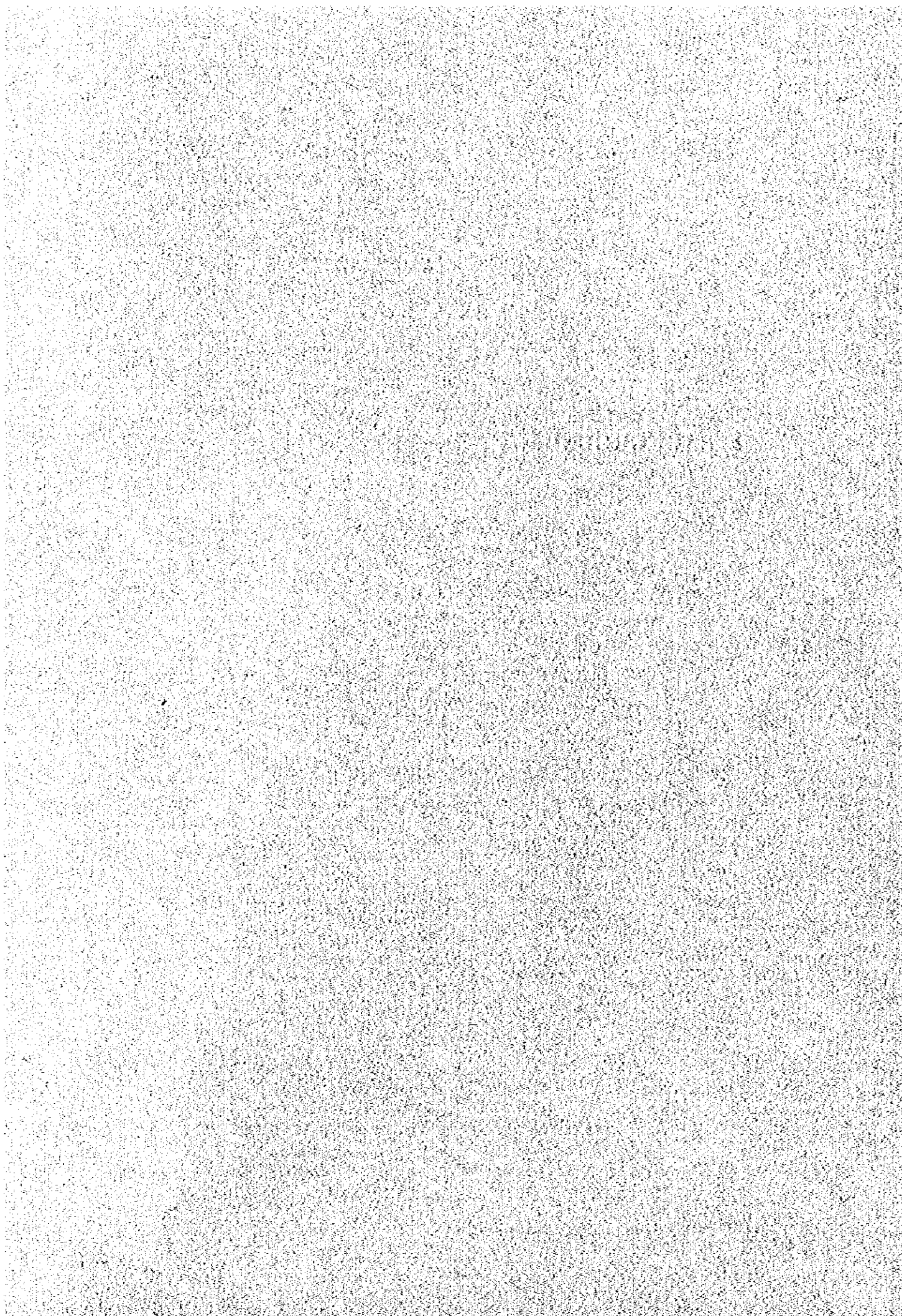


2. BACKGROUND



Chapter 2 Background

2-1 National Socio-Economic Development Plan and Economic Trend

Cote D'Ivoire, becoming independent in August, 1960, has set the pro-western, liberal economic policy under President Félix Houphouët Boigny. It achieved high growth of economy called "Ivorian Miracle" during the 1960s-70s, along with the political stability and positive governmental policy contributing to active foreign investment. In the First Three-Years Plan (1967-70), the emphasis was put on the Import Substitution Industry as well as the diversification and processing of agricultural production. The import substitution industry such as the packing, beverage, milling, oil, textile, sawing industry helped reduce the import. The high level of economic growth stayed in the Second Five-years Plan (1971-75). During the time special attention was paid to the improvement of rural living conditions. The average real growth rate during 1965-75 was 8% and did not go under 4%. This reflects an aspect of the high growth of economy. Moreover, the price of production for coffee and cocoa was stabilized by the exchange equalization account, although their prices tripled in 1976. The surplus funds gained through the exchange equalization account amounted to 16% of GDP in 1977, and the funds were applied to the great number of investment programs by the government.

In the Third Five-Years Plan (1976-1980), development of export industry, modernization of rural area, and promotion of less-developed region were underlined while renovation of agriculture, handicraft manufacturing, and traditional industry were stressed in the Forth Five-Years Plan (1981-1985). However, the sharp drop by 30% in the international price of coffee and cocoa in 1977 and 1978 aggravated the economic depression in the 1980s, and this inflated the cumulative deficit generated by the ambitious investment on development in the 1970s. The situation is illustrated by the fact that the fiscal deficit accounted for 12% of GDP in 1981, the deficit in the balance of current account reached 17% of GDP in the same year, the real GDP faced negative growth in 1983, and the debt service ratio amounted to 37.3%. Moreover, the negotiations for the reschedule of debt service eventually started in 1984. On the other hand, the government launched the structural adjustment program in 1981 with the support of The World Bank and the IMF. The objectives of the program are (1) the restoration of internal equilibrium through the cutback of public expenditures and administrative reforms, and (2) the restoration of external equilibrium by the reduction of dependence on the major cash crops, and the diversification of economy. Furthermore, it became inevitable to reconsider the development plan which required vast external assistance, and besides the Five-Years Plan, the Three-Years Mid-term Plan was created during 1984-1986. The Plan demonstrated the shift of the policy: the emphasis was put on development of infrastructure (agriculture,

road, housing, energy) rather than large-scale projects which used to be the priority of the development policy.

In the Fifth Five-Years Plan (1986-1990), the modernization of agriculture continued to sit on the top priority while development of traditional industry, vitalization of economic group, and efficient use of human resources are underlined. Moreover, the President set the economic reform plan (Ouattara Plan) to tackle the economic crisis and the plan has been carried out since June, 1990. The theme of the plan consisted of (1) increase and decrease of the tax, (2) reduction in the annual expenditure, and (3) increase in other income. The government set the mid-term objectives as stabilization of economy based on the contraction policy, cutback in government role, and restoration of competitiveness. Moreover, along with these economic plan, the structural adjustment program was carried on as an economic reform. The purpose of the program was to (1) improve the balance between the earnings and expenses of price stabilization funds of agricultural products, (2) reorganize and privatize public enterprises, and (3) enhance financial institution. With regard to the economic condition, it seemed to have slow recovery since 1984 taking advantage of obtaining approval for the postponement of debt service, and relatively favorable weather. However, rapid fall in international price of coffee and cocoa since 1986 caused the economic deterioration again in 1987, and the economy continued to be sluggish after 1988. In 1987, the London and Paris Club announced the suppression of the debt repayment in favor of Côte d'Ivoire. In 1990, the country faced the negative growth rate of the GDP, -1.7%, and did not move in a promising state.

In order to overcome the financial crisis in the 1980s, the mid-term economic plan during 1991-95 also highlights the economic stabilization scheme. The plan aims at realization of high level of economic growth achieved in the 1960s - 70s. In the plan, internal structural vulnerability of economy and institution is considered to be the critical constraint and points for improvement. Under the circumstances, the objectives of the mid-term economic plan (1991-95) are designated to facilitate investment, reduce deficit in the balance of international payments, and achieve sustainable economic growth based on the financial equilibrium. Special attention is paid to reduction of deficit through the enhancement of competitiveness and modernization in the production sector. As a target of the sustainable economic growth, the government aims at 5% growth rate of GDP by 1995 to correspond with the presumed 3.7% increase in population growth. For this purpose, it is essential to have 18% of investment / GDP ratio, 5 - 6% of public investment / GDP ratio, and lower the deficit in the balance of current account down to 5%. As for the comprehensive measurement of respective sector, of significance are the enhancement of private sector, expansion and diversification of production, and improvement of quality. With respect to the objectives of agricultural sector, the structural reform is emphasized.

The targets are (1) the improvement of export through the expansion of market for coffee, pineapple, and banana, (2) the reduction of import and reinforcement of production for domestic market especially in foodstuffs sector (rice, meat, dairy products, etc.), and (3) the enhancement of growth in cacao, cotton, sugar, oil and fat, and timber sector. Under this plan, it shows signs of slow economic recovery: the growth rate of GDP was -0.6% in 1991, and -0.2% in 1992. However, high debt service ratio such as 41.1% in 1991 and 43.9% in 1992 implies indispensability of reduction of cumulative debt.

The recent notable economic affair in Côte d'Ivoire is the 50% devaluation of franc CFA in January 12, 1994. In the African Franc region, the devaluation has influenced the financial and trade sector, and caused high inflation and deficiency in materials. The residents in Abidjan city in Côte d'Ivoire also face the increased cost of living by inflation. However, the government has controlled the serious increase in prices of commodities and wages through the policies, and the increase of the inflation rate in August, 1994 since January stayed 31% (according to the announcement of the government).

2-2 Agriculture

Côte d'Ivoire, a country facing the Gulf of Guinea in West Africa, has a territory of 322 thousands Km². With regard to climate conditions, about one third of the territory near the sea belongs to the tropical forest climate, conventionally called Guinean, characterized by abundant precipitation of more than 2,000 mm per year. The central region situated on the north of the former, having annual rainfall between 1,200 and 2,000 mm, shows characteristics of a transitional zone between tropical forest and savannah climate. Finally, the northern part of the country is dominated by the tropical savannah climate, called Soudanian, with annual precipitation of less than 1,200 mm.

Côte d'Ivoire has a total population of 12,910 thousands and its annual mean growth rate is 3.7%. The markedly high rate of population growth is due to that this country has accepted a number of immigrants and migrating workers from the neighboring countries of West Africa since her independence in 1960. In fact, about 1% in 3.7% would be attributed to those social factors. Rural population of 6,940 thousands, equivalent to 53.8% of the total (FAO: Production Yearbook, 1992), still remain as a majority of the population at present. One of the outstanding aspects of rural population, however, is rapidly decreasing rate as demonstrated by the comparison with value of 71% in 1975, for example. It is predicted that the advancing urbanization will result in an inversion of the ratio of rural to urban population before the year 2000.

By the grace of its diversified and productive climate conditions, Côte d'Ivoire has been a big producer and exporter of agricultural products from old times, and occupies the first place in cacao and the third place in coffee production in the world today. The fact that agricultural sector contributes to GDP by 46 % also indicates apparently that the Côte d'Ivoire is one of the first agricultural countries in West Africa. It is true that the export of agricultural products, cacao and coffee in particular, has contributed greatly to the continuous gain in the trade balance of this country.

To consider the structure of Ivorian agriculture, the FAO statistics (FAO: Production Yearbook, 1992) and the agricultural census of the Côte d'Ivoire carried out in 1984 give the land use of the country as shown in Table 2-2-1.

Table 2-2-1 Land use

(1) FAO : Production Yearbook, 1992						(1,000 ha)
	Arable land	Permanent crops	Permanent pasture	Forest & woodland	Other land	Land area
Area	2,430	1,260	13,000	7,079	8,031	31,800
(%)	(7.6)	(4.0)	(40.9)	(22.3)	(25.3)	(100)

(2) Agriculture census						
	Agriculture	Forest	Parks & reserves	Uncultivable land	Other land	Total
Area	3,485.9	3,501.0	1,946.0	2,232.0	20,921.6	32,236.5
(%)	(10.8)	(10.9)	(6.0)	(7.4)	(64.9)	(100)

(1) Forests of 'Forêts du Domaine Forestier Permanent'.

(2) Uncultivable land includes:

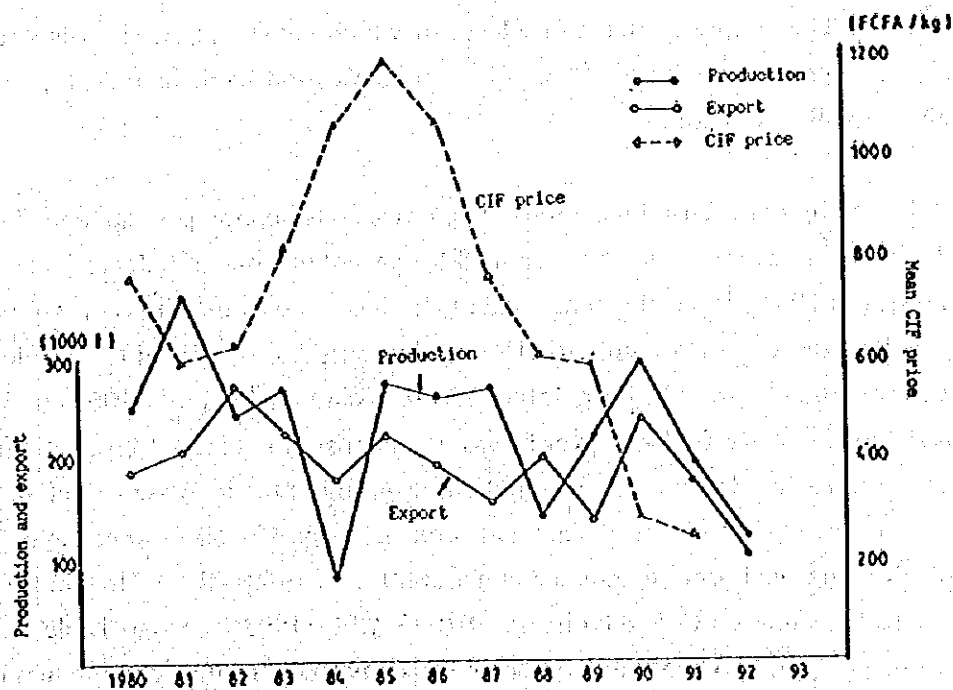
- Lakes, lagoons, rivers and streams...
- Building areas, roads, railways...
- Inselbergs and laterite zones...

(3) Other land means forests, savannas, permanent pasture...

