No.

Japan International Cooperation Agency (JICA)

National Center for Remote Sensing And Forest Cover Monitoring
Department of Forest and Natural Resources
Ministry of Rural Development
The Republic of Benin

THE STUDY ON CARTOGRAPHY, INVENTORY AND MANAGEMENT OF CLASSIFIED FOREST IN NORTHERN AREA IN BENIN

FINAL REPORT

« Main Text »

December 2000

Japan Forest Technical Association (JAFTA)
Sanyu Consultants INC.
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PREFACE

In response to the request from the Government of Republic of Benin, the Government of Japan decided to conduct a development study on the Study on Cartography, Inventory and Management of Classified Forest in Northern Area in Benin and entrusted the study to Japan International Cooperation Agency (JICA).

JICA sent to Benin a study team headed by Mr. Yutaka TAGUCHI, Japan Forest Technical Association, five times between October 1998 and November 2000.

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

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

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

December, 2000

Kunihiko Saito
President
Japan International Cooperation Agency

LETTER OF SUBMITTAL

Mr. Kunihiko Saito
President
Japan International Cooperation Agency

December 2000

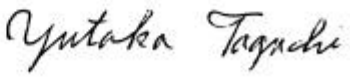
It gives me great pleasure to inform you that the development study on the Study on Cartography, Inventory and Management of Classified Forest in Northern Area in Benin has been completed and to hereby present you with the final report.

This report contains the results of the field surveys carried out between October 1998 and December 2000, together with an analysis of the results and plans formulated on the basis of such results in accordance with the contract concluded with the Japan International Cooperation Agency. During the period mentioned above, surveys were carried out to ascertain land use and the state of vegetation, as well as to ascertain the state of the local inhabitants. It was clear from the results of these surveys that the development of land for cultivation within the classified forest together with continued grazing within the area was causing the ongoing degradation of the classified forest. Therefore, with the aim of preserving forest resources, preserving the natural environment and developing forest functions to benefit the general public, we formulated a type of forest management plan that requires the participation and cooperation of the local inhabitants in order to restore and preserve the classified forest within the Intensive Study Area designated within the Study Area and realizes the sustainable and rational use of the classified forest.

I would like to express my thanks for the considerable assistance and guidance afforded to the study team by the staff of JICA, as well as by the staff of the Ministry of Foreign Affairs and the Ministry of Agriculture, Forestry and Fisheries. Furthermore, I would also like to thank the staff of the JICA Ivory Coast Office, the Ivory Coast Embassy of Japan, and the Department of Forest and Natural Resources of the Benin Ministry of Rural Development for their invaluable advice and cooperation.

It is my sincere hope that JICA will find this report useful for the future promotion of the plan.

Very truly yours



Yutaka Taguchi
Team Leader

The Study on Cartography, Inventory and Management of Classified Forest in Northern Area in Benin

Explanation of and discussions on Inception Report

Workshop with representatives of the local inhabitants (Beroubouay)

Workshop with villagers (Mani-Boké)

Technology Transfer Seminar (Parakou)

A noticeboard installed under this Study displays information on the Classified Forest

A Classified Forest boundary marker installed under this Study

Tree Savanna (Sa) in the Rainy Season

Tree Savanna (Sa) in the Dry Season

Tree height measurement during forest survey

Natural regeneration of *Isoberlinia* sp. after forest fire

Description of a soil profile

A representative soil profile of Ferralsols

Fire caused by the local inhabitants spreads to forest

Grazing conducted by Fulbe tribe in forest

Cultivation of Yam after felling of natural forest in Classified Forest

Cotton cultivation in Classified Forest

A Fulbe settlement in Classified Forest

A plantation of Tectona grandis

Contents

ACRONYMS (French)

ABE	: Agence Beninoise pour l'Environnement
APV	: Agent polyvalent de Vulgarisation
CARDER	: Centre d'Action Régionale pour le Développement Rural
CCS	: Complex Communal de Santé
CLCAM	: Caisse Locale de Crédit Agricole Mutuel
COBEMAG	: Coopérative Béninoise de Matériel Général
COTEB	: Complex Textile du Bénin
CSPP	: Centre de Santé de Sous-Préfecture
CVEC	: Caisse Villageoise d'Epargne et de Crédit
DBH	: Abréviation en anglais «Diameter (at) Breast Height» = Diamètre à heuteur d'homme
DE	: Direction de l'Environnement du Ministère de l'Environnement, de l'Habitat et de l'Urbanisme
DFRN	: Direction des Fôrets et des Ressources Naturelles
DVAP	: Direction de la Vulgarisation et de l'Appui aux Organisations Paysanes
FCFA	: Franc CFA (1 franc français = 100 francs CFA)
FECECAM	: Fédération des Caisses d'Epargne et de Crédit Agricol Mutuel
GF	: Groupement de Femmes
GPS	: Abréviation en anglais «Gepgraphic Positionning System»
GV	: Groupement Villageois des Producteurs
IEE	: Abréviation en anglais «Initial Environmental Evaluation» = Evaluation Initiale de l'Environnement
IGN	: Institut Géographique National
ISHOKAN	: Projet ISHOKAN
MEHU	: Ministère de l'Environnement, de l'Habitat et de l'Urbanisme
ONAB	: Office National du Bois
ONASA	: Office National de Stablisation Alimentaire
PGRN	: Projet de Gestion des Ressources Naturelles
S/W	: Abréviation en anglais «Scope of Work» = Convention d'Etendue des Travaux
SOBEBRA	: Société Béninoise de Brasserie
SONAPRA	: Société Nationale pour la Promotion Agricole
TS/F	: Technicien Spécialisé en Foresterie
UR-CLCAM	: Union des Réseaux des CLCAM
USPP	: Union Sous-Préfectorale des Producteurs

Summary

1. Outline of the Study

(1) Background and the Aim of the Study

In recent years the deterioration of forests within Benin has increased at an alarming rate. The major causes of this problem are said to be the expansion of farmland through logging and clearing, which is the result of the increased population, controlled burning, over-grazing, and the use of fire for the removal of wild animals, etc.

In order to overcome this problem, in 1993 the Republic of Benin enacted the Forest Law to regulate forest management, including detailed forest improvement plans for the use and improvement of classified forests. Furthermore, forest policies were formulated in 1994 to promote the participation of the local inhabitants in the management of forest resources, the rationalized management of forest resources, the protection and preservation of ecosystems, and the strengthening of the management system.

On the basis of the above, the government of Benin requested that Japan carry out a development study for the formulation of a forest management plan in three areas of classified forest, including Trois-Rivières. In response to this request a study team was sent from Japan to carry out the development study.

The purpose of this study was to prepare basic information regarding the above-mentioned three classified forests and to formulate a forest management plan through the participation of the local inhabitants. Technology regarding forestry was also transferred to appropriate institutions through the implementation of this study.

(2) Study Area

The Study Area included three areas of classified forest totaling approximately 550,000 ha, consisting of the Trois-Rivières Classified Forest in the northern part of Benin, the Ouénou-Bénou Classified Forest and the Upper Alibori River Classified Forest, as well as a 7km wide Buffer Zone surrounding the classified Forests.

An area within the Study Area on the western side of the Trois-Rivières Classified Forest (on the western side of the Bouli River) of approximately 46,000 ha, and the surrounding buffer zone were established as the intensive study area, which is the target area for the formulation of this forest management plan.

2. Results of the Survey in the Study Area

(1) Natural Conditions

1) Location

   * Northern Benin: 11°14'50"~10°7'55" North Latitude
   * Located in Gogounou, Segbana, Kalale, Bembereke, Kandi and Banikoala Districts in Borgu Province (Department), and in Kerou and Pehonko Districts, 123 km (north to south), 169 km (east to west)

2) Weather

   * Annual rainfall of 950~1,100 mm, dry season from November to April or May with occasional hot dry blasts (Harmattan).
   * Average annual temperature at Kandi of 25~32℃ with no dramatic change in temperature throughout the year.

3) Topography

* Mostly gentle hills and sporadic small plateaus with steep slopes are observed. Altitude 220~490m, geological features consisting of granite and gneiss. The soil type is ferruginous tropical soil.
* The Sota and Alibori Rivers, both tributaries of the Niger River, flow through the area, and a significant difference in water volume may be observed between the rainy season and the dry season. A small amount of water runs in the lower stream within the classified forest even in the dry season, but tributaries and the upper reaches of these rivers dry up.

4) Vegetation

The forest consists mainly of tree savannah, shrub savannah and mixed savannah, with riparian(gallery) forest being found alongside waterways. *Tectona grandis* plantations, mango and cashews orchards, etc., farm land and fallow ground may also be observed. *Vitellaria paradoxa* and *Parkia biglobosa* are growing on farmland.

(2) Economic Conditions

The results of the survey, which was carried out in Gogounou, Segbana, Kalale, Bembereke, Sinende in Borgu Province, (Department) are as follows.

1) Population

The total population of the five districts is 246,000, consisting of 26,000 households, and an average number of people per household of 9.5. The people basically belong to the Baatombu or Fulbe tribes.

Population by District

District	Population			Number of Households	Number of People per Household
	Male	Female	Total		
Bembereke	30,377	29,432	59,809	6,540	9.1
Gogounou	25,039	25,006	50,045	5,600	8.9
Kalale	31,467	31,338	62,805	6,269	10.0
Segbana	16,154	16,117	32,271	3,666	8.8
Sinende	20,670	20,099	40,769	3,887	10.5
Total	123,707	121,992	245,699	25,962	9.5

Source: Deuxieme Recensement General de la Population et de L'Habitat, Feb. 1992

2) Industry

Primary industry is the main form of industry, accounting for a 71.5% share of the working population.

Labor Population Ratio by District and Industry

(Unit: %)

Type of Industry	Bembereke	Gogounou	Kalale	Segbana	Sinende	Average of 5 Districts
Agriculture, Hunting, Fishery	56.6	61.7	75.8	85.2	78.1	71.5
Manufacturing	6.6	8.7	4.8	2.0	2.3	4.9
Construction, Civil Engineering	2.5	3.0	1.4	1.0	0.1	1.6
Commerce, Restaurant Business	10.2	15.9	6.9	5.3	16.8	11.0
Transportation, Communications	2.1	2.4	1.2	0.9	0.4	1.4
Other Service Industries*	22.0	8.3	9.9	5.6	2.3	9.6

Note: The source of this data is "Atlas Monographique". Figures in "Other Service Industries" are adjusted to make the total 100%.

3) Land Ownership System

As a rule, with the exception of the land registered as privately owned land, all land belongs to the State. However, the traditional land ownership system is still being used.

4) Organizations of Local Inhabitants

* The Agriculture Administration Bureau is encouraging the establishment of a Village Council in each settlement. Such committees have so far been established in 45 settlements of the total number of 145 settlements within the five districts. There are also other organizations as shown below.
* Traditional Organizations: (1) traditional religious groups (2) youth groups (3) women's groups (4) elders' groups (5) hunters group.
* Modern Organizations: (1) villager's groups (2) women's groups (3) district level agricultural producers associations (4) water union.

5) Lifestyle-Related Infrastructure

The development of roads, water sources, power and telephone, and other public facilities are all at an extremely low level.

(3) Farming and Livestock Raising

1) Farming Area

Farming area in Borgu Province (Department) is divided in three areas according to natural conditions and the state of commercial farming.

* Annual rainfall in the far north of the country is less than 900 mm and multiple types of crops are not grown. The main crops are maize, millet and sorghum.
* Annual rainfall in the northern area is approximately 1,000 mm, making it possible to grow a wide variety of crops. Cotton account for a large proportion of the crop growing area.
* The main crops in the southern area are maize, cotton, yams and sorghum.

2) Farming Production

* From 1992 to 1996 yams were the most widely grown crop due to their place as a major food item. Cotton accounts for the largest crop growing area.
* A single crop rotation is practiced and mixed cropping is rare.
* Fertilizer is not used except for cotton.

* Cultivation using animal-power is increasing mainly for cotton.

Main Crop Production (1992-1996 Average)

District		Bembereke	Gogounou	Kalale	Kandi	Segbana	Sinende
Cotton	Crop Growing Area (ha)	8,764	8,605	9,206	11,652	8,147	8,378
	Unit Yield (kg/ha)	4,047	1,541	1,359	1,012	1,012	1,483
	Production Volume (t)	15,870	13,287	12,983	16,113	8,392	12,400
Corn	Crop Growing Area (ha)	8,457	5,288	10,215	10,020	5,382	6,166
	Unit Yield (kg/ha)	1,229	1,080	1,143	1,235	1,063	1,391
	Production Volume (t)	10,210	5,973	11,954	12,571	5,787	8,583
Sorghum	Crop Growing Area (ha)	4,303	2,100	7,993	7,259	4,210	4,012
	Unit Yield (kg/ha)	922	538	838	643	671	962
	Production Volume (t)	4,058	1,452	6,499	5,895	3,894	3,697
Yam	Crop Growing Area (ha)	4,525	1,397	7,003	609	1,579	5,423
	Unit Yield (kg/ha)	9,970	4,272	10,835	8,294	9,991	12,609
	Production Volume (t)	44,646	9,379	74,516	4,754	15,226	67,765
Tapioka	Crop Growing Area (ha)	1,166	378	373	402	182	867
	Unit Yield (kg/ha)	7,894	5,346	6,398	5,551	6,964	8,502
	Production Volume (t)	9,335	2,014	2,929	2,257	1,320	7,993

Source: Raport Annuel Carder-Borgou

3) Livestock Raising

Borgu accounts for 58% of cattle and 38% of sheep/goats reared in Benin. There are two main types of livestock raising.

* Farming/grazing with an emphasis on livestock raising is the most common form of farming for the Fulbe tribe. This is one of the causes of forest deterioration due to the grazing and the controlled burning carried out in forest areas.
* Farming/grazing with an emphasis on farming is carried out by people other than the Baatonu tribe. This type of farming has been established together with the Forest Improvement Fund of animal-powered cultivation. There are many cases where nomadic grazing is contracted to the Fulbe tribe in the dry season.
* The main form of feed for livestock is wild grass with the remains of crops also being utilized. Leaves from standing trees are removed and given to livestock in nomadic grazing.

4) Distribution of Farm Products

* Farmers are motivated to grow specific crops for which distribution routes are established by the government.
* Agricultural products other than the above-mentioned crops are traded in regular marketplaces. Farmers who do not have storage facilities are at a disadvantage.

5) Distribution of Livestock Products

Livestock and dairy products are traded in the cities and settlements by the Fulbe tribe.

6) Support Service for Farmers

Equipment rental and loans are available from SONAPRA, CLACAM, CVEC, etc.

(4) Forest/Forestry

1) Forest Resources

The three classified forests in the Study Area account for 44.1% of the total area of the 31 classified forests in Benin. The two classified forests in Trois-Rivières and the Upper Alibori River are two of the largest.

However, according to the latest aerial photographs, the area of cultivated and the fallow ground has reached 10.4% of the total area of classified forest in Trois-Rivières, 15.6% in Ouénou-Bénou, 9.3% in the Upper Alibori River.

Area of Land Use and Vegetation Categories in the Study Area (Unit: ha)

Type	Area	District	Forest							Non forest				Total
			Gf	Fc	Sa	Sb	St	Others	Sub-total	Ch	Ja	Others	Sub-total	
Classified Forest	Trois-Riviere	GOGOUNOU	5,562	1,067	22,773	25,700	6,652	893	62,647	4,455	1,773	15	6,243	68,890
		BEMBEREKE	2,636	282	12,015	14,833	4,980	281	35,027	2,136	338	150	2,624	37,651
		SEGBANA	3,568	374	9,230	28,689	7,054	786	49,701	4,780	2,834	0	7,614	57,315
		KALALE	4,771	422	25,596	49,563	12,635	2,394	95,381	9,640	1,896	296	11,832	107,213
		Total	16,537	2,145	69,614	118,785	31,321	4,354	242,756	21,011	6,841	461	28,313	271,069
	Ouenou Benou	BEMBEREKE	2,202	2,738	10,399	11,233	3,375	85	30,032	5,570	812	17	6,399	36,431
		SINENDE						0	0			0	0	0
		Total	2,202	2,738	10,399	11,233	3,375	85	30,032	5,570	812	17	6,399	36,431
	Upper Alibori I	GOGOUNOU	12,967	478	46,996	81,048	27,556	1,895	170,940	11,647	3,856	382	15,885	186,825
		SINENDE	3,035	90	8,004	24,240	3,499	134	39,002	4,956	301	60	5,317	44,319
		KANDI						0	0			0	0	0
		BANICOALA						0	0			0	0	0
		Total	16,002	568	55,000	105,288	31,055	2,029	209,942	16,603	4,157	442	21,202	231,144
	Upper Alibori II	PEHONKO	1,035	84	2,070	11,311	2,481	114	17,095	890	496	66	1,452	18,547
		KEROU	843	16	894	4,644	2,882	190	9,469	2,051	158	0	2,209	11,678
		Total	1,878	100	2,964	15,955	5,363	304	26,564	2,941	654	66	3,661	30,225
	計		36,619	5,551	137,977	251,261	71,114	6,772	509,294	46,125	12,464	986	59,575	568,869
Buffer Zone	Trois-Riviere	GOGOUNOU	3,683	312	7,391	18,296	3,432	120	33,234	11,182	2,254	74	13,510	46,744
		BEMBEREKE	1,606	138	4,132	11,846	2,940	183	20,845	5,678	887	115	6,680	27,525
		SEGBANA	2,342	561	5,826	20,638	6,186	1,112	36,665	7,174	3,494	143	10,811	47,476
		KALALE	3,563	292	5,759	25,716	7,055	279	42,664	26,538	3,386	520	30,444	73,108
		Total	11,194	1,303	23,108	76,496	19,613	1,694	133,408	50,572	10,021	852	61,445	194,853
	Ouenou Benou	BEMBEREKE	1,674	1,795	5,758	11,031	3,954	108	24,320	22,990	1,604	405	24,999	49,319
		SINENDE	1,653	878	2,194	4,031	966	66	9,788	6,599	593	21	7,213	17,001
		Total	3,327	2,673	7,952	15,062	4,920	174	34,108	29,589	2,197	426	32,212	66,320
	Upper Alibori I	GOGOUNOU	527		809	1,845	1,795	36	5,012	1,726	256	0	1,982	6,994
		SINENDE	850	763	2,305	8,923	3,521	293	16,655	19,420	931	301	20,652	37,307
		KANDI	2,638	83	4,642	17,205	8,481	198	33,247	17,726	2,923	151	20,800	54,047
		BANICOALA	1,629	12	3,416	14,700	1,561	288	21,606	15,000	2,168	24	17,192	38,798
		Total	5,644	858	11,172	42,673	15,358	815	76,520	53,872	6,278	476	60,626	137,146
	Upper Alibori II	PEHONKO	1,761	811	3,874	10,847	4,540	476	22,309	3,805	986	131	4,922	27,231
		KEROU	2,525	702	3,913	17,416	6,701	1,027	32,284	6,172	2,050	9	8,231	40,515
			4,286	1,513	7,787	28,263	11,241	1,503	54,593	9,977	3,036	140	13,153	67,746
	Total		24,451	6,347	50,019	162,494	51,132	4,186	298,629	144,010	21,532	1,894	167,436	466,065
Grand total			61,070	11,898	187,996	413,755	122,246	10,958	807,923	190,135	33,996	2,880	227,011	1,034,934

2) Timber Production

* Timber produced from standing trees is used as timber when it is thick, used as posts when it is thin and round, with both being used in construction.

* Logging which are not based on the forest improvement plan is prohibited in classified forests. Logging in other state forests is also prohibited. Logging permits and transport permits are required for commercial logging in fuelwood forests and private plantations. Nevertheless, it still seems that illegal logging is sometimes carried out.

3) Afforestation

* Although the CARDER is also propagating afforestation through extension activities, the local inhabitants are only interested in fruit trees and fast-growing species of trees.

* A DFRN nursery and private nurseries are growing seedlings. These seedlings are distributed within the province and neighboring provinces, as well as other countries.

* Afforestation is carried out mainly for fruit trees. Enrichment for native species in the classified forest is also carried out.

4) Forest Use

Timber production, the grazing of livestock, cultivation, hunting, beekeeping, freshwater fishing, the collection of medicinal plants and the harvesting of grass etc. is carried out by the local inhabitants in the classified forest and buffer zone.

5) Processing and Marketing of Timber

There are no facilities for processing timber, such as mills etc.

6) Forest Management System

* Each Provincial DFRN Chief oversees Forestry Branch Office Chiefs, who in turn oversee Technical Officers at District Forestry Offices, who then oversees Community Management Officers. A Technical Officer from the District Forestry Office often doubles as a Community Management Officer as this position is often vacant.

* The flow of funds is as follows. Agricultural Administration Bureau → District Forestry Office → Community Management Officer.

7) Forest Fires

* The main causes of forest fires are as follows.

  ① Insufficient preparation for controlled burning for cultivation.

  ② Use of fire to remove wild animals.

  ③ Use of fire to promote new growth for nomadic grazing in the dry season.

* The only form of controlled burning that is permitted is early controlled burning at the beginning of the dry season as authorized by government bureaus.

Area Damaged by Wild Fires in Plantations

(Unit: ha)

District/ Species / Year	GOGOUNOU			BEMBEREKE			SINENDE			SEGBANA			KALALE			Total for 5 Districts			
	Teak	Cashew	Mango	Teak	Cashew	Mango	Teak	Cashew	Mango	Teak	Cashew	Mango	Teak	Cashew	Mango	Teak	Cashew	Mango	Total
1996	36	31	22	25	105	15	24	112	10	21	8	10	75	210	55	181	466	112	759
1997	12	8	12	10	55	14	15	107	5	12	15	9	41	160	31	90	345	71	506
1998	2	9	5	12	10	6	3	100	1	4	2		10	95	12	31	216	24	271

(5) Initial Environmental Survey

As the survey is still at the planning stage and environmental assessment is not required, only the initial environmental survey was carried out. Matters regarding the environment for the formulation of the plan are as follows.

