

THE SITUATION
FOR
THE IMPLEMENTATION OF FEDERAL POLICE TRAINING PROGRAMS
IN
THE REPUBLIC OF CHINA
FINAL REPORT
MANUSCRIPT

AUGUST 1989

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1989

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
MINISTRY OF AGRICULTURE AND ANIMAL RESOURCES
GOVERNMENT OF THE REPUBLIC OF CÔTE D'IVOIRE

**THE STUDY
FOR
THE INTEGRATED RURAL DEVELOPMENT PROJECT
IN
THE SAN-PÉDRO PLAIN**

**FINAL REPORT
MAIN REPORT**

AUGUST 1999

**PACIFIC CONSULTANTS INTERNATIONAL
PASCO INTERNATIONAL INC.**

Exchange Rate
(as of April 30 1999)

US\$ 1.00 = Yen 120.35 = 6.15 French Franc
French Franc 1.00= 100 CFA Franc
1.00 CFA Franc = Yen 0.20



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PREFACE

In response to a request from the Government of Republic of Côte d'Ivoire, the Government of Japan decided to conduct a development study on the Integrated Rural Development in the San-Pédro Plain, and entrusted the study to Japan International Cooperation Agency (JICA).

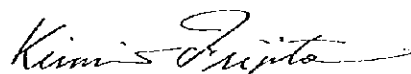
JICA sent to Côte d'Ivoire a study team headed by Mr. Masahito YAMANAKA, Pacific Consultants International, Japan, four times between February 1998 and July 1999.

The team held discussions with the officials concerned of the Government of Côte d'Ivoire, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Republic of Côte d'Ivoire for their close cooperation extended to the team.

August 1999



.....
Kimio FUJITA
President,
Japan International Cooperation Agency



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Mr. Kimio FUJITA
President
Japan International Cooperation Agency

Dear Sir,

LETTER OF TRANSMITTAL


We are pleased to submit the final report entitled " the Study on the Integrated Rural development in the San-Pédro Plain". The report contains the formulation of the Integrated Rural Development Project in the San-Pédro Plain, as well as the advice and suggestions of the authorities concerned of the Government of Japan and your agency. The comments made by the officials concerned of the Government of Côte d'Ivoire during the discussion on the draft final report are also included in this report.

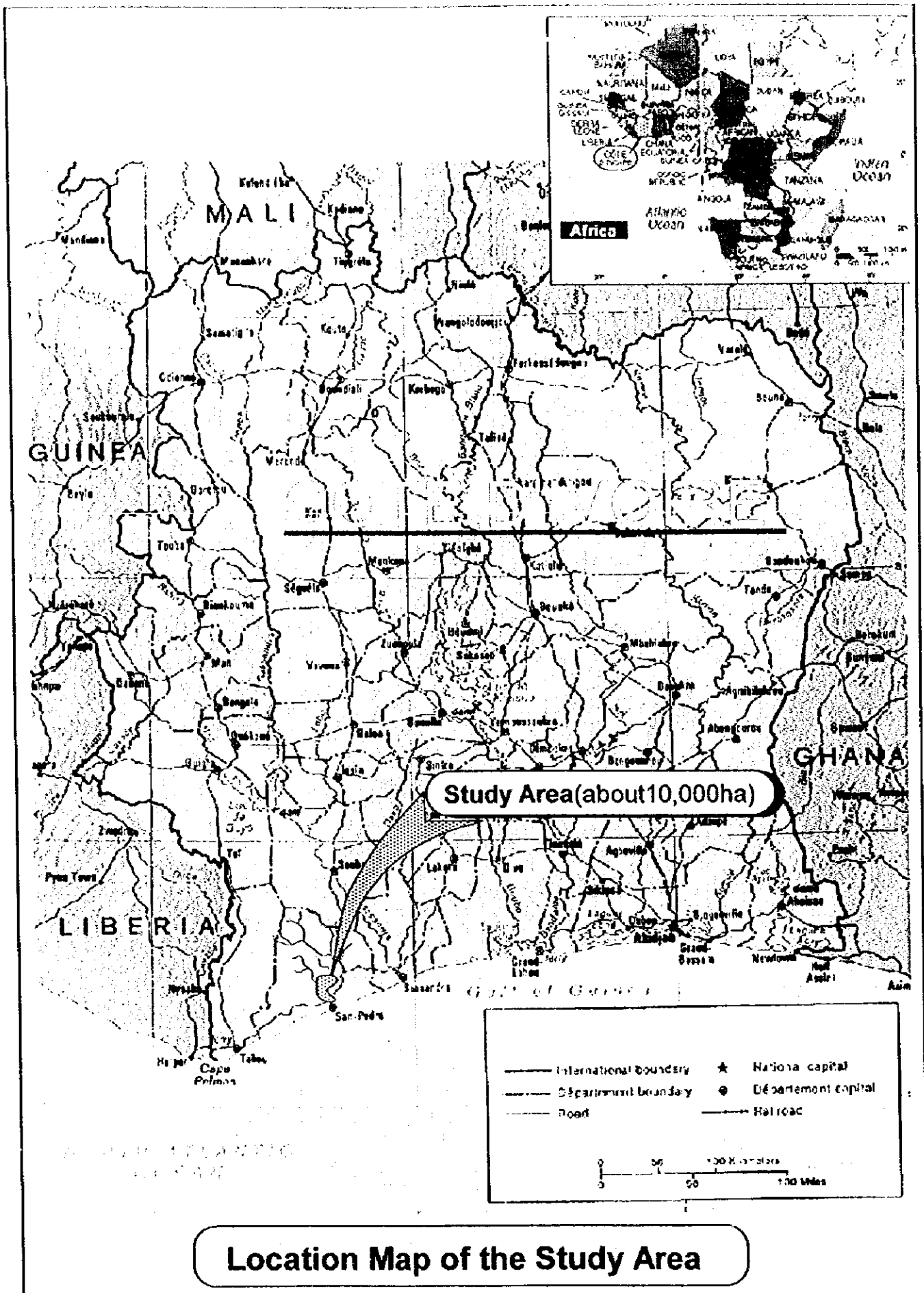
The study formulated the master plan of the Integrated Rural Development of the study area aiming the improvement of the farmers' standard of living based on the present situation and development potential. Among the projects/programs in the master plan, the San-Pédro Paddy Project Rehabilitation was selected as a high priority project. And the feasibility study was conducted on this San-Pédro Paddy Project Rehabilitation. The methodology of formulation and prioritization of projects for master plan are suggested in this report. We recommend, at first, the high priority project will be implemented as a model and pioneer project of the rural development of the study area based on the methodology suggested in this report. Also the projects/programs of the master plan will be followed so that improve the farmers' standard of living will be achieved in the study area and contribute the economic development in Côte d'Ivoire.

We wish to make this opportunity to express our sincere gratitude to your Agency, the Ministry of Foreign Affairs, the Ministry of Agriculture, Forestry and Fisheries and Embassy of Japan in Côte d'Ivoire. We also wish to express our deep gratitude to the officials concerned of the Government of Côte d'Ivoire for their close cooperation and assistance extended to us during our field survey.

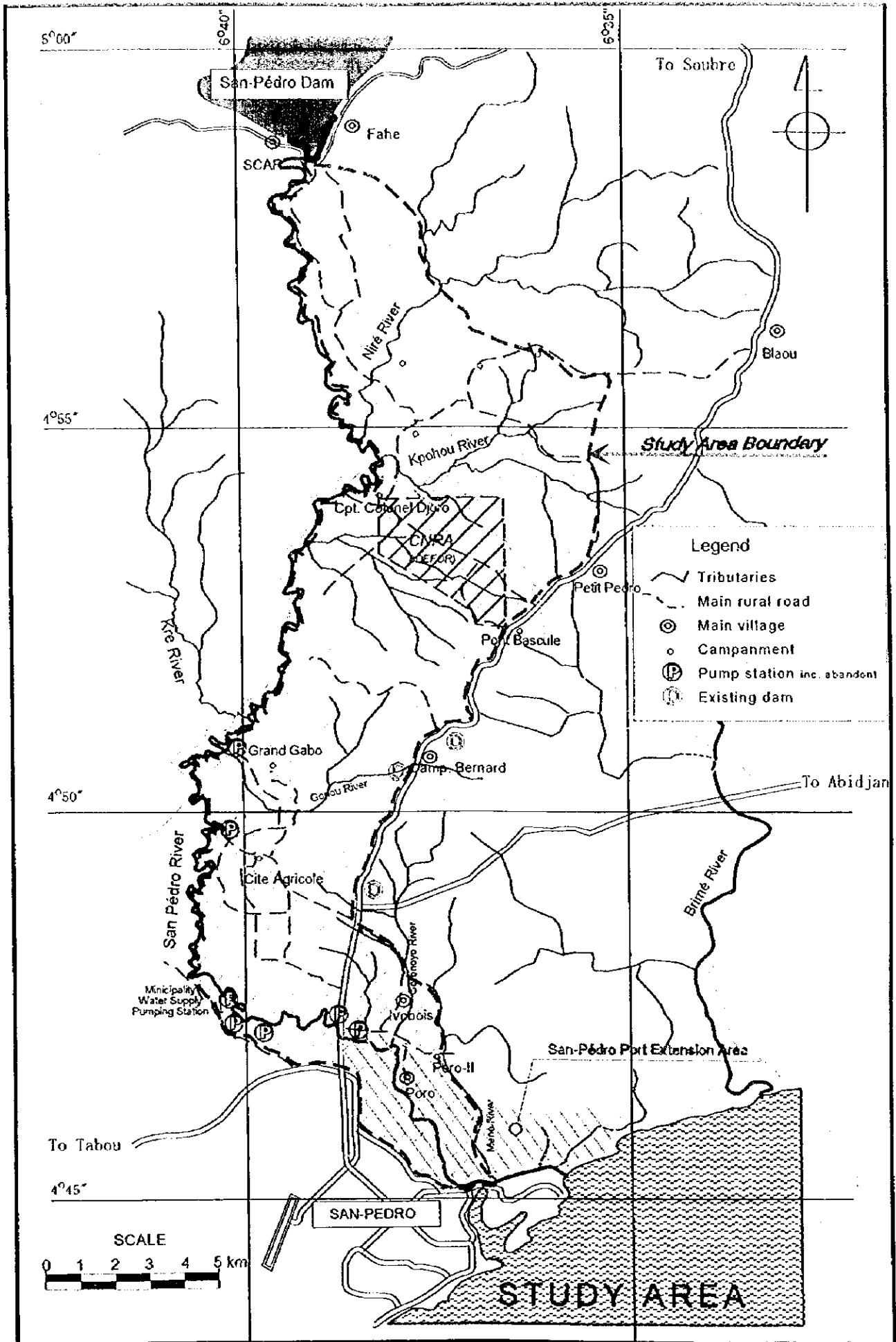
Very truly yours,

August 1999


Masahito YAMANAKA
Team Leader



Location Map of the Study Area



750000E

752000E

536000N

536000N

534000N

534000N

532000N

532000N

530000N

530000N

750000E

752000E

(P)
(abandoned)

Grand Gabo

Main Pumping Station
(abandoned)

(P)

Cité Agricole
Campus II

Abandoned
Garage

Gonou River

To Soubre

Cité Agricole
Campus I

To Abidjan

San-Pedro River

(P)

SODECT
Pumping

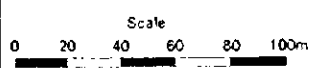
Lycée Professionnel
de San-Pedro

ANADER Office

(P)

LEGEND

-  Irrigation Canal
-  Drainage Canal
-  Road
-  Flood Protection Dike
-  Paddy Field
-  Village



PRIORITY PROJECT AREA



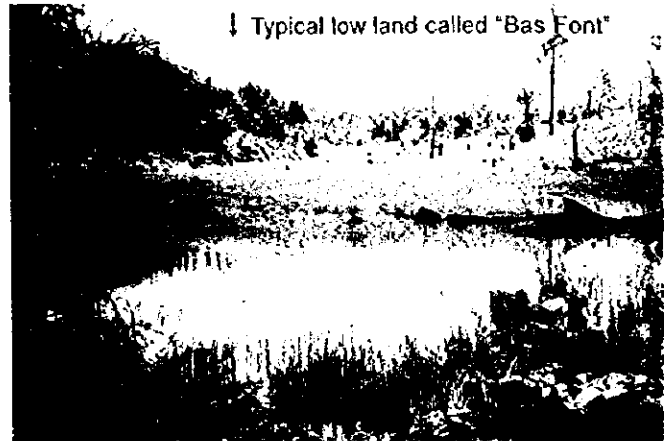
↑ Shifting Cultivation in hilly areas

← Cacao for export



↑ Harvest of upland paddy picking panicle

↓ Drying cacao



↓ Typical low land called "Bas Font"



↓ Cite Agricole area under rainfed cultivation (View from Campus II)

