

CHAPTER 5 : FEASIBILITY STUDY ON THE HIGH PRIORITY PROJECT

5.1 General

5.1.1 Location and General Features

The Rehabilitation of San-Pédro Paddy Development Project (hereinafter referred to as "the Project") Area has been selected as the high priority project/area. It is situated in the southern part of the Study Area. It covers a net irrigation area of 575 ha of an alluvial plain, starting from the abandoned small pumping station located uppermost in a series of five stations installed by the previous paddy irrigation project and down south to the junction of the national highway with the road to Poro. Major part of the area is surrounded by flood protection dikes from the San-Pédro river and its tributary, to the Gonou, which were constructed by the previous project.

There are three settlements in and adjacent to the Project Area apart from a several scattered houses. Campus II of Cité Agricole village is the biggest, with 52 households, located on a low hill surrounded by the north, west and central irrigation blocks of the previous project. Campus I of Cité Agricole, the smallest with eight households, is located along the connecting road of Campus II with the highway, at one km from its entrance. The village of Cité Agricole has the workshop area on a low hill, where an open garage, which is used to keep agricultural machinery is standing. Village Grand Gabo is located at the northern boundary of the Project Area, but their agricultural activities are mainly carried out at the north of the Area according to the information collected from the extension workers of ANADER. The village, therefore, is out of scope of the Project Area except from the viewpoint as a source of participants. At the southeastern tip of the Project Area, there is a cluster of hills through which the national highway goes. One finds a defunct rice mill on the west hill top and the Lycée Professionnel de San-Pédro on the east. Hills in and around the Area including the Campus II are to accommodate the settler families.

As stated in section 3.5.2, the pump irrigation system was introduced by ARSO/SODERIZ for the production rice to meet the increasing domestic demand in 1973. In 1976, it was expanded up to 650 ha with about 200 farmers. Due to several reasons, as analyzed in section 3.7, the operation of pump irrigation was ceased in 1993. However, a few farmers have continued to cultivate rainfed rice in the erstwhile-irrigated paddy fields. Therefore, in the Study Area, the farmers of the Project Area have the lowest average annual income, and under these conditions, they have a strong desire to restart the irrigated rice cultivation in the Project Area.

5.1.2 Administration

The Project Area is in San-Pédro Sub-prefecture and San-Pédro City, Department of San-Pédro, Bas-Sassandra Region. At the level of local government, Cité Agricole belongs to the rural area of San-Pédro City. It has a chief of the village and the official village committee to support him. Cité Agricole is an exception in terms of its constituent members, contrary to other villages in the vicinity. It is a planned settlement consisting of settlers without having any root in the villages of the vicinity, where a typical mixture (*mélange*) of minority ethnic groups of earth-chief and majority groups of settlers is found. In both cases the settlers themselves consist of several ethnic groups. All the local government of these villages including Cité Agricole, therefore, has to deal with this multiethnic structure. The residents of Cité Agricole have registered their name to the mayor's office, and participate in the mayor's election. The amount

of the city's budget in 1996 was 1.9 billion F.CFA, 62.5 % of which goes to investment. Within that much capacity, the administration of the municipality is to extend itself to the socio-economic service of the public facilities to its rural area which includes public primary school and public dispensary; the deficiency has to be filled up by the spirit of self-help on the part of the villagers.

5.2 Characteristics of the Project Area

5.2.1 Natural Conditions

(1) Land

The Project Area lays in the plain extending north of the city of San-Pédro. This area is surrounded by the San-Pédro river in the west and the south sides, the national road between San-Pédro and Soubré in the east side, and in the north side the Gonou river which is one of the secondary tributaries of the San-Pédro river as shown in Fig. 5.2.1. The area is gradually sloped from north to south with mild undulation, and the elevations are measured about 8.0 m at the northern end of the area, 5.0 - 6.0 m in the paddy field near Campus II, and 3.0 - 4.0 m at the south end.

Most of the area are considered to be low laying flood plain, where the run-off water stagnates because of poor drainage and are used for paddy cultivation. There are some elevated hills elevations of which are 20.0 to 25.0 m, and these areas are used for residential areas and also for tree crops cultivation.

In the north of the Project Area, there extend hilly areas elevations of which are over 60.0 m. Small valleys extend between these hills and the elevations of these areas are as low as about 4.0 m, resulting in poor drainage condition. The run-off water stagnating in these areas is drained slowly toward the Gonou river, and some of them flows into the Project Area. Many small rivers and drainage canals run in the Project Area forming network of flows and flow into the San-Pédro river.

The vegetation in the Project Area is classified to be tropical lowland rain forest, and was covered by the tropical rain forest as same as Rapide Grah Classified Forest and Tai National Park. After its development, more than 50% of it are cultivated mostly by the settlers. The Project Area had been dense natural swampy forest until ARSO started the development of rice cultivation. Therefore, secondary forest only remains in some hilly area of the Project Area. Along the Grand Canal, the natural forest or grassland spreads to swampy areas of lowland near the San-Pédro river and other tributaries (Fig. 5.2.2).

The soil in the Project Area is classified as UC-22 (Alluvial flat lowland). The soil is of hydromorphic silty clay to sandy silt deep soil, with heavy texture. Agricultural value is limited to cultures that tolerate water clogging, and this means that soil is suitable for rice cultivation. On the other hand, the soil in hilly area is classified as UC-27C (slope of convex). The soil in this area is deep red-yellowish sandy clay modal or altered ferrallitic, and it is suitable for perennial and traditional agriculture on its slope and drainage.

(2) Water Resources

Since the Project Area is basically situated in the low-laying plain expanding on the left bank of the San-Pédro river, the area has much potential to receive flood from the river and to be suffered from the inundation of run-off water in its southern end during the flood seasons. The run-off water from the hilly areas situated north of the area flows into the irrigation areas through the drainage channels running in and around the Project Area, and causes inundation in the areas during the wet seasons. The Gonou river flowing along the northern edge of the area in the southeast direction catches most of such run-off from the northern hilly area near the Cpt. Bernard. It drains the water to the San-Pédro river through the Geranova river, one of the primary tributaries of the San-Pédro river. There are, however, some effluents from the Gonou river flowing into the irrigation areas of the Project Area. These effluents are connected to the small drainage channels in the area, and the river water is considered to flow into the San-Pédro river passing these small channels.

The water of the San-Pédro river has to be treated for the use of drinking water supply because some of the observed values such as total coliform bacteria, acidity, electric conductivity and TDS exceed the allowable ranges. The water quality analysis of the groundwater in dug wells also indicates the tendency similar to the surface water. In the Project Area, there is no deep tubewell constructed under the assistance of the Ministry of Economic Infrastructure, but there are a lot of open wells dug by private farmers for the public use. According to the well survey on seven (7) and 16 wells in the Cité Agricole and the Grand Gabo villages, the pH values of the private well water are within the range from 4.0 to 5.0 and the electric conductivity varies from 100 to 300 $\mu\text{S}/\text{cm}$.

5.2.2 Social Conditions

(1) Unique Social Structure

It should be noted that Cité Agricole village, the only village in the Project Area, has unique characteristics. It was created under the initiative of the Government by inviting young volunteer-settlers with an attractive goal of "irrigated paddy cultivation to make money". On the other hand, other villages were expanded with the inflow of settlers who came there to have their own plantation by exploiting virgin forests or to be employed by ARSO. The people in Cité Agricole is shown in Table 5.2.1.

As described in section 3.6.2, Cité Agricole is classified as Type-2 village and the villagers have never felt themselves owing land to indigenous people on grounds that it was the "State" who settled them there. That is why this village seems to have more free atmosphere from "customs". In other words, they are more modern and/or democratic than people of neighboring villages. There are some more differences observed below between Cité Agricole and the other villages located in the Study Area.

	Cité Agricole	Other villages in the Study Area
Village chief	Elected by the villagers	One of earth chiefs' family members or the first settler in the village
Villagers' committee	Separated from the basic supporting organization to the leading party	Mixed up often with the basic supporting organization
Main activity	Food crop cultivation	Tree crops plantation
Major ethnic groups	Sénoufo, Yacouba	Mossi, Dioula, Baoulé
Acquisition of land	Given by the government or GVCs to selected farmers and/or applicants	Given by earth chief families in return for liquor or money in the case of settlers
Dwelling demarcation	Mixed ethnic groups in the same area	Generally exclusive area for each ethnic group
Housing	Concrete walls with tin roofing subsidized by government	Built of banco (earth) with the thatched roofing of wild raffia palm

In addition, the social assimilation among young generation in Cité Agricole seems to have spread more quickly and deeply than in other villages. It is probably due to higher school enrolment ratio, which shows villagers' greater concern on school education where socialization is taking place. Apparently, another reason is that people do not live separately by the ethnic groups in Cité Agricole, resulting in the villagers having more direct contacts in daily lives and more chances to know and understand each other.

(2) Rural Society

1) Family

The following table shows the family composition and characteristics obtained from the results of questionnaire.

Family Characteristics	Project Area
Total No. of members per family	7.3
In which living together	6.3
Potential work force : over 15 years old (men)	3.6 (2.0)
No. of children per couple	5.3
Average age of family Heads (their spouses)	44.7 (36.4)
Literacy rate of Family Heads (spouses) (%)	55.9 (27.5)

2) Information Dissipation and Communication

People usually get information on agricultural activities from 1) ANADER, 2) experienced farmers, 3) farmers working near their plots, 4) friends and 5) the farmers working on the way to their own farms. Most of the people go to ANADER zonal office for consultation with specialists or extension workers on the control of diseases and insect-pests giving damages in their farms. The farmers know well about which farmers are good at growing what crops, so that they visit the skilled farmers to learn about the new varieties and skills. As another example of technical transfer among farmers, it is noteworthy that the young farmers have organized some demonstration plots to introduce new crops to the others.

(3) Household Economy

Although irrigated paddy cultivation is not carried out at present, rice produced by rain-fed paddy cultivation once a year during rainy season is the main source of income for about 36 % of the households in the Project Area as shown in section 3.6.4. For 22 % of the households, vegetable cultivation is the main source of income, which is performed either throughout a year or only in dry season when the market prices of vegetables become high. In farmers' households, the income from rice is generally managed by husbands who are the owners of the

plots. In vegetable cultivation, women are always in charge of the sales of products. If wives had their own plots separated from their husbands', they could manage the incomes earned from their respective plots. In the case of common plots to couples, husbands keep incomes when amount is large and wives keep them when it is small.

Maize cultivation and contract farm works also are important income sources. The former is performed during rainy seasons, and latter is during land preparation periods for food crops (from February to April) and during harvesting seasons of cacao and coffee (from December to January). Though more than half of the farmers have their own plantations of tree crops with an average size of 3.3 ha, these plantations have not been in the stage of production yet, since most of them were planted after 1996.

(4) Land Management and Problems

The lands in the Project Area (lowland) which had been expropriated from the indigenous people (Kroumen) were developed by the government and then redistributed to settlers during the last irrigated paddy project period. In this Area, there are four GVCs, entrusted with the land management by the government. The GVCs have the authority to dispose the land from those who gave up farming and to redistribute it to other members or new settlers. However, since the end of operation of irrigation system, the farmers in the Project Area have started renting the land suitable for rain-fed paddy cultivation within themselves or to "outsiders" (inhabitants in San-Pédro city in particular). These situations mean that the land is no longer managed by GVCs but by individuals. Therefore, the number of farmers, the cultivated acreage as well as the location of plots vary with planting seasons. In 1982, farmers in Cité Agricole requested the government to fix the boundary of their farming area including both developed lowland and surrounding upland. In response to the request, MINAGRA carried out land survey and staked out to show the field boundaries. But the Ministry did not leave any written official paper for the farmers to recognize their rights to use land (1,690 ha in total: developed land 650 ha, surrounding slope land 1,040 ha). In the beginning of 1990s, owing to the exhaustion of forest resources "to sell", indigenous ethnic group of Kroumen of neighboring villages has started insisting their customary land rights on uplands both inside and outside of the developed area. And in fact, Kroumen people started selling these uplands to the residents of San-Pédro and settlers. On the other hand, the farmers of Cité Agricole, who had to diversify their farming due to the end of irrigated paddy cultivation, have started to plant perennial crops in the same uplands located in "their territory". Consequently, land disputes occurred between the farmers of Cité Agricole and Kroumen or others who bought land from Kroumen, resulting in some troubles, which include threatenings and a legal case.

5.2.3 Agriculture

The detailed survey of the existing agricultural conditions in the Project Area was carried out with 70 farmers having farming land in the Area. The surveys were carried out in cooperation with ANADER, San-Pedro.

(1) Farm Land

In the Project Area, 62% of the farming lands are classified as lowland with 94.3% of the total farmers, followed by upland (20.0 %) and tree crop land (17.6 %). The average land holding size per farmer is 6.7 ha.

Land Classification	Total Area		No. of Farmers Holding Land		Area per Farmer (ha)	
	(ha)	(%)	(No.)	(%)	Whole	Holder
Plain lowland	234.9	50.3	66	94.3	3.4	3.6
Valley lowland	56.4	12.1	22	31.4	0.8	2.6
Upland	93.6	20.0	52	74.3	1.3	1.8
Tree crop land	82.0	17.6	32	45.7	1.2	2.6
Total	466.9	100.0	70	100.0	6.7	6.7

(2) Agricultural Production

The major crop in the Project Area has lowland paddy sharing 36.7 % of the total cropped area, followed by maize (22.6 %), cassava (16.3 %) and tree crops such as coffee (13.6 %) and cacao (5.1 %) in 1998. The average yield per ha in 1998 was 1,118 kg for lowland rice, 701 kg for maize, 4,222 kg for cassava, 494 kg for coffee and 250 kg for cacao, the details of which are shown in Table 5.2.2.

Crop	Area (%)	Production (%)	Yield (kg/ha)	Crop	Area (%)	Production (%)	Yield (kg/ha)
Lowland paddy	36.7	30.2	1,118	Coffee	13.6	1.6	494
(Plain lowland)	(32.7)	(28.2)	(1,171)	Cacao	5.1	0.2	250
(Valley lowland)	(4.0)	(2.0)	(682)	Rubber	0	0	0
Maize	22.6	11.7	701	Oil palm	0	0	0
Cassava	16.3	50.5	4,222	Cola	0	0	0
Yam	0.4	1.5	5,000	Banana	1.7	-	-
Upland Rice	0	-	-	Others	1.6	1.1	-
Vegetable	2.0	3.2	-	Total	179.6 ha	243,990 kg	-

Source: JICA Study Team, 1998

(3) Farming Type

In the Project Area, four farming types exist. The most popular one is mixed crop farming of lowland, upland and tree crop, which shares 59.4 % of the total farming land and 43.0 % of the total farmers, followed by (L) + (U) farming sharing 20.3 % of the land and 31.0 % of the farmers, lowland farming sharing 17.4 % of the land and 23.0 % of the farmers and (L) + (T) farming sharing 2.9 % of the land and 3.0 % of the farmers. Single farming type is lowland type farming only.

