replaced so as to bear the hauling of a large quantity of collection. According to the hearing survey, sand and gravel can be collected at riverbed of the N'Zi River during the dry season.

- Akobakabo Village

Quartz gravel having 1 m to 1.3 m of thickness is deposited on the weathered schist layer in the cut surface of the national road. This quartz gravel can be used for concrete and filter. At the neighbouring collection site of quartz gravel, shale or silt rock with 15 mm or less of grain size is scattered on the weathered schist layer. This gravel is not suitable for concrete and filter because weathered and deteriorated even inside.

- Taniakro Village

The collection site is located about 200 m east of the national road. The sand layer is thickly covered with the top soil. Small quantity is collected actually.

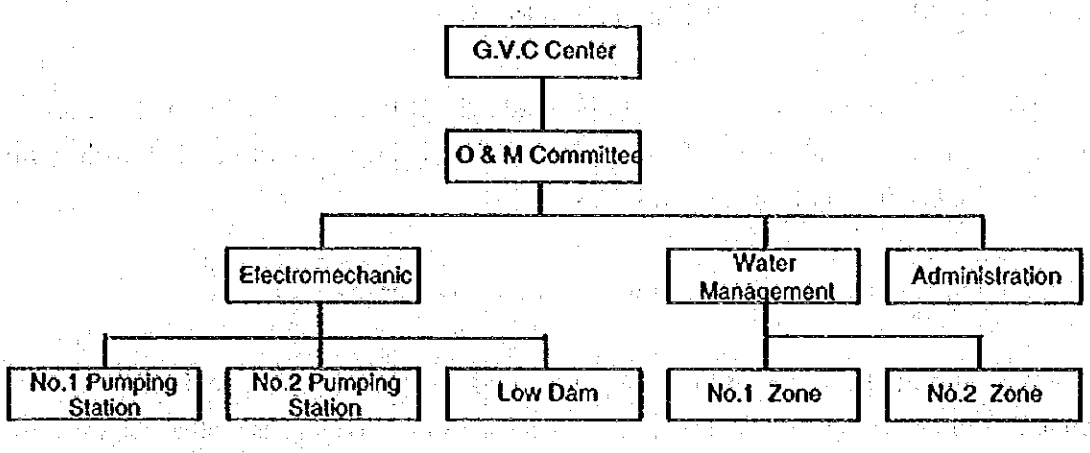
- Fronobo Village

The collection site for sand is located about 1.2 km west away from the national road. The collection is made even now for the public works of Bongouanou Prefecture since the construction of the national road. The thickness of top soil layer is some 1 m. The thickness of sand layer is so thin as 0.5 m to 1 m. Exhausted collection points are widely scattered. Potential survey for the possible quantity of collection should be made widely.

5-10 Operation & Maintenance

5-10-1 M'Bahiakro Area

An organization for the operation & maintenance is proposed to be established in the central office of G.V.C for efficient management of the irrigation & drainage facilities and rational distribution of the irrigation water. The proposed operation & management organization is as follows;



Proposed O & M organisation for M'Bahiakro area

The organization is composed of operation & maintenance committee, administration section, water management section and electromechanical section.

(1) Role of Organisation

- Operation & Maintenance Committee

The operation & maintenance committee is responsible for of the whole organisation.

- Administration Section

The administration section is responsible for administration of the organisation and the accounting.

- Water Management Section

The water management section is responsible for optimum distribution of the irrigation water in conformity with current water demand.

- Electromechanical Section

The electromechanic is responsible for operation, daily maintenance and periodical inspection of the pumping stations and the low dam. The easy repair and part change is also made.

The above-mentioned personnel can be appointed among beneficiary farmers.

(2) Operation, Maintenance and Repair of Farm Roads

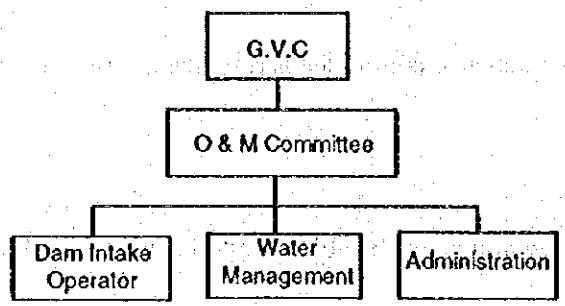
Weeding of the farm roads should be made about twice a year by the beneficiary farmers themselves, and repair of the weakened basecourse should be also made with laterite by the beneficiary farmers themselves.

(3) Operation, Maintenance and Repair of Irrigation & Drainage Canals

Weeding of the concrete lined canals should be made by the beneficiary farmers themselves prior to irrigation, and as for the earth canals the dredging as well as the weeding should be made by the beneficiary farmers themselves as an everyday farming practice.

5-10-2 Dam Irrigation Areas of Dienzou, Yannon, Eholié and Atofou

An organisation for the operation & maintenance is proposed to be established in the branch offices of G.V.C for efficient management of the irrigation & drainage facilities and rational distribution of the irrigation water. The proposed operation & management organisation is as follows;



Proposed O & M organisation for tributary dam areas

The organisation is composed of operation & maintenance committee, administration section, water management section and dam intake operator section.

(1) Role of Organisation

- Operation & Maintenance Committee

The operation & maintenance committee is responsible for everything of the organisation.

- Administration Section

The administration section is responsible for administration of the organisation and the accounting.

- Water Management Section

The water management section is responsible for optimum distribution of the irrigation water in conformity with current water demand.

- Dam Intake Operator Section

Operation of the dam intake gate is made together with the water management section. Operation & maintenance of the reservoir is also on the responsibility.

The above-mentioned personnel can be appointed among beneficiary farmers.

(2) Operation, Maintenance and Repair of Farm Roads

Weeding of the farm roads should be made about twice a year by the beneficiary farmers themselves, and repair of the weakened basecourse should be also made with laterite by the beneficiary farmers themselves.

(3) Operation, Maintenance and Repair of Irrigation & Drainage Canals

Weeding of the concrete lined canals should be made by the beneficiary farmers themselves prior to irrigation, and as for the earth canals the dredging as well as the weeding should be made by the beneficiary farmers themselves as an everyday farming practice.

5-11 Environmental Conservation

(1) Vegetation of Feasibility Study Area

(a) Atofou Area

Originally this area was covered by tropical semi-deciduous forests. The flat land along Atofou river is used mostly as slush and burn fields and forests with tall trees remained at the side and top of the hill. The vegetation seemed to be diverse and rich in this area.