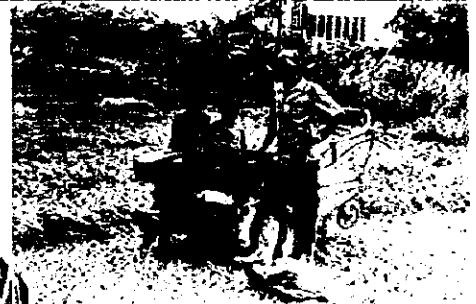


↑ Upland cultivation near the Cite Agricole area

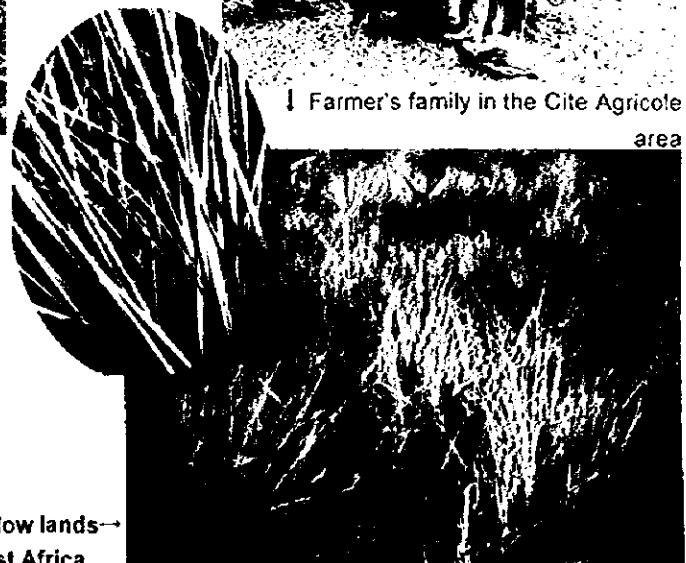


↑ Rainfed paddy field in the northern part of the Cite Agricole area under land preparation

↓ Rainfed paddy field in the Cite Agricole area (Right side of the canal is used for rainfed cultivation)



↓ Farmer's family in the Cite Agricole area



Rice Yellow Mottle Virus (RYMV) found Predominantly in low lands → of the West Africa



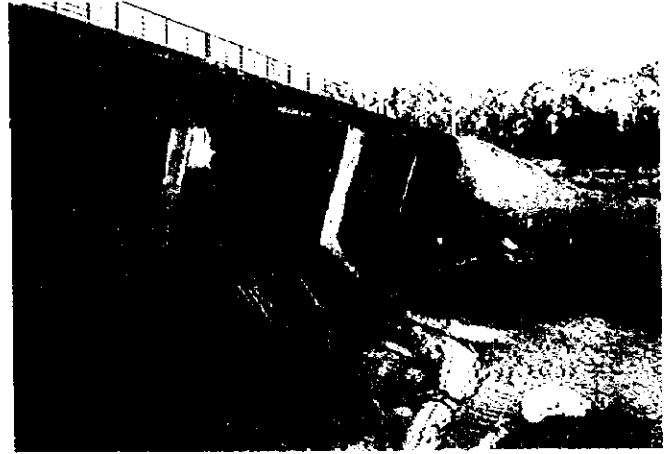
↑ Existing Pumping Station in the Cite Agricole area (Control panel and generator)

Submersible pumping unit → lifted up for inspection

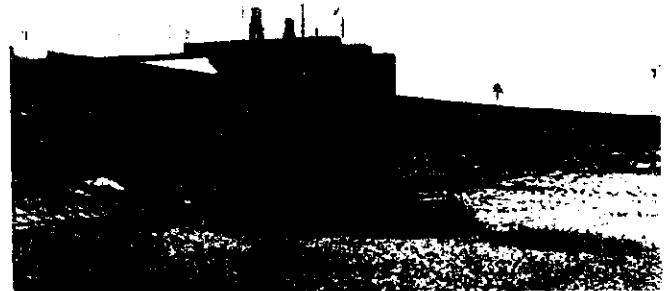
↓ Existing Turnout in the Cite Agricole area



↓ Melpic type downstream constant level gate in the Cite Agricole area



↑ Spillway of the San-Pedro Dam



↑ Existing intake for industrial purpose planned to be improved for irrigation

Existing check gate in → the Cite Agricole



← Existing turnout in the Cite Agricole area

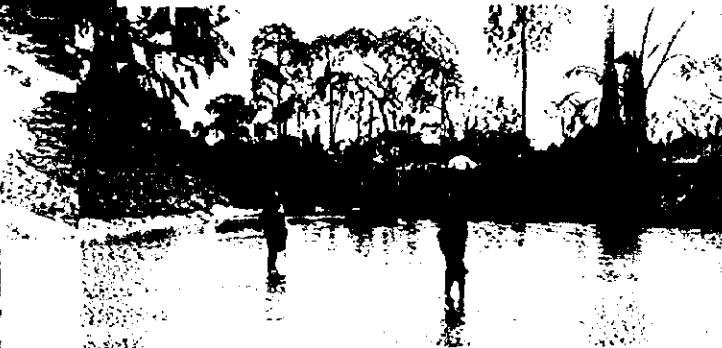
↓ Drainage culvert under the national road in the Cite Agricole area



← San-Pedro river downstream of the San-Pedro Dam



↓ Middle stream of the San-Pedro river



↑ Workshop for farmers in the Cite Agricole area



↑ Technical Consulting Committee on Water Use of the San-Pedro Dam

↓ Sampling for water quality analysis



↑ Discussion with farmers in Workshop

↓ Geodetic survey (Duch cone)



↓ Divers on survey of the existing intake



↑ Soil survey (pit excavation for sampling)



↓ Topographic survey (Grand canal)

↓ Topographic survey (existing canals)



EXECUTIVE SUMMARY

1 INTRODUCTION

1.1 Outline of the Study

In Côte d'Ivoire, the average production growth of main staple foods, roots and tubers, cassava and rice between 1976 and 1995 was estimated at 1.8 %, 2.8 %, and 4.6 %, respectively. Comparing to the estimated annual population growth of 4.0 %, production of staple foods except rice could not meet the requirement. Recently, rice consumption is increasing rapidly especially in urban area. Then imported rice counted 50% of total domestic products and shared 5% of total import value in 1990. Under these conditions, the Government of Côte d'Ivoire (GOCI) gives the effort to improve the self-sufficiency of food under the Agricultural Development Master Plan (1992-2015) and Rice Development Plan (1996-2005). In the Study Area, an irrigated paddy project covering about 350 ha was implemented by pumping irrigation water from the San-Pédro river by ARSO/SODERIZ in 1972. Irrigated rice cultivation was started by about 200 migrated farmers under the government subsidies. It had been stopped because of interruption in government subsidies and difficulty in pump operation due to high operation and repair costs.

Under the above-mentioned circumstances, GOCI made a request to the Government of Japan (GOJ) to extend its technical cooperation for formulating a master plan for the integrated rural development in the San-Pédro Plain and to conduct feasibility studies in the priority project area(s) in May 1996. Accordingly, Japan International Cooperation Agency (JICA), the official agency responsible for the implementation of technical cooperation programs of GOJ, dispatched a team to conduct the Study from February 1998 to March 1999.

1.2 Objectives of the Study

The objectives of the Study are:

- to formulate master plan of the integrated rural development project in the San-Pédro Plain, placing particular emphasis on the paddy-field agricultural development and improvement of rural infrastructures;
- to conduct feasibility study for the priority project area(s) selected through the master plan study; and
- to carry out, in the course of the Study, technology transfer to the counterpart personnel of Côte d'Ivoire.

The Study Area is located in Department (*Département*) of San-Pédro of Bas-Sassandra Region (*Région*), covers approximately 10,000 ha of San-Pédro Plain along the San-Pédro River from the San-Pédro Dam to San-Pédro city, the capital of Bas-Sassandra Region.

2 BACKGROUND OF THE STUDY

2.1 Brief Description of the Republic of Côte d'Ivoire

The Republic of Côte d'Ivoire is located in the central part of the coastal West Africa facing the Gulf of Guinea. The agricultural land is limited to only 11.6% of the total land area of 322,500

km². The estimated total population was 14.23 million in 1995 with 5.2 million economically active population, 36.4% of the total. There are four principal ethnic groups viz., 1) Akan, 2) Krou 3) Voltaic and 4) Mandé. Côte d'Ivoire is divided into 16 regions (*Régions*); which are sub-divided into departments (*Départments*) and then further to sub-prefectures (*Sous-préfectures*). The Seventh Medium Term Economic Development Plan was initiated in 1984 with a focus on stabilization of national economy by introducing restructuring measure. Since then a positive annual real GDP growth rates have been observed and in 1997 the per capita GDP was estimated to reach F.CFA 434,000.

On agriculture, major perennial cash crop in Côte d'Ivoire are cacao (31 % of the total cultivated area, 1,800,000 ha), coffee (24 %) and oil palm (3 %). Main food crops are maize (12 %), paddy (10 %), yam (5 %), cassava (4 %), taro (4 %), plantain banana (2 %), groundnut (2 %) and sorghum/millet (1 %). The remainder are industrial crops of cotton (0.4 %) and sugarcane (0.3 %). Among the 73,000 ha of the irrigated area, paddy accounts for about 40 %. The self-sufficiency ratio of rice is estimated at 58 % with the domestic production of 455,650 tons. In order to achieve self-reliance in rice production, the Government has made the 10-year plan '*Plan de Relance de la Riziculture, 1995-2005*' with a target growth rate of 9 %.

In the marketing network of food crops, middlemen play important role. However, in recent times, the farmers have been trying to make the situation more bargains by organizing themselves into "*Groupement Informel (GI)*" or "*Groupement à Vocation Coopérative (GVC)*" with the help of government agencies. In addition, "*Office d'Aide pour Commercialization des Produits Vivriers (OCPV)*" was established to increase efficiency of the marketing system of the food crops by supporting commercial transactions among producers, wholesalers, transporters, retailers and consumers.

Technology development for agriculture is carried out by eight (8) institutes; namely IDEFOR, (*Institut des Forêts*), IDESSA (*Institut des Savanes*), CIIRT (Ivorian Center for Technological Research), CIRES, I2T, LANADA, SODEXAN and WARDA (West Africa Rice Development Association). The technology extension support services is administrated by ANADER (*Agence National d'Appui au Développement Rural*).

There are around 169 classified forests in Côte d'Ivoire. The conservation, management of the living species and bio-diversity are shared by Direction of Environment and Direction of the Natural Protection. In Côte d'Ivoire, about 4,500 tons and 6,000 tons of pesticides were used in 1995 and 1996, respectively, 63% of which were insecticides. Beside the integrated pest management, the biological pest management approach has been applied through several projects in Côte d'Ivoire. The environmental law stipulates that those projects that are implemented in sensitive areas should require an environmental impact assessment (EIA) and that EIA report has to be submitted to MOE for the authorization of the project.

2.2 Brief Description of the Region

Bas-Sassandra Region, which was renamed from the Sud-Ouest Region, consists of four Departments; Sassandra, Soubré, San-Pédro and Tabou. The San-Pédro Department consists of two sub-prefectures; Grand Béréby and San-Pédro. The total population of the region was 1.4 million in 1988. The Gross Regional Product (GRP) of San-Pédro Region in 1996 was F.CFA

139.6 billion. The average farm household size in the region is 6.4 members with 3.9 economically active persons. The per capita GRP of San-Pédro is estimated at F.CFA 840,000, twice as much as the national average.

The total land area of the region is 26,417 km², cultivate land of which occupy 24%, followed by classified forests 22%, Taï National Park 10%, Buyo Lake 1% and others 43%. Average farm size in the region is 6.9 ha. The major food crops in the departments of Sassandra and Soubré are Paddy (production 45,000 ton in 1992), maize (52,250 ton), yam (70 ton), cassava (10 ton). 81 % of the farm holding grow four cash crops; cacao, coffee, oil palm and coco-palm.

3 THE STUDY AREA

3.1 Physiography

The Study Area is located at the left bank of the lower reaches of the San-Pédro River comprising ten villages. The total population in the Study Area was 12,800 in 1997. The average annual growth rate of population in San-Pédro Municipality is 7.6%. The area can be generally divided into two topographical categories; hilly areas with small and low valleys and low-lying flat areas. Three flat plains of around 1,200 ha are identified in the Study Area.

3.2 Natural Conditions

The Study Area belongs to the tropical rain forest climate zone. The annual rainfall is measured to be 1,379 mm with two distinctive rainy seasons viz., April to July (62% of total rainfall) and October to November (18%). The mean monthly temperature remains at around 26.4°C throughout the year. The San-Pédro river flows about 150 km in length and runs into the Study Area. It has a catchment area of about 3,340 km². The capacity of the multipurpose San-Pédro dam reservoir is 56.97 MCM. The annual specific discharges of the river are calculated to be 0.010m³/s/km² and 0.011m³/s/km² at Fahé and SODECI Pumping Station, respectively. The recorded maximum flood discharges are 252 m³/s at Fahé and 443 m³/s at the municipal water pump station. The annual runoff of 1,143 MCM seems to be enough to fulfill the demands of the municipal and the irrigation water supplies on the monthly average basis. The dam reservoir capacity of 24.96 MCM at the crest elevation of the dam spillway is considered enough to provide water for the irrigation and the municipal water demand even during the dry season. River mouth clogging and consequent inundation are the frequent occurrence from December to March in the down stream of San-Pédro river. The San-Pédro river water is of a little bit acidic and contains many general bacteria and iron ion, but is considered to be of acceptable quality for domestic and irrigation water supplies.

The vegetation in the Study Area is classified to be tropical lowland rain forest. 300 ha of natural forest, 155 ha of grasslands and 600 ha of tidal swamp areas are found in the Study Area. The soils of the Study Area can be divided mainly into 1) ferratic soils on hills, 2) hydromorphic colluvium soils in lowland area lying on the foot of the hills and 3) alluvial soils in the plain of San-Pédro and its tributary.

