

CHAPTER 4: MASTER PLAN OF INTEGRATED RURAL DEVELOPMENT

4.1 Development Potential and Constraints

As discussed in Chapter 3, the farmers in the Study Area of low-lying Bas Sassaandra Region are faced with the problem of low productivity of agricultural products and poor income. The large-scale paddy field of San-Pédro Paddy Development Project, developed in 1970s are abandoned from the rice production but still remain in the Study Area. The farmers in that area have the lowest standard of annual income. In this section, the development potential and constraints for the development are summarized.

4.1.1 Development Potential

The Study Area is suitable for cultivation of rice and most of other crops, judging from the prevailing climatic, topographic and pedological conditions. Also the Study Area is judged to have large development potential considering both natural and social resources.

(1) Agricultural Land Potential

Based on the morpho-pedological justification, the following areas have been selected as having irrigation development potential;

Area	Estimated Acreage (gross)	Estimated Net Irrigable Area
Fahé, San-Pédro Dam Downstream	430 ha	300 ha
Cpt. Colonel	130 ha	90 ha
San-Pédro Paddy Project Area	766 ha	575 ha
Total	1,326 ha	965 ha

Note: As far as the Right Bank irrigation areas, both of them have not enough catchment area, therefore only the pumping irrigation is possible. Considering the scale of the irrigable area, these areas shall be developed by private farmers then they are excluded potential area in this study.

(2) Water Resources

The future demand in the year of 2015 has been estimated to confirm the water balance in the San-Pédro river basin. The proposed demand of each sector is worked out as described below:

1) Irrigation

The diversion water requirement for the whole proposed irrigation areas (total 965 ha) is calculated as tabulated below. In this case, the irrigation water for all the proposed areas is to be taken from the San-Pédro dam.

Irrigation Area	(Unit: MCM)													Total
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar		
Upstream Area (965 ha)	3.3	0.0	2.2	3.8	2.1	1.7	1.6	0.3	3.2	3.5	4.2	3	28.7	

2) Municipal Water Supply

The future demand of municipal water supply for the San-Pédro city is estimated, considering the population increase, the extension of service area and the increase of consumption per capita. As a result, it is found that the production and distribution capacity of the water supply system will be increased up to 30,000 m³/day in 2015. Thus, the monthly diversion volume for municipal water is calculated as tabulated below. In this case, it is proposed that in the future also the raw water for the municipal water supply will be taken from the same location as the present SODECI pump station.

Item	(Unit: MCM)												Total
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	
Municipal Water Supply Demand	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.8	0.9	11.0

3) Industrial Water

Since no realistic industrial development plan exists, the water allocation for the industrial sector has not been considered.

4) Water Balance and Allocation

Considering the above water demands, the water balance of the San-Pédro river basin has been examined. The monthly run-off volume calculated for the drought rainfall of 5-year return period is applied for the balance calculation. The water balance for the hydrological year from April and to March is presented in Fig. 4.2.1 and its annual balance is summarized below:

- Total run-off volume:	527.2 MCM	(100.0%)
- Evaporation from the San-Pédro dam:	4.5 MCM	(0.9%)
- Irrigation water demand:	28.7 MCM	(5.4%)
- Municipal water supply demand:	11.0 MCM	(2.1%)
- Annual balance:	483.0 MCM	(91.6%)

The annual run-off in the San-Pédro river basin is estimated at 527.2 MCM for the drought year of 5-year return period, and the balance after deducting the various consumption is as large as 483.0 MCM, equivalent to 91.6% of the total run-off.

The monthly variation of the run-off volume at the tail of the dam is also calculated. As a result, it is found that the hydropower generation is possible throughout a year even in the drought years, and the possible hour of operation becomes over 2,900 hr. on condition that about 70% of the run-off at the tail of the dam are used for hydropower generation. This value is considered to be almost same as the total operation hour of the record for 1990.

Although the balance of run-off volume is confirmed 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.

(3) Social Development Potential

The ethnic diversity is a reality and can be a potential. A peaceful contact of different culture always produces something unique new ones. In the region, for example, Bakoué immigrants brought yam cultivation with them to widen the scope of food crop production. Changing of value-system in a community can be regarded as a potential, if the people are persuaded by reason and proof that will be worth while shouldering the task challenging their further effort. Changing from shifting cultivation to sedentary cultivation has a huge potential.

The existing traditional communities, based on the same ethnicity, nationality or religion, can lay the foundation of modern and official units which will be expected to evolve into formal groups whose purpose, objectives and goals are explicitly defined. In the Study Area, there is only one women's formal GVC at present. But the women seem to show more potential for being organized well because of more constraints they face than men and can't individually cope with: less accessibility to land, fund and market. Their will to overcome these difficulties leads them to form associations.

4.1.2 Constraints on Rural Development

In order to achieve the agricultural and rural development in the Study Area, the following items have become out as the constraints:

(1) Physical Constraints

- 1) **Erratic rainfall:** Rainfall pattern in the Study Area allows the annual crop cultivation without irrigation only in the wet season. Even in the wet season it becomes impossible in some years.
- 2) **Flooding in the wet season:** Lower plain suffers from floods caused by the San-Pédro river and its tributaries annually. These are caused by the topographic condition and small flow capacity of the San-Pédro river. San-Pédro Dam can control the flood in the downstream only a little because of its structural limitation and hydropower generation. Tributaries have no fixed river course in the lower plain.
- 3) **Drought in the dry season:** There is no water storage facility in the Study Area to supply water during the dry season. Shallow wells used for drinking water usually dry up in the dry season.

(2) Agricultural and Agro-economic Constraints

- 1) **Traditional shifting cultivation:** The shifting cultivation is most popular in the lowland and sloped land in the Study Area except for the San-Pédro Paddy Project Area. This practice with minimum agricultural input, results the production losses and causes land erosion.
- 2) **Commercial tree crop cultivation:** As same as other tropical forest area in Côte d'Ivoire, cacao and coffee cultivation on the slope of the hill occupies more than 70% of the total cultivated land in the Study Area and they are operated with less labour input. Recently rubber plantation development has been penetrating into the Study Area, that is operated by the contract farmers with a rubber manufacturing company. This tree crop cultivation is performed by hired labors and low insensitive production is dominant. Also acid soils and rainfall pattern is unfavorable for these tree crops especially cacao production.
- 3) **Underdevelopment of modern irrigation farming:** Although the paddy irrigation system was installed in the Study Area, it could not be sustained by the farmers. They did not have experience on modern irrigated farming and irrigation water management by group.
- 4) **Lack of agricultural equipment/machinery:** Although a few tractors were introduced in the area, especially in San-Pédro Paddy Project area, most of the farmers cultivated using the traditional tools (*daba, machette*). It is caused not only by financial ability but also by poor accessibility to the cheaper government equipment providing system (2KR).
- 5) **Low accessibility to agricultural market:** Shortage of transportation and poor rural road network obstruct the access of products to the market.
- 6) **Non availability agricultural credit/loan:** After closing BNDA, the farmers have lost their chance to receive cheap credit/loan for the agriculture.

(3) Social and Human Resources Constraints

- 1) **Various groups with different cultural background:** The Study Area consists of mainly three nationalities (Ivoirien, Malien and Burkinabé). They are further divided into more than 10 ethnic groups showing cultural diversity characterized by various knowledge, norms, beliefs or values. Among these different groups, ethnocentrism manifests as an obstacle to the formation of multi-ethnic organizations. Additionally, social factors such as ethnicity, gender and nationality determine the access to resources

and public services, and also attribute to political and socio-economic inequalities. This fact prevents people from not only forming but also maintaining organizations for the common objectives and interests.

- 2) **Land disputes:** Indeterminate title to land hinders its efficient use and investment in agricultural land. Moreover, it leads to land disputes as the demographic pressure increase. Though virgin forest has almost disappeared in the Study Area nowadays, newcomers or young generations are anxious to obtain their own plantation.
- 3) **Poor management of farmers' organizations:** In addition to the difficulty of formation, existing organizations (GVC) are not managed well, especially with regard to accounting. The lack of transparency concerning "money" is the biggest cause of the fission or dissolution of GVCs.
- 4) **Inadequate extension service:** Not only the number of extension workers is not enough but also the quality of their services is low, and the fact doesn't allow the farmers to receive sufficient and appropriate technical support.
- 5) **Low accessibility to basic social facilities:** People living in the Study Area sometimes can not reach educational or medical facilities due to complicated reasons: low density of facilities, lack of financial ability, bad condition of access roads and lack of transportation means.
- 6) **Limited accessibility to information:** Farmers can not have much information on agriculture (advanced technology, marketing etc.) as well as daily life to improve their farming or living condition. Then it is attributed to low literacy rate and limited exchange of information or experiences among individuals, particularly who belong to different ethnic groups.
- 7) **Dependence on assistance:** Subsidiary system supporting the agricultural development implanted deeply aid dependence in farmers' mind, and they got used to top-down way of thinking even regarding their own farming. The forfeit of autonomy is considered as one of barriers to "participatory" development.

4.2 Objectives of Integrated Rural Development

The Study aims to formulate an integrated development plan of the Study Area through solving the constraints for development of confirmed development potentials to 1) increase agricultural production, 2) enhance the prosperity of the Study Area 3) improve the living standard of the farmers. Finally, it can activate the regional economy and contribute the national economic development and self-sufficiency of food. Therefore, each development scheme of the plan shall be integrated and they shall be combined to get synergetic effects.

The irrigated paddy cultivation using the water resources of San-Pédro Dam was introduced to the San-Pédro plain within the Study Area in 1970s. However, it was abandoned recently because of several reasons. Then the rehabilitation of this project is expected to facilitate 1) to re-cultivate in the reclaimed paddy land, 2) to formulate the sustainable farming especially paddy and 3) to resettle the abandoned farmers in the Study Area. On the other hand, tree crop cultivation and lowland food crop cultivation are practiced in the eastern hilly parts of the Study Area, where most of the people are living. Agricultural and social development in this area is also important for the regional development. Additionally, careful consideration shall be paid to the environmental impact of the proposed development in the Study Area and its adjacent areas.

4.3 Basic Concepts of Integrated Rural Development

4.3.1 Basic Concepts for Rural Development

(1) Agricultural Development

In the Study Area, low land utilization and poor yield largely hinder the farming incomes. The land utilization ratio in the lowland is 61.7% in the wet season and 1.7% in the dry season. In the upland, it is 46.7% in the wet season and 8.3% in the dry season. Such low land utilization is mainly because of rainfed field conditions with useless irrigation facilities and poor drainage conditions in the lowland, and the traditional shifting cultivation in the upland. The poor yield is greatly caused by less input farming, bringing high risk and low result of inputs. On the tree crops, the low productivity of cacao is a problem caused by the unfavorable natural condition in the Study Area. Moreover, the farmers in the area strongly expect increase and sustainable farm income with improvement of irrigation and drainage facilities, introduction of promising crops and improved technology. Taking into consideration the above situations, the strategy for the agricultural development is set as:

***“Increase of farming income by
(1) Effective use of land;
(2) Increase of yield; and
(3) Introduction of promising crops”.***

To realize the strategy, it is required to strengthen the farmers' organization, the technology on extension activities and the marketing system. From the physical and agro-ecological viewpoints, the Study Area can be divided into three (3) agricultural zones; 1) undulated hill-top and their slope, 2) valley of hills as called “bas fonts” and 3) San-Pédro river left bank alluvial plain. Agricultural development shall be formulated based on these three (3) agricultural zones. (Fig. 4.3.1)

(2) Social Development

Not only the social but also the economic development mostly depends on people (participants), since the development for the people should be extended by the people (participants). And “Organization” must be one of the determinants to the development activities, because people can participate in the development more effectively through their organizations.

The plan is required to reflect potential participants' intentions and concerns harvested during the survey as well as the lessons gained from experiences in the past in order to respond to their needs and to motivate them to take part in the development activities in the short term. In the long run, the people have to “advance development” by themselves along the plan in order to become not only real beneficiaries but also actors of the development. From this standpoint, “organization of people” is an indispensable tool to participatory development and its strategy or plan should be elaborated in consideration of all aspects to be examined in the Study. From the social viewpoint, the organizations need the following basic principles:

- *help the members to get out of present difficulties that they can not individually cope with* (= motivations for people to associate with each other) ;
- *make best use of existing groups*, especially traditional ones (by gender, generation, ethnicity or religion) whose members act and help each other usually under the same rules and customs (= source of sustainability to maintain the organization at first stage);
- *promise to the members equity, benefit (above all economically) and empowerment* (= sustainable source to develop the organizations in the long term).

The concepts of the integrated rural development in the Study Area are shown in Fig. 4.3.2.

4.3.2 Proposed Target Year and Strategy

(1) Target Year

The Government has issued the long term national agricultural development plan (1992-2015) and national rice development plan (1996-2005). Considering these national development frameworks and the present conditions of the Study Area, 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.

(2) The Strategy of the Integrated Rural Development

The master plan has been formulated based on the above development concepts and target year. In the medium term master plan stage, the base of the development has been set for the implementation of the schemes which has the demonstration and training functions. Then the development of the whole Study Area is to be realized. The investment to the development schemes in medium and long terms is arranged considering the financial ability of the Government and also the farmers.

In due consideration of the failure of San-Pédro Paddy Project, the following process has been proposed for the implementation of the master plan:

- Farmers/villagers are targeted to improve their living standard through the agricultural and social development. They should take up the physical and institutional improvement by themselves.
- Farmers/villagers shall be involved in the development scheme from the planning stage and share the responsibility for implementation. The Government shall guide them and provide them with the required actions and coordination through the project implementation.
- After empowerment of the farmers/villagers through the implementation of the demonstrative development scheme, they are expected to maintain the sustainable development by themselves.

(3) Internal and External Conditions

The master plan shall be operated in sustainable conditions by the end users or farmers. The present ability of the farmers and regional conditions in the Study Area has to be evaluated in the formulation of the proposed plan. There are many aspects to be considered in relation to the implementation of the project. Land problem will require legal settlement by the Government. Also the large-scale investment cost shall meet the capability and scale of the Government budget. Among the required development measures, the projects urgently required and the ones of which problems can be easily solved within the region shall be implemented in the first stage. The projects requiring the assistance from the external agencies concerned shall be implemented in the second stage of the project.

4.3.3 Components of Integrated Rural Development

Through the careful analysis and the countermeasures on the development constraints are proposed as shown in Table 3.9.1, the master plan components of integrated rural development in San-Pédro Plain are summarized in Table 4.3.1, and the explanations are made hereinafter:

(1) Farmers Organization (OPA/COOP)

The functions of organizations are; 1) management (funds, land, water, etc.), 2) distribution to the members (responsibility, funds or input and information), 3) collection from the members (products, charges and opinions), 4) commercialization of products (quality control, marketing, stock and transportation), 5) maintenance (infrastructure and equipment) and 6) coordination and negotiation (among the members and with external organizations or parsons). The organizations lead, through its "sound" functions, the members to reach the goals: 1) to ensure the access to supporting system, at first, 2) to increase the production and 3) to improve the conditions of products commercialization. Existing groups have some of the above functions but not enough to evolve into self-reliant and sustainable organizations. The reinforcement or establishment of farmers' organizations, therefore, in the development, requires much efforts by themselves and also the improvement of external conditions related to the organizations such as technical supporting services, finance system, information networks, infrastructure, etc. And participants must be conscious of their powers and responsibilities through lessons in the process of development of their organizations. Then the following programs shall be implemented in the Master Plan:

- Create a unit cooperative (COOP) based on groups of people in same residential area, irrigation blocks or village, then organize a union of COOP in the village level.
- Maintain independence of treasury section from the secretariat section; let ANADER provide accountants to COOPs and educates the candidates of COOPs; cooperatives concerned are to pay remuneration to the accountants they chartered; deposit cash in COOPEC and keep accounting records.

(2) Lowland Farming

Agriculture in the lowland such as San-Pédro Paddy Area shall be developed basically by the irrigated paddy cultivation in order not only to secure the farmers' own food but also to contribute to the national policy of self-sufficiency in food. And introduce vegetable cultivation will increase the agricultural incomes and effective use of irrigation water. The following matters shall be considered:

- Stabilization of irrigation water sources
- Improvement of drainage canal
- Land leveling
- Introduction of double cropping of rice
- Introduction of mechanized farming
- Introduction of vegetable cultivation
- Improvement of farmers' organization
- Improvement of marketing system
- Improvement of technology support system

(3) Upland Farming

Food crop production shall be improved in upland. The upland farming shall include food crops such as maize, upland paddy, cowpea and leguminous crops, using land intensively to increase the productivity. The following matters shall be considered:

- Intensive use of land
- Introduction of new crop varieties
- Cropping system improvement

- Maintenance of soil fertility

(4) Tree Crops Farming

Tree crops in the Study Area occupy more than 70 % of the cultivated land. The cacao production in the area is decreasing not only due to the aging of trees but also natural conditions of the area. Therefore, the countermeasures against decreasing cacao productivity shall be studied in the formulation of the plan. Components of the tree crop farming shall include the following items:

- Selection of suitable crops
- Maintenance of soil fertility
- Improvement of crop management
- Construction of drying facilities (concrete yard)
- Improvement of marketing system

(5) Agricultural Extension Services

Training of the extension workers shall be performed through continuous education of the present workers of ANADER and also by recruiting the workers from outside.

(6) Agro-industry and Marketing

In order to increase the value of agricultural products, the following activities are proposed:

- Establishment of OPA for agro-industry: OPAs have to behave themselves like business-minded concerns and take part in any necessary agro-industry to improve the quality of their produce.
- Improvement of market access: OPAs have to take part in marketing activities as a business enterprise.
- Improvement of market information: Timely market information flow from OCPV is necessary.

(7) Agricultural Credits

Improvement of access to the agricultural credit: While each COOP joins COOPEC, reputation of having healthy cooperate structure shall be built up.

(8) Irrigation and Drainage

The following areas are considered as the irrigation development areas in the Master Plan (Fig.4.3.3).

Area	Acreage (gross)	Present conditions	Possible water sources for irrigation
Fahe, Dam downstream	430 ha	Cacao, coffee, upland crops and grass land. Rubber plantation area is increasing. southern arc is flood plain of the Niré river	San-Pédro dam through the unused industrial intakes
Cpt. Colonel	130 ha	Lowland paddy, forest, and upland crops. Causal inundation by San-Pédro river and tributaries	Extension of Fahe irrigation canal or small dam among the hills
San-Pédro Paddy Area	766 ha	Rainfed paddy and cultivable waste, Pump irrigation was practiced but stopped more than 4 years, pumps might be possible to use	San-Pédro Dam. Gravity irrigation by headworks installed in the San-Pédro river or re-use of existing pump

Irrigation development plan in these areas has been formulated on the following aspects after careful review and analysis of the reasons of previous failures of the irrigation project:

- Irrigation water requirement for paddy cultivation
- Available water sources
- O&M of irrigation system
- Rehabilitation of irrigation facilities
- Land leveling
- Drainage improvement

(9) Rural Infrastructure

Among the rural infrastructures, the following improvement plans are to be formulated. However, no rural electrification is considered due to the present situation of the sector at regional and national levels:

- Improvement of rural road networks
- Installation of rural water supply facilities

(10) Social Development

The socio-economic development depends on the group of people (participants). Therefore, the formulation of organization is one of the basic necessities of development activities. Many problems and constraints on the development such as access to KR-II can be solved directly or indirectly by organizing the concerned farmers into groups.