Irrigable area : Most of the irrigable area is used as slush and burn fields, planted with upland rice and peanut. The crop productibility is estimated as very high. There is a forest which we were told was never touched since the creation of the village.
Dam site and submerged area : The flat land of the dam site is mostly used as slush and burn fields. The crop planted were upland rice and maize. The hillside fields were planted with peanut, two varieties of yam, three varieties of melon, showing high productibility. In the submerged area, the secondary forests after slush and burn farming with the tall trees of original forest were observed.

(b) Eholie Area

Originally this area was covered by tropical semi-deciduous forests. Most lands were used as slush and burn fields rotationally. The original forest with old tall trees were found in surrounding area of the village. The forest land turned mostly to slash and burn fields and secondary forest. The native vegetation seemed to be very diverse and rich in this area.
Irrigable area : Most of the land was used as slush and burn fields, planted with yam, upland rice, cassava, maize and okra. Some palm trees, coffee, cacao and banana plantations were found. Parts of the irrigable area were covered with perennial weeds called "Sékou Touré" with discarded planting of pines apple trees. These showed that the fields were at the turning stage between slush and burn fields and secondary forests. Downstream of the irrigable area, there were over flooded grass plain of the N'Zi River.
Dam site and submerged area : The forest with tall trees remained dominant at the dam site and more so in the submerged area than in the irrigable area. The slash and burn fields are rather new in the submerged area.

(c) Dienzou Area

The Dienzou area is located at the boundary between the forest and the savanna. The down stream area was originally covered by tropical semi-deciduous forests. The lands were mostly used as slush and burn fields, coffee plantations and secondary forests. The upstream area was mostly arboreous savanna. Slush and burn fields in the area were rather few in number and low in crop productibility. The native vegetation in the arboreous savanna seemed to be simple and poor in this area.
Irrigable area : Most of the irrigable area is located in forest area. The land was used as slush and burn fields, planted mostly with yam and upland rice. New coffee planting was observed. The lower half of the irrigable area is constituted of newly growing secondary forests, some of which were after pineapple planting.
Dam site and submerged area : At the dam site, land was used as slush and burn fields, planted with yam and upland rice. The forest was found along Dienzou stream and hillside.

The trees were not as tall than in Atofou and Eholie. The submerged area was mostly arboreous savanna. Slush and burn fields were founded spottedly in the savanna.

(d) Yamnon Area

The Yamnon area is located at the boundary between forest and savanna. The area in the upper stream is originally covered with tropical semi-deciduous forest with tall trees. Presently the forest was opened as slush and burn fields. The slush and burn fields were very rare in the down stream arboreous savanna area. The native vegetation was rather simple and poor.

Irrigable area : The irrigable area was mostly savanna with spotted slush and burn fields. It was partly because the village had a wide land area, that there were no need of intensively opened fields. The crop productivity was rather low.

Dam site and submerged area : The dam site belongs to forest area and most old slush and burn fields are covered with "Sékou Touré" perennial weeds. Some fields presently under cultivation were planted with yam, upland rice and maize. Submerged areas were also forest areas with tall trees. Many slush and burn fields covered with "Sékou Touré" weeds were observed in the forests. The remaining old and tall trees were just cut down by wood industry buyers.

(2) Environmental Conservation Plan

(a) Conservation of Historical Forest

The primary forest surrounding Eholie village and graveyard have been respected and protected as "Holy forest" by villagers. The primary forest in the irrigable area of Atofou village, which have not yet been touched, is also respected and protected by the villagers. Those forest should be conserved considering their history and characteristics.

Technical approach for environmental conservation

- To conserve the historical forests, and protect them against exploitation.

(b) Soil Conservation at Tributary Dam Area

There are many cut and slush fields and secondary forests at the inundated area of tributary dams. It is expected that those lands will be explored as cut and slush fields after the dam construction and water inundation. The present way of cut and slush farming causes soil erosion in rainy season, especially in steep slopes. This may cause soil

sedimentation of the dam.

Technical approach for environmental conservation

- Reforestation and grass covering of slopes at tributary dam area.

5-12 Project Cost

The prerequisites and method of the cost estimation is as follows:

(1) Prices for unit quantities of work items of dams, on-farm works, rural roads and village water supply and operation costs of construction machinery were determined based on those obtained from some contractors operating in Côte d'Ivoire.
(2) Prices of steel pipes, cast iron pipes, pumps, flow-jet valves and rubber dams were determined based on those estimated by Japanes manufacturers.
(3) Unit prices of man power are based on those employed by DCGTx.
(4) Unit prices of agricultural machinery and mills are based on those estimated dealers in Côte d'Ivoire.
(5) Prices are as of August 1994.
(6) Quantities of work items were obtained based on plans of works compiled in the Annex.
(7) The employed exchange rates as of August 1994 are;
1 US$=100.8 Yen=5.29 France Franc, 1 France Franc=100 CFA. Franc,
This means that 1 CFA Franc=0.19 Yen.
(8) The expenditure for detailed design and supervision is estimated to be 10 % of the total cost of irrigation and drainage facilities, on-farm works, post-harvest facilities, rural roads and village water supply.
(9) For contingency, 10 % of the total investment cost is appropriated.

Based on the above-mentioned prerequisite and method, the project cost was estimated as given in Table 5-12-1.

Table 5-12-1 Project cost

I. Investment costs

1-1 Irrigation & Drainage facilities Unit; 1000 CFA F.

Items	Foreign Currency	Local Currency	Non Taxed Amount	Taxes	Total
(1) M'Bahiakro Site					
- 1 Low dam	1,166,172	576,723	1,742,895	435,724	2,178,619
- 2 Pumping stations & Conveyance pipelines	1,704,353	252,270	1,956,623	489,156	2,445,779
- On-farm works 453 ha	1,273,524	767,996	2,041,520	510,380	2,551,900
Sub-total	4,144,029	1,596,989	5,741,038	1,435,260	7,176,298
(2) Dienzou Site					
- 1 dam	845,047	455,025	1,300,072	325,018	1,625,090
- On-farm works 110 ha	507,884	311,928	819,812	204,953	1,024,765
- Compensation fees	-	12,325	12,325	0	12,325
Sub -total	1,352,931	779,278	2,132,209	529,971	2,662,180
(3) Yanmon site					
- 1 dam	802,093	431,896	1,233,989	308,497	1,542,486
- On-farm works 80 ha	334,401	211,084	545,485	136,371	681,856
- Compensation fees	-	1,350	1,350	0	1,350
Sub-total	1,136,494	644,330	1,780,824	444,868	2,225,692
(4) Eholie					
- 1 dam	1,189,793	640,657	1,830,450	457,613	2,288,063
- On-farm works 130 ha	508,122	315,932	824,054	206,014	1,030,068
- Compensation fees	-	3,042	3,042	0	3,042
Sub-total	1,697,915	959,631	2,657,546	663,627	3,321,173
(5) Atofou site					
- 1 dam	1,300,348	700,188	2,000,536	500,134	2,500,670
- On-farm works 200 ha	791,331	510,711	1,302,042	325,511	1,627,553
- Compensation fees	-	15,268	15,268	0	15,268
Sub-total	2,091,679	1,226,167	3,317,846	825,645	4,143,491
I-1 Total	10,423,068	5,206,395	15,629,463	3,899,371	19,528,834