Though classification criteria are not always identical, both data expose some unexpected features in land use of this agricultural country: the occupation rate of arable land combined with permanent crops and, further, that of forests are surprisingly low whereas the "uncultivable" and "other" lands consisted of permanent pastures and waste land dominate more than half of the country. It is due to the facts that natural tropical forests has been cleared in large extent to meet the increasing demand of timber for

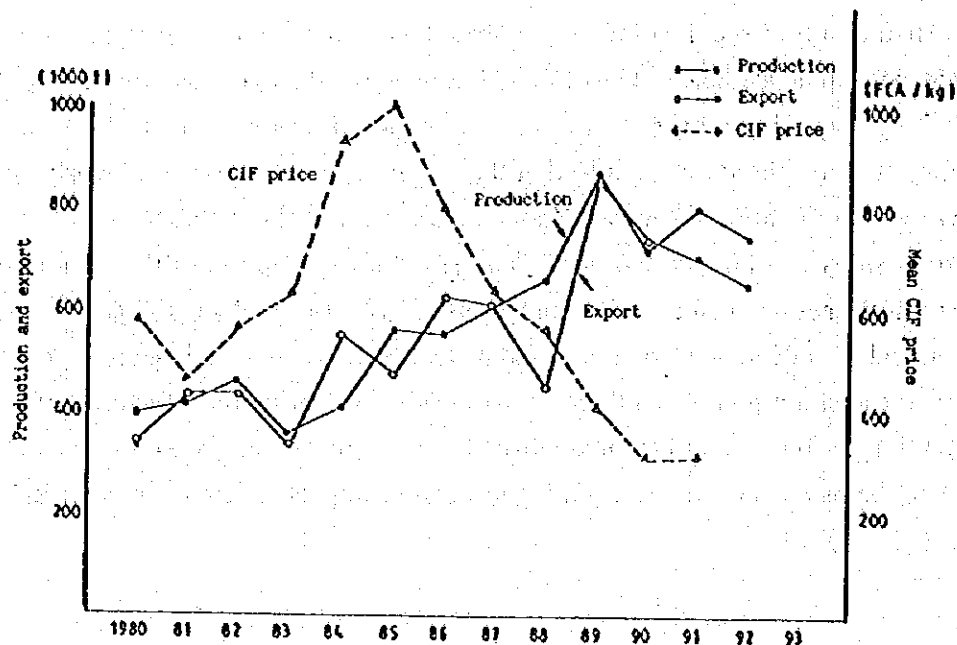
exportation since independence on one hand, and that the shifting agriculture based on "slash-and-burn" is still commonly practiced by farmers in almost all regions on the other.

Historically, Côte d'Ivoire's economy showed an excellent development in the two decades after independence. Thus Côte d'Ivoire enjoyed its gold age of "Ivorian Miracle" marked by surprisingly high rates of economic growth in most part of 1960s and 1970s. Special attention should be paid to that the major promoting power of Ivorian economic growth was agricultural resources. In fact, the economical development on both national and rural sides was largely dependent on the rapid exploitation of three commodities in agricultural sector, coffee, cacao and timber. At the end of 1970s, however, high economical growth attained to its end, and thereafter the Ivorian agriculture is going through a critical transition phase. Of three growth leaders in agricultural sector, coffee requires substantial rehabilitation to maintain growth, timber resources are in decline and cacao is facing to the market constraints resulting in a loss of impact to future growth (see Figures 2-2-1 and 2-2-2).



Source: Annals of agricultural statistics, Ministry of Agriculture

Figure 2-2-1. Changes in production volume, export and CIF price of coffee beans



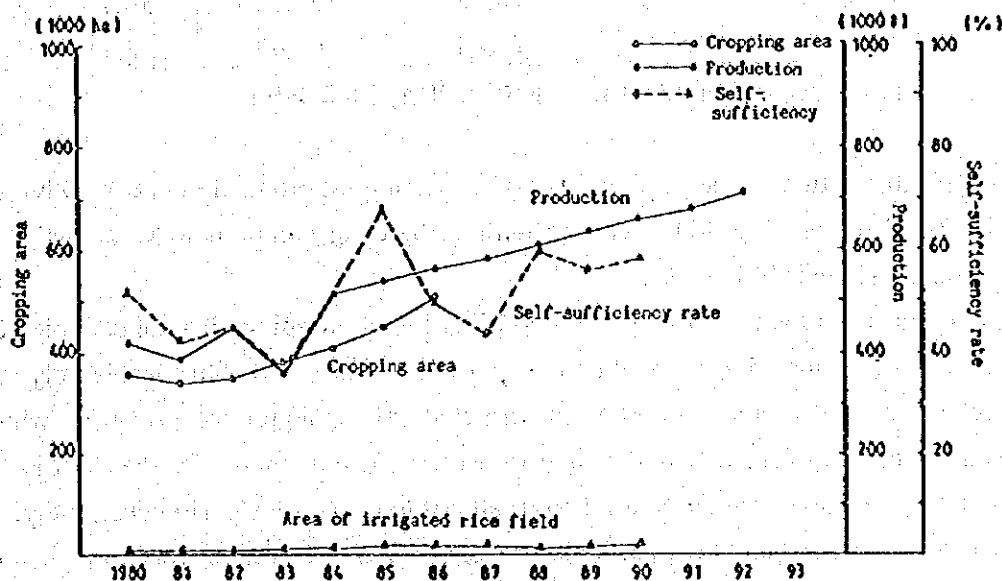
Source: Annals of agricultural statistics, Ministry of Agriculture

Figure 2-2-2 Changes in production volume, export and CIF price of cacao beans

On the other hand, food production in Côte d'Ivoire has not always been sufficient and stable. The supply of rice and wheat, of which consumption showed considerable growth in accordance with the changes of people's food habit in recent years, depend largely or totally on import.

Regarding rice sector, for example, white rice consumption per capita in Côte d'Ivoire has doubled in recent three decades; from 40 Kg/year at the time of independence in 1960 to 80 Kg/year in 1987. The national demand of rice increased by 5-6 times in association with the simultaneous population growth. During this period, the national rice production also showed remarkable growth; from 150 to 200 thousand tons in early 1960s to 650 to 700 thousand tons in early 1990s. Nevertheless, the increase in domestic production could not meet the increasing demand of consumption, resulting in the increase of rice importation. As a result, the rate of self-sufficiency has been as low as 40 - 60 % since the beginning of 1980s, though it had been maintained at about 80 % in 1960s (R. D. Hirsch: *Le Riz et les Politiques Rizicoles en Côte d'Ivoire 1960-1993*, CFD, 1993)(see also Table 2-2-2). The import of rice gives no negligible burden on trade balance, resulting in the loss of foreign money more than 300 billions of F CFA (values before devaluation) annually in the average (Rapport et Recommendation de la Commission de Reflexion pour le Développement des

Cultures Vivrières, MINAGRA, 1991). It is mentioned for the reason, that the increase of domestic production depended properly on the expansion of rain-fed rice culture, a typical derivative of shifting agriculture with slash-and-burn. Notwithstanding the fact that rain-fed rice occupies more than 90 % of seeded area and more than 80 % of production, the rice yield was not successfully improved on the basis of shifting system and has been stagnating on the level of less than 1 t/ha since 1960s. The area of irrigated rice culture was always between 10 and 20 thousand ha during these two decades, indicating that the retards are marked not only in the improvement of infrastructure but in cultural technology (see Fig. 2-2-3).



Source: Annals of agricultural statistics, Ministry of Agriculture

Figure 2-2-3 Changes in cropping area and production of rice

Table 2-2-2 Trend of demand and supply of rice in Côte d'Ivoire

Year	Production (1000t)		White rice	Import (t)	Self- sufficiency (%)
	Grain	White rice	demand (1000t)		
1980	420	273.0	525.7	252,686	51.9
1981	390	253.5	588.8	335,278	43.1
1982	450	292.5	649.2	356,740	45.1
1983	360	234.0	616.5	382,449	38.0
1984	514	334.1	654.9	320,800	51.0
1985	540	351.0	512.7	161,712	68.5
1986	560	364.0	725.0	360,979	50.2
1987	580	377.0	856.3	479,270	44.0
1988	610	396.5	662.7	266,247	59.8
1989	635	413.0	735.8	322,796	56.1
1990	657	427.0	735.4	308,432	58.1

Source: Annals of Agricultural Statistics, MINAGRA, 1980-1990.

To get information on the general aspects of agricultural production in Côte d'Ivoire, the summarized data in 1988/89, a year providing the most comprehensive statistics in recent years, are given in Table 2-2-3.

It is found from the table that more than half of total cropping area are occupied by coffee and cacao, the most important export crops of the country, but with considerably low yield level, coffee in particular, as compared with other principal producer countries, which suggests the necessity of fundamental countermeasures to restore them. On the other hand, the sum of cropping area devoted to food crops attains to nearly 40 %. However, the yield of every crop is always quite low, particularly in cereals. For example, very low yield of rice reflects that of rain-fed one, which, as mentioned above, is usually grown in cropping system of shifting cultivation without any application of fertilizers. The practices to grow other cereals and tuber crops including yam and cassava, the basic foods of the nation, are similarly based on the extensive shifting agriculture. Accordingly, since the structural factors derived from shifting system must be responsible to the over-all low yields of agricultural products, it will be necessary to pay much efforts not only in the modernization of cultural technology but in the education and mentality change of Ivorian farmers.

Table 2-2-3 Agricultural production in agricultural year 1988/89 in Côte d'Ivoire

Crop	Cropping area (ha)	Production (t)	Average yield (t/ha)
Cacao	1,873,300	867,770	0.46
Coffee	1,040,000	221,350	0.21
Oil palm	143,174	844,213	5.90
Coconut	34,533	55,436	1.61
Rubber	40,206	66,960	1.67
Total	3,131,000		
Sugar cane	21,672	1,335,183	61.6
Cotton	213,375	290,593	1.36
Total	235,000		
Yam	260,000*	2,600,000	10.0
Cassava	245,000*	1,460,000	6.0
Taro	212,000*	302,000	1.4
Plantain banana	133,000*	1,145,000	8.6
Corn	675,000*	480,000	0.71
Rice	545,000*	635,000	1.17
Ponio	N.D.	8,000	
Millet	74,000*	45,000	0.61
Sorghum	44,000*	25,000	0.57
Peanut	127,000*	126,000	0.99
Total	2,315,000		
Sum total	5,681,000		

Source: Annals of Agricultural and Forestry Statistics 1989, MINAGRA.

* : Complementary values cited from the Production Yearbook, FAO, 1990.

2-3 Agricultural Policy

Regarding the present situation of agriculture in Côte d'Ivoire, one of the official documents of the Ministry of Agriculture and Animal Resources (Rapport et Recommandation de la Commission de Reflexion pour le Développement des Cultures Vivrières, MINAGRA, 1991) stated as follows: "Côte d'Ivoire is in crisis. The population increases rapidly, the food production per capita tends to fall, the lands degrade, the receipts of exportation decrease, the deficit in balance of external commerce becomes grave, and enormous debts accumulate: All these problems are related to each other and the common term is agriculture."

(1) Master Plan of Agricultural Development 1992-2015

To overcome the crisis mentioned above, the Government of Côte d'Ivoire, by the support of the fund donors, particularly the World Bank, has decided "Middle Term Economic Plan of the Government 1991-1995" in 1991. In parallel to this, the Ministry of Agriculture and Animal Resources (MINAGRA), in response to the "Structural Adjustment Program in Agriculture (PASA)", has prepared a draft of "Master Plan of Agricultural Development 1991-2010 (Working paper)" in 1991, as a revision of the former Master Plan

adopted in 1988. Thereafter, this draft was corrected and modified through a series of discussions, and completed as the "Master Plan of Agricultural Development 1992-2015" which is published officially by MINAGRA in September 1993.

The Master Plan declares 5 basic targets as follows:

- Improvement of productivity and competitiveness.
- Search of self-sufficiency and security of foods.
- Promoting diversification of agricultural products.
- Development of marine and lagoon fisheries.
- Rehabilitation of forest resources.

The strategy for attaining the targets is founded on:

- Withdrawal of the State from production and commercial activities.
- Return of young generations to agricultural activities.
- Promotion of farmers' state and dynamization of localities.
- Re-concentration of extension activities to the fields of technical advice and training for the improvement of managing and commercial capacities of the farmers.
- Land improvement and application of land policies.
- Re-enforcement of research and development programs stressing on food and animal products.

(2) Price Guarantee and the Subsidy

Côte d'Ivoire has so far adopted policies such as the price guarantee system of the agricultural products by the government, the official price system and the subsidy for the farm input and seeds. These policies, as a result, weakened the price competitiveness of the domestic products and hindered the efficient price adjustments. To improve the situation, the government, by adopting policies based on the following considerations, intends to reinforce and invigorate the competitiveness of the domestic agriculture.

- Government intervention on taxation and price adjustment upon the shipment of agricultural products to the market should be reduced.
- Some protective measures should be taken for domestic production of cereals and meat in particular so that the food import would not impede local production.
- The establishment and invigoration of the agricultural producer organizations and the marketing agent organizations should be encouraged.
- Improvement in quality in all products should be promoted.

- The collection and readier access of the information on the market trends such as the price, production and consumption conditions should be supported.
- In provision for such a predictable situation as price fluctuations of the export products, members and other people concerned should establish a fund to guarantee producers stabilized prices.

As for the rice, the government employed strong intervention policies in the past. The policies included such operations as supplying guaranteed seeds, fertilizers and chemicals, free of charge, to the farms of irrigated rice cultivation, purchasing all the paddy produced by them, milling it in the government-owned mills, controlling and centralizing the rice imports in and regulating the producers' and consumers' rice prices, etc. However, due to the increasing financial obligations caused by these policies and to the implementation of the restructuring policy of the World Bank and the IMF, the government, since 1988, has been vigorously carrying out the policies of retreating from the sectors of the rice production, processing and marketing and privatizing them at the same time. For example, in 1991, the government stopped the free distribution of the seeds, fertilizers and chemicals to the farms with irrigated rice cultivation. Furthermore, in 1991, the system of official rice prices for the producers and consumers was abolished and almost totally liberalized. The only exception is the public rice (low-quality import rice including 35% of waste rice) for the low-income bracket. In 1992, the Cabinet Council to discuss the rice policies was established. In order to coordinate the rice production, processing and marketing according to decisions by this Cabinet, a rice cultivation promotion organization (SOPRORIZ), with a joint stock from the government and private companies, was established in June, 1993. However, it has not started its operations yet.

Meanwhile, those rice mills which are still owned by the government were entrusted to the management of private companies. However, the financial expenditures, including the loss compensation arising from the competition with the private rice mills, the expenses to run the import rice control organization and the inland transportation subsidy to maintain the import rice price at a uniform level all over the country, are still heavy on the government. The establishment of the rice price policies as well as the total privatization in this regard is under the negotiations between the government, the World Bank and the IMF.

(3) Marketing and the Post-Harvest

One of the goals of the Agricultural Development Master Plan determined by the government is to minimize its intervention to the marketing activities. At the same time the government is reconsidering the price system and the subsidy. However, while promoting the reinforcement of the product competitiveness, the government intends to achieve the

improvement of the marketing facilities, the reduction of the post-harvest losses and the sales of the products with high added values.

In order to improve the marketing system, the following policies have been suggested:

- The balance of the crop collection, storage and marketing abilities at the national level should be kept track of.
- To support the lower marketing channels in the rural areas, rural roads should be constructed or improved.
- The producer-level crop collection and the establishment of the storage facilities should be promoted.

In addition to policies on improvement of the marketing facilities, there are other important policies. These policies are concerned with the storage and the post-harvest management of the products. In these operations, the following items require special attention.