* Prohibition of the use of residual pesticide in the settlement nurseries.
* Avoidance of large areas of clear felling.
* Avoidance of the development of land with poor soil such as Leptosols, etc. and the unnecessary disturbance of topsoil, and the encouragement of early regeneration after logging.
* Avoidance of significant topographical changes and securing of proper rainwater drainage.

3. Survey in the Intensive Study Area

(1) Preparation of Topographical Maps

Topographical maps with a scale of 1:50,000 were created using the latest aerial photographs taken over an area of approximately 102,600 ha.

(2) Forest Survey

1) Stand Volume Survey

A survey on overall stand volume was carried out using sample plot survey method. A survey of stand volume in each forest type was carried out using the aerial photograph stand volume table, which was created using the data from the sample plot survey. After it was confirmed that there is no significant difference between the two estimated figures, the overall stand volume was estimated. The estimations are as follows.

* The sample plot survey was carried out using data from the preliminary survey and the random sampling method. A total of 95 plots were surveyed. The estimated error ratio was 15%.
* The total stand volume of forest types block was estimated to be 1,414,568 m^3. There was no significance difference between the estimated value and the sample plot survey.

Average/Dispersion Estimation by Random Sampling Method

(Unit: m^3/ha)

Layer	Area (ha)	Sample Number	Area Proportion	Average by Layer	Total Average	Sample Dispersion	Dispersion of Total Average
D1	14,568	42	0.346	13.60	4.70	63.91	0.1821
D2	14,841	35	0.353	28.14	9.92	58.95	0.2093
D3	10,415	13	0.247	55.85	13.81	473.31	2.2278
D4	2,280	4	0.054	136.00	7.36	6,278.67	4.6029
Total	42,104	94	1.000		35.80		7.2221

* Point 1 of D1 was not included because the stand volume had not been calculated (number of standing trees≥ DBH 10cm).

The total stand volume was estimated with a reliability of 95% from the above table.

Estimation of Total Volume

Total Average Volume (m^3/ha)	35.80
Standard Deviation of the Total Average (SV)	2.6874
T (0.05, 90) · SV	5.37
Confidence Interval of Average Volume (m^3/ha)	35.80±5.37
Confidence Interval of Total Volume (m^3)	1,507,323±226,098
Estimation Error Ratio	15.0%

2) Soil Survey

* A soil survey was carried out in accordance with the FAO/UNESCO soil classification standard. Six soil groups and 12 soil units were found.
* Soil distribution maps were prepared showing the soil unit on 1:20,000 scale topographical maps.
* Soil condition and land use was evaluated and ranked in Rank I~III.

3) Preparation of Forest Inventory Books

The results of the forest surveys and planning items were recorded in forest inventory books. These books were prepared for the classified forest and the buffer zone.

(3) Farming/Livestock Raising Survey

The state of farming and livestock raising was surveyed from various angles in order to clarify problems and directions for improvement. The land area required for the production of food for personal consumption was specially estimated in order to form the basis for establishing the Village Forestry Zone as a main part of the forest management plan to be carried out together with the people.

(4) Forest/Forestry Survey

* An overall survey was carried out with regard to logging and regeneration methods, the maturing age of trees, the logging cycle, forest fires, and forest management systems.
* A survey for the social forestry was also carried out with regard to fuelwood forest production, seedling production, fruit trees, beekeeping, fish farming, and forestry product processing.

(5) Survey to Ascertain the State of Local Inhabitants (First Part)

In order to clarify the state of local inhabitants who are directly involved in classified forests, settlement mapping, key informant interviews, preparation of seasonal labor calendars, as well as the survey on household income and expenditure, and group discussion were carried out. The following results were obtained.

* Tentative boundaries of settlements.
* Origin of settlements.
* Traditions and customs.
* Existing organizations of local inhabitants.
* Problems being faced by local inhabitants.

(6) Workshops for With Villagers

These were carried out in two parts. The purpose of the first part was to show people the basic concept of the forest management plan and to listen to their opinions in order to reflect them in the forest management plan draft.

The purpose of the second part was to show the draft to the local people, exchange opinions regarding the draft and obtain the understanding of the local inhabitants.

The main results were as follows.

* Awareness of the local inhabitants regarding the importance of the forest and the status of deteriorated forest resources was heightened.
* Basic consent with regard to the participation of local inhabitants in the management plan of the classified forest which will form the basis of classified forest zoning.

(7) Establishment of Classified Forest Boundaries

* The length of the target boundaries was approximately 70 km.
* The interval between boundary markers was approximately 500 m and 120 markers were laid.
* Notice boards were placed in 57 prominent locations.

(8) Forest Management Plan

1) Concept of the Management Plan

Forests can provide economic benefit for certain people as well as offering public benefit on a larger scale. The classified forest is established for the benefit of the general public. However, adequate consideration has to be given to the economy of the local inhabitants. Bearing this in mind, four main problems were raised (see below) with the aim of solving problems related to the formulation of the management plan.

* Preservation of areas of forest in water source area.
* Maintenance and improvement of forest production capacity.
* Transition from nomadic farming to fixed farming.
* Transition from extensive livestock farming to intensive livestock farming

2) Forest Management Units and Improvement Units

* The District Forestry Office has jurisdiction over improvement units in areas of classified forest.
* Improvement units in classified forests are areas of a certain size where historical, social, and natural conditions related to the settlements using such forests have to be considered. As a result, Zougou-Kpantrossi, Wessene, Pigourou, Kabanou and Mani-Boke were established as improvement units.

3) Classified Forest Plans

① Improvement Goals

* Improvement of such forest functions as water source protection, land conservation, wildlife protection, and bio-diversity preservation, etc.
* Nourishing the production forest for utilization of sustainable forest resources.

* Establishment of areas within classified forests which local inhabitants can use for themselves while preserving the forest.

② Zoning

a. Forest Zone

a) Conservation Forest Zone: A 3.5 km belt of forest stretching from the Bouli River within the Forest Zone. Conservation Forest I and II were established within this zone.

The following areas of forest shall be designated as Conservation Forest I.

* Areas of riparian forest within 500 m of the Bouli River.
* Areas of pure *Anogeissus leiocarpus* forest.
* Areas of forest on residual relief or tectonic relief.
* Areas of forest where soil conditions are bad and existing vegetation should be retained.

The following areas of forest shall be designated as Conservation Forest II.

* Forest within the Conservation Forest Zone other than Conservation Forest I.

b) Production Forest Zone: Areas within the Forest Zone with the exception of the Conservation Forest Zone. However, the following types of forest within the Production Forest shall be designated as Conservation Forest II.

* Areas of forest within 50m either side of waterways.
* Areas of pure *Anogeissus leiocarpus* forest.
* Areas of forest located on residual relief and tectonic relief.
* Areas of forest where soil conditions are bad and existing vegetation should be retained.

b. Silvi-pastoral Zone

Located between the Forestry Zone and the Village Forestry Zone, this zone is an area in which grazing is carried out. However, the following area within the Silvi-Pastoral Zone shall be Conservation Forest II.

* Areas of forest within 50 m of waterways

c. Village Forestry Zone

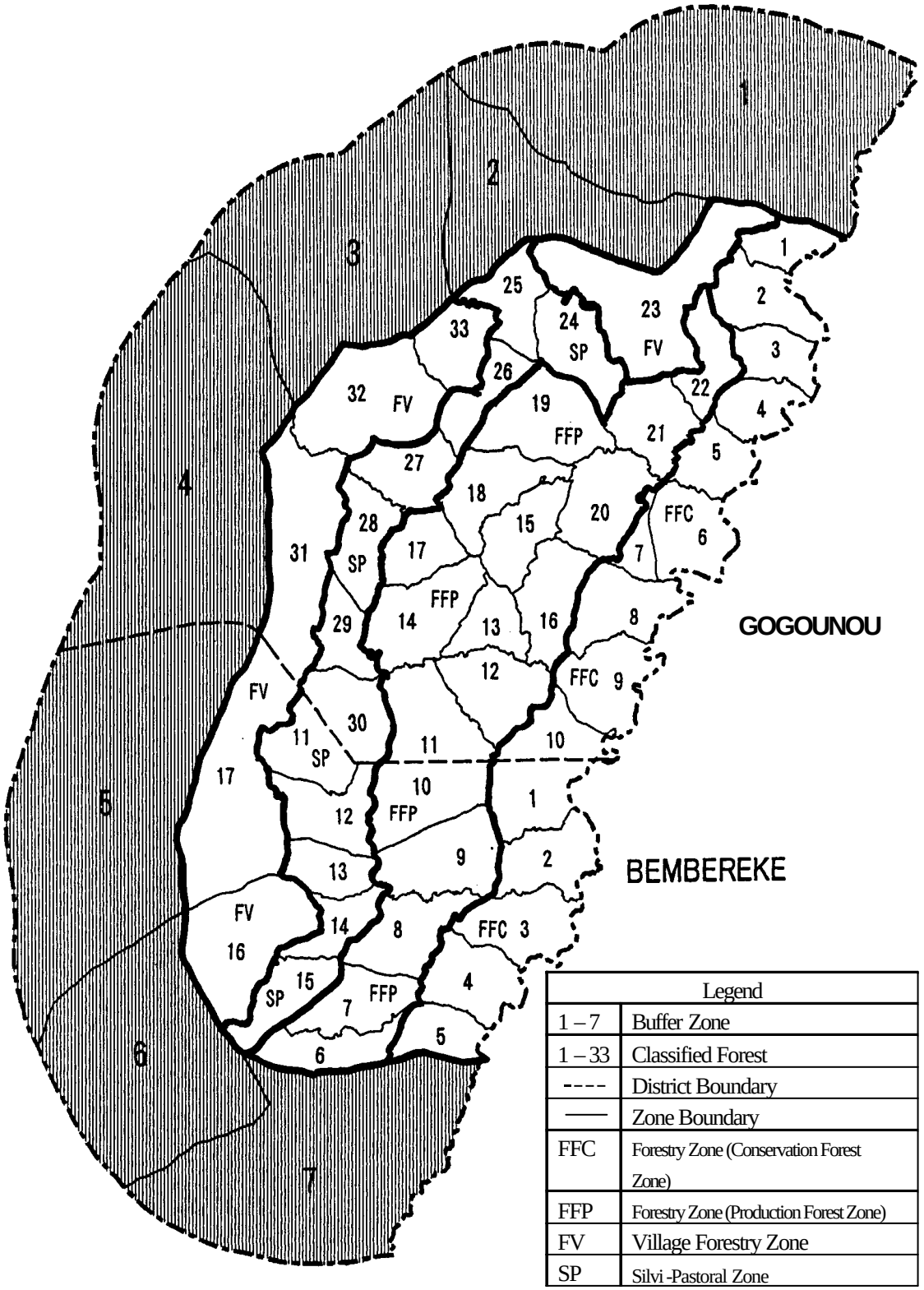
This is the area located on the boundary of the Classified Forest and the adjoining Buffer Zone in which the local inhabitants carry out farming and forestry activities. However, the following areas within the Village Forestry Zone shall be part of Conservation Forest II.

* Areas of forest within 50m either side of waterways.
* Areas of forest located on residual relief and tectonic relief.
* Areas of forest where soil conditions are bad and existing vegetation should be retained.

Area by Zone within Classified Forests

(Unit: ha)

Zoning			GOGOUNOU				BEMBEREKE			Total
			ZOUGOU-KPANTROSSI	WESSENE	PIGOUROU	Sous-total	KABANOU	MANI-BOKE	Sous-total	
Classified Forest	Forest Zone	Conservation Forest Zone	2,812	3,104	1,813	7,729	2,950	1,644	4,594	12,323
		Production Forest Zone	4,178	4,875	2,871	11,924	2,403	2,721	5,124	17,048
	Village Forestry Zone		2,709	2,772	2,311	7,792	2,893	1,912	4,805	12,597
	Silvi-Pastoral Zone		1,819	2,428	1,511	5,758	1,808	2,047	3,855	9,613
	Subtotal		11,518	13,179	8,506	33,203	10,054	8,324	18,378	51,581
Buffer Zone			13,998	6,563	9,277	29,838	9,222	12,561	21,783	51,621
Total			25,516	19,742	17,783	63,041	19,276	20,885	40,161	103,202


GOGOUNOU
BEMBEREKE
Legend
1 – 7 Buffer Zone
1 – 33 Classified Forest
---- District Boundary
—— Zone Boundary
FFC Forestry Zone (Conservation Forest Zone)
FFP Forestry Zone (Production Forest Zone)
FV Village Forestry Zone
SP Silvi -Pastoral Zone
Scale: 1/250,000

Zoning Map

③ Improvement Standards

a. Forest Zone

a) Conservation Forest Zone

(a) Conservation Forest I

* Logging and the removal of branches and leaves shall be prohibited.
* Controlled burning shall be totally prohibited.
* Grazing and the passage of livestock shall be prohibited.
* Planted, enrichment and direct planting of native species of trees shall be carried out in areas of cultivated land or fallow ground and areas of devastated forest in an endeavor to achieve rapid forest recovery.

(b) Conservation Forest II

* Controlled burning shall be totally prohibited.
* Grazing and the passage of livestock shall be prohibited.
* New planting shall be carried out in cultivated land and fallow ground in order to realize rapid forest recovery. Mixed planting shall be carried out of native species of trees.
* Enrichment shall be carried out in areas of devastated forest using native species of trees in order to help the forest to recover.
* Although thinning, improvement cutting and sanitation cutting may be carried out in order to help foster the forest, all other logging and the removal of branches and leaves shall be prohibited.
* Dense planting shall be carried out on the boundary with other zones in order to eliminate *Graminea* plants which act as fuel for forest fires.

b) Production Forest Zone

* Controlled burning shall be totally prohibited.
* Grazing and the passage of livestock shall be prohibited.
* Fuelwood forest shall be created through new planting and direct planting in cultivated land, fallow ground, Sa, Sb, and St. In addition to the planting of native species, introduced species of trees shall also be planted.
* Production forest for selective logging shall be created for timber production through planting and natural seeding in areas of natural forest outside Conservation Forest II and fuelwood production forest areas.
* Land being cultivated at the time of the implementation of the plan may continue to be cultivated until after crops have been harvested at which time the timber and fuelwood production forest shall be created.

b. Silvi-Pastoral Zone

* Grazing techniques shall be improved through formulating various grazing-related techniques, such as planned early controlled burning and the improvement of grazing capacity.
* In areas suitable for growing grass and shrubs, pasture improvement and the planting of feed trees shall be carried out.
* Man-made pasture shall be created in small areas of returned cultivated land and

fallow ground scattered throughout the zone and feed produced for the dry season.

* Areas of early controlled burning shall be determined in each improvement unit and carried out in a planned manner. The area around those areas where early controlled burning is to be carried out shall be cut back to serve as firebreaks to prevent fire from spreading to the surrounding area.
* Grazing areas for the rainy season and the dry season shall be determined and grazing carried out according to the season.
* In order to provide water for livestock during the dry season, dams shall be constructed on the Bouli River or waterways in this zone as a means of storing water. The drilling of wells within this zone shall also be planned.
* Areas of forest that should be preserved shall be treated in the same way as Conservation Forest II.
* The local inhabitants shall make payments to the Forest Improvement Fund etc. according to the number of livestock using the zone.

c. Village Forestry Zone

* The growing of cotton shall be prohibited.
* People using the land for cultivation within this zone shall be those people possessing land within the existing classified forest based on aerial photographs taken in 1998.
* Each household shall be allocated the use of 2.0 ha of land for cultivation and 2.0 ha of land for tree growing, making a total of 4 ha.
* Agroforestry (Taungya System) may be carried out in the 2.0 ha of land for tree planting.
* *Vitellaria paradoxa* and *Parkia biglobosa*, etc. shall be planted around each area of cultivated land.
* Areas of forest that should be preserved shall be handling in the same manner as Conservation Forest II.
* Areas retained as forest shall be left in their natural state.
* Paths for the passage of livestock (50 m wide) shall be established in this zone and it is handled in the same way as Conservation Forest II.
* Belts of trees shall be planted on the boundary with other zone to mark the boundary and prevent the spread of fires. The species which can be sources of nectar for beekeeping shall be used.
* The local inhabitants shall make payments to the Forest Improvement Fund according to the are a of cultivated land that they use.

④ Improvement Plan

The main points of this plan are as follows.

a. Plans for the Conservation Forest.

* The total area of Conservation Forest I is 3,307 ha.
* The total area of Conservation Forest II is 9,015 ha.
* Conservation Forest shall be restored and recovered using native species.
* Planting, supplementary planting and nurturing shall be completed in 5 years.

b. Production Forest Plans

* The total area of Production Forest is 14,480 ha. This includes 2,567 ha of Conservation Forest II spread throughout the Production Forest Zone.
* 36% of the Production Forest is used for timber production and 64% for fuelwood production.
* Fuelwood and posts are produced in the Fuelwood Forest using both native species and introduced species. Trees with a DBH 7 cm or more may be logged.

c. Silvi-Pastoral Zone Plans

* The target area for this plan is 8,083 ha. This includes 1,531 ha of Conservation Forest II spread throughout the Silvi-Pastoral Zone Plans.
* The creation of man-made pasture, the improvement of pasture, and the planting of feed trees shall be carried out to increase grazing capacity.
* Water holes for livestock shall be created.
* Grazing methods shall be rationalized.
* Modernization of livestock raising shall be carried out through the improvement of breeding methods, rearing management, and farm management.

d. Village Forestry Zone Plans

* The total area of the Village Forestry Zone is 11,300 ha. This includes 1,298 ha of Conservation Forest II spread throughout the Village Forestry Zone.
* Areas for cultivation and tree planting shall be created according to certain land preparation plans.
* The target area for land preparation shall be 5,443 ha.
* 50 m wide areas for the passage of livestock shall be established with a total length of 48,000 m.
* The selection of crops, crop growing rotation, cultivating methods, the maintenance and improvement of soil quality, protection from disease and pests, etc., as well as the improvement of the distribution system for agricultural products shall all be carried out for areas of cultivated land.
* Social forestry shall be promoted in areas of land for tree planting.

e. Improvement of Forest Roads

Forest roads necessary for the management of classified forests shall be divided into 3 types: Access Roads, Major Forest Roads, and Work Roads.

* The length of the access road is 9,000 m.
* The length of major forest roads is 19,500 m.
* The length of work roads is 35,200 m.

f. Other Necessary Infrastructure

Infrastructure shall be improved for the management of classified forest.

* Nurseries shall be established and managed by the settlement in each improvement unit.
* Necessary facilities shall be established as a part of forest fire prevention measures.
* A Forest Improvement Center shall be established in each improvement unit.

4) Plans for the Management of the Buffer Zone

A minimum management plan for the buffer zone shall be formulated in accordance with the management plan for the classified forest.

5) General Infrastructure Improvement Plan

It is considered that the promotion of a stable and improved lifestyle through the improvement of infrastructure will indirectly contribute to the improvement of the classified forests. Therefore, infrastructure shall be divided into two categories - facilities for livestock and facilities for the local society - and necessary improvements shall be made.

6) Plans for Management, Administration and Maintenance

① Improvement Unit

Three improvement units in Gogounou District and two improvement units in Bembereke District shall be established.

② Organizations of Local Inhabitants

* Forest Management Communication Council
* Forest Management Council
* Forest Improvement Unit Committee
* Zone Group

③ Forest Improvement Fund

* Payment from the income of timber production using production forest.
* Payment from the income of timber production (rearing of trees, etc.) using conservation forest areas.
* Payment from the income of timber production using the Village Forestry Zone and Silvi-pastoral Zone.
* Payment from beneficiaries including the following industries.

  Cultivation, fuelwood production, charcoal production, post production, and fruit growing within Village Forestry Zone.
  Grazing within Silvi-pastoral Zone.
  Hunting and fishing.
  Beekeeping.
  Payment from beneficiaries of Forest Improvement Fund/training.

7) Work Operation Plans

① Plan Prerequisites

* This forest improvement project shall be carried out with the involvement of the local inhabitants.
* The DFRN and the local inhabitants shall implement this plan together.
* An order of priority shall be given to each operation so that it can be carried out in the correct order.
* The period of this plan shall be 10 years.

② Classified Forest Improvement Work

* 1st/2nd Year: Preparation and establishment of areas within the Village Forestry Zone, creation of nurseries and subsequent production.
* 3rd Year: Commencement of commercial farming in the Village Forestry Zone, commencement of land preparation in the Silvi-pastoral Zone, commencement of timber production and tree planting in the boundary area of the classified forest.
* 4th Year: Enrichment of conservation forest preservation zones.
* 5th Year: Commencement of planned operations.

③ Outline of Operating Costs

* Initial Investment: Establishment of classified forest boundaries, establishment of areas within the Village Forestry Zone, timber production, etc.
* Operational Costs: Improvement, timber production, and tree planting, etc.
* Management and administration costs.
* Income from timber sales.
* Forest improvement Fund.

8) Forest Improvement Fund and Training

Forest Improvement Fund and training shall be carried out with regard to nursery operation, beekeeping, charcoal production, commercial farming and the improvement of livestock farming.

* There are two basic forms of Forest Improvement Fund and training.
* Forest Improvement Fund and training in each field.

1. Outline of the Study

1.1 Background of the Study

In Benin, a remarkable decrease in forest, the main causes of which are said to be felling, expansion of agricultural land, burning, overgrazing, trampling by livestock, bush fire to flash out wild animals, etc., all carried out under the pressure of an increasing population, is conspicuous in recent years.

To deal with this situation, the government of Benin enacted the Forest Law in 1993, which prescribes a forest improvement system and its contents in connection with the utilization and improvement of classified forests. Subsequently, the government adopted a forest policy in 1994 the main pillars of which are forest resources management through promotion of people's participation, the rational management of forest resources, forest resources conservation, protection of ecosystem and strengthening of management organizations.

In order to implement this policy, a Natural Resources Management Project (PGRN) with the assistance of the World Bank is being implemented in Toui Kilibo classified forest with satisfactory results for preparing and implementing forest improvement plans through people's participation. However, there is a shortage of the necessary aerial photographs, topographical maps, information on the contents of forest resources, other types of information on forest resources, other basic data, budget and personnel, etc., which hinders the implementation of the said policy in other classified forests.