I-2 Post- harvest facilities

Items	Foreign Currency	Local Currency	Non Taxed Amount	Taxes	Total
(1) M'Bahiakro Cooperative Association					
- 1 rice mill	20,088	2,232	22,320	8,680	31,000
- 1 storehouse 800 m^2	21,600	14,400	36,000	9,000	45,000
- 1 truck	24,030	2,670	26,700	10,383	37,083
Sub-total	65,718	19,302	85,020	28,063	113,083
(2) Dimbokro Cooperative Association					
- 1 rice mill	11,772	1,308	13,080	5,087	18,167
- 1 truck	24,030	2,670	26,700	10,383	37,083
Sub-total	35,802	3,978	39,780	15,470	55,250
(3) M'Batto Cooperative Association					
- 1 rice mill	11,772	1,308	13,080	5,087	18,167
- 1 truck	24,030	2,670	26,700	10,383	37,083
Sub-total	35,802	3,978	39,780	15,470	55,250
(4) Dienzou GVC					
- 1 storehouse 105 m^2	2,851	1,874	4,725	1,181	5,906
(5) Yanmon GVC					
- 1 storehouse 105 m^2	2,851	1,874	4,725	1,181	5,906
(3) Eholie GVC					
- 1 storehouse 105 m^2	2,851	1,874	4,725	1,181	5,906
(4) Atofou GVC					
- 1 storehouse 105 m^2	2,851	1,874	4,725	1,181	5,906
I-2 Total	148,726	34,754	183,480	63,728	247,208

I-3 Agricultural machinery

Items	Foreign Currency	Local Currency	Non Taxed Amount	Taxes	Total
(1) M'Bahiakro GVCs					
- 31 walking tractors	53,010	5,890	58,900	22,906	81,806
- 16 threshers	17,280	1,920	19,200	7,467	26,667
Sub-total	70,290	7,810	78,100	30,372	108,472
(2) Dienzou GVC					
- 6 walking tractors	10,260	1,140	11,400	4,433	15,833
- 3 threshers	3,240	360	3,600	1,400	5,000
Sub-total	13,500	1,500	15,000	5,833	20,833
(3) Yanmon GVC					
- 5 walking tractors	8,550	950	9,500	3,694	13,194
- 2 threshers	2,160	240	2,400	933	3,333
Sub-total	10,710	1,190	11,900	4,628	16,528
(4) Eholie GVC					
- 7 walking tractors	11,970	1,330	13,300	5,172	18,472
- 4 threshers	4,320	480	4,800	1,867	6,667
Sub-total	16,290	1,810	18,100	7,039	25,139
(5) Atofou GVC					
- 13 walking tractors	22,230	2,470	24,700	9,606	34,306
- 7 threshers	7,560	840	4,800	1,867	6,667
Sub-total	29,790	3,310	33,100	11,472	40,972
I-3 Total	140,580	15,620	156,200	59,344	211,944

I-4 Rural roads

Items	Foreign Currency	Local Currency	Non Taxed Amount	Taxes	Total
- M'Bahiakro 4.1 km	53,092	28,588	81,680	20,420	102,100
- Dienzou 9.9 km	147,943	79,661	227,604	56,901	284,505
- Yanmon 6.0 km	79,754	42,945	122,699	30,675	153,374
- Eholie 4.9 km	71,627	38,569	110,196	27,549	137,745
- Atofou 4.0 km	56,945	30,739	87,684	21,921	109,605
I-4 Total	409,361	220,502	629,863	157,466	787,329

I-5 Village water supply

Items		Foreign Currency	Local Currency	Non Taxed Amount	Taxes	Total
- M'Bahiakro	3 drilled wells	14,121	6,360	20,481	5,120	25,601
- Diénzou	2 drilled wells	9,414	4,240	13,654	3,414	17,068
- Yamnon	1 drilled well	4,707	2,120	6,827	1,707	8,534
- Eholié	3 drilled wells	14,121	6,360	20,481	5,120	25,601
- Atofou	4 drilled wells	18,828	8,480	27,308	6,827	34,135
I-5 Total		61,191	27,560	88,751	22,188	110,939

I-6 Detail Design & Supervision

Items	Foreign Currency	Local Currency	Non Taxed Amount	Taxes	Total
- Consultant Services	1,074,551	578,605	1,653,156	413,289	2,066,445
I-6 Total	1,074,551	578,605	1,653,156	413,289	2,066,445

I-7 Project administration & Supporting services

Items	Foreign Currency	Local Currency	Non Taxed Amount	Taxes	Total
- Project Executing Unit	20,700	14,180	34,880	0	34,880
- Extension services	70,200	7,800	78,000	0	78,000
- Cooperatives	7,650	850	8,500	0	8,500
- Training		12,600	12,600	0	12,600
I-7 Total	98,550	35,430	133,980	0	133,980

I-8 Fund for credit

Items	Foreign Currency	Local Currency	Non Taxed Amount	Taxes	Total
- Production expenditure		246,534	246,534	0	246,534
- Machinery and Equipment (included in I-2 & I-3)		(284,780)	(284,780)	0	(284,780)
I-8 Total		246,534	246,534	0	246,534

Total	12,356,027	6,365,400	18,721,427	4,616,787	23,338,214
I-9 Contingencies	1,234,973	636,600	1,871,573	461,213	2,333,786
Grand-total	13,591,000	7,002,000	20,593,000	5,078,000	25,672,000

II. Recurrent costs Unit; 1000 CFA F.

II-1 Operation & maintenance costs for irrigation & drainage facilities (annual costs)	
- M'Bahiakro	24,452
- Dienzou	843
- Yanmon	791
- Eholie	867
- Atofou	922
II-1 Total	25,875
II-2 Operation and maintenance costs of Post-harvest facilities (annual costs)	
- M'Bahiakro GVC Association	8,600
- Dimbokro GVC Association "Entente"	3,980
- M'Batto GVC Association	6,150
II-Total	18,730
II-3 Costs related to Extension services (for 10 years since the start))	
- M'Bahiakro	7,320
- Dimbokro	7,320
- M'Batto	7,320
II-3 Total	21,960
II-4 Costs related to Cooperative Associations (annual costs)	
- M'Bahiakro GVC Association	3,300
- Dimbokro GVC Association "Entente"	3,300
- M'Batto GVC Association	3,300
II-4 Total	9,900

Note ; The project cost with taxes are calculated by applying conversion factors to the cost without taxes. The conversion factors are quoted from FED report "Project d'Appui à la Riziculture Irrigée dans les Régions Centre et Centre Nord".