- Development of storing, packaging and processing methods which can be most economically and easily incorporated by the farmers. This is to reduce the loss of root and tuber plants as well as plantain bananas caused during the period between harvesting and consumption.
- Improvement of packaging and processing methods in order for general households in the areas to more economically consume the products that can be substituted for
- Analysis of existing problems to develop better processing methods of cereals, specially grain threshing method.
- Encouragement of local process of coffee, cacao, and cotton, which have long been major export crops of the country.

(4) Supporting System

In the government agricultural policies, it is considered to be important that the government change its role in the supporting system. More specifically, the establishment of measures for the government to withdraw from the supporting system and to reduce the burden of the public agencies are necessary. For this purpose, it is important for the government to promote the financial independence of the organizations related with this support. Furthermore, the government will establish organizations with social status, such as economic organizations, for the various associated business corporations which so far remained unorganized. In the initial stage, the economic independence of the various supporting organizations and groups are encouraged.

As a part of the consistent plan, of the agricultural development agencies which had been playing an important role in the agricultural extension service, three agencies, namely the Food Crop Development Agency (C.I.D.V.) supporting the food crop cultivation, the Modernization of Ivorian Agriculture (S.A.T.M.A.C.I.) supporting the production of coffee and cacao and the Livestock Development Agency (S.O.D.E.P.R.A.), were made into one organization in September, 1993 and became a new extension supporting organization (A.N.A.D.E.R.).

As for the agricultural financing, the institutional credit became impossible when the Agricultural Development Bank (B.N.D.A.) terminated its operations. As a result, the subsidy for the farm input and others have been on the decline. The government of Côte d'Ivoire is at present considering the means to solve this problem. In the Agricultural Development Master Plan for 1992-2015, the following two points are suggested in order to deal with the problem in the medium period.

(a) Agricultural Fund for each Production and Sales Channel

Attention should be given to operators of the official fund in each channel of production and sales. That is, the transfer of the responsibility of the secondary allocation of the fund to the specialized organizations and others needs to be considered.

Responding to the differences of the production and sales channels of the agricultural products, the government is exploring the possibilities of following two methods of fund raising.

(i) For the crops which are based on the small scale agricultural production and whose production and sales are systematically integrated (e.g. cotton, rubber and oil palm), fund raising will be secured through the establishment of a fund which allows the form of loans for the production means.

(ii) For the crops produced by organizations using modern business management (e.g. pineapples and bananas), it is suggested to secure the fund in the following methods: The specialized organizations or the federation of such organizations will establish a special guarantee fund or a means to support by using the product taxes. Or, in order to hedge the support risk by the private banks, the producers will raise funds by collecting a certain amount from themselves.

(b) Promotion of the Fund System of Mutual Aid Type in the Rural Areas

This measure will be used to meet the financial demand in the areas where the producer organization is not well developed (food crops). The measure also intends to support the household income of the rural life. The premise is that this financing measure is supported by the Rural Saving Fund (CRBP) and the Loan Cooperatives (COOPEC). This method will help farmers or community residents to construct the rural credit system of mutual aid type based on their own fund.

(5) Action Plans for Major Commodities

The Master Plan involves the action plans in middle term for major crops and animal resources. The action plans for the crops concerned with the study area are extracted below:

Coffee and cacao

- Reconstruction of coffee culture by laying stress on the increase of productivity, the rejuvenation of plantations and the quality improvement of coffee beans for dealing.
- Stabilization of cacao production in Côte d'Ivoire by reducing the total area of cacao plantations by 15 - 20 % on national level.

Cotton

- Financial equilibration of the sector by consolidating of new mechanism for price regulation, for example, by creating the cotton guarantee fund.
- Organization and responsibility participation of producers by promoting the cooperative movement.
- Strengthening the quality criteria, diversification of products and regionalization of production.

Rice

- Re-activation of productive efforts of the producers on the basis of modernization of production systems and improvement of productivity. Rehabilitation of existing irrigated perimeters and creation of new ones if land problem requires it. Extension of research results aiming stabilization and intensification of rice culture.
- Complete withdrawal of the State from the production and milling activities of rice.
- Mitigation of competitive conditions between domestic and imported rice by imposing tax on de luxe and imported white rice, and abolishing the subsidy related to transport charge of imported rice.
- Coherent management of policies on import and production of rice.

- Establishment of an inter professional organization to manage the rice sector.

Yam

- Organizing of mass commercialization.
- Promoting of yam production in dry season.
- Re-enforcement of research programs on yam variety breeding.
- Development of conservation and processing systems.

Vegetables

- Attaining the complete self-sufficiency of fresh productions as well as processed products.
- Taking-off of supplementary production for export.

Animal husbandry

- Improvement of socio-economic environment by maximizing the accessibility with respect to price, products and dealing points.
- Continuous efforts to improve the performance of production systems.
- Preservation and improvement of natural environment both on national and local level. Elimination of contagious diseases and vectors. Establishment of national program to preserve local African races.
- Improvement of the efficiency of institutional organizations by cutting-off the support costs of the State and suppressing the number of institutional middle men to the minimum.

Fish culture

- Application and extension of improved technology.
- Investigation of fish culture of new species.
- Development of shrimp culture by introduction of productive species.
- Improvement of yield in fish pond culture from 4 t to 8 t/ha.
- Promotion of organization of the producers, particularly of newly graduated young generations.
- Application of policy related to land and water rights.
- Training of fish growers and organization personnel.
- Optimization of feeding method for cultivable fish species.

The tables summarizing the action programs of agricultural, animal and timber production are given in Table 2-2-1. The action programs and the production targets of food crops in every 5 years' term covering the period 1991 - 2015 are summarized in Table 2-2-2.

On the whole, the Master Plan appears to concentrate special attention on agricultural products for export as coffee, cacao, oil palm, rubber, etc. However, the adopted policies to these commodities are stressed on reconstruction and structural adjustment, or diversification of export products, reflecting the difficulties caused by serious competition in the world market.

On the other hand, the Master Plan gives special emphasis on the production of food crops, taking into consideration the high rate of population growth of 3.7 % per year. Particularly in rice sector, the Plan proposes a quite ambitious action program to increase rice production by nearly 6 times during the period from 1990 to 2015. The development of irrigated rice culture occupies the first position in this program; about 20 % of national rice production will depend on irrigated perimeter by extending paddy field area to 39,000 ha and by realizing perfect double cropping there by the year of 2000, then the production share will grow further to about 23 % on 94,000 ha of paddy fields at the end of the Plan.

Table 2-3-1 Production targets by sectors

(I) Crop production (1000t)

Products	Base	Production target					Growth /year (%)	Major actions to be taken
	1990	1995	2000	2005	2010	2015		
Coffee	260	250	320	360	400	400	2.0	Rejuvenation, improvement of quality, arabusta.
Cacao	823	800	820	850	900	950	0.6	Rehabilitation, productivity.
Oil palm	229	250	239	235	230	232	0.0	Competitiveness, satisfaction of domestic demand.
Copra	23	23	23	23	23	23	0.0	Utilization of by-products.
Rubber	82	95	140	210	270	366	7.1	4% of world market in 2000.
Sugar	170	190	210	260	320	350	3.1	Satisfaction of domestic demand.
Cotton	250	300	375	470	587	734	5.0	Productivity, diversification, fibers and by-products.
Banana	136	217	267	329	404	496	4.2	Productivity, improvement.
Pineapple	214	269	481	601	751	1032	6.5	Productivity, quality, restructuration, market.
Citrus for essence	18	23	28	35	44	55	5.0	Processing, export.
Other fruits(*)	45	56	70	88	109	137	5.0	Dry season, processing, self-sufficiency, export.
Rice	687	1171	1609	2260	2990	3990	9.0	Rain-fed and irrigated, price liberalization, integration of production / processing.
Corn	484	553	645	737	875	1020	3.0	Intensification, storage, processing, export.
Millet / Sorghum / Fonio	76	80	90	100	110	120	1.9	Research / development for market.
Yam	2528	2530	2805	3210	3445	3818	1.6	Conservation, commerce, processing, dry season.
Plantain banana	1086	1400	1843	2180	2685	3343	4.6	Conditioning, commerce, processing, dry season.
Cassava	1393	1678	1710	2050	2420	3600	2.8	processing, production in the vicinity of consuming center.
Peanut	134	162	195	224	255	297	3.3	Regionalization, intensification, conditioning, commerce, processing, dry season.
Vegetables	392	526	648	781	890	1040	6.6	Self-sufficiency, export.

(*) Other fruits: citrus, cashew, avocado, mango, goyava, papaya solo and others.

(2) Animal production (1000t)

Products	Base	Production target					Growth / year (%)	Major actions to be taken
	1990	1995	2000	2005	2010	2015		
Beef	28	34	43	54	67	80	5.0	Sanitary action, genetics, Traditional and improved animal husbandry.
Mutton	6	8	19	25	30	36	3.0	
Pork	7	11	24	30	55	65	3.0	
Chicken	18	42	63	70	80	95	4.0	
Eggs	14	34	50	65	75	89	4.0	
Milk	18	22	28	36	46	58	5.0	
Marine and lagoon fisheries	72	86	100	100	120	132	2.0	Marine optimum potential. Développement lagoon fisheries.
Fresh water fisheries	20	25	30	55	86	138	12.0	Utilization of potential fresh water.

(3) Timber production (1000 m³)

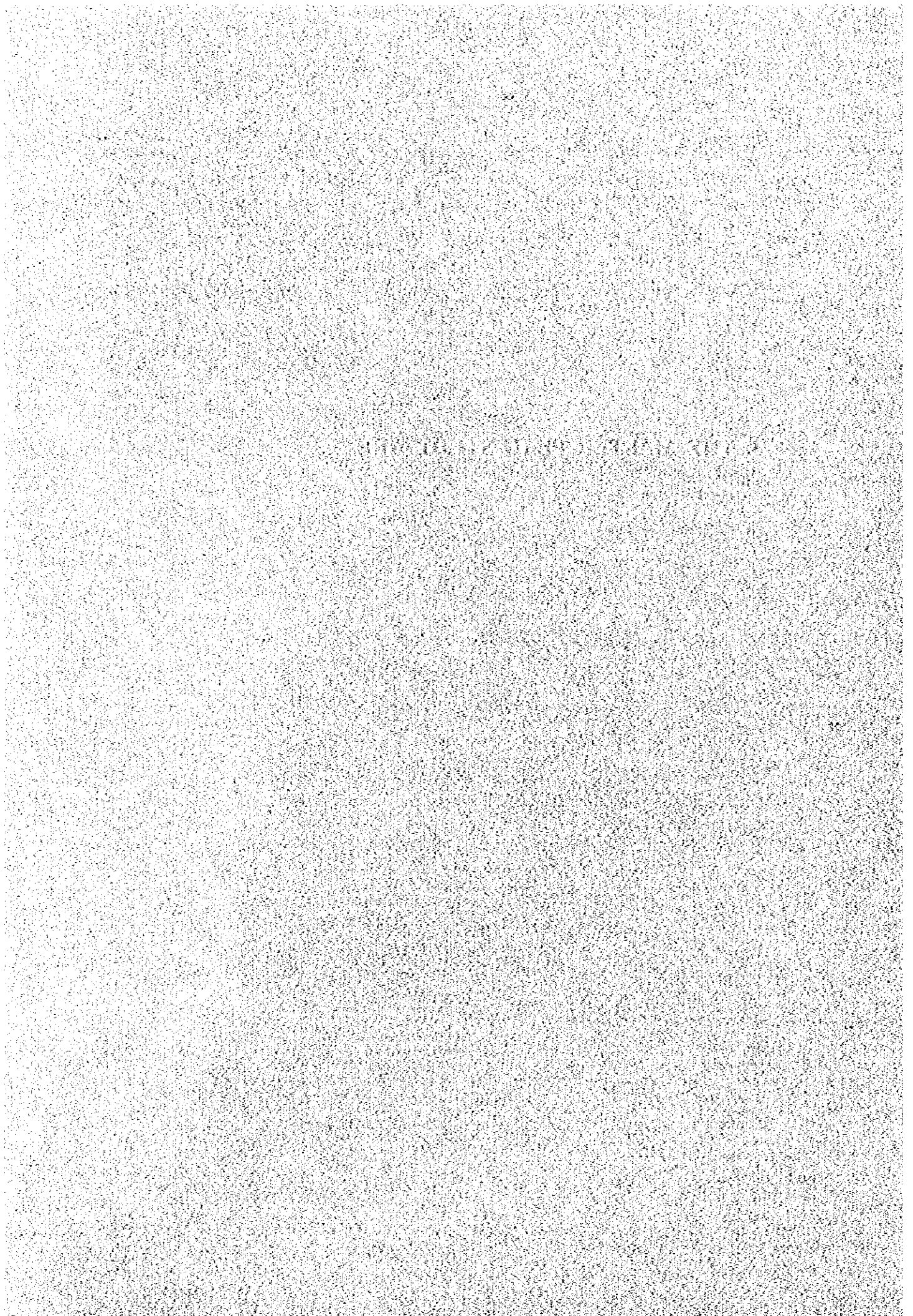
Products	Base	Production target				
	1990	1995	2000	2005	2010	2015
Natural forests	2100	1600	1200	1000	1000	1000
Managed forests	31	252	563	1100	1500	1800
Industrial plantations	55	190	280	1146	692	1253
Total	2186	2042	2043	3246	3192	4053

Table 2-3-2 Action program for food crop production of the Master Plan

5 Years program	1991-1995			1996-2000			2001-2005		
	Production 1000t	Yield t/ha	Area 1000ha	Production 1000t	Yield t/ha	Area 1000ha	Production 1000t	Yield t/ha	Area 1000ha
1. Rice									
Rain-fed rice	993	1.42	701.0	1597	2.06	774.5	1732.5	2.10	825.0
Irrigated rice	178	3.56	50.0	399	5.12	78.0	528.0	4.40	120.0
(double cropping)			(10.0)			(15.0)			(15.0)
new construction									
Total Rice	1171	1.56	751.0	1609	2.34	852.0	2260.5	2.39	945.0
2. Corn	552.6	2.00	276.3	645.5	2.20	93.4	737	2.40	307.12
3. Sorghum / Millet	80	0.80	100.0	90	0.90	100.0	100	1.00	100.0
4. Yam	2530	10.0	253.0	2805	11.0	255.0	3120	12.0	260.0
5. Plantain banana									
Banana in dry	950	1.36	700.0	1300	2.00	650.0	1540	2.20	700.0
season	450	15.0	30.0	543	15.5	35.0	640	16.0	40.0
Total Banana	1400	1.92	730.0	1843	2.69	685.0	2180	2.95	740.0
6. Cassava	1678.2	8.00	210.0	2070	9.00	230.0	2600	10.0	260.0
7. Taro	176.2	5.00	35.24	209.3	5.50	38.06	284.5	6.00	42.42
*. Peanut	162	1.20	135.0	195	1.30	150.0	224	1.40	160.0

5 Years program	2005-2010			2010-2015		
	Production 1000t	Yield t/ha	Area 1000ha	Production 1000t	Yield t/ha	Area 1000ha
1. Rice						
Rain-fed rice	2300	2.30	1000	3082.5	2.50	1127.4
Irrigated rice	690	4.60	150	907	5.12	188.0
(double cropping)			(15.0)			(15.0)
new construction						
Total Rice	2990	2.60	1150	3989.5	3.13	1315.4
2. Corn	875.5	2.70	324.26	1020.8	3.00	342.4
3. Sorghum / Millet	110	1.10	100.0	120	1.20	100.0
4. Yam	3445	13.0	265.0	3818	14.0	270.0
5. Plantain banana						
Banana in dry	1920	2.40	800.0	2430	2.60	800.0
season	765	17.0	45.0	913	18.0	50.0
Total Banana	2685	3.18	845.0	3343	3.79	850.0
6. Cassava	2970	11.0	270.0	3595.5	12.0	280.0
7. Taro	275.2	6.50	45.42	318.4	7.00	49.4
*. Peanut	255	1.50	170.0	297	1.60	180.0

3. THE MASTER PLAN STUDY AREA



CHAPTER 3. The Master Plan Study Area

3-1 Natural Conditions

3-1-1 Land

(1) Topography

The topography of the study area is characterized by alluvial plain, alluvial-colluvial terraces, and interfluves. Alluvial plain is located along the N'Zi river and its tributaries. The alluvial plain is flat to slightly undulated with elevation of 120 m in M'Bahiakro and 80 m in Dimbokro. The width of the alluvial plain varies from 50 m to 6,000 m along the N'Zi river, and is wider near the mouth of large tributaries such as Sounglou, Katie, and Mandia.