With the above mentioned background, the Government of Benin requested the assistance of the Government of Japan for the implementation of a development study in relation to formulation of forest management plan for three classified forests, including Trois-Rivieres. In response to this request, the Government of Japan sent the Preparatory Study Team (S/W discussion) to Benin. This study had been implemented based on the Scope of Work (S/W) signed between the Preparatory Study Team and the Government of Benin in November of 1997.

1.2 Objectives of the Study

The main objectives of the present Study are: (1) to provide basic information on the forests and to formulate a forest management plan through people's participation in the three classified forests in the Northern Area of Benin in order to prevent the progress of savannah in the Area, (2) to transfer relevant technologies to the counterpart personnel through the study.

1.3 Study Area

The Study Area consists of three classified forests in the northern part of Benin such as Trois Rivieres classified forest, Ouenou Benou classified forest and Alibori Superieur classified forest, totaling some 550,000 ha, and their surrounding area 7km wide Buffer Zone.

Within the Study Area an Intensive Study Area had been established covering a part of the western side of Trois Rivieres classified forest (to the west of Bouli river), which is some 46,000 ha, and the surrounding Buffer Zone. A forest management plan was formulated for the Intensive Study Area.

Location of the Study Area is shown in Fig. 1-3-1.

1.4 Implementation of the Study

The following surveys were conducted in the Study Area and in the Intensive Study Area.

(1) The Study Area

① Natural conditions survey and socio-economic conditions survey
② Aerial photography (scale 1/20,000)
③ Land use and vegetation survey and preparation of land use and vegetation maps (scale 1/50,000)

④ Survey to understand actual condition of the local inhabitants
⑤ Environmental assessment survey

(2) The Intensive Study Area

① Preparation of topographical maps (scale 1/50,000)
② Natural conditions survey and socio-economic conditions survey
③ Forest survey and soil survey
④ Survey to understand actual condition of the local inhabitants
⑤ Workshop with villagers
⑥ Establishment of the boundaries of classified forests
⑦ Preparation of forest management plan
⑧ Preparation of thematic maps (forest type maps, soil maps, forest management plan maps: scale 1/20,000)

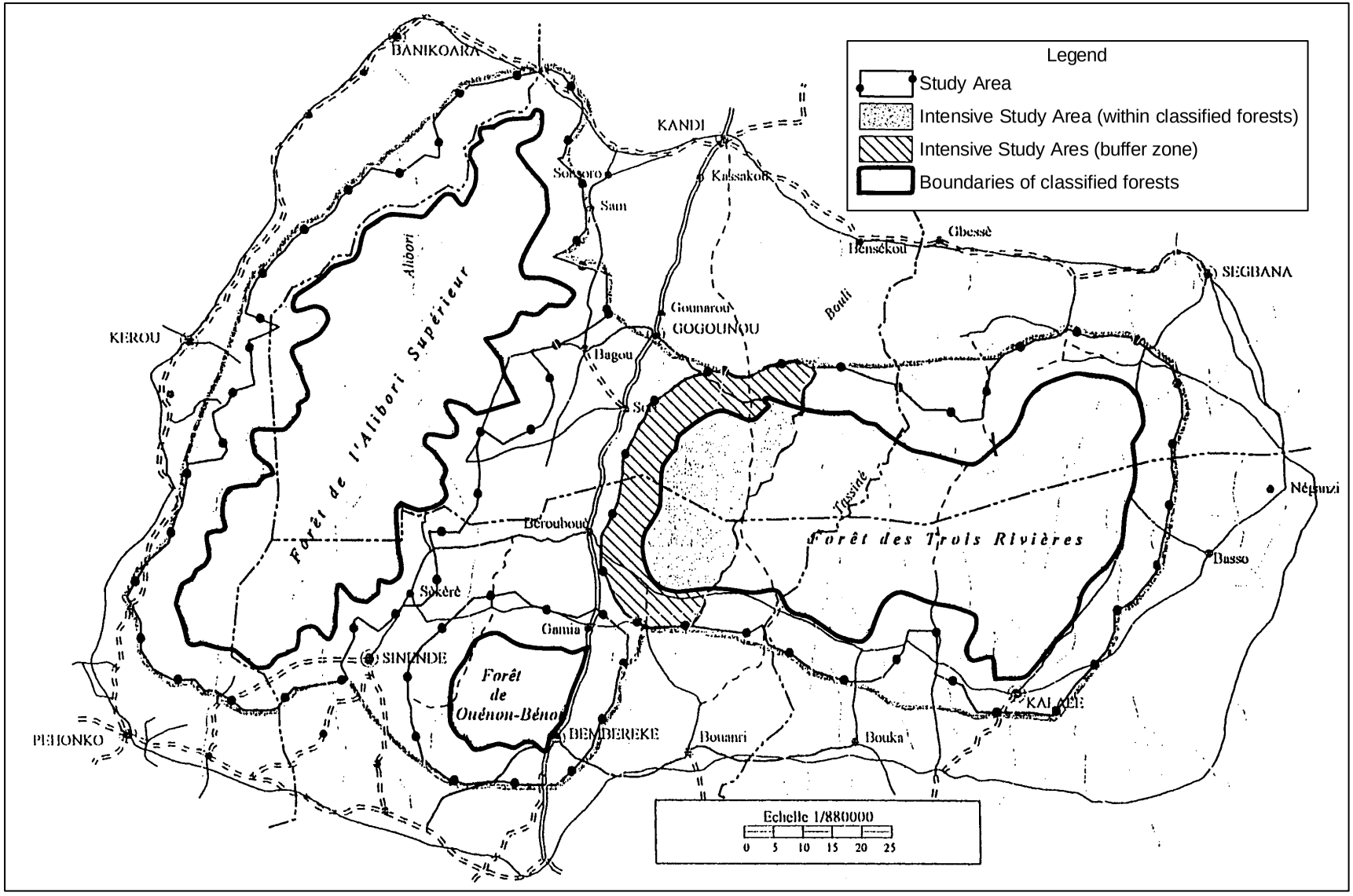


Fig. 1-3-1 Study Areas

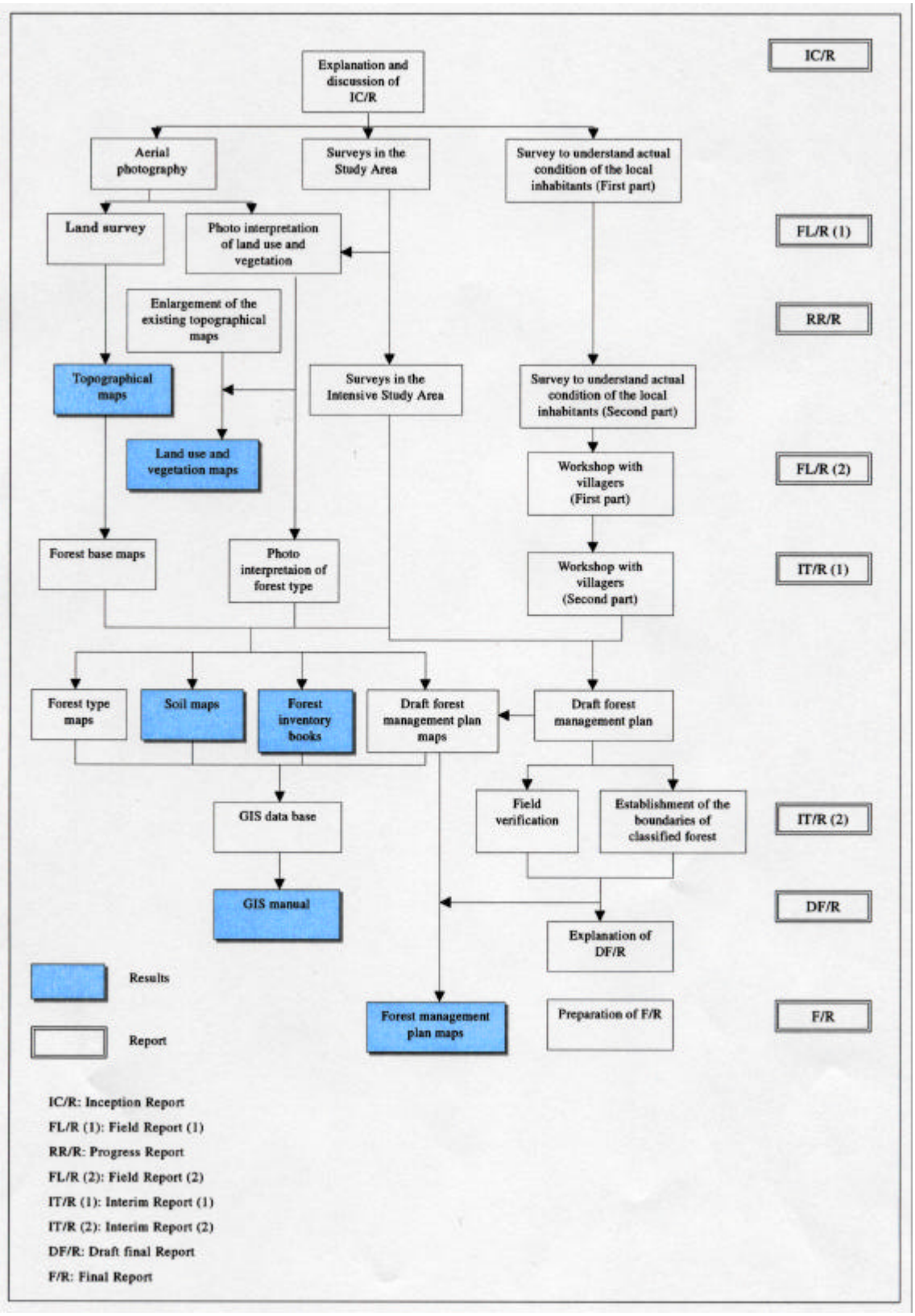


Figure 1-4-1 Flow Chart of Study

2. Survey in the Study Area

2.1 General Conditions

2.1.1 Natural Conditions

(1) Location

The Study Area is located between 10°7'55" and 11°14'50'' north latitude in the northern part of Benin. Administratively, most of the Study Area is situated in Gogounou, Segbana, Kalale, Bembereke and Sinende Districts (Kandi District and Banikoa District are part of the Buffer Zone) of the northern Borgou Province. A part of the western side of the Area is under the jurisdiction of Kerou and Pehonko Districts of Atakora Province. The Study Area is spread 123 km in South East direction and 169 km in east west direction.

(2) Weather

According to the data collected from the meteorological observation stations located in the surrounding areas of the Study Area and in Parakou (some 90 km to the south of the Study Area), the Study Area's average annual temperature is 27-28℃ and its annual rainfall is around 1,000 mm.

Average temperature of Kandi, which is located to the north of the Study Area, is 28.1℃. The same area's average minimum temperature for the month of January is 17.2℃ and average maximum temperature for the month of April is 38.7℃.

There are large variations in the annual amount of rainfall in the Study Area, but average annual rainfalls of Kandi, Segbana, Kerou and Kalale are 949 mm, 1,037 mm, 1,085 mm and 1,037 mm respectively.

According to Walter's climatic diagram (refer to Appendix 1 and 2) the dry season in Kandi is some two months longer than Parakou.

Table 2-1-1 Monthly Temperature and Rainfall

(Temperature)

Observation station	Month / Item	1	2	3	4	5	6	7	8	9	10	11	12	Average	Observation years
Kandi N11°08' Altitude 290 m	Average temperature (°C)	25.2	27.9	31.5	32.4	30.6	28.5	26.6	26.2	26.7	28.4	27.3	25.6	28.1	1988-1997
	Average maximum temperature(°C)	33.2	35.7	38.6	38.7	36.2	33.5	30.9	30.3	31.4	34.5	35.6	33.9	34.4	1988-1997
	Average minimum temperature(°C)	17.2	20.0	24.4	26.2	25.0	23.5	22.4	22.2	22.0	22.2	19.0	17.2	21.8	1988-1997
Parakou N9°21' Altitude 392 m	Average temperature (°C)	26.6	28.6	30.0	29.4	27.8	26.3	25.3	25.0	25.4	26.5	27.4	26.8	27.1	1988-1990 1992-1997
	Average maximum temperature(°C)	33.9	35.8	36.5	35.2	32.9	30.7	29.0	28.6	29.7	31.7	34.0	34.0	32.7	1988-1990 1992-1997
	Average minimum temperature(°C)	19.4	21.4	23.5	23.5	22.6	21.9	21.5	21.3	21.1	21.4	20.7	19.7	21.5	1988-1990 1992-1997

(Rainfall)

Observation station	Item \ Month	1	2	3	4	5	6	7	8	9	10	11	12	Total	Observation years
Kandi N11°08' H 290m	Rainfall (mm)	0.0	11.0	30.4	51.4	110.5	137.9	186.2	236.6	143.2	34.1	0.4	7.6	949.4	1988-1997
	Number of rainy days (days)	0	0	1	3	8	10	13	16	13	3	0	0	67	1961-1990
Segbana	Rainfall (mm)	0.5	0.5	6.4	44.4	101.2	137.0	181.0	307.7	210.6	42.5	5.4	0.1	1037.3	1969-1990
	Number of rainy days (days)	0	0	1	2	6	9	11	11	11	4	0	0	55	1977-1990
Kérou N10°50' H 314m	Rainfall (mm)	1.7	4.6	13.7	35.8	138.5	141.7	238.6	256.9	198.0	49.3	3.3	2.7	1084.8	1961-1990
	Number of rainy days (days)	0	0	2	5	8	11	16	19	15	5	2	0	83	1960-1974 1979-1982
Kalalé N10°18' H 410m	Rainfall (mm)	0.0	17.4	27.5	57.6	125.4	158.9	210.2	225.1	241.1	57.6	29.5	10.2	1160.5	1988,
	Number of rainy days (days)	0	0	2	4	7	10	12	14	14	6	0	0	69	1990-1997 1961-1990
Parakou N9°21' H 392m	Rainfall (mm)	11.7	2.4	37.8	91.2	117.4	153.7	246.1	257.3	239.2	89.9	11.8	5.6	1264.1	1988-1990
	Number of rainy days (days)	0	1	3	5	9	11	12	13	15	7	1	1	78	1992-1997 1961-1990

(Note) Only a day with a rainfall of more than 1 mm is counted as a rainy day.

(3) Topography, Geology and Soil

The Study Area is located in the upstream of Sota River and Alibori River, both of which are the tributaries of Niger River. Generally, its topography ranges from flat to gently sloping to undulating and is weakly dissected. Some semi plains which are thought to be old are found in the Area, while here and there isolated remnants of hills forming such topographical features as small plateaus or inselberg of laterite can be observed.

Elevation above the sea level ranges from 240 m to 400 m in Trois-Rivieres classified forest, from 220 m to 370 m in Alibori Superieur classified forest and from 330 m to 490 m in Ouenou Benou classified forest.

Granite and gneiss are the main rock types in the area. In a part of Trois-Rivieres classified forest sandstone and residual sediments are found, while in a part of Alibori Superieur classified forest leptinite (granular and banded metamorphic rock) can be observed. Gneiss to the west of National Road No. 2 contains magnesium.

Soils of the Study Area are mainly composed of ferruginous tropical soils. Parent materials of these soils in Trois-Rivieres classified forest consist of gneiss, granite-gneiss and sandstone, in Alibori Superieur classified forest of gneiss and in Ouenou Benou classified forest of gneiss and granite-gneiss. Shallow soils on the base rocks such as Leptosols or Gleysols are partially distributed in the area, while Leptosols are relatively widely distributed in north-south direction in Ouenou Benou classified forest.

(4) Drainage System

Sota River and Alibori River, which are the tributaries of Niger River, are flowing in the Study Area. Sota River flows in the eastern part of Trois Rivieres classified forest and Tassine River and Bouli River, which join Soli River, flow in its central and western parts. Alibori River, which joins Souedarou River which flows from Ouenou Benou classified forest, runs through Alibori Superieur classified forest. The slope along the banks of these rivers is mostly steep.

(5) Vegetation

Main forest vegetation in the Study Area consists of bush savannah, tree savannah and mix of the two savannahs as well as riparian (gallery) forest along rivers. In some parts of the Study Area there are *Tectona grandis* plantations, orchards of mango and cashew, etc., farm lands and fallow lands. Representative plant species of savannah are *Detarium microcarpum*, *Isoberlinia spp.*, *Vitellaria paradoxa*, *Parkia biglobosa*, *Combretum spp.*, etc. Plant species of riparian forest consists of

Daniellia oliveri, Anogeissus leiocarpus, Khaya senegalensis, Diospyros mespiliformis, Vitex doniana, etc.

2.1.2 Socio-economic Conditions

Socio-economic survey summarizes statistical data from five districts related to the Study Area such as Bembereke, Gogounou, Kalale and Segbana Districts.

(1) Population

Total population of the five districts is 245,699 persons, 123,707 of which is male and 121,992 of which is female. There are a total of 25,962 households and per household members are 9.5 persons. (refer to Appendix 3 for information on population by district)

Basically, inhabitants of the Study Area are composed of Baa-tonu and Fulbe tribes. Baa-tonu tribe had moved to the area from northern Nigeria and are currently settled in an area which borders to the north on Kandi, to the west on Kouande and to the south on Parakou. It can be said that the Study Area is situated exactly in the socio-cultural domain of Baa-tonu tribe.

Fulbe are a nomadic people who migrated from Niger. They have been living all over Borgou Province and peacefully coexist with the native population.

(2) Industry

Primary industries form the core of economic activity in the Study Area. The ratio of working population engaged in such sectors of primary industries as agriculture (including livestock raising sector), hunting and fisheries is some 71.5%. According to the annual reports published by the Agriculture Department of Borgou Province (CARDER), some 58% of cattle population and some 38% of sheep and goat population of the country are concentrated in Borgou Province. Considering the fact that the ratio of population of Fulbe tribe, who are engauged for their livings mainly in stock raising, is high in the Study Area, it can be safely assumed that the main economic activity in the Study Area is based on agriculture and livestock raising. (refer to Appendix 4 for working population ratio by district)

(3) Land Ownership System

Land use system in Benin consists of the land use regulated by modern laws and regulations and the customary land use.

The law concerning the use of land is "Law No. 65-25 pertaining to Land Management Regime and Land Right (Loi No. 65-25 portant organisation du Regime de la propriete fonciere au Dahomey)" which had been enacted in 1965. This law recognizes private ownership of land, introduces a land registration system, defines the land ownership and protects various rights of the owners of registered lands. However, Article 5 of the law states that "Land registration shall be voluntary except in the case of transfer and sale of state land (national land) or when, for the first time, a customary real estate is the target of some sort of documented contract". The law recognizes the existence of customary land ownership.

The following four forms of land ownership were found to exist in the Study Area.

- Classified forest (State land the development of which is regulated. Dwelling and cultivation in this land are prohibited by law but in reality there exist small hamlets and cultivated lands).
- State forest outside classified forest (it is known as free zone where in principle if protected plant species are not removed developmental activities are allowed).
- Village communal lands
- Private land, including cultivated land

The relationship between the existing condition of land ownership/use, ownership by law and customary ownership is shown in Table 2-1-2.

Table 2-1-2 Existing Condition of Land Ownership/Use, Ownership by Law and Customary Ownership

Category	Existing Condition	Ownership Right by Law	Customary Ownership Right
Classified Forest	State owned land	State owned	None
	Village communal land	State owned	Communal*
	Private land	State owned	Communal but used by private persons*
Outside Classified Forest	State owned land	State owned	None
	Village communal land	Village owned	Communal
	Private land	State owned	Communal but used by private persons
	Registered land	Owned privately or by corporations	Owned privately or by corporations

Note: * The land which under customary ownership right is considered as being (communally owned), (private occupancy use) is actually considered by local inhabitants as state owned land.

Problems of current land ownership system are two as described below.

Problem 1

There is a gap between the concept of ownership right and occupancy use right as considered customarily and as defined by laws and regulations. Local inhabitants fully understand that classified forests are state owned and that dwelling and cultivation are illegal in these forests. As the inhabitants regard lands outside classified forests as village communal lands or "lands that do not belong to anyone", customarily, they believe that "the person who first brings the land under cultivation possess the occupancy use right of that particular land". Since the occupancy use right can be inherited, it is very close to "ownership right". However, according to the laws and regulations, ownership rights of these lands belong to the state and the right local inhabitants obtain by first bringing the land under cultivation or actually cultivating it is "use right" only. It is at this point that the confrontation between "customary ownership right or occupancy use rights" and "ownership rights by law and regulations" may occur. Actually, the land outside classified forest is state land is also called "free zone", where the forest land can be developed if only the protected plant species are not felled.

Problem 2

Land ownership boundaries are unclear. In the case of officially designated classified forests such objects as roads and rivers form the boundaries, but since there are no markings along these boundaries in the field, the boundaries are unclear.

(4) Villager's Organizations

As part of a concrete policy concerning participatory approach, people should be organized if they are to participate positively.

On the initiative of the Agriculture Department of Borgou Province, a Villagers Consultation Committee (Comite de Cnoceltation) had been established in each village. The committee consists of various organizations of the villagers and the village chief, and plays an important role in enabling the inhabitants themselves to grasp their problems and needs clearly and to propose solutions to these problems. In the Study Area, such committees had been established in only 45 villages out of 145 villages of five districts that make the Study Area. In the Intensive Study

Area, out of 8 villages the committees had been organized in the three villages of Beroubouay-est, Wessene and Zougou-kpantrossi.

The existing villager's organizations in the Study Area are such traditional organizations as traditional religious organizations, youth societies, women's associations, elderly person's groups, hunters groups as well as such modern organizations as villager's group (GV), women's group (GF), agriculture producers association at the district level (USPP) and drinking water facilities management committees.

(5) Living Infrastructure

① Condition of Roads

Quenon-Benou and Alibori Superieur classified forests are located to the west and Trois-Rivierer classified forest to the east of National Road No.2 (RNIE: Route Nationale Inter-Etat), which almost runs through Benin and extends up to Niger. This is the only asphalted road in the area. Access roads to each village in the Study Area and roads for the transport of raw cotton, which are in poor condition and usable by vehicles only during the dry season, are branched out from the national road.