Besides that, organization itself can function as a communication unit, then it becomes indispensable for effective technical extension work and spread of basic education activities such as literacy activity, where supporting system for farmers has not been developed enough yet. Moreover, organizations can provide farmers with an occasion where an individual obtain ideas, skills and experiences through interactions with others and by trial and error process so as to free themselves from their dependency on the government.

On the other hand, organizing the farmers into associations may be accompanied with many troubles, particularly within a multiethnic immigrant society. Additionally, farmers do not have adequate abilities or skills to manage organization smoothly, regardless of its ethnic composition, either mono-ethnic or multiethnic. For more effective organizing and managing the organizations, the following measures are proposed.

- Old settlers of the first generation are organized based on groups of people sharing something common such as ethnicity, nationalities or religions, while the youth of the second generations, rather based on local groups i.e. by villages.
- Organizations provide members an opportunity to learn the improvement of their abilities, which ultimately leads the organizations themselves to evolve.
- Organization having simple function shall be developed into one with multifunction as its members are acquiring both experiences and abilities or skills.
- In consideration of the available existing external conditions (suppliers of land, capital and services), functions and official status (officially recognized cooperatives or not) of an organization shall evolve during the course of time.

Thus, the following schemes of organizing the women and youth who are not now the members of GVCs in order to provide them with the opportunity for participating in the proposed rural development more effectively.

- Formulation or Reinforcement of Women's Groups
- Creation of School Bodies and Diversification of its Activities
- Creation of Young Farmer's Club
- Improvement of accessibility to social facilities

(11) Environmental Conservation

The objective of environmental conservation and protection sets out two (2) types of favorable conditions, namely:

- The dynamics of rural development shall not impair the existing potential of natural resources now and in the future: Hunting and fishery resources typically belong to this type of resources;
- The implementation of the project shall not induce negative and unacceptable effects compared with the present conditions in terms of social and natural environment. Acceptability is determined by respecting the legal requirements and participation of local communities.

Fulfilling both these two (2) conditions will be the guarantee that environmental sustainability is taken into account. The first condition can be fulfilled, if certain specific objectives are implemented. These objectives can be identified according to the sensitive issues that have resulted from the analysis of the present conditions in the Study Area. They are:

1) Conservation and Protection of Natural and Environmental Resources

- to stop the depletion of the fishery resources;
- to take into account the local value of hunting for food;
- to control pressures that are threatening some valuable species.

2) Employment and Resettlement of People

Agricultural intensification implies to improve the management of environment as a prerequisite; otherwise induced demographic increase generates depletion of valuable resources and nuisances and degradation of environment. At the same time, intensification is the only way to improve the conditions for the proper conservation of important natural areas by preventing extensive use of land. Reasonable and proper balance of development needs to integrate and to plan the employment and resettlement aspects as the factors of sustainability for the social environment. The proximity of the Study Area to the classified forest on the one hand and to the San-Pédro city on the other hand make employment and resettlement a sensitive issue. The coordination between the objectives of the project and those of SODEFOR for the classified forest is desirable in this context.

3) Appropriate Use of Agro-chemicals

The use of pesticides raises potential threat on health through water consumption and consumption of fish or bush meat. Crawfish, which is very sensitive to water pollution, constitutes a valuable resource for the people. The same could be said of Cane Rat, which is, however, harmful to paddy fields. A lot of villagers depend on the fishes caught in the irrigation drains for their daily diet, which is a potential contamination route in the context of an intensified crop production. The problem of water contamination is a real one in the period of low water flow.

4) Prevention and control of water-born diseases

These measures can be integrated in a hygiene and sanitation improvement plan.

5) Integrated Management of Water Resources

The management of the water resources has become increasingly critical, because conflicted needs are ready to emerge in relationship on quantity and quality conditions of water use for agriculture, fish breeding, maintenance of a minimum river flow and development of water supply. The conservation of forest cover and the reforestation of Go watershed upstream is an example of issues to consider in the sustainability of the resources.

4.4 Formulation of Master Plan

4.4.1 OPA/COOP Formulation and Reinforcement Program

As shown in Fig.4.4.1, the reinforcement of OPA is one of the two pillars of the Master Plan, the target of which is to improve the living standard of the farmers in the area by increasing the agricultural production. The other is the improvement of infrastructures and facilities necessary for guaranteeing the farmers on the technically stable agricultural production.

'*Organisations Professionelles Agricoles*' (OPAs) imply any group of people who engage in agriculture. The GOCI, according to its short-term agricultural sector policy (1998-2000), conceives an ideal balance of power to be maintained between the OPAs and the mostly corporate private enterprises (except those of farmers, if any) in the context of free market economy in the sector, where the latter dominates the scene. Therefore, at the time of privatization, there is an urgent need for the OPAs to raise their operational efficiency to catch up the private enterprises to prosper themselves, at which the policy has been aiming. Among many types of OPA, '*Groupements à Vocation Coopérative*' (GVCs) have been the most significant profit-making bodies, and the government's effort has been centered on their development.

The observed fundamental phenomenon in the agricultural production system of the Study Area is a big jump from that of a traditional *Shifting Culture* to that of a *Sedentary Culture*. This change of land use has eventually resulted in the change of land property rights from communal ownership to individual ownership. It must have profoundly shaken the conceptual understanding of individual's mind on the land holding. This culture shock will resolve into an undercurrent of the individual's way of thinking for long time to come, whatever the programs are brought in in the process of the betterment of OPA operations.

Now, GOCI promulgated the new cooperative law (hereafter the law) in December 1997 in order to upgrade the quality of GVCs. The plan of formulation and reinforcement of GVCs for food-crops shall be developed observing the law as a benchmark. Article 5 of the law, for example, clearly writes that the objective of COOPs shall always contribute to promote the economy of the members. And an applicant for forming COOP is required to submit a technical and financial feasibility study of the project for which it is to be organized. This upgrading efforts of the standard of financial institutions, thus, have two references; of the final goal of satisfying the objective, and of the practical guide map which is to be made by the members themselves to reach the goal. The effort will start from helping them to conduct a feasibility study, while keep reminding them of the objective of COOPs that they are organizing.

In the Study Area the formulation of an organization across the different ethnicity has been found very difficult. First, therefore, as a counter-measure, a unit COOP shall be organized

based on the farmers in same residential area, irrigation block, village etc., if enough members can be recruited, then gradually induce them to form a union of COOP at the village level. Second, at the initial stage, the scope of a project shall be as narrow as possible so that even the uninitiated member could easily fathom the meaning, as are the cases with existing GVCs for production of cacao and coffee, whose activities are mostly limited to transporting and selling of the produce.

Then attention is directed to the division of labour in an organization, as poor management and unclear cash transaction seem to be an everyday occurrence. In the first instance, a clear-cut job description is to be written with an intention of rectifying the above-mentioned constraints. They will be eventually best solved by letting the treasury section be independent from the secretariat section. The zone office of ANADER may supervise the process. It is to be asked to modify its system so that it will be able to provide accountants to COOPs and to educate their novices or recruits at the same time. The COOP concerned shall prepare the budget for the cost of remuneration of the accountants they charter.

The process of producing food crops for market starts from preparation of farmland and ends with selling the produce. This span may roughly be divided into processes of cultivation, after-harvest processing and marketing, and each could further be sub-divided into segments. One can allocate required cost to each segment and estimate the corresponding financial benefits. So, a financial feasibility study could be conducted for any project that covers a certain part of the total process. The narrower is one's coverage of the span, the simpler is the structure of an OPA, but the more numbers of OPA are required to cover the total span. The optimal initial setup of each OPA depends on its natural, social and economic circumstances. They differ from a case to another.

4.4.2 Lowland Agricultural Development Program

The objective area for irrigation development in the Study Area is estimated at 1,326 ha in total, that is; 766 ha in San-Pédro Paddy Area, 430 ha in Fahé and 130 ha in Ctp. Colonel. From the viewpoints of ensuring own foodstuff and contribution to the national policy, it is proposed to introduce rice double cropping programs suitable for these irrigation development areas. However, to secure the best farming income and the more effective use of irrigation water, rice double cropping combined with vegetables are also proposed.

(1) Required Agricultural Infrastructure

In order to accomplish the lowland agricultural development programs, the following agricultural infrastructure improvement measures are required:

1) Stabilization of irrigation water

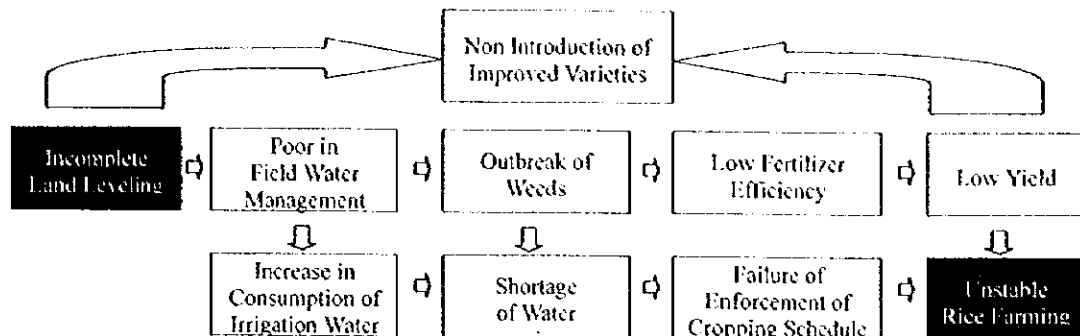
Ensuring water source is indispensable for stabilization of lowland farming. Furthermore, the irrigation canal density has to be improved to the level enabling the proposed irrigation schedule.

2) Development of drainage canal

Many of the fields have low productivity because of poor drainage, resulting in decrease of yield and abandonment of cropping due to submergence. Considering the above, the improvement of the drainage system is also indispensable.

3) Land leveling

Land leveling is the basic practice for the success in lowland rice farming. One of the great constraints on lowland rice farming in Africa is weeds, in general. Water shortage and unlevelled field conditions bring the severe outbreak of weeds and finally reach the unstable rice farming as shown below. In this project, land leveling by machinery at the stages of land reclamation and land preparation are to be planned.



(2) Rice Double Cropping Program

Two type of rice double cropping programs, one for transplanting culture and another for direct sowing culture, are proposed in consideration of the present habitual rice cultivation practice.

1) Variety to be used

New rice varieties WITA 7, WITA 8 and WITA 9, recently released from WARDA are introduced in both the programs of transplanting culture and direct sowing culture. These varieties have shorter duration than the present prevailing variety B-189 with yield potential of 7.1 to 8.6 ton/ha and tolerance to RYMV. A countermeasure to RYMV is needed as severe symptom like RYMV was found out in several fields in San-Pédro left bank.

2) Cropping schedule

Two cropping schedules for transplanting culture and direct sowing culture are proposed (Fig.4.4.2). Making the schedules, priority was given to set the harvesting times in the midst of the dry periods in each cropping seasons because drying of harvested grains will become serious problem for the farmers in future.

3) Mechanized land preparation

Mechanized land preparation with power tiller is to be introduced in these programs because well land leveling is the basic practice for the success in lowland rice culture. The cost of mechanized land preparation with power tiller is estimated at F.CFA 65,092/ha including the cost for the 1st and 2nd plowing.

4) Improved cultivation method

It is proposed to introduce the improved cultivation method in the planned rice double cropping. Details of the improved cultivation methods are shown in Table 5.4.1 for transplanting method and Table 5.4.2 for direct-sowing method.

5) Production, production costs and income

The target yield of paddy is set at 5,500 kg/ha for the transplanting cultivation and 4,500 kg/ha for the direct-sowing cultivation based on the prevailing climate condition in the Study Area. The production cost and income of the rice double cropping programs are shown in Fig. 4.4.3 and summarized as bellow:

		Production (kg/ha/year)	Unit Price (F.CFA/kg)	Production Cost (F.CFA/ha/year)	Gross income (F.CFA/ha/year)	Net Income (F.CFA/ha/year)
Present	In 1997	1,178	159	163,661	187,302	23,611
	High-yield year*	3,478	159	163,661	553,002	389,311
With Project	Transplanting	11,000	157	837,580	1,727,000	889,420
	Direct Sowing	9,000	157	751,500	1,413,000	658,500
	Average	10,000	157	796,040	1,570,000	773,960

*: Crop cutting survey by ANADER in high yield year.

(3) Rice and Vegetables Cropping Program

Two types of rice and vegetable cropping programs; that is, Rice and Tomato cropping program and Rice and Lettuce cropping program, are proposed as shown in Fig. 4.4.2. In this case, the vegetables are to be introduced to an area of 0.1 ha of the rice cultivation area 1.5 ha/farmer, which will result in estimated net annual income being twice that of the rice double cropping. Though a remarkably high income is obtained, the cultivation area shall be restricted by the relationship between the demand and the supply of the market and the available labor force in the area. The estimated incomes and expenditure of the rice cultivation combining tomato and lettuce farming in the total irrigation potential area, 965 ha, are shown below:

Cropping pattern	Season	Area (ha)	Crop	Yield (kg/ha)	Production (ton)	Gross Income (F.CFA 1,000)	Production Cost (F.CFA 1,000)	Total Net Amount (F.CFA/year)
Rice+Rice	Wet	837	Rice	5,000	4,185	657,045	333,142	323,903
	Dry	837	Rice	5,000	4,185	657,045	333,142	323,903
Rice+Tomato	Wet	64	Tomato	20,000	1,280	896,000	61,491	834,509
	Dry	64	Rice	5,000	320	50,240	52,473	24,767
Rice+Lettuce	Wet	64	Rice	5,000	320	50,240	52,473	24,767
	Dry	64	Lettuce	20,000	1,280	128,000	37,370	90,630
Total	Wet	901	Rice	5,000	4,505	707,285	358,616	348,669
		64	Tomato	20,000	1,280	896,000	61,491	834,509
	Dry	901	Rice	5,000	4,505	707,285	358,616	348,669
		64	Lettuce	20,000	1,280	128,000	37,370	90,630
	Total	1,930	-	-	11,570	2,438,570	816,093	1,622,477

(4) Other Related Programs

In order to implement the rice double cropping program, the following activities are required to be conducted at the same time:

- Water users' association and growers' association for group purchase of input materials and group forwarding of products are planned.
- Stabilized marketing system with reasonable price is planned.
- Technology support system: With introduction of mechanization and advanced technology on rice cultivation, a new technology extension system tied up with CFMAG, is necessary. In connection with the technology extension for the vegetables, an effective extension method with demonstration plots in collaboration with CNRA is planned.

(5) Appropriate Land Holding Size for Rice Double Cropping Agriculture

The agricultural development in the Study Area is expected to absorb the immigrants from the Rapide Grah Classified Forest by SODEFOR. And the re-distribution of developed land shall be prepared to provide the opportunity for the farmers there to join the project. The estimation of minimum scale of the farmland for one farm household is made based on the following criteria:

- Farm income by the paddy double cropping shall be more than the average annual salary of

Côte d'Ivoire at F.CFA 1,200,000.

- Rice double cropping income a year is F.CFA 773,960/ha (average of direct sowing and transplanting)

Then the minimum farmland requirement is estimated at 1.5 ha.

Area	Net area to be developed(ha)	No. of farms	Amount of production (ton/year)	Amount of net income (F.CFA 1,000/year)
Fahé, Dam downstream	300	200	3,000	232,188
Cpt. Colonel	90	60	900	69,656
San-Pedro Paddy Area	575	383	5,750	445,027
Total	965	643	9,650	746,871

4.4.3 Upland Agricultural Development Program

(1) Intensive Use of Land

In the Project Area, the net income of upland farming is the lowest (F.CFA 113,374 /ha), which is 62 % of the tree crop farming and 29% of the lowland paddy farming (Table 3.4.1). The lowest farming income is due to low yield and low land utilization resulting from the lowest input farming and the shifting cultivation. From such situation, the plan of upland agricultural development program focus on the intensive land use and increase in yield.

(2) Cropping Program

To achieve the targets, cropping programs combined with upland paddy (wet-season of the 1st year), maize (wet-season of the 2nd year) and high drought tolerant crops/varieties of cowpea (Tvu 11979, Tvu 11986, Tvu 12348, *Vigna unguiculata* L.) or groundnut in dry-season is proposed (Fig 4.4.4). These cowpeas were recently selected at International Institute for Tropical Agriculture (IITA) and have obtained the grain yields of 1 ton/ha in dry season of savanna in Nigeria. The adaptability test for the Study Area in the dry-season is being made by CNRA with the request of JICA Study Team.

The recommended cultivation and the estimated income and expenditure of the upland rice and the maize cultivation are shown in Fig. 4.4.4. 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 *Leucaena leucocephala* planted along contour lines is also proposed. The alley cropping provides green manure and mulching material for the food crops, browse for livestock, staking material, firewood and biologically fixed nitrogen to the crops. Plants along the contours of sloping land also controls soil erosion. It can easily be adopted by resource-poor farmers. The summarized results of the farming performance are shown below:

Cropping Year	Cropping Season	Crop	Production (kg/ha)	Production Cost (F.CFA/ha)	Gross Income (F.CFA/ha)	Net Income (F.CFA/ha)
1 st Year	Wet-season	Upland Rice	3,000	183,575	477,000	293,425
	Dry-season	Cowpea/groundnuts	1,000	52,500	200,000	147,500
2 nd Year	Wet-season	Maize	3,500	170,600	364,000	193,400
	Dry-season	Cowpea/groundnuts	1,000	52,500	200,000	147,500
Average per Year			4,250	229,589	620,500	390,913

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.

4.4.4 Tree Crop Development Program

(1) Low Productivity of Cacao

The target of tree crop development program is to increase the financial returns from cacao farming. Therefore, for the low productive cacao farming areas of 2,577 ha or 618 producers, a change of crop from cacao to coffee is proposed. ANADER also recommends coffee cultivation in place of cacao.