Farming Type	Cropped Area		No. of Farmers		Farming Type	Cropped Area		No. of Farmers	
	(ha)	(%)	(No.)	(%)		(ha)	(%)	(No.)	(%)
Lowland (L)	83.0	17.4	16	23.0	(L) + (T)	14.0	2.9	2	3.0
Upland (U)	0	0	0	0	(U) + (T)	0	0	0	0
Tree Crop Land (T)	0	0	0	0	(L) + (U) + (T)	283.9	59.4	30	43.0
(L) + (U)	97.0	20.3	22	31.0	Total	477.9	100.0	70	100.0

(4) Farming Income

In the Project Area, the net income was F.CAF 110,542 with F.CAF 43,084 /ha. The farming income per farmer in the Project Area is only 39.3 % of that of the Study Area. Such low farming income is due to low land utilization and low income per ha.

The net crop income of the Project Area is from upland crop farming in spite of the fact that the lowland accounts for 38.0 % of the total area. The net income of lowland farming in the Project Area is minus F.CAF 2,935,228 due to rain-fed field condition and low cultivation technology. There are two types of lowland, namely, valley bottom lowland and plain lowland. Though both

the lowlands are almost all rain-fed lowland, water source of the valley bottom lowland is more stable than that of the plain lowland.

Land Classification	Cropped Area		Farming Income	
	(ha)	(%)	(F.CAF)	(%)
Lowland	68	38.0	-2,935,228	-137.9
Upland	73	40.8	10,684,956	138.1
Tree Crop	38	21.2	-11,797	-0.2
Total	179	100.0	7,737,932	100.0

(5) Labor Input and Production Cost

In the cultivation of annual crops, around 80% of the total labor input is allotted to the land preparation, seeding and harvesting, which are the minimum requirements indispensable for cultivation. The remainder is allotted for weeding, application of fertilizer and disease and pest control, except bird control for paddy. Regarding the labor input by crop, the highest labor input is made for vegetable cultivation, followed by tree crops. Labor input for upland crops is the lowest where the input is nearly half for paddy cultivation. In the lowland paddy cultivation, total labor input including bird control is estimated at 217 man-day/ha, of which 5 %, 9 %, 5 %, 2 %, 9 % and 70 % is paid for land preparation, sowing and transplanting, weeding, harvesting and bird control, respectively. Such a labor-intensive cultivation is abnormal. The cause of the extremely high labor input paid for bird control is due to the limited paddy fields with concentrated attacks.

The present average labor wage is F.CAF 1,100 /day in the Project Area. The wage, however, is differed by farm work from F.CAF 750 /day for birds control to F.CAF 1,800 /day for chemical application work. About 85% of the crop production cost is the labor cost. As shown below, the production cost is the highest for vegetables, followed by lowland paddy, tree crops and upland crops.

(Unit: F.CAF/ha)

Crop	Seed/ Seedling	Fertilizer	Herbicide	Pesticide/ Insecticide	Machinery	Labor	Total
Paddy (Direct-sowing)	17,308 (7.6%)	9,244 (4.0%)	10,174 (4.5%)	2,794 (1.2%)	14,593 (6.4%)	174,180 (76.3%)	228,292 (100.0%)
Maize	1,438 (11.0%)	0 (0%)	0 (%)	0 (0%)	0 (0%)	11,620 (89.0%)	13,058 (100.0%)
Cassava	2,000 (2.2%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	90,860 (97.8%)	92,860 (100.0%)
Vegetable*	15,338 (3.7%)	28,948 (6.9%)	21,185 (5.1%)	0 (0%)	0 (0%)	350,743 (84.3%)	416,214 (100.0%)
Coffee**	2,575 (1.4%)	0 (0%)	0 (0%)	6,120 (3.4%)	700 (0.4%)	169,440 (94.8%)	178,835 (100.0%)
Cacao**	225 (0.1%)	0 (0%)	0 (0%)	1,091 (0.4%)	381 (0.2%)	244,017 (99.3%)	245,651 (100.0%)

Notes: *Tomato, Egg-plant, Okra, Cucumber, ** Fruit-bearing tree
Source: JICA Study Team

Regarding the material cost, in cereal crops, about 40% of the material cost is for seeds. Fertilizer cost is nil for the upland crops and in the case of cacao, pesticide cost accounts for 61% of the material.

(6) Consumption and Sale of Products

In spite of the extremely low production levels, 50% of the food crop products, 88% of the vegetable products and 100% of the tree crop products were sold by 80 %, 100 % and 100 % of the farmers, respectively in 1998. Especially, 843 kg out of 1,360 kg (62 %) produced paddy was sold, and the remainder was consumed at home by 7.5 persons of family member, which corresponds to only 45 kg per person per year in rice.

(7) Lowland Rice Cultivation

1) Field conditions

According to the data obtained from the interview survey, the land utilization of the plain lowland in the Project Area during the last five years was estimated at only 19.4 % On an average, 72 % of the farmers cultivate rice in 27 % of the plain lowland area.

	1994	1995	1996	1997	1998	Average
No. of farmers possessing plain lowland (A)	67	67	67	67	67	67
No. of farmers cultivated paddy (B)	49	43	51	48	51	48
(B)/(A)	73.1%	64.2%	76.1%	71.6%	76.1	72.2%
Area of plain lowland (ha) (C)	234.9	234.9	234.9	234.9	234.9	234.9
Area cultivated paddy (ha) (D)	56.7	59.9	74.8	63.0	58.7	62.6
Area cultivated other crops (ha) (E)	0.5	0.4	0.6	0.3	0.6	0.5
(D+E)/(C) (%)	24.4%	25.7%	32.1%	26.9%	25.2%	26.9%
Land utilization ratio (%)	17.8%	16.5%	24.4%	19.3%	19.2%	19.4%

Source: Feasibility Study, JICA Study Team

2) Number of family member and agricultural labor

The number of family member is estimated at 7.5 persons, 4 males and 3.5 females. The age structure is, 29 % of them below 10 years old, 69 % from 11 to 54 and 2 % above 55. The exclusive agricultural labor is 2.5 persons and the temporary agricultural labor is 2.5 persons per farm household. The average ages are 29, the youngest and 44, the oldest in the exclusive labors, and 11, the youngest and 24, the oldest in the temporary labor.

3) Machinery and agricultural tools

21 farmers (30.0 %) have one unit of power tiller, one farmer (1.4 %) has a pair of draft animal, 23 farmers (32.9 %) have a human power sprayer, one farmer (1.4 %) has a motor pump and one farmer (1.4 %) has a harvester. Among them, 62 % of the power tillers, 25 % of the human power sprayers and the motor pump are not under usable condition.

4) Type of cultivation

73% of the farmers perform direct sowing with broad casting (63.5 %), hill sowing (1.6 %) and mixed sowing of them (7.9 %), 3 % transplanting and 24 % mixed cultivation of them. The transplanting in the wet or dry fields is carried out by making planting holes with handle of *daba* (hoe). The mixed cultivation of transplanting and direct sowing is applied in the unlevelled fields.

5) Cropping Season

In most fields, sowing is done from March to June with the peak in May, and harvesting is done around 4 months later, starting from August and until to September.

6) Variety and Seed

BUAKE-189 is the most common variety, and 94 % of the farmers are using this variety. The other varieties in use are WITA-9, SC-1 and others. Only 67 % use their own seeds. The rest of them purchase the seeds from ANADER or friends. The average seed rate is 71 kg/ha for direct sowing culture and 45 kg/ha for transplanting culture. 25 % of the farmers practice pre-germination treatment of seeds with soaking in water for 2 days.

7) Nursery

A half of the transplanting farmers apply upland nursery and the other wet nursery. 92 % of the nurseries are located in the main fields. The nursery period ranges from 14 days to 30 days with the average of 18 days. During the nursery period, weeding is done 1.6 times an average, fertilizer application and disease and pest control are carried out 1.1 times, and daily water management activities are carried out daily.

8) Land preparation of main field

Plowing is done once by family (82 %), contractor (15 %) and family + contractor (3 %) with power tiller (75 % of the farmers), human (23 %) and draft animals. 20 % of the farmers perform 2nd plowing (harrowing and puddling) under the field condition of wet (69 %), dry (15 %) and submerged (15 %).

9) Weeding

Weeding is carried out more intensively in direct-sown fields than in transplanted fields, though weeding is done more than once in both fields during the paddy growing period. The method is by family labor in more than 83 % of the fields, with mainly manual in transplanted fields and with mainly herbicide in direct-sown fields.

10) Application of fertilizer

35 % of the farmers apply both basal and supplemental fertilizers. The application of basal fertilizer is 10, 18, 18 kg/ha in N,P,K and supplemental fertilizer is 10-18-18 or 10-20-20 in both of direct sowing culture and transplanting culture. As supplemental fertilizer, 22 to 25 kg/ha of N in the form of Urea is applied 24 days after sowing or after transplanting.

11) Disease and pest control

43% of the farmers control pest with Furadan. In the area, it seems that control of disease and pest is not economical at present due to the low degree of the damage. However, attention should be paid for Rice Yellow Mottle Virus (RYMV), because there were found out some fields were completely infected by this Virus in the area of Polo II, San-Pedro being adjacent to the Project Area, in the main crop of 1998.

12) Harvest and post-harvest activities

In 94 % plain lowland fields, the harvest is carried out by cutting hills with sickle. In more than 20 % of valley lowland fields, direct harvesting of panicles is done with knife. Threshing by striking panicles against a board is the common way. Drying of harvested grains is done at house yard and field. Harvested grains are stored in the living house or storage. Milling of rice with private milling machine is common, but occasionally it is done by manpower at home. The milling charge is F.CAF 20 /kg on average.

As same as other farmers in the Study Area, as stated above the farmers in the Project Area are performing agriculture under the considerations of 1) economic risk for agricultural input against the drought and flooding their field, 2) low accessibility to the agricultural input caused by their financial inability and 3) shortage of farming knowledge.

(8) Animal Production

The raising of livestock and animal husbandry activities are comparatively inactive due to the poor animal feed/fodder production.

(9) Agro-industry and Marketing

A rice mill with dry-yard attached was installed by the CIDV at the northeast corner of Cité Agricole Campus II in early 1990s. It is not functioning any more at present. There are no specific commercial activities. During the dry season, a few settlers grow vegetables along a network of drains in the area, and sell the produce at the nearby local markets. A sheltered market place was installed in front of the primary school grounds in Campus II of Cité Agricole. It is being used as the canteen for the school lunch.

(10) Farmers' Organization

In 1992, 13 GVCs in San-Pédro Paddy Development Project Area were unified into 4 GVCs based on the irrigation blocks of each main canal. Government stopped the supply of fuel in the same year, resulting in ceasing the operation of water pumps. Thereafter 4 GVCs formed a union in an effort to raise fund for their operation (Table 5.2.3). In 1993, a private company OCTID tried to enter by funding an experimental cultivation plot, but withdrew after one planting season due to boycott by leading farmers. Though four GVCs were recognized as official organizations by the government in 1995, no activity has been carried out as GVCs since then. In lowland across the road from the Project Area, irrigated paddy cultivation has been carried out since 1975, where its own GVC *Lycée Professionale* was formed in 1985 by the farmers who left the project. Though joint marketing has not been carried out since the stop of operation of water pumps, members are carrying out rain-fed paddy cultivation with their own planting schedule, using jointly owned tractors.

In 1995, after ceasing irrigated paddy cultivation, the first officially recognized women's farmer-organization GVC-FCA was founded in Cité Agricole with financial aid given from United Nations Population Fund (UNFPA), aiming at helping their husbands who lost source of income as well as their self-confidence. In its activities, members cultivate maize or paddy in the wet season and vegetables in the dry season, and income from harvest goes to each member after paying certain portion of the sale calculated per acreage to GVC. Pooled money is aimed at being used for mutual-help activities such as loans to the members for ceremonial occasions, school fees, etc., although no such activities have been carried out so far due to insufficient income caused by lack of rainfall and limited arable land acreage. In 1998, members who withdrew from FCA founded unofficial organization GVC Femme. Members of this new organization are cultivating paddy in the wet season and vegetables and cassava in the dry season. Ethnic problem lies behind the separation of women's group. GVC Femme mainly consists of Yacouba and GVC-FCA consists of Sénoufo.

5.2.4 Analysis of Farmers' Problem and Their Intention to the Development

According to the following steps with specified aims, the farmers who took part in the past project (hereinafter referred to as the farmers) were led to analyze the problems they faced while carrying out irrigated paddy cultivation in the past and to set the purposes for the future project based on the problems analyzed:

- 1) Individual interview to collect information on the project carried out in the past and opinions for the future project, which can be barely drawn from interview in-groups.
- 2) SWAP¹⁾ workshop (SWAP W/S) to lead the farmers for reaching a common understanding on the past project, then setting purposes for the future project in unanimous agreement summing up a series of individual interviews mentioned above.
- 3) PCM (ZOPP) workshop (PCM W/S) based on the problems pointed out during the SWAP W/S, to allow both the representatives of concerned government authorities and the farmers to reach consensus on the past and future projects and ultimately to share the responsibilities of each planned activities by both sides.

(1) Farmers' Review of Previous Project

Through the analysis of cited problems on the previous project done by the farmers themselves, all of them attributed their failure just to "deficit of water in the plots", which caused secondarily any other minus factors such as collapse of organizations, farmers' indiscipline attitude and low yield. The farmers cited the following factors as causes of water deficit, 1) and 2) of which concerning water pumps especially were pointed out by many of them.

- 1) Though many cases of mechanical troubles occurred as pumps were getting old, no prompt repair works were carried out, resulting in the ceasing of water supply.
- 2) Operation of new pumps was costly, thus it was impossible to operate them for a long time.
- 3) Damages of irrigation canals without concrete lining became grave as time went by, causing the increase in water loss.
- 4) Plots could not be filled with water enough due to incomplete land development, especially imperfect leveling from the beginning.
- 5) Water management carried out by supervising organizations and farmers after the departure of Taiwanese experts was inadequate.

In consideration of these problems, different approaches (gravity irrigation, concrete lining canals, land preparation etc.) from those of the past project are being considered, through which the trust and understanding of the farmers on the planned facilities may be obtained. The farmers also pointed out the problems of the supervising organizations. They mentioned as causes of troubles insufficient communication between the farmers (and their GVCs) and the supervising organizations as well as unclear task sharing of each of them. In the PCM W/S, this matter became a subject of discussion among farmers and government officials, and as a result, it gave light on the divergence of standpoints and misunderstanding on the past systems and experiences between both sides.

On the other hand, the farmers were not very stern in evaluating their own organizations such as GVCs. At SWAP W/S held aiming mainly at analyzing the problems of farmers' organizations,

¹⁾ Abbreviation for Success Weakness Aims Potential. Participatory method of analyzing the village situation.

most of the participants said that there were no problems in their organizations or solidarity". However, through the individual interviews, not a few farmers expressed the distrust of GVC committee members or village leaders, especially of their unclear accounting management and they look on the other GVCs with distrust or even hostile feeling, which may show farmers' basic manner of "no trust in others". Additionally, they seem too ready to be misled by "canards" and show excessive reaction to rumors concerning their interests in particular (Table 5.2.4).