② Water Source

Pumps, improved wells and unimproved wells are the water supply sources for the four districts (data for Gogounou District are unavailable). Regular tap-water is available only within 13 km of Bembereke District and within 8 km of Segbana District. (Refer to Appendix 5 for the water supply sources)

③ Electricity and Telephone

Electricity and telephone cervices are available in some parts of Bembereke District and Segbana District. In other areas these services are unavailable.

④ Public Facilities

Public facilities in the five districts consist of primary schools, middle schools, district health centers and cultural facilities (youth homes, readers centers, etc.). Communal health clinics exist in four districts (except Gogounou District) and drug stores in four districts (except Segbana District). A hospital exists in Bembereke District. (Refer to Appendix 6 for the number of public facilities by district)

Regarding education, at the national (country) level school attendance rate for primary education is 19.9% and for midlevel education is 6.5%, which is quite low. Some 71.5% of Benin's citizens are without a school education and the literacy rate stands at 25%. Illiteracy rate among women is some 80.8% and among men is some 61.3%.

The above mentioned health centers (CSSP: Centre de Sante de Sous-Prefecture) and communal health clinics (CCS: Complexe Communal de Sante) are public facilities, but due to poor financial conditions are either vacant and neglected or the staff are hired by the local inhabitants themselves.

2.1.3 Agriculture and Livestock Raising

(1) Classification of Agricultural Areas

Based on the natural environment (soil, weather condition) and farming (tribes, main form of livestock farming, management organization) the agricultural area of Borgou Province is classified into the following three areas and the characteristics of each area are described below.

① Extreme Northern Areas (two districts of Karimama and Malanville)

These areas are located to the north of the Study Area and have an annual rainfall of less than 900

mm which is not enough for cultivation of multiple crops. Main crops grown in these areas are corn, millet and sorghum, and the area cultivated with these crops is 70-80% of the area under cultivation in the extreme northern areas. Peanuts and raw cotton are the two cash crops grown in the area, and since cotton is grown using rain water it is greatly affected by weather condition. Double cropping such as planting grains in the rainy season when fields are inundated and cultivating vegetables in the dry season is practiced.

② Northern Areas (four districts of Segbana, Kandi, Banikora and Gogounou)

In the three districts of Segbana, Kandi, and Gogounou, located in the Study Area, annual rainfall is some 1,000 mm which makes the cultivation of various crops possible. In the surrounding areas of settlements tobacco and vegetables are grown. Main crops grown in the area are raw cotton, yam, corn and sorghum, and because compensation is provided by the government in connection with the sale price of cotton, most of the cultivable area are cultivated with raw cotton.

③ Southern Areas (Eight districts of Kalale, Bembereka, Sinende, Nikki, N'dali, Perere, Parakou and Tchaourou)

In Kalale, Bembereke and Sinende Districts, located in the Study Area, the production volume of corn is high, and corn, raw cotton and yam are cultivated as the main rotation crops. Planting ratio of the main crops is: corn 25%-50%, cotton 10%-40%, yam 11%-26% and sorghum 4%-15%.

(2) Agriculture Production

① Production Volume of Main Crops

Average production volume, unit yield (crop yield volume per hectare) and planted area of main crops from 1992-1996 are shown in Table 2-1-3. Yam as the main food crop is produced in high volumes and the highest cultivation area is occupied by the cash crop cotton. Such main food crops as corn, sorghum, yam and cassava are produced in all districts while millet is cultivated in the southern part of the Study Area in Bembereke and Kalale Districts.

Table 2-1-3 Production Volume of Main Crops (Average of 1992-1996)

District		Bembéréké	Gogounou	Kalalé	Kandi	Segbana	Sinendé
Cotton	Cultivated area (ha)	8,764	8,605	9,206	11,652	8,147	8,378
	Unit/Yeild (kg/ha)	4,047	1,541	1,359	1,379	1,012	1,483
	Production volume (kg)	15,870	13,287	12,983	16,113	8,392	12,400
Corn	Cultivated area (ha)	8,457	5,288	10,215	10,020	5,382	6,166
	Unit/Yeild (kg/ha)	1,229	1,080	1,143	1,235	1,063	1,391
	Production volume (kg)	10,210	5,973	11,954	12,571	5,787	8,583
Millet	Cultivated area (ha)	0	113	0	2,165	1,134	538
	Unit/Yeild (kg/ha)	0	685	0	686	610	610
	Production volume (kg)	0	78	0	1,819	806	435
Sorghum	Cultivated area (ha)	4,303	2,100	7,993	7,259	4,210	4,012
	Unit/Yeild (kg/ha)	922	538	838	643	671	962
	Production volume (kg)	4,058	1,452	6,499	5,895	3,894	3,697
Yam	Cultivated area (ha)	4,525	1,397	7,003	609	1,579	5,423
	Unit/Yeild (kg/ha)	9,970	4,272	10,835	8,294	9,991	12,609
	Production volume (kg)	44,646	9,379	74,516	4,754	15,226	67,765
Cassava	Cultivated area (ha)	1,166	378	373	402	182	867
	Unit/Yeild (kg/ha)	7,894	5,346	6,398	5,551	6,964	8,502
	Production volume (kg)	9,335	2,014	2,929	2,257	1,320	7,993
Sweet potato	Cultivated area (ha)	98	71	0	44	22	41
	Unit/Yeild (kg/ha)	3,451	3,558	0	1,742	1,565	3,994
	Production volume (kg)	340	300	0	124	87	166
Peanut	Cultivated area (ha)	801	772	1,443	5,518	940	773
	Unit/Yeild (kg/ha)	970	775	805	1,113	1,042	675
	Production volume (kg)	744	598	960	6,312	984	536
Cowpea	Cultivated area (ha)	768	773	1,292	2,486	516	1,071
	Unit/Yeild (kg/ha)	611	767	514	801	550	683
	Production volume (kg)	485	572	658	2,004	283	764
Tomato	Cultivated area (ha)	82	32	79	422	29	108
	Unit/Yeild (kg/ha)	3,500	2,154	2,843	3,217	3,335	7,646
	Production volume (kg)	361	85	283	1,714	113	853
Red pepper	Cultivated area (ha)	80	209	199	447	84	174
	Unit/Yeild (kg/ha)	888	820	1,250	473	730	980
	Production volume (kg)	74	146	312	245	78	192
Okra	Cultivated area (ha)	362	134	247	429	165	130
	Unit/Yeild (kg/ha)	2,208	905	2,509	1,437	2,382	3,469
	Production volume (kg)	907	144	778	782	409	535

Source : Rapport Annuel CARDER-Borgou (1997)

② Planting System

Historically the province of Borgou is an important base for food production in Benin. Cultivation system in the province is based on the cultivation of main crops which is influenced by the amount of rainfall, soil condition and the desire of farmers to grow certain crops. Mixed planting and inter planting of crops are not practiced in the province. Currently cotton as a promising cash crop is popular with the farmers and is incorporated in crop rotation. Until recently at the end of rotation the land was left fallow for a period of 5 to 10 years but currently the fallow period is shortened to between 2 and 3 years.

③ Supply of Materials Needed for Agricultural Production

(a) Fertilizer

Currently chemical fertilizer is supplied/sold by the Agriculture Promotion Public Corporation (SONAPRA) for cotton cultivation but because of its high price chemical fertilizer is not applied to other crops. Although application of chemical fertilizer increases yield in a short time, in the long term it results in reduced soil permeability, reduced water conservation capacity of soil and a reduction in the ability of soil to preserve fertility, and ultimately in a reduced land production capacity.

(b) Animal Power and Agriculture Machinery

Farming using animal power was introduced to Borgou Province under the government's guidance in the 1960s. The practice is currently widely applied in cotton cultivation and lending and borrowing of animals are common among the farmers. In comparison to human power, animal power used in farming increases the effective depth of soil, thus facilitating a better root growth, increases soil porosity rate, crop productivity and reduces manpower (energy) use in agricultural operations.

(3) Livestock Industry

① Number of Breeding Livestock

Livestock raising is widely practiced in Borgou Province. Some 58% of cattle and 38% of sheep/goat of the country are raised in this province. Type of livestock raised and livestock number in Bembereke and Kalale Districts of the Study Area are shown in Table 2-1-4.

Table 2-1-4 Number of Main Livestock

(Unit: head)

Kind of livestock/District	Bembereke	Kalale
Cattle	59,963	83,445
Sheep	19,877	34,698
Goat	12,953	24,698
Pork	0	44
Total	92,793	142,885

Source: Rapport annuel Carder-Borgou

② Types of Livestock Raising

The following two types of livestock raisings are practiced in Borgou Province.

(a) Agriculture and livestock raising type where livestock raising is the main occupation

This type is typical to Fulbe tribe. A large number of these people grow crops for self consumption and are actually engaged in half-stock farming and half-agriculture.

During the dry season, when water and fodder are in short supply, they take the custody of livestock belonging to Baa-tonu and other tribes and conduct shifting (mobile)-grazing. Forest destruction due to burning to insure the supply of fodder for the livestock under shifting (mobile)-grazing is continuing in the area.

(b) Agriculture and livestock raising where agriculture is the main occupation

People of Baa-tonu tribe were traditionally engaged in agriculture and were not accustomed to raising livestock. They started raising cattle after extension activities were conducted to introduce animal power for cultivation. During the dry season they entrust their cattle to Fulbe tribe for mobile-grazing.

(4) Sources of Livestock Fodder

During the rainy season fodder for cattle is provided from grasses grown in grazing lands. When stall-feeding is practiced during the dry season, runners of peanuts plants, leaves, runners of cowpea plants, etc. are feed to the livestock, and when mobile-grazing is conducted in the same season tree leaves and small branches are given to the livestock. Moreover, the newly emerging grasses and new sprouts, which appear as the result of burning, are feed to the livestock and this is one of the causes of forest degradation in the area.

(5) Distribution and Processing of Agricultural Products

① Distribution of Agricultural Products

Distribution of agricultural products in the area can be divided into the following two types.

Type 1

Monopoly distribution under which the government publicly decides the prices of such specific crops as cotton, peanuts, oil palm, *Vitellaria paradoxa* and pineapple, and public corporations and private industries buy these crops. In the Study Area, the Agriculture Promotion Corporation (SONAPRA) and private industries buy cotton. Due to the improved distribution route, a stable buying price, etc., farmers highly desire cotton cultivation.

Type 2

Market of a fixed duration. The market is opened every 4th day once a week during which time the surplus grains of farmers are traded. According to the data from the 1992 national census, a total of 27 fixed duration markets are registered in the Study Area. Since transaction prices in fixed duration markets are decided by a balance between demand and supply and are unstable, those farmers who do not posses storage facilities for their products are put in a disadvantageous position.

② Processing of Agricultural Products

Population of the secondary industry in Borgou Province is 4%. Agricultural products processing facilities are as follows.

Cotton processing factories	6 factories
Cashew nuts processing factory	1 factory
Agricultural equipment cooperatives for the production of agricultural equipment carried by cattle/agricultural products processing equipment (COBEMAC)	
Beer factory	1 factory (SO.BE.BRA)
General textile factory	1 factory (COTEB)
Seed sorting and processing factory	1 factory (UTSS)

Other facilities are flourmills in each village where milling of various types of grains are conducted. Also women from farming families are processing yam, sorghum, corn, peanuts and cowpea for self consumption or for sale.

③ Prices of Agricultural Products

The prices of agricultural products in Borgou Province is high in comparison to the prices of similar products in the surrounding areas such as Parakou, which is a consumption area, and the border town of Malamville. Table 2-1-5 shows data, collected through interview surveys, for market prices of agricultural products.

Table 2-1-5 Basic Prices of Crops

(Unit: FCFA/kg)

Crop type	Prix	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average price
Corn	Highest price	115	100	125	150	150	150	150	175	125	100	120	125	132
	Highest stable price	100	100	110	135	150	150	150	175	115	75	120	125	125
	Average	108	100	118	143	150	150	150	175	120	88	120	125	129
Sorghum	Highest price	160	160	200	200	200	225	275	270	270	250	200	200	218
	Highest stable price	150	150	195	200	150	200	225	265	270	250	175	200	203
	Average	155	155	198	200	175	213	250	268	270	250	188	200	211
Rice	Highest price	300	325	350	350	350	350	350	350	350	300	300	300	331
	Highest stable price	250	300	300	300	300	325	300	300	300	225	200	175	273
	Average	275	313	325	325	325	338	325	325	325	263	250	238	302
Yam	Highest price	90	125	150	150	160	175	-	130	130	120	110	100	131
	Highest stable price	90	125	150	150	150	150	-	115	125	115	105	95	125
	Average	90	125	150	150	155	163	-	123	128	118	108	98	128

Source: Investigation auprès du CARDER Borgou

④ Distribution of Livestock Products

(a) Livestock (live animals, meat, skin)

Distribution of livestock at the village level is conducted by Fulbe tribe. Live animals from various villages are brought to the fixed duration markets in Gogounou and Petit Paris in the Intensive Study Area for selling. Livestock meat for consumption from the market and the village slaughterhouses has to undergo examinations by veterinarians.

Livestock brokers buy and ship livestock to outside the districts (Parakou and Cotonou). The brokers have to obtain a certificate of vaccination for the livestock that are being shipped from the district branch office of the Agriculture Bureau for a fee of 100 FCFA per animal, regardless of the type of animal, and have to carry this certificate at all times.

(b) Dairy Products

Milk and cheese are important sources of cash income for Fulbe people. Fulbe women sell these products in the village or in the market daily.

(6) Support Services for Agriculture

The Agriculture Promotion Corporation (SONAPRA) and such agricultural financial institutions as Agriculture Credit Coffers (CLCAM) and the smaller Savings and Loans Coffer (CVEC) are the organizations which extend direct assistance to the farmers. Both CLCAM and CVEC are mutual support financial organizations with deposits from the affiliated persons as their original capital, and extend short term (one year) financial support mainly to the farmers. In organizational terms, above CLCAM and CVEC at the provincial level there exist Regional Agricultural Credit Coffers Union (URCLCAM) and at the country level Agricultural Savings and Loans Coffers League (FECECAM).

Currently the following two types of agricultural support services are available in the area.

① Material Credit (Credit en Nature)

Under this system, first material support is extended to farmers and later SONAPRA deduces the

price of the material from the agricultural products it buys from farmers. Agriculture Promotion Corporation (SONAPRA) provides chemical fertilizer, pesticide, etc. to the farmers during cotton cultivation and deduces the prices of these materials when it buys cotton from cotton growing farmers. Also CLCAM provides agricultural equipments to the farmers the prices of which are later paid to CLCAM by the farmers.

② Cash Credit (Credit Especes)

This is a cash lending support system operated by CLCAM. Currently farmers buy agricultural equipment through farmers organizations for which CLCAM provides financial support. CLCAM also provides loans to Cotton Cultivation Working Fund.

The actual results of loans in 1998 are as shown in Table 2-1-6.

Table 2-1-6: Balance Sheet of Lending by Village (Year 1998)

Village name	Cooperative/ Union	Cash lending system		Material lending system	
		Cases	Amount of money (FCFA)	Cases	Amount of money (FCFA)
Zougou-Pantrossi	272	40	9,460,000	6	807,350
Ouésséné	145	35	5,250,000	5	681,705
Pigourou	67	18	2,710,000	4	387,100
Kabanou	69	32	5,140,000	2	193,550
Mani-Boké	55	23	4,090,000	1	195,690
Total	608	148	26,650,000	18	2,265,395

2-1-4 Forest and Forestry

(1) Forest Resources

The land area of the three classified forests in the Study Area is 265,595 ha for Trois Rivieres, 33,977 ha for Ouenou Benou and 251,592 ha for Alibori Superieur, totaling some 551,164 ha. These classified forests constitute 44.1% of the 31 classified forests of the country, among which Trois Rivieres and Alibori Superieur are the largest from the view point of land area. However, as the photo interpretation results of aerial photographs taken for this study show, there are already farm lands in the classified forests which occupy some 10.4% of Trois Rivieres, 15.6% of Ouenou Benou and 9.3% of Alibori Superieur classified forests.

(2) Timber Production

From among the logs produced by felling/logging of live standing trees, those belonging to large diameter classes are used as sawn timber and thin ones are used as poles (simple sawn timber) in the construction industry, etc.

Forest Law of Benin prohibits felling of standing trees in classified forests other than the felling conducted according to forest improvement plan. In the free zone in classified forests, felling of trees within 25 meters of river and lake banks and felling of such protected plant species as *Khaya senegalensis, Terminalia superba, Vitellaria paradoxa* and *Parkia biglobosa,* etc. are prohibited. Commercial felling for fuelwood/private plantations requires felling permission and transportation permission from the DFRN. In Borgou Province, 100 felling permissions the felling volume of which was some 1,029,000 m^3 and 68 transportation permissions the sale volume of which was some 385,000 m^3 were granted in 1993. But according to interviews conducted with related persons, a large number of cuttings are carried out without applying for any permission and traces of illegal felling for commercial purposes can be seen inside classified forests.

(3) Afforestation

In Borgou Province, such planting activities as afforestation by the DFRN in classified forests, extension activities for planting in National Arbor Day (June first of every year) and planting of *Tectona grandis*, cashew, mango and fast growing tree species along field boundaries by people are conducted.

① Afforestation Species

Main tree species used in afforestation in Borgou Province are as shown in Table 2-1-7.

Table 2-1-7 Afforestation Species

Botanical name	Afforestation Species
Tectona grandis	Saw timber, pole, electricity pole
Acacia auriculiformis	Soil improvement, shading
Gmelina arborea	Along boundaries
Eucalyptus camaldulensis	Along boundaries
Leucaena leucocephala	Soil improvement
Cassia siamea	Along boundaries
Azadirachta indica	Avennue planting, fuelwood, shading
Anacardium occidentale	Fruit
Mangifera indica	Fruit
Khaya senegalensis	Avenue planting, saw timber
Chlorophora excelsa	Saw timber
Terminalia superba	Saw timber
Afzelia africana	Saw timber

According to the interviews conducted in the nurseries managed by the DFRN of Borgou, local inhabitants are strongly interested in such fruit trees and fast growing exotic species as cashew, mango, *Tectona grandis*, Eucalypts, etc., from which they can not obtain a quick income, and are less interested in such slow growing native species as *Khaya senegalensis, Milicia excelsa*, etc. The DFRN is supervising not only extension activities for afforestation during National Arbor Day, it also supervises the introduction of native species in classified forests.

② Nursery Practices

Pot seedlings are produced in the nurseries managed by Borgou Forest Department and in 40 private nurseries. Some 2 million seedlings had been produced in Borgou Province in 1997, which were utilized within the province and were sold in the neighboring provinces of Atacola and Zou and outside the country in Nigeria.

Among private nurseries village nurseries are managed by a group of villagers consisting of 7 to 8 persons who are interested in nursery operations. According to interviews conducted in village nurseries, the prices per seedling for mango (hybrid), cashew and *Tectona grandis* were 350 FCFA, 150 FCFA and 50 FCFA respectively.

The DFRN, in connection with extension activities for afforestation, assembles farmers from each village and trains them in nursery practices. It is expected that upon returning to their villages the trainees, under the technical supervision of forestry officers, will engage in nursery practices and nursery management. However, due to a lack of material incentives, effective results are not obtained from these trainings.

③ Actual Results of Afforestation

Both the government and civilians are conducting afforestaion. In classified forests, following the implementation of forest improvement plan, afforestation and/or enrichment planting using such native tree species as *Khaya senegalensis*, etc. are conducted. Afforestation land area in the five districts of Gogounou, Bembereke, Sinende, Segbana and Kalale related to the Study Area, was 354 ha in 1996, 476 ha in 1997 and 1,758 ha in 1998, totaling 2,588 ha in the three years. Some 75% of afforested area is planted with cashew, mango and citrus trees and among these species cashew at 61% occupies the major portion of afforested area. This is managed by NGOs, and ISHOKAN project is assisted by a Japanese organization and by organizations from several other countries, who in cooperation with Borgou province carry out extension activities. On the other hand, although the afforested land area of *Tectona grandis* is small, the number of trees planted per hectare of this species at 2,000 to 2,500 is high in comparison to fruit trees and fast growing trees. (Refer to Appendix 7 for afforestation land area by main tree species)

④ Tending

When afforestation sites are the former sites of cultivated lands brush cutting/weeding is omitted but in case of enrichment planting brush cutting/weeding is conducted. Since the initial growth of *Tectona grandis* is fast in case of regeneration by sprouts, brush cutting/weeding is not necessary. Ordinarily, bud pruning is conducted one year after planting but since tending of buds that subsequently grow on sprouts is not sufficient, there are many *Tectona grandis* forests with bended stems and inferior shape trees.

(4) Forest Utilization

In classified forests and in free zones local inhabitants utilize forest for timber production, as agriculture land and as grazing land for livestocks. Other forms of forest utilization are as follows.

① Hunting

As a forest is a wildlife habitat, local inhabitants hunt small mammals living in forest. The method of hunting applied is burning of dry grasses and flashing out of wild animals. This type of burning for hunting purposes is causing forest fire and soil degradation.

② Honey Collection

The traditional method of honey collection in the area is by felling and burning the tree in which honey is produced, and this type of traditional honey collection is also a cause of forest degradation.

③ Fresh Water Fishing

Some local inhabitants catch catfish, etc. from rivers for self consumption and for sale in the market to earn cash income.

④ Collection of Wild Fruits

Vitellaria paradoxa and *Parkia biglobosa* are important forest fruit trees among many fruit trees growing in the forest, and under forest law of Benin both of the species are declared protected and their felling is prohibits. Fruits from the two tree species are mainly collected by women and are a source of income for them, which is why the two tree species are also well preserved in cultivated areas. Fruit trees growing on the farmlands are owned by the owners of the farms, while in case of forest, one person or a group of persons enter into forest to collect fruits which will belong to that person or group. *Vitellaria paradoxa* is used as butter, soap, etc., and is also an export item.

In recent years, following the introduction of animal power and tractor for cultivation, due to interference with plowing, there are cases of uprooting and death of *Vitellaria paradoxa* and

Parkia biglobosa trees in farmlands.