(2) Shifting Cacao to Coffee

In the plan, 258 ha (10%) of the cacao field is to be changed to coffee within 5 years from 2000 to 2005, and 438 ha (17%) in the following 5 years as shown below:

Year of change to coffee	Number of Cacao Farmers		Area Cultivated		Average Net Income* (F.CFA/ha)
	Number	(%)	(ha)	(%)	
Up to 1999	118	19	206	8	-16,054**
2000-2005	68	11	258	10	-27,432
2006-2010	148	24	438	17	52,582
After 2011	284	46	1,675	65	310,031
Total	618	100	2,577	100	-

* Average of 1997 and high-yield year

** Young tree farms before bearing

Source: Interview survey, IICA

4.4.5 Agricultural Supporting System Improvement Program

(1) Lowland Farming Supporting System

The details of lowland farming supporting system are described in section 5.6.1.

(2) Upland Farming Supporting System

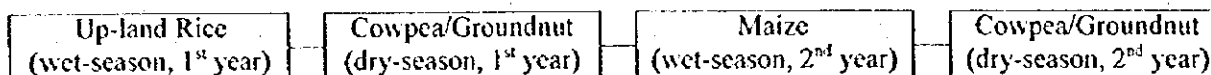
The target of improvement of upland farming is the increase in crop production and farming income based on the integrated production technology of application of fertilizer, improvement of cropping system (intensive land use) and introduction of alley cropping. ANADER is to diffuse the technology to the farmers through the demonstration fields.

1) Establishment of demonstration fields

ANADER establishes a demonstration field composed by 0.1ha of farmer's up-land field in each in-charge area of the extension workers.

2) Demonstration details

- Introduction of alley cropping: The seeds of *Leucaena leucocephala*, leguminous species, are sowed along contour line in width of 4 meters between hedgerows. This width is quite satisfactory for continuous food crop production. During cropping, the hedgerow is pruned at the height of 25 to 75 cm to avoid shading the food crop. The cut branches can be used for green manure or mulch material for the food crops, for small ruminants fodder in dry-season because of their high protein content and for source of firewood.
- Improvement of fertilizer application: Based on the recommended fertilizer application method by ANADER, application technique should be improved.
- Improvement of cropping system: Following intensive up-land cropping system integrated with the alley cropping and the improved fertilizer application is proposed.



Note: After the 3rd year, repeat the above cropping system.

(3) Tree Crop Supporting System

ANADER shall support the farmers on the following three points.

1) Selection of deficit cacao farm

Based on the data obtained from the interview survey, it is considered that the deficit cacao farm is the farm which has a yield of below 270 kg/ha. However, in the enforcement of changing crop on the farmer, it is needed to hear well the farmers' opinion with technical analysis of the farming.

2) Propagation and supply of seedlings/young trees

ANADER propagates the necessary amounts of coffee seedlings/young trees in its own station and supplies it to the farmers at cost (10,000 F.CFA/ha). The necessary amounts of nursery for the development plan are as below:

Year	2001	2002	2003	2004	2005	2006 to 2010
Area to be planted (ha)	52	52	52	52	52	438
Necessary young trees	78,000	78,000	78,000	78,000	78,000	657,000

Note: Planting density: 1,500/ha

3) Recommended plant husbandry

Coffee plant husbandry shall be made following to the ANADER's direction.

(4) Post-Harvest Development Program

In general, OPAs have to behave themselves like business enterprise and take part in any necessary agro-industry to improve the quality of their produce. As this type of program has potential to have high financial returns, a co-op could be organized.

Activities on post-harvest improvement program start from drying and storing of the crops before entering into further processing. Any OPA could be formed to provide the space with or without roof for members' use. Improvement in quality during these processes will contribute to fetch a correspondingly higher price. Then actual processing will begin. In the food-crops sub-sector, there are the processes of threshing and polishing of paddy, and flour milling of maize and cassava. Parboiling of paddy creates not only a higher value-added product, but also produces nutritionally enriched foodstuff for farmers' household use; and shall be brought into this process. The process, which so far carried out by individual farmers, shall be managed by any OPA. Then stocking of the produce is very important part of the process, as OPA could keep the produce until market is favorable to the seller, if they can financially afford to do so. To increase this type of affordability is an ultimate aim of the program, and the market information is obtainable through OCPV. Furthermore making an investment to more efficient mill than those used at present would be another important move in this process. Investment program of this activity is crucial to raise the overall productivity.

It is proposed to establish communal concrete drying yard, grain storage and rice milling facility in San-Pedro Paddy Area because of the large amount of harvested paddy, around 3,000 tons/season in the area or around 15 tons/household/season. The grain storage and the rice milling facility turn to farmers' advantage for the marketing. The details are as below:

- a) Concrete yard : 2,000 m² (25 m x 40 m x 2)
- b) Storage : 2,500 ton /hr of paddy

- e) Rice milling machine :Capacity- 1 ton of paddy / hour x 2 units

(5) Agricultural Marketing Improvement Programs

In general, as a business enterprise, OPAs have to take part in marketing activities including collection of up-to-date market information. At the moment OCPV provides some of them. The ultimate attitude towards better marketing in annual food crops is to make a planting plan based on the analysis of statistics on climates and seasonal market fluctuation, which requires long field experience with some determination to shoulder the risks, if any.

Good roads and passable transportation equipment are two other indispensable means to retain the quality of their produce as close as the level of finished products just after the processing, though they are out of bound of this marketing program. Introduction of better roads than those of present standard is one of the project components. The topic of purchasing transportation means without money belongs to the question of credit-worthiness of the OPA concerned.

(6) Agriculture Credit Program

Agricultural credit can be sub-divided into credit to industrial crops and that to food crops. The first has been handled by commercial banks, but the latter has not attracted them, though there have been a lot of demand for it in the Study Area. There have been two obstacles in the business of rural credit. The first one is financial costs with which the commercial banks have been burdened. They have exceeded the income expected from the interest to be received. The second is that, in many cases, the farmland could not be placed as collateral because of lack of liquidity.

However, in the national financial arena of Côte d'Ivoire, the *Caisse Rurale d'Epargne et de Prêts/ Coopérative d'Epargne et de Crédit* and several NGOs are ready to serve rural customers by providing micro credits. The former has a branch office in San-Pédro city and a few of the latter have a base in and around the city. On the other hand, any OPA that has no previous record of credit worthiness at its initial stage of project planning shall have no choice but to make an effort to show them its potential to repay an expected loan by exhibiting the feasibility of the plan and keeping the account open to the lenders.

4.4.6 Irrigation and Drainage Development Program

(1) Re-functioning of San-Pédro Paddy Project

Cultivation of rice under the pump irrigation was stopped because of the shortage of fund for purchasing fuel for the pump operation and other reasons. Among the irrigation development potential areas in the Study Area, only this area has irrigation infrastructures such as irrigation canal and properly land-leveled fields, even though they are not sufficient as discussed in section 3.7. Considering its location and scale, the rehabilitation of this area is considered as the most important and practicable irrigation development project area in the Study Area.

Considering the pump irrigation system being one of the most important factors of the failure of the project, several alternative water sources were studied in detail. As a result, it is judged that the most favorable irrigation system is gravity one from the economic and managerial points of view. The smallest investment cost on the rehabilitation of this project area may be realized by repairing the existing pump facilities without adverse environmental effects. However, it will require the high cost and high technique for the proper maintenance of pump equipment by the farmers themselves. Careful comparison study in consideration of "the sustainable operation of the facilities" was made.

1) Basic Conditions

- Highest ground elevation in the Project Area : 7.2m
- Highest water level of the Canal : 7.5m
- Grand canal hydraulic gradient : 1/5,000
- Present flow capacity of the San-Pédro river : 150 to 200m³/s
- Upsurge caused by weir installation during flood : not allowed
- Developed net irrigable area : 330 ha
- Expandable net irrigable area : 245 ha

2) Alternatives of Water Intake

Considering the above basic conditions and the survey results of San-Pédro river, the following alternatives are considered for the methods of intake of irrigation water:

	Alternatives	Canal Length	Intake Level Required	Protection of Right Bank	O&M
Pump Irrigation	Repair of existing pumps operated by diesel generators			No influence	- Same condition of previous failure
	Repair of Existing Pumps operated by Electricity			No influence	- High electricity tariff
Gravity Irrigation	Weir at Section 26 (at the confluence with the Kre river)	3.0km	EL.8.1m	Protection on the right bank required	- Occasional movable weir operation to reduce upsurge
	Weir at Section 33 (1.5km south of Cpt. Colonel)	8.1km	EL.9.2m	Less upsurge during normal water stage and less influence	- High rise of weir (H=5m) - Movable weir - Many drainage crossing conduits required - Long canal
	San-Pédro Grand Canal From Former Industrial Water Intake on the Dam	18.2km	EL.11.3m (EL.17.5m)	No influence	- Long canal with 3 irrigation areas. - Close coordination with CIE

Considering the influence of the up surge of headworks to the right bank classified forest area and previous failure of the irrigation system, it is possible to say that there are comparable. Three (3) alternative intake plans to be considered; Alternative 1: Rehabilitation of existing pumps to be operated by electricity. Alternative 2: Weir construction at south of Cpt. Colonel and Alternative 3: Rehabilitation of existing intake of San-Pédro dam and Grand Canal from the San-Pédro dam. The irrigable area of alternative 2 and 3 is 575 ha, but the alternative 1 can irrigate an area of 510 ha because of existing pump and its running capacity. The characteristics of corresponding alternatives are as follows:

Item	Alternative 1 (Pump)	Alternative 2 (Weir)	Alternative 3 (the Grand Canal)
Irrigable Area	510 ha	575 ha	575 ha (965 ha)
Beneficiary farmers	340 households	384 households	384 households (643 households)
Investment cost (million F.CFA)	3,529	6,704	6,358 (8,805)
EIRR	15.5 %	10.0 %	11.3 % (13.0%)
Average annual O&M costs F.CFA /ha (incl. replacement)	207,910 F.CFA	107,080 F.CFA	98,790 (72,058)*
Share of O&M costs in the planned paddy production costs (%)	22.0 %	11.3 %	10.4 % (7.6%)
Share of O&M costs in the planned net benefit of paddy	26.6 %	13.7 %	12.6 % (9.2 %)
Annual production of paddy	4,998 ton	5,635 ton	5,635 ton (9,457 ton)
Economic Net Present Value (million F.CFA)	3,830	2,840	3,653 (6,519)

Note : numbers in () is increase of full development including Fahe and Cpt. Colonel area

From the above, as the construction cost of Alternative 1 with F.CFA 3,529 mil. (where the rehabilitation cost of the pump: F.CFA 140 mil.) is the lowest, its EIRR of 15.5 % is the highest among the three (3) alternatives. For Alternative 2, as its construction cost of F.CFA 6,704 mil. is the highest, its EIRR of 10.0 % is found to be low. For Alternative 3, despite its long distance of Grand Canal for water conveyance, the construction is not so complex, resulting in a rather low construction cost of F.CFA 6,358 mil. and an EIRR of 11.3 %. From the national economic viewpoint for the project implementation, Alternative 1 (pump rehabilitation) is the best opportunity for investment.

After the completion of the project facilities, for the realization of facility management by the farmers themselves, the low charge on operation and maintenance costs on the farmers will be the most important issue for a "sustainable project management". The operation and maintenance costs of Alternative 1 will be F.CFA 207,910, or about 2.1 times those of Alternative 3 as F.CFA 98,790. Shares of O&M costs of in the planned paddy production costs and net benefit are 22%, 26.6% for Alternative 1, and 10.4%, 12.6% for Alternative 3. These figures show that Alternative 3 can reduce 11.5% of production costs and increase 14% of net benefits against Alternative 1. For making no pressure on the farmers' living conditions as well as for improving their living standards, Alternative 3 is considered as the best one.

It is impossible to realize a sustainable development and to contribute to the improvement of the farmers' living standards, if its farming plan is considered vulnerable to the change of the external conditions, even though the project shows a good economic return from the national economic viewpoint. The heavy burden of operation and maintenance costs is considered as one of the reasons why the San-Pédro Paddy Irrigation Project was failed although the pumping units were replaced by the external assistance. It is necessary to mitigate such burden of the farmers as much as possible in order to make the project bearable to the changes of external conditions such as fluctuation of rice price due to the change of future economic situations.

In succession with development by Alternative 3, an additional irrigation development potential area along the Grand Canal (Fahé and Cpt. Colonel areas totaling 490 ha) can be developed easily with low cost. In this case, the number of beneficiary farmers and annual rice production become 1.9 times of Alternative 1, thus contributing to the national economy greatly on attaining self-sufficiency of rice. Considering the above contexts, the San-Pédro Paddy Project Area will be irrigated by the water to 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 (Alternative 3).

3) Other rehabilitation works

In addition to the intakes, the following rehabilitation works shall be included in the project:

Item	Rehabilitation Works
Rehabilitation of irrigation facilities	<ul style="list-style-type: none"> - Irrigation canal lining- decrease water losses and head losses - Reconstruction of irrigation facilities including gates and checks - Improvement of O&M and inspection roads (rural roads) - Tertiary irrigation canal (by farmers)
Land leveling	<ul style="list-style-type: none"> - Securing of proper water ponding in each plot - Confirmation of equalized water distribution - Down sizing of plots by bunds and land consolidation or redistribution
Drainage improvement	<ul style="list-style-type: none"> - Maximization of cultivable land - Rearrangement of drainage system - Proper drainage management - Installation of retarding basin - Increasing road crossing culvert

4) Work Items and volume

Description		Work Volume			Remarks
		Alternative 1	Alternative 2	Alternative 3	
Water Intake Facility	Headworks installation	1 unit	-	-	
	Intakes in San-Pédro dam	-	1 unit	-	
	Rehabilitation of Existing pumps	-	-	1 unit	
Head Race		8.1 km	18.2 km	-	
Irrigation Facilities	Primary Canal		5.7 km		concrete lining
	Secondary Canal		7.5 km		concrete lining
	Tertiary Canal		20.1 km		concrete lining
Farmland Re-Leveling			575 ha		
Drainage Facilities	Primary Drainage Canal		3.4 km		
	Secondary Drainage Canal		10.3 km		
Road Works	Primary Road		5.1 km		grading
	Secondary Road		19.6 km		grading
	Inspection Road	11.7 km	21.3 km	-	

(2) Fahé Area Irrigation Development

Fahé irrigation project area is located just downstream of San-Pédro dam on the left bank with potential gross area of 430 ha (or 300 ha in net). The area spreads with 0.2 % slope southwards. And the southern boundary faces the casual flooding area caused by the flooding of the San-Pédro and Niré rivers. Presently, tree crops are planted in the elevated area and maize and paddy are cultivated in "bas-ponds". Rubber tree plantation started to extend from northern part of the area recently. There is no irrigation system in the area. Un-paved roads penetrate the area from the San-Pédro dam on the western border and at the center of the area. Upstream section of the San-Pédro Grand Canal (at 4.3 km) is used as the headrace canal for the Fahé irrigation project. And other major works of the irrigation and drainage facilities are summarized as follows:

Work Item		Work Volume	Remarks
Irrigation Facilities	Primary Canal	6.0 km	concrete lining
	Secondary Canal	6.0 km	
	Tertiary Canal	18.0 km	
Farmland Leveling		300 ha	reclamation
Drainage Facilities	Primary Drainage Canal	7.5 km	
	Secondary Drainage Canal	12.0 km	
Road Works	Primary Road	15.0 km	grading
	Secondary Road	6.0 km	grading

(3) Cpt. Colonel Area Irrigation Development

Cpt. Colonel irrigation area is located about 1.5 km south from Cpt. Colonel village. This area is spreading on the almost flat alluvial plain with 130 ha in gross (or 90 ha in net). Presently, this area is covered with forest and maize and upland paddy cultivation, and is inundated by the flood water from the San-Pédro river and its tributary coming from IDEFOR area. The area can be irrigated by pumped water from the San-Pédro river or the San-Pédro Grand Canal (at 10.1 km). Topographic condition of the area restricts a headwork construction to irrigate this area. The major works for the paddy irrigation development in this area are estimated as follows:

Work Item		Work Volume	Remarks
Irrigation Facilities	Primary Canal	1.8 km	concrete lining
	Secondary Canal	1.8 km	
	Tertiary Canal	5.4 km	
Farmland Leveling		90 ha	reclamation
Drainage Facilities	Primary Drainage Canal	2.3 km	
	Secondary Drainage Canal	3.6 km	
Road Works	Primary Road	4.5 km	grading
	Secondary Road	1.8 km	grading

(4) Water Balance on Actual River Flow

To confirm the allocation of surface water resources, the water balance was examined on daily basis. The daily mean discharges observed in the Fahé gauging station from April 1, 1992 to March 31, 1996 is applied for the simulation. The annual summary of the calculation is tabulated below:

Hydrological Year	Flow-in Dis. (m ³ /s)	Flow-in Vol. (MCM)	Irrig. Vol. (MCM)	Hydro-Power (MCM)	Operation Hours	Run-off Vol. Front Spillway (MCM)	Mon. Min. Dis. At Tail of Dam (m ³ /s)
1991 - 1992	24.05	764.70	28.72	468.72	5,208	267.23	1.98
1992 - 1993	14.74	465.20	28.72	312.21	3,469	138.60	0.84
1993 - 1994	15.21	481.60	28.72	341.55	3,795	111.33	2.22
1994 - 1995	29.03	917.18	28.72	536.40	5,960	347.93	1.79
1995 - 1996	21.25	670.10	28.72	482.85	5,365	162.82	5.14

As shown in the table, the inflow volume to reservoir varies from 465 MCM to 917 MCM, and the surface water resource is generally considered enough to provide irrigation water to the proposed command areas, and about 3,469 hours of hydropower generation is considered possible. The minimum discharge at the tail of dam reaches a minimum of 0.84 m³/s. This discharge is considered enough to fulfill the future municipal water supply demand which is estimated at about 350 lit./s for 2015.

4.4.7 Rural Infrastructures Improvement Program

(1) Rural Road Improvement

The road networks in the Study Area shall be improved in order to supplement the agricultural and social development. Totally about 20 km of road in the Study Area shall be improved and maintained by the villagers/farmers as experienced by the villagers in Cpt. Colonel. Technical assistance such as survey and design, road improvement equipment such as motor graders and bulldozers and also materials such as concrete pipes for drainage crossings shall be provided by the government agencies concerned. The labour forces required for the construction works shall be provided by the villagers/farmers without charge.

(2) Rural Water Supply Improvement

Considering the scale of villages in the Study Area, the groundwater is the most easily accessible source of the drinking water. Reliability and safety of groundwater, deep tubewells are favorable instead of shallow open wells. In the Study Area, about 10 tubewells have been installed by the hydrogeology section of Ministry of Economic Infrastructures under the Rural Hydraulic Development Project ("*Projet d'Hydraulique Rurale BAD-F*"). Same procedure shall be applied for further rural water supply scheme in the master plan. Minimum one tubewell for 9 villages, which don't have any tubewell at present, shall be installed. Previous experience of the tubewell construction, the quantity extraction is limited. Therefore, the water from tubewells shall be used only for drinking. Application for the scheme shall be made by the villagers' organization with participation of the majority.