(2) Task, Purpose and Responsibility for the Development Project

At the PCM W/S, "Insufficient rice production" was selected as the core problem, and four problems concerning farmers' organizations, water, agricultural inputs and access to agricultural machinery were pointed out as the direct causes related to the core problem.

Taking the results of the above problem analysis into account, "Sufficient quantity of water in plots" naturally became the most important factor to be ensured for the farmers. This factor and the following four ones were designated as outputs to be obtained for the achievement of the project purpose; that is, "Increase of rice production":

- Appropriate agricultural techniques are applied;
- Good working of cooperative can be ensured;
- Access to input is guaranteed; and
- Condition for buying agricultural machines is improved.

Several activities for each output were planned concretely, and responsibility for each activity was shared between farmers' and governmental sides to clarify which side is mainly undertaking each task. In the past project, the farmers had little authority to decide their own farming under the top-down management system where the decisions made by the government just came down to the farmers, so that they could hardly bear either ownership or responsibilities for the project. Moreover, the lack of communications between the farmers and supervisory organizations caused many confusions and mutual distrust. This time, through workshops, the farmers themselves joined in the discussions about the contents of the project together with the representatives of concerned government authorities, then ultimately came to an agreement with each other. As a result, the solidarity of the farmers has been strengthened and a clue to communication and clearly defined task sharing have been shown to both sides.

(3) Farmers' Intention to the Project

1) Farmers out of the Project Area

The main concern of the farmers in the area is "the production of tree crops such as coffee and cacao in the future". The farmers overwhelmingly have agreed to the concerned component of "switch the crop of plantations from cacao to coffee" proposed in the Master Plan, since it is reflecting real problems and needs they are facing. At the beginning, the farmers who had tree crop plantations near the site for the planned Grand Canal were very anxious about the expropriation of their land and/or damages to their plantations i.e. cutting down of their trees. Now that the representative of the government has explained clearly to the farmers that the land just required for the canal construction will be expropriated and the government will pay for trees damaged during the works, the concerned farmers have come to understand the situation. It is essential to ensure the understanding and consent of not only the people farming near the

site but also traditional owners of the concerned lands, i.e. earth chiefs, because the later who have a great influence on the former can be effective mediators in case of troubles with the former. At present, concerned villages have agreed to the implementation of the project, and in order to maintain good relations with these villages, it is also necessary to give them information on the Project continuously through extension workers and any other possible means.

2) Farmers in the Project Area

"Farmers in the Project Area" are defined as 1) Farmers living in the Project Area, 2) Farmers having agricultural activities in the Project Area, or 3) Participants in the past paddy project having intention of taking part in the future project. 96 households out of 137 total households in the Area have some experiences in irrigated paddy cultivation and the Project expects them to be the core farmers at the time of its implementation. Hereafter, these farmers will be called "senior farmers". In course of the Project plan formulation, the following farmers' intentions shall be carefully considered.

a) Appropriate farming acreage:

The senior farmers generally have agreed to the appropriate farming acreage (1.5 ha per household) and redistribution of plots proposed by the Study Team, though some of them complain that 1.5 ha are too small to earn enough for their family who has become larger than it was at the time of settlement. Meanwhile they are very intolerant of the fact that new comers will receive the same acreage of plot as them. In other words, they wish, above all, to be distinguished from the new comers because of their experiences in irrigated paddy cultivation. The senior farmers who have familiarized themselves with "extensive modern paddy cultivation" for a long time, tend to under-estimate the necessary farming work force, and they think that it will be "a piece of cake" to manage a plot of 1.5 ha. Therefore, it may happen that their experiences in paddy cultivation prevent them from practicing "new intensive cultivation".

b) Diversification of crops and technical training:

A half of the farmers in the Project Area have already started their tree crops plantation and about 70 % of the rest have intention to start a plantation because of lessons given by the last mono-culture project or its stability and durability in comparison with food cropping, according to many farmers. In addition, over 70 % of them intend to introduce vegetable cultivation into their farming and 50 % stock or fish raising. As for the training, 80 % of senior farmers hope to be trained again on irrigated paddy cultivation, especially on operation and maintenance of farm machinery. 30% and 25 % of them desire the training on vegetable cultivation and animal husbandry, respectively.

c) Farmers' organizations:

Since the farmers have been used to small groups such as GVCs, they are first of all required to innovate their old way of thinking before forming a huge cooperative (COOP). The farmers understand that their GVCs will be replaced by one COOP, but they do not see the differences between GVC and COOP, especially the merits of COOP in comparison with GVC. Therefore, they desire to have some training on COOP for all the farmers in order to learn about their new organization. Moreover, the farmers hope to establish the system in which the farmers themselves as members of COOP will be able to check the work done by the administrators and

the accountant. They, most of the young farmers particularly, wish to receive a training for management of COOP.

d) Anxiety of the weak:

In Cité Agricole, roughly 20 % of households consist of old people without young generations, or have disabled or sickly heads of household or spouse. These households regarded as the poorest of the poor are anxious that they can not be allowed to participate in future project, seeing that they can not find themselves qualified for the participants in consideration of their financial and labor force situations.

e) Land property:

The farmers desire the government to recognize officially the rights of ownership and/or cultivation of the land i.e. an assurance for the land they cultivate, since most of them were settled in accordance with the national policy and their motivation for farming declined due to redistribution of the plots they that experienced several times.

f) Income desired:

Desirable annual income per senior farmer's household is estimated at F.CFA 1,285,300 and per member of household at F.CFA 230,400.

3) Potential participants to the Project

Interview surveys targeting the farmers in the following areas were carried out to see the farmers' intention of participating in the Project to be implemented in future.

- In the Project Area (for all farmers)
- In the Study Area (focusing on the farmers near the site for the Grand Canal and in villages around the Project Area)
- In the classified forest on the right bank of the San Pédro river (for the farmers in a sampled village)

The results of the surveys are as follows:

Village/Area		Number of Households	Remarks
Project Area	Cité Agricole	136	including farmer living in other area including farmers in San-Pédro
Study Area		314	
Rapide Grah Area	Kourémoué	117	equivalent to 67% of sample household total 16,684 household
	Estimate	(11,161)	
Total		567	estimate total 11,728 households

In the Project Area, all households except one have intention for participation in irrigated paddy cultivation regardless of their past experience. However, about 40 % of them lack work forces (less than 3 members over 15 years old).

In the Study Area, inhabitants are motivated to join in the Project with the reason that cacao production, regarded as main industry of the country, remains stagnating and that suitable land for plantation is running short. The indigenous people who did not take part in the past project seem, this time, keen to be involved. Meanwhile, few farmers living in Fahé or Cpt.Colonele, main villages in the site for Grand Canal, express their intention to participate. The inhabitants

in these two villages express that they will wait for the project to come and develop their lands after selected as suitable areas for irrigation.

The inhabitants in the classified forest are willing to join in the Project in order to get away from their insecure life owing to a fear of evacuation, and their motive is without doubt even more earnest. Therefore it appears that a lot of people will apply for participation as shown in the estimation, once the recruitment activity is started in all over the classified forest. Moreover, there will also be many potential participants in San Pedro city in consideration of its population and employment situation.

5.3 Basic Concepts of the Development Plan

5.3.1 Basic Concept of Planning

The Rehabilitation of San-Pédro Paddy Development Project (hereinafter referred to as the Project) aims to 1) re-cultivate rice in the reclaimed paddy land, 2) formulate sustainable farming practices especially for paddy and 3) resettle the abandoned farmers as well as establish new settlement in the Project Area. Therefore, the Project shall be formulated to maximize the synergetic effects with the other programs and components proposed in the Master Plan. The water source for irrigation is to be the San-Pédro dam, and the reservoir water will be taken using the existing industrial water intake facility. The water is conveyed through the conveyance canal (the Grand Canal) to the Project Area. As stated in the Master Plan, the Project is a pilot project of the Integrated Rural Development in the San-Pédro Plain and is expected as to become the model project for other development projects/programs. Therefore, the Project shall cover all the components required for getting the final goal of the development, 1) improvement and stabilization of farmers' living standard, 2) achievement of rice self-sufficiency of the nation and 3) activating of regional economy as much as possible.

5.3.2 Components of the Project

The Project components consists of 1) Paddy agriculture development, 2) Farmers' organization (formulation and management), 3) Agricultural support (extension service, post-harvest, marketing, farmers' credit), 4) Rehabilitation of San-Pédro paddy development project area including demonstration farm, 5) Rural infrastructure improvement (rural water supply), 6) Social Development (women's group activities, pupils' association, youth group activities and improvement of accessibility to rural facilities) and 7) Environmental protection (Table 5.3.1).

The workshop held on the overall goal of "increase of rice production and increase of farmers' income" among the farmers and representatives of government agencies concerned also has identified the similar components as the actions required for the successful implementation of the Project.

5.4 Agricultural Development

5.4.1 Proposed Cropping Calendar and Target Yield

(1) Rice Double Cropping

1) Cropping calendar

As shown in Fig. 5.4.1 and 5.4.2, the following paddy double-cropping calendars for transplanting and direct sowing cultivation methods are proposed:

Cultivation Method	Variety to be Used	1 st Cropping		Fallow Period (days)	2 nd Cropping		Fallow Period (days)
		Sowing	Harvesting		Sowing	Harvesting	
Transplanting	WITA 7	Mar/20-May/04	Jul/26-Sep/09	46	Sep/10 - Oct/25	Jan/16-Mar/02	63
	WITA 8	Mar/20-May/04	Jul/23-Sep/06	49	Sep/10 - Oct/25	Jan/13-Feb/27	66
	WITA 9	Mar/20-May/04	Jul/18-Sep/01	54	Sep/10 - Oct/25	Jan/08-Feb/22	71
Direct sowing	WITA 7	Mar/20-May/04	Jul/21-Sep/04	51	Sep/10 - Oct/25	Jan/11-Feb/25	68
	WITA 8	Mar/20-May/04	Jul/18-Sep/01	54	Sep/10 - Oct/25	Jan/08-Feb/22	71
	WITA 9	Mar/20-May/04	Jul/13-Aug/27	59	Sep/10 - Oct/25	Jan/03-Feb/17	76

These are determined based on the following three conditions:

- Evasion of harvesting times in rainfall period: The harvesting times in both cropping seasons are set in the least rainfall period because the rainfall at harvesting time will become the most serious problem on timely operation of harvesting work and for drying of large quantities of harvested paddy (around 7.5 tons / season / farmer).
- Setting staggering period for 45 days: A staggering period of 45 days is set taking into considerations efficacious utilization of machinery and family labor, irrigation canal capacity, fallow periods between cropping and growing period, varieties to be introduced, etc.
- Introduction of high yielding varieties with tolerance to RYMV¹⁾: Three varieties, WITA 7, WITA 8 and WITA 9 are introduced. These varieties have the characteristics of shorter duration (120 to 128 days) than the present variety of B-189 (130 to 135 days), high yield potential (8.3 to 8.6 t/ha) and tolerance to RYMV.

2) Target yield

The target yield of rice is set at 5.5 tons/ha for the transplanting culture and 4.5 tons/ha for the direct sowing culture taking into consideration the meteorological conditions in the area such as remarkably low sunshine hours (4.8 hours on annual average), high temperature (26.2°C) and high humidity (84.7 %). The key factors for accomplishment of the target yields are assured supply of irrigation water, good land preparation (leveling and puddling) and weed control. Without execution of these key points, any improved technology can not be effective. For making the rice cultivation plan, special considerations are paid on the following factors;

- Amount of nitrogen to be applied is saved at 66 kg/ha taking into consideration the unfavorable meteorological conditions in the area.
- Synthetic weed control countermeasures are introduced such as mechanical land preparation which is the most effective control method of weeds, pre-germination treatment with herbicide and in-field water management where water depth is kept at around 3 inches throughout the growing period of paddy except application time of herbicide and before 10 days of harvesting.

¹⁾ Rice Yellow Mottle Virus

- Two control methods against RYMV are employed; that is, introduction of tolerant varieties and land preparation method the effect of which has been confirmed at Grand-Lahou. The method is to incorporate ratoons and paddy stocks into the field at the 1st plowing of paddy with power tiller under submerged field condition and keep the fields under submerged condition for 2 weeks until the 2nd plowing (puddling and leveling).
- Preventive control measures do not be employed against rice disease and pest due to the economic point of view.

(2) Rice and Vegetables Cropping

1) Cropping calendar

In order to increase the farming income, combined cropping of rice and vegetables is proposed as shown in table below and Fig.5.4.2. Vegetables to be introduced are selected in consideration of their suitability to the Area, profitability and adaptability to the cropping season in combination with rice.

Cropping System	1st Cropping		2nd Cropping	
	Sowing	Harvesting	Sowing	Harvesting
Tomato + Rice	Mar/10 - Apr/24	Jun/10 - Aug/31	Sep/10 - Oct/25	Jan/16 - Mar/02
Rice + lettuce	Mar/20 - May/04	Jul/26 - Sep/09	Sep/01 - Oct/15	Nov/30 - Jan/14
Tomato + Lettuce	Mar/10 - Apr/24	Jun/10 - Aug/31	Sep/01 - Oct/15	Nov/30 - Jan/14

2) Target yield

The target yield of the paddy and vegetables cropping is set at 5,000 kg/ha for the average of transplanting and direct-sowing rice cultivation and 20,000 kg/ha for both tomato and lettuce.

5.4.2 Farming and Production

(1) Rice Double Cropping

Farmers hold 3.6 ha of plain lowland on average at present. The average cropped area of rice in the last 5 years is only 1.0 ha per farmer on the rain-fed field condition. The production is estimated at 1,171 kg/ha on average. The net income is estimated at minus F.CAF 39,524/farmer.

In the plan, rice is to be cultivated twice a year. The paddy production is estimated at 15,000 kg/year per farmer, which is equivalent to 13 times that of the present. The net income is estimated at F.CAF 1,160,940/farmer, which is nearly equivalent to the average annual salary in Côte d'Ivoire. The details of the recommended technology for the transplanting culture and the direct sowing culture are shown in Table 5.4.1 and 5.4.2, respectively, and the estimated cost and income of the proposed transplanting culture and direct sowing culture of rice are shown in Table 5.4.3.

(2) Rice + Vegetable Cropping

In the case of introduction of tomato in the area of 0.1 ha of the 1st cropping, the total net income per farmer will become F.CAF 2,426,162/year, which is twice the average annual salary in Côte d'Ivoire. In the case of introduction of lettuce, the net income per farmer will become F.CFA 1,263,852/year as shown below. The estimated income and outgo of the proposed tomato and lettuce culture are shown in Table 5.5.4.