⑤ Others

Various medicinal plants and herbs grow in forest in the area. Specially, tree barks are used as medicine, and forest law allows collection of material for use as medicine in classified forests if such activity does not cause large injuries to forest trees. In the future also as an activity that benefits local inhabitants this type of forest use should be allowed co continue.

Moreover, Gui (*Pannicum maximum*), which is widely distributed in the forest floor in the Study Area, is used as thatching material, cover for grain storage facilities, fence, livestock fodder, etc.

(5) Forest Fire

Damage to *Tectona grandis*, cashew and mango plantations due to forest fire in the five districts of Gogounou, Bembereke, Sinende, Segbana and Kalale related to the Study Area amounted to 759 ha in 1996, 506 ha in 1997 and 271 ha in 1998. In 1996 and 1997 damaged area by fire was more than the plantation areas which were 307 ha and 303 ha respectively.

The followings are said to be the main causes of forest fire.

- Insufficiency of fire control during shifting cultivation
- Burning to flash out wild animals during hunting
- Burning in the dry season for new sprouts to emerge for livestock feed

The forest law of Benin stipulates that field fire (forest floor fire due to human actions) and burning of plantations damages plants. In order to control the serious damages that may be caused by field fires (grass burning) turning into forest fires, the law states such field fire expansion prevention measures as the supervision of burning at the start of the dry season (early fire) by the administrative authorities and prevention of uncontrolled burning. Moreover, under the law, to control field fire, the DFRN and owners of private forests have to establish firebreaks, lookouts, plant fire resistant tree species and local population have to cooperate in fire fighting activities.

However, in reality preventive measures such as (early burning) is practiced in limited areas only and fires are seen in January when burning is prohibited. Moreover, field fires occur each year and are one of the main causes of forest destruction in the area. (Refer to Appendix 8 for land area of plantations damaged by field fire)

(6) Timber Processing and Sale

Because wood is mostly used in the form of log as pole (roofing material, stake), timber processing facilities such as sawmills, etc. do not exist in the Study Area. The necessary board wood is supplied from Nigeria and Ghana mainly through Onab sawmills in the west and the city of Alarville in the north.

The price of pole in the suburbs of Parakou is 2,000-3,000 FCFA for large ones and 200-900 FCFA for slime and bent ones. Fuelwood is produced locally and consumed locally. Sacks of charcoal are sold along National Road No. 2 and are consumed in the Parakou and other cities. In the city of Parakou charcoal is sold at 50 FCFA per kilogram.

(7) Forest Management

As shown in Fig. 2-1-1, forest management of classified forests and free zones is conducted by field forest officers (Chef de Poste) stationed in each commune. The budget flow and workflow are separate as shown below. Budget flow: The Agriculture Department ⇒ District Forest Office (office of forestry technician in a district) ⇒ field forest officer. Work instructions: DFRN ⇒ Branch Office of the DFRN (Parakou, Kandi) ⇒ District Forest Office ⇒ field forest officer.

In the Study Area there are 13 locations where field forest officers have to be posted but in reality only 4 posts are filled while in the remaining 9 posts TS/F serve concurrently.

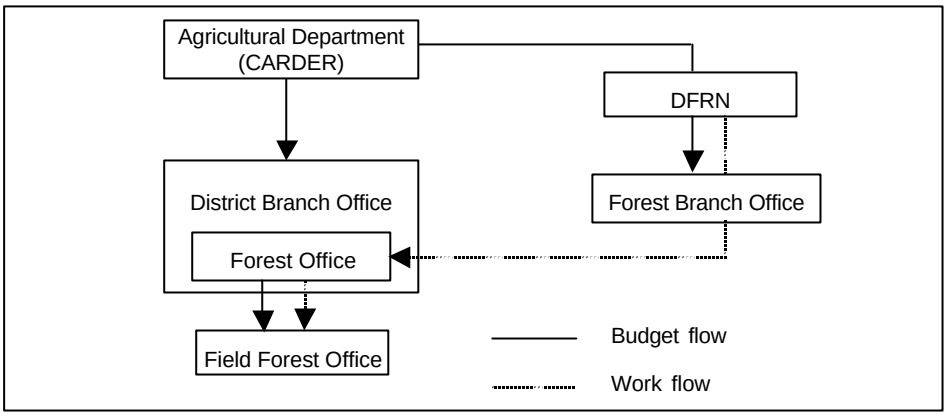


Figure 2-1-1 Organization of Forest Management

2.2 Aerial Photography

2.2.1 Photography Area and Specifications

Aerial photography covering some 1,200,000 ha area, including the Study Area located in the north of Benin, was conducted from 20 October, 1998 to 13 January, 1999.

Specifications of the aerial photographs are as mentioned below.

Photography scale	1/20,000
Photography height	3,300 m
Photography datum surface	300 m
Overlap	60%
Side lap	30%
Lens (focal length)	15 cm

2.2.2 Photography Courses and Volume of Photographs

Photography was conducted along 48 courses (including 15 courses of the Intensive Study Area) and the number of aerial photographs covering the Study Area and the Intensive Study Area were 2,396 and 231 respectively.

Aerial photograph lists and aerial photograph index map are shown in Appendix 9 and Appendix 10.

2.2.3 Photography Results

The results of photography are as shown below.

Negative films	1 set
Contact print	2 sets
Index map	1 set

2.3 Land Use and Vegetation Survey

2.3.1 Photo Interpretation Categories of Land Use and Vegetation

To prepare land use and vegetation maps of the Study Area, photo interpretation of land use and vegetation using the newly taken aerial photographs of the scale 1/20,000 was conducted. Photo interpretation categories and standards are as shown in Table 2-3-1.

Table 2-3-1 Land Use and Vegetation Categories and Standards

	Symbol	Category	Photo interpretation standards
Forest	Gf	Riparian forest	Forest containing high trees and distributed in narrow belts along rivers
	Fc	High forest	Tree height more than 5 meters, crown density 60-80% and little vegetation on the forest floor.
	Sa	Tree savanna	Tree height more than 5 meters and tree crown density 40-60%. Shrub height less than 5 meters and shrub crown density of under 40%
	Sb	Mixed savanna	Tree height more than 5 meters and tree crown density 40-60%. Shrub height less than 5 meters and shrub crown density of more than 40%
	St	Shrub Savanna	Tree height more than 5 meters and tree crown density less than 40%. Shrub height less than 5 meters and shrub crown density more than 40%
	Pf	Afforestation area	*Tectona grandis, Eucalypts*, etc.
	Td	Bare land	
	Tm	Marshes	
	Cl	Lateritic cuirasses	
	Ar	Rock outcrop	
Non-forest	Pr	Orchards	Mango, cashew
	Ch	Farmlands	Cotton, corn, sorghum, yam, etc.
	Ja	Fallow land	
	Ag	Settlements	
	Ce	Waterways	Including river banks
	Pe	Lakes and Marshes	
	Au	Others	Microwave base, area of transmission lines

2.3.2 Current Condition of Land Use and Vegetation

Actual condition of land use and vegetation of the Study Area obtained as the result of photo interpretation is shown in Table 2-3-2.

Although approximately 600ha were planted within the five districts (containing the Study Area) during the period from 1996 to 1998, as this consisted mainly of roadside planting and the planting of single trees, and the actual areas planted are smaller than the smallest unit of interpretation, they will not be shown on land use and vegetation maps. Therefore, vegetation do not appear in Table 2-3-2.

2.3.3 Preparation of Land Use and Vegetation Maps

(1) Enlargement of Existing Topographical Maps

Existing topographical maps of the scale 1/200,000 were enlarged to the scale 1/50,000. Changes over the past years in roads, settlements, etc. were plotted on the enlarged maps using information from the newly taken aerial photographs, and polyester based land use and vegetation base maps were prepared.

(2) Preparation of Land Use and Vegetation Maps

The results of photo interpretation on land use and vegetation were transferred to the enlarged maps (scale 1/50,000) produced from the existing topographical maps (scale 1/200,000), and land use and vegetation maps were prepared.

Table 2-3-2 Land Area by Land Use and Vegetation in the Study Area

Type	Area	District	Gf	Fc	Sa	Sb	St	Pf	Td	Tm	Cl	Ar	Pr	Ch	Ja	Ag	Ce	Pe	Au	Total
Classified Forest	Trois-Rivière	GOGOUNOU	5,562	1,067	22,773	25,700	6,652		608	239	46			4,455	1,773		15			68,890
		BEMBEREKE	2,636	282	12,015	14,833	4,980		50	134	97			2,136	338	13	66	71		37,651
		SEGBANA	3,568	374	9,230	28,689	7,054		146	92	548			4,780	2,834					57,315
		KALALE	4,771	422	25,596	49,563	12,635		219	606	1,569			9,640	1,896	38	205	53		107,213
		Subtotal	16,537	2,145	69,614	118,785	31,321	0			2,260	0	0	21,011	6,841	51	286	124	0	271,069
	Quénou Bénou	BEMBEREKE	2,202	2,738	10,399	11,233	3,375		49		36		0	5,570	812	17				36,431
		SINENDE																		0
		Subtotal	2,202	2,738	10,399	11,233	3,375	0	49	0	36	0	0	5,570	812	17	0	0	0	36,431
	Upper Alibori	GOGOUNOU	12,967	478	46,996	81,048	27,556		1,863		32		13	11,647	3,856		369			186,825
		SINENDE	3,035	90	8,004	24,240	3,499		109	25				4,956	301		60			44,319
		KANDI																		0
		BANICOALA																		0
		Subtotal	16,002	568	55,000	105,288	31,055	0	1,972	25	32	0	13	16,603	4,157	0	429	0	0	231,144
	Upper Alibori II	PEHONKO	1,035	84	2,070	11,311	2,481		114					890	496		66			18,547
		KEROU	843	16	894	4,644	2,882		190					2,051	158					11,678
		Subtotal	1,878	100	2,964	15,955	5,363	0	304	0	0	0	0	2,941	654	0	66	0	0	30,225
	Total		36,619	5,551	137,977	251,261	71,114	0	3,348	1,096	2,328	0	13	46,125	12,464	68	781	124	0	568,869
Buffer Zone	Trois-Rivière	GOGOUNOU	3,683	312	7,391	18,296	3,432		24	66	30			11,182	2,254	74				46,744
		BEMBEREKE	1,606	138	4,132	11,846	2,940		50	118	15			5,678	887	11	91	13		27,525
		SEGBANA	2,342	561	5,826	20,638	6,186		646	68	398			7,174	3,494	143				47,476
		KALALE	3,563	292	5,759	25,716	7,055		36	70	173		38	26,538	3,386	282	145	55		73,108
		Subtotal	11,194	1,303	23,108	76,496	19,613	0	756	322	616	0	38	50,572	10,021	510	236	68	0	194,853
	Quénou Bénou	BEMBEREKE	1,674	1,795	5,758	11,031	3,954		108		0		10	22,990	1,604	364			31	49,319
		SINENDE	1,653	878	2,194	4,031	966		0		66			6,599	593	21			0	17,001
		Subtotal	3,327	2,673	7,952	15,062	4,920	0	108	0	66	0	10	29,589	2,197	385	0	0	31	66,320
	Upper Alibori	GOGOUNOU	527		809	1,845	1,795		36					1,726	256					6,994
		SINENDE	850	763	2,305	8,923	3,521		126	94		73		19,420	931	258	43			37,307
		KANDI	2,638	83	4,642	17,205	8,481		126		50	22		17,726	2,923	127	24			54,047
		BANICOALA	1,629	12	3,416	14,700	1,561		288					15,000	2,168		24			38,798
		Subtotal	5,644	858	11,172	42,673	15,358	0	576	94	50	95	0	53,872	6,278	385	91	0	0	137,146
	Upper Alibori II	PEHONKO	1,761	811	3,874	10,847	4,540		476					3,805	986	58	73			27,231
		KEROU	2,525	702	3,913	17,416	6,701		1,027					6,172	2,050		9			40,515
		Subtotal	4,286	1,513	7,787	28,263	11,241	0	1,503	0	0	0	0	9,977	3,036	58	82	0	0	67,746
	Total		24,451	6,347	50,019	162,494	51,132	0	2,943	416	732	95	48	144,010	21,532	1, 338	409	68	31	466,065
Grand Total			61,070	11,898	187,996	413,755	122,246	0	6,291	1,512	3,060	95	61	190,135	33,996	1,406	1,190	192	31	1,034, 934

2.4 Survey to Ascertain the Actual State of the Local Inhabitants (First Part)

2.4.1 Survey Implementation

To determine the basic principles of the management plan for the classified forests, it is necessary to understand the actual living conditions of the local inhabitants through the direct contact with them. Therefore, basic information was collected on the villages and the local inhabitants with an aim of apprehending the general characteristics of the life of the populations in the Study Area (First Part).

The survey to understand actual conditions of the local inhabitants (First Part) consists of : a) Profile survey of the villages carried out by means of data collection and interviews with the heads of village, the representatives of the village organizations, primary school teachers and other people concerned. b) Survey of heads of household and household members through questionnaire survey. All eight villages in the Intensive Study Area were the subject of the questionnaire survey. In the Study Area, 12 villages were selected for questionnaire survey based on such factors as reliance on classified forest, size of the village principal production activities and ethnic groups.

Therefore, the total number of villages surveyed was twenty (8 villages in the Intensive Study Area and 12 villages in the Study Area.) The number of sample households to be surveyed in each village was calculated from the square root of the total number of households. This number is thus 107 for the Intensive Study Area and 121 for the Study Area, 228 on the whole. The subject households of questionnaire survey were chosen in a random way.

The selected villages and the final number of samples for the Intensive Study Area and the Study Area are indicated in Tables 2-4-1 and 2-4-2.

Table 2-4-1 Villages Selected for Questionnaire Survey and Final Number of Samples for the Intensive Study

District	Commune	Village	Population (person)	Number of households	Number of sampels
Bembéréké	Gamia	Ganro	1,800	188	13
		Mani-Boké	816	84	9
	Beroubouay	Beroubouay	5,066	546	23
		Kabanou	928	77	8*
Gogounou	Sori	Gamagou	3,282	360	18
		Wesséné	1,750	186	13
		Pigourou	792	62	7
	Zougou-Pantrossi	Zougou-Pantrossi	2,672	282	10
Total			17,106	1,785	107

Note: *) Sample breakdown is Kabanou 4, Bokbouerou 2 and Koussin 2

Table 2-4-2: Villages Selected for Questionnaire Survey and Final Number of Samples for the Study Area

District	Commune	Village	Population (person)	Number of households	Samples	Reliance on Classified forest	Village size	Production activity	Ethnic Group
Kalalé	Dunkassa	Dunkassa-Peulh	205	26	5	T	S	E/A	Fu
	Péonga	Boa	2,455	290	18	T	GG	A/E	Ba
	Kalalé	Zambara	829	78	8	T	M	A/E	Ba
		Nassikonzi	1,120	124	11	T	G	A/E	Ba
Segbana	Libanté	Bobéna	1,007	141	11	T	G	A/E	Bo
	Sokotindji	Sérékibé	733	91	9	T	M	A/E	Bo
Gogounou	Bagou	Kali	889	114	10	A	M	A/E	Ba
	Ouara	Lougou	962	72	8	A	M	A/E	Ba
Bembéréké	Bembéréké	Pédarou	1,362	121	11	O	G	A/E	Ba
Sinendé	Sékéré	Yarra-Peulh	341	30	5	A	S	A/E	Fu
	Sinendé	Kossia	919	91	9	O	M	E/A	Ba
		Guessou-Bani	2,544	275	16	A	GG	A/E	Ba
Total			13,366	1,453	121				

Note: T=Trois Rivieres, A=Alibori Superieur, O=Ouenou Benou

S=Population less than 500, M=Population from 500 to 999, G=Population from 1000 to 1999
GG=Population more than 2000

A/E=Agriculture/Livestock breeding, E/A=Livestock breeding/Agriculture

Ba=Baatonu tribe, Bo=Boo tribe, Fu=Fulbe tribe

2.4.2 Actual Condition of the Villages

(1) Location of the Village Boundaries

There are no charts on which the boundaries of the villages are shown. It is only the traditional village head (Chef Village Traditional) or the head of land (Chef de Terre) who knows the boundaries of his village. Moreover, the location of a village can change with time, because a provisional camping site for the livestock breeding can become a permanent dwelling as well as an entire village can move close to the newly built asphalt road. It is thus very difficult to identify all the villages in the area with the existing topographic maps on a 1/200,000 scale.

(2) Population Structure

The structure of the population by sex and by age brackets' is as shown in Table 2-4-3.

Table 2-4-3 Structure of the Population by Sex and by Age Brackets

(Unit: Person)

Sex	Man		Woman		Total of man and woman	
Age category	Actual number	%	Actual number	%	Actual number	%
0-5 years	450	22.4	411	21.1	861	21.7
6-15 years	730	36.2	591	30.4	1.321	33.4
16-24 years	234	11.6	292	15.0	526	13.3
25-44 years	400	19.9	443	22.8	843	21.3
45-59 years	113	5.6	122	6.3	235	5.9
Over 60 years	88	4.4	87	4.5	175	4.4
Total	2,015	100.0	1,946	100.0	3,961	100.0

As can be observed from the tables, in the Study Area the proportion of the young people of less than 15 years of age reaches to 55.1%. Proportion of the male population is a little high compared to that of the female proportion. This result corresponds well to a characteristic deduced from the data on the population of the 5 districts.

(3) Population Distribution by Ethnic Group

Distribution of the ethnic groups in the Study Area is shown in Table 2-4-4.

Table 2-4-4 Distribution of the Ethnic Groups

(Unit: household)

Ethnic Group	Number of answers	Proprotion (%)
Baatonu	157	68.9
Boo	38	16.7
Fulbe	24	10.5
Autres	9	3.9
Total	228	100.0

Baatombu tribe live mainly in the districts of Bemberek, Gogounou, Sinende and partly in Kalale. Boo tribe are distributed exclusively in the district of Segbana and partly in the district of Kalale and have a similar life style and culture as Baatombu tribe. Fulbe's life style and customs differ from those of Baatombu and Boo tribes and are living all over the Study Area, generally in the neighborhoods of Baatombu or Boo villages.

(4) In-migration

There is in-migration of young agricultural workers to the area from Atacora Province and a small number of Fon and Yoruba traders from the south. However, a large scale in-migration is not taking place in the area.

(5) Structure of the Traditional Society

① Family structure

The family structure of Baatonu, Boo and Fulbe tribes is almost the same. Generally, the family is made up of several households: grandparents, parents, sisters and brothers of the parents, married daughters, their children, all living in the same compound and forming an extended family.

This extended family is regarded as basic unit of the community. The family head has the role of ensuring the management of all the resources of the family, including the collected agricultural products belonging to the family. However, recently dependent married members of the households and the young single members are also living in the family compound. In addition to their family work, they cultivate especially cotton, in order to obtain sources of income necessary for the expenditure of their wives and children or for their own consumption.

② Structure of the Baatonu Tribe

In the Baatonu tribe, one distinguishes three principal classes: Wassangari, Baatombu (native inhabitants) and Gando.

These names represent different classes within the Baatonu community and not different groups of the Baatonu tribe. In each Baatonu village, there are traditional heads such as traditional village head, head of land, etc. These traditional heads play the role of judges and representatives for all the population of the village and also for the Fulbe people living in the

same locality. The traditional heads are also agents of tradition and customs. In spite of the many administrative changes, the traditional heads are respected by villagers, because they are regarded as those which still have a mythical power for the protection of the village against the evil spirits.

③ Structure of the Fulbe Tribe

In Fulbe trib, the head of family is called "Dotidjo" and is responsible for the livestock camping. The family head who controls several livestock camps is called "Rouga" and the head at the village or regional levels is called Djohuro". Djohuro in the Study Area is a Fulbe and was chosen by the traditional village heads of Baatonu tribe.

(6) Land Utilization

According to a report "Regime Foncier Contmier en Milieu Baatonu" written by MONRA Yarou, which analyzes traditional and customary land ownership systems in Baatonu area, traditionally the land was divided into the following four categories for use.

- Land for dwelling
- Land for agriculture
- Protected land or bush land for gathering and hunting. This land is also used for grazing and for dwelling by Fulbe nomads.
- Sacred sites or areas reserved for traditional village heads. The products of hunting and gathering from these sites are reserved for the traditional village heads.

Formerly, due to a small population, large areas for self sustaining agriculture were not required and land productivity could be maintained or restored thanks to the relatively long fallow. But, with the increase in population and the introduction of cash crops, it becomes necessary for the extensive agriculture practiced in the area to bring more land under cultivation and to reduce the period of the fallow in order to increase the production. The alternative which was easily adopted for this purpose was to clear forests and to use chemical fertilizer and agricultural pesticides. It is precisely the situation which one can see in the Study Area.

2.4.3 Living Condition of the Local Inhabitant

(1) Household Size

Household size as expressed by the number of surveyed household members is shown in Table 2-4-5.

Table 2-4-5 Household Size

Household size	Head of household (Man)		Head of household (Woman)		Total	
	Household	%	Household	%	Household	%
Small (4-15 members)	107	48.2	6	100.0	113	49.6
Medium (16-30 members)	93	41.9	0	0.0	93	40.8
Large (more than 30 members)	22	9.9	0	0.0	22	9.6
Total	222	100.0	6	100.0	228	100.0

As the result of the economic changes, the recent trend is towards the division of the extended families into several small independent households. However, because of polygamy and the population growth (annual rate of over 3%), households size is approximately 20 members. The largest household composed of 66 members.

Household size on the basis of result of this survey is larger than that of the national census, 1992 (average of 5 districts was 9.5 members per household). It is because in the present study all the members living in the same compound were included in one household instead of counting the married and economically independent members separately.

(2) Education Level

Information on education standards obtained as the result of household members survey shows that the majority of respondents did not receive an education. For example, the survey showed that in average 80.1% of man did not attend the school while the proportion among women is even higher; 86.9%. The rate of schooling is 22.1% for the men against 12.2% for the women. Generally, there is a high number of primary school dropouts, and those who complete primary education account for only 0.2% of boys and 0.1% of girls. Table 2-4-6 shows the answers given to the questions on the level of education, excluding household members of less than 6 years old.

