categories. (See Table E.6.2 and E.6.4.)

(3) Potential Area

In the center of the Study Area, dry season recession paddy is presently spread out about 1,600 ha. According to the field survey, all of the fields for recession paddy are not cultivated every year. Some of the fields are remained fallow or planted with mat grass last year. Early type of mat grass can be harvested within 2 months after transplanting so water requirement is less than that of recession paddy. Some farmers plant mat grass if they can not secure enough irrigation water for paddy. It is estimated that those areas are summed up to 20-30 % of the recession paddy area.

On the other hand, there are large areas of rainfed paddy, mostly distributed to the eastern part of the Study Area. Since there was a very high floodwater last year (peak water level - 9.92 meters at Phnom Penh, October 3rd, 1996), many rainfed paddy fields received serious flood damage not only in the Study Area but also in other huge areas. So it was observed that the dead straws still remained in the field. Although, it had serious flood damage last year, there were still some fallow fields here and there. The fallow area ratio is supposed to be about 30 % of total on the basis of field survey.

In addition to those two types of fallow paddy fields, if enough irrigation water is secured, some parts of the waste/grass/bush land area are possible to include in potential area for agricultural development. This land category is commonly distributed to the areas between 6 to 8-meter height and they are usually inundated for about 2 to 4 months according to the result of hydrological analysis. Because there are few reservoirs above 7-meter height that can provide irrigation water by gravity, those marginal lands can not be used as fields of recession paddy. Some areas in Vihearsour are used as seedbeds for recession paddy. Wet season upland crops are cultivated in the some of the land where receives gentle flood. But the farming of wet season upland crops is unsuitable in the area where receives floodwater for about 4-month, because enough growth periods can not be secured before flooding without irrigation system.

Based on the land classification, beneficial areas by the development stage are clarified. By the completion of Stage I development, agricultural production will increase in two major paddy areas and flood damage will be reduced in the rainfed paddy area, upland crops area and orchard. By the completion of Stage II and Stage III development, it will increase in the irrigation paddy + upland crops area and the recession paddy area, respectively. (See Table E.6.5.)

E.6.2 Farming and Production

(1) Proposed Cropping System

In the Study Area, there are three major cropping systems in accordance with agricultural land use categories; (1) recession paddy area, (2) rainfed paddy area and (3) irrigation paddy and upland crops area. Basically, those three systems do not change even after the completion of the development plan. The general characteristics of each cropping system and the projected agricultural effects are as follows. (See Table E.6.6.)

1) Recession Paddy Area

The main crop for this area is recession paddy broadly observed in the center of the Study Area. Usually, the period between transplanting and harvesting is about 3 months because IR varieties are commonly planted. However the transplanting season varies from October to February in accordance with the floodwater recession so harvesting season also varies from January to May. Without both flood control and irrigation systems, the cultivation of upland crops on recession paddy area is very limited.

Besides recession paddy, mat grass is presently cultivated as a substitutive crop for paddy in case of the shortage of irrigation water. The planted area will decrease after the rehabilitation of reservoirs is completed.

With the rehabilitation of reservoirs of Stage I development, enough water for irrigation is secured. In consequence, the recession paddy planted area will be expanded through the increment of cropping intensity.

Moreover, with the construction of flood control gates of Stage III development, it is possible to control the flow of floodwater into the recession paddy area. Accordingly, upland crop cultivation with natural rainfall before flooding will be expanded to some extent.

2) Rainfed Paddy Area

The main crop for this system is rainfed paddy broadly cultivated in the eastern part of the Study Area. Usually, the period between transplanting and harvesting ranges from 4 to 5 months because several local varieties with different growth duration are commonly planted. Transplanting season generally starts in July or August after the completion of land preparation. Harvesting season is on November or December.

Besides rainfed paddy, upland crops are not cultivated widely because it is very difficult to secure irrigation water in dry season due to its relatively high elevation in the area. The cultivation of upland crops on rainfed paddy area is just limited with small-scale, around

houses, and it will not be expanded to large-scale.

With the construction/rehabilitation of farm roads/dikes of Stage I development, it is possible to reduce the flood damage by controlling the flow of floodwater into the rainfed paddy area. Besides, the construction/rehabilitation of canal systems of Stage I development enables to enlarge the planted area through the increment of cropping intensity. Consequently, the production of rainfed paddy will increase.

3) Irrigation Paddy and Upland Crops Area

Upland crops such as maize, sesame, vegetables and so forth are mainly cultivated on the levee of the Mekong and along the colmatage canals. Usually, the cropping season starts in May or June when it begins to rain. If it is not flooded, double or triple cropping is possible. In this case, the final harvesting season is on February or March.

Besides upland crops, irrigation paddy is also practiced on the levee of the Mekong. However there are few effect of the planned facilities on irrigation paddy, because it is cultivated on relatively highland with irrigation water. Moreover, it is not dominant because it needs to pump up irrigation water from the Mekong and this means that only some farmers with mobile pumps can practice it.

With the construction/rehabilitation of farm roads/dikes of Stage I development, it is possible to reduce the flood damage of upland crops by controlling the flow of floodwater into the area. It is also supposed to expand the planted area through the increment of cropping intensity with the construction/rehabilitation of colmatage canals of Stage II development. Therefore the production of upland crops will increase.

(2) Farming Practice

Data of present farming practice by crop are collected from the Rural Socio-Economic Survey. Same as agricultural land use conditions, farming practices of major crops are not changed drastically in the future.

1) Recession Paddy

Photoperiod insensitive early/medium duration varieties such as IR66 and IR42 are presently planted in the Study Area. In the future, they will still remain the major varieties. IR42, released in the Philippines in 1977, has high yield potential and pest resistance but it has longer growth duration and taller height than IR66 (growth duration: 135 days, plant height: 110 cm). Some farmers may replace IR42 to other varieties because longer growth duration needs more irrigation water and taller height is subject to lodge. Some improved varieties, IR72, Kru and IR Kesar, released by CIAP in 1990 are

recommended for irrigated early duration paddy. (See Table E.6.7.)

The rehabilitation of reservoirs enables to keep more water and that makes it possible to irrigate more recession paddy fields by gravity. Consequently, working hours for irrigation will decrease but some operation/maintenance works for canals and reservoirs will be necessary.

Draft animals, both cattle and buffaloes, are generally used for land preparation, plowing and harrowing. At higher fields distributed in Prek Tamerk and Vihearsour, first plowing is conducted on July before flooding. In other fields, land preparation is usually commenced one month before transplanting. In accordance with the floodwater recession, transplanting is operated from October to February, from highland to lowland. The age of seedlings is usually 20 to 30 days. Harvesting season commonly starts on January to May, about 3 months after transplanting. (See Figure E.6.1.)

Although the present input rate is little, inorganic fertilizers are customarily used for recession paddy and the half of recession paddy practicing farmers use agricultural chemicals. At first, it is strongly recommended to effectively utilize natural material, such as manure, green manure, plant waste and ash, for the improvement of soil productivity. However, the application of inorganic fertilizers and agricultural chemicals will be more popular in the future because the improved varieties are usually reactive to inorganic fertilizer and they also need appropriate cultural management practices to attain high yield.

2) Rainfed Paddy

Photoperiod sensitive medium/late duration traditional varieties such as Sar Thungun and Bonla Phdau are presently planted. In 1992, CIAP released three higher-yield improved medium duration varieties developed by the IRRI, namely, Santepheap 1, Santepheap 2 and Santepheap 3 (santepheap means peace in Khmer). With suitable cultural management practices in station experiment, their yields exceed 3.5 ton/ha. Even on-farm experiments conducted from 1992 to 1995, those three varieties had 4 - 16% yield advantages over the local check. (See Table E.6.8.)

Also in 1995, more 6 higher-yield traditional varieties (CAR 1 to CAR 6: 3 of them are medium duration and 3 others are late duration) were released by CIAP. They are pure line selections from traditional Cambodian rice germplasm. CAR 1, CAR 2 and CAR 3 are suited for rainfed lowland paddy areas requiring photoperiod sensitive medium duration varieties and CAR 4, CAR 5 and CAR 6 are suited for rainfed lowland paddy areas requiring photoperiod sensitive late duration varieties. Their yields are superior to local check with various conditions. (See Table E.6.8.)

If it is possible to obtain certified seeds of those high-yield varieties, it is recommended to

replace present traditional varieties with new released varieties because the yield advantage of new varieties is obvious even in on-farm level.

The construction/rehabilitation of canal systems enables to keep water nearby paddy fields and that makes it possible to distribute water easily and secure water in case of erratic rainfall.

Land preparation and seedling raising are usually conducted from June to July and transplanting is done continuously. Harvesting season starts on November for medium duration varieties and for December with late duration varieties.

Generally, farmers do not use both inorganic fertilizers and agricultural chemicals for rainfed paddy. Because rainfed paddy has more possibility to receive flood damage than recession paddy, farmers do not tend to invest/apply fertilizers and agricultural chemicals for rainfed paddy. Firstly, it is strongly recommended to utilize natural material, such as manure, green manure, plant waste and ash, for the improvement of soil productivity as much as possible. However, if flood damage is reduced by the planned farm roads/dikes, the application of inorganic fertilizers and agricultural chemicals may be more common since appropriate application of inorganic fertilizer evidently enhances the yield.

3) Upland Crops

At present, upland crops such as sesame, cassava and maize are popular in wet season. In dry season, mungbean, tomato and watermelon are common. In the future, those planted crops will still planted but more vegetables will be cultivated gradually.

Although it needs to take ferryboat to go to Phnom Penh, it takes less than one hour by car or motorcycle from the Study Area to the capital, the largest market of agricultural production. Some farmers in Prek Tamerk have already started to sell leafy vegetables to Phnom Penh because it is lucrative even if they pay transportation fees. Even leafy vegetables are transported to Phnom Penh, fruit vegetables also have high potentiality selling to Phnom Penh if both quality and volume are satisfied. Water availability is one of the constraints in the area but after the rehabilitation of colmatage canals, it is possible to utilize water stored in the canals.

At present, seedling pots and mulching utilized natural material are common among the farmers. It is strongly recommended to effectively utilize natural material, such as manure, green manure, plant waste and ash, for the improvement of soil productivity.

The application of inorganic fertilizers and agricultural chemicals depends on the kind of planted crop. Cassava and maize are customarily planted without inorganic fertilizers and agricultural chemicals. On the other hand, sesame and vegetables are planted with some

inorganic fertilizers and agricultural chemicals at present, although the application amount is very little. If the farmers notice that the application of them enhances both crop yields and agricultural income, the application of inorganic fertilizers and agricultural chemicals will be more popular.

4) Farm Types and Labor Requirement

Based on the Rural Socio-Economic Survey, land use and proposed cropping patterns, three typical farm types are designated as follows.

Farm Type	Commune Distribution	Farm Size(ha)
Recession Paddy + Upland Crops	Prek Tamerk, Puk Reusei, Prek Ampil	0.5-1.0
Recession Paddy + Rainfed Paddy	Vihearsour	1.0-2.0
Rainfed Paddy + Animal Husbandry	Sanlung	0.7-1.4

According to the proposed cropping patterns, labor requirement in the Study Area will be the maximum in December because there are transplanting of recession paddy, harvesting of rainfed paddy and land preparation of two kinds of upland crops. Based on the estimation of labor requirement and labor supply, it is supposed that the labor forces in the Study Area afford the demands. (See Table E.6.9.)

(3) Yield and Production

Based on the Rural Socio-Economic Survey, present yields in the Study Area are calculated. Except for the yields of paddy, the calculated yields of upland crops are far higher than the yields of district and province (ex. Mungbean in dry season: calculated value-1.85 ton/ha, district yield-0.65 ton/ha, provincial yield-0.77 ton/ha). So the district yields are applied to the present yields for mungbean, vegetables and maize and the provincial yield is applied to the present yield for sesame.

Based on the experimental data of CIAP and the statistic data, the projected yields are estimated. As for recession paddy, the experimental data and the statistic data of dry season paddy are both relatively high, ranging 3.45-4.20 ton/ha. Average of those data is 3.74 ton/ha which represents 129% of present yield. Practical projected yield is set as 3.48 ton/ha, 20% higher than present yield. For wet season paddy, the experimental data and the statistic data are also high, ranging 2.09-4.24 ton/ha. Average of those data is 2.81 ton/ha which represents 175% of present yield. Practical projected yield is set as 1.93 ton/ha, which is 20% higher than present yield as same as dry season paddy. (See Table E.6.10.)

The projected production is calculated with the projected yields and the planted areas by each development stage. (See Table E.6.11, E.6.12 and Figure E.6.3.)

E.6.3 Agricultural Supporting Services

(1) Strengthening for Agricultural Research and Extension Services

With the development of agricultural infrastructure, the strengthening of agricultural supporting services is indispensable. In particular, agricultural extension service is very important because its activity directly has an effect on farming practices and agricultural productivity.

To strengthen present agricultural extension services for farmers, following two proposals should be done simultaneously with the development of agricultural infrastructure.

Increase in Agricultural Extension Personnel

- It is obvious that the number of agricultural extension officers is insufficient for 18 communes. (According to the target of Cambodia Australia Agricultural Extension Project, CAAEP, one agricultural extension officer covers 2 communes.) Without the personnel increment, it is difficult for farmers to receive ample extension services not only in the Study Area but also in whole district.