Alluvial-colluvial terraces are observed along the N'Zi river and large tributaries. They are classified into three types: low, middle, and high terraces. The low terrace presents everywhere along the N'Zi river. It has flat to gentle slope (0 - 2%), slightly undulated, and 3 to 5 m higher than the alluvial plain. The medium terrace is also observed often along the N'Zi river. It has gentle slope (1 to 3%). The high terraces are scattered along the N'Zi river. They are circled by the medium terrace and the height is 10 to 15 m higher than the medium terrace.

Interfluves present outside of alluvial plain and alluvial-colluvial terraces. They have plano-convex top. The lands of interfluves have flat to gently slope (1 to 3%) on the top and weak slope (2 to 7%) on the edge.

(2) Land Use

The Land Use of the study area is classified into nine categories based on the land use maps prepared by DCGTx and aerial photographs (scaled 1/20,000) prepared by JICA in 1993. The land use maps are presented in Figure 3-1-1. The area by land use category is given below:

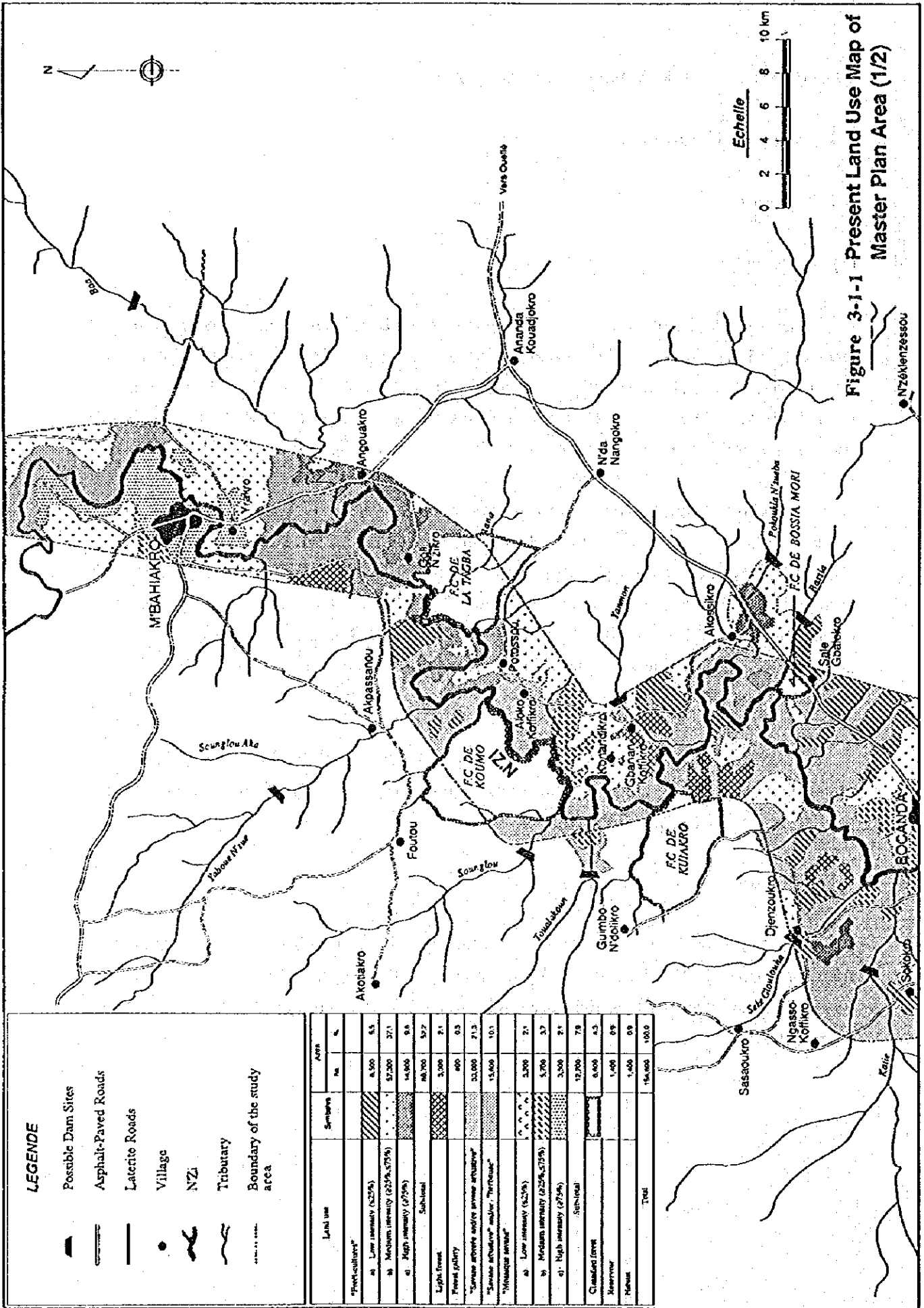


Figure 3-1-1 Present Land Use Map of Master Plan Area (1/2)

LEGENDE

- Possible Dam Sites
- Asphalt-Paved Roads
- Laterite Roads
- Village
- NZI
- Tributary
- Boundary of the study area

Land use	Semiars		Aars	
	Ha	%	Ha	%
Particuliers*				
a) Low intensity (25%)	8,500	6.5		
b) Medium intensity (25%, 27%)	87,200	27.1		
a) High intensity (27%)	14,000	9.6		
Subtotal	108,700	92.7		
Light forest	3,000	2.1		
Forest gallery	400	0.3		
"Savane arborescences and/or arbustives"	33,000	21.3		
"Savane arborescences" under "Thicket"	15,600	10.1		
"Wetland areas"				
a) Low intensity (25%)	3,200	2.1		
b) Medium intensity (25%, 27%)	3,700	3.2		
c) High intensity (27%)	3,000	2.1		
Subtotal	12,900	7.9		
Cleared forest	6,400	4.3		
Moors	1,400	0.9		
Mount	1,400	0.9		
Total	154,000	100.0		

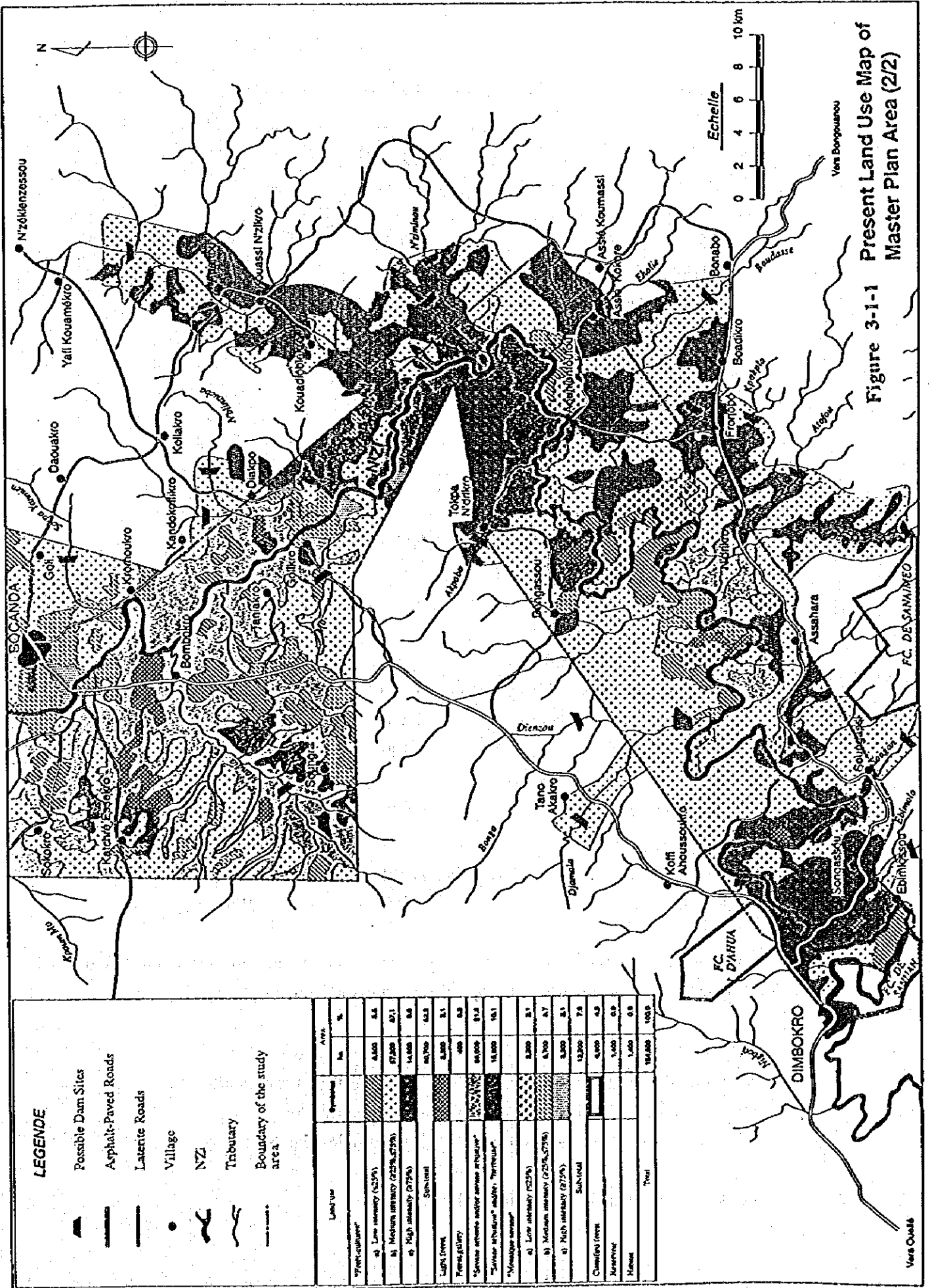


Figure 3-1-1 Present Land Use Map of Master Plan Area (2/2)

LEGENDE

- Possible Dam Sites
- Asphalt-Paved Roads
- Laterite Roads
- Village
- NZI
- Tributary
- Boundary of the study area

Land Use	Symbol	Area	No.	%
"Fruit-culture"				
a) Low intensity (52%)		4,650	4,6	5,6
b) Medium intensity (25%, 27%)		27,500	27,5	33,7
c) High intensity (23%)		14,800	14,8	18,3
Spruce		28,700	28,7	35,5
Light forest		3,300	3,3	4,1
Forest gallery		400	0,4	0,5
"Savane arboree and/or semiarboree"		66,000	66,0	81,8
"Savane arboree" mobile: "Termitier"		18,800	18,8	23,2
"Moutarde semier"				
a) Low intensity (52%)		3,300	3,3	4,1
b) Medium intensity (25%, 27%)		3,700	3,7	4,6
c) High intensity (23%)		3,300	3,3	4,1
SUB-TOTAL		13,300	13,3	16,4
Champs (rivers)		4,000	4,0	5,0
Arrière		1,400	1,4	1,7
Haute		1,400	1,4	1,7
Total		184,800	184,8	228,9

Table 3-1-1 Land use in the Master Plan study area

Land use	Area (ha)	(%)
"Forêt-cultures"		
Low intensity ($\leq 25\%$)	8,500	5.5
Medium intensity ($\geq 25\%, \leq 75\%$)	57,300	37.1
High intensity ($\geq 75\%$)	14,900	9.6
Sub-total	80,700	52.2
Light forest	3,300	2.1
Forest gallery	400	0.3
"Savane arborée and/or savane arbustive"	33,000	21.3
"Savane arbustive" and/or "herbeuse"	15,600	10.1
"Mosaïque savane"		
Low intensity ($\leq 25\%$)	3,200	2.1
Medium intensity ($\geq 25\%, \leq 75\%$)	5,700	3.7
High intensity ($\geq 75\%$)	3,300	2.1
Sub-total	12,200	7.9
Classified forest	6,600	4.3
Reservoir	1,400	0.9
Habitat	1,400	0.9
Total	154,600	100.0

In this table, the land of "forêt-cultures" and "mosaïque savane" are further classified into three depending on the intensity of crop cultivation in the land:

- Low intensity (less than 25% of land is used for agriculture)
 - Medium intensity (between 25% and 75% of land is used for agriculture)
 - High intensity (more than 75% of land is used for agriculture)
- *(it is assumed that the agricultural land includes fallow lands.)

The land use pattern closely relates with land form.

(3) Soil

Soil laboratory of DCGTx carried out reconnaissance soil survey in the northern part of the study area in 1991 and prepared morpho-pedological maps (scaled 1/100,000) and survey reports. For the southern part of the study area, JICA Study team subcontracted reconnaissance-level soil survey to DCGTx. The results of these soil surveys as well as field reconnaissance by JICA expert were used to grasp the soil conditions of the Master Plan study area.

Most of possible dam sites are located outside of the Master Plan study area. The soil conditions of the downstream of the dam sites were studied mainly based on the soil maps of the study area and the results of field reconnaissance.

The soils of in and around of the Master Plan study area are classified into following 16 cartographic units (U.C.):

- U.C.A	- U.C.1	- U.C.13
- U.C.TB	- U.C.4	- U.C.15
- U.C.TM	- U.C.8	- U.C.16
- U.C.TH	- U.C.9	- U.C.26
- U.C.g	- U.C.11	- U.C.27
- U.C.s		

General characteristics of each unit and their area within the Master Plan area are mentioned in Table 3-1-2. Soil maps are given in Figure 3-1-2.

In general, soils of the area are low in natural soil fertility and thus appropriate fertilization including longer fallow period is required to gain economically adequate yield.