Table 2-4-6 Education Level of Household Members

Education level	Sex				Total	
	Male		Female			
	Number of respondents	%	Number of respondents	%	Number of respondents	%
Without an education	1,483	73.6	1,691	86.9	3,174	80.1
Primary school	445	22.1	238	12.2	683	17.2
MIddle school	49	2.4	6	0.3	55	1.4
Others (religious schools, illiteracy schools)	30	1.5	10	0.5	40	1.0
Primary school graduates	4	0.2	1	0.1	5	0.1
Middle school graduates	4	0.2	0	0.0	4	0.1
Total	2,015	100.0	1,946	100.0	3,961	100.0

(3) Incomes and expenditure

① Income

Principal sources of income are as shown in Table 2-4-7.

The majority of the households depend mainly on agriculture and the second source of income is livestock breeding (cattle, sheep and goat).

Table 2-4-7 Principal Sources of Income of the Heads of Household

Source of income	Respondent	% (ratio of total respondents)
Sale of the agricultural produce	207	95.0
Sale of livestock	90	41.3
Sale of the processed agricultural products	38	17.4
Sale of the artisanal products	22	10.1
Sale of fruits	15	6.9
Sale of vegetables	8	3.7
Sale of the processed forest products	7	3.2
Sale of fuelwood	3	1.4

② Expenditure

Table 2-4-8 shows the principal expenditure items by ethnic group.

Table 2-4-8 Average Monthly Expenditure by Ethnic Group

(Unit: FCFA)

Rubrique		Baatonu	Fulbe	Boo	Others	Overall
Food	Amount	26,175	41,511	19,300	17,900	25,694
	%	48	50	33	36	45
Clothes	Amount	7,161	20,127	7,804	9,700	8,312
	%	13	25	13	20	14
Education	Amount	5,275	2,146	3,330	3,833	4,610
	%	10	3	6	8	8
Ceremony	Amount	10,690	11,237	16,980	12,500	12,064
	%	19	14	29	26	21
Others	Amount	5,691	7,010	11,187	4,833	6,893
	%	10	8	19	10	12
Total	Amount	53,481	82,032	57,690	48,766	56,334
	%	100	100	100	100	100

Incomes are mainly used for buying food. The reason that the proportion of the expenditure for food items is high despite the fact that the principal production activity is agriculture is that the principal agricultural products are not food crops but cash crops such as cotton in particular. The very high percentage of expenditure that Fulbe ethnic group spend on food items is explained by the fact that this group cultivate in small farmlands, mainly sorghum, which seldom satisfies household needs. And this force them to buy foods items.

Another characteristic of the area with regard to the expenditure is that the ceremonies consume a relatively large part of the incomes. Among the ceremonies such as marriage, child birth, funeral and agricultural festivals, those related to the funeral ceremony have a particular importance to the local inhabitants. Each year significant sums of money, food and livestock are used for these ceremonies.

(4) Living Condition

① Drinking Water

Main drinking water sources used are: well (puits), well with hand pumps, well with electric pumps (forage), rivers, springs, etc. There are unimproved and improved wells and buckets are used in both wells to collect water. The improvement of the water sources is carried out with the assistance of various donor organizations but despite these efforts the drinking water supply is not yet sufficient.

Transport of water is mainly the work of women. However, the men take part in this work especially when water becomes rare in the dry season, during which period, the men dig riverbeds to create small ponds for water collection. Table 2-4-9 shows the time taken by the women to transport water in the dry and rainy seasons.

Table 2-4-9 Time Taken for Searching Drinking Water in the Dry and Rainy Seazons

Source	Time (Unite: minutes)					
	Minimum		Average		Maximum	
	Rainy season	Dry season	Rainy season	Dry season	Rainy season	Dry season
Well equipped with electric pump	3	3	15	49	45	240
Well equipped with manual pump	5	2	20	48	90	240
Shallow well	1	1	15	35	60	120
River	5	10	23	72	120	180
Water tank	1		9		15	
Rain water	1		6		20	
Spring	30	120	30	120	30	120

② Fuel

The fuel used by the local inhabitants is fuelwood. Collecting fuelwood is also the work of women, who mainly collect wood from the dead trees and branches of the dead trees. Frequency of fuelwood collection and the distance covered are indicated in Table 2-4-10.

Some 50% of the respondents collect fuelwood every day, 53% cover a distance of 1 to 4 km and 37% cover a distance of more than 4 km to collect fuelwood. Fuelwood collection time ranges from 3 minutes to 480 minutes, averaging at 2 hours and 45 minutes.

Table 2-4-10 Frequency of Fuelwood Collection and Distance Covered

Frequency	Distance covered						Total	
	Less than 1 km		1-4 km		More than 4 km			
	Number of respondents	%	Number of respondents	%	Number of respondents	%	Number of respondents	%
Daily	13	11.3	63	54.8	39	33.9	115	100.0
Less than 3 times per week	1	1.6	32	50.8	30	47.6	63	100.0
Once per week	5	16.1	16	51.6	10	32.3	31	100.0
Not even once per week	4	21.1	10	52.6	5	26.3	19	100.0
Total	23	10.1	121	53.1	84	36.8	228	100.0

Daily consumption volume of fuelwood also varies from 2 kg to 75 kg with the average volume of 20.3 kg.

In response to the question “Is fuelwood sufficient currently?”, more then 90% of the surveyed household heads give such answers as “no excessive shortage” and “sufficient”, “which indicate that local inhabitants are not concerned about the supply of fuelwood for the moment.

③ Food

Table 2-4-11 shows the method of acquisition and the availability of the cereals (corn, sorghum), vegetables, meat, fish and the forest products (nut of *Vitellaria paradoxa* and *Parkia biglobosa).*

Table 2-4-11 Method of Acquisition and Availability of Principal Foods

Method of Acquisition & Availability	Cereals		Vegetables		Meat		Fish		Forest products	
	Number of respondents	%	Number of respondents	%	Number of respondents	%	Number of respondents	%	Number of respondents	%
Harvest more than household consumption	85	41.5	48	26.2	7	4.1			59	35.1
Harvest more or less equals household consumption	64	31.2	74	40.4	8	4.7	7	5.3	68	40.5
Engage in barter to cover sonsumption need	56	27.3	61	33.3	154	91.1	125	94.7	41	24.4
Total	205		183		169		132		168	

Self sufficiency rate of the households is 73% for cereals, 67% for vegetables and 76% for the forest products. However, concerning the meat and fish, more than 90% of the households depend on the purchase or barter to cover their needs. Moreover, the duration of shortage of the foodstuffs is 2.3 months for cereals, 4.2 months for vegetables, 6.6 months for the meat and 3.6 months for the forest products.

④ Housing In the Study Area

There are two types of housing: group housing and camping.

Group housing is characteristic of the areas inhabited by Baatombu and Boo tribes. This type of housing consists of rooms in a rectangular concession. The large space which is surrounded by various rooms of the concession is the place where the main part of the activities of household is held and the processing of agricultural and forest product is carried out.

Camping is mainly the type of housing used by the Fulbe ethnic group and consist of small round or square shaped rooms. In these camps, there are grazing lands around homes, surrounded by small farmlands where food is produced for self-consumption. In much of cases, the campings of Fulbe tribe are several kilometers away from the villages of Baatombu or Boo tribes.

(5) Principal Economic Activities

① Agriculture

Farming is both the major economic activity of the local inhabitants as well as their major source of income. Of the 228 households surveyed, 226 households possessed farmland while the remaining 2 households were leasing farmland.

As is shown in Table 2-4-12, size of the farmlands varies from 2 ha to 20 ha, farmlands of 5 ha to 10 ha accounts for 31.9%, the highest proprotion, and the average size of the farmlands is 9.5 ha.

Table 2-4-12 Farmland Size

Farmland size category	Number of respondents	%
Less than 5 ha	67	29.7
5 ha to less than 10 ha	72	31.9
10 ha to less than 15 ha	38	16.8
15 ha to less than 20 ha	25	11.1
More than 20 ha	24	10.6
Total	226	100.0

The principal crops grown are cotton, corn, sorghum, yam, niébé and groundnut.

The important crops for the farmers are cotton, corn, sorghum, and yam in the rainy season and

gombe and pepper in the dry season. Table 2-4-13 shows the average land area for the cultivation of important crops in the rainy season. The average cultivation area is 5.6 ha for cotton and 1.9 ha for the food crops such as corn, yam, sorghum, etc.

Table 2-4-13 Average Cultivation Area of Important Crops in the Rainy Season

Crop	Number of respondents	Total area (ha)	Average cultivation area (ha)
Cotton	154	858.8	5.6
Corn	43	104.8	2.4
Yam	20	17.5	0.9
Sorghum	10	17.8	1.8
Groundnut	1	0.8	0.8
Overall	228	999.5	4.4

Moreover, 163 out of 226 heads of household who practice agriculture cultivated their farmlands in 1996/97 agriculture year, and land cultivated in the area annually is shown in Table 2-4-14. There is a rather large variation in the area of land under cultivation (from 0.25 ha to 15 ha) and the average area of cultivated land per household is 2.8 ha.

Table 2-4-14 Annually Cultivated Land Area

Category of the land cultivated annualy	Number of respondents	%
Less than 5 ha	136	83.0
5 ha to less than 10 ha	13	8.0
10 ha to less than 15 ha	9	6.0
15 ha to less than 30 ha	5	3.0
Total	163	100.0

② Livestock Breeding

In the Study Area, the livestock breeding occupies a significant place after agriculture. Until now, Baatombu and Boo tribes were engaged exclusively in agriculture and Fulbe tribe in livestock breeding. But recently it is noted that Baatombu tribe raise livestock and Fulbe tribe who attempt to settle permanently conduct agriculture to obtain their own food.

Average number of livestock raised by ethnic group is shown in Table 2-4-15.

Table 2-4-15 Average Number of Livestock Raised by Ethnic Group

Ethnic group	Cow		Bull		Sheep		Goat		Poultry	
	Household number	Average livestock head	Household number	Average livestock head	Household number	Average livestock head	Household number	Average livestock head	Household number	Average livestock head
Baatonu	64	14	140	8	49	6	95	7	110	22
Fulbe	20	35	24	15	18	13	13	10	21	29
Boo	16	4	29	5	15	6	20	5	31	26
Autres	2	15	7	5	1	7	2	12	5	20
Ensemble	102	16	200	8	83	8	130	7	187	23

Principal livestocks raised are cattle and poultry and other livestocks raised are sheep and goat. One of the characteristics of livestock breeding in this area is that there are many households raising bulls. It is because the bulls are used not only for meat production but in recent years for plowing and other agricultural operations.

Admittedly, each ethnic group possesses certain number of livestock but the breeding of cattle remains in the hands of Fulbe tribe. Normally, Baatombu and Boo tribes entrust their livestock to Fulbe tribe for guarding and feeding.

③ Fresh Water Fishing

Fishing is carried out specially when water level is low in the rivers and in the ponds. The method used is such traditional method of fishing as (casting) net. In general, fishing is an activity relegated to the second rank and fishing is not practiced in the dam reservois.

④ Trade

The trade is developed very little. In the majority of the cases, the shops exist in the large villages which are located along the National Road No.2. However, in the periodic markets, the professional tradesmen sell articles of primary need such as metal or plastic sheets, Baatonu women sell processed agricultural products and Fulbe women sell dairy products. Also, occasionally women carry fuelwood on their heads to sell in the market. The market is the meeting place for the local inhibitants and the majority of the exchanges of goods are carried out in these markets.

⑤ Processed Agricultural and Forest Products

In general, the Baatonu and Boo women process agricultural produce such as yam, sorghum corn, groundnut and niebe for self consumption and for sale. As for as the forest products are concerned, the women make mustard from *Parkia biglobaosa* nuts and butter from *Vitellaria paradoxa*. These processed forest products are intended for self consumption and for sale in the market.

(6) Forest Utilization

The following forest utilization was confirmed in the Study Area.

- Classified Forest (Felling and dwelling is prohibited)
- Forests other than classified forest (practically free felling, provided that the protected tree species are not felled)
- Communal forests of the village (forests on the collective land of the village)
- Afforestation area (afforestation area for private use)

The survey found that classified forest is being utilized by 53.5% of the local inhabitants, communal forest by 26.3%, afforestation area by 18.9% and those who do not use forest accounted for 1.3% of the inhabitants. Table 2-4-16 shows the objectives of forest utilization in the area.

Table 2-4-16 Objectives of Forest Utilization

Objective	Number of respondents	%	Remarks
Fuelwood collection	51	22.4	
Wood felled for pole	77	33.7	Cattle sheds, thatching, small room
Forest product collection	35	15.3	*Vitellaria paradoxa, Parkia biglobosa, Adansonia digitata, Tamarindus indica*
Honey collection	12	5.3	
Hunting	23	10.1	
Others	30	13.2	
Total	228	100.0	

(7) Gender

The results of survey on the work sharing by men and women are shown in Table 2-4-17.

Table 2-4-17 Main Works Shared by Men and Women

(Unit: %)

Type of work	Often		Sometimes		Never	
	Female	Male	Female	Male	Female	Male
Searching for water	94.9	5.1	71.4	28.6	7.4	92.6
Cooking	96.9	3.1	62.2	37.8	6.0	94.0
Laundry	93.2	6.8	47.4	52.6	9.4	90.6
Sewing	61.9	38.1	78.6	21.4	53.1	46.9
Cultivation (plowing)	10.8	89.2	66.7	33.3	91.5	8.5
Seed sowing/planting	50.6	49.4	69.4	30.6	80.6	19.4
Weeding	41.4	58.6	86.0	14.0	90.1	9.9

From the data mentioned in the table above, it becomes clear that such works as searching for water, cooking and laundry are mainly carried out by the women while the plowing, sowing/planting and weeding are done by the men. However, since the women also take part in seed sowing/planting and weeding works, it can be said that they deal not only with household activities but play a significant role as labour in the production activity.

2.5 Initial Environmental Survey

In accordance with the Environmental Action Plan of Benin formulated in 1993, the Department of Environment (DE) in the Ministry of Environment, Settlement and Town planning (MEHU) took the necessary actions for the enactment of the Basic Law on the Environment (Law No. 98-030) which was recently adopted by the National Assembly. In 1995, the Benin Environment Agency (ABE) was created to ensure the implementation of the governmental policy. The agency endeavours to arrange each aspect of the environment in particular the provisions against natural disasters and the implementation of the system of impact study on the environment. This system of impact study on the environment forces any initiator of a project to evaluate the environmental impacts of the project in question. Legislations on the environment in Benin are listed in Appendix-11.

Since the present study is in the planning phase it is exempted from the said evaluation, and instead an initial environmental survey is carried out within the framework of this study. It is to be mentioned that this survey was carried out in conformity with Environmental Guidelines on JICA

development Studies and by taking into consideration the directives of impact study on the environment for forest improvement plan, formulated by the Benin Environment Agency (ABE).

2.5.1 Natural and Social Environments of the Study Area

A reconnaissance of the Study Area was carried out to understand the characteristics of the social environment (ownership and use of land, economic activities, customs, local inhabitants, hygiene, population, etc.) and natural environment (climate, hydrolog, topography, geology, vegetation and rare species, etc.) of the area.

Table 2-5-1 Social Environment of the Study Area

Land ownership	Classified forests are owned by the State. Forests other than classified forests in principle belong to the State but according to customs to the village
Use of land	Forests, arable lands (raw cotton, corn, yam), fallow land/orchards, etc. Grazing in the fallow land and in the forests.
Economic activities in the surrounding areas	Agriculture and livestock breeding
Customary system (right of use of the forests)	Land is traditionally divided by the head of the village. The forest belongs to the village but felling (with the exception of protected tree species) is done individually.
Local inhabitants	Baatonu and Boo tribes conduct agriculture and Fulbe tribe breed livestock.
Public health	16 dispensaries, 12 midwife services,1 hospital and 1 public health center in each district headquarters
Population	123,707 men and 121,922 women, on the whole 245,699 persons
Others	Islam 67.7%, traditional religion 10.3%, Catholic 5.5% and Protestant 1.5%

Table 2-5-2 Natural Environment of the Study Area

Climate	Annual average temperature: 27 to 28 0°C, annual average precipitation: 950 to 1,230 mm
Vegetation	Savanna vegetation consisting of Isoberlinia, Terminalia, Parkia, Combretum, Pterocarpus, etc. and riparian forest consisting of Khaya and Daniellia
Topography	Flat and Undulating land with gentle slopes of an altitude from 220 to 490 meters
Geology and Soil	Aluminous-ferrite soils made from gneiss and granite parent materials
Hydrology	Sota River and Alibori River, the tributaries of the Niger River system
Ecosystem	No special ecosystem
Rare fauna and flora	Species in danger of disappearance are not confirmed
Others	The bush fire which is carried out each year causes forest devastation and may lead to desertification.

Table 2-5-3

Points to be Particulary Considered with Regard to the Environment in the Neighbourhoods of the Study Area

Points to be particularly considered with regard to the environmental conditions	Points to be considered or not with regard to the environment					
	In the Study Area			Outside the Study Area		
Specially Designated Area						
Flora and fauna covered by the Washington Convention	Yes	Not	Unknown	Yes	Not	Unknown
Designated area under the convention on migratory wild fauna	Yes	Not	Unknown	Yes	Not	Unknown
Designated area under the Ramsar Convention	Yes	Not	Unknown	Yes	Not	Unknown
Designated area under the convention concerning the protection of the world cultural and natural heritage	Yes	Not	Unknown	Yes	Not	Unknown
Designated area under the convention on biodiversity	Yes	Not	Unknown	Yes	Not	Unknown
National parks, reserves of wild animals	Yes	Not	Unknown	Yes	Not	Unknown
Hunting area	Yes	Not	Unknown	Yes	Not	Unknown
Social Environment						
Settlement area of the native people	Yes	Not	Unknown	Yes	Not	Unknown
Historic buildings, cultural heritage and splendid sites	Yes	Not	Unknown	Yes	Not	Unknown
Area of economic activities with negative influence	Yes	Not	Unknown	Yes	Not	Unknown
**Natural Environment						
Arid and semi-arid areas (including savanna, thorn-bush and dry tropical forest)	Yes	Not	Unknown	Yes	Not	Unknown
Seasonal forest	Yes	Not	Unknown	Yes	Not	Unknown
Tropical rain forest	Yes	Not	Unknown	Yes	Not	Unknown
Swampy area	Yes	Not	Unknown	Yes	Not	Unknown
Peat land	Yes	Not	Unknown	Yes	Not	Unknown
Quarry, very steep land, eroded land, devastated land	Yes	Not	Unknown	Yes	Not	Unknown
Water bodies (lake, artificail basin)	Yes	Not	Unknown	Yes	Not	Unknown

Appendix 12 presents fauna and flora as mentioned in the Washington Convention, and among them those species the habitats of which were confirmed or highly likely to exist in the Study Area.

Pendjari National Park and Hunting Area, Atakora Hunting Area, W National Park and Djona Hunting Area are located in the north and the north-west of the Study Area. The Pendjari National park is designated as wildlife sanctuary under "Man and the Biosphere" (MAB) program by UNESCO for international biological research. Moreover, currently there is a movement to classify the W National Park as world heritage site (the Niger side of the park is already classified as world heritage).

2.5.2 Contents of the Plan

The plan to be worked out within the framework of this study will be a basic forest management plan for the classified forests based on the local inhabitants participation. A forest improvement plan will be prepared on the basis of this basic plan, and when implemented, the contents of the plan will be as described in Table 2-5-4.

Table 2-5-4 Contents of the Plan

Plan	Work	Principal works
Conservation forest	* Restoration of forest in the farmland and fallow lands * Enrichment	
Production forest	* Restoration of forest in the farmlands and fallow lands * Production of saw timber and fuelwood (selective felling and clear felling in compartments) * Introduction of useful tree species	Spur road Work site Afforestation zone
Silvo-pastoral	* Creation of the artificial grasslands * Improvement of the natural grasslands * Installation of drinking water points for the cattle * Pasture for livestock	 Artificial grasslands Water Points
Village forestry	* Improvement of the lands to be used by the local inhabitants * Establishment of corridors of passage for the cattle * Production of fuelwood	Agricultural land, afforestation zone Corridors of passage for the cattle Fuelwood forests
Forest roads	* Improvement of network of forest roads * Maintenance and repair of the forest roads	Forest roads Riverbed roads
Production of seedlings	* Installation of the village nurseries * Production of seedlings	Village nurseries
Forest protection	* Installation of the watchtowers * Establishment of firebreak tree belts * Prohibition of burning	Watchtowers Firebreak tree belts
Related infrastructures	* Forest improvement centers * Stores for agricultural produce * Women centers * Simple charcoal kilns	Forest improvement centers Stores for agricultural produce Women centers Simple charcoal kilns

2.5.3 Evaluation of Environmental Items

Based on the contents of the Plan mentioned in 2.5.2 above, the degree of impact, the influences on the environment (negative and positive) and effective measures to minimize the negative influences, which the execution of the said plan will involve, are examined according to the environmental items checklist. The results are presented in Appendix 13, and evaluated items are as follows:

Social Life: life of the inhabitants, population, economic activities, customs

Health and hygiene

Cultural heritage and rare sites

Rare wildlife and ecosystem

Soil and land: Soil, land

Hydrology and water quality: hydrology, water quality, water temperature, atmosphere

2.5.4 Environmental Elements to be Considered for Plan Preparation

On the basis of the environmental items checklist the elements to be considered for planning are summarized below.

① Social life

The present forest management plan does not envisage a forcible settlement of the local inhabitants but it presupposes the prohibition of permanent farming and the opening of new arable lands in the classified forest. However, the limitations that will be imposed on the farming in the classified forests, permanency of farming, the prohibition of the cotton cultivation and the

limitations on the zone of grazing may have some impact on the social life and economic activities of the populations.

However, the present study applied a participatory approach right from the formulation phase of the forest management plan, and the planning, plan implementation and management processes were sufficiently explained to the local inhabitants. Thus, it is expected that this approach will result in mitigation of negative effects on the environment. Moreover, it is essential to find new sources of cash income instead of cotton and to carry out extension activities with regard to intensive agriculture and livestock breading.