Training of Present Agricultural Extension Officers

- Since both Ksach Kandal district and the Study Area have a variety of farming types, skilled officers with wide knowledge are necessary. But two present agricultural extension officers have never studied in college/university. Although there is not fixed training schedule provided through CAAEP, systematic training should be given to them.
- Some of the agricultural chemicals used in the Study Area are organophosphorus insecticides and they have toxicity. Since they are sold in local market, agricultural extension officer should firstly acquire the appropriate usage of both agricultural chemicals and inorganic fertilizers and secondly spread it to farmers. Instead of high toxic chemicals, low toxic ones should be used in the future.

For the effective agricultural extension service in future, the tie-up with the operation and maintenance supporting office should be reinforced. The operation of water control facilities makes an great effect on crop yields because the appropriate timing of irrigation and drainage is important for crop growth. So the periodic visit extension service with the staff of the operation and maintenance supporting office is recommendable. In particular, the actual operation of facilities should be demonstrated through the field guidance at various villages and the practical farming practices are also extended at the same time. At least, the visiting extension service should be conducted in both the starting time and the receding time of flood.

Basic data accumulation of agricultural conditions, such as annual flood period and depth,

major crops, soil features and so forth, in each village is essential for agricultural extension service. At present, there is a supporter of district agricultural office in each commune. So the supporter system should be extended in village level and the basic data should be accumulated through the supporter. Without the above-mentioned data accumulation, the provision of the appropriate practical measures in the specific village/area is difficult.

To assist farmers immediately and directly until the establishment of agricultural extension system, the present periodical seminar should be continued even if only oral lecture is given. Some agricultural institutes, NGOs and other donor countries present effective seminar so it is one option to ask them to held seminar at the operation and maintenance supporting office.

Prek Leap Agricultural College is near the Study Area, the other side of the Mekong River on the way to Phnom Penh. If it is possible, it is realistic to ask cooperation with the college as a development model area.

In future, upland cropping will be more popular on the levee of the Mekong River. For the referential data of upland cropping, the textbook of cropping standard for upland crops is published in Khmer. Those materials should be utilized more effectively for agricultural extension activity. (See Table E.6.13 and E.6.14.)

Research activity in Cambodia remains still primitive and even the national research institutes do not work efficiently at present. It is difficult to conduct research activity only for the Study Area but the useful research results applicable to the agriculture in the Study Area should be spread through the extension services.

(2) Agricultural Credit System

Despite of higher need for rural credit, various informal credits with higher interest rates has been practiced in Cambodia because of no institutional credit system. The result of the Rural Socio-Economic Survey indicates that most of farm households in the Study Area live on the lower income than the poverty line and marginal households facing with rice deficit even for home consumption have to borrow their rice and/or reduce their food intake/consumption. In addition, nearly 100% of borrowers from GRET applies short-term credit. This indicates that most farmers are in need of money to buy agricultural materials and rice itself.

Development of the agricultural credit, therefore, is necessary to support those households by providing loans not only for household rice deficits but also for improvement of paddy cultivation. Expansion of these agricultural credits will help to improve food security among poverty groups and to foster sustainable farm households. Agricultural credit is also needed to develop small-scale agro-processing and home industries in the rural areas.

Experiences by GRET and other NGOs working in and around the Study Area should be highly evaluated because of its acceptable organizing system of farmers and lending system based on collective guarantees. Cambodia government established Credit Committee for Rural Development (CCRD) by the Sub-decree No. 30 on February 1995, which will be responsible to manage and improve this field. It is suggested that the central financial institute should be created to serve as the central of agricultural and rural credit for all class of farm households under the management and coordination of CCRD. Experiences by NGOs like GRET will contribute to conduct a successful agricultural and rural credit.

(3) Post-Harvest, Processing and Marketing

The Study Area has been facing with food constraint on paddy/rice deficit and cannot afford to sell amount of crops to other consuming areas excluding a little number of livestock like pigs, piglets and ducks, which are transported to Phnom Penh. This imply that efforts to increase paddy production through the improvement of irrigation systems should be given priority more than provision of processing activities.

In fact, some home industries such as producing mat, noodle and smoked fishes are managed in small-scale. These small-scale home industries should be encouraged and extended to improve family incomes since the current family incomes in the Study Area are stagnant at lower level than poverty line. Rush and mat grass could be processed into not only mat but also cushion (Kapok inside), huts etc.. For that purpose, rural credit services should be strengthened to motivate farmers to invest in these home industries.

Processing technologies limited into some farmers must be educated to all class of farmers, in particular poor households to alleviate regional disparity in incomes and human/institutional development.

Development of credit system and strengthening of technologies mentioned above will be supported by the district office and operation/maintenance supporting office.

Rice mills would be the major post-harvest activities in the near future, too. The number of rice mills and their capacities could meet rural requirement.

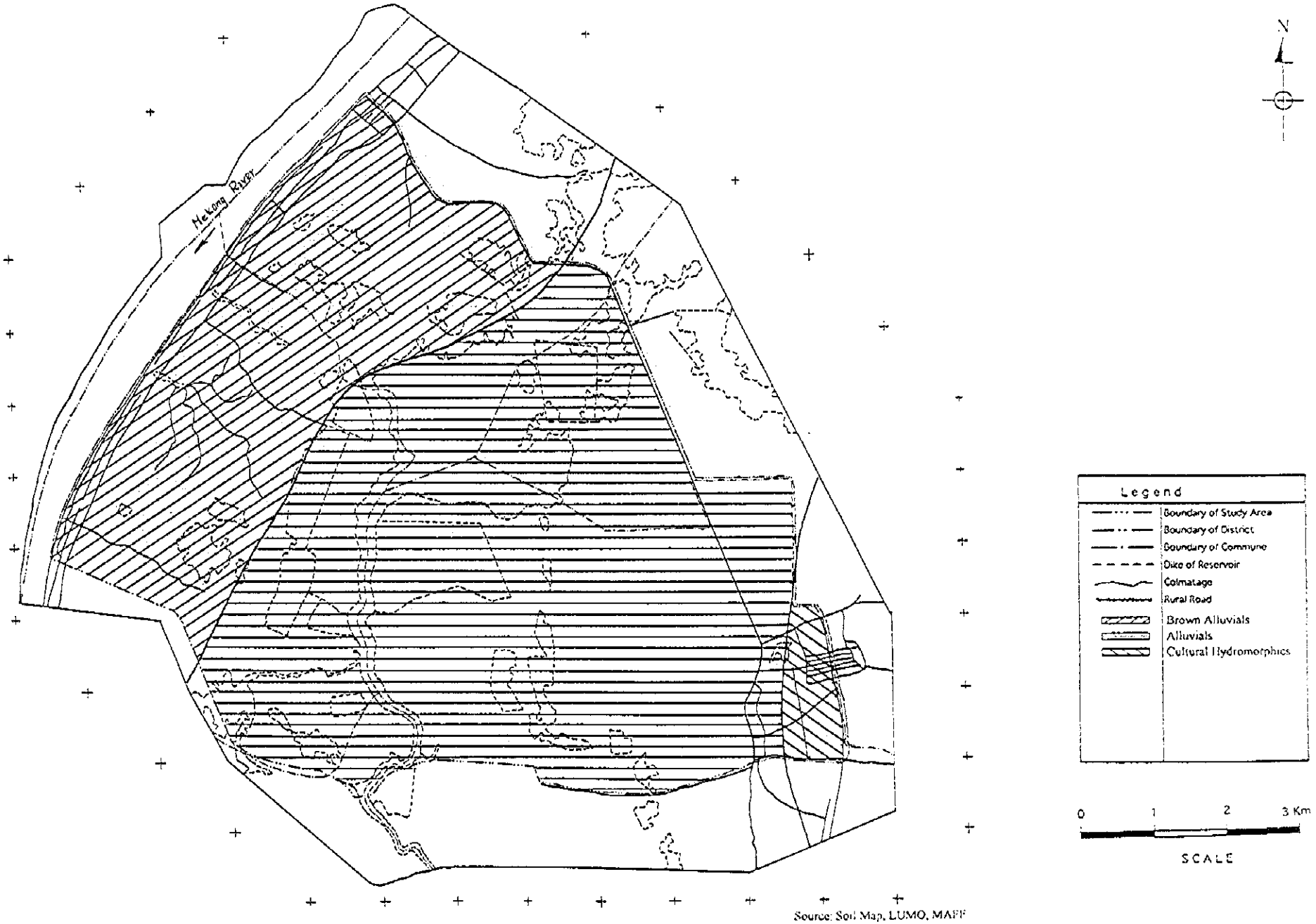
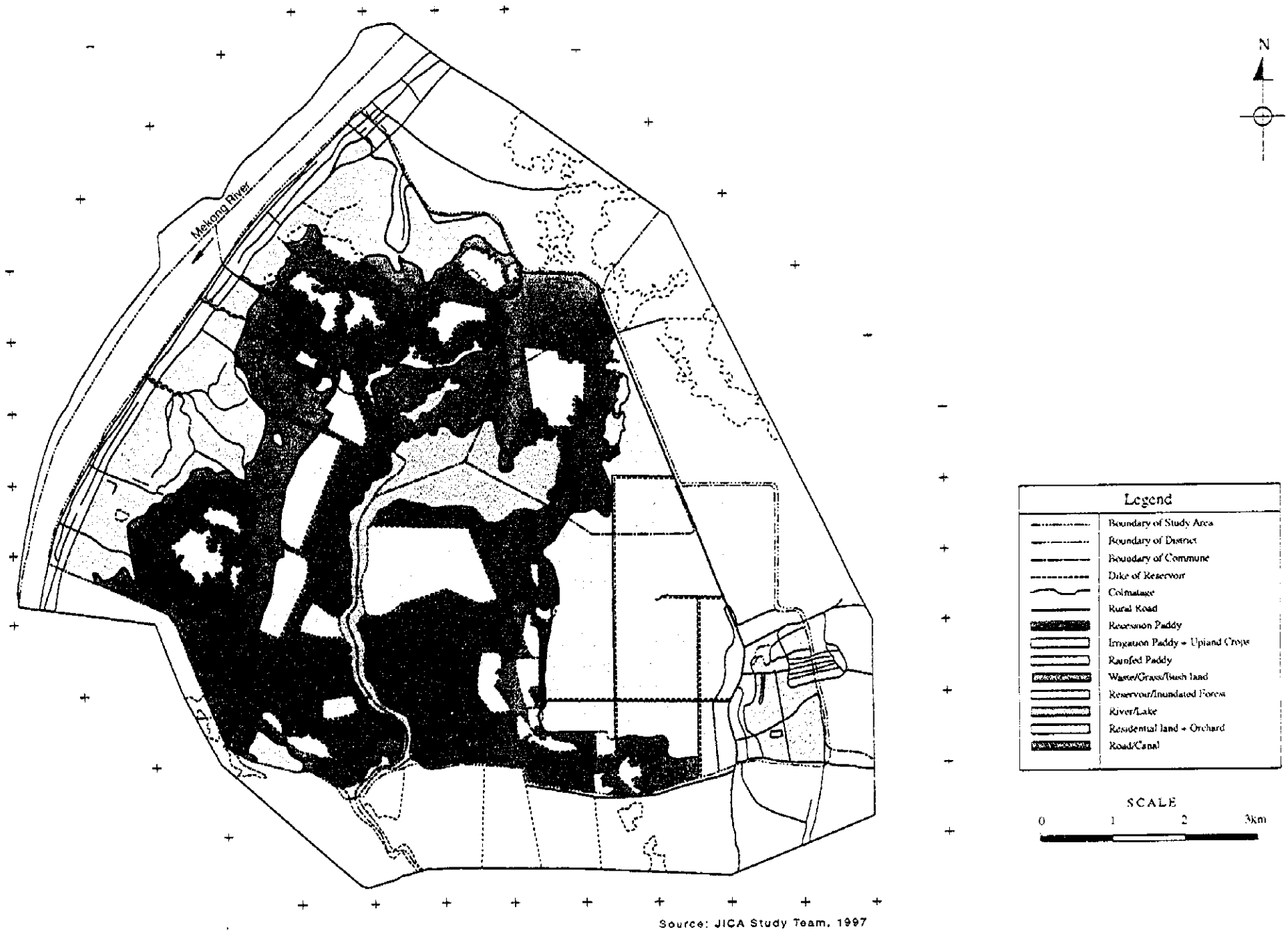


Figure E.5.1 Soil Map of the Study Area



Source: JICA Study Team, 1997

Figure E.5.2 Present Land Use Map of the Study Area

Table E.5.1 Present Land Use in the Study Area by Commune and Elevation

(Unit : ha)