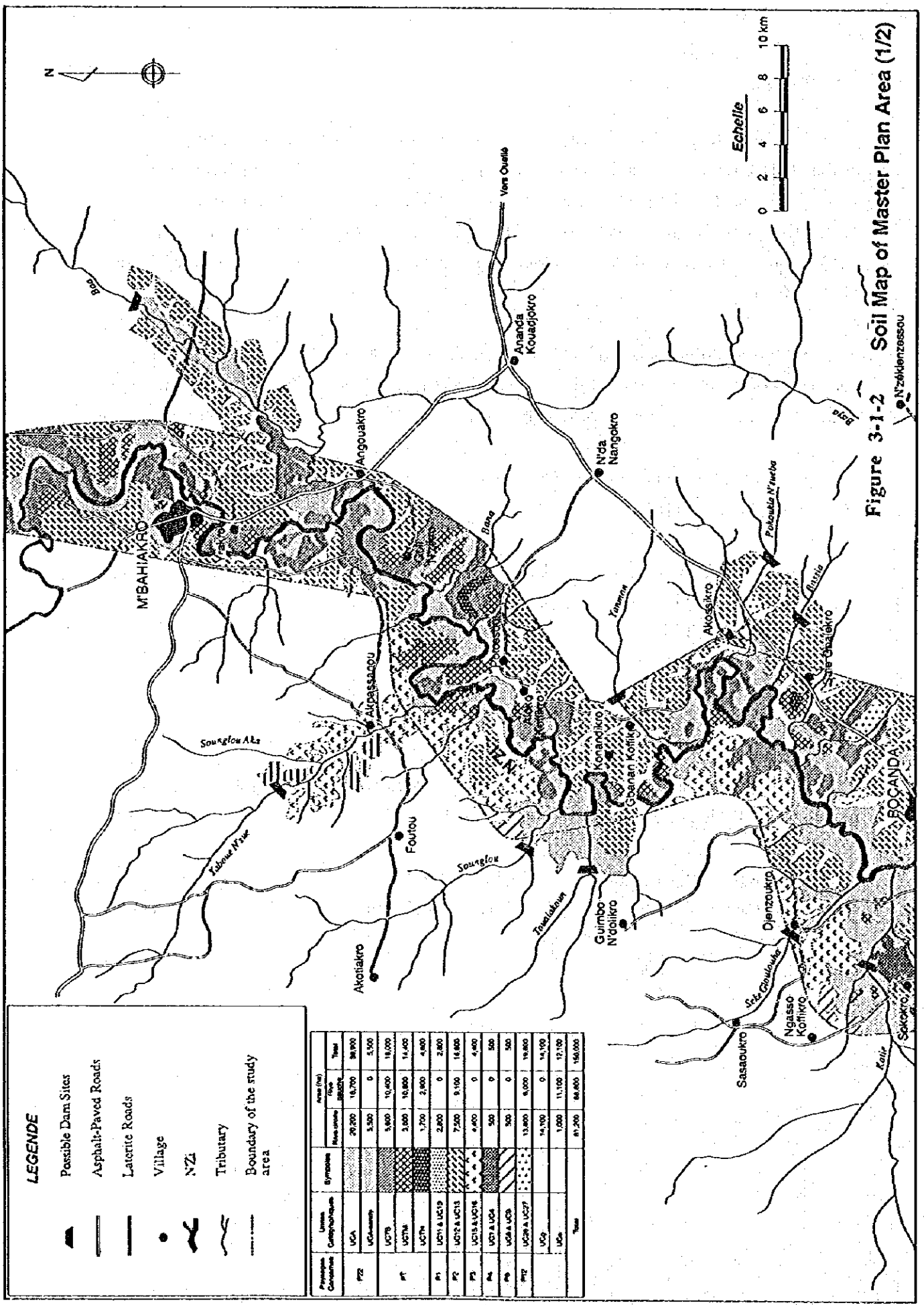


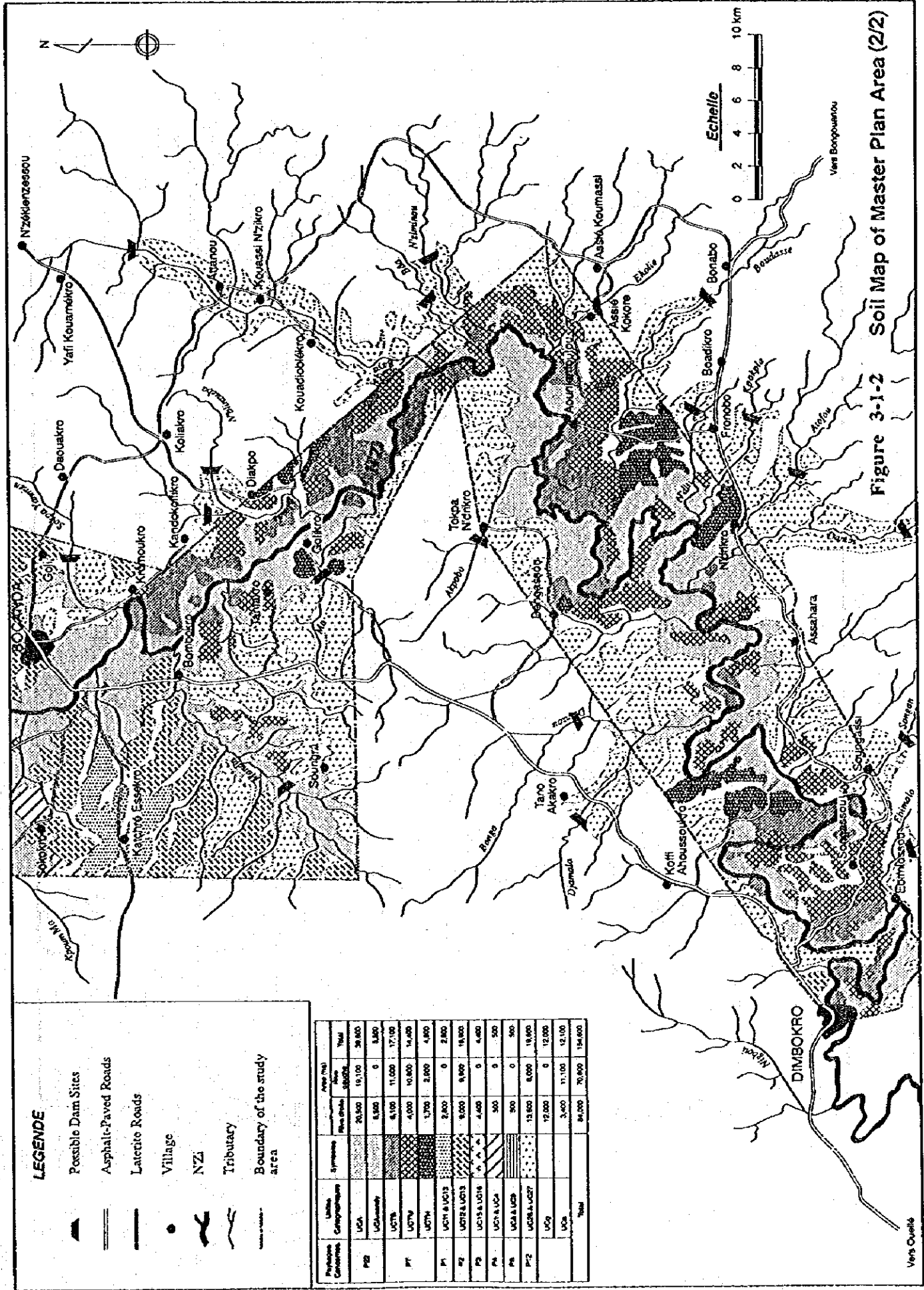
Figure 3-1-2 Soil Map of Master Plan Area (1/2)

LEGENDE

- Possible Dam Sites
- Asphalt-Paved Roads
- Laterite Roads
- Village
- NZI
- Tributary
- Boundary of the study area

Proportion Coefficient	Unités Géographiques	Symbole	Superficie (ha)	Area (%)	
P2	UCA	[Symbol]	20,200	16,700	36,900
	UCa	[Symbol]	5,300	0	5,300
P1	UC7B	[Symbol]	5,800	10,400	16,200
	UC7M	[Symbol]	3,000	10,800	14,400
	UC7n	[Symbol]	1,700	2,800	4,800
P3	UC11 & UC13	[Symbol]	2,800	0	2,800
	UC12 & UC13	[Symbol]	7,200	9,100	16,800
P4	UC15 & UC16	[Symbol]	4,400	0	4,400
	UC1 & UC4	[Symbol]	500	0	500
P5	UC8 & UC9	[Symbol]	500	0	500
	UC3 & UC7	[Symbol]	13,800	8,000	19,800
P6	UC9	[Symbol]	14,700	0	14,700
	UC6	[Symbol]	1,000	11,100	12,100
	Total		81,200	84,800	166,000

Figure 3-1-2 Soil Map of Master Plan Area (2/2)



LEGENDE

- Possible Dam Sites
- Asphalt-Paved Roads
- Laterite Roads
- Village
- NZI
- Tributary
- Boundary of the study area

Polygone Caractéristique	Unités Caractéristiques	Symboles	Area (ha)	
			Area totale	Total
P2	UCA		20,500	19,100
	UCa		8,800	0
P1	UC7B		6,100	11,000
	UC7V		4,000	10,800
	UC7A		1,700	2,800
P3	UC4 & UC13		2,800	0
	UC12 & UC15		6,000	9,900
P5	UC15 & UC18		4,400	0
	UC18 & UC4		500	0
P6	UC4 & UC9		500	0
	UC9 & UC27		13,000	6,000
P7	UC9		12,000	0
	UC4		3,400	11,100
	Total		84,000	70,800

Table 3-1-2 Area and characteristics of each soil unit

Physiographic Unit	Cartographic Unit	Characteristics	Area (ha)		
			Right Bank	Left Bank	Total
P22	UCA	Sols hydromorphes à texture variable: limon dans les remblais et bourrelets; argile et limon dans les dépressions avec en profondeur horizons graveleux; induration localisée dans les remblais anciens. Engorgement et inondation saisonnière.	20,500	19,100	39,600
	UCA-sandy	Sols hydromorphes à texture limon-sableuse sur argileuse sauf en périphérie où les sols sont sableux. Inondation saisonnière.	5,500	0	5,500
PT	UCTB	Sols hydromorphes à texture limon-sableuse ou argile-limon-sableuse, avec parfois présence de gravier et galets de quarts en profondeur. Induration localisée en profondeur. Inondation saisonnière possible.	6,100	11,000	17,100
	UCTM	Sols profonds de texture sablo-limoneuse sur argile-sableuse, avec parfois de graviers et galets de quarts arrondis en profondeur. Hydromorphe en profondeur. Induration localisée.	4,000	10,600	14,600
	UCTH	Sols rouges, profonds, de texture argilo-sableuse, gravillonnaires avec présence souvent de graviers et galets de quartz arrondis à faible profondeur. Induration localisée.	1,700	2,900	4,600
P1	UC11	Sol gravillonnaires, rouges, indurés, argilo-sableuse et localement engorgés et latéritiques à la base.			
	UC13	Sol gravillonnaires, rouges, profonds, argilo-sableuse, latéritiques à moyenne ou grande profondeur, localement indurés et hydromorphe en aval.	2,800	0	2,800
P2	UC12	Sol gravillonnaires, rouges, de texture argilo-sableuse, fréquemment indurés et latéritiques à la base.			
	UC13	Sol gravillonnaires, rouges, de texture argilo-sableuse, profonds, latéritiques à la base, localement indurés et hydromorphe en aval.	9,000	9,900	18,900
P3	UC15	Sols ferrallitiques gravillonnaires, de texture argilo-sableuse, profonds, latéritiques à la base, très localement indurés.			
	UC16	Sols ferrallitiques gravillonnaires, plus ou moins indurés et hydromorphes à l'aval.	4,400	0	4,400
P4	UC1	Lithosols. Roche nue.			
	UC4	Sols gravillonnaires, sablo-argileux à argilo-sableux à faciès rajeunis et indurés localement.	500	0	500
P8	UC8	Sols ferrallitiques gravillonnaires, sableux, latéritiques en profondeur, localement indurés.			
	UC9	Sols ferrallitiques gravillonnaires, sableux, latéritiques plus ou moins indurés.	500	0	500
P12	UC26	Sols profonds, ocre rouges, de texture argilo-sableux, peu gravillonnaires, latéritiques en profondeur.			
	UC27	Sols profonds, ocre rouges, gravillonnaires, de texture argilo-sableux sur latérite profonde, induration localisée en aval.	13,600	6,000	19,600
	UCg	Amont: sols sableux, hydromorphes sur latérite ou cuirasse, affleurements rocheux. Bas-fond: texture variable généralement grossière.	12,000	0	12,000
	UCs	Amont: sols limoneux à sableux sur latérite ou cuirasse à profondeur variable. Bas-fond: matériaux colluviaux ou alluviaux limoneux à limono-argileux. Inondation saisonnière.	3,400	11,100	14,500
Total			84,000	70,600	154,600

Remarks: UCA, UCA-sandy, UCg, and UCs are not distinguished in Soil Maps (Figure C-1-3).

(4) Land Suitability for Agricultural Uses

The lands of the study area were assessed in terms of their present suitability for irrigated rice and rain fed (upland) crop cultivation mainly based on the information from soil surveys. The lands of each U.C. were classified into four suitability classes: highly suitable (class 1), moderately suitable (class 2), marginally suitable (class 3), and not suitable (class 4). Drainage condition, flood risk, gravel contents, soil texture, natural soil fertility, and topographic condition were taken into account for the classification.

The results of land suitability classification are presented in Tables 3-1-3. The areas of each land suitability class are tabulated as below.

Table 3-1-3 Area by land suitability class

	(Unit: ha)		
Land suitability	Right bank	Left bank	Total
<u>For irrigated rice cultivation</u>			
(1) Highly suitable	6,100	11,000	17,100
(2) Moderately suitable	23,900	30,200	54,100
(3) Marginally suitable	17,500	0	17,500
(4) Not suitable	36,500	29,400	65,900
Total	84,000	70,600	154,600
<u>For rain fed crop cultivation</u>			
(1) Highly suitable	0	0	0
(2) Moderately suitable	42,600	40,400	83,000
(3) Marginally suitable	41,400	30,200	71,600
(4) Not suitable	0	0	0
Total	84,000	70,600	154,600

The land of UCTB (17,100 ha) is the most suitable for irrigated rice cultivation (class 1). UCA (39,600 ha), UCs (14,500 ha), UCA-sableuse (5,500 ha) and UCg (12,000 ha) follow in the order of suitability. Major limiting factors for irrigated rice cultivation are flood risk along the N'Zi river and high infiltration rate in the land of UCA-sableuse and UCg.

The land of UCA (including UCA-sableuse) is classified as marginally suitable (class 3) for rain fed upland-crop cultivation because of the poor drainage capacity. Other lands are classified as moderately suitable (class 2). Land suitability for irrigated upland-crop cultivation is assumed to be the same as that for rain fed upland-crop cultivation.