② Hygiene and Health

The prohibition of cotton cultivation in the classified forest may reduce the use of agricultural chemicals but it is necessary to avoid using such chemicals in the newly established village nurseries.

③ Historic Buildings, Cultural Heritage and Race Sites

There are no rare sites, historic buildings and cultural heritage to be considered particularly in the area concerned.

④ Rare Wildlife and Ecosystems

There are no areas classified for protection of particular fauna and flora and the ecosystem. However, to mitigate negative impacts on the habitats of the animals by the abrupt change of the vegetation, clear felling in large areas should be avoided and forest should not be left as small isolated patches.

⑤ Soil and Land

When establishing agricultural lands, grasslands and production forests, it is necessary to carry out a soil survey and to avoid the development activities on the fragile type of soils such as Leptosols. Being given that generally the soil is shallow in the area, it is advised not to disturb the soil too much at the time of construction work. Moreover, it is necessary to quickly cover land surface by regeneration and to minimize the duration of its exposure.

⑥ Hydrology and Water Quality

Since torrential rains are expected in the rainy season, it is necessary to take measures for a safe draining of rain water along roads and other structures to minimize the topographic deformation and erosion of land.

3. Survey of the Intensive Study Area

3.1 Preparation of Topographical Maps

Topographical maps(1:50,000 scale) of approximately 102,600 ha Intensive Study Area were prepared in the following way using aerial photographs (1:20,000 scale).

(1) Land Survey

① Pricking

A total of 23 pricking points (18 horizontal control points and 5 auxiliary leveling points) were selected using existing topographical maps with a scale of 1:200,000.

② Surveying of Control Points

GPS surveying of 23 selected points was carried out using the established Mani and Dougoulaye survey points for Appendix and survey results recorded in the survey chart.

③ Leveling

As there was an existing leveling point alongside State Highway 2 which runs north-south along the western side of the target area, 60 km of leveling along road and 5 GPS control points (altitude) were enough to obtain a sufficient degree of accuracy.

④ On-site Survey

This survey was carried out using aerial photographs and on-site surveys to identify vegetation patterns, road width and the presence of bridges.

⑤ Appendix Documents

The names of settlements and waterways, etc. were applied from existing 1:200,000 scale topographical maps. On-site surveys were also used to gather information regarding settlement names and place names, etc.

⑥ Editing, Checking and Correction of Maps

Sample maps scale1:50,000 was prepared after which editing, checking and correction of the spelling of names and verification of numbers, etc. was carried out in preparation for the creation of the topographical maps.

(2) Aerial Triangulation

207 model points were selected from which to carry out aerial triangulation of the entire target area. Aerial triangulation was carried out using the bundle method with 23 level datum and 91 altitude datum. The difference between the datum differential of the aerial triangulation survey and the permissible degree of accuracy is as shown in Table 3-1-1.

Table 3-1-1 Datum Differential and the Permissible Degree of Accuracy of the Aerial Triangulation Survey

Category		Datum Differential	Permissible Degree of Accuracy
Level Position	Maximum Error	1.009 m	4.8 m
	Standard Deviation	0.503 m	2.4 m
Altitude	Maximum Error	1.508 m	4.8 m
	Standard Deviation	0.583 m	2.4 m

(3) Digital Mapping

Based on the prepared interpretation standards, expression classifications, acquired standards and data structure, and using the results of aerial triangulation and aerial photographs, an analytical map-making machine (WILD BC-2) was used to digitize information on topography and landmarks, in order to create digital maps.

- Contour lines were input at 50 m, 10 m and 5 m intervals.
- The maps were based on the specifications determined by the People's Republic of Benin.

(4) Editing of Figures

Numerical data from the approximately 102,600 ha Intensive Study Area was divided in such a way that it would fit into two 1:50,000 scale topographical maps and attributes edited using an editing machine.

- Administrative boundaries and symbols were based on the 1:200,000 scale topographical maps of the People's Republic of Benin and on on-site surveys, etc.

3.2 Forest Survey

3.2.1 Preliminary Forest Survey

A preliminary survey was carried out to collect data, such as the state of forest, survey processes and the state of access etc., that was necessary to design the forest survey. Aerial photographs were used to select 18 areas of forest with different forest types cover, 0.1 ha circular plots were established (17.85 m radius) in each area of forest, and a survey carried out of every tree within each of the plots. The 18 areas of forest with different forest types are shown below.

Forest Type	Number of Plots
Gf	2
Fc	1
Sa	6
Sb	3
St	6
Total	18

Survey items included land condition (location, direction, slope), forest condition (forest type, undergrowth, tree species, diameter at breast height (hereafter referred to as DBH), and tree height, etc.). Forest type codes are the same as those shown in Table 3-2-2.

The single tree volume was calculated using the formula used by the DFRN when the single tree volume in Logging Permit applications are determined.

$$V = \frac{D^2 H \pi}{4} \times 0.33$$

V: Single Tree Volume
D: DBH
H: Tree Height

The average values by forest type obtained from the plot survey are shown in Table 3-2-1.

Table 3-2-1 Average Values by Forest Type

Forest Type Symbol	No. of Plots	Plot No.	Average Values			
			No. of Trees/ha	DBH (cm)	Tree Height (m)	Volume (m^3/ha)
Gf	2	2, 7	480	22.5	8.5	113
Fc	1	10	1180	11.0	7.0	98
Sa	6	1, 3, 9, 12, 13, 17	570	13.0	6.2	34
Sb	3	5, 6 ,8	440	16.2	7.7	41
St	6	4, 11, 14, 15, 16, 18	830	9.5	4.8	19

The results of the plot survey are shown in Appendix 14 at the end of this volume.

According to the result of the survey, the necessary sample plots for the forest survey are as shown below. The average value for volume in the 18 plots was 42.4 m^3 per ha, with a standard deviation of 35.6 m^3 per ha and a variation coefficient of 84%. From these results and using the following formula, the number of sample plots for the forest survey was obtained.

$$n = \left(\frac{t \cdot cv}{E}\right)^2 \times S = \left(\frac{2 \times 0.84}{0.20}\right)^2 \times 1.2 = 84.7 = 85$$

t: The Distribution of t Value t=2.0
cv: Coefficient of Variation cv=84%
E: Estimated Error Ratio E=20%
S: Coefficient of Safety S=1.2

It was found from the above calculations that the necessary number of sample plots was 85.

3.2.2 Interpretation of Aerial Photographs

Photo interpretation of land use and forest type was carried out for the forest of the Intensive Study Area. Interpretation standards for land use and forest type are shown in Table 3-2-2 while tree height and crown density are shown in Table 3-2-3. Interpretations of land use and forest type were corrected and adjusted based on the results of on-site surveys and forest surveys.

Table 3-2-2 Interpretation Categories and Standards

	Forest Cover Symbol	Category	Interpretation Standards
Forest	Gf	Riparian Forest	Areas of high trees located in narrow belts alongside waterways.
	Fc	High Forest	Areas of trees (5m) with a crown density of 60-80% where there is little vegetation on the forest floor.
	Sa	Tree Savannah	Areas of trees (5m) with a crown density of 40-60% where there are also shrubs (<5m) with a crown density of less than 40%.
	Sb	Mixed Savannah	Areas of trees (5m) with a crown density of 40-60% where there are also shrubs (<5m) with a crown density of not less than 40%.
	St	Shrub Savannah	Areas of trees (5m) with a crown density of less than 40% where there are also shrubs (<5m) with a crown density of not less than 40%.
	Pf	Afforestation area	*Tectona grandis*, Eucalyptus, etc.
	Td	Bare Land	
	Tm	Marshes	
	Cl	Laterite cuirasses	
	Ar	Rocky outcrop	
Non-Forest	Pr	Orchards	Mangoes, Cashews
	Ch	Farmlands	Cotton, Maize, Sorghum, Yams, etc.
	Ja	Fallow land	
	Ag	Settlements	
	Ce	Waterways	Including river banks
	Pe	Lakes and Marshes	
	Au	Other	Microwave Stations, Power Pylons

Table 3-2-3 Tree Height and Crown Density

Classification	Symbol	Variation
Tree Height	H1	-9 m
	H2	10-19 m
	H3	20 m-
Crown Density	D1	-24%
	D2	25-49%
	D3	50-74%
	D4	75%-

3.2.3 Creation of Forest Type Maps

After the results of photo-interpretation had been corrected and adjusted the interpretation units transferred to 1:20,000 scale topographical maps and forest type maps were created. The area by forest type calculated from the maps is shown in Table 3-2-4.

Table 3-2-4 Area by Forest Type and Crown Density

(Unit: ha)

Forest Type Symbol	Crown Density				
	D1	D2	D3	D4	Total
Fc	0	0	0	118	118
Gf	60	589	2,070	842	3,561
Sa	1,888	4,342	5,980	1,177	13,387
Sb	7,403	9,512	2,365	143	19,423
St	5,217	398	0	0	5,615
Total	14,568	14,841	10,415	2,280	42,104

3.2.4 Sampling Survey

In order to estimate the growing stock of the classified forest within the Intensive Study Area, a forest survey was carried out based on the sampling survey method.

(1) Sampling Design

① Sampling Method

The survey was caried out by Stratified Random Sampling method based on the interpretation of aerial photographs.

② Stratification

Of forest type classified by means of the interpretation of aerial photographs, riparian forest was classified as Layer I, high forest as Layer II, tree savannah as Layer III, mixed savannah as layer IV and shrub savannah as Layer V according to crown density.

③ Determination of the Number of Sample Plots

In addition to the necessary number of plots (85) obtained from the results of the preliminary survey, 10 more supplementary plots were added to make a total of 95.

④ Location of Sample Plots

The location of the plots was determined by using the stratified area proportional location method. A 100 m ×100 m grid was established on 1:20,000 scale forest type maps and sample plot points established on the intersecting points of the grid. The 95 selected points were distributed according to the proportional area of each stratified layer (see Table 3-2-5). Sampling of the intersection points was carried out using a table of random numbers. The location of each sampling point established on the forest type map was recorded on the aerial photographs.

Table 3-2-5 Number of Plots by Layer

Layer	Forest Type Symbol	Crown Density				No. of Plots
		D1	D2	D3	D4	
I	GF		2	6	2	10
II	Fc				2	2
III	Sa	5	18	6		29
IV	Sb	25	15	1		41
V	St	13				13
Total		43	35	13	4	95

(2) Plot Survey

In each sample plot point established on aerial photographs a 0.1ha circular shaped plot was established (17.84m radius) and in it all trees with a DBH of more than 4cm were surveyed.

A list of the survey items is shown below.

① Outline of Plots

* Commune, Village
* Topography
* Direction

* Slope (°)
* Forest Type
* Undergrowth
* GPS Data
* Comments: Former fallow land and cultivated land, recent logging, etc.

② Forest State

* Trees
* DBH: Trees were measured at a height of 1.3 m above the ground with measurements being rounded to the nearest 2 cm. Trees to be surveyed had a DBH of not less than 10 cm while trees of less than 10 cm were only counted.
* Tree Height: Measured from ground level to tree top in 1 m graduations.
* Comments: Damage from pests, burned trunks, holes in trunks, etc.

(3) Plot Survey Results

Survey results are shown in Table 3-2-6 by forest type. The Forest Survey Plot List and Forest Survey Plot Location Maps used in the sampling survey can be found in Appendix 15 and Appendix 16 respectively.

Table 3-2-6 Results by Forest Type

Forest Type	Gf	Sa	Sb	St	Fc	Total
No. of Plots	10	29	41	13	2	95
No. of Species	60	74	80	53	23	103
No. of Trees/ha (DBH ≥ 10 cm)	262	228	335	128	365	267
Average DBH (cm)	25	20	16	16	21	18
Average Tree Height (m)	11	8	7	6	13	8
Average Timber Volume (m^3)	90	29	21	6	68	30

① Species Found

A total of 102 tree species were found in the 95 surveyed plots.

The most common tree species found in each of the forest type were as follows. Riparian forest (Gf): *Anogeissus leiocarpus, Annona senegalensis, Crossopteryx febrifuga, Combretum glitinosum*; high forest (Fc): *Feretia apodenthera, Anogeissus leiocarpus*; tree savannah (Sa): *Isoberlinia doka, Detarium microcaroum, Vitellaria paradoxa*; mixed savannah (Sb): *Detarium microcarpum, Crossopteryx febrifuga, Vitellaria paradoxa, Terminaria avicennioides*; and shrub savannah (St): T*erminalia avicennioides, Detarium microcarpum.*

The complete list of trees appeared in the plots can be found in Appendix 17 and Appendix 18.

② Proportion of Trees with DBH of More Than 10 cm

Of the trees found in 95 of the plots, species with a high proportion of trees with a DBH of more than 10 cm were *Isoberlinia tomentosa* (88%), *Isoberlinia doka/tomentosa* (81%), *Pterocarpus erinaceus* (80%), *Anogeissus leiocarpus* (77%), *Isoberlinia doka* (72%) and *Daniellia oliveri* (71%), etc.

A list of the species with a high proportion of trees with a DBH of more than 10 cm can be found in Appendix 19.

(4) Growing Stock Estimation

① Total Growing Stock Estimated by Stratified Random Sampling

Based on the data obtained from the plot survey, the total growing stock within the classified forest in the Intensive Study Area was estimated (see Table 3-2-7). The stratification of trees and crown density (D) were used as there was a correlation between stand growing stock and crown density. Total growing stock estimates were carried out of standing trees with a DBH of more than 10 cm.

Table 3-2-7 Calculation of Average and Distribution using the Stratified Random Sampling Method

(Unit: m^3/ha)

Layer	Area (ha)	No. of Samples	Area Proportion	Average by Layer	Total Average	Sample Distribution	Total Average Distribution
D1	14,568	42	0.346	13.60	4.70	63.91	0.1821
D2	14,841	35	0.353	28.14	9.92	58.95	0.2093
D3	10,415	13	0.247	55.85	13.81	473.31	2.2278
D4	2,280	4	0.054	136.00	7.36	6,278.67	4.6029
Total	42,104	94	1.000		35.80		7.2221

* One sample from D1 was removed as it was not counted in timber volume calculations (no standing trees of DBH of more than 10 cm).

Total growing stock estimated with a 95% degree of confidence from Table 3-2-9 is shown in Table 3-3-9.

Table 3-3-9 Total Growing Stock Estimate Results

Total Average Growing Stock (m^3/ha)	35.80
Total Average Standard Deviation (Sv)	2.6874
t (0.05, 90) · SV	5.37
Confidence Interval of Average Growing Stock (m^3/ha)	35.80±5.37
Confidence Interval of Total Growing Stock (m^3)	1,507,323±226,098
Estimated Error Ratio	15.0%

② Total Growing Stock Estimates from Volumes Calculated Method using Aerial Photographs

The per ha stand volume was calculated using the aerial photograph stand volume table by forest type category (created from the results of plot surveys) for each forest type of the classified forest within the Intensive Study Area. The stand volume was obtained by multiplying the volume obtained by the area of each forest type and then calculating the total growing stock from the volume of each area. The result obtained was 1,414,568 m^3.

The aerial photograph stand volume table is shown in Appendix 20.

When there are no aerial photographs, the simple stand volume table shown in Appendix 21 is used to estimate stand volume.

③ Total Growing Stock Comparison

As can be seen from the following, the total growing stock of the classified forest within the Intensive Study Area calculated in ② above falls within the degree of confidence (95% degree of confidence, 15% error ratio) of the total growing stock estimated using the Stratified Random Sampling method found in ① above.

* Total growing stock by accumulation: 1,414,568 m^3

* Total growing stock by Stratified Random Sampling: 1,507,323 m^3±226,098 m^3

Therefore, it was judged that the total growing stock by accumulation falls within the scope of the target accuracy of the sampling design.

3.2.5 Creation of Forest Inventory Books

Data from compartments and sub-compartments by forest type, which were established in 4.2 Forest Management Units and Improvement Units based on the forest type maps, were recorded and forest inventory books were prepared.

Separate forest inventory books were created for both the classified forest and the buffer zone and included the items shown below for each area (the legend for recorded items can be found in Appendix 22).

① Classified Forest

a. Management unit (district).
b. Improvement unit.
c. Forest compartment number and sub-compartment number.
d. Zoning.
e. Land use and vegetation, forest type and land area.
f. State of forest (tree height, crown density, timber volume per ha, stand volume).
g. State of land (altitude, location, slope, special topography, soil group).
h. Comments.

② Buffer Zone

a. Management unit (district).
b. Land use and vegetation, forest type and land area.
c. Land use and forest type and land area.
d. State of forest (tree height, crown density).
e. State of land (altitude, location, slope, special topography, soil group).
f. Comments.

Land use and vegetation and area by forest type by improvement unit as shown in forest inventory books are presented in Table 3-2-9 and Table 3-2-10.

Table 3-2-9 Improvement Unit, Land Use and Vegetation/Area by Forest Type (Classified Forest)

(Unit: ha)

	Forest Type Symbol	Gogounou				Bembéréké			Total
		Zougou-Kpantrossi	Wesséné	Pigourou	Total partiel	Kabanou	Mani-Boké	Total partiel	
Forest	Gf	587.19	861.31	830.26	2,278.76	707.81	574.07	1,281.88	3,560.64
	Fc	8.16	13.07	0.00	21.23	53.52	42.94	96.46	117.69
	Sa	3,666.61	3,571.37	1,655.24	8,893.22	2,537.90	1,956.21	4,494.11	13,387.33
	Sb	3,635.33	4,889.71	3,883.72	12,408.76	3,667.03	3,347.26	7,014.29	19,423.05
	St	1,072.49	1,202.98	912.15	3,187.62	1,210.39	1,216.99	2,427.38	5,615.00
	Pf	0.00	0.00	0.00	0.00	0.00	0.85	0.85	0.85
	Td	5.90	0.00	0.00	5.90	0.00	0.00	0.00	5.90
	Tm	19.16	49.93	97.28	166.37	91.14	41.85	132.99	299.36
	Cl	82.60	137.64	9.23	229.47	57.12	84.07	141.19	370.66
	Ar	0.00	3.49	0.00	3.49	2.00	0.00	2.00	5.49
	Subtotal	9,077.44	10,729.50	7,387.88	27,194.82	8,326.91	7,264.24	15,591.15	42,785.97
Non-Forest	Ch	1,289.30	1,967.48	715.23	3,972.01	1,363.15	815.75	2,178.90	6,150.91
	Ja	1,116.73	462.09	368.82	1,947.64	334.50	217.00	551.50	2,499.14
	Ag	0.00	0.00	2.71	2.71	22.86	8.59	31.45	34.16
	Ce	31.78	13.65	30.84	76.27	0.00	18.69	18.69	94.96
	Au	3.11	6.33	0.00	9.44	6.64	0.00	6.64	16.08
	Subtotal	2,440.92	2,449.55	1,117.60	6,008.07	1,727.15	1,060.03	2,787.18	8,795.25
Total		11,518.36	13,179.05	8,505.48	33,202.89	10,054.06	8,324.27	18,378.33	51,581.22

Table 3-2-10 Improvement Unit, Land Use and Vegetation/Area by Forest Type (Buffer Zone)

(Unit: ha)

	Forest Cover Code	Gogounou				Bembéréké			Total
		Zougou-Kpantrossi	Wesséné	Pigourou	Total partiel	Kabanou	Mani-Boké	Total partiel	
Forest	Gf	802.23	161.91	395.79	1,359.93	410.89	816.49	1,227.38	2,587.31
	Fc	251.79	35.15	44.88	331.82	67.94	162.78	230.72	562.54
	Sa	2,410.23	508.95	348.22	3,267.40	407.20	2,906.30	3,313.50	6,580.90
	Sb	3,324.29	2,196.87	2,588.07	8,109.23	2,309.00	2,885.74	5,194.74	13,303.97
	St	2,467.44	1,170.41	1,609.37	5,247.22	2,182.35	2,047.04	4,229.39	9,476.61
	Pf	3.26	0.00	0.00	3.26	2.09	0.00	2.09	5.35
	Tm	33.64	43.12	22.89	99.65	66.79	56.98	123.77	223.42
	Cl	7.37	0.00	4.85	12.22	3.94	24.23	28.17	40.39
	Ar	4.80	13.33	4.68	22.81	0.00	0.00	0.00	22.81
	Pr	4.92	0.00	3.81	8.73	0.00	0.66	0.66	9.39
	Subtotal	9,309.97	4,129.74	5,022.56	18,462.27	5,450.20	8,900.22	14,350.42	32,812.69
Non-Forest	Ch	3,256.69	2,085.16	3,913.89	9,255.74	3,297.13	2,734.70	6,031.83	15,287.57
	Ja	1,383.01	337.69	312.29	2,032.99	437.89	826.46	1,264.35	3,297.34
	Ag	36.08	4.50	27.90	68.48	6.79	29.91	36.70	105.18
	Ce	11.93	0.00	0.00	11.93	3.43	33.78	37.21	49.14
	Pe	0.00	5.20	0.00	5.20	7.79	35.47	43.26	48.46
	Au	0.00	1.04	0.00	1.04	19.10	0.00	19.10	20.14
	Subtotal	4,687.71	2,433.59	4,254.08	11,375.38	3,772.13	3,660.32	7,432.45	18,807.83
Total		13,997.68	6,563.33	9,276.64	29,837.65	9,222.33	12,560.54	21,782.87	51,620.52

3.3 Soil Survey

3.3.1 Soil Classification

A soil survey was carried out pursuant to the FAO/UNESCO Soil Classification Standards (FAO/UNESCO, World Soil Resources Report 60, Soil Map of the World, Revised Legend by the Food and Agriculture Organization of the United Nations-Rome, 1990).

Soils distributed within the surveyed area were classified into 6 major soil groupings and 12 soil units as shown in Table 3-3-1 according to soil profile characteristics from the results of soil profile description.