Conditions	Land Holding size (ha)	Cultivated Crops	Cultivated Area (ha)	Yield (kg/ha)	Production (kg)	Net Income (F.CAF)
Present	3.6	Rice	0.89	1,171	1,041	-39,524
[Plan 1] Rice + Rice	1.5	Rice(1 st)	1.5	5,000	7,500	580,470
		Rice(2 nd)	1.5	5,000	7,500	580,470
		Total	3.0	-	15,000	1,160,940
[Plan 2] Rice + Tomato	1.5	Rice(1 st)	1.4	5,000	7,000	541,772
		Rice(2 nd)	1.5	5,000	7,500	580,470
		Tomato(1 st)	0.1	20,000	2,000	1,303,920
		Total	3.0	-	16,500	2,426,162
[Plan 3] Rice + Lettuce	1.5	Rice(1 st)	1.4	5,000	7,000	541,772
		Rice(2 nd)	1.5	5,000	7,500	580,470
		Lettuce(1 st)	0.1	20,000	2,000	146,610
		Total	3.0	-	16,500	1,268,852

5.4.3 Labor Requirement and Mechanized Farming

(1) Labor Requirement

Labor requirement for the proposed rice cultivation is shown in Fig.5.4.3. The largest labor is required for transplanting and harvesting; that is, 40 man-day/ha for transplanting and 50 man-days/ha for harvesting including threshing. To complete these farm works in a day, around five times the family labor is required. However, the labor shortages for these farm work can be solved by mutual use of family labor in the Project Area by staggered cropping for 45 days. Therefore, mutual use of family labor among the different staggered areas in the Project Area is needed.

(2) Mechanized Farming

Mechanized land preparation is indispensable to carry out scheduled rice double cropping smoothly and to ensure the target yield. The number of power tillers required for the Project Area (575 ha) is around 60 units of 14 CV power tiller as one unit for each 10 ha. In the Project Area, there are 21 units of power tiller at present, 13 units of which are unusable. In the case of Sakassou Project, 24 out of 64 units are unusable. It is essential for mechanized farming to have proper maintenance of machinery, training of operators and complete equipment of spare parts. The cost of mechanical land preparation is estimated at F.CFA 65,092 /ha. The cost of the power tiller (14 CV) was F.CAF 3,000,000 per unit at KR-II price in 1998. It is, therefore, necessary to prepare the funds of F.CAF 180,000,000 for purchasing 60 units of power tiller. The amount can be paid back in 5 years.

5.4.4 Appropriate Land Holding Size

Appropriate land holding scale is decided at 1.5 ha per farm household based on the net income obtained from the rice double cropping, which is equivalent to the average of annual salary (F.CFA 1,160,000) in Côte d'Ivoire. Looking from the viewpoint of labour requirement, 1.5 ha is also proper farming scale for the rice double cropping by mutual use of family labor in the Project Area.

5.4.5 Farm Household Economy

Table 5.4.5 gives the farm economy of an average satellite household¹⁾ of the Project Area. With the introduction of transplanting method, in which an average yield of 5.5 ton/ha/crop is

¹⁾The farm household which does not have a cultivator.

envisaged, the household economy of the Project Area will eventually be improved. With the land holding of 1.5 ha and two crops a year, an average net farm income of the majority households will reach F.CFA 1.6 million of 1998 price by selling paddy to their COOP at the price of F.CFA 157 /kg minus 1 % commission after deducting 1.2 ton of paddy for its self-consumption.

In the rice cultivation calendar in 1.5 ha field, in which mechanization is limited to the land preparation only, requirement of manual labor exceeds its supply from the household concerned during the transplanting and harvesting periods. However, if mutual labor exchange among the COOP members goes smoothly and farmers overcome an unaccustomed posture in manual rice transplanting, there won't be any shortage of the labor pool as a whole.

After paying the annual debt of housing loan of F.CFA 234,000 and deducting 10% saving, the disposable income will be F.CFA 1.4 million. Assuming that most of the basic foodstuff be self-sufficient, the disposable income would be 28 % more than that of the average residents of San-Pédro city. O&M of the canals require wage labor. However, it will be reduced by providing some member's family labor instead of hired labor force.

5.5 Irrigation and Drainage Development

5.5.1 Irrigation Plan

(1) Irrigable Area

Basically the irrigable area of the Project is the same as the previous ARSO/SODERIZ developed area covering about 600 ha. The following modification of the area is made on the irrigable area:

- a) Involve the northern extension, which is presently irrigated by another pump separately.
- b) Omit the southernmost area which is irrigated by separate pump but is included in the San-Pédro Port Extension Area.

Total gross irrigable area excluding the hilly area spreading in the Project Area is estimated at 766 ha. Net irrigable area is estimated to be 75 % of gross area, 575 ha, after considering the area to be occupied by irrigation and drainage facilities.

(2) Irrigation Method and Cultivation Block

1) Irrigation water intake

The Project Area will be irrigated by San-Pédro dam through the Grand Canal by gravity.

2) Irrigation method

As practiced for paddy cultivation, the proposed irrigation method is the flooding one bounded by the field levee. As the irrigation water is conveyed through 18.2 km long Grand Canal from San-Pédro Dam, the irrigation water supply is made for 24 hour a day continuously when it is required. No farm pond is considered. Irrigation area is divided into four rotation blocks based on the canal alignment. The irrigation water distribution is to be rotated block by block and each rotation be made within 10 days.

3) Arrangement of farmland block (Fig. 5.5.1)

Field Lot

- Considering the mechanized cultivation, the size of a field lot is set at 30 m x 100 m (0.3 ha)
- A field lot is the minimum area for effective land leveling and crop diversification.
- A field lot shall be surrounded by the fixed earth levee with 30 cm crest wide and maximum 30 cm high tripod.
- A field lot can be divided into several plots by providing temporary levees.
- A field lot is the unit of irrigation to be made in a day.

Field Block

- Individual farmers are provided with 1.5ha field.
- Basically, one field block is divided into 20 field lots.
- A field block is irrigated within 5 days.

Irrigation Block

- The irrigable area in the Project Area is divided into 4 irrigation block based on the irrigation canal command area
- An irrigation block is irrigated within 10 days

(3) Irrigation Water Requirements

1) Estimation of irrigation water requirements

Irrigation water requirements are composed of crop water consumption, puddling water for land preparation, ponding water for field management and irrigation losses based on the cropping calendar. The paddy is mainly cultivated in the Project Area and tomato or other vegetables are planned to cultivate in small area in the dry season. Since the water consumption of paddy is larger than that of tomato, then the irrigation water requirements are estimated based on the paddy cultivation. The estimation has been made using the following procedure on the 10-days basis.

2) Reference evapotranspiration(ET_o)

Crop water requirement is estimated based on the revised FAO method, Penman-Monteith method described in FAO Irrigation and Drainage Paper No.49. Using the available climatic data, the reference evapotranspiration (ET_o) is calculated by the CROPWAT for windows developed by FAO and HDS. The calculation results are shown as follows:

San-Pédro AP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
ET _o (mm/day)	3.8	4.1	4.4	4.3	3.9	3.9	3.4	3.2	3.4	3.9	3.8	3.5

3) Crop coefficients (K_c)

Referring to the crop coefficient shown in FAO Irrigation and Drainage Paper No.24 and coefficients applied for similar projects, the crop coefficient (K_c) at each paddy growing stage is decided.

4) Percolation losses

Ponded water in the paddy field percolates into the ground. Percolation loss is estimated at 5 mm/day considering the soil types and topographic conditions of the Project Area.

5) Puddling water requirement

Considering the soil water holding characteristics and root depth of rice, the puddling water requirement needed before sowing paddy is set at 150mm. The puddling period in each tertiary block is planned to be within 10 days.

6) Effective rainfall (ER)

a. Drought rainfall

Crop-water-needs can be fully or partly met by rainfall. The dependable level of rainfall is set as selected 4 years out of 5 years. This means that the irrigation plan is made based on the drought probability being 20 % (1/5 year). It is favorable to use rainfall data of longer period in order to obtain the better results, then the drought monthly rainfall data at IDDEFOR are analyzed and drought rainfall is estimated as shown below:

b. Effective rainfall

Effective monthly rainfall is estimated based on the USA Soil Conservation method using the drought rainfall of 20 % probability at IDDEFOR-San-Pédro station between 1972 and 1998.

(Unit: mm/month)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly mean rainfall	17.5	48.3	82.9	108.0	239.7	366.0	91.4	66.5	76.2	128.4	90.3	38.8
Probable monthly rainfall	14.9	41.0	70.4	91.7	203.6	310.9	77.7	56.5	64.7	109.0	76.7	33.0
Effective monthly rainfall	14.5	38.3	62.5	78.2	137.3	156.1	68.0	51.4	58.0	90.0	67.3	31.3

7) Nursery bed requirement (NW)

Proposed farming plan of the paddy cultivation is prepared on condition that the direct sowing is applied for 50 % of the field and transplanting for the remaining. In the case of direct sowing, paddy field shall be of no ponding condition after puddling is completed. For transplanting, the nursery bed is required at 5 % of total paddy field. In the plan, 50 % of normal Kc is applied for the field of direct sowing for 20 days period immediately after sowing.

8) Field ponding water depth (PM)

Continuous water ponding of 75 mm during paddy growing period is considered up to 20 days before harvesting due to the weed control, etc.

9) Irrigation efficiency (Ei)

Considering the efficiency of the operation and maintenance of the canal, the main irrigation canal is planned to be of concrete-lined one up to the secondary canals. Referring to standards and previous experiences, the irrigation efficiency of the Project is set at 65% as shown below:

Efficiencies	Condition	Ratio
Conveyance Efficiency (Ec)	Continuous supply with no substantial change flow*	90 %**
Field Canal Efficiency (Eb)	Block larger than 20 ha, lined*	90 %
Field Application Efficiency (Ea)	Surface irrigation, basin and level border	80 %
Irrigation Efficiency (=Ec*Eb*Ea)		65 %

Notes: * ICID/ILRI, FAO Irrigation and Drainage Paper 24, ** Moritz formula for canal seepage losses:

$S = 0.0619 * C * \sqrt{Q/V}$ where S = Seepage losses (m³/sec/km), Q = Discharge (m³/sec), V = velocity (m/sec), C = coefficient (minimum for sandy loam cemented with gravel and soil pan at 0.06). Then Q=1.2(m³/sec) and V=0.8(m/sec), S=0.0045(m³/sec/km). Increase of canal length 18 km, S=0.082(m³/sec). It is equivalent to 6.8% of canal discharge.

10) Unit Irrigation water requirement

As the results of the above items and cropping calendar, the unit irrigation water requirement is set at 1.62 lit/sec/ha.

5.5.2 Drainage Plan

(1) Present Drainage System and Constraints

The drainage condition of the Project Area is generally characterized by the flood-prone nature and poor drainage capacity due to low elevation of the area as shown in Fig. 5.5.5. The floodwater of the San-Pédro river reaches sometimes the low lying areas around Grand Gabo and flows into the Gonou river and the small channels in the paddy areas together with the run-off of the Gonou river itself.

The drainage water consisting a part of flood in the upper Gonou and the San-Pédro is at present removed by gravity through the drainage channels in the area. When the previous paddy irrigation project was implemented, these drainage channels were constructed by merely improving the existing natural streams, resulting complicated drainage networks.

There are three (3) drainage channels, which directly flow into the San-Pédro river, but they do not function as expected because of the inundation along the San-Pédro river during the flood. In the eastern side of the area, there exist two (2) streams flowing into the Geranova river. This area is also suffered from poor drainage capacity because of water stagnation occurred near the conjunction with the San-Pédro river. Some flood protection dikes are constructed along the San-Pédro and the Gonou rivers to mitigate the intrusion of such flood and run-off from the outside of the paddy areas, but they are found to be insufficient.

Considering the above situation, the drainage system is proposed as follows:

- Flood protection dikes shall be provided along the northern side of the Project Area to prevent the intrusion of the floodwater from the San-Pédro river and the run-off from the Gonou river.
- In order to facilitate the drainage effects by gravity in normal time and to prevent the intrusion of stagnated water from the San-Pédro river during the flood, drainage sluices shall be provided at the drainage outlets.
- The existing drainage canals shall be improved by dredging in order to facilitate smooth flow of drainage water as well as to reduce the waste land for development.
- To reduce the drainage load in downstream of the drainage system especially in the southern part of the area, the drainage water of the northern extension area (D-Block) shall be removed directly to the San-Pédro river.

(2) Drainage Requirement

Taking into account the importance of the system and the growing of paddy, the sum of continuous 3-days rainfall of 10-year return period is employed for determining the drainage requirement in the Project Area. The unit drainage requirements for the paddy fields and the other areas are proposed to be 7.75 lit./sec/ha and 33.53 lit./sec/ha, respectively.

5.5.3 The San-Pédro Dam Intake and Grand Canal

(1) Intake

The original plan of industrial development for the San-Pédro Dam was cancelled after installation of water intake on the San-Pédro Dam in 1970s. The existing industrial water intake is planned to be utilized as the intake of irrigation water for the Project. Its structural details are obtained from the contractor of the Dam. Intake tower and its gates were confirmed by the Study Team in January 1999, but the conduits under the Dam embankment could not be confirmed. According to the workers who were the labor of intake structure in Fahé, the construction of the conduit was stopped under the Dam embankment.

Two existing old manual operation intake gates at the Dam site with dimension 1.6 x 1.3 m shall be replaced with new ones. The conduits shall be extended from the existing conduit end. After crossing existing road, a butterfly valve with box shall be installed to control intake water discharge and the discharge measurement devices such as Parshall flume shall be installed at the beginning point of the Grand Canal.

(2) The Grand Canal

The Grand Canal of 18.2 km is the conveyance canal conveying the irrigation water from San-Pédro Dam to the Project Area through the future irrigation areas of Fahé and Cpt. Colonel. Considering the operation and maintenance, the Grand Canal shall be of concrete lining. Inspection road for the operation and maintenance of the irrigation canal shall be provided along the Canal. The road is also considered as the main rural road of the Study Area transporting the agricultural products along the Grand Canal. Longitudinal profile and standard sections of the Grand Canal is shown in Fig. 5.5.2 and Fig. 5.5.3.

(3) Design Discharge and Grand Canal Section

The canal capacity is 0.93 m³/sec for irrigating 575 ha of the Project Area. Due consideration of the further extension of the irrigation area of upper reaches, the cross section of the Canal has been determined. According to the longitudinal survey results, ground slope and required canal capacity of its each section are shown as follows:

Section No.	Section	Command Area (ha)*	Required Canal Capacity (m ³ /sec)	Slope
1	Intake up to main diversion for Fahé Area	965	1.56	1/800
2	Fahé main diversion to Cpt. Colonel	665	1.08	1/1,000 4,000
3	Cpt. Colonel to Main canal of San-Pédro Paddy Irrigation development	575	0.93	1/4,000

Note : * including future extension.

(4) Related Structures

1) Canal related structures

The Grand Canal passes through many swamps and tributaries and also crosses the rural roads, resulting eight siphons, thirteen box culverts, sixteen drainpipes and two drops to be installed.