Table 3-1-4 shows the area suitable for irrigated rice field in the downstream of the possible dam sites of the N'Zi tributaries and the relevant soil types. A total of 14,600 ha is classified as suitable for irrigated rice cultivation. Out of the suitable lands, the lands located in the right bank of the N'Zi river and the north of Mandia river are classified as marginally suitable due to sandy nature of soils in the area. Meanwhile, other lands are classified as moderately suitable.

Table 3-1-4 Soil suitability classification

Topographic Unit	Soil Unit	Soil suitability		Area (ha)		
		For irrigated rice	For upland crops	Right bank	Left bank	Total
P22	UCA	2f	3df	20,500	19,100	39,600
	UCA-sandy	3i	3df	5,500	0	5,500
PT	UCTB	1(f)	2d(f)s	6,100	11,000	17,100
	UCTM	4gt	2gs	4,000	10,600	14,600
	UCTH	4gt	2gs	1,700	2,900	4,600
P1	UC11 & UC13	4gt	2gs	2,800	0	2,800
P2	UC12 & UC13	4gt	2gs	9,000	9,900	18,900
P3	UC15 & UC16	4gt	2gs	4,400	0	4,400
P4	UC1 & UC4	4gt	2gs	500	0	500
P8	UC8 & UC9	4gt	2gs	500	0	500
P12	UC26 & UC27	4gt	2gs	13,600	6,000	19,600
	UCg	3i	3df	12,000	0	12,000
	UCs	2f	3df	3,400	11,100	14,500
Total				84,000	70,600	154,600

Remarks:

Suitability Classification

- 1: Highly suitable
- 2: Moderately suitable
- 3: Marginally suitable
- 4: Unsuitable

Constraints

- d: poor drainage capacity
- f: risk of flood damage
- g: high gravel contents
- i: sandy soil
- s: low natural fertility
- t: topographic condition

Table 3-1-5 Suitable area for irrigation in the downstream of possible dam site

Dam sites (river name)		Irrigable area (ha)	Relevant Soil Unit
Right bank of N'Zi River			
1	Yaboue N'zue	270	UCg, UCA/UCA-sableuse
2	Sounglou	290	UCg, UCA/UCA-sableuse
3	Toualakoun	310	UCg, UCA/UCA-sableuse
4	Seke Gtoulouha	350	UCg, UCA/UCA-sableuse
5	Katie	560	UCg, UCA/UCA-sableuse
6	Mandia	760	UCg, UCA/UCA-sableuse
7	Mo	280	UCA
8	Akpobo	1,000	UCs, UCA
9	Dienzou	360	UCg, UCs, UCA
10	Djamala	340	UCs, UCA
sub-total		4,520	
Left bank of N'Zi River			
11	Baa	1,800	UCA, UCTB
12	Yanmon	420	UCs, UCA
13	Pokouklo N'zueba	250	UCs, UCA
14	Bossia	100	UCs, UCA
15	Sokpa Yanmien	280	UCs, UCA
16	Abode	230	UCs, UCA
17	N'blizueba	240	UCs, UCA
18	Baya	600	UCs, UCA
19	Baa	40	UCs,
20	N'ziminou	80	UCs,
21	Eholie	230	UCs, UCA
22	Boudasse	520	UCs, UCA, UCTB
23	N'diti	620	UCs, UCA
24	Kpokpla	620	UCs, UCA
25	Atofou	1,400	UCs, UCA
26	Damin	1,700	UCs, UCA
27	Songan	400	UCs, UCA
28	Ebimolo	550	UCs, UCA
Sub-total		10,080	
Total		14,600	

Remark:

The area above shows suitable area for irrigation from dam sites down to the N'Zi. Some of these area are within the Master Plan area.

3-1-2 Climate

The most representative weather station is located in Dimbokro at an elevation of 92 meters. Available rainfall, temperature, relative humidity, sunshine hours, wind speed and potential evapotranspiration data have been summarized in the Figures 3.1.3 and 3.1.4 and in the Table 3.1.6 and discussed in the following section.

(1) Annual Rainfall

Figure 3.1.3 shows the temporal or time dependent variations in annual rainfall for Dimbokro for the past 71 years. Rainfall is generally above the mean (1169 mm) up to late 1960's except for the severe droughts of early 1950's where rainfall deviations of more than 45% from the mean were recorded. Two important peaks of abundant rainfall (deviations of more than 75% from the mean) are observed respectively in late 1930's and 1960's. Rainfall stays somewhat below the mean after late 1960's.

(2) Mean Monthly Rainfall

Monthly rainfall data for Dimbokro are portrayed in Figure 3.1.4 and in Table 3.1.6 and show that Dimbokro has in average a bi-modal rainfall season characterized by a first rainy season from March to July, with peak rainfall typically occurring in June and a shorter second rainy season from September to November with the highest rainfall being generally recorded in September. Dry periods are more common at the onset, and termination of rains where small rainfall amounts are collected. This average configuration is altered from year to year by single mode rainy season similar to that observed during the dry year of 1983 where the second wet season was very small or even non existent; thus making the farmers of this area unable to plan for an appropriate crop calendar.

(3) Other Meteorological Parameters

The mean monthly temperatures are practically constant throughout the year and are very close to the annual mean of 27.0 °C. The amplitude between the mean maximum temperature and the mean minimum temperature is between 9-11 °C during the rainy months and can reach 14 °C during the long rainy season from November to February, specially when the Harmattan is dominant.

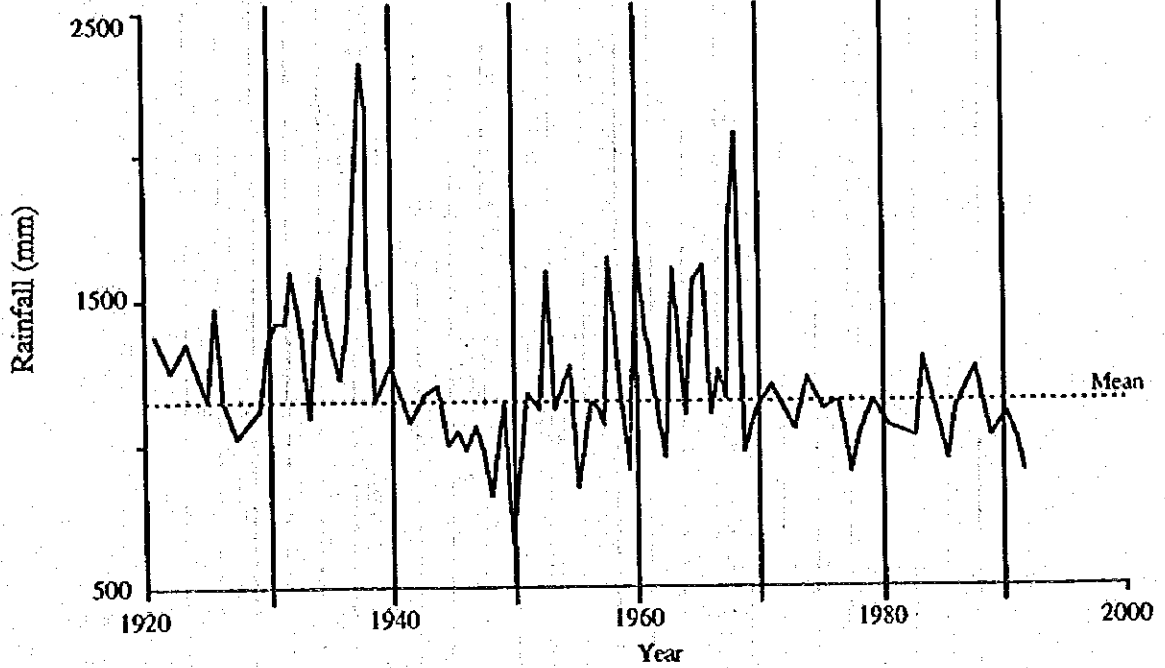


Figure 3-1-3 Variation of annual rainfall at Dimbokro

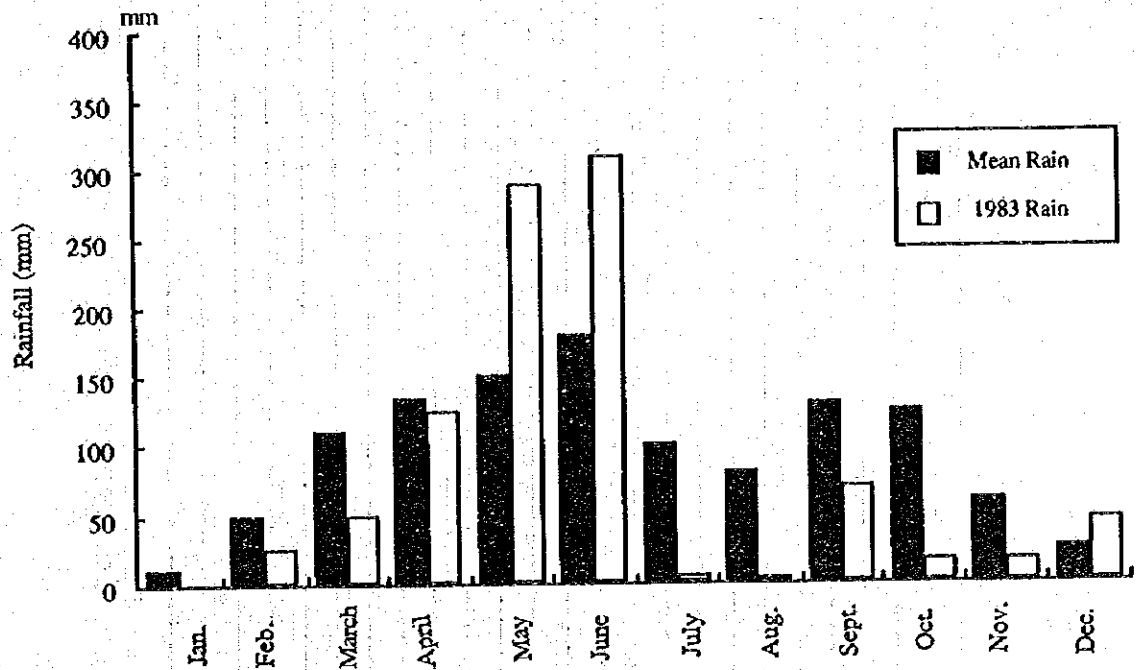


Figure 3-1-4 Rainfall of Dimbokro; comparing mean rainfall to that of 1983

Table 3-1-6 Dimbokro meteorological data

ITEMS	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly
Rainfall (mm)													
Mean (1965-1992)	12.1	52.8	105.5	132.9	152.8	180.4	98.7	67.3	125.5	113	47.7	20.8	1109.6
1983	0	30	48.4	119.1	290.5	353.5	4.4	1.4	58.2	11.5	12.1	38.7	967.8
Temperature (degree C)													
Mean	25.7	28.8	28.5	28.7	27.7	26.5	25.6	25.5	26.9	26.6	27.1	25.9	27
Max	34.3	35.8	35	34.5	33.6	31.8	30.4	30.1	31.2	32	33	32.2	32.8
Min	19.9	22.7	23.3	23.5	23	21.6	22	22	22.3	22.5	22.3	20.5	22
Relative Humidity(%)													
Mean	65	66	71	74	77	80	81	81	81	79	78	75	75
Max	93	93	94	95	96	97	96	95	96	97	97	97	96
Min	37	38	47	53	58	63	66	66	65	61	58	53	55
Sunshine hours													
Mean	6.5	6.7	6.5	7.1	6.8	5.4	3.6	3.2	4.5	5.9	6.6	5.8	5.7
Wind (m/s)													
Mean	1	1.1	0.8	0.7	0.6	0.7	0.7	0.8	0.5	0.6	1	0.5	0.5
Evapotr. (Penman) (mm)													
Mean	109	108	113	113	109	92	79	76	83	100	106	97	1185.0

Note: The periods considered for the means are 1980-1989 for all parameters except for rainfall (1965-1992) and relative humidity (1988-1992)

The maximum relative humidity remains above 90% throughout the year. The average minimum relative humidity exhibits a single mode with values higher than 60% during the humid months and drops to its minimum of 37-38% between the dry period of January to February.

Wind blow generally at low velocities ranging from 0.5 to 1.0 m/s most of the year, exceeding slightly this threshold when the harmattan is dominant in February.

The daily mean sunshine hours ranges approximately between 6 and 7 hours throughout the year except for June to September where the range drops to around 3 to 4 hours.

The monthly potential evapotranspiration calculated from the non modified Penman formula shows values fluctuating from 76 mm in August to 113 mm in March and April with the lowest and highest daily rate amounting to respectively 2.5 mm/day in August and 3.9 mm/day in February the hottest month. Between November to March, and August, the driest months of the year, potential evapotranspiration exceeds the volume of rainfall and amounts to a mean annual value of 1185.0 mm against 1109.6 mm for rainfall.

3-1-3 Hydrologic Conditions

(1) River System

The project area is drained exclusively by the river N'Zi which is a left bank tributary of the Bandama river and is 630 km long in total. At the confluence with the Bandama the catchment area amounts to 35,000 km² reduces to only 24,000 km² at the city of Dimbokro, the southern limit of the study area. In the northern limit (M'Bahiakro) the catchment area becomes 15,700 km². Between M'Bahiakro and Dimbokro numerous tributaries are draining vast land surfaces.

The N'Zi river, one of the three major tributaries (Marahoue, Bandama Blanc and N'Zi) of the Bandama river, originates in the vicinity of Tafire and flows down southward taking a meandering course. The N'Zi river itself also has many tributaries, among which the Yeboue N'Zue, Soungourou, Seke Gloulouba, Kachie, Mandia and Baya rivers are predominant in the study area.

(2) Water Resources

Data of annual runoff volume with the 5-year return period value and the

corresponding runoff coefficients for the N'Zi and two of its major tributaries are shown in Table 3.1.7. The coefficients values do not exceed 5% in the smaller catchment areas along the M'Be and Soungourou and are less than 10% along the N'Zi suggesting as mentioned earlier the somewhat higher evaporation volume as compared to rainfall. It can therefore be observed several MCM difference in runoff volume between years of good rainfall as opposed to drought years. At Dimbokro for example, the years 1989 and 1983 show respectively runoff volumes amounting to 2639 MCM and 70 MCM.

According to the Table 3.1.8 showing the monthly runoff data, the total volume stored in the N'Zi river in 6 months from December to May is 4-5% of the total annual volume. The lowest flow occurs in February or March, which is 2 MCM of monthly mean runoff volume at the Dimbokro measuring station. The highest flow occurs in October following the second peak rainfall of September, which amounts to 442 MCM of monthly mean runoff volume at the same station. As for the tributaries, Soungourou and M'Be, the volume recorded during February or March the month of lowest flow is either nil or very low and ranges from 0 to 0.1 MCM. On the other hand, the maximum volume recorded in the wet season ranges from 16-35 MCM of monthly mean runoff volume.

Using the existing discharge and rainfall data, the runoff ratio (%) were computed for each month from 1965 to 1992 for the area between M'Bahiakro and Dimbokro and from 1983 to 1992 for respectively M'Be and Soungourou catchment areas.