5-13 Implementation Plan

5-13-1 Organization for the Project Implementation

The organization for the project implementation is proposed as below.

(1) The executing agency for the project will be the Ministry of Agriculture and Animal Resources (MINAGRA), in which the Department of Agricultural Modernization (DME) will be in charge of its secretariate functions including planning and administration of the project execution and the Department of Planning (DP) in charge of monitoring and assessing the project execution.

(2) A central steering committee will be established for coordination at the central government level on planning, budgeting and implementation for the project. It will be composed of representatives from government agencies concerned, namely, MINAGRA, the Automonous Sinking Fund (CAA), DCGTx, the National Rural Development Agency (ANADER), the Ministry of Family and Women Promotion (MFPF), the Ministry of Economy, Finance and Planning (MCEFP) and the funding agencies.

(3) A project executing unit, composed of a project manager and his staff,will be established to be in charge of the field level management of the project execution, including public information, animation of local organizations and people concerned, appointment and organization of participant farmers, arrangement of required lands and coordination of below-mentioned concerned organizations' activities regarding the project execution.

(4) DCGTx will be in charge of the technical control regarding detailed designs and execution of construction works through an agreement signed with MINAGRA.

(5) ANADER will be in charge of training and extension of farming and water management technologies for participant farmers through an agreement signed with the project executing unit.

(6) The Ministry of Family Affairs and Women Promotion (MFPF) will be in charge of activities regarding the organization and animation of women through an agreement signed with MINAGRA.

(7) The Office Providing Support for the Commercialization of Food Stuff (OCPV) will support participant farmers regarding the commercialization of their products through an agreement signed with MINAGRA.

5-13-2 Project Implementation Schedule

When preparing the project implemnetation, MINAGRA should explain the project outline to concerned organizations and people of related villages to get their full understanding and to confirm their willingness of participations to the project. In parallel, MINAGRA is to establish the staring committee mentioned in "5-13-1" and conduct preparatory works to decide the framework of the project including the project scale and financial arrangement. After the project framework is decided, the project executing unit is to be set up and a consultant is to be contracted for detailed design and supervision of construction works. The project implementation schedule after that is shown in Table 5-13-1.

One of the most important factors for successful project implementation is animation of participating farmers. It includes the following items:

(1) to obtain agreement of people of related villages to the project implementation,
(2) to select participating farmers and to establish farmers' organizations,
(3) to have participating farmers engaged in construction works including on-farm works to encourage their willingness to participate in the project and to help them raise farming fund.
(4) to conduct technical extension and training of farming and water management for participating farmers.

Although, in Table 5-13-1, all 5 districts of the development priority area are planned for simultaneous development, the implementation schedule can also be divided into two stages or more as the case may be, because each site has a development plan technically independent from those of the other sites.