Commune	Land Elevation (m)	Farm land	Waste/ Grass/Bush land	Reservoir /Inundated Forest	River/Lake	Residential land	Road Canal	Total	Distribution
Prek Tamerk	>9.0	92	-	-	-	79	6	177	14.6%
	8.0-9.0	184	-	-	-	9	5	198	16.3%
	<8.0	327	311	122	77	-	2	839	69.1%
	Sub Total	603	311	122	77	88	13	1,214	100.0%
	Distribution	49.7%	25.6%	10.0%	6.3%	7.2%	1.1%	100.0%	-
Puk Reusei	>9.0	128	-	-	-	96	29	253	13.7%
	8.0-9.0	226	9	-	-	-	20	255	13.8%
	<8.0	693	356	231	48	-	15	1,343	72.6%
	Sub Total	1,047	365	231	48	96	64	1,851	100.0%
	Distribution	56.6%	19.7%	12.5%	2.6%	5.2%	3.5%	100.0%	-
Sanlung	>9.0	16	1	-	-	-	2	19	3.3%
	8.0-9.0	166	16	-	-	-	-	182	31.3%
	<8.0	95	152	57	76	-	-	380	65.4%
	Sub Total	277	169	57	76	-	2	581	100.0%
	Distribution	47.7%	29.1%	9.8%	13.1%	0.0%	0.3%	100.0%	-
Vihear-sour	>9.0	249	-	9	-	115	11	384	16.7%
	8.0-9.0	733	12	-	-	-	2	747	32.5%
	<8.0	552	220	260	135	-	2	1,169	50.8%
	Sub Total	1,534	232	269	135	115	15	2,300	100.0%
	Distribution	66.7%	10.1%	11.7%	5.9%	5.0%	0.7%	100.0%	-
Prek Ampil	>9.0	-	-	-	-	-	-	-	0.0%
	8.0-9.0	9	-	-	-	-	-	9	4.9%
	<8.0	95	50	13	17	-	-	175	95.1%
	Sub Total	104	50	13	17	-	-	184	100.0%
	Distribution	56.5%	27.2%	7.1%	9.2%	0.0%	0.0%	100.0%	-
Total	>9.0	485	1	9	-	290	48	833	13.6%
	8.0-9.0	1,318	37	-	-	9	27	1,391	22.7%
	<8.0	1,762	1,089	683	353	-	19	3,906	63.7%
	Total	3,565	1,127	692	353	299	94	6,130	100.0%
	Distribution	58.2%	18.4%	11.3%	5.8%	4.9%	1.5%	100.0%	-

Source : JICA Study Team, July. 1997

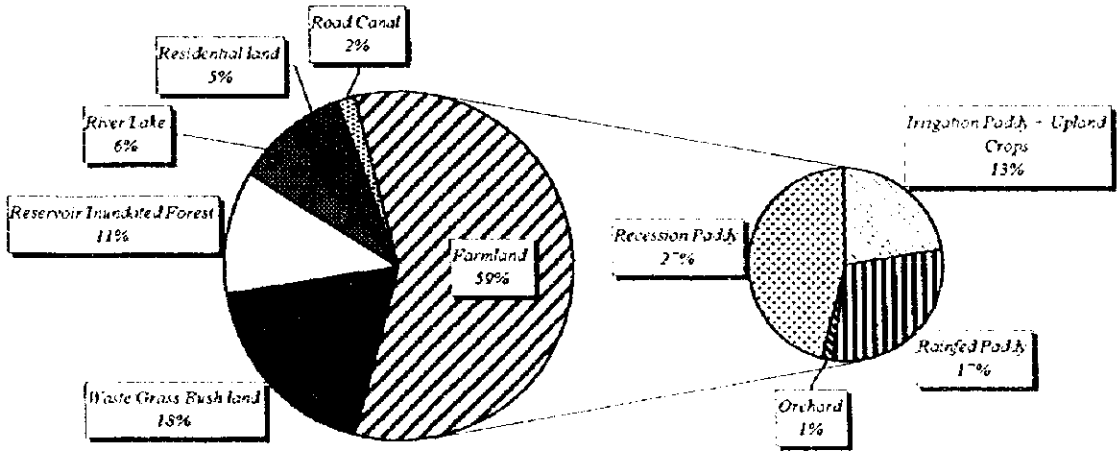
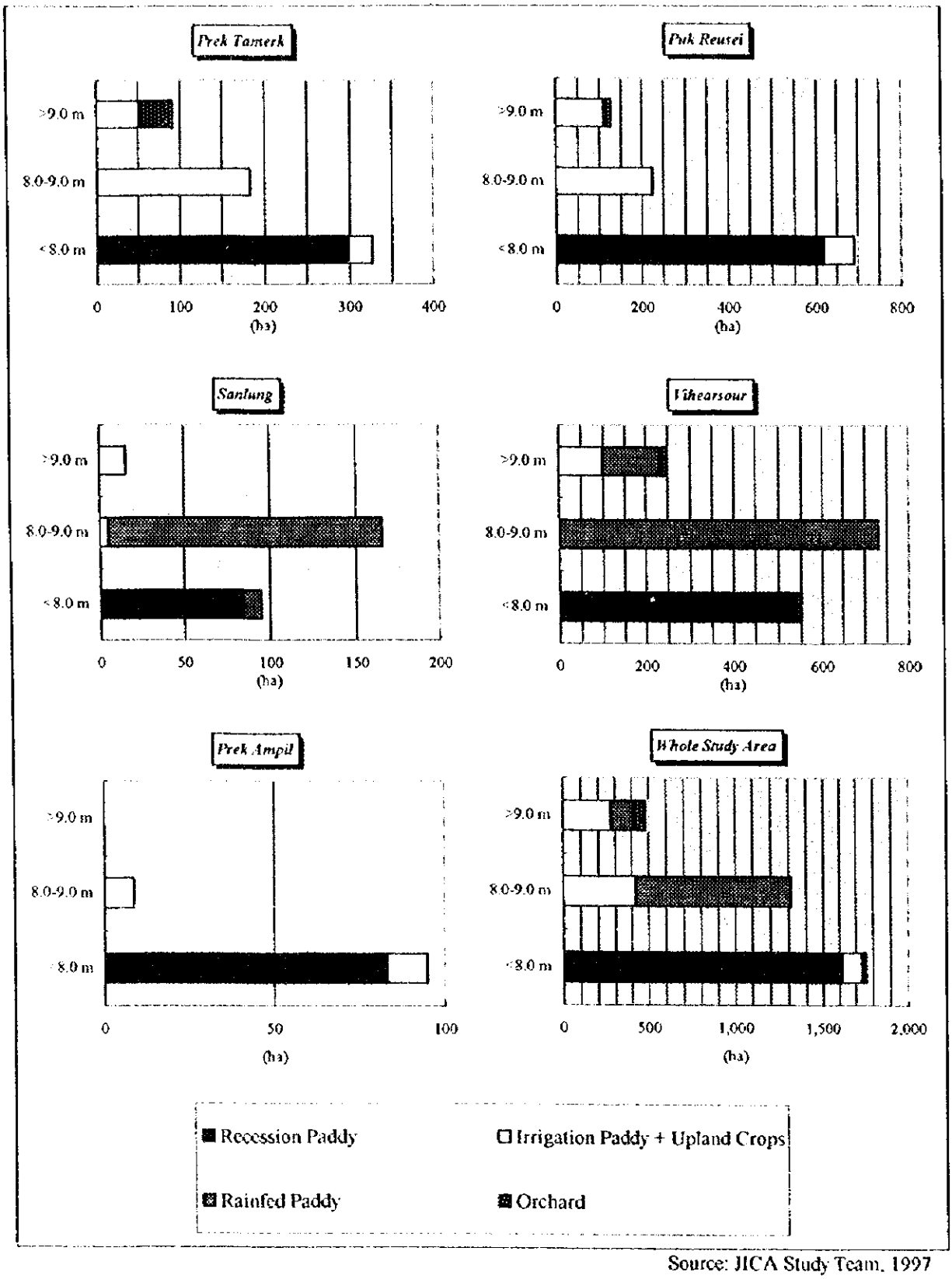


Figure E.5.3 Present Land Use in the Study Area



Source: JICA Study Team, 1997

Figure E.5.4 Present Agricultural Land Use by Commune and Elevation

Table E.5.2 Present Agricultural Land Use in the Study Area
by Commune and Elevation

(Unit : ha)

Commune	Land Elevation (m)	Recession Paddy	Irrigation Paddy + Upland Crops	Rainfed Paddy	Orchard	Total	Distribution
Prek Tamerk	>9.0	-	52	-	40	92	15.3%
	8.0-9.0	-	184	-	-	184	30.5%
	<8.0	298	29	-	-	327	54.2%
	Sub Total	298	265	-	40	603	100.0%
	Distribution	49.4%	43.9%	0.0%	6.6%	100.0%	-
Puk Reusei	>9.0	-	111	-	17	128	12.2%
	8.0-9.0	-	226	-	-	226	21.6%
	<8.0	619	74	-	-	693	66.2%
	Sub Total	619	411	-	17	1,047	100.0%
	Distribution	59.1%	39.3%	0.0%	1.6%	100.0%	-
Sanlung	>9.0	-	16	-	-	16	5.8%
	8.0-9.0	-	5	161	-	166	59.9%
	<8.0	84	-	11	-	95	34.3%
	Sub Total	84	21	172	-	277	100.0%
	Distribution	30.3%	7.6%	62.1%	0.0%	100.0%	-
Vihear-sour	>9.0	-	99	133	17	249	16.2%
	8.0-9.0	-	-	733	-	733	47.8%
	<8.0	538	-	14	-	552	36.0%
	Sub Total	538	99	880	17	1,534	100.0%
	Distribution	35.1%	6.5%	57.4%	1.1%	100.0%	-
Prek Ampil	>9.0	-	-	-	-	-	0.0%
	8.0-9.0	-	9	-	-	9	8.7%
	<8.0	83	12	-	-	95	91.3%
	Sub Total	83	21	-	-	104	100.0%
	Distribution	79.8%	20.2%	0.0%	0.0%	100.0%	-
Total	>9.0	-	278	133	74	485	13.6%
	8.0-9.0	-	424	894	-	1,318	37.0%
	<8.0	1,622	115	25	-	1,762	49.4%
	Total	1,622	817	1,052	74	3,565	100.0%
	Distribution	45.5%	22.9%	29.5%	2.1%	100.0%	-

Source : JICA Study Team, July, 1997

Table E.5.3 Farmland Ownership of Interviewed Farmers in the Study Area

Commune	Number of Interviewed Farmer	Farmland Ownership (household)				Field Size (ha)				
		Paddy Field		Upland Field		Average			Minimum Field Size	Maximum Field Size
		Own	Not Own	Own	Not Own	Paddy	Upland	Total		
Prek Tamerk	100	100	0	52	48	0.54	0.44	0.77	0.12	5.30
Puk Reusei	182	173	9	130	52	0.49	0.17	0.58	0.15	3.00
Sanlung	25	25	0	16	9	0.77	0.50	1.09	0.15	4.00
Vihearsour	175	175	0	18	157	1.62	0.57	1.68	0.10	12.00
Prek Ampil	18	18	0	8	10	0.61	0.13	0.67	0.20	1.62
Total	500	491	9	224	276	0.92	0.29	1.03	0.10	12.00
Distribution	-	98%	2%	45%	55%	-	-	-	-	-

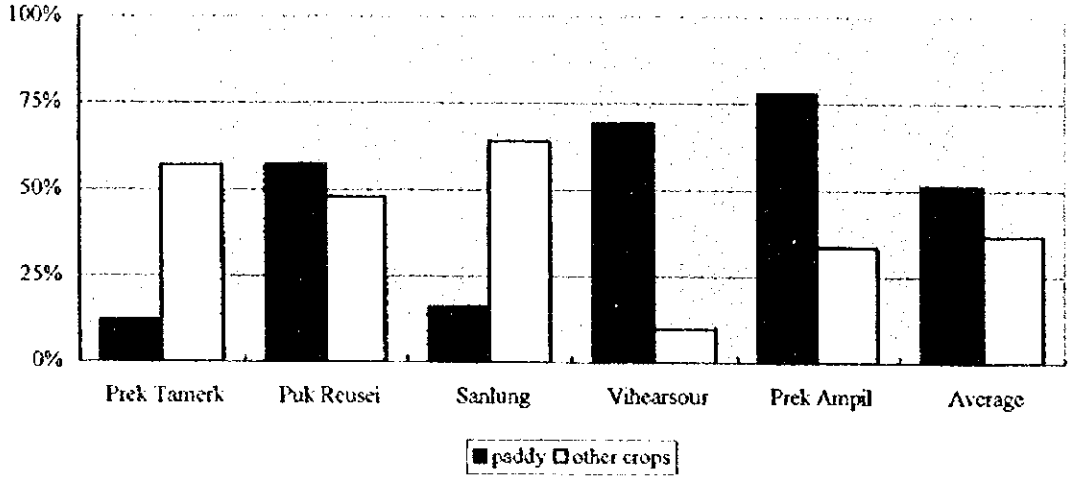
Source: Rural Socio-Economic Survey, JICA Study Team, 1997

Note: Field sizes are based on land owned farmers.