4.4.8 Social Development Program

The women seem to have much potential for solidarity. The first program intends to involve them more effectively in agricultural development activities through their organization, which will contribute toward raising women's economic self-reliance and finally gaining their self-confidence.

The second and third programs target children or youth directly and adults indirectly. In the Study Area, it is possible to say, "children are the future of the region". Because the children socialized in the mixed society from their birth may show possibility of forming an integrated society over the differences, particularly ethnicity and religion which their parents have hardly surmounted for a long time. The Programs aim in the first place to train the children or youth to be organized and to have cooperative mind through the practical education. Then, it intends to organize the adults under the same interest "for children", because children's matter such as education or food is always one of the biggest concerns for adults as shown in the results of survey related to problems in family. To solve them, the adults prefer, therefore, being organized over the differences. And finally, the Program will help the village children to be trained on farming: their future profession. In addition to the strategies mentioned earlier, these programs are based upon the following same principles:

- make best use of participants' contribution financially, materially and physically;
- improve the accessibility to the existing external resources, particularly the access to the existing funds supplied by the government, NGO, etc., through their organization in order to reinforce the financial and technical abilities;
- lead the participants not only to plan the activities on their own initiative so as to make them responsible but also to evaluate the activities by themselves for feed-backing to the next planning.

Realization of the Programs along these principles requires strong technical supports which are supposed to be mainly given by ANADER, NGO, external technical cooperation, etc. The supports cover various fields such as organization, account, agriculture, commercialization and so on. Much emphasis should be placed on accountancy training after learning lessons from the experiences in the past. Improvement in quality and quantity of supporting services is one of the determinants to the success of these Programs.

(1) Formulation or Reinforcement of Women's Groups

For the development of food crops production, women and its organizations are considered as key-actors, since men are busy in taking care of their coffee and cacao plantation. Furthermore, they seem easy to be organized, if the Program could show them practical interest or solution to their problem on "money" particularly. And with a little assistance, they could obtain many "fruits".

Now some women's groups generally in the same ethnic line are producing vegetables as well as rice for commercial purposes. This trend seems to be expanding gradually from one village to another because of its small economic success shown by the forerunners. The Program helps women to have them more organized or consolidated through the actions mentioned below and leads them toward economic self-dependence. Then it will promise them regular income, which stabilize family economy mostly relying on men's unstable income, and contribute consequently to financial stability of their family. The targeted products depend on the groups, but vegetables and/or rice are proposed based on the observed cases. These products also contribute to food security in their family.

Taking account of the constraints and experiences given by the women, the Program will be carried out in the following stages in order to develop the organizations gradually.

- 1st stage: Acquisition of suitable land and creation of permanent water intake points such

as reservoir, wells and river for production in group (the group shall be acknowledged as a contact group by ANADER to obtain its technical support)

Creation of common fund and introduction of mutual aid and reward system

- 2nd stage: Promotion of collective purchase and use of agricultural input such as seeds, chemicals, fertilizer and sprayers (the group shall have access to 2KR input)
- 3rd stage: Promotion of collective commercialization based on marketing information
- 4th stage: Introduction of simple food processing technology using their own products

(2) Formulation of School Bodies and Diversification of its Activities

Now, some schools have its body, association of pupils, conducting activities such as the exchange programs with other schools or organizations of contractual work (weeding or care of plantation, for example) carried out by the pupils to generate funds. On the other hand, some schools are equipped with canteen built by parents' contribution, and WFP is supporting the school meals. However, WFP is now planning to withdraw from this service and preparing the funds for the creation of school meal provision system to be managed by the villagers. The Program, firstly, aims at creating or reinforcing pupils' body regarded as training for "organization" at school, a model in the mixed society. Then it proposes to diversify their activities including farming which will be combined with the efforts toward the food provision to school in cooperation with other villagers' groups. The activities should be planned and carried out on pupils' own initiative so that they will be able to foster a sense of responsibility.

The following activities are to be carried out at each school:

- Introduction of small-scale agricultural activities such as vegetable cultivation, fruit tree planting and poultry breeding for school consumption as well as marketing.
- Creation of partnership between the school body and villagers' groups (PTA, women's group, etc.) who provide the pupils with not only technical support but also assistance in kind, especially food crops for meals.
- Realization of school lunch based on the products and benefits to be generated by themselves and supporters.

First of all, the Program will lay the foundation of the future mixed organization in the harmoniously mixed society. Secondly, agricultural activities carried by the body will help children to prepare themselves to go into the rural community. In the short term, the Program will allow schools to supply meals to the pupils often suffering from lack of food.

(3) Formulation of Young Farmer's Clubs

About 40% of children between 7 and 14 years old don't go to school and they often help their parents at home or in farmland. This figure goes up particularly in hamlets remote from the main village. In some villages, however, some good attempts are observed like construction of a private school by parents expecting their children to have access to education, and volunteers or teachers hired by the parents to give the children some lessons. The Program aims at giving the children as well as youth in the remote hamlets who can not attend school an opportunity for receiving not only basic education but also practical training on agriculture, by making good use of villagers' voluntary spirit which has been already shown in some hamlets.

As villagers' large contribution is indispensable for the realization, the Program requires much effort to enlighten them and lead them to the participation. The following activities are proposed;

- Organizing villagers' collective work to build a club cabin and equip it with minimum furniture such as blackboard, tables and benches,
- Programming courses in reading, writing and calculation given to children by volunteers from inside or outside the village, and
- Organizing children's practical farming work in group with ANADER's or parents' assistance in technique or material after the acquisition of common plots.

Basic education shall be provided for children or youth until they are able to acquire the literacy. Additionally, they will absorb new technologies and way of thinking on agriculture through farming practices, thanks to their more flexible nature than adults, which could lead the next generation to get rid of the old type of agriculture, shifting cultivation.

(4) Improvement of Accessibility to Social Facilities

1) Access to basic education

To improve the access to basic education, the Program proposes the following direct or indirect measures, which have strong relation with the other sectors' Programs.

- Recognition of private school as public school
- Improvement of road condition and transportation means
- Increase families' financial ability

2) Accessibility to medical facilities

There are two dispensaries around the Study Area: one in Gabiadji, the other one in Blahou (now under construction), and there are some public and private medical facilities in San-Pédro. Above all, the Plan aims to ensure physical access to these places for the inhabitants in the remote area through the improvement of road conditions and transportation means.

3) Creation of children's day-care facilities in villages

It is very often observed that mothers bring their babies or little children to the fields and carry them on their back during the farm work, which occasionally causes children's sick. At home, care of little children taken by small girls sometimes prevents them from attending school. The creation of day-care service system is proposed, therefore, to reduce the burden on women and to improve the little children's health condition. The service will be provided by old women who have much knowledge about diseases and also young women in the village. The villagers could contribute to the construction of "day-care cabin", if it's necessary. After creating the day-care service system in each main village, the departmental direction of public health will be strongly required to start visiting counseling service on children's health. It is desirable to create this service side by side with Program (1).

4.4.9 Environmental Conservation Program

The objective of environmental conservation and protection are:

- The dynamics of rural development shall not impair the existing potential of natural resources now and in the future. Hunting and fishery resources typically belong to this type of resources.
- The implementation of the project shall not induce negative and unacceptable effects compared with the present conditions in term of social and natural environment.

Fulfilling both these conditions will be the guarantee that environmental sustainability has been

taken into account. These conditions can be fulfilled if certain specific measures are implemented. Each of the mentioned schemes is more or less concerned with measures like public awareness, public education, training, participation, involvement of women and institutional coordination. Actions described below will ensure the integration of environment in the implementation of the project.

(1) Protection of Natural Resources

Natural environment in the Study Area has been already described as strongly affected by agricultural development. However, it is assumed that even in such degraded environment, there are species that have adapted to the mixed habitat. Such species can be valuable ones as ecological resources (biodiversity) or as hunting or fishery resources (bush meat and fish). Their protection is then an important task especially within the context of environmental sustainability, which implies a long-term vision. Issues are:

- To find an acceptable balance between intensified agriculture and conservation of hunting and fishery resources;
- To ensure the conservation of certain forest habitats in order to preserve refuge places for fauna species easily adaptable to an environment largely constituted in crop fields. This point is a basic one for the protection of useful species and for the conservation of ecologically important species; and
- To ensure the conservation of the river environment and its fauna species (task also related to water management); Control of fishing and conservation of the fishery resources are the key aspects.

(2) Achievement of Environmental Synergy

Agricultural intensification as it is considered in the project is feasible, if associated with improvement of the management of environment as a prerequisite; otherwise induced demographic increase would generate depletion of valuable resources, as well as production of nuisances and degradation of the environment. From the point of view of the environment, intensification is the only way to improve conditions for making possible the proper conservation of important natural areas in Côte d'Ivoire, by preventing extensive use of land. Within the scope of the project, agricultural intensification must contribute to the achievement of the protection objectives of the Rapide Grah forest, and indirectly to the conservation of the Taï forest.

The importance of developing synergy between the project area and the classified forest of Rapides Grah has 2 justifications: a) To harmonize the objectives of the project with those of managing the Rapides Grah forest; b) Take opportunity of this synergy for progressing toward a water-basin-wide institutional coordination, which will prepare to establish an integrated management of water. The need for an integrated management of water and water related resources (fishery) would be exacerbated with implementation of the project. When developing the area as planned, there are two potential risks of deviation of the objectives at long-term:

- the project area puts additional pressure on the classified forest; and
- the project area receives the spontaneous pressures from the people of the classified forest.

Both alternatives are not sustainable. Balanced development means that the project is able to bring benefits for its own area together with the Rapide Grah classified forest. This is possible through the planned resettlement of people and the organized employment of available labor.

As a result, the resettlement plan of people from the Rapide Grah classified forest as well as the recovery plan needs consideration, because it contributes to the objectives of SODEFOR and to the global sustainability in the end. Although the potential of resettlement of farmers is almost negligible in comparison with the whole problem of the classified forest, SODEFOR has agreed that the project can contribute to its own objectives either directly (resettlement of people) and indirectly (demonstration value of the project).

(3) Appropriate Use of Agro-chemicals

The use of pesticides raises potential threat on health and environment through water consumption, bush meat consumption and the food chain of wild animals. Crawfish, which is very sensitive to water pollution, constitute a valuable resource for the local people. Bush meat provided by widely consumed Cane Rat could also constitute a sanitary problem in case of contamination. A lot of villagers depend on the fishes caught in the drains of the irrigation area for their daily diet, which is a potential contamination route in the context of an intensified paddy production. Surface water contamination is also a serious risk during the drought season because of the higher concentration of substances at this time. Then, planing the use and control of pesticides should be done with focus on the following aspects:

- Improvement of the control system of pesticides, specially the clarification and the enforcement of jurisdictions concerned;
- Development of information and training; enhancing farmers' awareness about the environmental issues of pesticides use and improving the communication between institutions and farmers; and
- Planing of an integrated pest management in paddy cultivation at the time when the above measures are consolidated

(4) Prevention and Control of Water Borne Diseases

Measures of prevention and control of water borne diseases can be integrated in an improvement plan of hygiene and sanitation. Basically, the following measures should be performed:

- Anti-malarial measures in accordance with the propositions of the National Program of Fight with Malaria;
- Follow-up of the health conditions related to environmental conditions by the Sanitary Districts and the Regional Agencies for Public Hygiene;
- Launching of awareness campaigns for farmers engaged in irrigation works; first to protect themselves, and second to fight against malaria and schistosomiasis vectors.
- Assisting the farmers to develop anti-vectors techniques like intermittent irrigation, management of water and drainage conditions, preservation of the fisheries (example of Tilapia that feed larva) and others; and
- Enhancing the awareness and self-care levels for health care, especially for early diagnosis and treatment.

(5) Integrated Management of Water Resources

The management of the water resources will become increasingly critical, because conflicted needs are ready to emerge in relationship with quantity and quality conditions of water use for agriculture, fish breeding, maintenance of a minimum river flow and development of water supply. The conservation of forest cover and the reforestation of Go watershed upstream is an

example of the issues to be considered in the sustainability of the water resource.

A prerequisite to the water resources management is that the institutional, juridical and regulatory reform has been achieved. It is the High Commission for Hydraulics that is in charge of implementing this water policy within the water basin of the Study Area. However, the concrete implementation of a more integrated approach shall be determined by the role of communities and institutions locally within the scope of the project: a) Organization among the groups of farmers to find an equitable allocation of water resources; b) Coordination between the Project Office and SODEFOR as a preliminary step to setting up a water basin wide approach.

4.5 Implementation of Master Plan

4.5.1 Prioritization of Projects and Programs

In order to determine the implementation schedule, the prioritization of the projects or programs has been considered based on the following criteria:

Item	Description
Urgency	Projects expected to become as the countermeasures against the constraints for the development that should be solved urgently
Realization	Projects to be implemented by a proposed executing agency or organization without any difficulty
Adaptability	Projects expected not to have any kind of contradiction with the plans at higher-level such as the national development plan for other sector
Farmers' Needs	Projects expected to meet the most urgent needs of the farmers/villagers in the Study Area
Sustainability	Projects expected to have sustainable development potential and not to have huge negative environmental impact
Impact	Projects expected to have a high socio-economic impact
Model	Projects expected to be used as model and demonstration projects for other areas
Economy	Projects expected to provide the farmers high profits
Synergetic effects	Project expected to have a high synergistic effects through the combination with those project or others of the same or different sector

Proposed projects/programs can be classified into two categories; 1) projects/programs covering specific areas and 2) those covering whole of the Study Area. Also the projects/programs covering the whole Study Area have the different contents or weight of targets. Therefore, the prioritization will be studied based on the following three areas based on the above criteria;

- 1) Hilly sloped area spreading the eastern part of the Study Area,
- 2) Valley area surrounded by hills, and
- 3) Low plain area along the San-Pédro river.

Results of the analysis are shown in Table 4.5.1. The low plain paddy development project/program is considered to have the highest priority in the integrated rural development in the Study Area. And as the base for agricultural development, the formulation and reinforcement of farmers' organization should be started not later than the low plain paddy development project/program.

According to the survey on food supply and demand by FAO, the average value from 1992 to 1996 shows that the total domestic production of rice was 596,000 tons while imported rice was estimated at 375,000 tons equivalent to 38.6 % of the domestic consumption of the country. Further, the amount of the imported rice shared 3.7 % (US\$101 million) of the total amount of

imports in 1996 (US\$ 2.7 billion). According to the estimate by the World Bank, the imported rice is considered more competitive than the domestic, because the retail price of domestic rice in 1991/92 (Abidjan) was F.CFA 173/kg, while that of imported rice was as low as F.CFA 160/kg (FOB Bangkok F.CFA 57.33/kg). However, the retail price of domestic rice rose to F.CFA 300/kg in Abidjan in 1998 due to the devaluation of CFA Franc, which was lower than F.CFA 400/kg for that of imported rice. It is considered that the economical 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 (1992), because of improvement of economic situation of rice cultivation, increasing rice consumption and improvement of profitability of rice production.

4.5.2 Implementation Plan

(1) Organization for the Implementation

Executing agency of the Integrated Rural Development in San-Pédro Plain shall be MINAGRA as shown in Fig. 4.5.1. At the central government level, the Central Management Committee for the Project shall be formulated for the budgetary preparation and political coordination among government agencies concerned. The board shall be composed of MINAGRA, PNR, ANADER, Ministry of Economic Infrastructure, Ministry of Finance and Treasury, Ministry of Family and Women Promotion, High Commissioner Office for Hydraulics and other agencies, and PNR of MINAGRA will be the secretariat of the committee.

The Project Office shall be established in San-Pédro to make the preparation work for the implementation and to implement the construction works. The Project Office shall be headed by the Project manager to be appointed by the Central Management Committee, and agricultural engineers from MINAGRA and PNR, farmers' organization specialist from ANADER, agricultural extension workers including paddy cultivation specialists from ANADER, finance and administrative officers, advisor from foreign technical assistance organization and secretariat should be its members.

Project Manager shall be responsible for the implementation of the Project and discussion and negotiation with their farmers for the participation to the project implementation. One of other functions of the Project Office shall be project monitoring and evaluation. The Regional Coordination Committee shall also be formulated. It is chaired by the Project Manager and composed to the representatives of Regional Governors Office, San-Pédro Municipality, Regional Office of Ministry of Economic Infrastructures, CIE, SODECI and San-Pédro Port Authority. The Coordination Committee meeting shall be held once a quarter and at the time requested by the Project Manager to discuss the inter-organizational matters.

(2) Implementation Procedure

At the initial stage of the Project implementation, the Project Office shall explain the Project outline to the organizations and farmers concerned to obtain their full understanding and willingness of participation to the Project. In parallel, MINAGRA shall confirm the project implementation frameworks from the Central Coordination Board and take action for the preparation of financial resources for the Project. Then Project Office shall employ a consultant to conduct the detailed plan, design and supervision of the construction works. The most important factor for the successful project implementation is animation of the participating farmers. It includes the following items:

- To obtain agreement of the farmers involved in the project implementation;

- To select participating farmers and to establish farmers' organizations;
- To make participating farmers engage in the construction works including on-farm works to encourage their willingness to participate in the Project and to help them to raise farming fund; and
- To conduct technical extension and training of farming and water management to the participating farmers.

The important factor at the stage of the Project implementation is acquisition of land ownership. It is important to give special considerations on the land problems when there are conflicts of interests between indigenous people and immigrants, and also between the government and the present holders of usufruct. These considerations shall include but not limited to the following;

- Provided that the expropriation of land by the government is necessary, the agreement should be reached through the discussion with the usufruct holders. The contents of the agreement should be stipulated and kept by both parties.
- In that case, as for the expropriation of somehow cultivated land, the immediate compensation by the authority should be carried out.

(3) Implementation Schedule

Based on the prioritization components of the integrated rural development, projects/programs shall be implemented. During the medium term period high priority projects/programs shall be implemented based on the availability of the finance sources; that is formulation and reinforcement of farmers' organizations, lowland paddy development program and rehabilitation of San-Pédro Paddy Project area. Based on the evaluation of medium term activity results, the next projects and programs shall be implemented up to the long term target year of 2015. The concepts of the implementation schedule together with other activities and implementation schedule are shown in Fig. 4.5.2.

(4) Operation and Maintenance (O&M)

Basically, all projects/programs shall be operated and maintained by the farmers' or villagers organization and farmers' participation. Appropriate advice and guidance shall be given to them by ANADER and MINAGRA.

1) Irrigation and Drainage System

O&M works for irrigation system is consist of i) water management, ii) facility maintenance and iii) administration as shown below:

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

All farmers' organizations (OPAs) in the irrigation command area have to establish the water users' organization for the O&M of irrigation and drainage facilities with the assistance of ANADER. Some part of water management and facility maintenance may be carried out by private institutions on contract bases.