3.3 Social Conditions

The Study Area has the diversified social structures characterized by "multi-ethnicity"

(Kourmen, Bakoué, Wané, Baoulé, Gouro, Yacouba, Diola, Sénoufo, Lobi, Mossi, Songhai, Dogon) and "multi-religion", (Christian, Muslim, Animist). Today in the Study Area, the immigrant population (from Burkina Faso, Mali, Guinea) is far larger than indigenous population, and especially Burkinabé people are more in number than whole Ivorian nationals.

In the Study Area, public primary schools, private primary schools, Koranic schools are providing education to children. As the Area has no secondary school, the village children have to go to San-Pedro, Sassandra or other big cities for attending junior high school. The most serious problem for the schools is shortage of teachers sent by the government against the number of classes.

The "obscure" property situation of customary land right and modern land right has been hindering agricultural development in rural areas. These land right problems are characterized by the influx of immigrants, the increase of population pressure along with the decrease in virgin forests, and cause some disputes between earth-chiefs of different ethnic groups or between indigenous people and immigrants.

Total length of the main rural roads in the Study Area is 29 km. The rural electrification has been completed only in the Fahé village. There is no piped water supply system in the Study Area except for San-Pédro city.

3.4 Agriculture

(1) Production

The total cultivated area in the Study Area is 5,458 ha. The number of farm household is estimated at 912. The average land holding per farm household is 6.0 ha, ranging from 0.3 ha in minimum to 48 ha in maximum. Major crops are cacao (47.2% of the total cultivated area), coffee (19.7%), rice (14.4%), maize (7.1%) and cassava (4.1%). In recent years, the areas of rubber and coffee are increasing. The average yield of major crops remain low and it was 1,178 kg/ha for lowland paddy, 866 kg/ha for maize, 2,314 kg/ha for cassava, 343 kg/ha for cacao and 447 kg/ha for coffee in 1997. Recently, the low productivity of cacao in the Study Area become the problem, 35 % of cacao producers' balance sheets are estimated to be minus.

The most popular farming type is mixed crop farming of lowland crop, upland crop and tree crop, which shared 67.1 % of the total area and practiced by 48.7 % of the total farmers. Single farming type such as lowland farming, upland farming and tree crop farming accounts for only 11.1 % of the gross cultivated area. Around 75% of the labor input is allotted to the land preparation, seeding and harvesting. Among the crops, the production cost is the highest for lowland paddy (F.CFA 163,661/ha), followed by upland paddy (F.CFA 157,869/ha), vegetables (F.CFA 137,295/ha), maize (F.CFA 99,829/ha), cacao (F.CFA 67,377/ha) and coffee (F.CFA 48,454/ha).

(2) Livestock and Aquaculture

In the Study Area, a poultry is the most common livestock, which are raised by 60 % of the farmers. Sheep, goat and pig are bred by 8 %, 8 % and 5 % of the farmers, respectively. Besides commercial production of tilapia and carp, small-scale pisciculture is found in three

campements of Petit Pédro village; Konan Kro, Pont Bascule and Zilé Kro.

(3) Agro-industry and Agricultural Marketing

In the Study Area, there used to be a rice mill with a stock capacity of 10,000 tons but no more in use mainly because of lack of modern transportation and partly because of insufficient running costs. A weekly village market opens on Fridays at Petit Pédro and on Sundays at Blaou and Cpt. Colonel, where mini-scale agricultural marketing activities take place. They are no so active because of small amount of agricultural production in the Study Area.

(4) Agricultural Supporting Services

The new technologies and varieties developed by the institutes/organizations are handed over to ANADER zone offices after adaptability tests. Then the technologies are diffused to the farmers by the extension workers. At present, nine extension workers and one supervisor are assigned in the San-Pédro zone unit in which the Study Area is included. Each extension worker takes care of 274 farmers on average. The urgent and biggest problem in the extension activities is the insufficient budget for visiting farmers.

For the development of rural social infrastructures such as school buildings, rural roads and other agricultural production facilities, *Fonds Régionaux d'Aménagement Rural* (FRAR) has been allocated in the national development budget. On the other hand, for the individual farmers and OPAs, only two savings and credit cooperatives have been available nationwide.

(5) Farmers' Organization

In the Study Area, there are 24 officially recognized *Groupements à Vocation Coopérative* (GVC) 18 GVCs of which for tree crop marketing and 6 for food crop production and marketing. The problems common to both types of GVCs are 1) unfair money management by the administrative committees of GVCs due to lack of their abilities in financial affairs and 2) slow payment procedure due to lack of liquid funds in GVCs. In addition to these two factors, another problem is organizing the immigrant farming society due to its ethnic diversity and economic disparity. There are other *Organisation Professionnelle Agricole* (OPA)s such as various technology transfer contact groups, water committees for management of drinking water wells, young farmers' organizations and other organizations for maintaining primary schools and religious services.

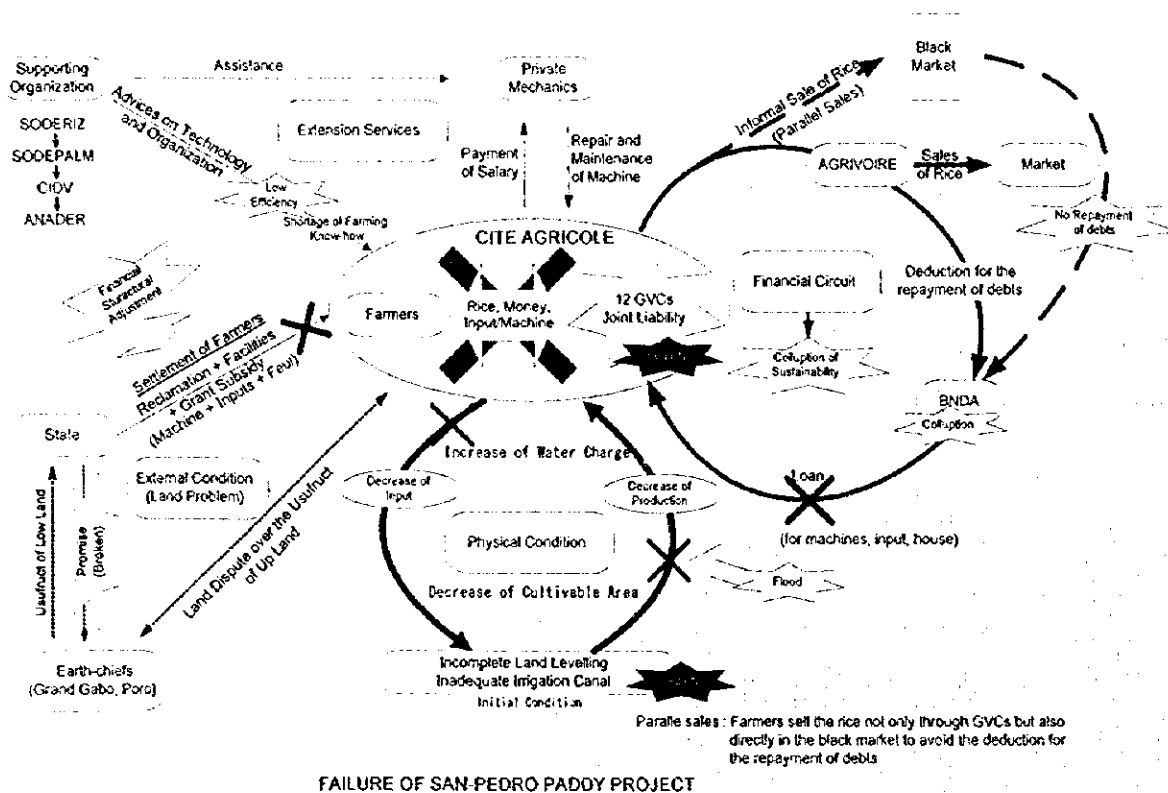
3.5 Irrigation and Drainage

(1) San-Pédro Paddy Project Area

The project was started in 1970s for 650 ha of paddy field with 200 farmers. After 13 years it decreased to 330 ha. The project area is divided into four blocks irrigated by individual main canals with a total canal length of 20.5 km and 9.5 km for main and secondary canals, respectively. The project area is protected by flood dykes from the San-Pédro and Gonou rivers. There are many drains in the area with gentle slope without any dykes. Installed drainage culverts mostly have small capacity. Therefore, the large area becomes the retarding basin, and drainage canal areas occupy large portion of the cultivable area.

In the project area, 13 GVCs were created one after another with the expansion of the project area and the operation and maintenance of the irrigation system was carried out by these GVCs. Even during the initial period, there were many water troubles/conflicts among the farmers, which could not be solved by the farmers organizations. Throughout the period of the project operation, the pump O&M and other agricultural activities were conducted by the governmental organization giving little opportunity to the farmers to develop their required skills.

The reasons of the failure of the San-Pédro Paddy Project can be classified into engineering aspects and social aspects. The engineering deficiencies are; 1) insufficiency of irrigation water, 2) inadequate land leveling of field lots and 3) poor drainage as a result of inadequate drainage planning. The social limiting factors are; 1) lack of precedent projects to gain experience, 2) diversity in participants, 3) young age of participants, 4) intervention and over dependence on Government and 5) land problems. The correlative effects on the project failure are summarized as shown below:



(2) Small Scale Irrigation Areas and Drainage

The following small-scale irrigation areas were also developed in the same period; 1) Grand Gabo Paddy Project Area - 10 ha 2) Right Bank Paddy Area - 10 ha, 3) Cpt. Bernard ARSO Pond Area and 4) Northern Lycée Professional Valley. Because of inefficiency of pump and difficulty of extension of cultivation land, they were either stopped their operation or being operated below the planned potential.

Annual flood volume is estimated to be more than 200m³/sec in the Study Area. Many seasonal ponds are found along the San-Pédro river in its southern part during the wet season. Drainage

culverts under the highway are constructed using corrugated steel pipes. Some of them are deteriorated and partially collapsed and upstream areas of them become swampy.

3.6 Rural Society and Household Economy

(1) Rural Society

In the Study Area, most of the villages are composed of several ethnic groups and each of them has its own residential area. The key members of the village are Village chief, Secretary, Earth-chief, Doyens, Ethnic community chief and Religious chiefs. Additionally, the villagers' committee members and representatives of the other official groups can be also considered as notables of the village. Villages in the Study Area can be classified into either Type 1 or Type 2. In the type 1 villages (Cpt. Bernard, Blahou, Grand Gabo, Fahé), an earth-chief with his descent group and some immigrant ethnic groups that form numerical majority coexist. Meanwhile, the type 2 villages (Cité Agricole, Pont Bascule, Petit Pédro, Scaf) consist of only immigrant ethnic groups and usually there is no superordinate-subordinate type of relationship among them.

Average family size is 8.6 members with economically active population of 3.6 persons per family. Villagers make the best use of mouth-to-mouth communication within the ethnic or religious communities covering whole village. But information is not conveyed easily between different ethnic communities due to language barriers and lack of will to communicate with the other ethnic people.

Generally speaking, the tree crop production is regarded as the field of men and women concentrate their efforts on the production of food crops such as rice, maize, cassava, yam and vegetables. The market gardening of eggplants, okras, chilies, tomatoes, is also developed among women.

(2) Household Economy

The crop production constitutes the most important income source for more than 70% of the households. The sources of average annual income of a household are agriculture including livestock and fishing; F.CFA 990,000 and non-agriculture; F.CFA 302,000. Most of the households in the villages have second income source other than agriculture, which varies between 17% to 100% of the total income.

(3) Problems and Solutions Proposed by Farmers

The common problems as expressed by the farmers are drinking water, health and children's education in addition to lack of transportation facilities and electricity supply. The problems related to agriculture and the countermeasures taken by the farmers are summarized as follows.

		Problems	Measures taken or proposed by Farmers
Tree Crops	Production	Damages caused by insects (termites, especially) Degradation of the soil quality. Insufficient care of plantation Unsuitability of cacao to the soil quality of the region	Control with insecticide Application of fertilizer Employment of contractors Replacement of cacao by coffee or rubber
	Marketing	Low official price of products Low purchase prices of products imposed by middle men Bad qualities of products linked to drying GVC badly organized	? Organizing GVCs Construction of appropriate drying place Division of GVC according to ethnic groups
Food crops		Difficulties in transporting or gathering products	1. Rent of trucks / 2. Fusion of GVCs to get credits
		Impossible water control (excess or lack) Lack of means of plowing Rainfall reducing or badly distributed	Choice of more suitable place Hiring contracted machine (tractor) Changing the place to cultivate Abandonment of the cultivation
Market gardening		Damages caused by insects, pest, and animal Weed	Control with pest/insecticide or watch Control with herbicide or manual weeding
		Damages caused by insects, pest, and snails Successive increase of rent (for immigrant women) Shortage of water in dry season Flood in low land in rainy season	Control with pest/insecticide 1. Lease by a group, 2. Lease of the land away from village Digging wells near plots Cultivation in upland during rainy season
		Difficult access to market (for the women living in villages remote from the main road)	Transport of products on their head as far as to the main road
		Low price of products imposed by purchasers	1. Acquisition of fixed customers, 2. Trying production during dry season

3.7 Environmental Conditions

(1) Environmental Resources

The natural habitats of the Study Area can be characterized as the lowland swampy forest, the upland forest and the San-Pédro river and its banks. In the Study Area, the main species that are hunted and consumed by the villagers are the Cane Rat, Squirrel, Hedgehog, Rat, Snail, Duiker, Varanus, Frog, Crawfish, Porcupine, Python, Crocodile and several common birds. Fishing is clearly divided into unorganized subsistence level fishing and organized commercial fishing done by experienced fishermen in the San-Pédro river and the dam reservoir. There could be 31 fish species in the river, but certain of these species have been proliferating while others have reached extinction. Species like *Tilapia Nilotis*, *Labeo*, *Eutropius Mentalis*, all the *Mormyrops*, *Synodontis Occidentalis* and *Auchenoglanis Occidentalis* are no more presents in the river. The population of crawfishes has considerably decreased. Tortoises that were in high number 10 years ago in the San-Pédro river cannot be observed now.