Table E.5.4 Number of Interviewed Farmers by Income Source and Commune

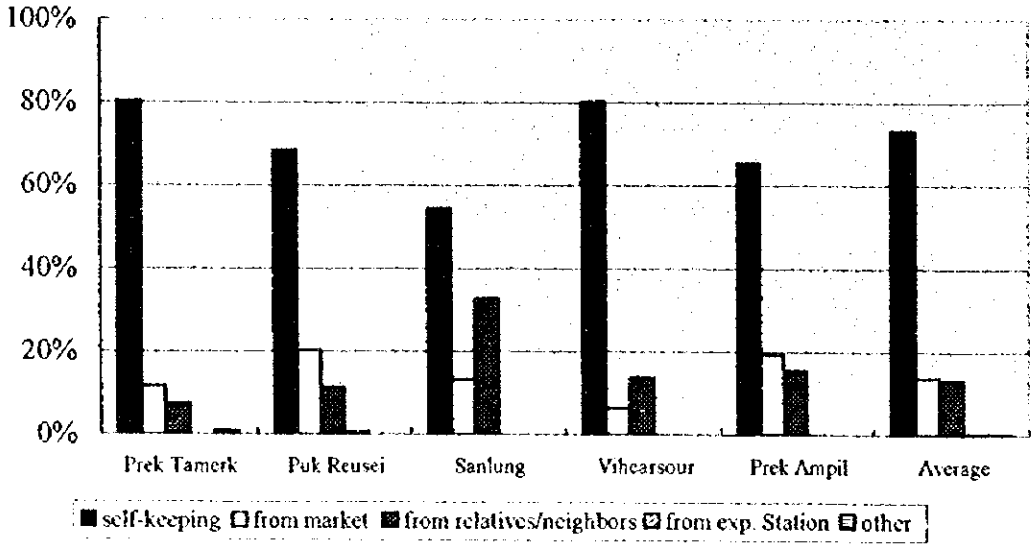
Commune	Farm income > Fishery income = 0	Farm income > Fishery income > 0	Fishery income > Farm income > 0	Fishery income > Farm income = 0	Unknown	Total
Prek Tamerk	74	24	2	0	0	100
Puk Reusei	139	28	7	1	7	182
Sanlung	24	1	0	0	0	25
Vihearsour	138	21	9	3	4	175
Prek Ampil	14	4	0	0	0	18
Total	389	78	18	4	11	500

Source: Rural Socio-Economic Survey, JICA Study Team



Source: Rural Socio-Economic Survey, JICA Study Team, 1997

Figure E.5.5 Percentage of Farm Product Selling Farmer by Crop and Commune



Source: Rural Socio-Economic Survey, JICA Study Team, 1997

Figure E.5.6 Procurement of Paddy Seed for Nursery in the Study Area

Table E.5.5 Paddy Cropping Practice in the Study Area

Commune	Practicing Paddy Type			Average Planted Area (ha)				Average Production (ton)				Average Yield (ton/ha)				Major Variety	
	Dry (D)	Wet (W)	(D+W)	(D)	(W)	(D)/ (D+W)	(W)/ (D+W)	(D)	(W)	(D)/ (D+W)	(W)/ (D+W)	(D)	(W)	(D)/ (D+W)	(W)/ (D+W)	Dry	Wet
Prek Tamerk	64	16	20	0.47	0.26	0.37	0.27	1.54	0.78	0.83	0.54	3.27	2.93	2.26	1.97	IR66	IR66
Puk Reusei	50	36	54	0.43	0.51	0.36	0.26	1.42	1.48	1.18	0.63	3.30	2.92	3.27	2.45	IR66	Kloeng
Sanlung	0	22	3	-	0.68	0.40	1.07	-	1.01	1.53	1.55	-	1.49	3.83	1.46	-	Sar Thungun
Vihearsour	18	8	140	0.90	0.92	0.81	0.88	2.58	1.17	2.19	1.13	2.86	1.27	2.70	1.28	IR42	Sar Thungun
Prek Ampil	12	3	2	0.57	0.70	0.27	0.34	1.73	1.53	0.77	0.88	3.04	2.19	2.86	2.58	IR66	Kloeng
Total/Average	144	85	219	0.52	0.55	0.65	0.67	1.65	1.20	1.79	0.96	3.17	2.18	2.77	1.42	-	-
Distribution	32%	19%	49%	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Source: Rural Socio-Economic Survey, JICA Study Team, 1997

Note: The data of Puk Reusei Kandal village are excluded.

Table E.5.6 Upland Crops Planted Area by Commune

Commune	1996/97 Planted Area (ha)															
	Maize		Vegetables			Cassava	Sweet Potato	Taro	Mung bean	Ground nut	Sugar cane	Chili	Sesame	Mat Grass	Tobacco	Jute
	White	Red	Fruit	Leaf	Tuber											
Prek Tamerk	10	3	16	5	11	4	2	3	1	3	20	34	10	20	2	20
Puk Reusei	16	1	17	1	9	2	1	2	2	3	15	36	18	20	3	6
Sanlung	0	0	0	0	0	0	0	0	0	0	0	0	0	26	0	0
Vihearsour	4	0	4	4	1	0	0	0	0	0	0	0	0	20	0	0
Prek Ampil	18	1	10	2	6	2	1	0	0	2	6	48	18	10	4	4
TOTAL (A)	48	5	47	12	27	8	4	5	3	8	41	118	46	96	9	30
Whole District (B)	135	5	216	33	80	25	31	25	15	25	55	365	105	255	38	46
Distribution (A/B)	35.6%	100.0%	21.8%	36.4%	33.8%	32.0%	12.9%	20.0%	20.0%	32.0%	74.5%	32.3%	43.8%	37.6%	23.7%	65.2%

Source: District Agriculture Office, Ksach Kandal

Table E 5.7 Farming Practices of Wet Season Paddy in the Study Area

Commune	Number of Analysed Farmer	No. of Practiced Farmer	Seed Requirement for Nursery (kg/ha)	Urea Application				Agricultural Chemicals Application			
				No. of Applied Farmers	%	Average Amount (kg/ha)	Average Cost (Riel)	No. of Applied Farmers	%	Methyl Parathion (Folidol)	Mevin-phos
Prek Tamerk	100	36	120	36	100%	181	148,822	13	36%	4	8
Puk Reusei	156	90	118	85	94%	134	104,520	30	33%	15	4
Sanlung	25	25	115	0	0%	-	-	-	-	-	-
Vihearsour	175	148	122	50	34%	84	67,637	29	20%	28	-
Prek Ampil	18	5	131	5	100%	137	109,600	3	60%	0	3
Total/Average	474	304	120	176	58%	129	102,754	75	25%	47	15

Source: Rural Socio-Economic Survey, JICA Study Team, 1997
Note: Urea is the most popular fertilizer in the Study Area.
The data of Puk Reusei Kandal village are excluded.

Table E 5.8 Farming Practices of Dry Season Paddy in the Study Area

Commune	Number of Analysed Farmer	No. of Practiced Farmer	Seed Requirement for Nursery (kg/ha)	Urea Application				Agricultural Chemicals Application			
				No. of Applied Farmers	%	Average Amount (kg/ha)	Average Cost (Riel)	No. of Applied Farmers	%	Methyl Parathion (Folidol)	Mevin-phos
Prek Tamerk	100	84	127	84	100%	181	147,171	47	56%	18	21
Puk Reusei	156	104	140	102	98%	153	121,124	67	64%	47	4
Sanlung	25	3	170	0	0%	-	-	-	-	-	-
Vihearsour	175	158	132	122	77%	90	73,463	61	39%	60	0
Prek Ampil	18	16	153	16	100%	105	84,788	6	38%	3	0
Total/Average	474	365	134	324	89%	134	107,875	181	50%	128	25

Source: Rural Socio-Economic Survey, JICA Study Team, 1997
Note: Urea is the most popular fertilizer in the Study Area.
The data of Puk Reusei Kandal village are excluded.

Table E 5.9 Genral Paddy Cropping Period by Season and Commune

Commune	Wet Season					Dry Season				
	Variety Name	No. of Farmers	Land Prep. Month	Transplant. Month	Harvesting Month	Variety Name	No. of Farmers	Land Prep. Month	Transplant. Month	Harvesting Month
Prek Tamerk	IR66	26/36	7/8	8/9	11/12	IR66	50/84	7/8,10	10/11/12	1/2/3
Puk Reusei	Kloeng	48/90	6/7	7/8	10/11/12	IR66	85/95	10/11/12	11/12/1	2/3/4
	IR66	22/90	6/7	7/8	10/11	-	-	-	-	-
	Sar Thungun	15/90	4/5	5/6	10/11	-	-	-	-	-
Sanlung	Sar Thungun	19/25	6	7	12	-	-	-	-	-
	Bonla Phdau	6/25	6	7	11	-	-	-	-	-
Vihearsour	Sar Thungun	134/148	6	7	12	IR42	104/158	7,11/12	12/1	3/4
Prek Ampil	-	-	-	-	-	IR66	14/17	12	1	4

Source: Rural Socio-Economic Survey, JICA Study Team, 1997

Table E 5.10 Animal Raising of Interviewed Farmers in the Study Area

Commune	Number of Interviewed Farmer	Draft Animal			Pigs			Chicken			Duck		
		Number of Owned Farmer	%	AVG. Heads	Number of Owned Farmer	%	AVG. Heads	Number of Owned Farmer	%	AVG. Heads	Number of Owned Farmer	%	AVG. Heads
Prek Tamerk	100	52	52%	2.3	67	67%	1.4	82	82%	9.8	4	4%	3.5
Puk Reusei	182	88	48%	2.4	100	55%	1.5	174	96%	9.5	8	4%	7.9
Sanlung	25	11	44%	2.1	24	96%	2.3	24	96%	11.1	3	12%	6.3
Vihearsour	175	115	66%	2.4	119	68%	1.8	152	87%	12.2	29	17%	7.9
Prek Ampil	18	8	44%	2.1	6	33%	1.8	18	100%	9.7	1	6%	1.0
Total/Average	500	274	55%	2.3	316	63%	1.7	450	90%	10.6	45	9%	7.2

Source: Rural Socio-Economic Survey, JICA Study Team, 1997

Table E.5.11 Farm Machine Ownership of Interviewed Farmers in the Study Area

Commune	Number of Interviewed Farmer	Tractor		Thresher		Hand Sprayer		Mobile Pump	
		Number of Owned Farmer	%	Number of Owned Farmer	%	Number of Owned Farmer	%	Number of Owned Farmer	%
Prek Tamerk	100	0	0%	0	0%	8	8%	16	16%
Puk Reusei	182	1	1%	58	32%	28	15%	27	15%
Sanlung	25	0	0%	0	0%	0	0%	0	0%
Vihearsour	175	0	0%	2	1%	19	11%	11	6%
Prek Ampil	18	0	0%	2	11%	0	0%	1	6%
Total/Average	500	1	0%	62	12%	55	11%	55	11%

Source: Rural Socio-Economic Survey, JICA Study Team, 1997

Table E.5.12 Cropping Season and Land Elevation Based on the Interview

No	Commune	Village	Elevation (m)	Flood Period and Cropping Pattern (4 5 6 7 8 9 10 11 12 1 2 3)	Paddy Variety
1	Vihearsour	Seda	9.5	Paddy	Sar Thungun, Kloeng
2	Puk Reusei	Agn Chang Krom	9.0-9.5	Sesame; Paddy	
3	Sanlung	Sanlung	9.0-9.5	Paddy	Bonla Phdau
4	Prek Tamerk	Anlong	9.0	Maize Sesame; Paddy	IR66, Kloeng
5	Vihearsour	Seda	8.5-9.5	Paddy	Bonla Phdau
6	Puk Reusei	P. Reusei Leu	9.0	Sesame; Paddy	
7	Prek Tamerk	Svay Att Kandal	9.0	Cabbage; Paddy	IR66
8	Puk Reusei	Agn Chang Krom	9.0	Mungbean; Maize Sesame; Upland Crop	
9	Puk Reusei	P. Reusei Kandal	8.5-9.0	Taro; Cabbage	
10	Prek Tamerk	Svay Att Leu	8.5	Cauliflower; Cabbage; Paddy	IR66
11	Puk Reusei	Kroch Seauch	8.5	Maize Sesame; Paddy; Mungbean	IR66
12	Puk Reusei	Agn Chang Leu	8.5	Paddy; Wax gourd	IR66
13	Prek Tamerk	B. Kagnchap Cheung	7.5-8.0	Paddy	IR66, Kloeng
14	Prek Tamerk	Svay Att Kandal	7.5	Paddy; Paddy	Sar Thungun, Kloeng, IR66
15	Prek Tamerk	Svay Att Kandal	6.5-7.0	Paddy	IR66
16	Prek Tamerk	B. Kagnchap Tbong	6.0	Paddy	IR66
17	Puk Reusei	P. Reusei Kandal	5.5-6.0	Paddy	IR66
18	Sanlung	Sanlung	5.5-6.0	Paddy	IR66
19	Vihearsour	Seda	5.0-5.5	Paddy	IR66
20	Vihearsour	Seda	5.0-5.5	Paddy	