2) Demonstration farm / training center

Demonstration farm and training facilities for the extension workers and farmers shall be managed by ANADER. Demonstration of farming practice and trial shall be made using the farmland of private farmers based on the contract with these farmers under the program, input material and equipment supplied by ANADER. It will be used for the training of extension workers and farmers together with technical guidance and lecture at the training center.

(5) Requirement of the External Assistance

Irrigated paddy cultivation has been introduced recently to Côte d'Ivoire, Referring to the results of the previous experience of San-Pédro Paddy Development Project and the situation of quality and quantity of present extension services, the foreign experts for modern paddy cultivation are strongly requested to support the Project implementation with strong leadership for the performance and O&M of irrigated paddy cultivation.

4.5.3 Cost Estimate

(1) Investment Costs

Based on the plan of the Project, quantities of works are estimated. Unit rates of respective works are estimated referring to the previous similar works implemented and standard of Japan. The following exchange rates, as of April 1999, are applied; US\$ 1.00 = Yen 120.35 = F.F. 6.15 = F.CFA 615, F.CFA 1.0 = Yen 0.20. The total project cost (for 965 ha irrigation development) has been estimated at F.CFA 8,806 million.

(2) Annual Operation and Maintenance Costs

Operation and Maintenance costs of irrigation and drainage system after the completion of construction works are estimated at F.CFA 65 million/year based on the previous experience and planned formulation of O&M. It includes the system operation and inspection costs including fuel or electricity for pumps/gates and salary for gate-men and pump operators, and the maintenance costs for irrigation facilities such as pumps and gates.

(3) Replacement Cost

Useful life of irrigation facilities such as pump, gates and other facilities is shorter than the Project life. Therefore, the replacement of these facilities is required during the project life, and it is estimated at F.CFA 177 million as same as those of investment of each facility.

4.6 Evaluation of Master Plan

4.6.1 General

The Master Plan is to construct the Grand Canal from the San-Pédro dam to San-Pédro Paddy Development area, in order to irrigate this area during the medium term, then during the long term period, to irrigate the Fahé and Cpt. Colonel paddy potential areas along the Canal using the same water source. The evaluation of Master Plan has been made based on this planning using investment costs of required socio-economic infrastructures including irrigation

facilities.

The evaluation compares 'with' situation and 'without' situation of the plan using the discounted flow of the net benefit of the both cases. In this case, only the increase of paddy production due to double crops a year by better water management and better production method which require a technical and social training are enumerated. The plan envisages that it will choose a program with minimum investment at the initial stage. At the same time it will observe the progress of technical and social transfer to the farmers, before full investment is done in order to make sure full use of water resource potentials effectively.

In this estimate, project life is set at 50 years and social discount rate at 6.25 %. At present the paddy cultivation is actually carried out only in about 50 ha, and the rest is mostly left as cultivable waste except the area used for tree crop cultivation. The net incremental benefit due to implementing the irrigation development of 965 ha is estimated on the assumption that the present areas of single paddy cultivation cover 100 ha, estimating that the value of present tree crops is an equivalent amount of the produce from 50 ha single crop paddy cultivation.

4.6.2 Economic Evaluation

In the economic evaluation, the estimate adopts two conversion factors; the one, economic farm gate price of paddy is set at F.CFA 147/kg, and the other, Standard Conversion Factor is set at 0.87. With these assumptions, the economic cost benefit ratio is estimated at $B/C = 5.0$, the economic internal rate of return at $EIRR = 13.0\%$ and the economic net present value at a social discount rate of 6.25 % at $NPV (6.25\%) = F.CFA 6.52$ billion.

4.6.3 Financial Evaluation

A farm gate price of paddy is set at F.CFA 157/kg in the financial evaluation. The cost benefit ratio is estimated at $B/C = 3.8$, the financial internal rate of return is at $FIRR = 9.7\%$, and the financial net present value at a social discount rate of 6.25 % at $NPV (6.25\%) = F.CFA 3.79$ 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 F.CFA 1,200,000, three times more than the present net income of F.CFA 400,000 by a single crop in a year.

4.6.4 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, which includes rural electrification. Intensification of agriculture 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, will contribute both to the goal of self-sufficiency of food crops and economy in terms of foreign reserve of the country.

4.6.5 Initial Environmental Examination

(1) Purpose of IEE

The Initial Environmental Examination (IEE) is useful in order to find out the possible negative effects of the project on the social and natural environment. This IEE is a procedure which is recommended by JICA and which follows an official checklist established for the agricultural sector. The purpose of IEE is to clarify the needs for further environmental assessment. This

IEE and the study of present conditions of the Study Area within this report constitute the environmental report which is required by BEIE as part of the environmental procedures of Côte d'Ivoire.

(2) Background Conditions of the Project

The possible negative effects of the project as identified by IEE are better understood when taking into account the following environmental background on the one hand and project background on the other hand.

1) Summary of Environmental Conditions of San-Pédro Area

The environmental background can be characterized as follows:

- Although land occupation is going to be saturated, the development of the area is still determined by a dynamics of pioneer front, which means immigration, deforestation, melting pot of areas, traditional land tenure, new settlements, increasing demographic pressure. These specific conditions are those of an area which represents the last attempt of new development front based on land clearance in Côte d'Ivoire.
- Surrounding areas around the Study Area meet a series of environmental pressures actually outside control: Demographic increase and extensive agriculture in the Rapide Grah classified forest; demographic increase and spontaneous settlements of population in the town of San-Pédro without being accompanied with the basic sanitary facilities. The table below summarizes the environmental characteristics of the potentially sensitive areas around the Study Area.

	Main environmental issues	Relationship with the Study Area
San Pédro River	- lack of river management - depletion of fishery resources - agricultural encroachment on riverbanks	- irrigation water source - potential of fishery resource for local people
Rapide Grah Forest	- deforestation - difficulty to execute the development plan - conflicts between SODEFOR and people (resettlement issue)	- nearby area - San Pedro river in common with the Study Area - need of coordination
San-Pédro City	- final pool of regional immigration - demographic increase - degraded conditions of sanitation - lack of water supply	- regional urban pole, regional market - downstream city
Coastal Area	- urbanization - modified hydrology, silting of river mouth - swampy forest with agricultural use	- downstream area

2) Basic Components of Project

Irrigation development of the lowlands

- Sector 1: Irrigated paddy fields (575 ha) in the southern part of the area (San-Pédro plain), with rehabilitation of land already allocated among 130 households and extension of land already cultivated;
- Sector 2: Irrigated paddy fields (90 ha) in the central part of land already cultivated;
- Sector 3: Irrigated paddy fields (300 ha) in the northern part of land almost already cultivated but eventually including plots of swampy forest;
- Water intake directly made from the dam reservoir through a 18.2 km canal serving Sectors 3 and 2, and eventually Sector 1.
- Improvement of drainage canals; land leveling; total irrigation annual water demand will amount 29.4 million cubic meters which is 6 % of annual runoff.

Agricultural development

- Mechanization of agriculture
- Introduction of new crops
- Intensified use of uplands (cropping system)
- Maintenance of soil fertility

Rural infrastructure development

- Improvement of rural roads network
- Rural water supply facilities

(3) Screening the Effects of the Project

The screening checklist has been fulfilled as shown in Table 4.6.1 for evaluating the social and natural environment. The reading of the screening table needs some important remarks:

- Since the checklist items are standardized items of JICA approach, they do not always fit well with the possible problems in the field. However, ranking has been made taking into account this aspect as far as possible.
- Ranking C is made from the point of view of the project on a whole. It remains possible that impacts are effective in limited geographical area or for sub-items.
- The checklist is prepared based upon the planned components of the Project.

(4) Results of Screening

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. This initial examination shows that the analysis of the sociological effects at the stage of the feasibility study must be performed within the scope of the environmental evaluation, taking into account the results of the sociological evaluation study. Both studies will be part of the feasibility study of the Project. Expected negative effects of the Project to be considered for further study for maintaining environmental quality are:

- Use of agro-chemicals;
- Degradation of certain resource base (hunting and fishing);
- Conservation of swampy forest and certain fauna species;
- Sustainable use of water resources;
- Prevention of water-borne diseases;
- Settling conditions of the newcomers.

These evaluation items are almost pertinent to all the geographical sectors involved in the Project. However, the nature conservation aspect is more specifically relevant to the northern section of the Study Area. Within the scope of the social problems raised by the initial examination, the theme of the planned settling the newcomers into the Project Area presents several issues such as the adaptation to the social and environmental constraints within the Project Area, the acceptance of the radical change in life style, the improvement of sanitary conditions and the contribution to the objectives of recovering the released land in the classified forest.

(5) Environmental Assessment

It appears that the social environment is more subject to receive the possible negative effects of

the project than it is for the natural environment. It is planned that the feasibility study will include a specific social study, which finally aims at the communities' consensus and participation for implementing the Project. 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

From the evaluation of the priority projects, the lowland paddy development program is selected as the most effective and urgently required to implement. Then herein, the priority project areas of the paddy development for the feasibility study in the Study Area are considered among the following areas:

- 1) San-Pédro Paddy Project Area
- 2) Cpt. Colonel Area
- 3) Fahé Area

Through the comparison of these three (3) areas based on the socio-economic circumstances, etc. for project implementation, the highest priority project site for the feasibility study has been selected accordingly. The social and economic features of each aforementioned areas are shown in Table 4.7.1.

The San-Pédro Paddy Development Area has a high IRR of 22.4 % 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 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 Development Project is evaluated as the most suitable site for the priority project.

Considering the above contexts, the San-Pédro Paddy Development 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 by providing a new conveyance canal (Grand Canal) of 18.2 km for conveying the irrigation water (Alternative 3). It is necessary to study on the possibility to include other programs proposed as the components of the master plan as well as the elements for the necessary irrigation facilities, reinforcement of farmers' organization and possibility of step-wise implementation of the Project. Especially, it is necessary to propose the measures required for farmers' organization and agricultural extension to be considered in such step-wise implementation.

Table 4.3.1 Integrated Rural Development Components

Sector	Present Problems	Project/Program	Activities	Purpose
Farmers' Organizations (OPAs)	Low selling prices of agricultural products determined by middle men or companies	Formulation OPAs	F Formulate OPAs based on residential area, irrigation blocks and village at first, the make a union	Sustainable Agricultural Development
	Poor management for treasury	Improvement of OPA Management	Maintain independence of treasury section	
Agricultural Development	Abandonment of previous irrigation system	Lowland Paddy Development	Mechanized irrigated paddy double cropping	Increase yield and income
	Erratic rainfall, flooding in rainy season and drought in dry season	Bas Fonds Agricultural Development	Introduction of cowpea for the maintaining soil fertilities and sustainable production	Sustainable Development
	Low productivity of cacao together with low inputs	Tree Crop Development	Shifting cacao to coffee	Contribution of Food Self-sufficiency
Agricultural Supporting System	Insufficient extension services on technical and quantity	Improvement of Extension Services	Improvement of technical level of extension officers through the demonstration farm activities and training	Improvement of production Efficiency
	Low selling prices of agricultural products determined by middle men or companies	Improvement of Post Harvest, Value-Add	Installation of drying yards, rice milling equipment and storage by OPAs for value-add	Value-add of agricultural products
	Selling prices of agricultural products immediate after harvesting	Improvement of Marketing	Improve accessibility to agricultural information	Efficient agricultural production
	No saving caused by low productivity and low input for the risky cultivation	Agricultural Credit	Improvement of access to the existing loan/credit facilities (and project farming fund)	Sustainable agricultural Development
	Abandonment of previous irrigation system	Rehabilitation of San-Pédro Paddy Development Area (Cite Agricole)	Options for irrigation water source ① pump rehabilitation and operated electricity ② Headwork at Cpt.Colonel ③ Head race canal from San-Pédro Dam	Increase yield and income
Irrigation and Drainage Development	Low efficiency of traditional cultivation	Irrigation Development in Fabe & Cpt. Colonel area	Gravity irrigation with Grande canal from San-Pédro Dam (or pumping for Cpt. Colonel area)	Sustainable Development
	Lack of rural road network in the Study Area especially along the San-Pédro river	Rural Road Improvement	Main rural road improvement by the farmers provided the material and technical	
Rural Infrastructure	Villagers have to take their drinking water from their own shallow wells, some of which may be contaminated.	Improvement of Rural water Supply	Access to the on-going rural water supply project of AIDB etc.	
	Lack of communication among the groups in the community	Formulation and reinforcement of Women's Group	Betterment of women's economic situation through group production of vegetable etc.	
Social Development	Lack of communication among the groups in the community	Formulation of School Bodies and diversification of their activities	Formulate the school bodies for the production of canteen materials and for the purchase educational equipment/facilities	
	Lack of communication among the groups in the community	Formulation of agricultural youth club	Formulation of educational facilities and operated by parents/volunteers for the education	
	Lack of access to the rural facilities	Improvement of access to the rural facilities	Improvement of access to educational and medical facilities by traffic means and facilities	
	Increased pressure on wildlife	Conservation of natural resources	Watershed wide management of water environment, with focus on swamps, regulation / control of hunting	
Environmental Conservation	Spreading of water borne diseases	Institutional improvement	Preventive measures for protection of people and against malaria vectors; observation network; public awareness heightening	
	Increased use of agrochemical	Institutional improvement for control and use of products; appropriate human resources	Shift from furadan product to appropriate product; code of good practice for proper handling of products	
	Possible frustration and Conflicts	Land recovery plan; Return of crops land in Rapide Grab; new settlers settlement plan	Preparation to change in life style, consumption patterns, mentality; application of paddy production incentives and selection criteria of settlers	Sustainable agricultural Development

Table 4.5.1 Prioritization of Projects/Program in the Master Plan

Sector	Project/Program	Target Area			Selection Criteria									
		Hilltop and Sloped Area	Bas Forns	Lowland	Urgency	Realization	Adaptability	Farmers' Needs	Sustainability	Impact	Model	Economy	Synergistic effects	Total Evaluation
Farmers Organization (OPA)	-Formulation & reinforcement of OPAs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	8
	Improvement of OPA Management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4
Agricultural Development	Paddy Agriculture Development	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	8
	Upland Agriculture Development	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	3
	Tree Crop Development	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	3
Agricultural Supporting Services	Improvement Agricultural Extension	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	5
	Post-harvest Development	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	5
	Improvement of Marketing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	5
	Farmers' Credit	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	6
Irrigation & Drainage	Rehabilitation San-Pédro Paddy Development Project Area and Demonstration farms	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	8
	Installation of Irrigation system Fahé & Cpt. Colonel Areas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	6
Rural Infrastructure	Rural Road Improvement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	6
	Rural Water Supply	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4
Social Development	Formulation of Women's Group	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	6
	School Body	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4
	Formulation of Young Farmers Club	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4
	Improvement of accessibility to rural facilities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4
Environmental Protection	Integrated pest control	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	2
	Improvement public Sanitation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4
	Conservation of Rapide Grah Classified Forest	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	5
	Survey of the Biodiversity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	2

Table 4.6.1 Environmental Screening Results of the Project (1/2)

(1) Social Environment	Items	Rank	Specific Issues And Observations
1. Social life			
	Planned resettlement	C	Resettlement is not a component of the project, but it could be proposed as a policy measure / SODEFOR
	Spontaneous resettlement	C	Cannot be excluded but its relative importance will depend on land use and land tenure factors
	Change in life style	A	Change from a subsistence economy into market economy; need of responsabilization, organization;
	Social conflicts	A	Might result of income disparities in a context of ethnic disparity; intertwined with land rights, fishing rights
	Indigenes, minorities, ethnies	x	The project area is already a melting pot of ethnies, with minorities etc. No basic change due to the project
	Demographic growth	C	Proximity of San-Pédro city, need of additional labor are factors of limited demographic growth
	Drastic change in the demographic structure	x	Not relevant
	Relocation of economic activities	x	Intensification of the existing agricultural activity, with improvement of the cultivation systems
	Change in economic activity, unemployment	x	Agricultural intensification will increase employment opportunities
	Increased income disparity	B	Depends on a) equity in the allocated paddy plots; b) equity in benefits allocation of paddy cultivation
	Adjustment of water rights / fishing rights	A	Potential water use conflicts exacerbated by increased use and quality effects in the downstream
	Social structural change / reorganization	C	Reorganization and responsabilization are partial objectives of the project and do not affect present conditions
	New trends of traditional customs	A	Change from shifting to sedentary cultivation, extensive to intensive agriculture, rainfed to irrigated crops
	Others		
2. Health and sanitation			
	Increased use of agrochemical products	A	Intensification implies the use of agrochemical
	Outbreak of endemic disease such as Buruli	A	More population on more extensive inundated land increase risk of occurrence of malaria, possibly Buruli disease
	Occurrence of transmissible disease	B	Increased risk of transmission of water-born diseases by unsuitable water consumption (diarrhea, Guinea worm)
	Residual toxicity by accumulation of toxic	A	Agrochemical are potential contaminants in the alimentary chain (fishing products, field game, water)
	Waste quantity increase	x	Not relevant
	Others		
3. Cultural patrimony, landscape			
	Destruction of remains and assets	x	Not relevant
	Loss of valuable landscape	x	Not relevant
	Mineral resources	x	Not relevant
	Others		

A: Serious potential impact that needs special consideration for acceptability or feasibility; B: Notable potential impact that could be unacceptable in some cases ;

C: Globally negligible potential impact that should be acceptable or limited to a small area, or improbable but unknown effect; x: no impact or not relevant;

Table 4.6.1 Environmental Screening Results of the Project (2/2)