Fuelwood is generally extracted from the remaining woody hills, but is increasingly shifting to the plantations like rubber trees, because of deforestation. The villagers are aware of the quick depletion of the fuelwood resources, but they are unable to stop it. A lot of plants are collected around the villages for cooking and medical treatment. Other supplying functions of plants are the production of *bangui* drink from the palm trees, the supply of *papo* leaves by the *rafia* trees in the swamps for roofing and wood materials for housing. Inherited elements of the original habitats like isolated trees, woody hills partially preserved and a few forest swamps can be found in the Study Area. The species still observed in some parts of the Rapide Grah Forest like buffalo chimpanzee and elephants were also living in the Study Area more than 10 years ago. Crocodiles are found in swampy forest. It seems that they are a very few and move between the San Pedro river and the swampy forest according to seasons. Animals partly protected and certainly present in the area include pythons, pangolin and possibly certain species of monkeys.

(2) Environmental Diseases

Water-born / water-related diseases, specially diarrhea, malaria, bilharziose, and Guinean worm are wide spread in the Study Area. More than 17,000 cases of malaria were reported in 1996/97, in which San-Pédro area represented 57 % of the cases. During the same period, more than 3000 cases of diarrhea were met with 50 % of the cases in San-Pédro only. Control of malaria disease has been given priority at national level through the national program of fight against malaria. The main measures for prevention are chemoprophylaxis, fight against vectors and information /education activities. The human resources of the Regional Agency for Public Hygiene in San-Pédro is constituted of nine persons in total, of which only one technician for all the District, and no laboratory infrastructure.

4 MASTER PLAN OF INTEGRATED RURAL DEVELOPMENT

4.1 Development Potential and Constraints

(1) Development Potential

Annual incomes of farm household in the Study Area show 90 % of San-Pédro Sub-prefecture's. Most of the farmers in the Study Area have to rely upon non-agricultural sectors. As stated in previous chapter, the farmers can not concentrate agriculture under the high risk of production, and they are living at the low level. Natural conditions such as soil and climate have the high development potential for agriculture. Therefore, after the installation of agricultural infrastructure under the due consideration of regional characteristics, farmers can concentrate agriculture without risks and they can improve their living standard.

Based on the morpho-pedological justification, a total net irrigable area of 965 ha are identified as having agricultural development potential; Fahé (300 ha), Cpt. Colonel (90 ha) and San-Pédro Paddy Project Area (575 ha). The estimated irrigation water demand for this area will be 28.7 MCM. Considering total run-off volume of 527.2 MCM, municipal water demand of 11 MCM and evaporation loss of 4.5 MCM, hydrological water balance is calculated as 483.0 MCM. Although enough water will be available for irrigation on the monthly basis, extremely low discharge may occur in the daily variation. It is, therefore, important to prepare proper rules of water allocation among the water users in order to provide for such urgent cases.

Regarding the social development potential, the existing traditional communities can lay the foundation of modern and official units. The women in the Study Area seem to show more potential for being organized to form associations well, because of their experience of having more constraints which can't individually cope with.

(2) Constraints on Rural Development

The following factors have been identified as constraints in achieving the agricultural and rural development in the Study Area: 1) Physical Constraints : erratic rainfall and resultant flooding in the wet season and drought in the dry season 2) Agricultural and Agro-economic Constraints : traditional shifting cultivation, unfavorable natural conditions for cacao production, underdevelopment of modern irrigation farming, lack of agricultural equipment/machinery, low accessibility to agricultural market and non-availability of agricultural credit/loan. 3) Social and Human Resources Constraints : ethnic diversity, frequent

land disputes, poor management of farmers' organizations, inadequate extension service, low accessibility to basic social facilities, limited accessibility to information and dependence on assistance.

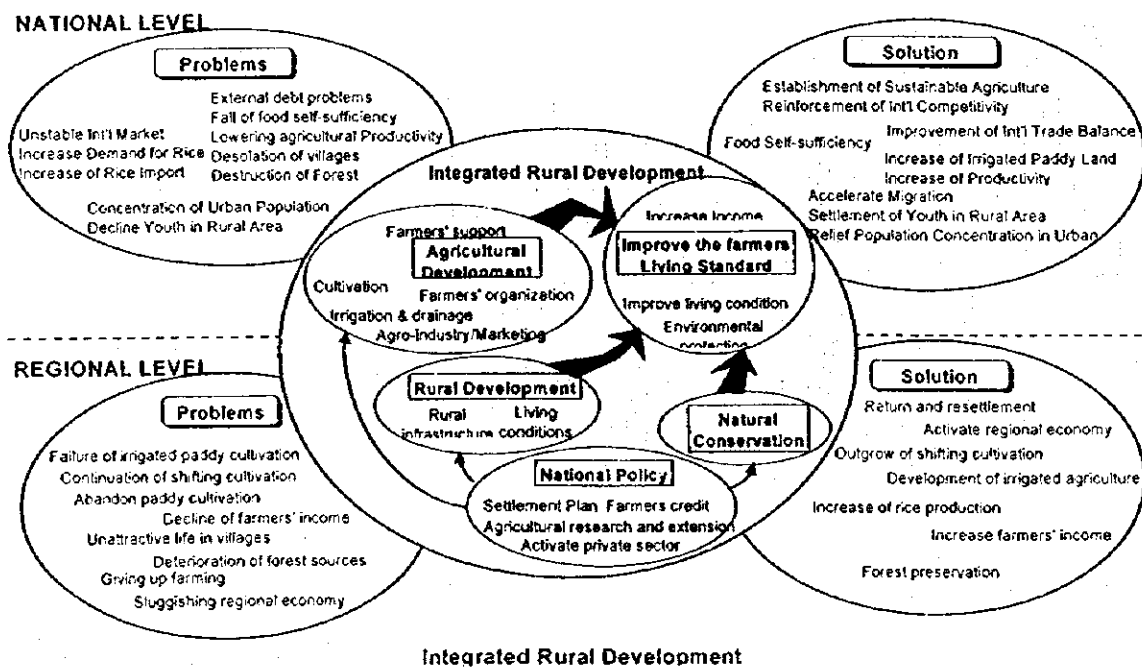
4.2 Objectives of Integrated Rural Development

Under the due consideration of the development potential and constraints in the Study Area as mentioned above, the objectives of the master plan of the integrated development of the Study Area is set to improve or install the agricultural infrastructure, mainly for irrigated paddy cultivation, so that increase the agricultural production, then finally achieve the improvement of farmers living standard. Its results can contribute the regional and national economic development.

4.3 Basic Concepts and Components of Integrated Rural Development

(1) Basic Concepts

The strategy on the agricultural development is set to increase the farming income by effective use of land, increase of yield and introduction of promising crops. To realize the strategy, farmers' organization, technology on extension activities and the marketing system shall be strengthened. The proposed agricultural development shall be formulated for the following 3 zones; 1) Undulated hilt-top and their slope, 2) Valley of hills called "bas fonts" and 3) San-Pédro river left bank alluvial plain. From the social viewpoint, the development concept shall conform to the following principles viz.; helping the members to get out of present difficulties, making best use of existing farmers groups and promising to the members equity, benefit and empowerment. The concept of the proposed integrated rural development in the Study Area is shown in the following figure.



The target year of the proposed master plan for the San-Pédro Plain Integrated Rural

Development is set in two stages; the year of 2005 for the medium term plan and 2015 for the long term plan. The following process shall be adopted; 1) Farmers/villagers are targeted to improve their living standard through the agricultural and social development, 2) Farmers/villagers shall be involved in the development scheme from the planning stage and share the responsibility for implementation of the Master Plan and 3) After empowerment of the farmers/villagers, they are expected to maintain the sustainable development by themselves.

(2) Master Plan Components

Master plan components of integrated rural development in San-Pédro Plain are summarized in the table below:

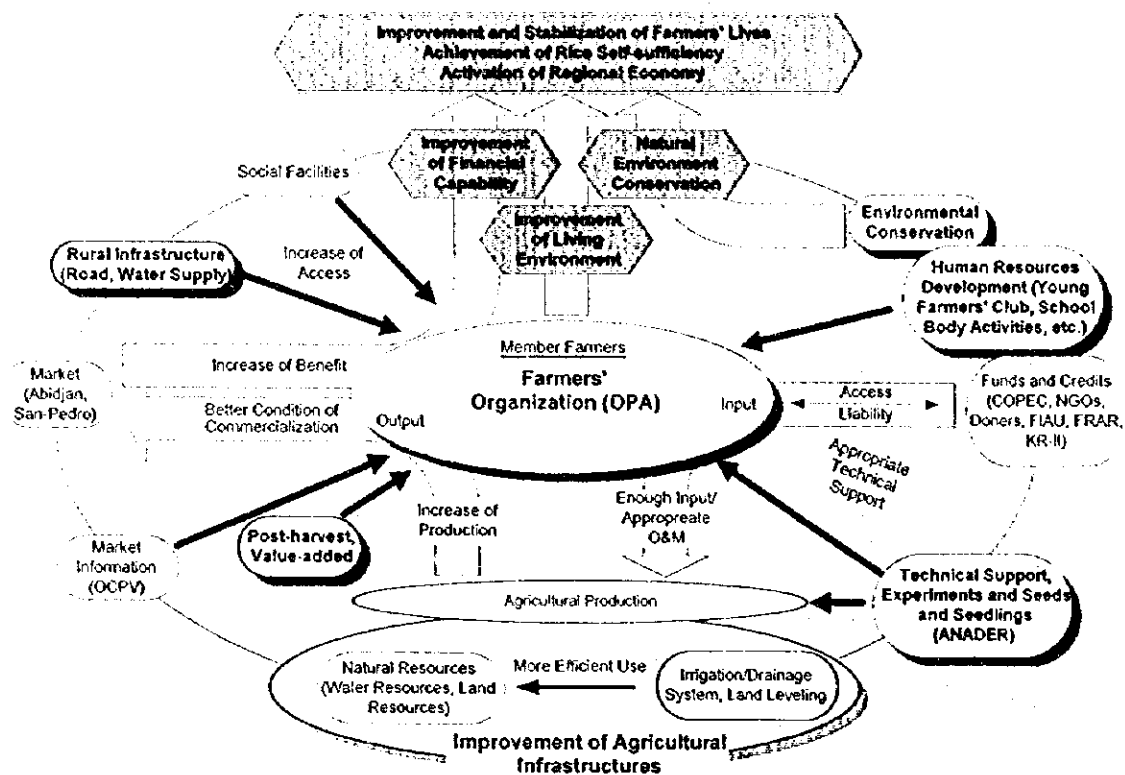
Sector	Project/Program	Activities
Farmers' Organizations (OPAs)	Formulation of OPAs	Formulate OPAs based residential area, irrigation block and villages groups at first
	Improvement of OPA Management	Maintain independence of treasury section
Agricultural Development	Lowland Paddy Development	Mechanized irrigated paddy double cropping and irrigated vegetable cultivation
	Upland Agricultural Development	Introduction of cowpea for the maintaining soil fertilities and sustainable production
	Tree Crop Development	Shifting cacao to coffee
Agricultural Supporting System	Improvement of Extension Services	Improvement of technical level of extension offices through the demonstration farm activities and training
	Improvement of Post Harvest, Value-Add	Installation of drying yards, rice milling equipment and storage by OPAs for value-add
	Improvement of Marketing	Improve accessibility to agricultural information
Irrigation and Drainage Development	Agricultural Credit	Improvement of access to the existing loan/credit facilities (and project farming fund)
	Rehabilitation of San-Pédro Paddy Project Area (Cité Agricole)	Options for irrigation water source ① pump rehabilitation and operated with electricity
Rural Infrastructure	Irrigation Development in Fahé & Cpt. Colonel area	② Headworks at Cpt. Colonel ③ Grand Canal from San-Pédro Dam Gravity irrigation with Grand Canal from San-Pédro Dam (or pumping for Cpt. Colonel area)
	Rural Road Improvement	Main rural road improvement by the farmers with the material provided by government
Social Development	Improvement of Rural Water Supply	By the on-going rural water supply project of AfDB etc.
	Formulation and Reinforcement of Women's Group	Betterment of women's economic situation through group production of vegetable etc.
	Formulation of School Bodies and Diversification of their Activities	Formulate the school bodies for the production of canteen materials and for the purchase of educational equipment/facilities
	Formulation of Agricultural Youth Club	Formulation of educational facilities operated by parents/volunteers for the education
Environmental Conservation	Improvement of Access to the Rural Facilities	Improvement of access to educational and medical facilities by traffic means and facilities
	Protection of natural Resources	Conservation of forest habitats.
	Achievement of Environmental Synergy	Balance between Rapide Grah classified forest conservation and the development, cooperation in organizations and institutions
	Use of Agro-chemicals Appropriate	Improvement of control system of pesticide, enlightenment of farmers, improving of transmission of information, establishment of pest control system etc.
	Control of Water-borne Diseases	Eradication of malaria, enlightenment of farmers, etc.
	Integrated Management of Water Resources	Improvement of function of High-Commissioner's Office for Hydraulic, establishment of cooperation system between Project Office and SODEFOR

4.4 Formulation of Master Plan

(1) Formulation and Reinforcement of OPA/COOP

The farmers' organization is the base of the proposed rural development as shown in the figure. A unit COOP shall be organized by farmers based the residential area, irrigation block and villages, then gradually a union of COOP shall be induced at the village level. At the initial stage, the scope of works shall be as narrow as possible so that even the uninitiated members could easily fathom the meaning of the work, in which the activities are mostly limited to transporting and selling of the produce. Then attention shall be directed to the division of members in an organization, due to poor management and unclear cash transaction. In order to solve this problem, scope of work of respective positions shall be made clear and accounting section shall be independent from the general administration. Training of accountants shall be

made with the assistance and central of ANADER.