2) Inspection road and related structures

The inspection road is constructed along the Grand Canal. The inspection road has also functions as the main rural road for the villagers along the Canal. The width of the road is 6 m

and the gravel pavement is constructed at 4.5 m width for allowing the passage of two pick-up cars. Its total length is almost the same as that of the Grand Canal.

5.5.4 Irrigation Facilities

(1) Irrigation Canal

1) Arrangement of irrigation canals

Net irrigation area is 575 ha. It is divided into four irrigation blocks. A-block is located in the western part covering 64 ha. B-Block is located in the central part covering 194 ha. C-Block is located in the eastern part covering 227 ha. D-Block is located in the northern part covering 89 ha. The water measurement devices such as the Parshall flume are installed at the first diversion structure of each block. Irrigation schematic diagram is shown in Fig. 5.5.6. Almost all the primary and secondary canals are aligned as same as the existing canal route (Fig. 5.5.5). Total lengths of the canals are 5.7 km of the primary canal, 7.5 km of the secondary canals and 20.1 km of the tertiary canals.

2) Canal section

Primary and secondary canals are of concrete lining for reducing the conveyance loss and O&M cost of irrigation canal. Tertiary canal with the irrigation command area less than 30 ha is the earth canal. Canal design capacity shall be 1.62 lit/sec/ha as stated in section 5.5.1.

(2) Irrigation Canal Related Structures

Diversion works with the steel gates, check structures, turnouts controlled by small slide gates, measurement devices of mainly Parshall flume type at the beginning of secondary canals, spillways, pre-cast concrete pipe culvert crossing under the roads and canal crossing farm road bridges are the main irrigation canal related structures. Most of the existing structures need repair/re-insulation because of deterioration of the existing ones and change of canal structure from earth lined ones to concrete lined ones.

(3) Operation and Maintenance (O&M) Road

O&M roads of primary and secondary canals are considered as the main farm roads. They are planned to be of gravel surfacing with effective widths of 6.0 and 4.0 m for the roads along primary & secondary and tertiary canals, respectively. Existing O&M roads are under rather better condition and to be improved under the Project.

5.5.5 Drainage Facilities

(1) Drainage Canals

The present drainage channels shall be improved by dredging to facilitate the drainage effects as well as effective land utilization. As shown in Fig. 5.5.7, the present complicated drainage network should be simplified to enable effective drainage. The drained water in D-Block shall be removed separately to the San-Pédro river by constructing new drainage canal, and that of eastern part of the area (a part of C-Block) shall be removed toward the Geranova river by improving the existing drains. The drainage water of the remaining areas (A-Block and B-Block) shall be removed to the San-Pédro river directly, and the existing three (3) outlets shall be gathered and unified. The approximate distances of the proposed drainage canals are tabulated below:

No.	Category	Distance (km)
1.	Main Drainage Canals	3.4
2.	Secondary Drainage Canals	10.3
3.	Lateral Drainage Canals	20.1

(2) Road and Canal Crossing Structures

Drainage culverts and cross drains shall be provided as required. The required number of such crossing structures on the main and the secondary drainage canals are tentatively proposed as fourteen box culverts.

(3) Flood Protection Dikes

There are some flood protection dikes along the San-Pédro and the Gonou rivers to prevent the area from the intrusion of flood water. To make such protection from the flood intrusion completely, it is proposed to provide some additional dikes especially along the Gonou river. The existing dikes shall also be repaired and heightened. The proposed locations of protection dikes are indicated in Fig. 5.5.5. The total length of the proposed dikes is to be about 670 m.

(4) Drainage Sluices

Drainage sluices are proposed to be constructed in order to facilitate the gravity flow in normal time as well as to prevent the flood water intrusion from the rivers during the flood. Sluice gates and/or flap gates shall be equipped on drainage sluices depending upon the required discharge of drainage flow. Two (2) drainage sluices and eight (8) flap gates are proposed to be provided as indicated in Fig. 5.5.5.

(5) Drainage Facilities on the Grand Canal

Since the Grand Canal of 18.2 km passes from north to south in parallel with the San-Pédro river, it crosses many streams and tributaries. To facilitate the original drainage function as well as to avoid the disturbance on these drainage, cross drainage structures are proposed to be provided including drainage culverts and siphons. The sizes and dimensions of these cross drainage structures are planned based on the flood flow estimated on the probable rainfall of 10-year return period.

5.5.6 On-Farm Development

(1) On-Farm Works

On-farm works include the tertiary canal and drains, diversion box, farm roads and land consolidation. Considering group cultivation especially land preparation by power tiller and standard holding area of the farmers, the standard area of tertiary block is determined as 15 ha. Considering the application of mechanized farming, the standard lot of paddy field is set at 0.3 ha (100m x 30m) as shown in Fig. 5.5.1.

(2) Land Leveling

Most of the reclaimed paddy field in the Project Area is incomplete. Therefore, the land leveling works shall be implemented in all the paddy field in the Project Area. The leveling shall be implemented based on field survey in each lot, and the surface soil handling shall be applied to avoid uneven growth of rice at the initial cropping period. Considering the weed control, the ponding depth during paddy growing period is set at 7.5 cm. Therefore, the degree of leveling

shall be ± 7.5 cm in each plot. According to the sample survey, the undulation of existing paddy field ranges between ± 12.5 and ± 20.5 cm after dividing into the proposed field lots of 0.3 ha. Careful survey for determining the field elevation shall be made during the detailed design stage.

(3) Tertiary Canals and Related Structures

According to the sample area measurement, the tertiary irrigation and drainage canals and related structures are estimated as follows:

Tertiary Facilities	Quantity per ha
Irrigation Canal	35 m
Drainage Canal	35 m
Related Structures (Turnout)	0.17

5.5.7 Operation and Maintenance Plan

(1) Operation and Maintenance Works

O&M works for irrigation system consist of 1) water management, 2) facility maintenance and 3) administration as shown below, and locks for the opening at each gate of diversions and inlets shall be installed for the strict distribution of the irrigation water based on the irrigation rotation plan.

O&M Works	Items	Contents	Proposed Work Interval
Water Management	Decision of Water Distribution	To collect the information of water requirement from farmers and to decide the water distribution plan and water supply plan after adjustment of water amount and period	Every crop season
	Irrigation Water Supply	To operate the irrigation facilities based on the water supply plan	Every day during irrigation
	Observation	To observe the water use condition by a periodical patrol	Every day during irrigation
Maintenance of Facilities	Inspection	To inspect function, water leakage, facility injury, etc. and to make repair plan of facilities	One time each before and after irrigation period and every time for watching
	Repair /Replacement	To repair the facilities based on the repair plan	Proper time based on the necessity (basically once after the irrigation period)
Administration	Irrigation Fee Collection	To decide the water fee in consideration of required fund for O&M cost and farmers' payment capacity and to collect the irrigation fee	Every crop season

(2) Water Users' Association

All farmers' organizations in the Grand Canal command area shall formulate a Water Users' Association (WUA) for the O&M of irrigation and drainage under the supervision of the Project Office. Some parts of facility maintenance are to be carried out by private enterprises on contract basis. O&M of the irrigation and drainage system in the Project Area shall be implemented by member farmers under the control of the Irrigation Committee of COOP. Considering the extension of irrigation area at Fahé and Cpt. Colonel, the O&M of Grand Canal shall be made by the farmers employed and controlled by the WUA.

5.6 Agricultural Supporting

5.6.1. Agricultural Supporting Services

(1) Agricultural Equipment and Inputs

The following agricultural equipment with spare parts and inputs shall be purchased through KR-II and ANADER:

- Power tiller (14 CV) : 60 units
- Spare parts: lump sum
- Sprayer: 366 units (383 farmers -- 17 farmers)
- NPK (10:20:20): 120 tons (210 kg/ha x 575 ha)
- Urea : 60 tons (105 kg/ha x 575 ha)
- Herbicide: 5,750 lit. (5 lit/ha x 2 x 575 ha)
- WITA 7: 9.6 tons (50 kg/ha x 192 ha)
- WITA 8: 9.6 tons (50 kg/ha x 192 ha)
- WITA 9: 9.6 tons (50 kg/ha x 192 ha)

It is proposed that the arrangement of the above rice seeds is done by ANADER, San-Pedro; that is, ANADER produces the necessary amounts of seeds at the training and demonstration fields combining with farmer's training.

(2) Farmer's Training

The following the three training programs are enforced. The details of the training program are explained in 5.6.5.

- Training of extension workers at CFMAG
- Training of machine operators at CFMAG
- Training of farmers at the Project Area

(3) Technology Extension by ANADER

ANADER is considered to be the sole organization capable of providing the agricultural extension services to the farmers in Côte d'Ivoire. Therefore ANADER is expected to take responsibility on the technology extension services to the farmers, the most important activities in the Project.

(4) Preparation of Farming Funds

Prior to implementation of the Project, at least the following farming funds shall be arranged:

Item	Quantity	Unit Rate	Cost (F.CFA)	Remarks
Power tiller (14 CV)	60 units	3,000,000	180,000,000	Cost w/o spare parts
Manual sprayer	366 units	35,000	12,810,000	
NPK (10:20:20)	120 tons	190,000	22,800,000	
Urea	60 tons	170,000	10,200,000	
Herbicide	5,750 lit.	6,000	34,500,000	
Total			260,310,000	

Notes : Repayment period Power tiller (14 CV): 5 years (F.CFA 600,000/year/unit x 5 years)
Others: 6 months to 1 year.

(5) Technical Assistance by Rice Expert

Technology transfer to the new settlers who have scarcely any or no experience on irrigated rice cultivation is very important to the success of the Project. Through the demonstration of high-yielding crop situations and best farm management practices such as land preparation and weed control by establishing demonstration plots, appropriate technology shall be transferred to them. For the success of the farmer's training and the demonstration activities, effective support of foreign rice experts is indispensable.

5.6.2 Farmers' Organization

With the promulgation of the new law of 97-721 relating to COOP, the old law of 77-332 was abrogated on which the juristic persons of the present GVCs are based. A transitional period of three years will have been passed by December 2000. The proposed COOP must fully conform to the new law.

(1) Proposed Organization

Taking the prospect of having about 400 households in the Project Area into account, then considering the size favorable to negotiate a loan with a third party or to be the guarantor of the members who want to loan money, a single COOP for the entire Project Area may produce an optimum situation. Every participant of the Project shall be its member. In the final established stage, the organization of the COOP of Cité Agricole would look like an example given in Fig. 5.6.1, though future circumstances surrounding the Project may dictate a certain necessary compromise here and there within the room provided by the new COOP law.

1) Basis of livelihood

The entirety of the COOP will consist of four or six (when the two bigger blocks are divided into two each) basic functional units, which are formed of between 60 and 90 owners of paddy fields located along the main canals of the Project. A formation of sub-units will be required to facilitate fair distribution of water along the length of the tertiary canal network and to make the teamwork in a unit area, which is created due to a staggering period of farming calendar. Original residents who have been persevering with the farming will form the nucleus of the new unit to guide settlers, making use of their experience as well as their tenacity.

Six committees are proposed to be set up to secure smooth operation of a rice double cropping. Each of them shall deal with affairs on irrigation, paddy farming, machinery, agricultural input, marketing and arbitration. Each committee handles both internal and external affairs (responsibility of negotiation with any third party rests upon vice president in charge) relating to its subjects. At unit level, committee members shall be equal in number at first, and every member shall belong to one of them. At COOP level, each two elected members from the one at unit level form each of committees. Each committee elects chairman to represent itself in the directors' board. Each committee deals with daily affairs which are under its jurisdiction approved by the general assembly.

- a) **IRRIGATION COMMITTEE:** It will establish the rules on the use of water aiming at its fair distribution, rights and responsibilities of users; they include providing the manual of O&M of the canals (including the Grand Canal), setting the irrigation water rate and pre-

fixed O&M cost, overseeing their collection and O/M works, regular and contingent, and coordinating labor requirement with the Farming Committee.

- b) **FARMING COMMITTEE:** This Committee will be responsible for organizing the contact groups for ANADER, propagating necessary farming information acquired through ANADER and CNRA or members, and encouraging research and development activities among members. It will manage a mutual labor exchange at the time of transplanting and harvesting, coordinating labor requirement with the Irrigation Committee.
- c) **MACHINERY COMMITTEE:** This is a transitional set up to help the negotiation between 60 members of the COOP who will be owners of cultivators and the dealers smoothly under the PNR supervision in buying cultivators through KR-II channel. To provide owners with a part time job of repair and maintenance of machines may at first be carried out under its guidance to augment the dealers' aftercare service.
- d) **INPUT COMMITTEE:** An existence of a COOP of almost 400 membership with almost 600 ha of paddy field under rice double cropping has corresponding negotiating power over the purchase of agricultural inputs. If inputs be bought by the arrangement of KR-II, the PNR would be instrumental to get a favorable deferred term. Purchase in bulk involves repackaging and warehousing. This service with created discount price, which is to be overseen by the Committee, shall surely entitle the management of the COOP to get commission from the members.
- e) **MARKETING COMMITTEE:** It will negotiate the sale of paddy with the established national mill operators, which usually join forces with transporters and wholesalers. Destiny of this Committee will depend on the marketing strategy, which will be taken by the COOP. The Committee could promote the positive course to be taken by the COOP.
- f) **ARBITRATION COMMITTEE:** It will give verdict to enforce internal regulations stipulated by the statutes of the COOP or internal rules approved by the general assembly, such as on the compulsory minimum sales volume to the COOP by the members. It advises the executives to take a step to follow it, as a judge in a trial by jury does. The decision may sometimes involve the exclusion of any offended member from the COOP; in that case, the article 27 of the COOP law is to be referred to.

2) Welfare of community

Voluntary groups are formed within the COOP and registered as such to the secretariat of the COOP. Through their activities, it is hoped that they will increase the feeling of amenity in the village life and mitigate the tension in a multi-ethnic society.

3) Council of administration (COA) = Directors' Board

Fig. 5.6.1 gives the gist of the COA. It consists of representatives from four blocks of the Council, the executives, chairmen of six committees, representatives from the voluntary groups and the auditor-cum-legal advisor. Four executives are elected directly by the general assembly. The article 15 dictates that president and a vice president (VP) in charge of daily affairs are again elected by the COA members. Another VP is in charge of accounting and the third VP in charge of external affairs. Voluntary groups will be represented by three COA members, one of whom, at least, is a woman. The functions, duty and corresponding power of the board is clear-cut as prescribed in the COOP law. Though the article 14 of the COOP law prescribes that the functions of administrators be without a fee, actual time spent for the execution of his duty would be compensated on cash terms. A professional accountant and a professional secretary shall be employed. Remuneration for auditor-cum-legal advisor shall be budgeted.