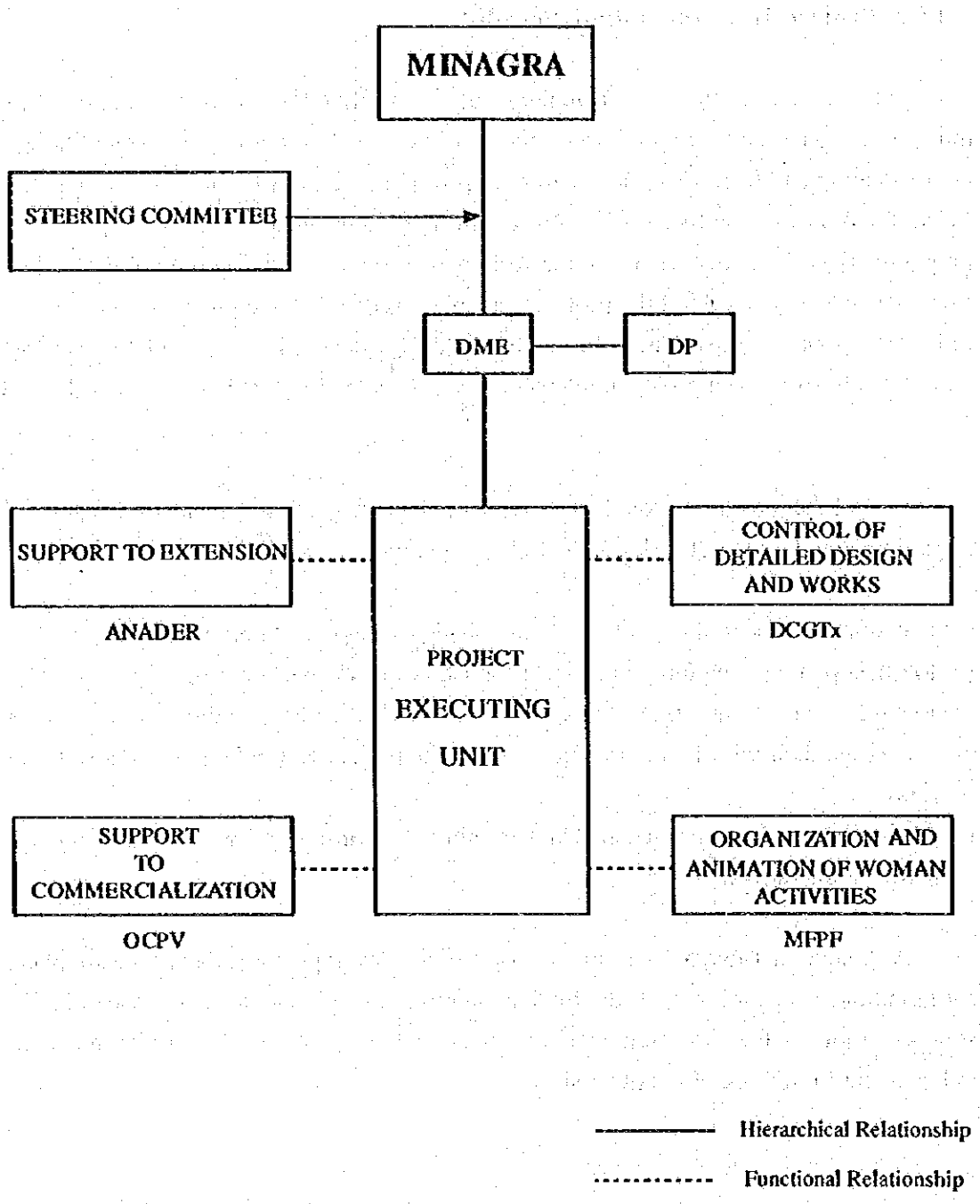


Figure 5-13-1 Organization for project implementation

Table 5-13-1 Project implementation schedule

Items	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year
[Construction Works]							
Topographical & Geological Surveys		Bid					
Detailed Design							
Irrigation & Drainage Works							
M'BAHIAKRO							
_ 1 low dam		Prp	Main	Rubber			
_ Pumping Stations & Conveyance Pipes		Prp	Main	Pump			
		Prp	Main				
_ On-farm Works							
DIENZOU							
_ 1 dam		Prp	Main	Test			
_ On-farm Works		Prp	Main				
YANMON							
_ 1 dam		Prp	Main	Test			
_ On-farm Works		Prp	Main				
EHOLIE							
_ 1 dam		Prp	Main	Test			
_ On-farm Works		Prp	Main				
ATOPOU							
_ 1 dam		Prp	Main	Test			
_ On-farm Works		Prp	Main				
Post-harvest Facilities							
_ storehouses							
_ Rice mills							
Agricultural Machinery							
Rural Roads							
Village Water Supply							
[Supporting Services]							
Organization of Farmers							
Extension Services							
Training of farmers							
Project Fund for Farming Credit							

Note: Bid; Bidding, Prp; Preparatory work, Main; Main work, Rubber; Installation of rubber dam, Pump; Installation of pumps, Test; Water storing test

5-14 Project Evaluation

5-14-1 Purpose of the Project Evaluation

The purpose of the project evaluation is to make comprehensive analyses of the effects brought by the project to the society as a whole. In this process, quantitative analyses as well as examination on the effects that are non-quantifiable but bear important meanings will be made.

5-14-2 Organization and Methods of the Project Evaluation

In the project evaluation, not only the quantitative analyses will be made according to the following economic and financial evaluations, but also enough considerations will be given to the social and environmental effects of the project.

(1) Economic Evaluation

The economic evaluation assesses how much the implementation of the project would contribute to the national economic growth by comparing the benefit with the cost. There are three ways to judge the economic efficiency of a project; the economic internal rate of return (EIRR), the net present value (NPV) and benefit/cost ratio (B/C Ratio). For this project, the EIRR will be applied.

(2) Financial Evaluation

The financial evaluation assesses how the farm management of a farmer, who is the direct beneficiary of the project, is carried out and whether the farming system is sustainable. For this project, the primary focus is on sustainability. Some model farms are chosen from the surveyed areas and judged according to the farm budget analysis.

(3) Sensitivity Analysis

In the project evaluation, it is necessary to examine the possible effects of the future uncertainties on the project profitability through the sensitivity analysis. Some predictable cases are chosen for the purpose of comparative analysis.

5-14-3 Basic Evaluation Conditions

(1) Evaluation Period

The evaluation period for this project is set as 50 years including the construction work period. The first four years are initial investment period.

(2) Irrigation Benefits

The size of the area as well as the numbers of the farming households which will benefit from the irrigation are shown in the table below.

Table 5-14-1 Areas and households benefiting from the irrigation

Sites	Area of development (ha)			Number of households	
	Farm land with irrigation	Farm land without irrigation	Total	Number of households	Number of people
M'Bahiakro	432	21	453	304	1,885
Dienzou	90	20	110	220	1,364
Yanmon	65	15	80	160	992
Eholie	105	25	130	260	1,612
Atofou	190	10	200	400	2,480
Total	882	91	973	1,344	8,333

Note: The number of the benefiting households is calculated from the number of already participating households in M'Bahiakro project. For other sites, the number is calculated from the presumption that 1 household will have 0.5 ha of cultivated land. The number of people benefiting are derived from the average number of persons in one household.

(3) Price Standards

The financial prices are based on the market prices of August, 1994. Although some fluctuations for the rice price, free competition is taken as the precondition for the present evaluation.

(4) Exchange Rate

The exchange rate is set as 1.00 US$ = 529 CFA = 100.8 yen, which is the average official exchange rate in August, 1994.

(5) Conversion Factors

The conversion factors are the ones calculated by the European Development Fund

after the CFA F denomination in January, 1994. These factors are shown in the Annex of the Project Evaluation.

(6) Appearance of the Benefits

The appearance of the benefits depends on how well the farmers acquired the cultivation and management skills. This project assumes that the target will be reached in five years, starting in the ensuing year after the completion of the construction work, as shown in the following:

Table 5-14-2 The Appearance of the benefits

1st year	2nd year	3rd year	4th year	5th year
30%	40%	60%	80%	100%

5-14-4 Project Benefits

(1) Quantifiable Benefits

The direct benefits arising from the implementation of this project are derived from the increased agricultural production through irrigated farming. The benefits of increased production consist of cultivation of rice, vegetables and other crops in some areas.

(2) Intangible Benefits

The implementation of the project will produce not only the above mentioned quantifiable benefits, but also the ones that are difficult to quantify. For example, we can expect that the construction of the farming roads will reduce the transportation expenses for the agricultural products and consumption goods, and that the establishment of the wells will save the labor for drawing water and improve the sanitary conditions. These benefits are smaller than the agricultural benefits and cannot be quantified because of the difficulty involved in the quantification.

5-14-5 Economic Evaluation

(1) Economic Expenses

The project period is set at 50 years. The remaining value after the termination of the project is ignored as negligible. The economic operating expenses include those for

construction, clerical work, agricultural support, consultation, contingency and finally administration and maintenance of the facilities, which arise after the completion of construction. The expenses for the roads and water supplies are excluded from the economic costs, for they should rather be calculated as the infrastructure development. Also, agricultural production costs are excluded, for they will be calculated in the benefit quantification. To convert the operating expenses to economic prices, the conversion factors of the construction, as listed in the European Development Fund data, are used in the calculations.