Component of Integrated Rural Development and Farmers' Organization (OPA)

(2) Lowland Agricultural Development Programs

It is proposed to introduce rice double cropping programs in 1,326 ha of the irrigation development areas. However, to secure the best farming income and the more effective use of irrigation water, rice double cropping programs combined with vegetables are also proposed. In order to implement the proposed farming programs successfully, the following agricultural infrastructure improvement measures are required: 1) Stabilization of irrigation water, 2) Development of drainage canal and 3) Land leveling.

Two type of rice double cropping programs; transplanting culture and direct sowing culture, are proposed in consideration of the present habitual rice cultivation practice. The salient features of the program are 1) Short duration variety - WITA 7, WITA 8, WITA 9 and B-189, 2) Two cropping schedules for transplanting culture and direct sowing, 3) Mechanized land preparation with power tiller, 4) Improved cultivation method for transplanting method and direct-sowing method and 5) Increased average annual net income of F.CFA 773,960/ha.

Two types of rice and vegetable cropping programs, viz. Rice and Tomato cropping program and Rice and Lettuce cropping program are proposed. In order to implement the rice double cropping program, the following activities are required; 1) Water users' association and growers' association for group purchase of input materials and group forwarding of products, 2) Stabilized marketing system with reasonable price and 3) Technology support system.

The minimum farmland requirement is estimated at 1.5 ha, based on the desired annual income

and the potential income obtainable from rice double cropping. The target annual paddy production, cultivated area, and number of farms in the proposed areas are 1) Fahé: 3,000 tons from 300 ha with 200 farmers, 2) Cpt. Colonel: 900 tons from 90 ha with 60 farmers and 3) San-Pedro Paddy Area: 5,750 tons from 575 ha with 383 farmers.

(3) Upland Agricultural Development Programs

To increase net income level, cropping programs combined with upland paddy, maize and high drought tolerant crops/varieties of cowpea or groundnut in dry-season are proposed. Alley cropping food production method, in which maize or upland rice is grown in alleys formed by hedgerows of trees or shrubs of leguminous species planted along contour lines, is also proposed.

As a result of this, the following income increase is projected. Upland rice: F.CFA 293,425/ha, Maize: F.CFA 193,400/ha and Cowpea: F.CFA 147,500. The net incomes are quite high than that of the present farming. Moreover, the cowpeas and groundnut may contribute for maintaining the soil fertility through nitrogen fixation and the prevention of soil erosion by covering the soil.

(4) Tree Crops Development Program

The target of tree crop development program is to increase the financial returns from cacao farming. In the low productive cacao farming areas, change of crop from cacao to coffee is proposed in three phases. In total 2,577 ha of land and to be transferred from cacao land to coffee one, involving 618 farmers.

(5) Agricultural Supporting System Improvement Program

The demonstration of the intensive upland cropping system viz.; [upland rice]-[cowpea/groundnut]-[maize]-[cowpea/groundnut], with the alley cropping and the improved fertilizer application in 0.1 ha field lots is proposed. Supporting system for tree cropping comprises identification of the low yield cacao farm (yield less than 270 kg/ha) and improving the propagation and supply of seedling of coffee tree. The requirements of quality seedling for implementing the development plan are estimated at 78,000 kg/year.

In order to improve the post-harvest system, it is proposed to establish the following facilities in San-Pedro Paddy Area; 1) Concrete drying yard: 2,000 m², 2) Storage: 2,530 ton of paddy and 3) Rice milling machine: 2 units with a capacity of 1 ton paddy/hour. Better marketing plan shall also be conceptualized based on cropping pattern, climate changes and seasonal price fluctuations. The *Caisse Rurals d'Epargne et de Prêts/ Coopérative d'Epargne et de Crédit* and several NGOs shall serve rural customers by providing micro credits.

(6) Irrigation and Drainage Development Programs

1) Re-functioning of San-Pédro Paddy Project

The most favorable irrigation system is gravity one from the viewpoint of farmers' burden and technical operation and maintenance of facilities and considering causes of failure of pump irrigation system adopted in the San-Pédro Paddy Project. The smallest investment on the rehabilitation of this project area may be realized by repairing the existing pump facilities

without causing adverse environmental effects. Careful comparison has been done in consideration of the sustainable operation of the facilities. Three alternative plans were considered; Alternative 1 : Pump rehabilitation and its operation with electricity, Alternative 2 : Weir at south of Cpt. Colonel and Alternative 3 : Construction of the Grand Canal from the San-Pédro dam.

As a result of the alternative study, Alternative 1; as the project cost with F.CFA 3,529 million (where the rehabilitation cost of the pump: F.CFA 140 million.) is the lowest, its EIRR of 15.5 % is the highest among the three alternatives. Alternative 2; as the project cost of F.CFA 6,704 million is the highest, its EIRR of 10.0 % is found to be the lowest. Also Alternative 2 still have possibility to cause inundation in the classified forest area during the flooding period. Alternative 3; despite its long distance for water conveyance, the construction is not so complex, resulting in a rather low construction cost of F.CFA 6,358 million and its EIRR of 11.3 %. From the national economic viewpoint for project implementation, It is possible to say that Alternative 1 is the best opportunity for investment. The operation and maintenance costs per ha including replacement cost for each alternative have also been calculated. The operation and maintenance costs of Alternative 1 will be F.CFA 207,910 or 2.1 times those of Alternative 3 of F.CFA 98,790. Under the planned irrigated paddy development plan, Alternative 3 can reduce the production cost at 11.5% and increase the net income at 14.0 % comparing with Alternative 1. For making no pressure on farmers' living conditions as well as for improving their living standards, Alternative 3 is considered as the best one. Therefore, the irrigation water for the area will be taken at the existing intake on the San-Pédro dam providing a new conveyance canal (Grand Canal) of 18.2 km for conveying the irrigation water.

Rehabilitation of other related items comprise 1) Rehabilitation of irrigation facilities - irrigation canal lining, reconstruction of irrigation facilities including gates and checks, improvement of O&M and inspection roads, improvement of tertiary irrigation canal, 2) Land leveling - securing of uniform water ponding in each plot, confirmation of equalized water distribution, down-sizing of plots by bunds and land consolidation or redistribution and 3) Drainage improvement - maximization of cultivable land, rearrangement of drainage system, proper drainage management, installation of retarding basin and increasing road crossing culverts.

It is estimated that 5.7 km of main canal and 7.5 km of secondary canal are required to be concrete lined, and 20.1 km of tertiary canal needed to rehabilitate. 13.7 km of drainage canals in total are to be modernized/constructed, 575 ha of farmlands are to be leveled and 46.0 km of farm roads are to be improved.

2) Fahé Area Irrigation Development

Fahé irrigation area is located in the down stream of San-Pedro dam and has a potential gross area of 430 ha. Major works of the irrigation and drainage facilities of this area are summarized as 1) Irrigation facilities: primary canals of 6 km (concrete lining), secondary canals of 6 km, tertiary canals of 18 km, 2) Farmland leveling of 300 ha, 3) Drainage facilities: primary drains of 7.5 km, secondary drains of 12 km and 4) Road works of 21 km (grading).

3) Cpt. Colonel Area Irrigation Development

Cpt. Colonel irrigation area is located about 1.5 km south from Cpt. Colonel village having a flat alluvial plain area of 130 ha. Major works for the paddy irrigation development in this area are

1) Irrigation facilities: primary canal of 1.8 km (concrete lining), secondary canals of 1.8 km, tertiary canal of 5.4 km, 2) Farmland leveling of 90 ha, 3) Drainage facilities: primary drains of 2.3 km, secondary drains of 3.6 km and 4) Road works of 6.3 km (grading).

(7) Rural Infrastructures

Totally about 20 km of road in the Study Area shall be improved and maintained by the villagers/farmers with technical assistance from the government and labor provided by the villagers/farmers themselves. Considering the scale of villages in the Study Area, the groundwater is the most easily accessible source of the drinking water. Deep tube wells are favorable instead of shallow open wells on their safety against the contamination of wastewater. Minimum nine tube wells are expected to be installed among 15 villages in the Study Area.

(8) Social Development

The following social development programs are proposed as a holistic approach to the integrated rural development.

1) Reinforcement of Women's Groups

The program shall be carried out in the following four stages; 1) Acquisition of suitable land and permanent water intake points and creation of mutual aid fund, 2) Promotion of collective purchase and use of agricultural inputs, 3) Promotion of collective selling of outputs and 4) Introduction of simple food processing technology. In addition, children's day-care facilities shall be created.

2) Formulation of Pupils' Committee and Diversification of its Activities

This program shall have the following activities; 1) Introduction of small-scale agricultural activities, 2) Creation of partnership between the pupils' committee and villagers' groups and 3) Realization of school lunch based on the products and benefits generated by themselves and supporters.

3) Formulation of Young Farmer's Clubs

The following activities are proposed in this program: 1) Organizing villagers' collective work to build a club cabin and equip it with minimum furniture, 2) Programming courses in reading, writing and calculation given to children by volunteers and 3) Organizing children's practical farming work in group with ANADER's or parents' assistance in technique or material.

4) Improvement of Accessibility to Social Facilities

The following improvement measures are proposed: 1) Improvement of access to basic education - acceptance of private school established by the villagers themselves as public school, improvement of road condition and transportation means and increase of families' financial ability and 2) Improvement of access to medical facilities - ensured access to dispensaries in Gabiadji and Blahou and public and private medical facilities in San-Pédro.

(9) Environmental Conservation

Actions described below will ensure that the implementation of the proposed integrated rural development will not impair the existing potential of natural resources and will not induce negative and unacceptable effects.

1) Protection of Natural Resources

Finding an acceptable balance between the intensified agriculture and conservation of hunting and fishery resources, ensuring the conservation of certain forest habitats, the river environment and its fauna species by control of fishing and conservation of the fishery resources.

2) Achievement of Environmental Synergy

This will be achieved by harmonizing the implementation of the project with protection of the Rapides Grah classified forest. Taking opportunity of this synergy for progressing toward a water basin wide institutional coordination for integrated management of water. The project will contribute to the resettlement plan of people from the Rapide Grah classified forest as well as the forest recovery plan either directly (resettlement of people) or indirectly (demonstration value of the project).

3) Appropriate Use of Agro-chemicals

Use and control of pesticides should be done with focus on 1) Improvement of the control system of pesticides, 2) Development of information and training, and enhancing farmers' awareness about the environmental issues of pesticides use, and improving the communication between institutions and farmers and 3) Planing of an integrated pest management in paddy cultivation.

4) Control of Water-Borne Diseases

Measures of prevention and control of water-borne diseases will be integrated in an improvement plan of hygiene and sanitation. Basically, the following measures should be performed; 1) Anti-malarial measures, 2) Follow-up of the health conditions related to environmental conditions, 3) Launching of awareness campaigns for farmers engaged in irrigation works, first to protect themselves, second to fight against malaria and schistosomiasis vectors, 4) Assisting the farmers to develop anti-vectors techniques and 5) Enhancing the awareness and self-care levels for health care, especially for early diagnosis and treatment.

5) Integrated Management of Water Resources

Apart from the responsibilities of the government agencies, the concrete implementation of a more integrated approach is determined by the role of communities and institutions within the scope of the project by organizing the groups of farmers to find an equitable allocation of water resources and coordinating between the Project Office and SODEFOR as a preliminary step to setting up a water basin wide approach.