Source: JICA Study Team, 1997

····· Flood —— Paddy - - - - Upland Crop

Table E.5.13 Various yield data in Ksach Kandal District

Year	Area	Season	Crop	Harvested Area (ha)	Production (ton)	Yield (ton/ha)	Data Source
1995	Prek Tamerk	Wet	Paddy - Early	111.0	333.0	3.00	District Agriculture Office
1995	Puk Reusei	Wet	Paddy - Early	5.0	15.0	3.00	District Agriculture Office
1995	Sanlung	Wet	Paddy - Early	277.0	831.0	3.00	District Agriculture Office
1995	Vihearsour	Wet	Paddy - Early	388.0	1,164.0	3.00	District Agriculture Office
1995	Prek Ampil	Wet	Paddy - Early	5.0	15.0	3.00	District Agriculture Office
1995	Prek Tamerk	Wet	Paddy - Medium	101.0	252.5	2.50	District Agriculture Office
1995	Puk Reusei	Wet	Paddy - Medium	135.0	337.5	2.50	District Agriculture Office
1995	Sanlung	Wet	Paddy - Medium	764.0	1,910.0	2.50	District Agriculture Office
1995	Vihearsour	Wet	Paddy - Medium	85.0	212.5	2.50	District Agriculture Office
1995	Prek Ampil	Wet	Paddy - Medium	17.0	42.5	2.50	District Agriculture Office
1995	Vihearsour	Wet	Paddy - Late	687.0	1,854.9	2.70	District Agriculture Office
1995	Ksach Kandal	Wet	Paddy - Early	1,955.0	5,865.0	3.00	District Agriculture Office
1995	Ksach Kandal	Wet	Paddy - Medium	3,925.0	9,812.5	2.50	District Agriculture Office
1995	Ksach Kandal	Wet	Paddy - Late	722.0	1,949.4	2.70	District Agriculture Office
1995	Ksach Kandal	Wet	Paddy - Early IR	1,072.0	4,106.0	3.83	Provincial Agriculture Office
1995	Ksach Kandal	Wet	Paddy - Medium IR	1,109.0	4,702.0	4.24	Provincial Agriculture Office
1995	Ksach Kandal	Wet	Paddy - 3 months	883.0	2,031.0	2.30	Provincial Agriculture Office
1995	Ksach Kandal	Wet	Paddy - 4 months	2,851.0	6,985.0	2.45	Provincial Agriculture Office
1995	Ksach Kandal	Wet	Paddy - 6 months	722.0	2,173.0	3.01	Provincial Agriculture Office
1995	Ksach Kandal	Wet	Maize	504.0	771.0	1.53	Provincial Agriculture Office
1995	Ksach Kandal	Wet	Sweet potato	46.0	184.0	4.00	Provincial Agriculture Office
1995	Ksach Kandal	Wet	Cassava	30.0	150.0	5.00	Provincial Agriculture Office
1995	Ksach Kandal	Wet	Mungbean	27.0	5.0	0.19	Provincial Agriculture Office
1995	Ksach Kandal	Wet	Vegetables	228.0	1,000.0	4.39	Provincial Agriculture Office
1995	Ksach Kandal	Wet	Sesame	250.0	37.0	0.15	Provincial Agriculture Office
1995	Ksach Kandal	Wet	Peanut	70.0	13.0	0.19	Provincial Agriculture Office
1995	Ksach Kandal	Wet	Jute	157.0	109.0	0.69	Provincial Agriculture Office
1994/95	Ksach Kandal	Dry	Paddy - Early IR	1,586.0	6,098.0	3.84	Provincial Agriculture Office
1994/95	Ksach Kandal	Dry	Paddy - Medium IR	1,530.0	5,365.0	3.51	Provincial Agriculture Office
1994/95	Ksach Kandal	Dry	Paddy - 3 months	924.0	3,240.0	3.51	Provincial Agriculture Office
1994/95	Ksach Kandal	Dry	Paddy - 4 months	960.0	3,485.0	3.63	Provincial Agriculture Office
1995/96	Ksach Kandal	Dry	Maize	10.0	12.0	1.20	Provincial Agriculture Office
1995/96	Ksach Kandal	Dry	Sweet potato	46.0	253.0	5.50	Provincial Agriculture Office
1995/96	Ksach Kandal	Dry	Cassava	30.0	210.0	7.00	Provincial Agriculture Office
1995/96	Ksach Kandal	Dry	Mungbean	170.0	110.0	0.65	Provincial Agriculture Office
1995/96	Ksach Kandal	Dry	Tobacco	50.0	27.0	0.54	Provincial Agriculture Office
1995/96	Ksach Kandal	Dry	Vegetables	410.0	2,050.0	5.00	Provincial Agriculture Office
1995/96	Ksach Kandal	Dry	Peanut	70.0	77.0	1.10	Provincial Agriculture Office
1995/96	Ksach Kandal	Dry	Sugarcane	60.0	2,100.0	35.00	Provincial Agriculture Office
1995/96	Ksach Kandal	Dry	Castoroil plant	7.0	8.0	1.14	Provincial Agriculture Office
1995/96	Ksach Kandal	Dry	Mat grass	900.0	180.0	0.20	Provincial Agriculture Office

Note: Data of upland crops are planted area.

Table E.5.14 Yield Data of Common Upland Crops in the Study Area by Season

Item	Wet Season				Dry season			
	sesame	cassava	maize	cucumber	mat grass	mungbean	tomato	watermelon
Average Yield (ton/ha)	1.26	5.59	1.94	5.55	0.97	1.85	12.34	4.14
MIN - MAX (ton/ha)	0.3-8.0	4.0-8.0	0.6-3.5	4.1-8.0	0.1-4.0	0.7-3.0	3.0-30.0	3.6-5.0
No. of Practiced Farmers	33	14	10	5	62	21	8	8

Source: Rural Socio-Economic Survey, JICA Study Team

Note: In wet season, 85 farmers practice upland crops.
In dry season, 144 farmers practice upladn crops.

Table E.5.15 Livestock Statistics of the Concerned Five Commune (1997.6)

(Unit : head)

Commune	Cattle						Buffaloe					
	< 3 Years Old			>= 3 Years Old			< 3 Years Old			>= 3 Years Old		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
Prek Tamerk	442	440	882	513	822	1,335	3	2	5	6	6	12
Puk Reusei	745	565	1,310	549	1,107	1,656	7	5	12	10	20	30
Sanlung	121	229	350	25	313	338	123	116	239	230	227	457
Vihearsour	202	331	533	40	467	507	152	156	308	272	448	720
Prek Ampil	524	712	1,236	349	1,038	1,387	6	5	11	8	20	28
Total	2,034	2,277	4,311	1,476	3,747	5,223	291	284	575	526	721	1,247
District Total	4,462	5,447	9,909	3,261	8,343	11,604	789	826	1,615	1,320	1,938	3,258
Distribution(%)	45.6%	41.8%	43.5%	45.3%	44.9%	45.0%	36.9%	34.4%	35.6%	39.8%	37.2%	38.3%

Commune	Horse						Pig					Chicken	Duck
	< 3 Years Old			>= 3 Years Old			For Breeding			For Meat	Baby		
	Male	Female	Total	Male	Female	Total	Male	Female	Total				
Prek Tamerk	6	3	9	15	16	31	1	7	8	1,050	20	11,000	500
Puk Reusei	7	9	16	5	16	21	0	3	3	1,020	10	12,000	200
Sanlung	3	3	6	5	3	8	1	14	15	700	20	8,400	200
Vihearsour	11	6	17	12	7	19	0	8	8	1,070	30	7,300	600
Prek Ampil	2	1	3	5	3	8	0	4	4	880	30	11,000	200
Total	29	22	51	42	45	87	2	36	38	4,720	110	49,700	1,700
District Total	49	42	91	85	93	178	7	76	83	13,000	700	130,350	8,080
Distribution(%)	59.2%	52.4%	56.0%	49.4%	48.4%	48.9%	28.6%	47.4%	45.8%	36.3%	15.7%	38.1%	21.0%

Source : District Agriculture Office, Ksach Kandal

Table E.5.16 Number of Farm Labor by Sex and Commune

(Unit : persons)

Commune	No. of Iterviewed Farmer	No. of Farm Labor				No. of Farm Labor per Household			
		Male		Female		Male		Female	
		Full-time	Part-time	Full-time	Part-time	Full-time	Part-time	Full-time	Part-time
Prek Tamerk	100	164	48	123	94	1.64	0.48	1.23	0.94
Puk Reusei	182	289	65	192	121	1.59	0.36	1.05	0.66
Sanlung	25	15	9	23	19	0.60	0.36	0.92	0.76
Vihearsour	175	249	109	165	180	1.42	0.62	0.94	1.03
Prek Ampil	18	33	8	17	21	1.83	0.44	0.94	1.17
Total/Average	500	750	239	520	435	1.50	0.48	1.04	0.87

Source : Rural Socio-Economic Survey, JICA Study Team

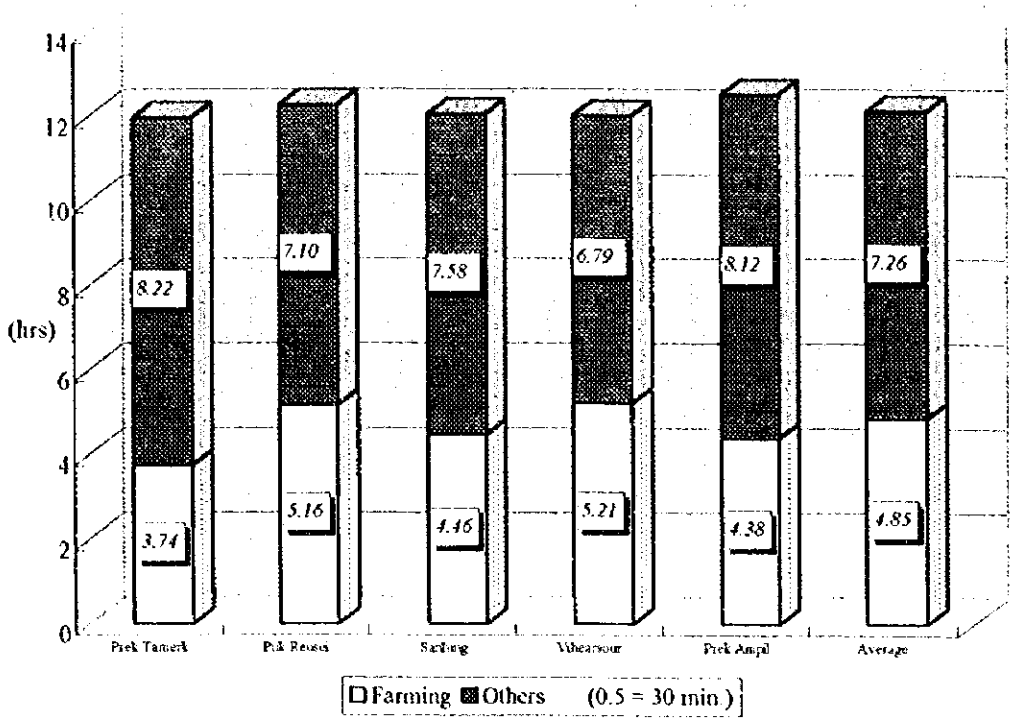
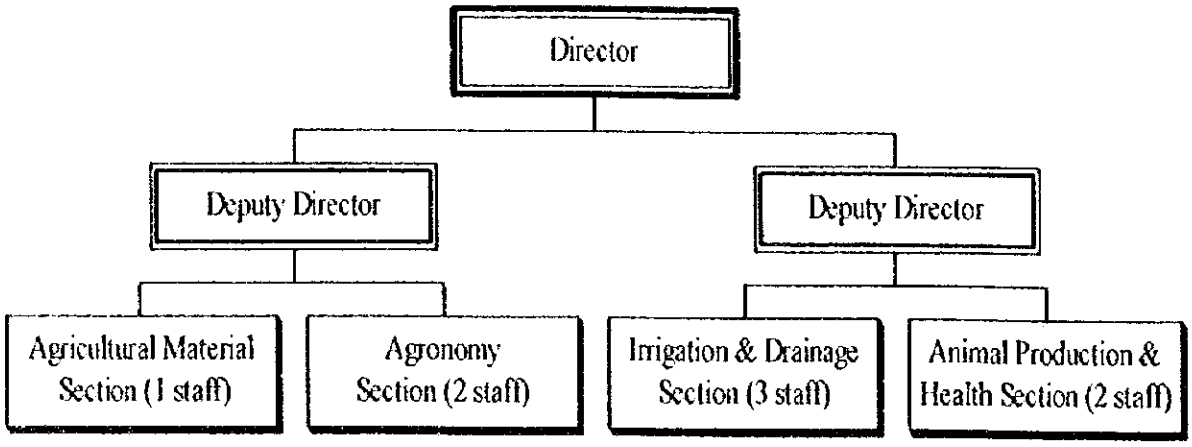