(2) Preparatory Committee of Founding COOP (PCFC)

The Project Office shall work for formulation of the Preparatory Committee of Founding COOP (PCFC) for the Project in the early stage of the Project implementation, and during the construction period of the Project shall execute a special series of training of the new settlers and farmers who will take an active part in the farming practice in irrigated paddy field. Besides its original objectives, matters of utmost concern of the PCFC include the formulation of a Water Users Association (WUA) of the Grand Canal with the other interested parties along it under the supervision of the government concerned, as it is obviously a lifeline to the villagers. The association shall provide the legal foundation to define the rights and duties of the parties concerned on which collaboration and cost sharing with each other on the O&M of the Grand Canal will be negotiated.

5.6.3 Farming Funds

Before starting the rice farming in Cité Agricole as the farmers, all the new settlers have to have their own house to live, a few scores of farmers have to buy cultivators at their own risk, and all of them have to buy agricultural inputs before the first trial. The first two cost them in the order of F.CFA 3 million each, and the third around 300 thousand F.CFA. It is obvious that few could afford to do without relying on loan. Yet, to begin with, they must have some F.CFA 100 thousand for down payment to house, water rate and contribution to create a COOP, which will act as their main guarantor, before the lenders are invited to negotiate. Here is a sketch for three aspects of future cash flow of those who will cast in their lots with the Project.

(1) Capital Formation by Their Own Hands

Construction works for the Project are estimated to involve about 83 thousand unskilled labor during the period of two years (114 man-day on average for 730 days). A net daily wage is estimated at F.CFA 2,850, which is around three times more than ordinary agricultural wage. If one saves two thirds of one's daily wage, an accumulated amount of saving would reach F.CFA 300,000 after 158 days of labor. On the other hand, at a rough estimate, if all the 383 members of the COOP give a laborer each to the construction works for 158 days, 73 % of the total unskilled labor would be allocated to the major future beneficiaries, which looks reasonable.

(2) COOP as a Guarantor

The COOP proposed in section 5.6.2 would act as a guarantor to its members who want to get loans for their basic capital requirements in the new life with the Project in Cité Agricole. So, the existence of this COOP with 383 membership should be the first to be realized to help the members establish themselves in their new places or fields. The COOP's initial base fund consists of contribution of the members. Then the cash sources required to run its office relies on the commission derived from the sale of paddy and purchase of input. Table 5.6.1 is an example of financial records of the COOP at its initial stage.

(3) Financial Institutions

1) Housing fund

All the selected new settlers' households are to be provided with the leveled housing lot of some 600 m² by the GOCI. Municipality and village council will facilitate the process of registration for domicile and other administrative and legal matters by opening an information cum reception desk at Campus II of Cité Agricole. As to accommodations, among the selected

relatively well-off new settlers and those who have supports from relatives of his/her original town may be able to build their houses by their own resources. The majority will need funds to build it, to which '*Fonds de Soutien à L'habitat (FSH)*' will be able to give a low-interest housing loan. The procedures of obtaining the loan for rural housing are as follows:

- i) to form a cooperative of between 10 and 30 membership,
- ii) to submit technical papers on the housing projects,
- iii) to submit financial papers on the housing projects,
- iv) to have cash equivalent to 5% of the cost of building as the initial capital,
- v) to have cash equivalent to 5% of the cost of building as pledge, and
- vi) to take out life insurance.

The conditions of the loan are as follows:

- i) the maximum amount: F.CFA 5 million including tax,
- ii) interest rate : 2% (variable),
- iii) the maximum duration of amortization: 15 years,
- iv) guarantee by an agricultural COOP to which the borrower belongs, and
- v) the maximum period of construction works is 8 months.

If a farm house costs a household F.CFA 3 million, a one-time down payment will be 300 thousand at the beginning, then amortization 180 thousand, and interest payment 54 thousand at the end of the first year.

2) Cultivator

One in seven households is required to have a cultivator to create an optimum situation in coping with the paddy farming schedule, taking its capacity and price into account. As is the case with building of accommodation, the selected relatively well-off new settlers who have savings or pensions and those who have supports from relatives of his/her original town will be entitled to be one of the '*Paysant avec Motoculture (PPM)*' by buying the cultivators through the arrangement of KR-II. The majority will need funds to buy them. PNR, which has been managing the process of distribution, could be of instrumental to their negotiation.

Those who do not need to spend the saved F.CFA 300 thousand for their housing purposes, mostly the present residents of Cité Agricole, could be the candidates to be the owners of the cultivator. By rendering service of plowing to six satellite farmers, the owner can claim F.CFA 1.08 million a year. Half of it will go to installment and the other half for depreciation. Interest aside, with adding 120 thousand from their own pocket, they will be able to pay back the debt in five years time, while the redemption fund will be ready at the same time for trading a new ones. From that time onward, all the money earned by extracting useful life from the cultivator will become net profit to them.

3) Agricultural input

During the initial year of the Project, input will have to be bought either on credit or using a low-interest input loan. As major part of input can be bought through the arrangement of the KR II, the PNR, which has been managing the process of distribution, could also be helpful to their negotiation. Some of private sector initiatives are found even now in lending short term money

to agriculturists. One of them is '*Fonds Ivoirien de Developpement et D'Investissement (FIDI)*'. The conditions of the loan are as follows:

- i) the maximum amount : F.CFA 50,000
- ii) interest rate : 15% per year
- iii) term of the loan : 4 months
- iv) guarantor is required

5.6.4 Agro-industry and Agricultural Marketing

(1) Agro-Industry

Post-harvest processing of paddy starts from its timely drying and then proper warehousing after weighing and bagging, which are very important to achieve the best quality rice. Agro-industry in relation with paddy farming, therefore, includes rice milling (both threshing of paddy and polishing of brown rice) and parboiling. Both activities in the context of local market area is within the reach of small enterprises, and any private initiative is welcome. At present some small mills are found in the vicinity and some amounts of parboiled rice are made at farmers' individual household, though their quality is poor. On the other hand, the proposed COOP in its initial stage will have to be preoccupied in selling the harvested paddy prior to contemplating further means of adding value to its produce. Only when the quality of paddy become stabilized, the COOP will be in a position to ponder over its competence to go into the business of rice milling. Milling of 3,000 tons of paddy at a time, twice a year, is not at all an easy task to handle. Milling of 250 tons of paddy for domestic use, however, will surely attract small entrepreneurs. Parboiled rice has always secured niche markets because of its value-added properties of nutritiousness and easiness to store without losing quality, though extra heating sources are required for processing.

(2) Agricultural Marketing

In the marketing of paddy, the final scope is to establish its own brand-name in polished rice market, like 'SUN' of Australia, for example. It requires good planning, excellent quality control and targeting the niche market. Therefore it is still too early to have a control unit of production in the Marketing Committee. The commodity of the sale being paddy in bulk, it is recommended that the COOP concentrate its effort to raise and stabilize the quality of paddy by regulating/controlling the drying process and storing process as the first step. Probable strategy may be to approach big scale buyers on blanket contract with as much volume as possible. Its contract had better be pre-arranged by assessing the quality at the paddy field when it is ripen. Meanwhile, small-scale local mill operators can meet the demand for threshing and polishing for domestic use.

There always exists tendency of over-investing in drying and storing, because all the year round the facilities are idle except for the twice a year peak periods. In the investment plan, removable arrangement or alternative use be planned so that it can be used by other purposes when the lot is vacant, like drying tree crops or storing agricultural inputs.

5.6.5 Training Plan

(1) Basic Concept of Demonstration and Training

The present level of farmer's rice cultivation technique is extremely low and the new settlers mostly have no experience for irrigated rice farming. Moreover, ANADER has no extension worker who has the required knowledge and experience for irrigated rice cultivation. On the other hand, irrigated rice double cropping cultivation requires precise water management and scheduled cropping and high-yielding cultivation technology. The Project also needs to train power tiller operators, as mechanical land preparation will be introduced. The farmer's training is basically field practice training carried out in a 30 ha of the training farm, and the operator's and extension worker's training are lecture and practices carried out at CFMADG. The demonstration activities are carried out at farmer's fields in the Project Area so as to demonstrate the outcome of the recommended technology.

(2) Farmers/New settlers Training

Training of farmers / new settlers (383 persons) is to be carried out in a 30 ha a training farm, with pump irrigation facilities, during the period from February 2002 to February 2003 before the completion of field preparation of the Project Area as described below:

1) Target of training

The target of training is to give farmers experience for high yielding irrigated rice cultivation technology through field practices.

2) Contents of training

Training consists of field practices and brief site lectures. Each trainee can get experience for recommended rice cultivation techniques throughout a whole rice-growing period in the assigned paddy field of 0.15 ha. The costs of necessary inputs for the rice cultivation such as fertilizer, herbicide, pesticide and land preparation by power tiller are to be paid by the trainee themselves after harvesting the paddy. The product obtained from the 0.15 ha lot belongs to the trainees. The main practices to be trained are as follows:

- Preparation of quality seed (selection of seed, pre-germination of seed, disinfection of seed)
- Establishment of nursery
- Raising of seedling
- Land preparation (plowing and puddling)
- Transplanting
- Application of fertilizer
- Weed control
- Disease and pest control
- In-field water management
- Harvesting, threshing and drying of harvested grains

The main lectures are:

- Knowledge of scheduled rice double cropping
- Mutual use of agricultural labor
- Irrigation system in the Project Area

- Scientific explanation of each farm practice

3) Training schedule

Technical direction for cultivation practices and brief site lecture for rice cultivation technology are to be carried out by two (2) extension workers of ANADER, San-Pédro specially trained at CFMAG and possibly by foreign rice experts. The training schedule is given below:

Batch	No. of trainees to be received	Period of training	Cropping season
1	48	March/16 – July/28 (135 days)	1 st season
2	48	April/01 – Aug/13 (135 days)	1 st season
3	48	April/16 – Aug/28 (135 days)	1 st season
4	48	May/01 – Sep/12 (135 days)	1 st season
5	48	Sep/16 – Jan/28 (135 days)	2 nd season
6	48	Oct/01 – Feb/12 (135 days)	2 nd season
7	48	Oct/16 – Feb/27 (135 days)	2 nd season
8	47	Nov/01 – March/15 (135 days)	2 nd season
Total	383	March/16, 2002 – March/15, 2003	

(3) Training of Extension Workers

At least two persons are needed to work as full time agricultural extension workers in charge of the Project Area. Therefore, prior to the above farmers /new settlers training, two extension workers of ANADER, San-Pedro are to be selected and specially trained at CFMAG on theoretical and practical aspects of mechanized irrigated rice cultivation.

(4) Demonstration

1) Demonstration plot

Field demonstration is also important as same as training so as to confirm the results of the input technology by farmer's own eyes. The demonstration is performed using the actual farmer's farmland in the Project Area as follows:

Scale	Demonstration
1 plot for each field lot of 0.3 ha	Rice double cropping by transplanting
1 plot for each field lot of 0.3 ha	Rice double cropping by direct sowing
1 plot for each field lot of 0.3 ha	Vegetables (tomato for the 1 st season and lettuce for the 2 nd season)

The demonstration activities for vegetable cultivation have to be carried out carefully with technical support of CNRA.

2) Input and output

The farmer who provide the demonstration plots have to offer the necessary labor force and input materials under the guidance of the extension workers. All the outputs belong to the farmers. Extension workers collect the necessary data for technical and economic analyses of the demonstration plots.

(5) Required Facilities

The training activities discussed above shall be conducted in the training farm of 30 ha proposed to be constructed in the Project Area, and the irrigation to such farm lands shall be made utilizing the existing pumping facilities and the training activities shall be started in parallel with the start of the construction of the Project facilities. The training of the farmers/new settlers will have to be completed within a limited time, and the farmlands used for

the training shall be returned to the farmers and/or settlers as the ordinary farmland for the full-scale operation.

1) Location of training farm

The training farm of 30 ha is proposed to be located at the northwestern corner of the western block, considering the access from the present village area as well as the existing pumping station.

2) Irrigation Facilities

One of the existing pumping units is proposed to be utilized for the irrigation of this training farm. Considering the limited period of such training, the minimum extent of repairing shall be made for the pumping unit. Irrigation canals and related facilities shall be constructed for irrigating 30 ha farmlands rehabilitating the existing irrigation canals. About two-(2) km of tertiary-level irrigation canals shall be constructed to distribute the irrigation water properly to each trainee's farm lot.

3) Land preparation

The land leveling is one of the most important works in preparing the training farms. The leveling shall be conducted for each farm lot of 0.3 ha with the same preciseness as that of full-scale operation.

4) Other related facilities

Roads and drainage canals shall also be constructed so as to provide a situation compatible to the farming in full-scale operation after the completion of the Project.

5.7 Settlement Plan

5.7.1 Settlers Requirement

383 farmers are expected to cultivate 1.5 ha of paddy field in the Project Area. Presently 92 farmers live in the Project Area. The remaining 291 farmers including the farmers not living in the Project Area but having lowland in the area will be received in the Project Area as the new settlers.

5.7.2 Selection of New Settlers

On the qualification of the new settler, the 1st priority is given to the farmers holding lowland in the Project Area at present. As the 2nd priority, the qualification is given to the family who has more than three agricultural labors from 18 to 50 years old with healthy body, and also given to the group composed of three volitional young men/women to the rice farming in this area. All the new settlers are obligated to produce the minimum yield of 4.0 tons of paddy per ha per season. If the settler can not get the minimum yield without a valid reason, he/she must obey special technical advice of the extension workers, and if he/she can not get the minimum yield again in the following season, he/she is to lose the qualification as the settler. It is considered that judging from technical and social consciousness levels of the farmers in this country, an establishment of such a regulation is one of the key factors for the success of the Project. In fact, the farmers of Sakassou project, which is one of the most successful paddy development projects in Côte d'Ivoire point out the importance of such regulation for the success of the project

5.5.3 Distribution of Paddy Field

The total 575 ha of cultivable land of rice double cropping composed by 4 irrigation blocks are to be distributed to 383 settlers with 1.5 ha paddy field each. The new settlers presently living in the Project Area or near the Project Area are entitled to receive lots in the nearest irrigation block. The farming net income will be largely increased with the introduction of more profitable vegetables such as tomato and lettuce. The 1.5 ha of paddy field is composed by 5 field lots of 0.3 ha each which is a proper size for mechanical land preparation. In the case of introducing vegetable, the field plot is to be separated by levees. The proper area for vegetable cultivation is around 0.1 ha per farmer.

5.7.4 Development of New Settlement Area

(1) Selection of New Settlement Area

Area for the new settlers is proposed at the non-irrigable gentle hill areas adjacent to the paddy field as shown in Fig. 5.7.1. Based on the average area of 1,300 m² per house in Campus II of Cite Agricole, including the community facilities such as school, new settlement area totaling 35 ha can absorb 291 householders, and together with existing householders, the total of 383 householders can live in the Project Area.