4.5 Implementation of Master Plan

(1) Prioritization of Project and Program

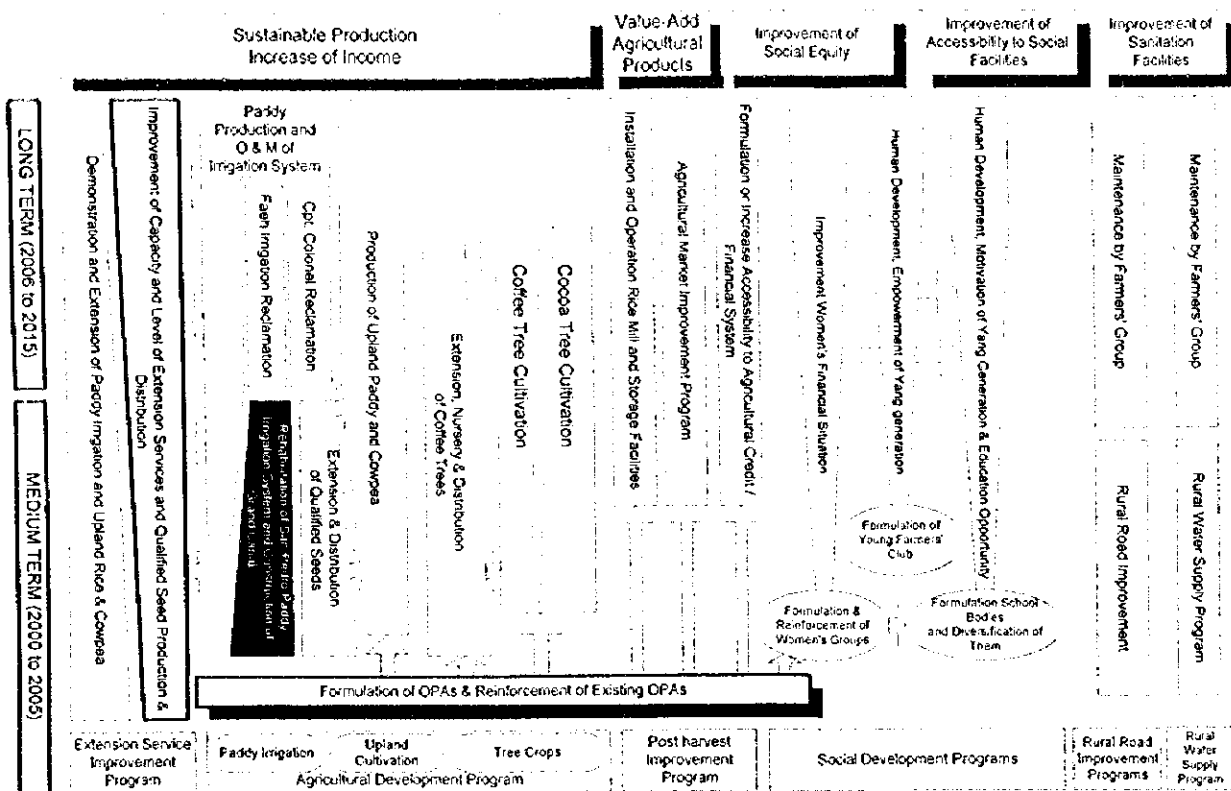
In order to determine the implementation schedule, the prioritization of the projects or programs has been made based the criteria of (i) urgency, (ii) realization, (iii) adaptability, (iv) farmers' need, (v) sustainability, (vi) socio-economic impact, (vii) demonstrative model, (viii) project benefits, and (ix) synergetic effects. The prioritization was studied considering the characteristics of the following three areas; 1) Hilly sloped area spreading in the eastern part of the Study Area, 2) Valley area surrounded by hills and 3) Low plain area along the San-Pédro river.

The low plain paddy development project/program is considered to have the highest priority for the integrated rural development in the Study Area. And as the base for agricultural development, the formulation and reinforcement of farmers' organization shall be started not later than the low plain paddy development project/program. It is considered that the economic advantage of the domestic rice has been much improved. Therefore, the priority and viability of the irrigated paddy cultivation is considered higher comparing with those of the failed San-Pédro Paddy Project because of improvement of economic situation of rice cultivation, increasing rice consumption and improvement of profitability of rice production.

(2) Implementation Plan

Excuting agency of the Integrated Rural Development in the Study Area shall be MINAGRA. At the central government level, Project Coordination Board shall be formulated for the budgetary preparation and political coordination among government agencies concerned. The Project Office shall be established in San-Pédro to make the preparation work for the implementation, discussion and explanation to the farmers, and implementation of construction works. Project Manger shall be responsible for the implementation of the project and discussion and negotiation with the farmers for the participation to the project implementation. Also a regional coordination committee shall be formulated with the Project Manager as the chairman and regional representatives as its members.

At the initial stage of the project implementation, the Project Office shall explain the project outline to organizations and farmers concerned to obtain their full understanding and willingness of participation to the Project. It includes 1) Obtaining agreement of the farmers involved in the project implementation, 2) Selection of participating farmers and establishing farmers' organizations, 3) Encouraging the farmers to participate in farm construction works and to help them raise farming fund and 4) Implementing technical extension and training of farming and water management for participating farmers. The concepts of the implementation schedule together with other activities and implementation schedule are shown in the figure presented below:



Master Plan Implementation Concept

Basically, all the project/program shall be operated and maintained by the farmers' or villagers' organizations and with farmers' participation. All the farmers' organizations (OPAs) in the irrigation command areas shall establish water users' organizations for O&M of irrigation and drainage facilities and shall be responsible for 1) Collection of information on water requirement from farmers and to decide the water distribution plan and water supply plan after adjusting water amount and period, 2) Operation of the irrigation facilities based on the water supply plan, 3) Observation of the water use condition with a periodical patrol, 4) Inspection of water leakage, facility injury, etc. and to make repair plan of facilities, 5) Repairing the facilities based on the repair plan and 6) Deciding the water fee with a consideration of required fund for O&M cost and farmers' payment capacity an to collect the water fee.

Demonstration of farming practice and trial shall be made based on the contract with the farmers using, input materials and equipment supplied by ANADER. Referring with the situation of quality and quantity of present extension services, foreign experts for modern paddy cultivation are definitively needed to support the development of the proposed farming.

(3) Cost Estimate

The project cost for the entire Master Plan project components has been estimated based on the following: within the medium term, San-Pédro Paddy Area (575 ha) shall be developed through the construction of the Grand Canal, then remaining irrigation potential areas of Fahé (300 ha) and Cpt. Colonel (90 ha) shall be developed within the long term. As a result, the total project cost (for 965 ha irrigation development) has been estimated at F.CFA 8,806 million. and annual O&M cost at F.CFA 65 million.

4.6 Evaluation of Master Plan

(1) Economic Evaluation

In the evaluation the following assumptions are made: Project life is set at 50 years and social discount rate as 6.25%. The net incremental benefit due to implementing the irrigation development of 965 ha has been estimated on the assumption that the value of present tree crops is equivalent to the produce from 50 ha single crop paddy cultivation. In the conversion of financial price to economic one, the following conditions are adopted: 1) economic farm gate price of paddy is set at F.CFA 147/kg and 2) the standard conversion factor (SCF) is set at 0.87. As a result, the economic indicators are $EB/C= 5.0$, $EIRR=13.0\%$ and $ENPV$ at 6.25% of social discount rate = F.CFA 6.5 billion.

(2) Financial Evaluation

The results of the financial evaluation are $FB/C= 3.8$, $FIRR=9.7\%$ and $FNPV$ at 6.25% of social discount rate = F.CFA 3.8 billion. Annual net income of the standard farmers with 1.5 ha land holding size by paddy growing with two crops a year is estimated at about F.CFA 1.2 million, three times the present net income of F.CFA 0.4 million of a single crop in a year.

(3) Synergetic Effects

Synergetic effects expected from the implementation of the Master Plan will culminate in the betterment of overall rural economy and life of the Study Area. Intensification of agricultural usage in irrigated paddy production will attract more agricultural laborers into the Study Area. And in the level of national economy, rice produced from the irrigated paddy field, which will be rehabilitated on newly created by the plan, will contribute both to the goal of self-sufficiency of food crops and economy in terms of foreign reserve of the country.

(4) Initial Environmental Examination

Initial screening of the environmental effects of the Project shows that the impacts on the natural environment will be generally limited, while the main issues will be mostly related to the social environment. Main issues to be considered for further study of the possible negative effects of the project and measures needed to maintain the environmental quality are 1) Use of agro-chemicals, 2) Degradation of hunting and fishing resources, 3) Conservation of swampy forest and certain fauna species, 4) Sustainable use of water resources, 5) Prevention of water-born diseases and 6) Settling conditions of the newcomers. The study of the local conditions and the examination of the potential effects of the project on environment suggest that a targeted environmental assessment study will be appropriate and that an EIA may not be necessary.

4.7 Selection of High Priority Project Area for Feasibility Study

Through the evaluation of the priority projects, the lowland paddy development program has been selected as the most effective one urgently required to implement. Then herein, the priority project areas of paddy development for the feasibility study in the Study Area are considered among 1) San-Pédro Paddy Project Area, 2) Cpt. Colonel Area and 3) Fahé Area. Through the comparison of these three areas based on several circumstances of project implementation, the highest priority project site for the feasibility study has been selected accordingly.

The San-Pédro Paddy Development Area has a high IRR of 15.0 % and a highest beneficiary population of 383 families. As this area has been equipped with irrigation facilities, the rehabilitation of these facilities will offer high positive impacts to the project. Besides, as the farmers presently living in this area have experiences on paddy cultivation, the effectiveness from extension of farming techniques, therefore, can be expected. From these viewpoints and based on socio-economic conditions, the area of San-Pédro Paddy Project has been evaluated as the most suitable site for priority project. Considering the above contexts, the San-Pédro Paddy Project Area has been selected as the priority area for the further feasibility study, and the irrigation water for the area will be taken at the existing intake on the San-Pédro dam providing a new conveyance canal (Grand Canal) of 18.2 km.

5 FEASIBILITY STUDY ON THE HIGH PRIORITY PROJECT

5.1 Characteristics of the Project Area

(1) Natural Conditions

The Project, Rehabilitation of San-Pédro Paddy Development Project, is situated in the southern part of Study Area, covering a net irrigation area of 575 ha of alluvial plain. There are three settlements in and adjacent to the Project Area apart from a several scattered houses. The vegetation of 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. According to the morpho-pedological survey 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 of tolerating 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. The run-off water from the hilly areas 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 season. The Gonou river flowing along the northern edge of the area in the southeast direction collects most of such run-off from the northern hilly area near the Cpt. Bernard. There are, however, some effluents from the Gonou river flowing into the irrigation areas.

(2) Social Conditions

Cité Agricole, the only village in the Priority Area, has unique characteristics, different from that of other villages in the Study Area as shown below.

Item	Characteristics
Village chief	Elected by the villagers
Villagers' committee	Separated from the basic supporting organization to the leading party
Main activity	Food crop cultivation
Major ethnic groups	Sénoufo, Yacouba
Acquisition of land	Given to selected farmers and/or applicants by the government or GVCs
Dwelling demarcation	Mixed ethnic groups in the same area
Housing	Concrete walls with tin roofing subsidized by government

The size of the family in the Project Area is summarized in the following table:

Family Characteristics	
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)

Rain-fed paddy cultivation during wet season is the main source of income for about 30% of the households in the Project Area. For 17 % of the households, vegetable cultivation in dry season is the main source of income. Maize cultivation and contract farm work also is other income sources. More than half of the farmers have their own plantations of tree crops with an average size of 3.2 ha.

In the Project Area, there are five GVCs, entrusted with the land management by the government. After the end of the 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". Due to coexistence of customary and legal land rights, land disputes are occurring between farmers of Cité Agricole and Kroumen or others who have bought land from Kroumen, resulting in some troubles, which include threatening and a legal case.

(3) Agriculture

In the Project Area, 62% of the total farming land are classified as lowland followed by upland (20.0 %) and tree crop land (17.6 %). The average land holding size per farmer is 6.7 ha in the Project Area slightly larger than that of the Study Area. The major crop in the Project Area was 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 of major crops are 1,118 kg/ha for lowland rice, 701 kg/ha for maize, 4,222 kg/ha for cassava, 494 kg/ha for coffee and 250 kg/ha for cacao.

In the Project Area, the most popular farming type is mixed crop farming of Lowland + Upland + Tree crop, which shares 59.4 % of the total farming land and 43.0 % of the total farmers, followed by Lowland + Upland farming sharing 22% of the land and 31.0% of the farmers, Lowland farming sharing 17.4% of the cultivated area and 23.0% of the farmers and Lowland + Tree crop farming shares 2.9 % of the land and 3.0% of the farmers. The net income is F.CFA 110,542 with F.CFA 43,084 /ha. The production cost is the highest for vegetables (F.CFA 350,743/ha), followed by rainfed lowland paddy (F.CFA 174,180/ha).

In the cultivation of annual crops, around 80% of the total labor input are allotted to the land preparation, seeding and harvesting, which are the minimum requirements indispensable for cultivation. The remainders are allotted for weeding, application of fertilizer and disease and pest control, except bird control for paddy. In the lowland paddy cultivation, total labor input including bird control is estimated at 217 man-day/ha.

More than three fourth of the farmers practice direct-sowing by broad casting, while others follow hill sowing method. The common machinery and agricultural tools used for rice cultivation are power tiller, draft animal, manual power sprayer, motor pump. But most of the power tillers and sprayers are in non- usable condition now. In most paddy fields, sowing is made from March to June with the peak in May, and harvesting is done four months later, starting from August and until to September. Short duration BUAKE-189, WITA-9 and SC-1 are most common varieties. The average seed rate is 71 kg/ha for direct sowing culture and 45 kg/ha for transplanting culture. About half of the transplanted farmers adopt upland nursery and others prefer submerged nursery, with the nursery period ranging from 14 days to 30 days.

(4) Agro-industry and Marketing

There are neither agro-industry nor specific commercial activities. During the dry season, a few immigrants grow vegetables along the network of drains in the area, and sell the produce at the nearby local markets.

(5) Farmers' Organization

In 1992, 12 GVCs in San-Pédro Paddy Development Project Area were unified into four GVCs based on the irrigation blocks. Thereafter these four GVCs formed a union in an effort to raise fund for pump operation but it failed. 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. The first officially recognized women's farmer-organization GVC-FCA was founded in Cité Agricole in 1995.

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

All of the farmers attributed the failure of the previous project primarily to "deficit of water in the plots". They mentioned other factors such as collapse of organizations, farmers' indiscipline, and low yield as a secondary one. The farmers cited the following factors as causes of water deficit: 1) No prompt pump repair works, 2) Expensive operation of new pumps, 3) Damages of irrigation canals and resultant water losses, and 4) Imperfect leveling and land development. The farmers also pointed out that insufficient communication between farmers their GVCs and supervising organizations as well as unclear task sharing as troubles that led to the failure of the Project.