To estimate the runoff ratio of the dam sites, the obtained monthly ratio were regressed on rainfall for each of the three areas cited above. No clear relationship were found. The same observation were recorded when runoff was regressed on rainfall in either the dry or the rainy season. From these considerations and due to the fact that the mean yearly values of the runoff ratio were very close for the three areas, the means of the obtained monthly ratio were taken to represent the basic runoff ratio of the dam sites. These values were then adjusted by a coefficient, C_i , determined empirically to account for rainfall.

The coefficient, C_i , for a given rain i is the ratio of the actual runoff ratio from that rain i to the runoff ratio from the mean monthly rainfall of that area. For safety reasons, the coefficients computed for M'Be were selected as they were higher for small amount of rain and lower otherwise.

The computed runoff ratio are shown in Table 3-1-9 and will be used to determine the water availability in the tributaries. The table shows only April to November values as those for December to March were neglected because they were very low.

Table 3.1.7 Flow volume (MCN) for NZi and its tributaries and annual runoff ratios

River Station	NZi Fékérou		NZi W' Bahiako		NZi Bocanda		NZi Dimokro		M'Be Anaoundrik		Sounngourou R. Mahiako	
	Catchment area (km ²)	Annual flow volume (MCN)	Runoff ratio (%)	Annual flow volume (MCN)	Runoff ratio (%)	Annual flow volume (MCN)	Runoff ratio (%)	Annual flow volume (MCN)	Runoff ratio (%)	Annual flow volume (MCN)	Runoff ratio (%)	Annual flow volume (MCN)
1965	1,510.0	12.7	2,165.0	11.4	2,170.0	11.7	2,231.0	12.7	3,224	12.7		
1966	1,577.0	20.0	2,029.0	17.7	2,147.0	10.7	2,207.0	10.5	3,224	10.5		
1967	675.0	14.2	800.0	9.6	*	*	809.0	4.0		4.0		
1968	3,043.0	14.4	*	*	*	*	5,416.0	13.4		13.4		
1969	510.0	9.3	741.0	7.8	*	*	708.0	3.7		3.7		
1970	1,101.0	17.2	*	*	*	*	1,449.0	6.7		6.7		
1971	984.0	9.3	1,505.0	9.3	1,606.0	8.6	1,435.0	6.4		6.4		
1972	*	*	*	*	*	*	819.0	3.6		3.6		
1973	554.0	3.7	763.0	3.3	919.0	3.5	1,148.0	4.4		4.4		
1974	629.0	9.6	967.0	11.1	1,001.0	5.6	1,013.0	6.5		6.5		
1975	876.0	7.7	1,014.0	5.2	964.0	9.5	1,032.0	4.1		4.1		
1976	91.0	1.0	100.0	6	*	*	*	*		*		
1977	*	*	1,168.0	6.6	*	*	*	*		*		
1978	*	*	217.0	2.9	284.0	2.6	402.0	2.2		2.2		
1979	1,327.0	14.4	1,658.0	11.2	1,728.0	13.5	*	*		*		
1980	1,267.0	17.7	1,951.0	10.2	2,031.0	8.4	1,951.0	6.6		6.6		
1981	563.0	9.7	820.0	9.1	856.0	9.8	840.0	8.0		8.0		
1982	171.0	3.6	214.0	2.6	257.0	3.5	371.0	2.8		2.8		
1983	13.0	4	30.0	3	40.0	3	70.0	3		3		
1984	572.0	4.9	943.0	5.1	1,011.0	5.6	1,108.0	7.3		7.3		
1985	*	*	2,318.0	13.0	2,501.0	8.8	2,445.0	9.2		9.2		
1986	406.0	4.8	419.0	3.4	454.0	3.2	437.0	3.4		3.4		
1987	829.0	10.9	1,377.0	11.1	1,315.0	10.4	1,485.0	4.6		4.6		
1988	614.0	6.8	1,013.0	7.3	1,033.0	4.4	1,172.0	4.7		4.7		
1989	1,399.0	8.9	2,301.0	9.6	2,324.0	9.5	2,639.0	10.5		10.5		
1990	*	*	446.0	5.0	*	*	*	*		*		
1991	*	*	289.0	2.0	*	*	884.0	5.2		5.2		
1992	266.0	9.3	289.0	2.0	*	*	*	*		*		
Mean	863.0	9.3	1,052.0	7.3	1,258.0	7.2	1,394.0	6.1	141.6	3.9	59.5	4.7
5 years return period value	266.0	3.7	289.0	2.9	454.0	3.5	708.0	3.6	43.9	1.3	10.9	1.3

* represents missing values

Table 3-1-8 Mean monthly flow (MCM) for NZi and some tributaries.

River	NZi	NZi	NZi	NZi	MTBc	Soungourou
Station	MTBahakro	Bocanda	Dimbokro	Akafoundrik	R. MBahakro	
Catchment area (km ²)	15,700	20,500	24,100	3,224	852.8	
Month	Mean flow (MCM)	Mean flow (MCM)	Mean flow (MCM)	Mean flow (MCM)	Mean flow (MCM)	Mean flow (MCM)
	5 years return period flow	5 years return period flow	5 years return period flow	5 years return period flow	5 years return period flow	5 years return period flow
January	3	0	2	6	1	0.4
February	1	0	1	2	0	0.1
March	2	0	3	2	0	0.2
April	9	0	6	10	2	0.2
May	17	3	18	23	8	1.3
June	51	7	61	75	20	1.8
July	81	5	92	105	11	3.8
August	181	12	198	176	22	9.4
September	393	42	359	349	33	16.4
October	304	85	334	442	90	8.8
November	80	26	97	121	41	2.5
December	17	4	20	25	9	0.8

Note: Basic data for MBahakro, Bocanda and Dimbokro are of 1965-1992, those for Akafoundrik and Rie MBahakro are of 1983-1992

Table 3-1-9

Monthly runoff ratio given as a function of rainfall for the N'Zi tributaries catchment areas

Rain (mm)	Ci $Ci = (\text{runoff rain } i) / (\text{runoff mean monthly rain})$	Basic runoff ratio (%)								
		Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	
		0.3	0.9	1.4	3.8	6.6	8.2	10.7	7.0	
		Monthly runoff ratio(%)								
		Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	
	Ci									
<20	.566	.2	.5	.8	2.2	3.7	4.6	6.1	4.0	
20-40	.659	.2	.6	.9	2.5	4.3	5.4	7.1	4.6	
40-60	.751	.2	.7	1.1	2.9	5.0	6.2	8.0	5.3	
60-80	.844	.3	.8	1.2	3.2	5.6	6.9	9.0	5.9	
80-100	.937	.3	.8	1.3	3.6	6.2	7.7	10.0	6.6	
100-120	1.0	.3	.9	1.4	3.8	6.6	8.2	10.7	7.0	
120-140	1.1	.3	1.0	1.5	4.2	7.3	9.0	11.8	7.7	
140-160	1.2	.3	1.1	1.7	4.6	7.9	9.8	12.8	8.4	
160-180	1.3	.4	1.2	1.8	4.9	8.6	10.7	13.9	9.1	
180-200	1.4	.4	1.3	2.0	5.3	9.2	11.5	15.0	9.8	
200-220	1.5	.5	1.4	2.1	5.7	9.9	12.3	16.1	10.5	
220-240	1.6	.5	1.4	2.2	6.1	10.6	13.1	17.1	11.2	
240-260	1.7	.5	1.5	2.4	6.5	11.2	13.9	18.2	11.9	
260-280	1.8	.5	1.6	2.5	6.8	11.9	14.8	19.3	12.6	
280-300	1.9	.6	1.7	2.7	7.2	12.5	15.6	20.3	13.3	
300-320	2.0	.6	1.8	2.8	7.6	13.2	16.4	21.4	14.0	
320-340	2.1	.6	1.9	2.9	8.0	13.9	17.2	22.5	14.7	

(3) Water Quality

The results of water quality analysis for samples chosen on the N'Zi and some of the main tributaries located in the study area are summarized in Table 3.1.10. The table shows that there are no major problems related to the suitability of the different water sources for irrigation.

Table 3-1-10 Results of water quality analysis

River	Soungourou (Akoitiko)	Manda	Kaha	N'Zi (Dimboko)	N'Zi (Avonka)	S. Goulouha (Djenakro)	Boya (Kakhep'faco)	N'Zi Downstream (M'Batiko)	N'Zi Upstream (M'Batiko)	Agnissou (Adhou)
pH	6.5	6.3	6.2	6.8	6.6	6	5.6	6.7	6.6	6.5
C.E. (microS/cm)	81	38	45	68	76	69	128	68	68	138
Suspended sediments (g/l)	0.3	0.3	0.2	0.3	0.2	0.5	0.2	0.2	0.3	0.2
Ca++ meq/l	0.2	0.14	0.12	0.12	0.12	0.18	0.52	0.12	0.12	0.23
Mg++ meq/l	0.05	0.03	0.03	0.05	0.05	0.03	0.34	0.04	0.04	0.24
K+ meq/l	0.09	0.06	0.09	0.09	0.02	0.13	0.39	0.09	0.09	0.25
Na+ meq/l	0.28	0.14	0.09	0.27	0.24	0.16	0.04	0.22	0.21	0.3
Total N meq/l	0.3	0.3	0.32	0.3	0.3	0.4	0.4	0.28	0.28	0.32
Cl- meq/l	0.3	0.28	0.26	0.26	0.28	0.28	0.28	0.3	0.28	0.3

(4) Flood Condition

Around 40% of the study area, 58,200 ha in gross, is situated in the lower alluvial plain or lower terraces extending along the N'Zi river. Based on the results of field investigation and inquiries to riparian people, the flooded area was demarcated on the topographic maps of scale 1:50,000 and measured to be 43,000 ha. According to the farmers, floods have heavily attacked four or five times in the past 20 years and in most cases stagnated there for two to three weeks. Due to these flood attacks, the farmers have never tried to cultivate crops in these areas except a few patches of land, though the soils in these areas are mostly fertile and suitable for cultivation of various crops, particularly for paddy cultivation. For the utilization of these lands to their full potentials, therefore, the flood protection works are sine qua non.

(5) Estimation of Discharges and Water Levels for Major Floods

The discharges and water levels at different points on the N'Zi and the two major tributaries, Soungourou and M'Be, for flood of recurrence 10, 100 and 1000 years have been estimated for design purposes. The results are shown on Table 3.1.11.

Tableau 3-1-11 Discharge, Q, water level, H, for flood of given return periods

River	Catchment area (km ²)	Q10 (m ³ /s)	Q100 (m ³ /s)	Q1000 (m ³ /s)	H10 (cm)	H100 (cm)
N'Zi at Dimbokro	24 100	452	732	1006	728	1055.2
N'Zi at Bocanda	20 500	466	749	1027	927	1382
N'Zi at M'Bahiakro	15 700	470	757	1039	1109	1620
N'Zi at Fétékro	10 000	420	677	928		
M'Be at Akafoundrikro	3224	44	75	105		
Soungourou at Route M'Bahiakro	852.8	41	68	93		

Note: Basic data are for 1954-1992 for M'Bahiakro, 1955-1992 for Bocanda and Dimbokro, 1959-1992 for Fetekro and 1983-1992 for Akafoundrikro and Rte M'Bahiakro

3-1-4 Environment

Since the major environmental problems in Côte d'Ivoire are pointed out as rapid deforestation, pollution in sprawling urban area, and endangered species of fauna and flora, the present environment study was conducted along with the major environmental problems above mentioned.

(1) Responsible Government Organization and Non-Government Organization related to Environmental Matters

The main governmental organizations related to environmental matters are 14 ministries including the Ministry in charge of Environment and Tourism, the Ministry in charge of Mines and Energies, and the Ministry in charge of Agriculture and Animal Resources (Table 3-1-11). Central organization is the Ministry in charge of Environment and Tourism which was established by the reorganization in 1993. The ministry is responsible to propose a program and a national view on all the environmental matters to the government as well as the global trends of environmental policy. The Ministry in charge of Agriculture and Animal Resources covers in agricultural development, including fight against deforestation and bush fire, management of national parks and reserves, maintenance and protection of soils, water, and fauna and flora for future development.

Sixteen domestic organizations like RECI and GONGASI, and three international organizations like HELP and WILD LIFE are active as NGO in Côte d'Ivoire (Table 3-1-12).

By the reorganization of ministries, Regional Department of Ministry of Environment and Tourism in Yamoussoukro had responsibility to the regional environmental matters including the study area at present. Regional Environmental Action Plan was published in May 1994. The sub-committee II covers the sector of agriculture and natural resources in this area.

(2) Laws, Regulations and Guidelines and Non-Government Organization related to Environmental Matters

The Forest and Nature Protection Law was established in 1965, and amended several times. Ministry in charge of Agriculture and Animal Resources ratified Washington Convention and Ramsar Convention in February 1993. Presently, the legislation of environmental law is being in discussion, and will be completed in the near future. Environmental impact assessment will be included in the law. Although environmental impact assessment is not presently regulated by law and registration, some actual activities have been done by the assistance of non-government organization, as it was the case in the road construction from Grand Bassan to Santafe by the assistance of World Bank.

Côte d'Ivoire ratified Ramsar Convention in 1993. However no specific wetlands or swamps were registered in this country. Wild World Life Foundation is one of the private sectors on nature conservation organizations in this country.

(3) Protection of Historical Remains and Cultural Assets

Fifty-one archeological important place were known in Côte d'Ivoire (J. N. Liacou, 1984). The ruins of mid stone age (mesoneolithique) were reported in Dimbokro and M'Bahiakro.

The information was obtained from the archeologists of the Institute of Historical Art and Archeology of Africa, University of Abidjan. The area including Toumodi and Dimbokro was intensely studied since this area was the center of V-shape zone on the boundary of forest and savanna. The historical place was located at Kpebo village, Toumodi, 42 km south from Dimbokro in the south. The archeological evidence were collected and studied in the Institute. The village located clearly outside of the study area in the present project. There was a report from M'Bahiakro. Since the exploration was not carried out, the exact site is unclear so far.

(4) National Parks, Natural Reserves, and Botanical Reserves

There are eight national parks (1,742,100 ha), four natural reserves (226,500 ha), and seven botanical reserves (230,818 ha) in this country. National parks are for the protection and conservation of wild animals and their forest in nature, natural reserves and botanical reserves are for the protection and conservation for future study of forest and trees in nature. The lands are owned by the Government and managed by the SODEFOR. Hunting in these area is strictly prohibited.

There are no natural parks, natural reserves and botanical reserves in and around the study area.

(5) Classified Forest (Conservation Forest)

In Côte d'Ivoire, 252 classified forests (4,250,826 ha) are assigned in all over the country for the conservation of forest environment, water resources protection and timber production. The lands are owned by the government and managed by SODEFOR. Hunting is not prohibited in the classified forests.

According to FAO Production Statistics, the forest land covered 11,130,000 ha (34.5% of whole national land area) in 1975. The forest lands reduced to 7,360,000 ha (22.8% of whole national land area) in 1990. It was because of agricultural exploitation for coffee and cacao production, timber cutting for exporting, and loss by wild fire. The total area of national parks, natural reserves and botanical reserves occupied 6,450,246 ha (20.0% of whole national land area).