Category	Village or Area	Area (m ²)	Average Area (m ² /house)*	No. of Householders	Remarks
Existing Villages	Grand Gabo	-		27	
	Campus I	-		5	
	Campus II	79,000	1,300	60	including the community facility
	Sub-total			92	
New Settlement Area (proposed)	Settlement (1)	204,000	1,250	162	
	Settlement (2)	26,000	1,000	26	Eastern extension of Campus II
	Settlement (3)	40,000	1,000	40	Southwestern extension of Campus II
	Settlement (4)	80,000	1,250	63	Southern out-skirt
	Total	350,000		291	
Total				383	

(2) Development of New Settlement Area

As a result of the settlement of new farmers, some new villages are to be created in the Project Area. The following lessons drawn from the precedent experiences of Cité Agricole will be helpful to the project when a new community is about to be created again by gathering the people with different social background.

- a) Residential lots will be distributed to each villager by drawing lots regardless of nationality, ethnic group and home village so that the villagers will have more contacts with the "others".
- b) The transmission of official information should be well systematized both in an area and among areas in order that information be distributed to all the villagers impartially. This system will be based on communication unit composed of 15 to 20 households and the channels of information between the village chief and each unit will be drawn clearly after the settlement. The information related to the interests of all the villagers should be transmitted directly from the concerned administration services or the Project Office to the villagers by organizing a villagers' meeting. In any case, it is essential to get rid of partial distribution of information.

- c) The events which can involve all the villagers, such as harvesting festival, rice-planting competition and football game, will be held by the villages in cooperation with the Project Office in the beginning. The organization of the events will be transferred gradually to the villages as they take root in the villagers' life.
- d) The shade of trees provides a place of relaxation for the villagers. Therefore, big trees should be left for the community, remaining intact at the time of the site preparation.

(3) New Community Infrastructure and Facilities

1) Community roads

Community road with side ditches shall be of 3 m width, simple gravel paved, shall be constructed in new settlement area connecting with existing rural/farm roads.

2) Community water supply

Totally 4 tubewells for the rural water supply shall be provided in the settlement area at 500 persons/well. At the initial stage of the Project, the minimum 2 wells shall be constructed by the Project, and the remaining shall be installed by the villagers applying the AfDB Rural Water Supply Project and FRAU.

3) Community center

In the new settlement areas where more than 50 households are settled, the site for community center will be reserved near the crossroads at the planing stage. The community center shall be as simple as one in traditional village and built by the villagers themselves.

According to the result of survey, the number of preschool children (0-6 years old) per family is around one on average. In each residential unit, simple village day-care service shall be set up by organizing women in the unit so that mothers not bring their small children to farmland. The service shall be provided by some of the women taking their turn in the unit or paid baby-sitter. Women just before or after delivery or primary school girl on vacation can take charge of this service. And in case of employing aged and/or sickly women, it will lead the weak to have a role in the community. At the beginning, villager's house or shade tree will be used for the service.

Most of the women interviewed during the survey strongly hoped to have literacy lessons. They recognize that "letter" is indispensable to manage their organization and to have access to several supporting services. Young volunteers gave them some literacy classes but they have ceased due to lack of both teaching materials and their teaching skills. There is no NGO for literacy activities in San Pedro but private teaching groups charging some fee for the lessons. The Project plans to give the villagers literacy lessons at their own charge by making use of the private groups and the primary school or community center as facility.

5.8 Social Development

5.8.1 Rural Infrastructure Improvement

(1) Rural Road

The inspection road along the Grand Canal is considered as the main rural road penetrating the Study Area. Other O&M and farm roads along irrigation canals in the Project Area have functions as the rural and community roads. They need rehabilitation such as leveling the

undulated road surface and gravel pavement. Community and access roads in the settlement areas are required to be constructed by the Project.

(2) Rural Water Supply

Existing villages in the Project Area have no rural water supply system. There is a tubewell and a water tank constructed by CIDV but not watered yet in Campus II of Cité Agricole. These facilities are to be developed by the villagers themselves.

5.8.2 Social Development

(1) Women's Paddy Cultivation Support Program

Men as mentioned earlier have mostly managed incomes earned from irrigated paddy cultivation, and women have almost no income source from which they earn disposable money for themselves. In this Program, women's work shall be organized in order to establish a system of earning income through their work, which has been carried out individually or within the community members without payment. In addition, through the process of getting out of old fixed idea of (irrigated) lands belonging to men, Program aims to help women manage lands and farm by themselves, thus obtain economic and mental independence by their own efforts. Organization of women in rural communities shall be carried out in three stages as shown below:

1) 1st stage: Form women's working groups in each irrigation block and create the source of income by contracting farm work

Volunteer women are recruited from each irrigation block, and they are formed into working groups of 10-15 each (it is desirable to include at least one Sénoufo woman or those who have experience in irrigated rice cultivation). Each group shall have a head, a sub-head, an accountant and a technical leader. The head carries out external affairs such as negotiation with other groups or farmers, that is, their clients. The sub-head performs coordination activities within the group. Working schedule shall be purchased and managed by these two leaders. The accountant manages fund, which will be used for mutual aid or diversification of their work. The technical leader has a role of transmitting techniques learned from ANADER or skilled farmers to other members. Price of contract farm work will be decided through negotiation between the group and individual farmers, and gained profit will be divided equally among participant members. As a basic rule, payment should be made in cash, avoiding the payment made in the form of products or returned labor. In each agricultural season, each member deposits certain amount in group's account to accumulate the joint fund.

2) 2nd stage: Joint upland field management by working group and diversify the source of women's income

Groups shall start upland cultivation when the production of the irrigated rice of each household becomes stable. Land preparation, purchase of agricultural inputs and sale of products are to be carried out jointly, but each member has to manage her own plot and the profit obtained from each plot belongs to the individual member. At this stage, the women's groups are involved in the supporting activities for school lunch; cultivation of food crops other than rice and vegetables in order to supply them school lunch at a low price.

3) 3rd stage: Joint irrigated plot management

For women's groups performing excellent contribution to school lunch activities, joint plots shall be given inside irrigated areas in consultation with COOP that manages the land, and the women's groups will cultivate and manage the plots by themselves. They will enjoy the same responsibilities and privileges on the plots as the COOP gives to member-farmers.

(2) School Lunch Assistance Program

With the aim of lightening the burdens of mothers who have to go home to prepare lunch for their school children by stopping their farm work, Cité Agricole has been giving school lunch with the help of WFP since 1989. WFP is providing rice and other materials free of charge, and paid-cooks (village women) are preparing lunch for up to 100 pupils a day. As mentioned in 3.3.3, for the withdrawal from school lunch program, WFP is trying to organize village women in cooperation with Regional / District Inspection Office, aiming at self-management of school lunch by village. This Program shall be carried out in partnership with concerned organizations to provide other villages with a good model and it consists of the following four actions to lead the villagers gradually to complete self-management.

- Establishment of self-management system within PTA (reinforcement of existing committee)
- Complete supply of paddy at a modest price by COOP (about 9 tons/year)
- Supply of cheap materials for lunch (through vegetable cultivation in upland fields by the above mentioned women's groups and the pupils' association, or at irrigated fields by COOP and contractual farmers)
- Supply of protein sources (through poultry and/or fish raising by PTA, women's groups and the pupils' association)

400 meals in two schools on average (250 meals for existing one, 150 for new one) a day with 150 school days a year making total of 60,000 meals per year will be served to pupils when the Program achieves its aim.

(3) Pupils' Activity Support Program

About 20 % of the primary school pupils in Cité Agricole go to secondary schools. The rest of them have to work as trainees in vehicle maintenance shops or sawmills in San-Pédro, or help their parents in the farm. During peak farming seasons, children are regarded as important family work force in rice planting work together with female members. The Program proposes the following plans as part of extra-curriculum activities managed by the school in order to improve children's knowledge and skills in farming, thus revitalizing the pupils' association.

- a) Guidance in paddy planting techniques: Technical extension workers of ANADER teach paddy-planting techniques to children in demonstration farms. By grouping children and introducing playing elements such as competition in work speed or correctness of works, children will be taught the paddy cultivation without the image of hard work. Pupils can also study natural science through observation of growing paddy and actual work in the farms.
- b) Pupils' garden: Outside the irrigated area, vegetable gardens managed by pupils' association are established. With the help of PTA and teachers, annual cropping schedule

is planned by pupils themselves. The products are sold to villagers or used for school lunch. And its profits are pooled as the pupils' association fund.

- c) Formation of paddy-planting children's groups: Wednesdays (no school days) in peak farming seasons are named as "self-activity days for pupils' association" and each ten-member group of children practices contractual farm work in the farmers' plot. PTA whose member are also farmers acts as an intermediary between the pupils' association and client-farmers. Maximum ten groups from two schools in a day can be dispatched, and the profit goes to pupils' association¹⁾.

(4) Educational Facilities Improvement Program

In addition to the existing school, a new school with six classrooms is to be opened in the new settlement area. Then, bigger chance of education will be provided to the children of newly settled families. The result of village survey indicates that education of children is one of the most serious matters for the families who live in the villages without school especially in the remote hamlets located near the planned Grand Canal. Assurance of access to the education, therefore, can be one of the motivations of these families to join the Project and settle themselves in the Project Area. It is presumed that some 400 families including the existing families will use these two schools; i.e. 250 families for existing school and 150 families for planned new school. Construction of the school facilities may be requested to FRAU by Village Committee through Municipality Office, while 27.5 % of the total (equivalent to F.CFA 15.8 million) are to be shared by the villagers. Maintenance and management of school facilities of the new school are carried out by PTA like that of existing one.

(5) Clinic Rehabilitation Program

Cité Agricole belongs to San-Pédro medical unit and is assured of medical treatments with medical facilities of the Municipality. However, with the implementation of the Project, the Project Area will have big villages having 383 families with some 2,300 persons all together. In Campus II, there exists old dispensary facilities constructed by the government in the past, and this facility can be usable with some renovation works. In connection with the above renovation and nurse's house construction, the same approach as (4) can be considered and 27.5% of the required costs have to be born by the villagers. This dispensary is also expected to benefit the inhabitants living alongside the planned canal, who have difficulty in access to medical facilities at present due to their remoteness from the paved road.

5.9 Implementation Plan

5.9.1 Executing Organization

(1) Executing Agencies and Organization

The Project is one of projects/programs proposed by the Master Plan. Therefore, as stated in section 4.5.2, the executing agency of the Project shall be Ministry of Agriculture and Animal Resources (MINAGRA). PNR, MINAGRA shall be responsible for secretariat functions including the planning and management of the Project execution and the Directorate of Planning (DP) shall be in charge of monitoring and assessing the Project execution. The

¹⁾ The direction of extra-curricular activities of MEN recognized that pupils' association can engage in contractual works and the money earned from these works can be used for the activities of pupils' association.

Management Committee in the central government and the Project Office in San-Pédro shall be formulated.

(2) Implementation of Project

The Project shall be implemented by the same organization of the Master Plan Implementation as the pioneer activities. The Project Office shall manage the implementation of the components of the Project, especially the following:

- Preparation of construction of the Grand Canal and rehabilitation of the irrigation and drainage facilities
- Settlement of land disputes in the Project Area before the commencement of construction
- Selection of new settlers and training them
- Assistance for formulation of farmers' organization (COOP)
- Guarantor for the credit of initial agricultural fund until COOP functions
- Coordinating the San-Pédro Dam water use together with HCII authorities
- Management of construction tendering and execution of contractor's works
- Operation and maintenance of the Project

5.9.2 Implementation Schedule

(1) Implementation Procedure

The procedure of the Project implementation shall be performed under the farmers' participation in principal, The Project Office shall employ a consultant to conduct the detailed plan, design and supervision of the Project construction works. The most important factor for the successful Project implementation is animation of the participating farmers. It includes the following items:

- To obtain agreement of the farmers to be involved in the Project,
- To select participating farmers and establish farmers' organizations,
- To have participating farmers engaged in construction works including on-farm works to encourage their willingness to participate in the Project and to help them raise farming fund, and
- To conduct technical extension and training of farming and water management for participating farmers.

(2) Implementation Schedule

The Project implementation schedule is summarized in Fig. 5.9.1. At first, the implementation organization shall be formulated to prepare the detailed design, select the participating farmers including the selection of new settlers and assist the formulation of farmers' organization. The construction period of the irrigation and drainage system of the Project is set at two years. At the initial stage of the construction, the training/demonstration farm shall be constructed so as to start the training of farmers immediately.

5.9.3 Internal Responsibility and External Assistance

(1) Technical Assistance

Irrigated paddy cultivation has been introduced recently to Côte d'Ivoire. Referring to the result of the previous experience of the San-Pédro Paddy Development Project and the situation of

quality and quantity of the present extension services, foreign expertise for modern irrigated rice cultivation are indispensable to support the development with strong leadership for the implementation and O&M of irrigated paddy cultivation.

(4) Internal Responsibilities

Referring to the result of PCM workshop, the demarcation of responsibilities of the concerned governmental organizations and the farmers to be involved for the Project activities are summarized in Table 5.9.1.

5.10 Project Cost

5.10.1 Investment Costs

(1) Bases of Estimation

The Project cost has been estimated in due compliance with the following conditions.

1) Cost of machinery, equipment and materials

The construction works is to be carried out by the contractor(s) on contract basis with the Project Executing Agency. The contractor(s) shall be responsible for procurement of machinery, equipment and materials to be used for construction works and the cost of machinery and equipment shall be included in the depreciation cost.

2) Unit price

The unit prices of wages, materials, equipment and machinery are estimated based on the current price prevailing in Côte d'Ivoire.

3) Demarcation of foreign currency portion and local currency portion

Each component of the construction works is divided into foreign currency portion and local currency portion; the former price is estimated based on CIF at port of Abidjan as of February 1999 and the latter is on the market price at the proposed project site of the country.

4) Expenses and benefit

The expenses and benefit of contractor(s) shall be 20 % of the direct construction costs.

5) Consulting services

The costs of detailed design and construction supervision shall be 10% of the sum of construction costs.

6) Physical contingency

The physical contingency shall be 10% of the total investment cost.

7) Foreign exchange rate

The foreign exchange rates applied for this estimate are US\$1.00 = ¥120.35 and FF. 1.00 = F.CFA 100.00 = ¥19.56 as of April 30, 1999. Therefore, F.CFA 1.00 is equivalent to ¥0.20.