(a) Initial Investment

The initial investment expenses for each area, as converted to economic expenses, are as follows:

Table 5-14-3 The Initial investment expenses

Unit: 1000 CFA F

Year	M'Bahiakro	Dienzou	Yanmon	Eholie	Atofou
1996	158,869	58,427	49,066	73,129	90,951
1997	1,386,125	735,505	620,553	920,823	1,139,036
1998	1,360,295	734,697	619,745	920,015	1,138,228
1999	3,906,088	955,171	805,021	1,197,360	1,482,370
Total	6,811,377	2,483,800	2,094,385	3,111,327	3,850,585

(b) Administration and Maintenance Expenses

The highest annual administration and maintenance expenses of any one year are 32,861 thousand CFA F for M'Bahiakro area, 6,888 thousand CFA F for Dienzou area, 6,801 thousand CFA F for Yanmon area, 6,901 thousand CFA F for Eholie area and 6,951 thousand CFA F for Atofou area.

(c) Replacement Expenses

Supposing the useful life of a pump is 25 years, the replacement expense for M'Bahiakro area is 209,524 thousand CFA F.

(2) Economic Benefits

The project benefits are those from the increased agricultural production gained as a

result of the implementation of irrigation and agricultural support activities. The calculation of the benefits applies the increased benefit approach, in which the cases with and without project implementation are compared. The benefits used for the calculation include the quantifiable ones, which are already described above, but exclude those intangible and non-quantifiable ones. Of all the farm products and inputs, the internationally traded goods have the border prices based on the World Bank and the European Development Fund data. The domestically traded goods have the prices converted according to the conversion factors.

The increased benefits for each area are shown in the following tables:

Table 5-14-4 Increased benefits (1/5) - M'Bahiakro

Name of crops	Benefits				Increasead benefit
	Without project		With project		
	area (ha)	benefit (1000 FCFA)	area (ha)	benefit (1000 FCFA)	(1000 FCFA)
1. Paddy	226	11,769	588	544,843	533,074
2. Vegetable	0	0	86	122,550	122,550
3. Other (Upland crops)	0	0	21	19,211	19,211
Total	226	11,769	695	689,604	674,835

Table 5-14-4 Increased benefits (2/5) - Dienzou

Name of crops	Benefits				Increasead benefit
	Without project		With project		
	area (ha)	benefit (1000 FCFA)	area (ha)	benefit (1000 FCFA)	(1000 FCFA)
1. Paddy	0	0	122	111,874	111,874
2. Vegetable	0	0	18	25,650	25,650
3. Other (Upland crops)	0	0	20	18,328	18,328
Total	0	0	160	155,852	155,852

Table 5-14-4 Increased benefits (3/5) - Yanmon

Name of crops	Benefits				Increasead benefit
	Without project		With project		
	area (ha)	benefit (1000 FCFA)	area (ha)	benefit (1000 FCFA)	(1000 FCFA)
1. Paddy	0	0	88	80,696	80,696
2. Vegetable	0	0	13	18,810	18,810
3. Other (Upland crops)	0	0	15	13,779	13,779
Total	0	0	116	113,285	113,285

Table 5-14-4 Increased benefits (4/5) - Eholie

Name of crops	Benefits				Increasead benefit
	Without project		With project		
	area (ha)	benefit (1000 FCFA)	area (ha)	benefit (1000 FCFA)	(1000 FCFA)
1. Paddy	0	0	143	131,131	131,131
2. Vegetable	0	0	21	30,210	30.210
3. Other (Upland crops)	0	0	25	22,876	22,876
Total	0	0	189	184,217	184,217

Table 5-14-4 Increased benefits (5/5) - Atofou

Name of crops	Benefits				Increasead benefit
	Without project		With project		
	area (ha)	benefit (1000 FCFA)	area (ha)	benefit (1000 FCFA)	(1000 FCFA)
1. Paddy	0	0	258	236,586	236,586
2. Vegetable	0	0	38	54,150	54,150
3.Other (Upland crops)	0	0	10	9,230	9,230
Total	0	0	306	299,966	299,966

In M'Bahiakro site, only 226 ha of the existing development land is cultivated for rice (according to the 1994 survey), and there is an apprehension that the planted area may further decrease due to a shortage of operating expenses or a pump malfunctioning. Therefore, the present rice cultivated area of 226 ha was used for "Without" case. For the

tributary stream dam areas, zero is entered in its "Without" case because the benefited lands are not cultivated yet and their ravine locations will not allow future cultivation except for low land cultivation as in this project.

5-14-6 Economic Internal Rate of Return

(1) Economic Internal Rate of Return

The economic internal rate of return (EIRR) is used to judge the project's contribution to the national economy in comparison with the opportunity cost rate of capital. The Côte d'Ivoire opportunity cost rate of capital concerning the agricultural matters is approximately 5% according to the Ministry of Agriculture and Animal Resources. The EIRR for these F/S areas is as follows:

Table 5-14-5 Economic internal rate of revenue

F/S areas	Internal rate of return (%)
M'Bahiakro	7.5
Dienzou	4.6
Yanmon	3.8
Eholie	4.3
Atofou	6.0
Total	5.9

As shown above, the EIRR for the F/S area as a whole rises a little above the opportunity cost rate of capital, whereas the EIRR for some or the individual areas fall far short of it. The Côte d'Ivoire government aims at the promotion of agriculture through the lowland development, where the water resource can be obtained with relative ease and where administration and maintenance can be carried out by the farmers more easily. The selection of the F/S areas in this project is made in accordance with the government aim and focuses on the lowland development. However, the lowlands in general have a low profitability because large benefit areas cannot be obtained in these lands and the maintenance cost per unit area is higher. Therefore, the EIRR tends to be higher for the areas with larger benefited areas.

(2) Sensitivity Analysis

The sensitivity analysis is made on all the areas. The some cases with future uncertain changes are proposed as follows:

Case 1: The appearance of benefits is delayed for two years, due to the construction extension.

Case 2: The construction costs rise by 20%.

Case 3: The target yield is not achieved because of the insufficient agricultural support and the delay in acquisition of agricultural skills. Here, the rice yield is supposed to have been reduced from 6 t/ha to 4 t/ha.

Case 4: The cultivation in the dry season is not at all possible due to the shortage of the operating capital and the water supply, resulting in the decrease of planted areas by 40% below target.