(2) Natural Environment		Specific Issues And Observations	
Items	Rank		
4. Biological and ecological issues			
Deterioration or degradation of vegetation	x	Project is not a factor of degradation of the natural vegetation, since it mainly affects farming land only	
Important species (fauna, flora)	C	Basically, there are no important species affected by project; but remains possible on a case by case basis	
Ecological diversity (biodiversity)	C	Biodiversity is relevant in terms of wild resources used by the local people; limited possible effect	
Proliferation of harmful species (pest)	B	Increased proliferation of birds, rodents and others; most of these species have also hunting value;	
Destruction, degradation of wetland, swamp	C	Encroachment on swamps, if any, would be limited to small and isolated plots, but should be considered	
Destruction tropical forest / wild area	x	There is no tropical forest neither wild area that is concerned with the project	
Destruction of mangrove forest	x	Mangrove forest at the estuary is far from the project area, already degraded, and of small extension	
Degradation of coral reef	x	Not relevant	
others	C	The project could have direct / indirect effects on the resource base, specially the bush meat, locally	
5. Soil and land			
Soil erosion	C	No increased soil erosion; new cultivation systems in uplands integrate the objective of soil conservation	
Soil salinization	x	Not relevant	
Deterioration of soil fertility	x	Not relevant since the present system has already degraded soil fertility	
Contamination of soil	C	Contamination of sediments by agrochemical is improbable	
Loss of land / desertification	x	Not relevant	
Loss of hinterland / loss of buffer zone	x	Not relevant	
Ground subsidence	x	Not relevant	
Others			
6. Hydrology, water / air quality			
Change in surface water hydrology	B	The hydrologic pattern is already strongly affected, and the project basically takes advantage of dam reservoir	
Change in hydrogeology, groundwater table	x	The project should not have incidence on hydrogeology	
Occurrence of flooding, water storage	x	Not relevant in an area already subject to floods induced by existing development works downstream	
Sedimentation	x	Possible in irrigation canals and downstream, but not more critical than the present condition	
Degradation of riverbed	x	Project is not a special cause of degradation of the riverbed, specially with maintaining a minimum river flow	
River navigation	x	Not relevant	
Degradation of water quality	A	Use of agrochemical and organic matter have potential effect on water quality	
Eutrophication	C	Possible downstream in specific conditions; unknown	
Intrusion of salty water	C	Improbable since the project does not modify the present conditions of flowing at the estuary	
Air pollution	x	Not relevant, excepted during engineering works	
Others			

A: Serious potential impact that needs special consideration for acceptability or feasibility; B: Notable potential impact that could be unacceptable in some cases ;

C: Globally negligible potential impact that should be acceptable or limited to a small area, or improbable but unknown effect; x: no impact or not relevant

Table 4.7.1 Comparison of Irrigated Paddy Development Project Areas

Item	San-Pédro Paddy Development Area	Cpt. Colonel Area	Fahé Area
Economic Aspects	Investment Cost	F.CFA 1,083 million	F.CFA 1,543 million
	IRR	6.4 %	13.2 %
	No. of Beneficiaries	60	200
Social Aspects	Potential	<p>The inhabitants have much trust in their earth-chief (called "Colonel") living with them, and it is possible to set up the firm organization led by Colonel.</p> <p>Most of the habitants are Burkinabé and Gouro, who are closely united, and the organization formation seems to be easy.</p> <p>The inhabitants of the classified forest have started immigrating to this hamlet and they can be considered as potential labor force.</p>	<p>There is a large village of Burkinabé (SCAF) near the site, and if their organized labor force can be mobilized, the high productivity is expected. However, the constraints regarding to the problems with earth-chiefs mentioned below should be solved.</p>
		<p>The proposed project site should be expropriated by the government. But a part of it became a subject under conflict over its usufruct between indigenous families. And the expropriation of the parts of site located in the neighboring earth-chiefs' land will be also tough. Since these people who have already experienced the expropriation of land during San-Pédro Paddy Irrigation Project believe that the government broke the promise of compensation, they seem to have a distrust of the government.</p>	<p>Fahé is the typical village of type I, and <the village-related matters> are decided by 7 indigenous families. Accordingly, matters against their interests (for example, the expropriation of their plantations) are difficult to be consented.</p> <p>In addition, as mentioned in the report, the distrust against the government is strong due to a few times of expropriation by the government.</p>
	Constraints	<p>It is necessary to call for new settlers in consideration of small number of households.</p> <p>Provided that newcomers (including earth-chiefs) participate in the project, the organization formation will be complicated and needs taking much account of the relationship between the newcomers and the present inhabitants.</p> <p>The redistribution of plots seems necessary and may bring about confusion as well as frustration among the inhabitants who have negative experiences from the previous cases.</p>	<p>The negotiation on expropriation will take time and seems to be very tough.</p>

Note: Investment cost of head race canal from San-Pédro Dam is not included.

Description	(Unit: MCM)												Annual
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	
1. Upstream of Dam													
Run-off at San-Pedro Dam	27.2	32.3	69.5	38.6	35.5	55.3	61.2	41.7	19.5	10.0	7.9	16.6	415.2
Evaporation at Dam (8km ²)	0.4	0.4	0.2	0.4	0.3	0.3	0.3	0.3	0.3	0.5	0.5	0.4	4.5
Irrigation Req. for Three (3) Areas	3.8	2.1	1.7	1.6	0.3	3.2	3.4	4.2	3.0	3.3	0.0	2.2	28.7
Reserve for Next Month	1.9	2.2	4.8	2.7	2.5	3.8	4.2	2.9	-9.0	-1.6	-3.7	-7.7	-
Storage in Reservoir (Max. 25 MCM)	1.9	4.1	8.9	11.6	14.1	17.9	22.1	25.0	16.0	11.3	7.7	0.0	-
Balance at Tail of Dam	21.1	27.5	62.7	34.0	32.4	48.0	53.2	34.3	25.3	10.8	11.1	21.6	382.0
2. Middle Reach from Dam to SODECI Intake													
(Possible Hydropower (hr))	(164)	(214)	(488)	(264)	(252)	(373)	(414)	(267)	(196)	(84)	(86)	(168)	(2,971)
3. Downstream Reach from SODECI Intake to River Mouth													
Municipal Water Demand (SODECI)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.8	0.9	11.0
Balance after SODECI	23.8	34.9	63.7	44.5	41.4	52.2	58.9	37.2	27.3	15.3	14.8	24.1	478.0
Run-off after SODECI	0.2	0.4	2.0	0.5	0.5	0.2	0.3	0.2	0.1	0.3	0.2	0.2	5.0
Balance at River Mouth	24.0	35.3	65.7	45.0	41.9	52.4	59.2	37.4	27.4	15.5	15.0	24.2	483.0

Note: - The production capacity of 30,000 m³/day is considered for the future demand of the municipal water supply.

- Industrial water supply is not considered in the above balance, since no realistic industrial development plan does not exist.

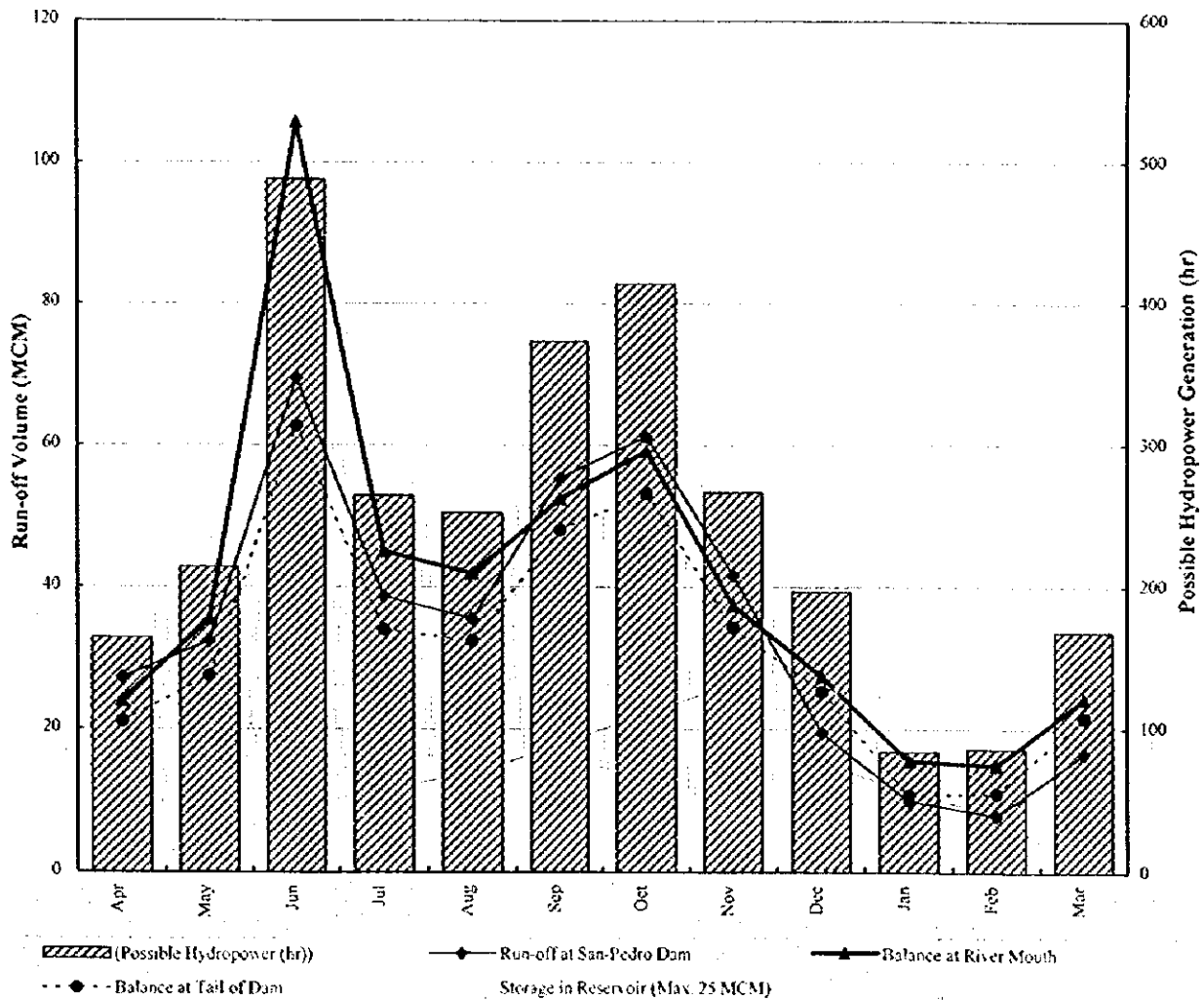


Fig. 4.2.1 Future Water Balance in San-Pedro River Basin

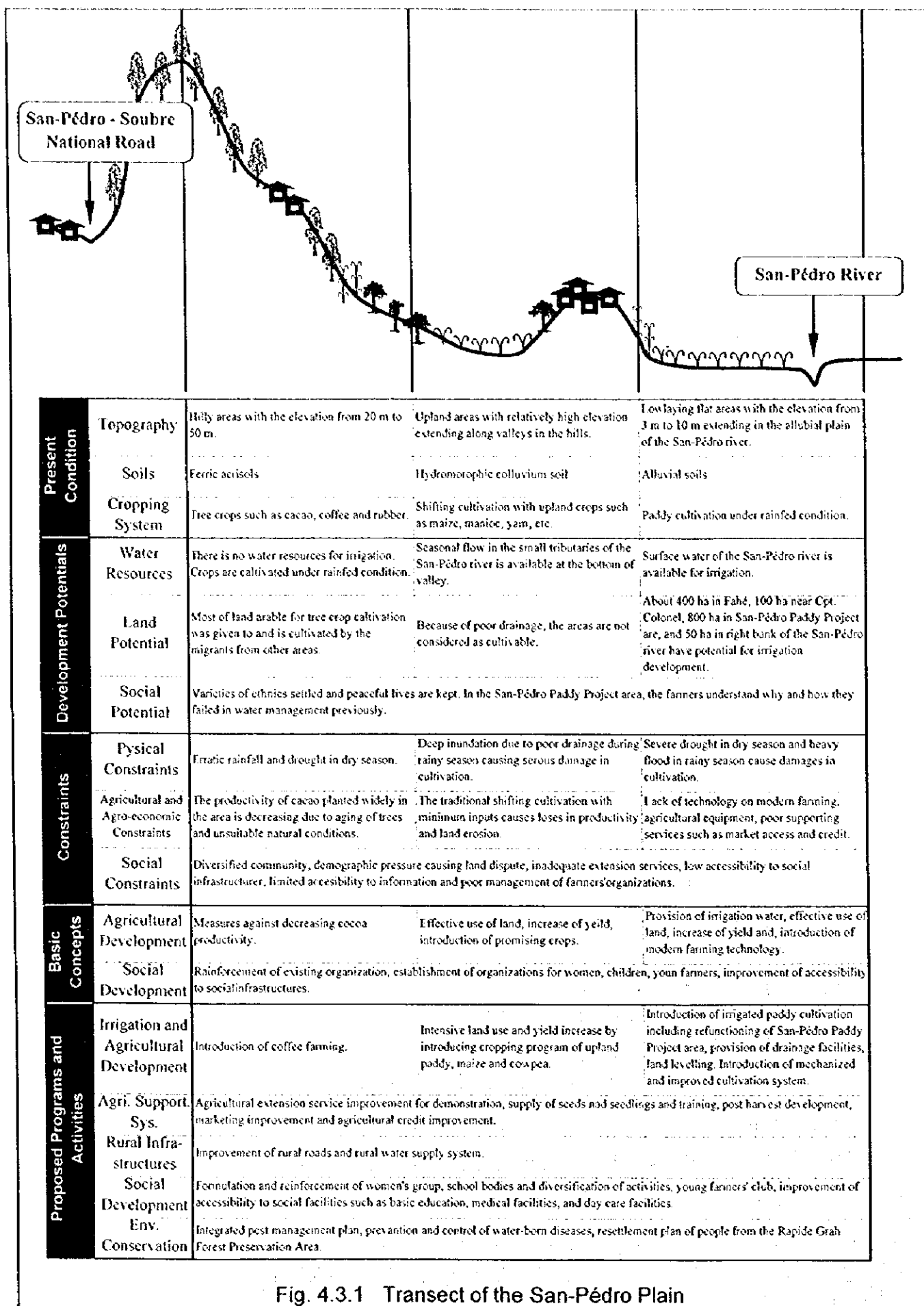


Fig. 4.3.1 Transect of the San-Pédro Plain

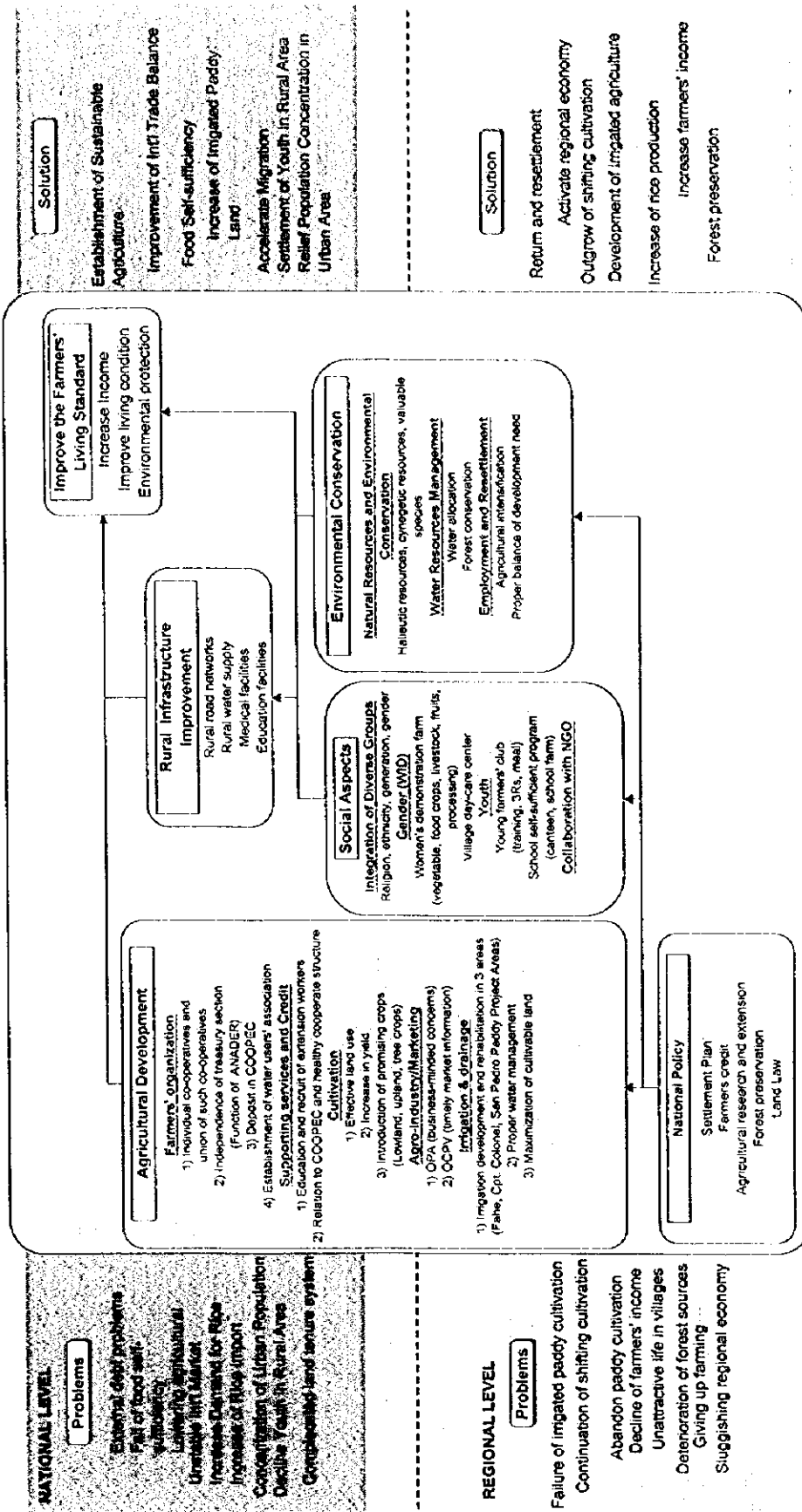


Fig. 4.3.2 CONCEPT OF INTEGRATED RURAL DEVELOPMENT

NATIONAL LEVEL

Problems

- External debt problems
- Fall of food self-sufficiency
- Lowering agricultural Unstable Int'l Market
- Increase Demand for Rice
- Increase of Rice Import
- Concentration of Urban Population
- Decline Youth in Rural Area
- Complicated land tenure system

Solution

- Establishment of Sustainable Agriculture
- Improvement of Int'l Trade Balance
- Food Self-sufficiency
- Increase of Irrigated Paddy Land
- Accelerate Migration
- Settlement of Youth in Rural Area
- Relief Population Concentration in Urban Area

REGIONAL LEVEL

Problems

- Failure of irrigated paddy cultivation
- Continuation of shifting cultivation
- Abandon paddy cultivation
- Decline of farmers' income
- Unattractive life in villages
- Deterioration of forest sources
- Giving up farming
- Stagnating regional economy

Solution

- Return and resettlement
- Activate regional economy
- Outgrow of shifting cultivation
- Development of irrigated agriculture
- Increase of rice production
- Increase farmers' income
- Forest preservation