(2) Project Cost

Based on the above-mentioned prerequisite and methods, the Project cost is estimated as shown below and Table 5.10.1:

(Unit: 1,000 F.CFA)

Item	Local Currency	Foreign Currency	Non Taxed Amount	Taxes	Total
1. Irrigation and Drainage Facilities	823,875	3,462,156	4286,031	531,310	4,817,371
2. Post-harvest Facilities	59,076	84,433	143,509	15,208	158,717
3. Land Development for Settlement Area	35,742	16,002	51,744	8,820	60,654
4. Rural Water Supply	7,157	15,598	22,755	2,420	25,175
5. Community Facilities	22,000	33,000	55,000	5,500	60,500
6. Consulting Service Cost	46,544	418,895	465,439	46,544	511,983
7. Project Administration and Supporting Services	373,759	95,370	469,129	47,234	516,363
Total	1,368,153	4,125,454	5,493,607	657,066	6,150,673
Physical contingencies	136,815	412,545	49,361	65,706	615,067
Grand Total	1,504,969	4,537,999	6,042,968	722,772	6,765,740

5.10.2 Operation and Maintenance Costs

The annual costs for operation and maintenance of irrigation and drainage facilities of the Project are estimated as follows:

(Unit: 1,000 F.CFA/year)

Item	Local Currency	Foreign Currency	Non Taxed Amount	Taxes	Total
Maintenance Cost	11,831	19,707	31,538	3,871	35,408
Operation Expenses	32,612	850	33,462	1,631	35,092
Office Administration (Chief+4Admi.)	12,600	0	12,600	630	13,230
Gate Operator (5 operators)	8,640	0	8,640	432	9,072
Transportation (motor cycles & pick up)	5,000	0	5,000	250	5,250
Tools etc. (20% of labour costs)	4,248	850	5,098	212	5,310
Others Expenses (10% of Labour costs)	2,124	0	2,124	106	2,230
Total	44,443	20,557	65,000	5,501	70,501

Also the gates of intake, check gates and drainage sluices are to be renewed every 25 years and the replacement costs are estimated as follows:

(Unit: 1,000 F.CFA/ 25years)

Item	Local Currency	Foreign Currency	Non Taxed Amount	Taxes	Total
1. Drainage gates	22,400	100,800	123,200	16,800	140,000
2. Intake gates etc.	4,840	27,410	32,250	4,760	37,010
Total	27,240	128,210	155,450	21,560	177,010

5.11 Project Evaluation

5.11.1 General

(1) Distinctive Features of the Project

The expected benefits, both tangible and intangible, then synergetic, are extracted from distinctiveness of the Project mentioned below:

1) Making use of potential water capacity of the San-Pédro dam

Since the San-Pédro dam was built in the late 1970s, the stored water has been used only for non-regular power generation. The Project attempts to make use of the reservoir water for irrigation, for which around 5 % of the flow shall be allocated.

2) Reconstruction of abandoned irrigated paddy fields

The Project will involve not only the restructuring of the field and rehabilitating the village of Cité Agricole, which was founded by the selected settlers for cultivating the irrigated paddy field, but also expanding both sizes. The net paddy field covered by the Project is to be 575 ha and number of households to be engaged in irrigated paddy farming is 383, which will support a total family members of around 2,300 heads.

3) Technical transfer to new settlers

The Project will conduct training courses to the new settlers who are novices at paddy cultivation during two-year construction period so that it will go off without a hitch. Transmigration project from Java to the Barito basin of south Borneo by the Dutch government in 1938 has shown that even a single season trial would go a long way toward transferring the basic techniques of paddy cultivation.

4) Boosting paddy production

The Project will first produce more than 6 thousand tons of paddy in 2003 by farming with labor-intensive transplanting method twice a year. It would constitute about 12% of the increased irrigated paddy production in that year planned by the PNR.

5) Capital formation utilizing unskilled labor quota required during the construction period

The new settlers and the residents of Cité Agricole, the future beneficiaries of the Project, will fill major part of the requirement of the unskilled labor during the construction period. They will save major part of their wages to appropriate the sum for their own capital requirement in the initial stage of the Project.

6) Maintenance of an ecological equilibrium of the present environment

Paddy is the only crop suitable for a specific topographic land-type of lowland, and with irrigated farming method, efficient and, at the same time, sustainable land use can be maintained.

7) Helping the improvement of the classified forest on the right bank of the San-Pédro river

The Project does this by a) giving up of installing a weir to avoid inundating the lower area of its right bank and b) receiving some new settlers from the illegal dwellers in the classified forest on the right bank to help the improvement of its quality as a specimen forest.

8) Opening of rural road using the right of way of the proposed Grand Canal

Creation of a grade-up rural road will enhance the over-all social amenity in the area along and beyond it by providing the inhabitants with a shorter through-road to and from San-Pédro, quicker and safer, and passable all the year round.

(2) Synergetic Effects

Synergetic effects expected from the implementation of the Project will culminate in the betterment of overall rural economy and life of the Project Area and the surrounding areas.

At the level of national economy

- a) Increase of domestic paddy production will contribute to reducing the amount of import of rice, hence to the goal of both increase in the self-sufficiency rate of food crops and decrease in use of foreign exchange.

At the local level

- b) The income from paddy production will have a stabilizing effect against vicissitudes of economy based on cacao and coffee production.
- c) Intensification of agricultural usage of irrigated paddy field will eventually attract some more seasonal operators of cultivator and agricultural laborers to the area during the periods of plowing, transplanting and harvesting.
- d) The paddy production using cultivators and a few thousand villagers with bicycles or motorcycles will attract a few small-scale rice-mills, mechanics and, probably and eventually, transporters to the area.
- e) Creating a decent multiethnic farming society: Above mentioned features will help enable the villagers of Cité Agricole to lead a better rural life by their own initiative;
 - Solid farm economy will secure the basic cash income far beyond subsistent farming for individual households.
 - Harmonious life in the community with basic human needs will be maintained by continuous effort of running successfully the COOP of the Project, and keeping a friendly term with the neighboring communities by cooperating each other to look forward to gaining further betterment of the area by uniting.

(3) Evaluation Methodology

The methodology used in this appraisal is to estimate the major countable net benefits, which are calculated from the equation: "with project situation" minus "without project situation" in their discounted flow during the Project life.

- a) The estimated benefits from introduction of irrigation water are those from increased production of paddy, whose quality will be improved by introduction of better farming and post-harvest treatment.
- b) An estimated benefits derived from creation of a rural through-road are: 1) Fahé and beyond: Saved amount of transport cost due to an introduction of the new short-cut route, and 2) Cité Agricole and Grand Gabo: Amount of transport cost charged by new operators, which is equivalent to the saving of time.

(4) Bases of Evaluation

Valuables used in the estimates of both economic and financial appraisal are as follows:

- Irrigated land created by the Project is set at 575 ha,
- Construction period is set at 2 years,
- Project life is set at 50 years,
- Social discount rate is set at 6.25 %,
- Financial prices are based on the market prices collected during this study period.
- Exchange rates are set at F.CFA 1.00 = ¥ 0.20 and ¥ 120.35 = US\$ 1.00 as of April 30, 1999.

5.11.2 Economic Evaluation

(1) Economic Conversion Factors

The economic conversion factors in the evaluation areas follows:

- | | |
|-------------------------------------|--------------------------------|
| 1) Standard Conversion Factor (SCF) | = 0.87 |
| 2) Economic farm-gate paddy price | = F.CFA 147 (see Table 5.11.1) |
| 3) Economic unskilled labor factor | = 0.5 |
| 4) Economic land price | = 0 |
| 5) Sunk cost for San-Pédro dam | = F.CFA 3 million/ year |
| 6) Sunk cost for ex-project | = 0 |

(2) B/C Ratio, NPV and IRR

Economic benefit/cost (E.B/C), economic net present value (ENPV) at the discount rate of 6.25 %, and economic internal rate of return (EIRR) are estimated at EB/C = 3.7, ENPV (at 6.25 %) = F.CFA 3,150 million and EIRR = 10.4 %.

(3) Sensitivity Analysis

Three alternative cases with some probability of occurrence are examined here. They are cases with 1) increase of costs by 10 %, 2) decrease of benefits by 10 % and 3) combination of the cases 1) and 2). The results are 9.3 %, 9.2 % and 8.3 %, respectively.

5.11.3 Financial Evaluation

(1) Farm Household Economy

The analysis of farm household economy is given in section 5.4.5 and Table 5.4.5.

(2) B/C Ratio and FIRR

Financial benefit/cost (F.B/C), financial net present value (FNPV) at the discount rate of 6.25 % and financial internal rate of return (FIRR) are estimated at FB/C = 2.8, FNPV (at 6.25 %) = F.CFA 1,040 million and FIRR = 7.4 %.

(3) Sensitivity Analysis

Three alternative cases with some probability of occurrence are examined here. They are cases with 1) increase of costs by 10 %, 2) decrease of benefits by 10 per cent and 3) combination of the cases 1) and 2). The results are 6.6 %, 6.5 % and 5.7 %, respectively.

5.11.4 Environmental Assessment

(1) Effects on the Natural Environment

1) Basic Indicators

Within the Study Area, forest covers approximately 2,500 ha of land, which is 25% of the total area. This forest is classified as lowland forest (plain forest and swampy forest), upland forest and IDEFOR forest which is mixed lowland and upland forest. The following should be noted:

- Upland forest (1,139 ha without the IDEFOR forest of 607 ha) is in the process of irreversible clearing by local farmers.

- Swampy forest (16% of total forest, 70% of lowland forest and 4% of Study Area) shows various states of degradation from forest to grassy land but has on a whole a better environmental value than the upland forest.
- The planned Grand Canal cuts through small forest pieces on 20% to 25% of the length, of which about 15% is constituted of swampy forest and more than 50% of plain forest (the remaining being through the IDEFOR forest). Forest clearing induced by the Canal is estimated to be about 5ha in total.
- The Canal will affect at maximum 8% of the IDEFOR forest, directly through cutting (more than 1 ha) and indirectly through isolation of forest habitat (49 ha).

2) Issues

- San-Pédro river: Land clearing for crops on riverbanks is accentuating the double dynamics of sedimentation / erosion in convex / concave banks, respectively. Seasonal natural closing of the river mouth by sea silting creates lake-like condition in the San-Pédro river.
- Swamps: They are permanently or periodically inundated and present several degrees of rehabilitation or conservation of grassy or bushy land, raphia trees forest and mixed forest. Stagnant water and absence of sun light under canopy provide very specific living conditions for the aquatic species ("black fishes"). Swampy forest is a habitat for wildlife species including a large variety of local birds. Other functions of swamps include temporary refuge for wildlife, pool of organic matter that will feed fishes during high water in rainy season, regulation of flooding, fishery during the drought season, supply of papo leaves for housing, and possibly assimilating of agrochemical products that are used in uplands.
- Wildlife: There are species that have a capacity to adapt to the rural environment (Duikers, Buffalo, Bushbuck), and those that merely depend on the swamps habitat (Forest-crocodile, Pythons, Varanus); Wildlife is strongly affected by the loss of forest habitat, human presence, and hunting.
- Environmental conservation: There is a poor institutional organization for the protection of the environment in the San-Pédro area, due to lack of jurisdictions or coordination among the relevant agencies like the Regional Directory of Environment, the Regional Directory of Agriculture and Animal Resources, the Port Administration, the San Pédro Municipality, the Regional Antenna for Public Hygiene and the Sanitary District of San-Pédro. This institutional deficiency means that implementing the countermeasures on the potential impacts of the Project in view of sustainability will be largely determined by the capacity to improve the existing institutional conditions.

3) Effects

Table 5.11.2 is the review of the effects of the Project on the natural environment and their acceptability. In this table, plain forest means forest after clearing of the flat land and not liable to agricultural development because of the presence permanent water bodies.

(2) Effects on the Social Environment

1) Basic indicators

Assuming an allocation of irrigation paddy field of 1.5 ha per household, and an average of 5.5 persons per household, it can be estimated that the Project will directly induce the settlement of about 2,300 persons, which on a whole does not raise acute problems. However, the increase of population (4 times of the present one) will mainly concern with Cité Agricole.

2) Issues

- Resettlement: From the environmental standpoint, it is desirable that criteria for selection of the new settlers to the Project should include the whole family and not only the number of active persons. If not, since there is no room for further land development in the area of reception, people would decide to expand the rice cultivation to the areas outside the paddy field, which will remain easily accessible from Cité Agricole. In that case, the rule of rice production quota could be considered as a guarantee that the new settler will prefer paddy cultivation, but the farmers will also see in traditional field crops a guarantee against possible failure in cultivating paddy fields, which could result in weakening the incentive aspect of the rule and finally allow failure. This point is especially relevant for the farmers of Rapide Grah where the cultivation field will be returned by the farmers to SODEFOR. Advantages expected from this measure are; a) effective trends toward intensive agriculture substituted to extensive and environmentally damaging agriculture; b) motivating people to achieve the objectives of paddy cultivation.
- Health and sanitation: Local health conditions need special considerations because of specific worrying problems. Malaria is endemic and cases of serious malaria are on the increase. The area is specially concerned with the new and frightening disease of Ulcer of Buruli. Health problems place a serious burden on inhabitants of Cité Agricole, including the high rate of Ulcer of Buruli. Diarrhea is a serious threat caused by contamination of potable water. Intoxication by pesticides is also reported.
- Land and resources: Livelihood is still largely supported by hunting, fishing, and collection of fuelwood, housing materials and other products. The area cannot support the population increase induced by the Project in Cité Agricole from the viewpoint of traditional use of land and resources. As a result, the new conditions of living will satisfy the objective of a better life for the farmers, if there is effective shift in life style and mentality.
- Life style: People will have several social and environmental constraints to be solved under the new rules of land use water use, and social organization. For new settlers, there will be no more possibility for traditional practices like land clearing or free settlement for cultivation.
- Landscape: Integrating the landscape value in the Project belongs to the set of improvement measures for the quality of livelihood. In the irrigation project area of Fahé and Cpt. Colonel, maintenance of the existing large kapok trees on site would provide the following advantages: Increasing the landscape value, the social value (shade, landmark), the biological value (preservation of isolated tree species) and the educative value (forest heritage, awareness about forest clearing, knowledge of trees).

3) Effects

Effects on the social environment are reviewed in Table 5.11.3. The table shows that effects in the field of social life mainly deal with Cité Agricole area. They can be resumed as a global constraint shifting from traditional economy to modern one radically.

(3) Environmental Acceptability

Environmental acceptability has been evaluated above for the effects of the Project on the local environment as a result of evaluating their importance in terms of loss in environmental quality or loss in quality of life. Since acceptability level of the effects on the quality of life is a subjective judgement, the standpoint adopted is that development is a necessity to face the

demographic increase and to adapt to the new environmental conditions of livelihood. This level of evaluation has provided acceptability levels from the standpoint of environmental sustainability of the Project, which is a basic requirement. Furthermore, the global understanding of environmental acceptability of the Project implies to check the environmental significance of the Project on a larger scale to take into account additional environmental criteria. Global environment and environmental space have been retained as the criteria.

Table 5.11.4 shows a summary of three (3) scales of environmental acceptability of the Project, including the results of the sustainability review presented above. It shows that the Project has a definitively good level of acceptability from the environmental point of view.

(4) Environmental Plan and Measures

Table 5.11.5 shows the review of the measures needed for taking into account the environmental constraints of the Project, and of the related planning or complementary tools for good implementation of these measures.

5.11.5 Comprehensive Evaluation

From the results of economic and financial evaluation, the implementation of the Project has been judged to be feasible. Furthermore, the negative effects of the Project on natural and social environments will be within the acceptable level. Earlier implementation of the Project will bring about more desirable effects on the improvement of the area especially living standards of the farmers in the area, resulting in more substantial contribution to the economy of the region.