Farmers in the Project Area are defined as the ones who are living in the Project Area or having agricultural activities in the Project Area and have intention to take part in the future project. Most of the farmers cite 1.5 ha per household as the appropriate farming size. However, some of them complain that 1.5 ha are not enough to earn for their family. Regarding crop diversification, a half of the farmers have started tree crop plantation and about 70 % of the rest have intention to start a plantation. In addition, over 70 % of them intend to introduce vegetable

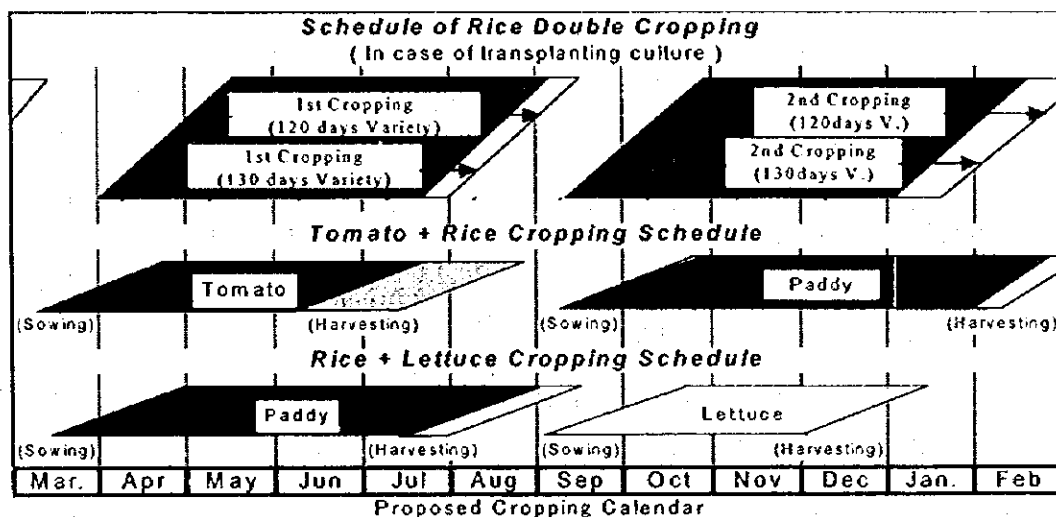
cultivation into their farming and 50 % stock or fish raising. As for the training, 80 % of senior farmers hope to be trained again on irrigated paddy cultivation. 30% and 25 % of them also desire the training on vegetable cultivation and animal husbandry respectively.

All of the farmers express their desire to have some training on cooperative in order to learn about their new organization. Moreover, the farmers hope to establish the system to check the work done by the administrators and the accountants. In Cité Agricole, roughly 20 % of households consist of old people without young generations, or have disabled or sickly heads of household or spouse and are anxious that they can not be allowed to participate in the future project. They also emphasize the government to recognize officially the rights of ownership and/or cultivation of the land. Desirable annual income per farmer's household is estimated at F.CFA 1,285,300 and per member of household at F.CFA 230,400. In the Project Area, all the households except one, experienced or not, have intention to participate in the Project. However, about 40 % of them are lacking in work forces. According to the farm household survey, the number of farmers who intend to participate in the Project is estimated to be 136 in the Project Area, 314 in the Study Area and 117 among sampled farmers in Rapide Grah Classified Forest.

5.3 Agricultural Development

(1) Proposed Cropping Calendar and Target Yield

The proposed cropping calendar, shown in the figure below, is determined based on the following: 1) Evasion of harvesting in rainfall period, 2) Setting of staggering period for 45 days, and 3) Introduction of high yielding varieties with tolerance to RYMV. The target yield of rice is set at 5,500 kg/ha for the transplanting culture and 4,500 kg/ha for the direct sowing culture. The key points for accomplishment of the target yields are assured supply of irrigation water, complete land preparation (leveling and puddling) and weed control.



For making the rice cultivation plan, special considerations are paid on the following points; 1) Amount of nitrogen to be applied is 66 kg/ha, 2) Synthetic weed control countermeasure is introduced, 3) Control methods against RYMV are employed and 4) Preventive control measures are employed against rice disease and pest due to the reason of economic point of view.

Moreover, in order to increase the farming income, combined cropping of rice and vegetables is proposed. In the scenario, 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.

In the rice double cropping plan, rice is cultivated twice a year. The paddy production is estimated at 15,000 kg/year per farmer, which is equivalent to 13 times the present production level. The net income is estimated at F.CAF 1,160,940 /farmer. In the case of rice + vegetable cropping, tomato crop is to be introduced in an area of 0.1 ha of the 1st cropping, resulting in a total net income of F.CAF 2,426,162 /year. If lettuce is introduced, the net income per farmer is estimated to be F.CFA 1,263,852/year.

(2) Labour Requirements, Mechanization and Appropriate Scale of Cultivation Area

In the labor requirement for the proposed rice cultivation, the largest labor force is required for transplanting and harvesting; 40 man-day/ha during transplanting and 50 man-days/ha during harvesting including threshing. To complete these farm works in a day, around 5 times the family labor is required. However, the labor shortages for these farm works can be solved by mutual use of family labor in the Project Area in staggered cropping for 45 days.

Appropriate scale of land holding has been decided at 1.5 ha per farm household based on the net income to be obtained from the rice double cropping and labor requirement.

(3) Farm Household Economy

With the 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 cooperative at the price of F.CFA 157 /kg. After paying the annual debt of housing loan of F.CFA 234 thousand and deducting 10% saving, disposable income will become 1.4 million F.CFA. Assuming that most of the basic foodstuff be self-sufficient, the disposable income will become 28 % more than that of the average residents of San-Pédro city. O&M of the canals require wage labor, which will be filled by some members' family labor.

5.4 Irrigation and Drainage Development

(1) Irrigation Plan

The proposed irrigation method for the 575 ha irrigable area is the flooding one bounded by the field levee. The irrigation water supply is made for 24 hour a day continuously when it is required. Irrigation area is divided into four blocks based on the canal alignment and water distribution being done in 10 days rotation. The size of field lot is determined as 30 m x 100 m (0.3 ha), considering the minimum area required for land leveling and crop diversification. In principle, a field lot is the unit of irrigation to be made in a day. As individual farmers are provided with 1.5 ha field basically, one field block is divided into 20 field lots and it can be irrigated within 5 days. The estimated crop water requirement varies between 3.2 mm/day in August to 4.4 mm/day in March. Percolation loss is calculated at 5 mm/day considering the soil types and topographic conditions of the Project Area. The puddling water requirement needed before sowing paddy is set at 150mm. The estimated effective monthly rainfall fluctuates between 137.3 mm in May and 14.5 mm in January. A continuous water ponding of 75 mm

during paddy growing period is considered and an irrigation efficiency of 65% is assumed. As a result of the above considerations and cropping calendar, the unit irrigation water requirement is set at 1.62 lit/sec/ha.

(2) Drainage Plan

The drainage condition of the Project Area is generally characterized by the flood prone nature and poor drainage capacity due to low elevation. Considering the present situation, the proposed drainage system shall include 1) Provision of flood protection dikes along the northern side of the Project Area to prevent the intrusion of the floodwater and the run-off, 2) Installation of drainage sluices at the drainage outlets in order to facilitate the drainage effects by gravity and to prevent the intrusion of stagnated water, 3) Improvement of existing drainage canals by dredging, straightening and widening and 4) Reducing the drainage load in downstream of the drainage system especially in the southern part of the area and north extension 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 l/sec/ha, respectively.

(3) San-Pédro Dam Intake and Grand Canal

Two existing old manual operation intake gates on the Dam with dimension 1.6 x 1.3 m shall be replaced by new one. The conduits shall be extended from the existing conduit end. A butterfly valve with box shall be installed to control intake water discharge. Discharge measurement devices such as Parshall flume shall be installed at the beginning point of the Grand Canal. Considering the operation and maintenance, the Grand Canal of 18.2 km shall be of concrete lining. Inspection road for the operation and maintenance of irrigation canal shall be provided along the Canal. The required canal capacity of each section are estimated as follows: 1) Intake up to main diversion for Fahé Area – 1.56 m³/sec, 2) Fahé main diversion to Cpt. Colonel – 1.08 m³/sec and 3) Cpt. Colonel to the San-Pédro Paddy Project Area - 0.93 m³/sec. In total, eight siphons, thirteen box culverts, sixteen drainpipes and two drops are to be installed.

(4) Irrigation and Drainage Facilities

Net irrigation area of 575 ha will be divided into four blocks: Northern Block - 64 ha, Central Block - 194 ha, Eastern Block - 227 ha, Western Block - 89 ha. Total lengths of the canals are estimated as 5.7 km of the primary canal, 7.5 km of the secondary canals and 20.1 km of the tertiary canals. It is planned in such a way that almost all the primary and secondary canals shall be aligned along the existing canal route. Primary and secondary canals are of concrete lining and tertiary canals are earth canal. Canal design capacity shall be 1.62 lit/sec/ha. Most of the existing structures such as diversion works with the steel gates, check structures, turnouts, measurement devices, spillways, concrete pipe culverts crossing under the roads needs their replacement. O&M roads of primary and secondary canals are planned to be the gravel roads.

The present complicated drainage network should be simplified by either constructing new canals or improving the existing drains to enable effective drainage. The length of the proposed drainage canals are: 1) Main Drainage Canals – 3.4 km, 2) Secondary Drainage Canals – 10.3 km, and 3) Lateral Drainage Canals – 20.1 km. Drainage culverts – 14 units shall be provided. To prevent flood water intrusion, in addition to repairing and heightening of present dykes, it is proposed to provide about 670 m long additional dikes, especially along the Gonou river. Ten

drainage sluices (2 sluice gates and 8 flap gates) are also proposed to be installed.

(5) On-Farm Development

Considering group cultivation especially land preparation by power tiller and standard holding area of the farmers, the standard size of tertiary block is designed as 15 ha. Taking into account the mechanized farming, the standard lot of paddy field shall be of 0.3 ha (100m x 30m). The leveling shall be implemented after field survey in each lot to avoid uneven growth of rice. The leveling accuracy of plots are set as ± 7 cm, considering factors such as weed control and ponding water depth. The planned tertiary irrigation and drainage canals and related structures in one ha of command area are irrigation canal – 35 m, drainage canal – 35 m.

(6) Operation and Maintenance Plan

All the farmers' organizations (COOPs) in the Grand Canal command area shall formulate a Water Users' Association (WUA) for the O&M of irrigation and drainage. 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. Required subordinate staff shall be hired and equipment shall be purchased. O&M works for irrigation system consist of 1) Water management, 2) Facility maintenance and 3) Administration with the following responsibilities: a) Collection of information on water requirement from farmers and to decide the water distribution plan and water supply plan after adjustment of water amount and period, b) Operation of the irrigation facilities based on the water supply plan, c) Observing the water use condition by a periodical patrol, d) Inspecting the water leakage, facility injury, etc. and to make repair plan of facilities, e) Repairing the facilities based on the repair plan, and f) Fixing the water fee in consideration of required cost for O&M and farmers' payment capacity.

5.5 Agricultural Supporting

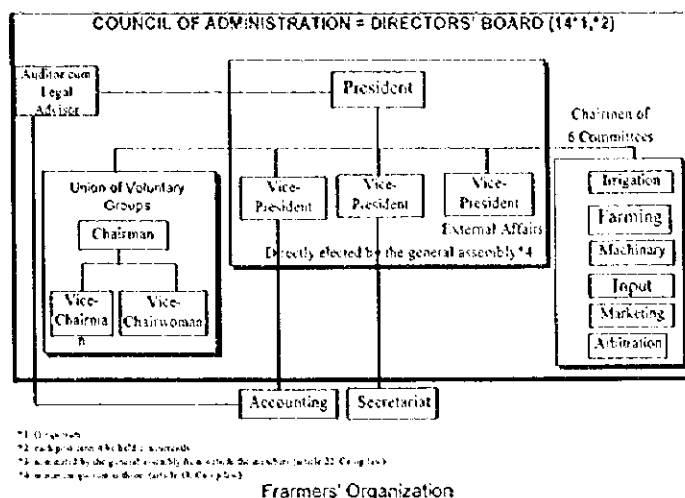
(1) Agricultural Supporting Services

The number of power tiller required for the Project Area of 575 ha is around 60 units of 14 CV power tiller as one unit for each 10 ha. It is essential for mechanized farming to properly maintain machinery and train the operators. The cost of the power tiller is F.CAF 3 million per unit. It is, therefore, necessary to prepare an initial fund of F.CAF 180 million for the purchase of 60 units of power tiller. The following agricultural equipment with spare parts and inputs shall be purchased as the 1st year materials for cultivation: 1) Power tiller (14 CV) : 60 units and spare parts, 2) Sprayer: 366 units, 3) Fertilizer: NPK (10:20:20): 120 tons, Urea : 60 tons, 4) Herbicide: 5,750 lit., 5) Seeds: WITA 7: 9.6 tons, WITA 8: 9.6 tons, and WITA 9: 9.6 tons. These agricultural inputs can be purchased through KR-II under PNR.

The following training will be enforced: 1) Training of extension workers at CFMAG, 2) Training of machine operators at CFMAG and 3) Training of farmers in the Project Area. ANADER is expected to take responsibility on the technology extension services to the farmers. Prior to enforcement of the Project, a farming fund of F.CA 260.31 million shall be arranged. Through the demonstration of high-yielding crop situations and best farm management practices such as land preparation and weed control by the establishment of demonstration plots, appropriate technology shall be transferred to the farmers with the effective support of foreign rice experts and ANADER extension workers.