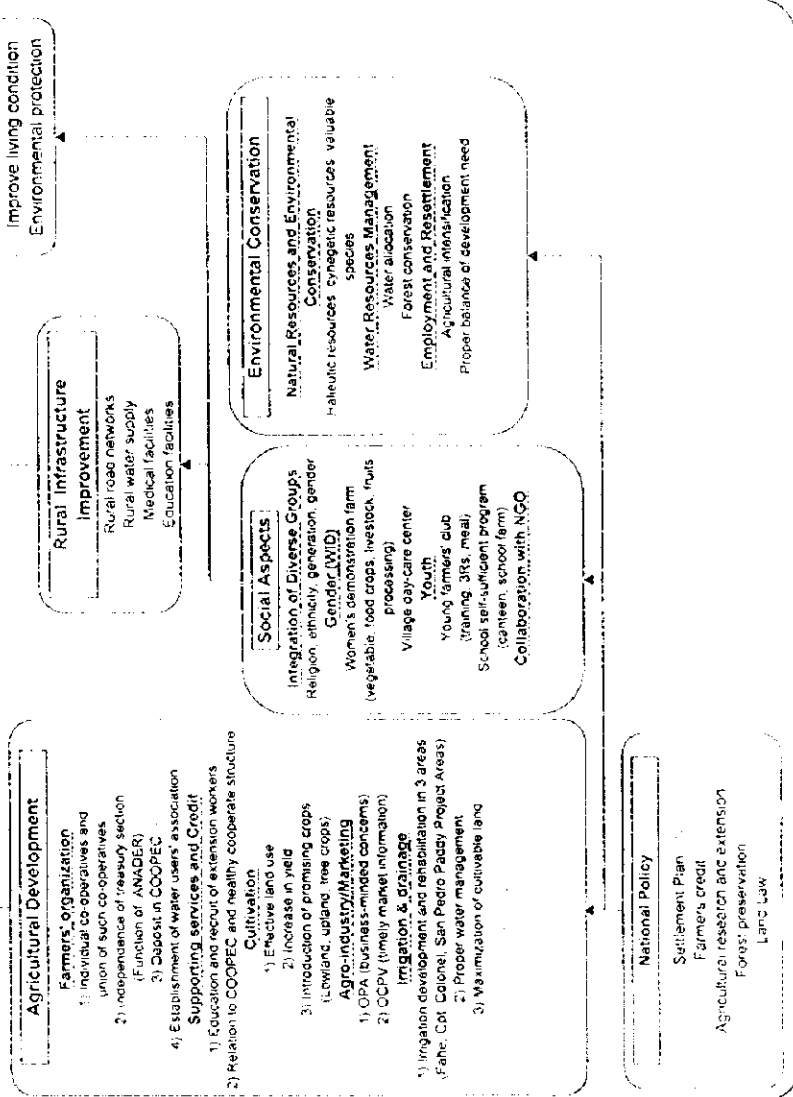


FIG. 4.3.2 CONCEPT OF INTEGRATED RURAL DEVELOPMENT

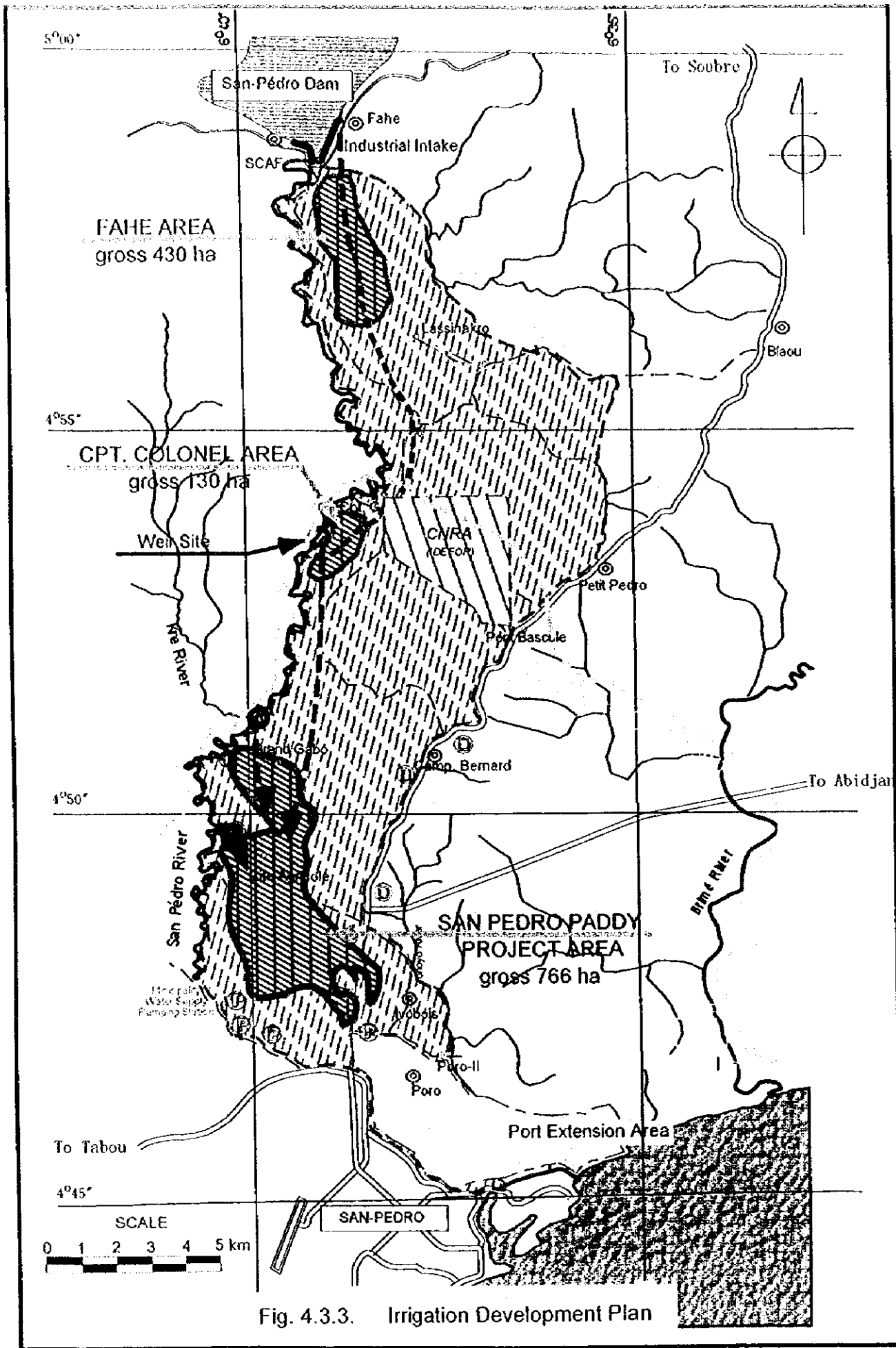


Fig. 4.3.3. Irrigation Development Plan

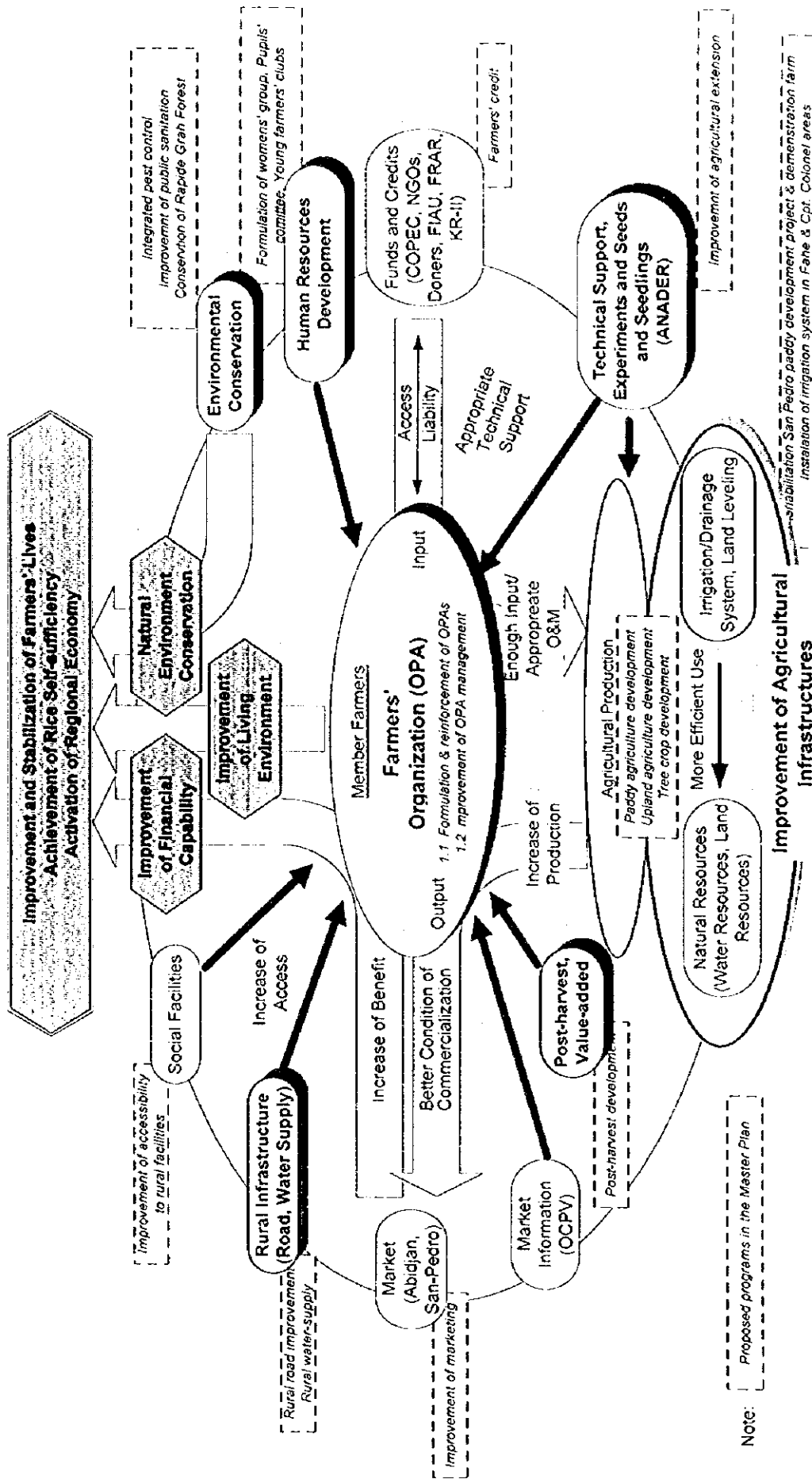
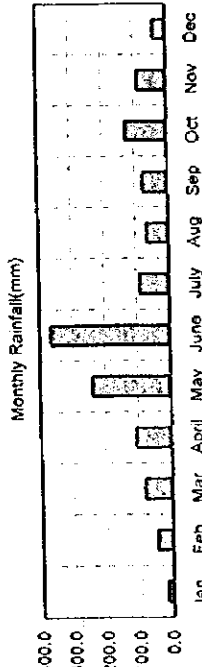


Fig. 4.4.1 Components of Integrated Rural Development and Farmers Organization (OPA)

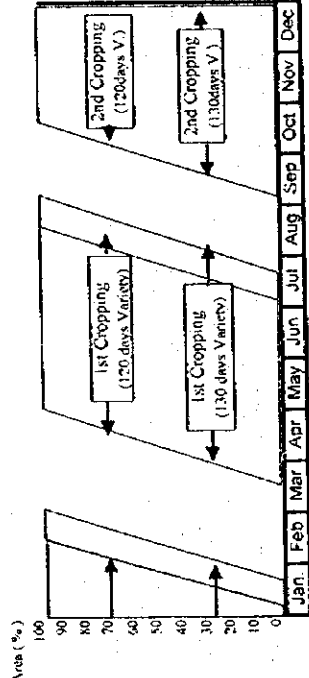
Monthly Meteorological Data of the Study Area

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total/Ave
Rainfall (mm)	17.5	46.3	82.9	108.0	239.7	366.0	91.4	66.5	76.2	128.4	90.3	38.8	1,354
Temp (Ave)	26.5	27.2	27.7	27.5	27.0	25.7	24.8	24.7	25.4	25.7	26.4	26.3	26.2
Humidity (%)	81.0	81.9	81.8	83.1	85.3	87.2	85.6	87.7	87.6	86.4	85.7	83.3	84.7
Sunshine (hour)	4.0	5.5	5.3	6.1	5.2	3.3	3.5	3.1	3.7	3.9	6.3	4.0	4.8

Source: DLEFOL, San-Pedro Station and San-Pedro Airport *

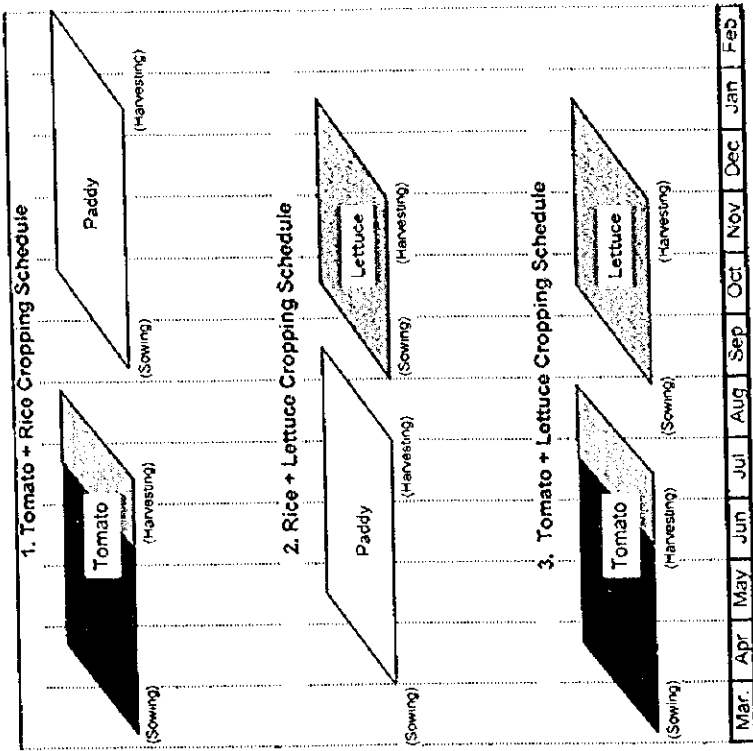


Schedule of Rice Double Cropping (In case of transplanting culture)



Cultivation Method	Cultivar to be used (No. of days)	1st Cropping		2nd Cropping		Fallow period
		Sowing	Harvesting	Sowing	Harvesting	
Trans-planting	WITA 7 (125)	3/20-5/04	7/26-9/09	9/10-10/25	1/10-3/02	61 days
	WITA 8 (125)	3/20-5/04	7/23-9/06	9/10-10/25	1/11-2/27	66 days
Direct-Sowing	WITA 7 (130)	3/20-5/04	7/18-9/01	9/10-10/25	1/08-2/22	71 days
	WITA 7 (123)	3/20-5/04	7/21-9/04	9/10-10/25	1/11-2/25	68 days
	WITA 8 (120)	3/20-5/04	7/18-9/01	9/10-10/25	1/08-2/22	71 days
	WITA 9 (115)	3/20-5/04	7/18-9/27	9/10-10/25	1/03-2/17	76 days

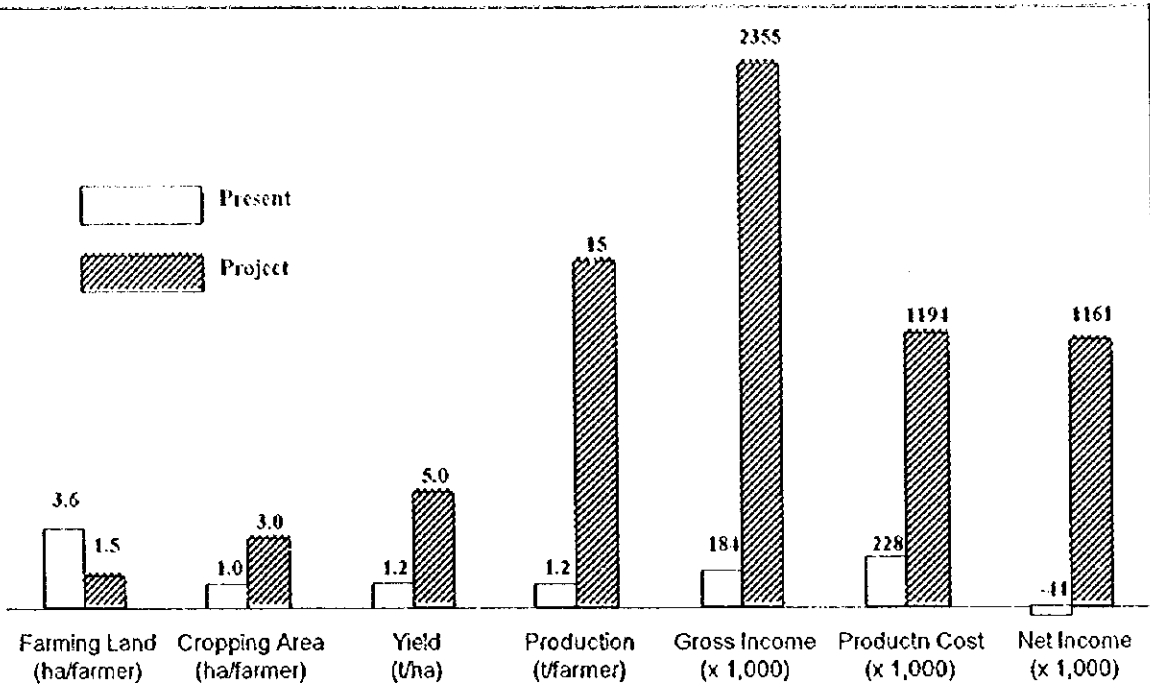
(1) Schedule of Rice Double Cropping (In case of transplanting culture)



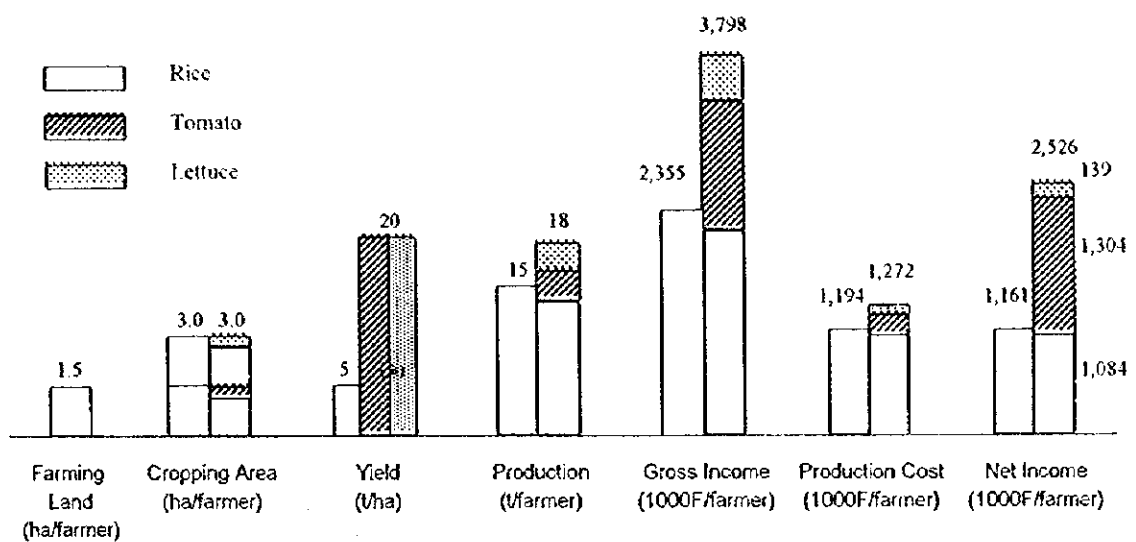
Cropping	Variety to be Used	1st Cropping		2nd Cropping	
		Sowing	Harvesting	Sowing	Harvesting
Rice + Rice	WITA 7	3/20-5/04	7/26-9/09	9/10-10/25	1/10-3/02
Tomato + Rice	WITA 7	3/10-4/24	6/10-8/31	9/10-10/25	1/10-3/02
Rice + Lettuce	WITA 7	3/20-5/04	7/26-9/09	9/01-10/15	1/09-2/14
Tomato + Lettuce	WITA 7	3/10-4/24	6/10-8/31	9/01-10/15	1/09-2/14