The results are shown in the following table:

Table 5-14-6 Sensitivity analysis

Case	EIRR (%)
All 4 Cases	5.9
Case 1	5.2
Case 2	4.8
Case 3	4.1
Case 4	3.7

5-14-7 Financial Evaluation

(1) Farm Financial Evaluation

The farm financial evaluation is used to examine the revenue and expenditure of an average farm when it implemented the planned agricultural operations. The revenue by the operation types of a typical farm, as described in 5-5-5 Agricultural Operation Plans, are shown in the following:

Table 5-14-7 Revenue by the operation types of a typical Farm

Type	Cultivated area			Net benefit CFA F/year	
	Paddy (ha)	Vegetable (ha)	Upland crops (ha)	Sales of paddy	Sales of white rice
I	0.4	0.1	0.5	334,141	557,545
II	0.8	0.2	0.5	712,289	1,115,383
III	0.8	0.2	1	668,289	1,115,383

Note: The benefit is calculated assuming that it reaches the target yield.

All of the operating revenues, whether the farmers sell paddy or rice, are expected to exceed by far the average revenue of 157,300 CFA per year (the data by the farm financial survey) in these areas.

(2) Water Charges

As a general rule, water charges are to be met by the farmers. However, the expenses for the administration and maintenance of the irrigation facilities and the agricultural cooperatives are evaluated here as the water charges. The water charges per hectare for each area, which are derived from the total planted area, are shown in the following:

Table 5-14-8 Water charges

Sites	Water charge CFA F/ha	Proportion with respect to sale revenue	
		Sales of Paddy	Sales of White Rice
M'Bahiakro	38,000	4.8	2.8
Dienzou	18,000	2.2	1.3
Yanmon	24,000	2.9	1.7
Eholie	15,000	1.8	1.1
Atofou	9,000	1.1	0.7

The proportion of water charges to the planned operation sales revenue varies among the areas from 1.1% to 4.8% in case of paddy selling. However, there is no serious impediment to the farmers' ability to make payment. Even if the sales revenue drops by half because of a reduced harvest, the proportion will remain in the payable range of 2.2% to 9.6%. The manageability and low cost of the maintenance and administration are important factors which makes it possible for the farmers to sustain agricultural operations. It is

estimated that the low-cost maintenance and administration is possible in the four lowland F/S development areas. On the other hand, the M'Bahiakro project, which already has a certain degree of experience in irrigation, is expected to be properly managed after rehabilitation.

5-14-8 Effects on the Social Economy

(1) Creation of New Farming Land

In the tributary stream dam development area, the creation of new and well-conditioned farm land. The new farm land can be distributed to the young generations who must presently work away from home.

(2) Bringing Back the Younger Generation to the Farming Villages

Because rice cultivation requires the labor force of the youth, the creation of excellent farming land will promote the settled residence of the youth in the rural areas . To "return the younger generation to the farming villages" is one of the primary goals of the Côte d'Ivoire Agriculture Master Plan.

(3) Increased Production of the Primary Crops

The increased production of rice and vegetables will greatly improve the country's self-sufficiency of both of these import crops.

(4) Improvement of the Local Economy in the Farming Villages

Since the cash crop shortage caused by the stagnation of coffee and cacao, which had been both export crops, the farm economy has deteriorated. The establishment of rice and vegetables as cash crops will improve the poor economic conditions and lead to the expansion of consumption and investment, which in turn contributes to the improvement of economy in the local area as a whole.

(5) Promotion of Agriculture-Related Industries

The industries associated with the agriculture in general, the sales of the agricultural products and the sales and production of the farm inputs are expected to be promoted after the implementation of the project. In addition, 35% of the project operating expenses will be raised in domestic currency. This means that the equivalent amount of domestic materials

and equipment will be purchased, leading to the promotion of all related industries.

(6) Creation of Employment

After the implementation of the project, the labor force for the agricultural production and construction will be needed, resulting in the creation of a large number of employment opportunities. In all the areas, it is expected that 915,000 man-days for the annual agricultural labor and 3,280,000 man-days for the construction work during the construction period would be created.

(7) Effect of the Agricultural Skill Acquisition

The acquisition of the agricultural skills in the project areas will have a ripple effect that can stretch across the neighboring areas.

(8) Reduced Use of Slash-and-Burn Agriculture

The introduction of the irrigated agriculture will reduce the application of conventional slash-and-burn cultivation of the dry-field rice.

In addition to the positive effects as mentioned above, the implementation of the project may create some negative influences.

(1) Limited Number of Beneficiaries

As the benefited areas of the project implementation will be limited, it is not possible for all the village residents in the associated areas to receive equal benefits. In other words it is possible that an unfair difference between the beneficiaries and non-beneficiaries be created. Therefore, sufficient consultations and explanatory meetings between the administration and the potentially benefiting farmers is required.

(2) Influence of the Intensive Agriculture

The introduction of irrigation will be accompanied by an intensive agriculture, where more chemicals and fertilizers will be used. The utilization of chemicals and fertilizers will not become a serious problem, because the application is limited to a small scale. In addition, it is important to instruct the farmers of the proper handling and standards of the chemicals. The extension organizations should bear the responsibility of instruction, but at the same time, it is necessary to establish a system for environmental management.

(3) Influence of the Construction Work

Sufficient considerations should be given to the following possibilities of the direct influence from the construction work.

- As the planned dams in some areas will submerge a part of the existing farming land (coffee and cacao plantation), the lost area, though it is not large, will need to be financially compensated for.
- As the project areas include some traditionally sacred lands of the villages, this problem should be solved by giving sufficient explanatory meetings, or by excluding the lands from the project areas in some cases.
- Some farmers may carry out slash-and-burn agriculture on the neighboring tilted lands where the access will be improved due to the dam constructions. Since slush-and-burn agriculture will cause the erosion and outflow of the soil and may result in soil accumulation in the dams, trees and covering plants should be planted on these tilted lands.

5-14-9 Comprehensive Evaluation

The result of the economic evaluation in total rises a little above the Côte d'Ivoire opportunity cost rate of capital, while falling short of it in some areas. Meanwhile, the financial evaluation indicates that a sustainable and healthy farm management is possible, if given the proper agricultural support. The comparison of the EIRR between the mainstream pumped areas and the tributary stream dammed areas shows that the latter has the lower EIRR. However, it is difficult to determine which is superior, pumped areas or dammed areas, considering that the gravity irrigation in the tributary stream comes with easier maintenance, administration and low cost.

The implementation of this project will be greatly contribute to the following points:

(1) The implementation will promote food security and self-sufficiency policy, one of the priority goals of the national plan, to provide for the future population growth.

(2) It will play a leading role in the future development plans for the agriculture and local economy of the area where both agriculture and local economy have been deteriorated since the stagnation of coffee and cacao production.