(2) Farmers' Organization

Taking the expected 383 households in the Project, the size favorable to negotiate a loan with a third party or to be the guarantor of the members into account, a single COOP covering the entire Project Area shall be formed with every participant of the Project as its member. The proposed organization of the COOP in the Project Area as shown in the figure.



*1 0-1 month
 *2 1-3 months
 *3 As decided by the general assembly
 *4 As decided by the general assembly

The entirety of the COOP shall consist of four basic functional units, which are formed by 60 - 90 owners of paddy fields. Six committees are proposed to deal with affairs on irrigation, paddy farming, machinery, agricultural inputs, marketing and arbitration. Each committee elects chairman to represent itself in the directors' board and deal with daily affairs which are under its jurisdiction approved in the general assembly. In addition, through voluntary groups' activities, it is hoped to increase the feeling of amenity in the village life and mitigate the tension in a multi-ethnic society.

The Council of Administration (COA) consists of the representatives of four blocks, the executives, chairmen of six committees, representatives from the voluntary groups and the auditor cum legal advisor. The functions, duty and corresponding power of the board is clear-cut as prescribed in the COOP law. Matters of utmost concern of the Preparatory Committee of Founding COOP(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. The WUA will 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.

(3) Agricultural Financing

Construction works for the Project are estimated to involve about 83 thousand unskilled labor during the period of two years. A net daily wage is estimated at F.CFA 2,850. 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, which will turn to be required capital for farming in the future. COOP shall 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. The main share of COOP's initial base fund will be the contribution of the members. All the selected new settlers' households are to be provided with the leveled housing lot of some 600 m² by GOCI. If a farm house costs F.CFA 3 million, a one-time down payment will be F.CFA 300 thousand at the beginning, then amortization F.CFA 180 thousand, and interest payment F.CFA 54 thousand at the end of the first year. Moreover, one in seven households is required to have a cultivator. The majority will need fund

to buy them. PNR which has been managing the process of distribution could be of instrumental to their negotiation. By rendering service of plowing to six satellite farmers, the owner can claim F.CFA 1.08 million a year. In the initial periods of the Project, agricultural 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.

(4) Agro-industry and Agricultural Marketing

Agro-industry in relation with paddy farming includes rice milling and polishing. Both activities in the context of local market area are within the reach of small enterprises, and any private initiative is welcome. The proposed COOP in its initial stage will have to be preoccupied in selling the harvested paddy, prior to contemplate further means of adding value to its produce. As the commodity of the sale being paddy in bulk, 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.

(5) Training Plan

The farmer's training is basically field practice, and the operator's and extension worker's training is lecture and practice carried out at CFMAG. Training of farmers / new settlers - 383 persons, is to be carried out in a 30 ha mini-project-field. Training consists of field practice and brief site lecture. The main practices of training are 1) Preparation of quality seed, 2) Establishment of nursery, 3) Raising of seedling, 4) Land preparation, 5) Transplanting, 6) Application of fertilizer 7) Weed control and disease and pest control, 8) Field water management, and 9) Harvesting, threshing and drying of harvested grains. The main lectures will cover 1) Knowledge of scheduled rice double cropping, 2) Mutual use of agricultural labor, 3) Irrigation system in the Project Area, and 4) Scientific explanation of each farm practice. Prior to the above farmers /new settlers training, two extension workers shall be selected and specially trained on theoretical and practical aspects of mechanized irrigated rice cultivation. Demonstration shall be done on rice double cropping and vegetable farming in 0.3 ha of farmer's field plot. The demonstration activities for vegetable cultivation have to be carried out carefully with technical support of CNRA.

Considering the limited period of such training, the minimum extent of repairing shall be made for the existing pumping unit. Irrigation canals and related facilities shall be constructed for irrigating 30 ha farm lands by rehabilitating the existing irrigation canals and about 2 km length of tertiary level irrigation canals shall be newly constructed. Perfect land leveling shall be conducted for each farm lot of 0.3 ha with the same preciseness as that of full-scale operation. 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. The demonstration of farming after such training is proposed to be conducted in the farmers' lands of 30 ha within the Project Area for 1) Double cropping paddy cultivation by transplanting, 2) Double cropping paddy cultivation by direct sowing paddy and 3) Double cropping paddy with the combination of vegetables such as tomato and lettuce.

5.5 Settlement Plan

(1) Selection of New Settlers

Total 291 farmers in addition to present 92 low land farmers are to be received in the Project Area as new settlers. In the selection process of new settlers, the 1st priority shall be given to the farmers presently holding lowland in the Project Area and the 2nd priority is to be those whose family has more than three economically active agricultural labors. Preferences shall also be given to the groups composed of three volitional young men/women for rice farming in this area. All the new settlers are obligated to produce minimum yield of 4.0 tons in paddy per ha per season.

(2) Development of New Settlement Area

Based on the average area of 1,300 m² per house in Campus II of Cité Agricole including the community facilities such as school, new settlement area of total 35 ha can absorb 291 householders, and together with existing householders total 383 householder can live in the Project Area. The new settlement shall consist of four villages with following propositions: Settlement 1 to 20.4 ha with 162 households, Settlement 2 to 2.6 ha with 26 households, Settlement 3 to 4.0 ha with 40 households, and Settlement 4 to 8.0 ha with 63 households.

Important considerations to be made while developing new settlement areas are 1) Residential lots shall be distributed to each villager by drawing lots regardless of nationality, ethnic group and home village, 2) The transmission of official information should be well systematized both in an area and among areas, 3) The events which can involve all the villagers shall be held by the villages in cooperation with the Project office in the beginning, and 4) Big trees as recreational places should be left for the community, remaining intact at the time of the site preparation. Community roads, community water supply from four tube wells and community center shall be provided as the rural infrastructures.

5.6 Social Development

(1) Women's Paddy Cultivation Support Program

In this program, women's work shall be organized in order to establish a system of earning income through their work. Organization of women in rural communities shall be carried out in the following three stages: 1) Formation of women's working groups in each irrigation block and creation of source of income by contracting farm work, 2) Promoting the joint management of upland field by working groups and diversifying the source of women's income, and 3) Implementing the joint management of irrigated plot.

(2) School Lunch Assistance Program

With the aim of lightening the burdens of mothers who had to go home to prepare lunch for their school children by stopping their farm work, this program shall be carried out in partnership with related organizations. The following four actions shall be undertaken gradually to complete self-management: 1) Establishment of self-management system within PTA (reinforcement of existing committee), 2) Complete supply of paddy at a modest price by cooperative (about 9 tons/year), 3) Supply of cheaper materials for lunch (through vegetables cultivation in upland fields by the women's groups and the pupils' association, or at irrigated

fields by cooperative and contractual farmers), and 4) Supply of protein sources (through poultry and/or fish raising by PTA, women's groups and the pupils' association).

(3) Pupils' Activity Support Program

The program proposes the following plans as extracurricular activities to improve children's knowledge and skills in farming, thus revitalizing the pupils' association: 1) Providing guidance in paddy planting techniques, 2) Establishing pupils' garden, and 3) Formation of paddy planting children's groups.

(4) Educational Facilities Improvement Program

A new school with six classrooms shall be opened in the new settlement area. Construction of the school facilities shall be requested to FIAU by village committee through municipality office. Maintenance and management of school facilities at the new school are to be carried out by PTA like that of existing school.

(5) Clinic Rehabilitation Program

The existing old dispensary facilities in Campus II shall be renovated. Houses for nurses shall be constructed. 27.5 % of the required costs have to be born by the villagers.

5.7 Implementation Plan

(1) Implementation Organization

As the Project is the component of the proposed projects/program of the Master Plan, the Project shall be implemented under the same organization and procedure. The executing agency of the Project shall be Ministry of Agriculture and Animal Resources (MINAGRA). The Project management committee in central government level and Project office in San-Pédro shall be established. The Project Office in San-Pédro shall manage the implementation of the following components: 1) Preparation of construction of the Grand Canal and rehabilitation of the irrigation and drainage facilities, 2) Settlement of dispute on land in the Project Area, 3) Selection of new settlers, 4) Assistance for formulation of farmers' organization, 5) Guarantor for the credit of initial agricultural fund, 6) Coordinating on the San-Pédro Dam water use, 7) Management of construction tendering and execution of contractor's works, and 8) Operation and maintenance of the Project.

(2) Implementation Schedule

The Project shall be implemented by the farmers participation. The most important factor for the successful Project implementation is animation of the participating farmers, which includes the following items: 1) Obtaining agreement of the farmers involved in the Project, 2) Selection of participating farmers and establishing farmers' organizations, 3) Engaging the participants in construction works and to help them raise farming fund, and 4) Conducting technical extension and training on farming and water management for participating farmers. The Project implementation is planned to complete in 2 years of construction of irrigation and drainage system. At the initial stage of the construction, the training/demonstration farm shall be constructed so as to start the training of farmers immediately. Participation of foreign experts for modern irrigated rice cultivation are indispensable for the success of the Project in terms of

introduction of modern irrigated rice cultivation and also O&M technique to the farmers. In this case the foreign experts should lead the farmers with their strong leadership.

5.8 Project Cost

Based on the prerequisites and regular calculation methods, the total Project cost has been estimated as F.CFA 6,765 million with the following breakdowns: 1) Irrigation and Drainage Facilities – F.CFA 4,817 million, 2) Post-harvest Facilities -- F.CFA 159 million, 3) Land Development for Settlement Area - F.CFA 61 million, 4) Rural Water Supply – F.CFA 25 million, 5) Community Facilities -- F.CFA 60.5 million, 6) Detailed Design and Supervision – F.CFA 512 million, 7) Project Administration and Supporting Services -- F.CFA 516 million and 8) Physical Contingency -- F.CFA 615 million. The annual costs for operation and maintenance of irrigation and drainage facilities of the Project is estimated as F.CFA 70.501 million.

5.9 Project Evaluation

(1) Importance of the Project

The distinctive features of the Project can be summarized as 1) Maximum use of potential water capacity of the San-Pédro dam, 2) Reconstruction of an abandoned irrigated paddy field, 3) Technical transfer to new settlers, 4) Boosting paddy production, 5) Capital formation utilizing unskilled labor quota required during the construction period, 6) Maintenance of an ecological equilibrium in the present environment, 7) Improvement of the classified forest on the right bank of the San-Pédro river, 8) Opening of rural road using the right of way of the proposed Grand Canal, etc.

Moreover, the following synergetic effects are expected from the Project: 1) Increase of domestic paddy production will contribute for reducing the amount of import of rice, and decrease in use of foreign exchange, 2) Income from paddy production will have a stabilizing effect against vicissitudes of economy based on cacao and coffee production, 3) Intensification of irrigated paddy production will eventually attract some more seasonal operators to the area, 4) Paddy production will attract a few small-scale rice-mills, mechanics and, probably and eventually, transporters to the area, and 5) Creating a harmonious multiethnic farming society.

(2) Economic and Financial Evaluation

The economic evaluation is made based on the assumptions of Construction period - 2 years, Project life - 50 years, Social discount rate - 6.25 % and Standard Conversion Factor - 0.87. Exchange rates are set at F.CFA 1.00 = ¥ 0.20, and ¥ 120.35 = US\$ 1.00 as of April 30, 1999.

The economic evaluation results in EB/C=3.7, EIRR=10.4 %, ENPV=F.CFA 3,150 million. Sensitivity analysis is carried out for three alternative cases of 1) increase of costs by 10 %, 2) decrease of benefits by 10 % and 3) combination of the case 1) and 2). They are 9.3 %, 9.2 % and 8.3 %, respectively.

The results of the financial evaluation are FB/C=2.8, FIRR=7.4, FNPV=F.CFA 1,040 million.

Sensitivity Analysis is carried out for three alternative cases of 1) increase of costs by 10 %, 2) decrease of benefits by 10 % and 3) combination of the case 1) and 2). They are 6.6 %, 6.5 % and 5.7%, respectively.

From the results of economic and financial evaluation, the Project implementation has been judged to be feasible.

(3) Environmental Assessment

The comprehensive review of the effects of the Project on the natural environment and their acceptability has been conducted. Also the effects on social environment are reviewed. These reviews show that effects in the field of social life is mainly in the Cité Agricole area. This constraint is acceptable in a context of development policy, and there are no specific measures to be taken. In the field of health and sanitation, acceptability of the Project is strongly determined by the adoption of basic preventive measures. Three-scale environmental acceptability of the Project including results of the sustainability review shows that the Project has definitively good level of acceptability from the environmental point of view.

6. Recommendations

The Priority Project was selected among the projects/programs of the Master Plan of the Study Area. Therefore, the project shall be implemented as a pioneer and model of the Master Plan implementation so that accelerates the implementation of other proposed project/programs. On the implementation of the Project, the following points shall be assured.

- 1) The participatory approach shall be expanded to the stages of preparatory and implementation of the Project based on the activity made during the Study.
- 2) Land disputes shall be settled with the traditional land owners of the Project Area and settle the land ownership of previously settled farmers' before the construction and settlement of new farmers.
- 3) Training of the extension workers for irrigated rice cultivation shall be started before the training cultivation of farmers under the existing training facilities or introduction of foreign experts on paddy cultivation and irrigation.
- 4) Formulate the San-Pédro dam water operation regulation by the technical committee on water use of the dam under the High Commissioner's Office of Hydraulics.