(2) Schedule of Mixed Cropping

Fig. 4.4.2 Cropping Calendar for Lowland Agricultural Development



(1) Income of Rice Farming in the Plain Lowland, Present and With Project

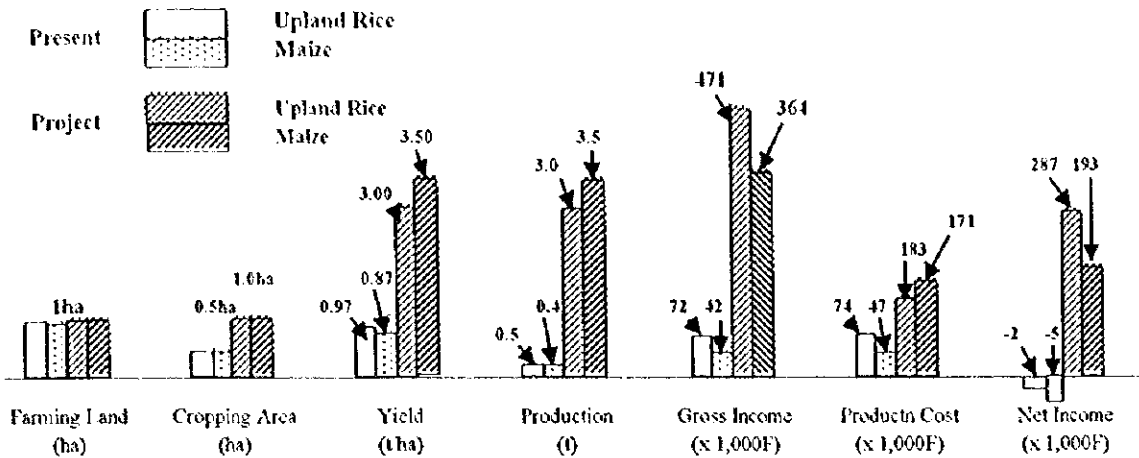


(2) Farming Income in the Plain Lowland With Rice Double Cropping and Rice + Vegetable Cropping

(3) Farming Income in the Plain Lowland, Present and with Project

Farming Type	Holding land (ha)	Cropping Area (ha)	Crop	Yield (kg/ha)	Production (t)	Unit Price (F.CFA/kg)	Gross Income (F.CFA)	Production Cost (F.CFA)	Net Income (F.CFA)
Present	3.6	1.0	Rice	1,171	1,171	157	183,847	228,292	▲ 44,445
R+R farming	1.5	3.0	Rice	5,000	15,000	157	2,355,000	1,194,060	1,160,940
R+V farming	1.5	2.8	Rice	5,000	14,000	157	2,198,000	1,114,456	1,083,544
		0.1	Tomato	20,000	2,000	700	1,400,000	96,080	1,303,920
		0.1	Lettuce	20,000	2,000	100	200,000	61,140	138,860
Total	3.0	-	-	-	18,000	-	3,798,000	1,271,676	2,526,324

Fig. 4.4.3 Lowland Agriculture Development Plan and Present Conditions



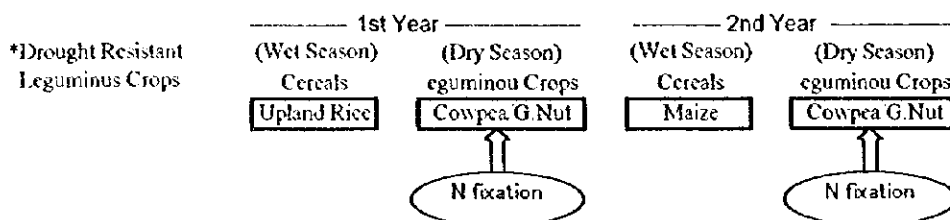
Farming Income in the Upland, Present and With Project

Farming Income in the Upland, Present and With Project

	Farming Land	Cropping Area	Yield (kg/ha)	Production (kg)	Unit Price (F/kg)	Gross Income (F)	Production Cost (F)	Net Income (F)	
Present (A)	Upland Rice	1.0	0.5	974	458	157	71,871	74,198	▲ 2,327
	Maize	1.0	0.5	866	407	104	42,330	46,920	▲ 4,590
Project (B)	Upland Rice	1.0	1.0	3,000	3,000	157	471,000	183,575	287,425
	Maize	1.0	1.0	3,500	3,500	104	364,000	170,600	193,400
(B)/(A)	Upland Rice	1.0	2.1	3.1	6.6	1.0	6.6	2.5	-123.5
	Maize	1.0	2.1	4.0	8.6	1.0	8.6	3.6	-42.1

Maintenance of Soil Fertility in the Upland for Intensive Farming

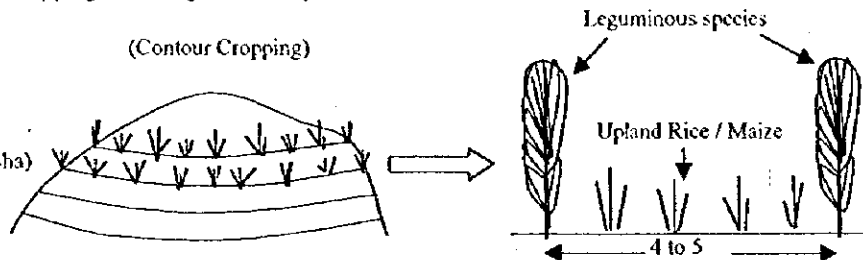
- (1) Application of fertilizer
- (2) Improvement of Cropping System



(3) Introduction of Alley Cropping with Leguminous species**

** Leguminous species

- Leucaena leucocephala ipil-ipil (Philippines)
- white popinae (English)
- lamtoro ramtoro (Indonesia)
- Gliricidia sepium
- Hemingia congesta



(Usefulness of Alley Cropping)

- Provide green manure and mulch material (Prevent evaporation of soil moisture and control of weeds)
- Prevent soil erosion
- Provide biologically fixed nitrogen to the companion crop
- Provide prunings fodder for small ruminants such as goats and sheep
- Provide prunings for staking material and firewood

Fig. 4.4.4 Upland Agricultural Development Plan and Present Conditions

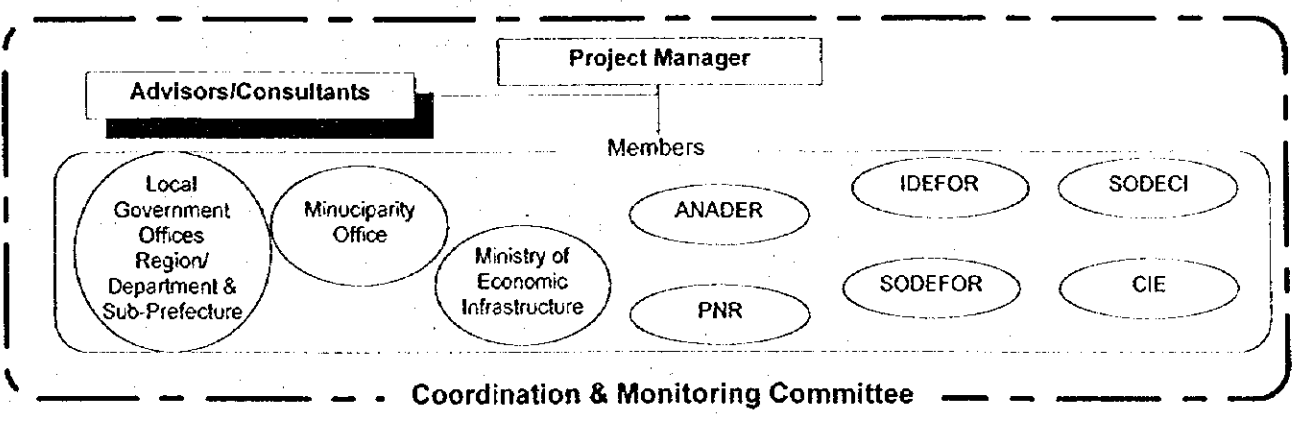
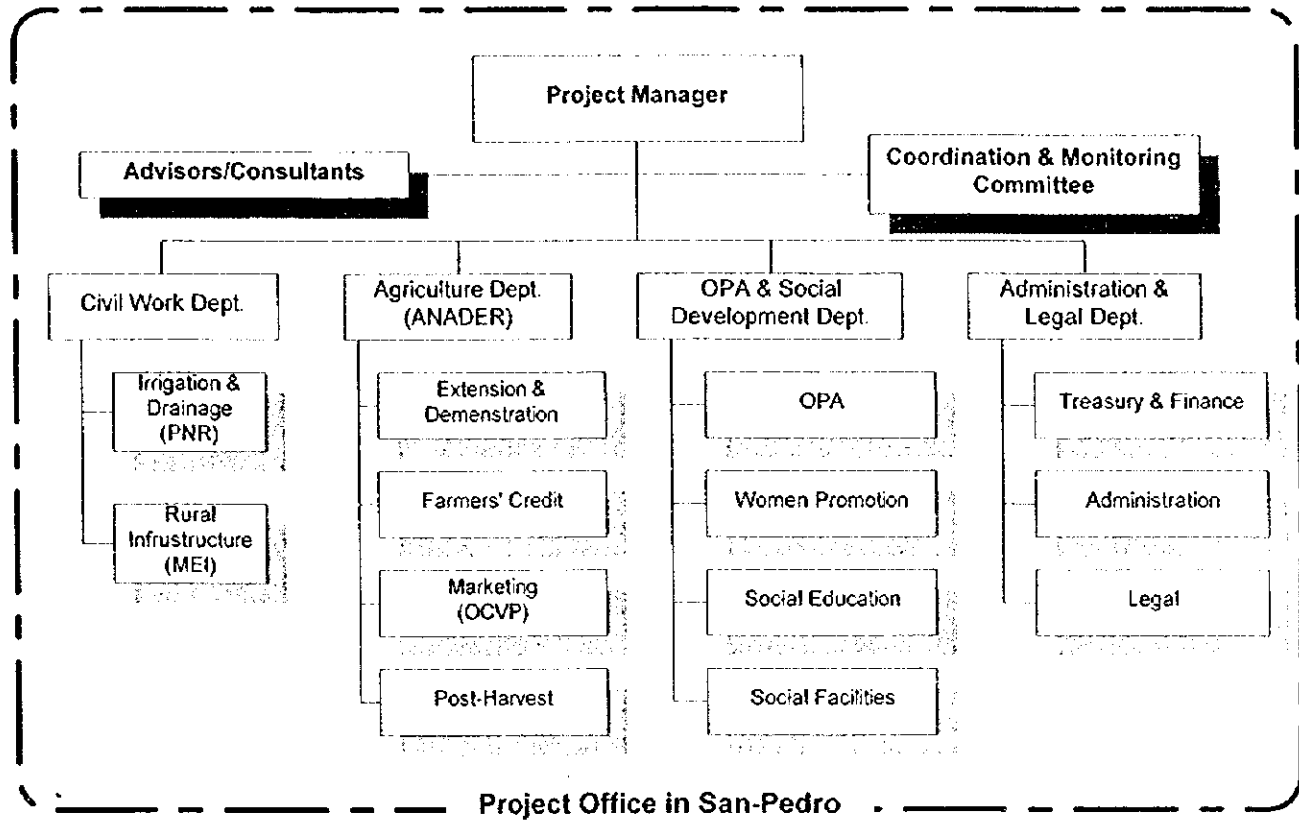
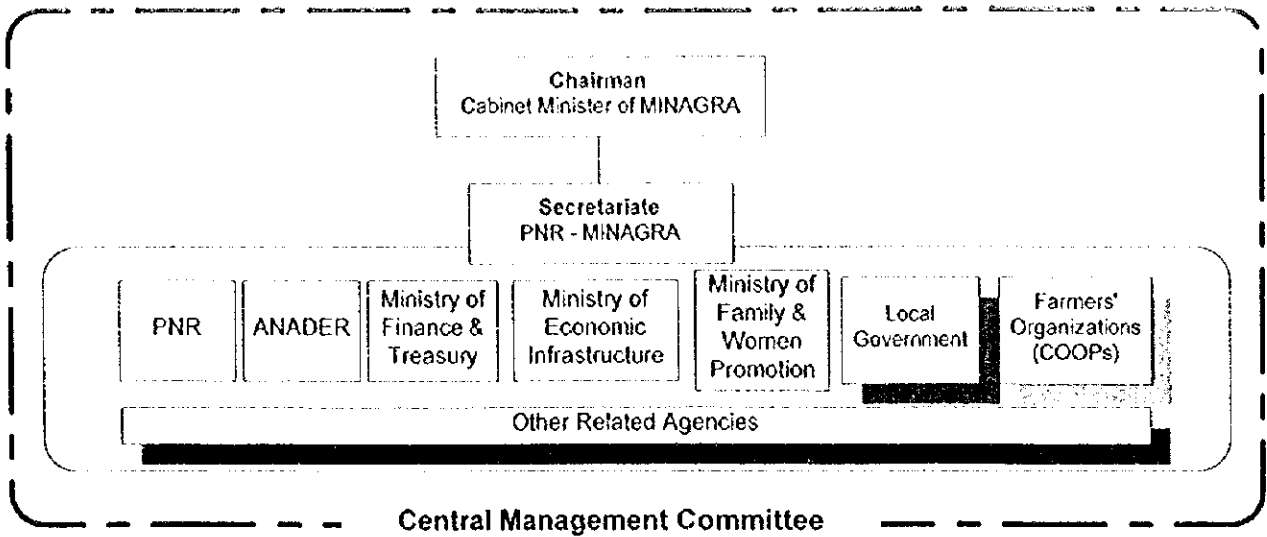


Fig. 4.5.1 PROJECT IMPLEMENTATION ORGANIZATION

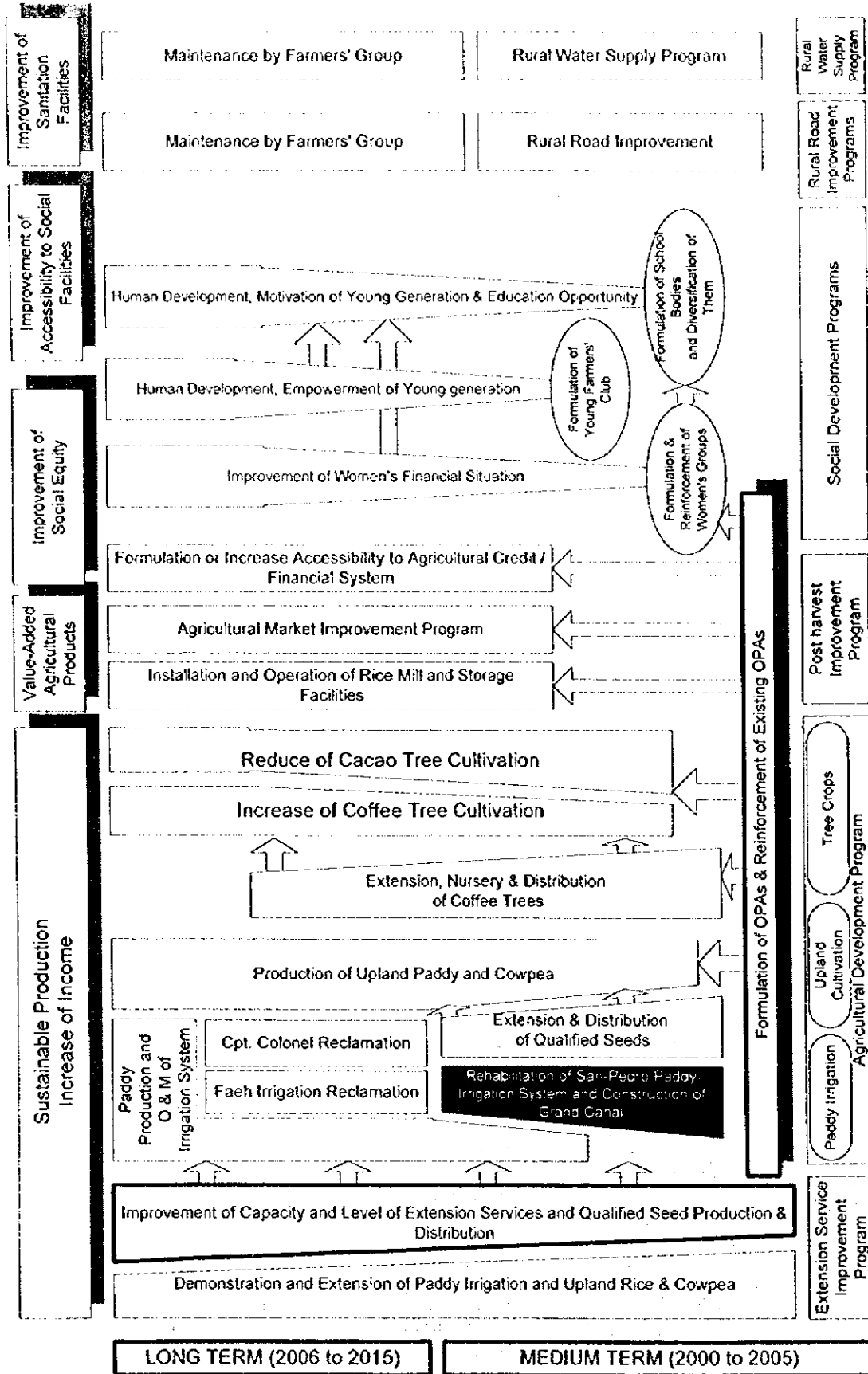


Fig. 4.5.2 Master Plan Implementation Concept