(3) It will help increase the income of the villagers, improve their living standards, provide more opportunities of employment, stop the outflow of the youth from the farming

villages which is now a growing social problem, and encourage them to return home.

6. RECOMMENDATION

CHAPTER 6 Recommendation

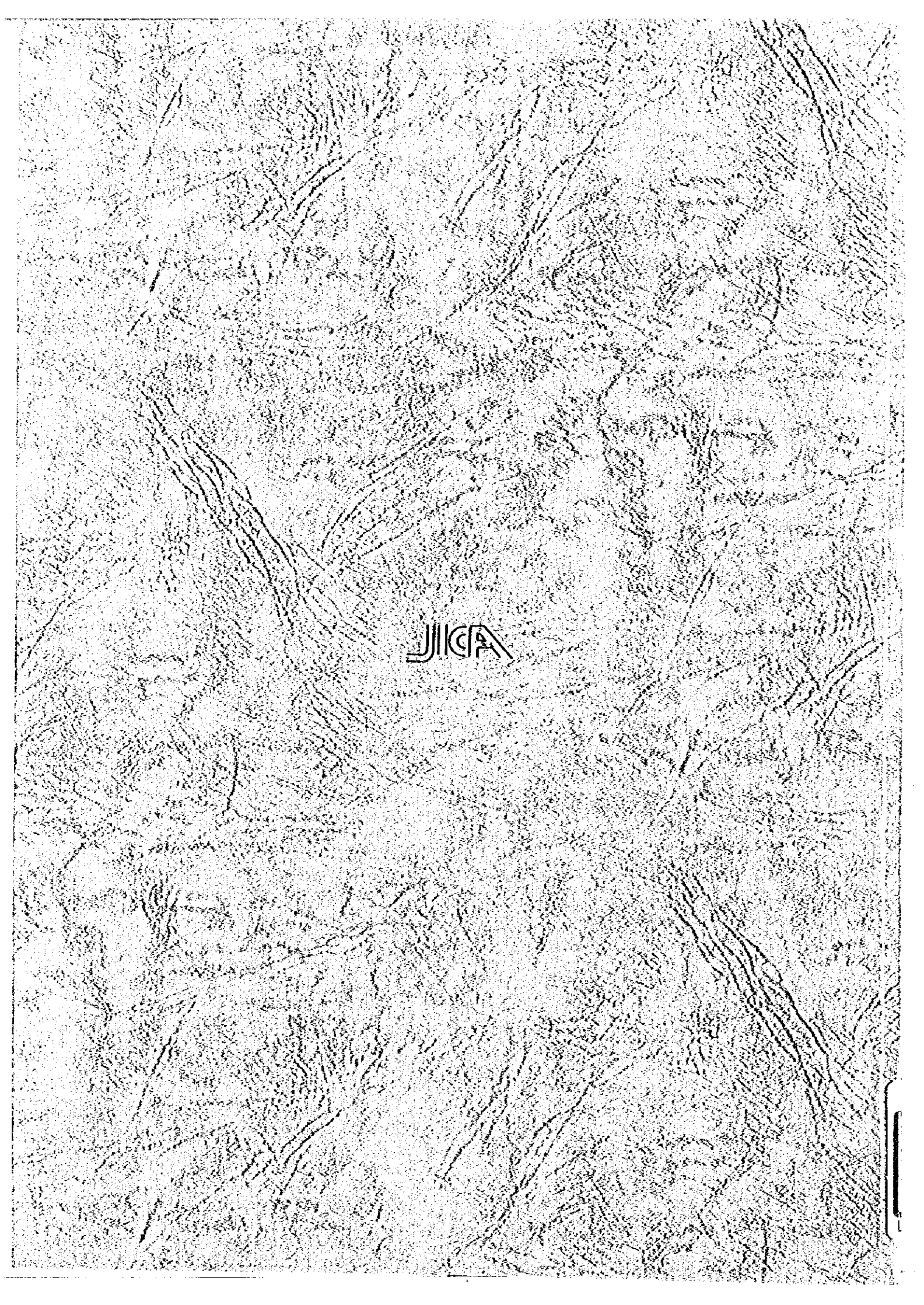
(1) After examining the current situation and the potential for rural development of the 150,000-hectare study area in the middle basin of the N'Zi River from various standpoints, we have worked out the Master Plan for the integrated rural development project targeting an area of 4,638 hectares, whose size is deemed appropriate for a project to be completed by 2015. Development priority areas with a total area of 973 hectares were selected, and feasibility study was conducted for these areas in order to make a development plan that is technically, economically, and socially viable.

(2) Carrying out the integrated rural development project, which focuses on increasing the production of rice and other food crops by utilizing the land, water, and other resources in the study area according to the Master Plan, will contribute to the government's agricultural policy for achieving self-sufficiency, will restore the agriculture of this area that has been in a slump due to the recent decline in cacao and coffee production, and is expected to contribute greatly to alleviating the efflux of younger generation and building up the local economy by increasing the income of farming households and creating more employment opportunities. Thus, it is recommended that the Government of Côte d'Ivoire implement the project in the development priority area of the study area that are established as model sites to acquire experience and then carry out the works laid out in the Master Plan one by one.

(3) In the Master Plan and the development plan for the development priority area, it is recommended to implement the project by integrating the construction of warehouses and rice mills, procurement of agricultural equipment, improvement of access roads, establishment of farmer's organization, education and training, establishment of a farm-management fund along with the development of irrigation and drainage systems and farm land. In order for the farmers and farmers' organizations in the study area that are inexperienced in modern irrigated farming to become successful in farming and operating an agricultural cooperative, it is important to integrate all components and implement them simultaneously. Organizing farmers' associations and providing education and training in farming techniques are especially crucial for smooth maintenance of irrigation and drainage facilities, cultivation of crops, and sales of farm products as well as giving sufficient consideration to establishing a fund to cover the cost for starting irrigated farming and purchasing agricultural equipment for the farmers, who currently have no access to effective agricultural credit. Also, it is desirable to develop rural road and village water-supply systems while building infrastructure for farming in order to assist the settlement of people in the villages.

(4) In order to smoothly implement the project while integrating various components as

mentioned earlier, it is recommended that the Ministry of Agriculture and Animal Resources, the executing agency of the project, establishes an effective implementing system, in which the relevant organizations of the central government and the study area can cooperate closely. As for the farmers related to the development sites, it is recommended to (1) confirm their willingness to participate in the project before implementing the project in the area, (2) thoroughly explain about the project, and (3) employ the farmers in the construction works so that they can develop a sense of participation in the project and earn funds for future farming.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