Figure E.5.7 Distribution of Farming Practice to Female Daily Working Hours

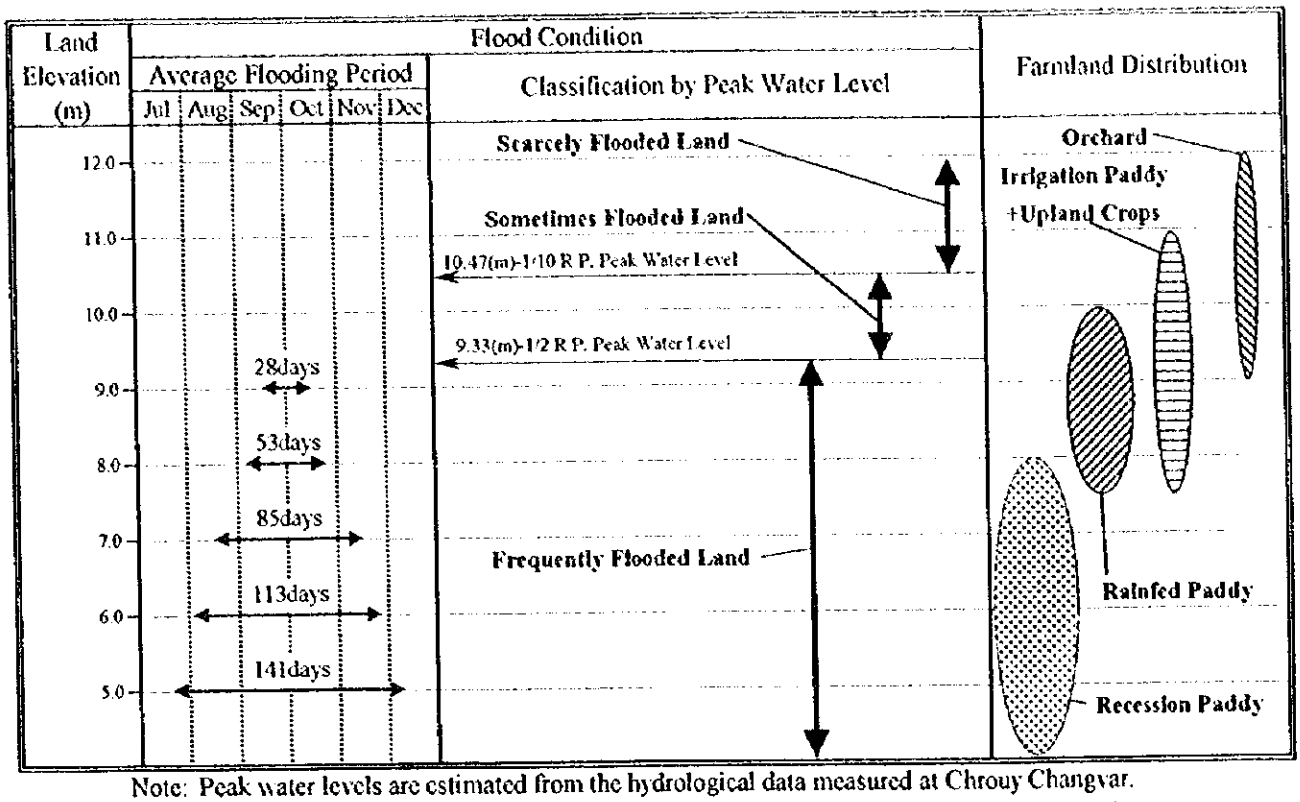
Source: JICA Study Team, 1997

Figure E.5.8 Organization Chart of District Agriculture Office in Ksach Kandal



Source: District Agriculture Office, Ksach Kandal

Table E.6.1 Some Indices Limiting Agricultural Land Classification in the Study Area



Note: Peak water levels are estimated from the hydrological data measured at Chrouy Changvar. Peak water levels over 9.0 (m) are 11-year among 23-year. The average flooding period, 28days, is the average of 11-year data.

Source: JICA Study Team

Table E.6.2 Agricultural Land Classification in the Study Area

Land Elevation (m)	Flooding Period (months)	Non-flooding Period (months)	Recession Paddy Area (1,622ha)	Rainfed Paddy Area (1,052ha)	Irrigation Paddy +Upland Crops Area (817ha)	Orchard (74ha)
12.0	0	12	I : High potentiality for upland crop farming (60ha)	I : Scarce flood damage (133ha)	I : Scarce flood damage (75ha)	I : Scarce flood damage (32ha)
11.0	0	12				
10.0	0-1	11-12			II : Sometimes flood damage (203ha)	II : Sometimes flood damage (42ha)
9.0	1-2	10-11		II : Sometimes flood damage (894ha)		
8.0	2-3	9-10		III : Frequent flood damage (25ha)	III : Frequent flood damage (539ha)	
7.0	3-4	8-9	II : Medium potentiality for upland crop farming (301ha)			
6.0	4-5	7-8	III : Low potentiality for upland crop farming (1,261ha)			
5.0	5-6	6-7				

Source: JICA Study Team

Table E.6.3 Harvested Area Rate in the Concerned Five Districts

Commune	1996/97 Dry Season Paddy (28.4.1997)												
	Planned Area (ha)	a Cultivated Area (ha)				b.Harvested Area (ha)				Harvested Area Rate (a/b)			
		IR Variety		Local	Total	IR Variety		Local	Total	IR Variety		Local	Total
		3 month	4 month	4 month		3 month	4 month	4 month		3 month	4 month	4 month	
PREK TAMERK Commune	450	320	80	50	450	320	80	50	450	100.0%	100.0%	100.0%	100.0%
PUK REUSEI Commune	650	650	100	80	830	650	100	80	830	100.0%	100.0%	100.0%	100.0%
SANLUNG Commune	160	150	0	0	150	150	0	0	150	100.0%	-	-	100.0%
VIHEARSOUR Commune	755	700	0	0	700	700	0	0	700	100.0%	-	-	100.0%
PREK AMPIL Commune	630	600	0	0	600	600	0	0	600	100.0%	-	-	100.0%
SUB TOTAL (A)	2,645	2,420	180	130	2,730	2,420	180	130	2,730	100.0%	100.0%	100.0%	100.0%
Ksach Kandal District (B)	5,000	4,555	315	130	5,000	4,555	315	130	5,000	100.0%	100.0%	100.0%	100.0%
Distribution (A/B)	52.9%	53.1%	57.1%	100.0%	54.6%	53.1%	57.1%	100.0%	54.6%	-	-	-	-

Commune	1996 Wet Season Paddy (15.10.1996)											
	Planned Area (ha)	a Cultivated Area (ha)				b.Harvested Area (ha)				Harvested Area Rate (a/b)		
		3 month		Medium	Total	3 month		Medium	Total	IR Variety	Local	Total
		IR	Local	Local		IR	Local	Local		3 month	4 month	4 month	
PREK TAMERK Commune	250	160	0	30	190	85	0	0	85	53.1%	-	0.0%	44.7%
PUK REUSEI Commune	210	138	0	0	138	0	0	0	0	0.0%	-	-	0.0%
SANLUNG Commune	1,100	36	144	970	1,150	25	0	0	25	69.4%	0.0%	0.0%	2.2%
VIHEARSOUR Commune	1,190	60	180	950	1,190	10	0	244	254	16.7%	0.0%	25.7%	21.3%
PREK AMPIL Commune	70	70	0	0	70	30	0	0	30	42.9%	-	-	42.9%
SUB TOTAL (A)	2,820	464	324	1,950	2,738	150	0	244	394	32.3%	0.0%	12.5%	14.4%
Ksach Kandal District (B)	7,000	1,514	570	4,892	6,976	927	3	1,610	2,540	61.2%	0.5%	32.9%	36.4%
Distribution (A/B)	40.3%	30.6%	56.8%	39.9%	39.2%	16.2%	0.0%	15.2%	15.5%	-	-	-	-

Commune	1995 Wet Season Paddy (15.2.1996)											
	a.Cultivated Area (ha)				b.Harvested Area (ha)				Harvested Area Rate (a/b)			
	Early	Medium	Late	Total	Early	Medium	Late	Total	Early	Medium	Late	Total
PREK TAMERK Commune	135	115	0	250	111	101	0	212	82.2%	-	-	84.8%
PUK REUSEI Commune	15	135	0	150	5	135	0	140	33.3%	100.0%	-	93.3%
SANLUNG Commune	282	918	0	1,200	277	764	0	1,041	98.2%	83.2%	-	86.8%
VIHEARSOUR Commune	396	92	702	1,190	388	85	687	1,160	98.0%	92.4%	97.9%	97.5%
PREK AMPIL Commune	93	17	0	110	93	17	0	110	100.0%	100.0%	-	100.0%
SUB TOTAL (A)	921	1,277	702	2,900	874	1,102	687	2,663	94.9%	86.3%	97.9%	91.8%
Ksach Kandal District (B)	2,276	4,241	737	7,254	1,955	3,925	722	6,602	85.9%	92.5%	98.0%	91.0%
Distribution (A/B)	40.5%	30.1%	95.3%	40.0%	44.7%	28.1%	95.2%	40.3%	-	-	-	-

Note : Peak water level in 1995 - 9.12 (m) in Phnom Penh
Peak water level in 1996 - 9.92 (m) in Phnom Penh
Source : District Agricultural Office, Ksach Kandal

Tabel E.6.4 Land Classification of Recession Paddy Area

Class	Non-flooded Conditions		Available Cropping Season for Upland Crops	Land Elevation (m)	Potentiality for Upland Crops
	Month	Season			
I	9 - 10	Oct/Nov - Aug/Sep	May/June - Aug/Sep	7.0 - 8.0	High
II	8 - 9	Nov - Aug	May/June - Aug	6.0 - 7.0	Medium
III	< 8	Nov/Dec - Jul/Aug	May/June - Jul/Aug	< 6.0	Low

Source: JICA Study Team

Tabel E.6.5 Potential Areas by the Development Stage

Development Stage	Effective Area			
	Recession Paddy	Rainfed Paddy	Irrigation Paddy + Upland Crops	Orchard
Stage I	P.A.I.	P.A.I., F.D.R.	F.D.R.	F.D.R.
Stage II	-	-	P.A.I.	-
Stage III	P.A.I.(Upland Crops)	-	-	-

Source: JICA Study Team
Abbrev.: P.A.I.-Planted Area Increase, F.D.R.-Flood Damage Reduction

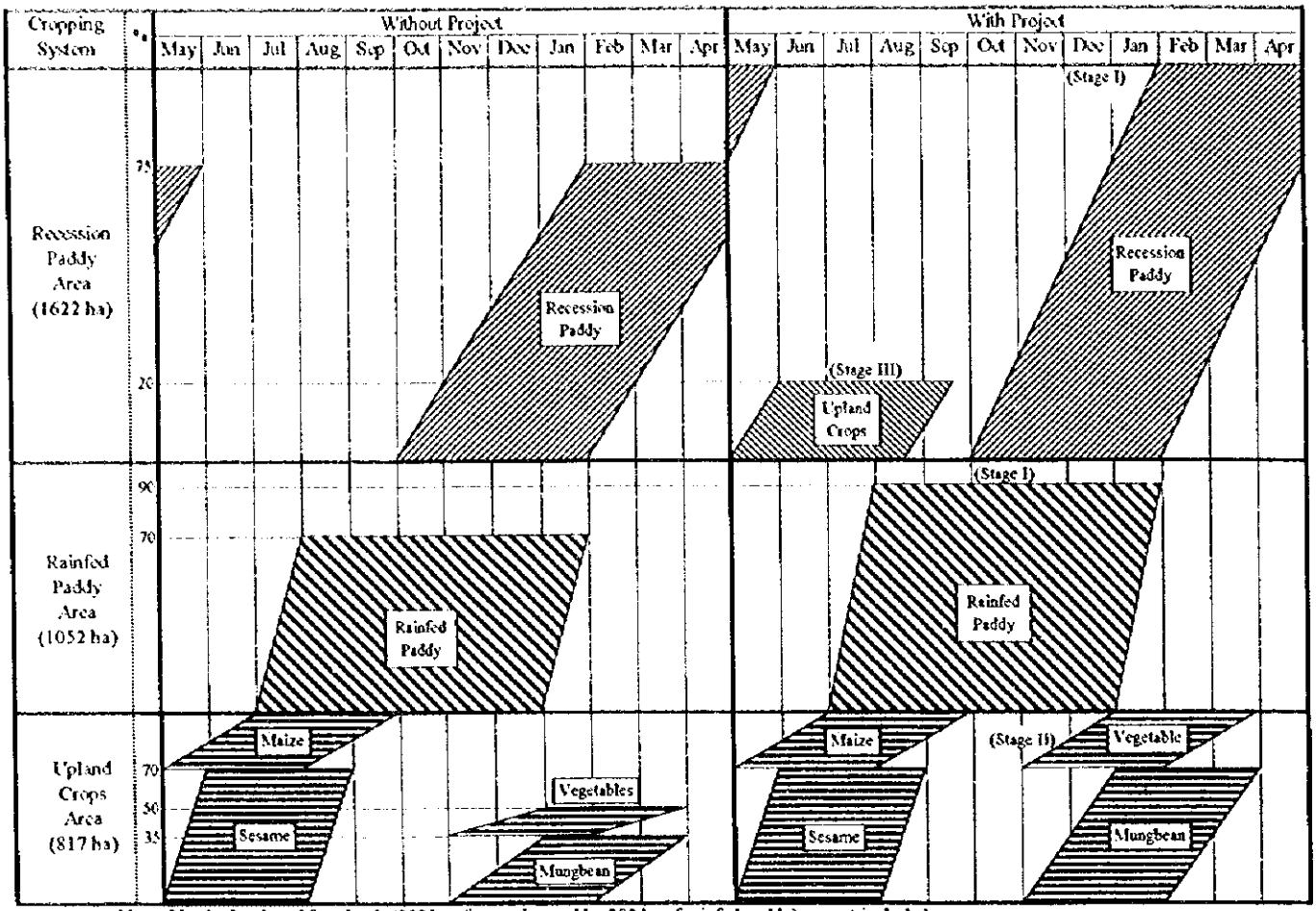
Table E.6.6 Summary of Potential Area and Agricultural Effect in accordance with the Development Stage

Development Stage and Components	Recession Paddy Area (1,622ha)		Rainfed Paddy Area (1,052ha)		Irrigation Paddy +Upland Crops Area (817ha)		Orchard (74ha)	
	Class	Agricultural Effect	Class	Agricultural Effect	Class	Agricultural Effect	Class	Agricultural Effect
Stage I								
(1) Construction/rehabilitation of farm roads/dikes	-	-	II, III (919ha)	Flood damage will be reduced.	II, III (742ha)	Flood damage will be reduced.	II (42ha)	Flood damage will be reduced.
(2) Rehabilitation of reservoirs	I, II, III (1,622ha)	Cropping intensity will increase.	-	-	-	-	-	-
(3) Construction/rehabilitation of canal systems	-	-	I, II, III (1,052ha)	Cropping intensity will increase.	-	-	-	-
(4) Construction of weir at Boeng Phtea	-	-	-	-	-	-	-	-
Combined Effect	II, III (282ha)	Farmland development in non-arable land.	II, III (282ha)	Farmland development in non-arable land.	-	-	-	-
Stage II								
(1) Construction/rehabilitation of colmatage canals	-	-	-	-	I, II, III (817ha)	Cropping intensity will increase.	-	-
Stage III								
(1) Construction of flood control gates	I, II, III (1,622ha)	Upland crops planted area will increase.	-	-	-	-	-	-
(2) Construction of farm roads	-	-	-	-	-	-	-	-

Note: Please refer to Table E.6.2 for Class I, II and III.