The topographical characteristic of this country is rather flat, and not divided as mountain area and plain area. The trend to dry weather is told in the long term change of climate in this country. Therefore classified forests distributed in the whole country are very important in terms of environmental conservation and protection of water resources in national wide.

The 34 species of important forest trees are recommended for timber production and reforestation. They are teak, samba, acajou, and others in common name. Eleven species belong to Millaceae and six to Leguminosae.

There are eight classified forests in the study area, and 19 classified forests in the surrounding area (Table 3-1-13).

In the classified forests, short period cultivation (1-4 years) by neighboring village people are allowed with the regulation of planting short term crops (maize, peanuts, sweet potato, cassava, yam, etc.) at assigned small lot of land. At the end of allowed cultivation period, SODEFOR provides tree seedling to plant in the lot. Village farmer transfer the lot to plant their short term crop after they plant the seedling in the old lot. In this way, the conservation of forest land and reforestation is on going stepwise in the classified forests. Recently tree cutting without permission is happening, however the inspection is not so frequent because of shortage of trip budget.

Table 3-1-12 Government organization related to environment matters

Ministry / Correspondence to environment / Attached institution	
1. Ministry in charge of Environment and Tourism	To propose a program and a national view on all the environmental matters to the government as well as the global trends of environment policy Institution : Central Laboratory for Marine and Lagoon Area
2. Ministry in charge of Construction and Town Planning	To correspond to environmental problems in construction and town planning
3. Ministry in charge of Mines and Energy	To control industrial environment, pollution, refuses, and harmful effects Institution : National Testing Laboratory of Meteorology Quality and Pollution Analysis
4. Ministry in charge of Scientific Research and Technical Teaching	To study and discover natural ecosystem, mechanism of ecosystem degradation Institution : Center of Oceanographic Research, Institute of Research on New Energy, Institute of Tropical Ecology, Tropical Forest Research Center
5. Ministry in charge of Agriculture and Animal Resources	To fight against deforestation and bush fire, reserve protected area, water, soil Institution : Society of Forest Plantation Development (SODEFOR) National Committee of Forest Defense and Fight against Bush Fire
6. Ministry in charge of Equipment and Transport	To manage continental water, feed drinking water in urban and rural area
7. Ministry in charge of National Education	To prefer environmental education at all levels of instructive systems
8. Ministry in charge of Health and Social Protection	To take care of anything linked to public healthiness and quality of existence
9. Ministry in charge of Territory and Security	To take part all actions leading to improve quality of living standard
10. Ministry in charge of Culture	To protect and develop authentic heritage
11. Ministry in charge of Youth and Sports Association	To bring participation of youth and NGO into prevention of nuisances and environmental degeneration
12. Ministry in charge of Communication	To assumes to sensitize masses through media of press
13. Ministry in charge of Woman Promotion	To sensitize women to use less fire wood, promote new energy and cooking
14. Ministry in charge of Economy and Finance	To manage state credits allocated environmental improvement

Table 3-1-13 Non-Government Organization (NGO) related to environment

I. Domestic Organization

1. The RECI (Network for Environmental Association)
2. The GONGACI (Group of Active NGO of Côte d'Ivoire)
3. LIEPSC (International League for Survey and Promotion for Collectivities Health)
4. CI Nature (Côte d'Ivoire Nature)
5. Croix Verte
6. L'AJACEM (Man Ancient Circle of Youth Association)
7. L'OMSOES (Organization OMS for a health Environment)
8. Le Club Dix
9. Afrique Commune
10. Cupen (University Club for Protection of Environment)
11. ECHOPREN
12. Afrique Environnementale
13. CI Ecologie
14. AMCAV Port-Bouet (Association for Mnaging Port Bouet District)
15. Le Group Essor (Sub-Regional Species)
16. RGAS (Space Group Action, Salubrity)

International Organization

1. HBLP My People International
 2. WILD LIFE Conservation International
 3. L'ARBA (Retraining Agency for Environment in Africa)
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Table 3-1-14 Classified forests in and around the study area

Name	Area (ha)	Sub-Prefecture	Department	Region
I. Topographic Map "M' Bahiakro " (1/200,000)				
1. Bessa Boka	11,300	Brobe	Brobe	Centre-Nord
2. Mafa	10,200	Brobe	Brobe	Centre-Nord
3. Fetekro	2,900	Brobe	Bouake	Centre-Nord
4. Laka	7,100	Brobe	Bouake	Centre-Nord
5. Benna Fuko	760	Bouake	Bouake	Centre-Nord
6. Bobo		Bouake	Bouake	Centre-Nord
7. Kanoumou	6,400	Didievi	Yamoussoukro	Centre
8. Tagba *	2,300	Quelle	Daoukro	Centre
9. Baya (Baa) *	6,000	Quelle	Daoukro	Centre
10. Kulakro *		Kouassi Kouassikro	Dimbokro	Centre
11. Koumo *	4,000	Kouassi Kouassifro	Dimbokro	Centre
(Koumo Kofi Kouadikro)				
12. Bossia Mori *	200	Bocanda	Dimbokro	Centre
(Be Bush)				
II. Topographic Map "Dimbokro" (1/200,000)				
13. Abeanou	21,000	Daoukro	Daoukro	Centre
14. N'doukouassikro	600	Bocanda	Dimbokro	Centre
15. Tebe	6,000	Dimbokro	Dimbokro	Centre
16. Bodio	3,600	Dimbokro	Dimbokro	Centre
17. Ahua *	4,600	Dimbokro	Dimbokro	Centre
18. Sanyan (Sanuan)*	3,520	Dimbokro	Dimbokro	Centre
19. Abouderessou	2,000	Dimbokro	Dimbokro	Centre
20. Doubele	15,100	M'batto	Bongouanou	Centre
21. Serebi	2,800	M'batto	Bongouanou	Centre
22. Prouncho	8,000	M'batto	Bongouanou	Centre
(Pruncho)				
23. Sanaimbo *	5,000	M'batto	Bongouanou	Centre
24. Seguie	36,000	M'batto	Bongouanou	Centre
25. Orumboboka	3,000	Toumodi	Toumodi	Centre
26. Mando	16,000	Toumodi	Toumodi	Centre
27. Assouby	14,000	Akoupe	Adzope	Sud

Note : The classified forests with asterisk are located in the study area

(6) Protection of Important Fauna

Côte d'Ivoire designates important wild animals and birds to be protected. They are 31 species of mammals like elephant, hippopotamus, lamantin, chimpanzee, potto monkey, musk deer and pangolin, 12 birds like massager, pintade, marabout giant abyssinian calao, aigrette, grue couronnée, jabiru and aigle. The registration to the Red Data Book of IUCN (International Union of Nature Conservation) is not done yet.

Hippopotamus, one of the important protected species of fauna in Côte d'Ivoire, was reported to live at the swamp of old N'Zi river near Gali Nzikro village in the study area in the Phase I Study. When we visited the village on August 27, 1994, the village people told that hippopotamuses moved away several days ago because the swamp dried out due to no rain for four months or more. The number of animals exceeded one hundred. The figure showed enough population to last and propagate. Many newly printed foot stamps, waste and eaten grass were found near the stream at the boundary of swamp grass plain and hill forest. According to the village guide, crocodiles were spotted in the swamp.

In the camp of Ahua village near Dimbokro, two hippopotamuses live in the main stream of N'Zi. They have probably moved away upstream of the N'Zi River. In the dry season, the animals come in the ditch of the river.

The hippopotamus in Côte d'Ivoire consisted of two species, *H. nain* and *H. amphibie*. The former is class A rank and the latter is class C rank by the Law of Protection of Fauna and Hunting (1965). Presently, the species name of the hippopotamus is not clear.

Monkey, squirrel, giant flying squirrel and rabbit were observed during vegetation survey of the study area. Also the trap for agouti, gazelle and rabbit were seen. It means that this area is still rich in wild life.

(7) Major Vegetation Types and their Distribution

Vegetation types of Côte d'Ivoire are distributed into the Guinea area (southern zone), Mesophile area (mid zone) and Sudanese area (northern zone).

(a) Guinea area

Littoral area (Littoral forest, littoral savanna, mangrove forest)

Rain forest area (Drain soil forest : five types of forest like Eremosphata forest, hydromorphic soil forest = constant and periodic hydromorphic forest)

(b) Mesophile area

Semi-deciduous forest area (Drain soil forest : two types of forest like Celtis forest, swampy swallow forest, re-growing forest)

Savanna area (Small island bit forest, gallery forest, arborescent savanna, shrub forest)

(c) Sudanese area

Sub-Sudanese area (Common forest, gallery forest, arborescent forest, shrubby savanna)

Sudanese area (Gallery forest, mixed formation)

The study area is located on the border area of semi-deciduous forest area and savanna area in mesophile area. So various types of vegetation of forest and savanna were observed. Along the main stream of N'Zi river and tributaries, various constitution of trees and grass species in the gallery forest were observed. The vegetation type and major tree and grass species in and around study area shown in Annex.

(8) Protection of Important Species of Flora

L. A. Ashi (1988) published the list of the 66 species of important flora in Côte d'Ivoire. Since there was no information on plant species found in the study area, vegetation survey was carried out, especially in four tributary area. However no specific plant was ascertained in the area.

(9) Fish, Fishing Right and Water Use in N'Zi River

According to the Regional Environmental Action Plan (1994), the fish species in N'Zi river are as follows; *Chrysotothis velifer* (Machoiron), *Tilapia nilotica* (Carpe), *Heterobranchus* (Silure), *Alistes imberi* (Mabaio), *Labeo coubis*, *Morlnunus* sp., *Synodontis shali*. They are rather common in tropics.

People of Côte d'Ivoire are permitted to catch fish with free charge. The water is used for drinking by the citizens of Dimbokro, Bocanda, and M'Bahiakro. The water is also used for industrial purposes by UTEXI Factory in Dimbokro.

Table 3-1-15 Vegetation type and main tree and grass species in and around the study area

Savanna

1. Wooded, arborescent or shrubby savannas on drained soils
 - a. High arborescent stratum (8-20m)

Main tree species : *Daniellia oliveri*, *Lophira lanceolata*, *Burkea africana*, *Vitellaria paradoxa*, *Azelia africana*, *Pterocarpus erinaceus*, *Isobertinia doka*, *Ficus glumosa*
 - b. Shrubby stratum (2-8m)

Main tree species : *Datarium microcarpum*, *Terminalia avicennoides*, *Crossopteryx febrifuga*, *Pericopsis laxiflora*, *Gardenia erubescens*, *Ptiliosigma thonningii*, *Nauclea latifolia*, *Combretum ghasalense*
 - c. Higher herbaceous stratum (- 2.5m)

Main grass species :

Graminaceae : *Hyparrhenia subplumosa*, *H. smiphiana*, *Panicum phragmitoides*, *Schizachyrium sanguineum*, *Andropogon schisensis*

Other grass : *Annona senegalensis*, *Pseudarthria hookeri*, *Cachlaspermum planchani*
 - d. Lower herbaceous stratum

Main grass species :

Graminaceae : *Digitaria delicatula*, *Eragrostis turgida*

Other grass : *Rynchosia sublobata*, *Dilochos chrysanthus*, *Desmodium gangeticum*, *Vigna multivervis*, *Cyperus tunui culmis*, *Fimbristylis dichotoma*, *Bulbostylis pilosa*
2. Arborescent or shrubby savanna on hydromorphic soils and swampy soils
 - a. Arborescent savanna with *Terminalia macroptera*

Main tree species : *Terminalia macroptera*, *T. laxiflora*, *Crossopteryx febrifuga*

Main grass species : *Hyparrhenia subplumosa*, *Smithiana elymandra*, *Loudetia simplex*
 - b. Arborescent savanna with *Daniellia oliveri*

Main tree species : *Daniellia oliveri*, *Lophira lanceolata*

Main grass species : *Andropogon africanus*, *Brachiaria jubata*
 - c. Arborescent savanna with *Entada abyssinica*

Main tree species : *Entada abyssinica*, *Kigelia africana*, *Acacia campylacantha*, *Cola cordifolia*

Main grass species : *Afromomum latifolium*, *Andropogon macrophyllus*, *Imperata cylindrica*
 - d. Shrubby savanna with *Mitragyna inermis*

Main tree species : *Mitragyna inermis*, *Acacia sieberiana*, *Crossopteryx febrifuga*, *Combretum ghasalense*

Main grass species : *Vetiveria fulvibarbis*, *Andropogon africanus*, *Brachiaria jubata*
3. Grassy savanna
 - a. Grassy savanna on hydromorphic soils

Main tree species : *Daniellia oliveri*, *Terminalia macroptera*

Main grass species :

Graminaceae : *Andropogon africanus*, *Brachiaria jubata*, *Panicum pilgeri*, *Loudetia simplex*, *Monocymbium cerasiforme*, *Vetiveria fulvibarbis*

Other grass : *Sporobolus pyramidalis*, *Microchloa indica*, *Eragrostis turgida*, *Digitaria delicatula*
 - b. Grassy savanna on alluvial plains

Main tree species : *Mitragyna inermis*, *Acacia sieberiana*, *Crossopteryx febrifuga*, *Combretum ghasalense*

Main grass species : *Vetiveria fulvibarbis*, *Andropogon africanus*, *Brachiaria jubata*
 - c. Tabular savanna on lateritic soils ("Bowe")

Main tree species : *Cyanotis lanata*, *Polycarpea termifolia*, *Spermacoce filifolia*

Main grass species : *Macrochloa indica*, *Brachyana obtusiflora*, *Oropetium aristatum*

(10) Quantity and Quality of Surface Water in N'Zi River

Since the seasonal change of surface water is very large every year, minimum supply of surface water would be requested for drinking and washing for peoples, and for life of fishes and hippopotamus.

There was the case that water pollution had taken place due to agricultural activities in this area. Over dressing of fertilizer and agrochemicals by legume growing farmers and coffee seedling growers caused the deterioration of water quality and damaged the life of fishes in the river.

(11) Human Diseases in Irrigated Rice Production Area

According to the leader of agricultural cooperative at Atofou, malaria and phylaria diseases are found in villages near the study area, where newly irrigated rice fields are introduced. Dimbokro physician answered to this matter as follows. Although malaria was spread out, phylaria was very isolated and is not a common disease. People with onkoselma are treated every year.

(12) Conservation of Landscape

The landscape in the study area is very typical of tropical semi-deciduous forest and savanna. Therefore, no specific scenery to be protected is present in this area.

(13) Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA)

Using the format of JICA guideline of environmental consideration for agricultural development project, initial environmental examination (IEE) was carried out in the phase I field survey. Six (6) environmental components that will be impacted unquestionably by the project were identified. One (1) environmental component that will be likely to be impacted by the project was also identified. However, 17 environmental components remained to be not fully known. Therefore, in the phase II field study, those environmental components were further studied, referring the new knowledge on environmental matters previously mentioned. Finally, seven (7) environmental components (1 social and 6 natural) were identified to be unquestionably or likely to be impacted by the project.

Matrix of impact identification in the following shows the relation to the seven identified environmental components and the impact location and impact stage.