Source: JICA Study Team, 1997

Figure E.6.1 Present and Proposed Cropping Patterns



Note: Newly developed farmlands (282 ha of recession paddy, 282 ha of rainfed paddy) are not included.
Source: JICA Study Team

Table E.6.7 General Characteristics of Recommended Paddy Varieties for Dry Season

Variety	Dry Season Yield (ton/ha)	Growth Duration (days)	Height (cm)
IR72	4.0	115	81
Kru	4.1	113	83
IR Kesar	4.2	117	91
IR 66	4.0	109	77

Source: "Rice Production in Cambodia", H. J. Nesbitt, 1996, CIAP

Table E.6.8 Yields of Recommended Paddy Varieties for Wet Season

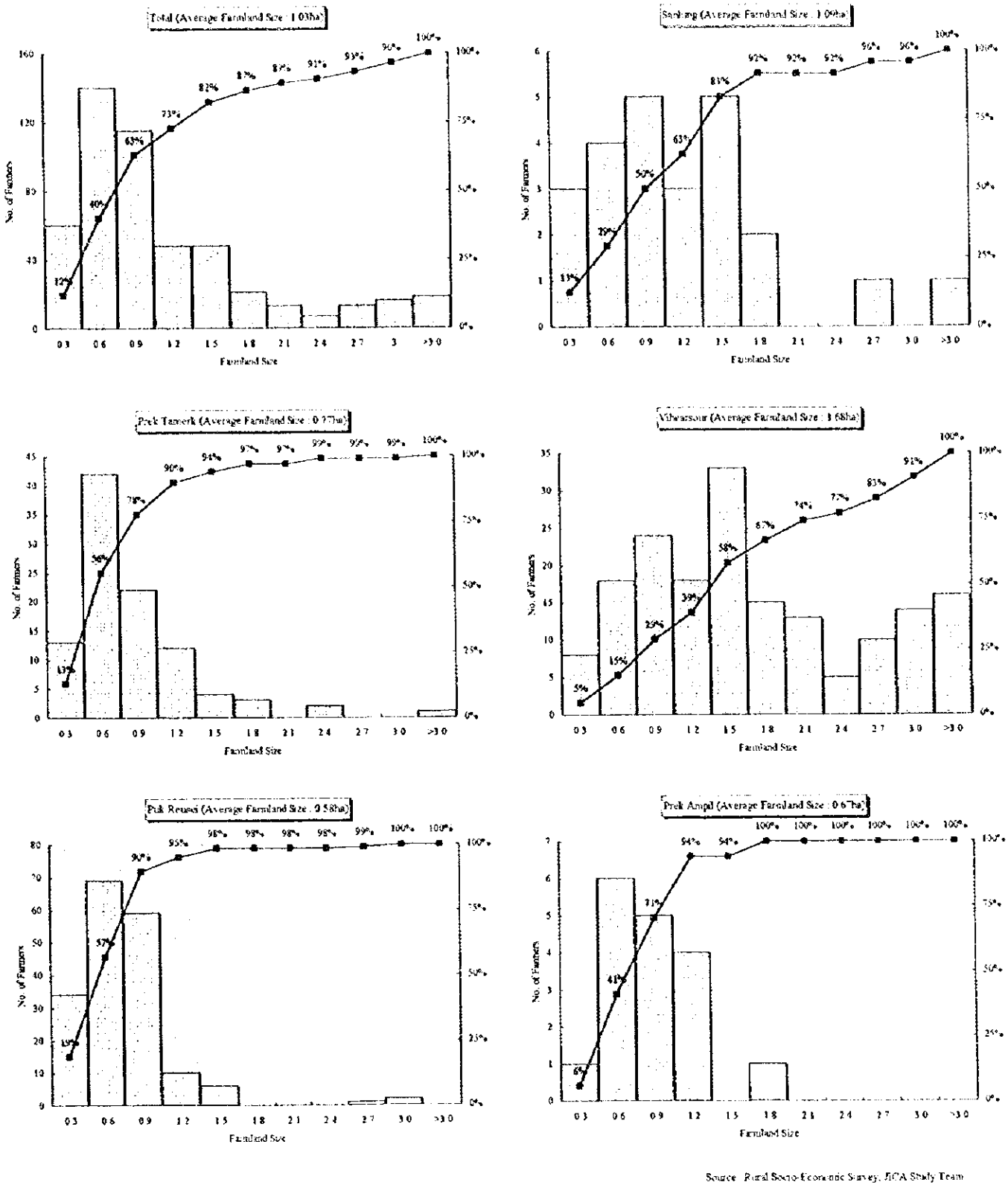
Developed by IRRI

Variety	Yield of On-farm Trials (ton/ha)					Height (cm)
	1992	1993	1994	1995	Mean	
Santepheap 1	2.7	2.3	2.4	2.5	2.5	106
Santepheap 2	2.9	2.4	2.4	2.6	2.6	108
Santepheap 3	3.1	2.5	2.5	2.8	2.8	106
Local Check	2.5	2.3	2.2	2.5	2.4	-

Selected from Cambodian Pure Line

Variety	Yield (ton/ha)					Height (cm)
	Affected by Fertilizer		Affected by Stress			
	Added	Absent	Absent	Drought	Flood	
CAR 1	2.9	2.6	2.8	2.7	2.7	127
CAR 2	2.9	2.6	2.7	2.7	2.7	126
CAR 3	2.9	2.7	2.9	2.5	2.4	122
Local Check	2.6	2.3	2.5	2.4	2.3	-
CAR 4	3.1	3.1	-	-	-	132
CAR 5	2.9	2.9	-	-	-	134
CAR 6	3.0	3.0	-	-	-	129
Local Check	2.3	2.7	-	-	-	-

Source: "Rice Production in Cambodia", H. J. Nesbitt, 1996, CIAP



Source: Rural Socio-Economic Survey, JICA Study Team

Figure E.6.2 Histograms of Number of Farmers by Farmland Size by Commune

Table E.6.9 Evaluation of Agricultural Labor Requirement in December

-Labor Requirement in December

Required Labor by Crop

Item	Recession Paddy	Rainfed Paddy	Upland Crops
Unit Labor Requirement	Land Preparation - 15 (MD/ha) Transplanting - 33 (MD/ha)	Harvesting - 44 (MD/ha)	Land Preparation - 15 (MD/ha) Transplanting - 16 (MD/ha) Seeding - 2 (MD/ha)
Planted Area (ha)	1622 (ha) x 100 (%) / 5 (months) =324.4 + 282 (ha) (newly developed land)	1052 (ha) x 90 (%) / 2 (months) =473.4 + 282 (ha) (newly developed land)	817 (ha) x 30 (%) / 3 (months) =81.7 817 (ha) x 70 (%) / 3 (months) =190.6
Required Labor	15 (MD/ha) x 607 (ha) = 9105 (MD) 33 (MD/ha) x 607 (ha) = 20031 (MD)	44 (MD/ha) x 756 (ha) = 33264 (MD)	15 (MD/ha) x 273 (ha) = 4095 (MD) 16 (MD/ha) x 82 (ha) = 1312 (MD) 2 (MD/ha) x 191 (ha) = 382 (MD)

Data: "Farm Mechanization and Crop Production in Cambodia", Baseline Survey Report No.5, 1995, CIAP

Total Required Labor in December : 9105 + 20031 + 33264 + 4095 + 1312 + 382 = 68189 (MD)

Required Labor per day : 68189 (MD) / 25 (days) = **2727.56 (MD)**

-Present Agricultural Labor Condition in the Study Area

Estimation of Farm Household

Farm Household Rate : 90 (%)

4992 x 90 (%) = 4042.8 (H/H)

Average Full-time Farm Labor per H/H

1.49 (m) + 1.05 (f) = 2.53 (persons)

Total Available Farm Labor

4043(H/H) x 2.53 (persons) = **10228.8 (MD) >> 2727.56 (MD)**

Table E.6.11 Comparison of Agricultural Production with/without Project

Developent Stage and Crop	Total Area (ha)	Without Project				With Project			
		Cropping Intensity	Planted Area (ha)	Yield (ton/ha)	Production (ton)	Cropping Intensity	Planted Area (ha)	Yield (ton/ha)	Production (ton)
Stage I									
Recession Paddy	1,622	75%	1,217	2.90	3,529	100%	1,622	3.48	5,645
Recession Paddy (Newly developed)							282	3.48	981
Rainfed Paddy	1,052	70%	736	1.61	1,185	90%	947	1.93	1,828
Rainfed Paddy (Newly developed)							282	1.93	544
Total			1,953		4,714		3,133		8,998
Stage II									
Upland Crops (Mungbean)	817	35%	286	0.65	186	70%	572	0.78	446
Upland Crops (Vegetables)	817	15%	123	5.00	615	30%	245	6.00	1,470
Total			409		801		817		1,916
Stage III									
Upland Crops (Maize)	1,622	0%	0	1.53	0	6%	97	1.84	178
Upland Crops (Sesame)	1,622	0%	0	0.45	0	14%	227	0.54	123
Total			0		0		324		301

Source: JICA Study Team, 1997

Table E.6.10 Estimation of the Projected Yield in the Study Area

Crop	Present Yield (ton/ha)	Referential Yield Data		Projected Yield (ton/ha)
Recession Paddy	2.90 (Average of 363 farmers)	Average of 144 farmers among 500 interviewees (practicing only dry season paddy)	3.17	
		Average of 219 farmers among 500 interviewees (practicing both dry and wet season paddy)	2.77	
		94/95 Average of District - early IR	3.84	
		94/95 Average of District - medium IR	3.51	
		94/95 Average of District - 3 months	3.51	
		94/95 Average of District - 4 months	3.63	
		94/95 Average of Province - dry season	3.77	
		95/96 Average of Province - dry season	3.45	
		Improved IR varieties*	4.0-4.2	3.48
Rainfed Paddy	1.61 (Average of 304 farmers)	Average of 85 farmers among 500 interviewees (practicing only wet season paddy)	2.18	
		Average of 219 farmers among 500 interviewees (practicing both dry and wet season paddy)	1.42	
		95 Average of the five concerned communes (early)	3.00	
		95 Average of the five concerned communes (medium)	2.50	
		95 Average of District - early IR	3.83	
		95 Average of District - medium IR	4.24	
		95 Average of District - 3 months	2.30	
		95 Average of District - 4 months	2.45	
		95 Average of District - 6 months	3.01	
		94/95 Average of Province - wet season	2.09	
		95/96 Average of Province - wet season	2.23	
		Released varieties by CIAP*	2.4-2.9	1.93
Mungbean (Dry)	0.65 (Average of District) (1995)	Average of 21 farmers among 500 interviewees (range : 0.7-3.0)	1.85	
		95 Average of District	0.65	
		Average of Province and Cambodia		
		1990 1991 1992 1993 1994 1995		
		Prov. 0.67 0.75 0.45 0.48 0.70 0.80		
		Cam. 0.48 0.48 0.58 0.52 0.65 0.78		
		Cropping standard of Cambodia**	0.5-1.5	0.78
Vegetables (Dry)	5.00 (Average of District) (1995)	Average of 8 farmers among 500 interviewees (tomato) (range : 3.0-30.0)	12.34	
		Average of 8 farmers among 500 interviewees (watermelon) (range : 3.6-5.0)	4.14	
		95 Average of Province	4.62	
		Cropping standard of Cambodia** (tomato)	15.0-30.0	
		Cropping standard of Cambodia** (watermelon)	12.0-22.0	6.00
Maize (Wet)	1.53 (Average of District) (1995)	Average of 10 farmers among 500 interviewees (range : 0.6-3.5)	1.94	
		95 Average of Province - wet season	1.53	
		Average of Province and Cambodia		
		1990 1991 1992 1993 1994 1995		
		Prov. 1.38 1.92 2.32 2.06 3.18 2.84		
		Cam. 1.35 1.40 1.32 1.31 1.49 1.79		1.84
Sesame (Wet)	0.45 (Average of Province) (1995)	Average of 33 farmers among 500 interviewees (range : 0.3-8.0)	1.26	
		95 Average of Kratie Province	0.60	
		95 Average of Kampong Cham Province	0.50	
		95 Average of Prey Veng Province	0.30	
		Average of Province and Cambodia		
		1990 1991 1992 1993 1994		
		Prov. 0.40 0.42 0.46 0.27 0.45		
		Cam. 0.50 0.50 0.46 0.47 0.44		0.54

Note: *:"Rice Production in Cambodia", H. J. Nesbitt, 1996, CIAP

**:"Vegetables in Cambodia", Kbal Koh Vegetable Research Station, MAFF

Table E.6.12 Change of the Cropping Areas in Accordance with the Development Stage

(Unit : ha)

Item	Land Area	Without Project	Stage I	Stage I+II	Stage I+II+III
Recession paddy	1,622	1,217	1,622	1,622	1,622
Recession paddy (newly developed)	0	0	282	282	282
Recession paddy (2nd cropping)	0	0	0	0	324
Rainfed paddy	1,052	736	947	947	947
Rainfed paddy (newly developed)	0	0	282	282	282
Upland crops (1st cropping)	817	817	817	817	817
Upland crops (2nd cropping)	0	419	419	817	817
Orchard	74	74	74	74	74
Total	3,565	3,263	4,443	4,841	5,165

Source: JICA Study Team

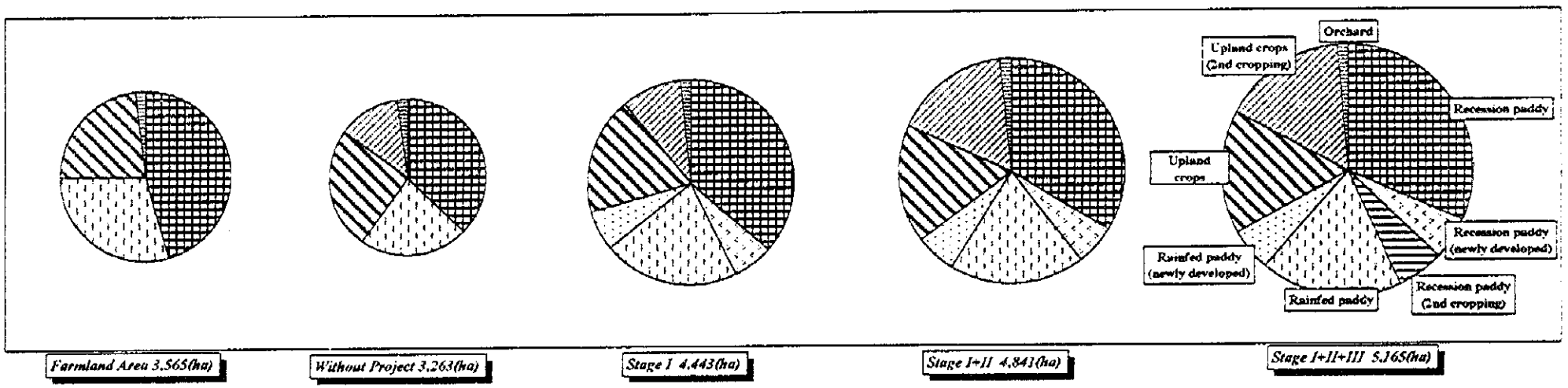


Figure E.6.3 Change of the Cropping Areas in Accordance with the Development Stage

Table E.6.13 Summary of Cropping Standards for All Season Upland Crops

Crop	Planting Method	Planting Density		Fertilizer Application				Time of Harvesting	Yield (ton/ha)
		Row (cm)	Cheng(cm)	Kind	Amount	Stage	N-P_2O_5-K_2O (kg/ha)		
Water Convolvulus	Direct Sowing (D.S.)	18-20	2-3	Manure	6-8 ton/ha	Basal Dressing	60-0-0 (fertile soil)	25-28 days after sowing (DAS)	15-30
				Urea	60 g/row[1)]	10 days after sowing	90-30-30 (poor soil)		
				Urea	60 g/row	20 days after sowing			
Leaf Lettuce	D.S. Transplanting (Tr.)	15-20	15-20	Manure or 15-15-15	8-10 ton/ha 400 kg/ha	Basal Dressing	90-30-30 (fertile soil) 120-60-60 (poor soil)	35-45 DAS 25-30 days after trans-planting (DAT)	10-25
				Urea	60 g/row	10 days after planting			
				Urea	60 g/row	20 days after planting			
Mustard Green	D.S. Tr.	20-30	20-30	Manure or 15-15-15	8-10 ton/ha 400 kg/ha	Basal Dressing	90-30-30 (fertile soil) 120-60-60 (poor soil)	40-45 DAS 30-40 DAT	20-30
				Urea	60 g/row	10 days after planting			
				Urea	60 g/row	20 days after planting			
Chinese Kale	D.S. Tr.	25-30	25-30	Manure or 15-15-15	8-10 ton/ha 400 kg/ha	Basal Dressing	60-30-30 (fertile soil) 90-60-60 (poor soil)	45-55 DAS 30-40 DAT	20-35
				Urea or 15-15-15	60 g/row 175 g/row	14 days after planting and heading period			
Eggplant	Tr.	100 50	60-80 40	Manure or 15-15-15	8-10 ton/ha 300 kg/ha	Basal Dressing	30-0-0 (fertile soil) 30-30-30 (fertile soil)	75 DAT	-
				Urea or 15-15-15	90 kg/ha 250 kg/ha	2-3 weeks after Tr. and early fruiting stage	60-60-60 (poor soil) 120-90-90 (poor soil)		
Cucumber	D.S. Tr.	30-130	40-50	Manure or 15-15-15	15-30 ton/ha 400 kg/ha	Basal Dressing	90-60-60 (fertile soil) 120-90-90 (poor soil)	40-50 DAS	20-30
				Urea or 15-15-15	100 kg/ha 300 kg/ha	Spreading stage or when stem grows even after 2-3 harvesting			
Pumpkin	D.S. Tr.	200 300	100 150-200	Manure	5-10 ton/ha (1 kg/clump)	Basal Dressing	45-0-0 (fertile soil) 60-30-30	75 DAS	10-25
				Urea 15-15-15 16-20-0	1 spoon/clump 2 spoon/clump 3 spoon/clump	When plant height becomes 50 cm.	90-60-60 (poor soil)		
				Urea 15-15-15 16-20-0	1 spoon/clump 2 spoon/clump 3 spoon/clump	If fruits are small.			
Bitter Gourd	D.S.	100-110	40-50	Manure	10-20 ton/ha (1 kg/clump)	Basal Dressing	60-60-60 (fertile soil) 90-60-60 (poor soil)	50-60 DAS	7-12
				Urea or 15-15-15	60 kg/ha 200 kg/ha	Vegetative growth stage and after 1st fruit grows			
Mung Bean	D.S.	40-50 (30 kg seed/ha)	5-7	Manure 15-15-15	4-6 ton/ha 200-300 kg/ha	Basal Dressing	None:30-30-30 (fertile soil) 30-60-60 (poor soil)	60-80 DAS	0.5-1.5
Yardlong Bean	D.S.	120-150	40-50	Manure 16-20-0 or 15-15-15	4-6 ton/ha 250 kg/ha	Basal Dressing One month after planting and after 1st harvesting	30-30-30 (fertile soil) 60-60-30 (poor soil)	50-60 DAS	12-16
Snap Bean	D.S.	120-130	30	Manure 16-20-0 or 15-15-15	4-6 ton/ha 250 kg/ha	Basal Dressing One month after planting and after 1st harvesting	30-30-30 (fertile soil) 60-60-30 (poor soil)	50 DAS	4-10
Shallot	Plant bulbs	20 2 bulbs/clump	15	Manure 15-15-15	8-10 ton/ha 200-300 kg/ha	Basal Dressing 3-4 weeks after planting	60-60-60 (fertile soil) 90-90-60 (poor soil)	90-100 DAT	
Bunching Onion	Plant bulbs	15-20	15-20	Manure 15-15-15	8-10 ton/ha 200-300 kg/ha	Basal Dressing 3-4 weeks after planting	60-60-60 (fertile soil) 90-90-60 (poor soil)	35-45 DAT	1.5-3
Sweet Corn	Ds.	80 2 stalks/clump	50	Manure or 16-20-0 or 15-15-15	6-8 ton/ha 200 kg/ha 200 kg/ha	Basal Dressing	60-30-0 (fertile soil) 60-60-60 90-60-60 (poor soil)	70-75 DAS	4-6 (green fruit)
				16-20-0 or 15-15-15	200 kg/ha 200 kg/ha	When plant height becomes 30-40 cm.			

Source: "Vegetables in Cambodia", Kbal Koh Vegetable Research Station, MAFF

Note: 1)- Row : 8.0 m x 1.1 m

Table E.6.14 Summary of Cropping Standards for Dry Season Upland Crops

Crop	Planting Method	Planting Density		Fertilizer Application				Time of Harvesting	Yield (ton/ha)
		Row (cm)	Clump(cm)	Kind	Amount	Stage	N-P_2O_5-K_2O (kg/ha)		
Pe-tsai	Direct Sowing transplanting	20-40	20-40	Manure or 15-15-15 Urea	8-10 ton/ha 400 kg/ha 60 g/row[1)]	Basal Dressing 10 days after planting	60-30-30 (fertile soil) 90-60-60 (poor soil)	30 days after trans-planting (DAT)	10-18
Chinese Cabbage (early variety)	D.S. Tr.	25	25	Manure or 15-15-15 Urea or 15-15-15	8-10 ton/ha 400 kg/ha 60 g/row 175 g/row	Basal Dressing 10 days after planting	60-30-30 (fertile soil) 90-60-60 (poor soil)	30-40 DAT	20-35
Chinese Cabbage (late variety)	Tr.	50-60	40-50	Manure or 15-15-15 Urea or 15-15-15	8-10 ton/ha 400 kg/ha 60 g/row 175 g/row	Basal Dressing 10-14 days after planting	60-30-30 (fertile soil) 90-60-60 (poor soil)	40-45 DAT	18-30
Headed Cabbage	Tr.	50	40-50	Manure or 15-15-15 Urea or 15-15-15	8-10 ton/ha 400 kg/ha 60 g/row 175 g/row	Basal Dressing 14 days after planting and heading period	60-30-30 (fertile soil) 90-60-60 (poor soil)	55-65 DAT	30-40
Cauliflower	Tr.	40-60	40	Manure or 15-15-15 Urea or 15-15-15	8-10 ton/ha 400 kg/ha 60 g/row 175 g/row	Basal Dressing 14 days after planting and heading period	60-30-30 (fertile soil) 90-60-60 (poor soil)	45-65 DAT	12-18
Chinese Radish	D.S.	20	10-15	Manure or 15-15-15 Urea or 15-15-15	8-10 ton/ha 400 kg/ha 120 g/row 400 kg/ha	Basal Dressing When stalks height becomes 10 cm.	60-60-60 (fertile soil) 90-60-60 (poor soil)	50-60 days after sowing (DAS)	25-70
Tomtato	Tr.	70-80 50-80	70 40	Manure or 15-15-15 Urea or 15-15-15	8-10 ton/ha 300 kg/ha 90 kg/ha 250 kg/ha	Basal Dressing 2-3 weeks after Tr. and early fruiting stage	30-0-0 (fertile soil) 30-30-30 (fertile soil) 60-60-60 (poor soil) 120-90-90 (poor soil)	50-65 DAT	15-30 or 20-50
Green Pepper	Tr.	40	40	Manure or 15-15-15 Urea or 15-15-15	8-10 ton/ha 300 kg/ha 70 kg/ha 200 kg/ha	Basal Dressing 3 weeks after Tr.	30-30-30 (fertile soil) 60-60-60 (poor soil)	50-60 DAT	8-20
Watermelon	D.S. Tr.	200-300	100-200	Manure (1 kg/clump) 15-15-15 15-15-15 Urea or 16-20-0	3 ton/ha 100 kg/ha 200 kg/ha 70 kg/ha 200 kg/ha	Basal Dressing 20-30 cm height 10-14 days after previous application	90-90-90 (fertile soil) 120-120-120 (poor soil)	70-75 DAT	12-22
Onion	D.S. Tr.	15	10	Manure 15-15-15 Urea	8-10 ton/ha 400 kg/ha 70 kg/ha	Basal Dressing One week after Tr. Bulb growing stage	60-60-60 (fertile soil) 120-120-90 (poor soil)	110-120 DAS or 80-90 DAT	30-45
Sweet Potato	Plant cuttings	100	20-30	Manure or 15-15-15 15-15-15	6-8 ton/ha 200 kg/ha 200 kg/ha	Basal Dressing One month after planting	30-0-0 (fertile soil) 30-30-30 60-60-60 (poor soil)	70-90 DAT	10-18

Source: "Vegetables in Cambodia", Khal Koh Vegetable Research Station, MAFF

Note: 1) Row : 8.0 m x 1.1 m