Table 3-3-1 Major Soil Groupings, Soil Units and their Physical Characteristics

Major Soil Group/Soil Unit	Main Characteristics
1. Fluvisols (FL)	Immature soil formed of layers of alluvium or comparatively new sediments carried and deposited by waterways, and gravel, and clay, etc.
1) Dystric Fluvisols (FLd)	Fluvisols with a low degree of fertility containing small amounts of base groups and organic material, etc.
2. Regosols (RE)	Immature soil formed of unconsolidated, coarse parent material, such as sand and gravel, etc. Apart from the A horizon, which contains organic material, the other horizons are not especially developed.
1) Dystric Regosols (REd)	Regosols with a low degree of fertility containing small amounts of nutrients such as base groups.
3. Gleysols (GL)	Soil formed of unconsolidated material with the surface horizons containing gleyic properties in the top 50 cm.
1) Dystric Gleysols (GLd)	Gleysols of a low degree of fertility containing small amounts of nutrients such as base groups.
2) Eutric Gleysols (GLe)	Gleysols of a high degree of fertility containing large amounts of nutrients such as base groups.
4. Leptosols (LP)	Thin soil of up to 10 cm consisting of hard rock or a continuous solid layer or accumulations of more than 75 cm of coarse sandy soil with no other horizons developed apart from the A horizon .
1) Dystric Leptosols (LPd)	Leptosols of a low degree of fertility containing small amounts of nutrients such as base groups.
2) Eutric Leptosols (LPe)	Leptosols of a high degree of fertility containing large amounts of nutrients such as base groups.
3) Umbric Leptosols (GLu)	Leptosols containing an umbric A horizon with rich organic matter.
5. Podzols (PZ)	Spodic B horizon: Soil with organic matter and iron or aluminum or a combination of both in a continuous solid subhorizon beneath the A horizon.
1) Haplic Podzols (PZh)	Podzols with a continuous albic horizon with a depth of more than 2 cm.
2) Gleyic Podzols (PZg)	Podzols with gleyic properties within 100 cm of the surface horizon.
6. Ferrasols (FR)	Soil containing a Ferralic B horizon (a B horizon containing high concentrations of 3·2 sesquioxides).
1) Haplic Ferrasols (FRh)	Ferralsols that are not particularly red and do not contain high levels of organic material.
2) Xanthic Ferrasols (FRx)	Ferralsols with a strong brown Ferralic B horizon containing no organic matter.
3) Rhodic Ferrasols (FRr)	Ferralsols with a strong red Ferralic B horizon containing no organic matter.

The soil survey location map, soil profile description results and soil group characteristics can be found in Appendixes 23, 24, and 25.

3.3.2 Soil Distribution

Distribution of soils found in the surveyed area was shown on topographical maps with a scale of 1:20,000 with soil units as mapping units. With regard to soil units, where multiple soil units are mixed and the distribution properties are unclear, these were shown as mixed areas with multiple soil types. An outline of soil distribution is shown below.

* Fluvisols and Gleysols are mixed in an irregular manner in waterways or in low land along

waterways. Although it is possible to further classify both of these soil groups into multiple soil units, Dystric Fluvisols (FLd) is the only soil unit for Fluvisols. Although Gleysols consist of Dystric Gleysols (GLd) and Eutric Gleysols (GLe), as the distribution of these three soil units is irregular (including Dystric Fluvisols (FLd)) they were shown as FL-GL. There is no problem in forest management with handling these as the same soil type.

* In the area surrounding the small hills on the tectonic line in the western area, Regosols, the parent material of which are gneiss granite, run in a north-south belt.
* Outcrops of iron rock or extremely thin layers of Leptosols can be seen on the convex shape of the eroded surface or elevated residual relief on the plateau.
* Haplic Ferralsols and Xanthic Ferralsols are widely distributed on the flat ground in the middle of the plateau. Elsewhere on the plateau, Rhodic Ferralsols with a strong red color are found distributed within the sedimentary rock from the Cretaceous Period known as Kandi sandstone. Although Distric Gleysols are distributed in the convex areas of the plateau, areas where this soil appears are flooded during the rainy season. Haplic podzols are found in the cultivated area of the plateau.
* Gleysols are found from the flat areas on the lower parts of the plateau to the areas with the convex shape.

3.3.3 Soil Conditions and Land Use

Based on soil conditions and environmental conditions the 12 soil unit classifications were ranked according to their degree of suitability for forest operations and land use, and are shown in Table 3-2-2. Points for consideration with regard to ranking are shown below.

(1) Rank I

Distributed mainly along waterways, these areas consist of mainly mixed areas of Fluvisols and Gleysols. Planting of most species of forest trees is possible and this area provides the best possibility of growth. However, as this area is expected to flood during the rainy season, it is necessary to verify flood levels before planting tree species that are susceptible to flooding.

(2) Rank II

Ferralsols are the main type of soil with small areas of Eutric Gleysols and Podzols. It is possible to grow both native species and exotic species. These soils contain low concentrations of base groups, such as calcium and magnesium, etc., and organic matter 10-15 cm below the surface. Although trees can be expected to grow moderately, short cutting cycles should be avoided due to the low fertility of the soil.

(3) Rank III

Soil in areas of exposed gneiss granite or iron rock with a north-south structure or in rather shallow positions. An examination of the soil profiles showed that it is an immature soil with large volumes of grit, making these difficult conditions for trees to grow in. While in some areas of Leptosols exotic species are hardy enough to cope with the poor soil conditions, generally this type of soil is not good for growing. Planting should be confined to the smallest extent possible.

Table 3-3-2 Soil and Forest Operations

Soil Group/Soil Unit	Rank	Forest Operations
1. Fluviosols (FL)		
1) Dystric Fluvisols (FLd)	I	Planting of Most Species of Trees
2. Regosols (RE)		
1) Dystric Regosols (REd)	III	Natural Forest
3. Gleysols (GL)		
1) Dystric Gleysols (GLd)	III	Natural Forest
2) Eutric Gleysols (GLe)	II	Planting Possible
4. Leptosols (LP)		
1) Dystric Leptosols (LPd)	III	Natural Forest
2) Eutric Leptosols (LPe)	III	Natural Forest
3) Umbric Leptosols (GLu)	III	Natural Forest
5. Podzols (PZ)		
1) Haplic Podzols (PZh)	II	Planting Possible
6. Ferrasols (FR)		
1) Haplic Ferrasols (FRh)	II	Planting Possible
2) Xanthic Ferrasols (FRx)	II	Planting Possible
3) Rhodic Ferrasols (FRr)	II	Planting Possible

3.4 Farming and Stock Raising Survey

3.4.1 Farming in the Intensive Study Area

(1) Ownership of Farmland

As a rule, the State shall retain ownership of all land. However, traditional chiefs and land chiefs are given the right to use the land (the right to reside in and cultivate the land) within which they are given the right to exercise their individual hereditary rights (the right to reside in and cultivate the land). A survey to ascertain the state of the local inhabitants revealed the scale of farmland ownership of the 107 farmers within the Intensive Study Area. These results are shown in Table 3-4-1.

Table 3-4-1 Scale of Farmland Ownership

(unit: ha)

Province / Ownership Scale	GOGOUNOU		BEMBEREKE	
	No. of Farmers	Farmland Area	No. of Farmers	Farmland Area
≤ 1.0 ha	- -	-	1 (1.9%)	0.50
1 - 1.9	2 (3.6%)	2.75	- -	-
2.0 - 4.9	8 (14.5%)	30.76	8 (15.4%)	25.93
5.0 - 9.9	19 (34.5%)	122.25	17 (32.7%)	127.64
10.0 - 14.9	13 (23.6%)	143.39	12 (23.1%)	145.75
15.0 - 19.9	8 (14.5%)	125.50	4 (7.7%)	66.00
≥ 20.0	5 (9.1%)	110.75	10 (19.2%)	258.25
Total	55 (100%)	535.40	52 (100%)	624.07
Average	-	9.74	12.00	-

Although the scale of farmland ownership per farmer ranges from less than 1 ha to more than 20 ha, in both areas the highest proportion of farmers possessed land ranging in size from 5 ha to 10 ha.

The average scale for Bembereke was larger than that of Gogounou.

(2) Crop Growing Area Trends

In Gogounou and Bembereke, which include the Intensive Study Area, the main crops are cotton, maize, yams and sorghum and between them they account for approximately 90% of crop growing land. The crop growing areas for 1988 and 1998 by crop are shown in Table 3-4-2.

Although the crop growing area is increasing in both Gogounou and Bembereke, the area used for growing cotton is increasing at the fastest rate and the proportion of land used for growing cotton doubled over the period of 10 years. Maize, rice and yams are next, although the area used for growing maize and yams is almost the same and the proportion of land used for growing these two crops has not basically changed over the 10 year period.

Table 3-4-2 Crop Growing Area Trends

Crop	Gogounou					Bembéréké				
	1988		1998		Increase Ratio	1988		1998		Increase Ratio
Cotton	3,209	23.9%	14,721	55.9%	16.5%	3,919	22.0%	20,450	42.4%	18.0%
Maize	2,248	16.7%	4,380	16.6%	6.9%	4,313	24.2%	12,090	25.1%	10.9%
Sorghum	3,276	24.3%	2,022	7.7%	-4.7%	4,796	26.9%	5,260	10.9%	0.9%
Yams	1,133	8.4%	1,944	7.4%	5.5%	2,384	13.4%	6,215	12.9%	10.1%
Tapioca	423	3.1%	447	1.7%	0.6%	961	5.4%	1,965	4.1%	7.4%
Peanuts	1,912	14.2%	1,093	4.1%	-5.4%	423	2.4%	972	2.0%	8.7%
Cowpeas	1,131	8.4%	1,369	5.2%	1.9%	1,010	5.7%	1,113	2.3%	1.0%
Rice	122	0.9%	367	1.4%	11.6%	27	0.2%	126	0.3%	16.7%
Total	13,454	100%	26,343	100%	6.95%	17,833	100%	48,191	100%	10.45%

Source: Rapport Annuel Carder-Borgou (1998)

(3) Estimated Area of Land for Growing Food for Self Sufficieney

① Estimates from Statistics

The per adult annual farm product growing area required to be self sufficient as calculated by the Agriculture Administration Bureau was calculated on the basis of the per adult annual food consumption volume of main crops provided by the Stable Food Supply Corporation (ONASA) and the unit yield as calculated by the Agriculture Administration Bureau. In Gogounou and Bembereke, the per adult land area used for growing food for self sufficiency was 0.150 ha and 0.1985 ha respectively while the average per adult land area used for growing food for self sufficiency was 0.174 ha. If the household size is 9.7 people (see (4) farming population) then the necessary land area required for growing food for self sufficiency per farmer is 1.69 ha.

② Estimates from the Survey to Ascertain the State of the Local Inhabitants

The main foods consumed in the villages are yams, maize, tapioca and sorghum. Based on the area of land required for self sufficiency as determined by the Agriculture Administration was obtained by multiplying the average per meal consumption volume per adult by the annual number of meals and dividing it by the unit yield. The land required for self sufficiency was 0.23 ha, and if there is an average of 9.7 people per household, then the land required for self sufficiency per household is 2.23 ha (please see Table 3-4-3).

Table 3-4-3 Area Required for Self Sufficiency

Crops	Annual No. of Meals	Per Adult Consumption Volume (kg)	Annual Consumption Volume (kg)	Unit Yield (kg/ha)	Area for Self Sufficiency (ha)	
					By Crop	Total
Yams	336	0.88	296	9,500	0.03	0.23
Maize	574	0.38	109	1,525	0.07	
Sorghum			109	900	0.12	
Tapioca			44	7,000	0.01	

③ Estimate of Land Area Required for Self Sufficient Food Production

Although the land area necessary for a single farmer to achieve self sufficiency is 1.69 ha according to statistics and 2.23 ha according to the survey to ascertain the state of local inhabitants, in this survey the land area required for a single farmer to achieve self-sufficiency was taken to be 2.23 ha.

(4) Farming Population

According to the results of the Pre Farming Census carried out in Benin, the farming population ratio (proportion of the total population accounted for by the farming population) in the 6 settlements in Gogounou and the 6 settlements in Bembereke was almost 100%. The population per farm was 8.6-14.5 people with an average of 9.7 people. The farm worker ratio (the proportion of the farming population over the age of 15 and under the age of 60 that are farm workers) was approximately 50% and the number of farm workers per farm was 6.3 people over the 12 settlements, which is more than the average of 4.8 people for Borgu as a whole. The farming population by settlement can be found in Appendix 26 at the end of this volume.

(5) Farm Production

① Exploitational Farm Production

The present form of farming is exploitational farming which uses only the degree of fertility of the soil. With cotton and yam growing in particular, as productivity increases according to the degree of fertility of the soil, repeated shifting cultivation is practiced with farmers moving from one area of high fertility to the next. In addition, the price of materials required for farming and factors apart from social factors, such as the distribution of farm products and the securing of markets, etc., place definite restraints on fixed farming.

② Unit Yield Volumes and Production Volumes

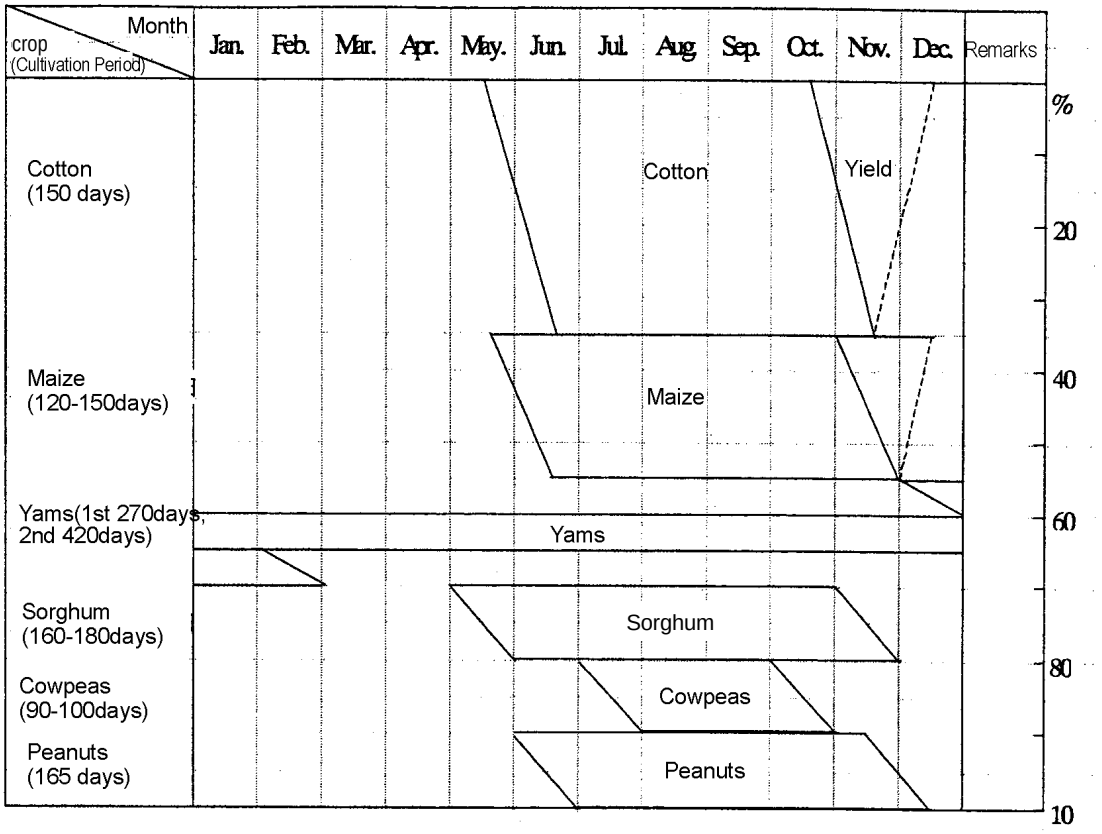
The average unit yield (3 year average for Gogounou and 5 year average for Bembereke) for the main crops of settlements related to the Intensive Study Area is shown below.

In Gogounou, although the settlement average unit yield for cotton at 1,111 kg/ha was lower than the district average of 1,541 kg/ha, the settlement average unit yields for maize, sorghum and yams were 1,451 kg/ha, 799 kg/ha and 9,119 kg/ha respectively, which were higher than the district average unit yields at 1,080 kg/ha, 538 kg/ha and 4,272 kg/ha respectively.

In Bembereke, although the settlement average unit yields for cotton and maize at 1,345 kg/ha and 1,128 kg/ha were lower than the district averages of 4,047 kg/ha and 1,229 kg/ha, the settlement average unit yields for sorghum and yams were 990 kg/ha and 11,617 kg/ha respectively, which were higher than the district average unit yields at 922 kg/ha and 9,970 kg/ha respectively. Crop unit yields can be found in Appendix 27.

Present Crop Growing Systems

Present crop growing systems are shown in Figure 3-4-1. Cotton is left in the fields to dry after the flower has opened until it is harvested and as the growing period is more than 150 days and maize, etc. also requires a long growing period, it is difficult to grow two crops in a single year.



Note: The % on the right of the chart refers to the proportion of production volumes.

Figure 3-4-1 Present Crop Growing System

④ Present Crop Rotation Growing System

The present typical crop rotational growing system for cotton growing is shown in Table 3-4-4.

Table 3-4-4 Present Crop Rotation Growing System

1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year
Yams	Cotton	Cotton	Maize Sorghum	Maize Sorghum	Tapioca	Fallow

After the land has been cleared, yams are grown, in the second and third year cotton is grown, in the fourth and fifth years maize and sorghum are grown, in the sixth year tapioca is grown and in the seventh year the ground is left fallow. Generally the ground is left fallow for five to six years, although in recent years the trend has been to only leave it for two to three years. This is due to the increase in population and the fact that farmland has to be used to grow crops to feed people, meaning that it is not possible to leave the ground fallow for longer periods of time. In Pigourou and Mani-Boke, there are some fields that are never allowed to remain fallow. The Farm Calendar for the present rotational crop growing system can be found in Appendix 28.

⑤ Commercial Farming and Production Materials

(a) Seeds and Seedlings

Cotton seeds are supplied by the Farming Promotion Corporation (SONAPRA). With regard to maize, improved species of seed are now widely used due to the mediation of Farm Improvement and Forest Improvement Fund Officers. Compared with native species, the improved species of seed have better unit yields and are more resistant to disease and pests. Recovered seed and seed potatoes are used for sorghum, cowpeas and yams.

(b) Fertilizer

Although chemical fertilizers are being used for cotton, they are hardly ever used for other crops. Commonly used fertilizer for cotton growing includes the composite fertilizer 15-15-15 and urea. Although the Fulbe tribe uses some manure from livestock, they do not, however, use any organic fertilizer or compost.

(c) Animal-Power and Farm Machinery

Animal-powered farming has been carried out in Borgu Province (Department) since the 1960s and is centered mainly around cotton growing. By using loans to purchase equipment for cultivation using bullocks, most of the farmers in the classified forest now use animals for ploughing, soil preparation and transporting harvests. Although tractors are used for ploughing on the comparatively large areas of farmland in the buffer zone, they are not used within the classified forest at all. Other work is carried out using manpower.

(d) Farm Workers

Although farm work is usually taken care of by family members, as cotton growing requires a large number of workers, there are times when workers other than family members may be employed.

(e) Crop Production Costs

Per ha production costs for the main crops, including the cost of purchasing seeds, fertilizer, and pesticides, as well as labor costs, are as follows. Cotton (175,400 FCFA/ha), maize (141,985 FCFA/ha), and yams (179,000 FCFA/ha). Details regarding such costs, etc., can be found in Appendix 29.

3.4.2 Farming in Five Settlements

The present state of farming in five settlements within the classified forest (Zougou-Kpantrossi, Wessene, Pigourou, Kabanou and Mani-Boke) are as follows.

(1) Farmland Area

The area of farmland (cultivated land and fallow ground) by village obtained from forest type maps created through the interpretation of aerial photographs is shown in Table 3-4-5.

Table 3-4-5 Farmland Area by Village

(unit: ha)

Category	Classified Forest				Buffer Zone				Total	
Settlement	Cultivated Land	Fallow Ground	Total	%	Cultivated Land	Fallow Ground	Total	%	Total Area	%
Zougou-Kpantrossi	1,289.30	1,116.03	2,406.03	34	3,256.69	1,383.01	4,639.70	66	7,045.73	100
Wesséné	1,967.48	462.09	2,429.57	50	2,085.16	337.69	2,422.85	50	4,852.42	100
Pigourou	715.23	368.82	1,084.05	20	3,913.89	312.29	4,226.18	80	5,310.23	100
Kabanou	1,363.15	334.50	1,697.65	31	3,297.13	437.89	3,735.02	69	5,432.67	100
Mani-Boké	815.75	217.00	1,032.75	22	2,734.70	826.46	3,561.16	78	4,593.91	100

Wessene has the largest proportion of authorized farmland in the classified forest at 50%, while Pigourou has the lowest proportion at 20%.

(2) Crop Growing Area

The total of cotton growing land area for all five settlements is 2,900 ha, with approximately 50% of that area being located within the classified forest. The proportion for Kabanou is especially high at 80%. The area of land used for growing cotton is shown in Table 3-4-6.

Table 3-4-6 Cotton Growing Land Area

(Unit: ha)

Settlement	Classified Forest	Buffer Zone	Total
Zougou-K	173.7 (23%)	576.3 (77%)	750.0
Wesséné	436.0 (56%)	349.0 (44%)	785.0
Pigourou	202.1 (43%)	272.9 (57%)	475.0
Kabanou	355.0 (81%)	85.0 (19%)	440.0
Mani-Boké	236.2 (52%)	213.8 (48%)	450.0
Total	1,403.6 (48%)	1,496.4 (52%)	2,900.0

Note: % indicates the total proportion of land used for growing cotton for each settlement.

The crop growing area of the classified forest was calculated by multiplying the field area within the classified forest obtained in (1) above by the crop growing ratio obtained through interviews with typical farmers. Results indicated that the average crop growing area for crops other than cotton was 2.09 ha per farmer. The processes used for calculating this figure can be found in Appendix 30.

(3) Farmer Income

A survey of the average income and expenditure of farmers was carried out based on the results of interviews. Characteristics of the income and expenditure of farmers in the five settlements are shown below. Details can be found in Appendix 31.

* Most of the income was derived from the sale of cotton. Most farm products and livestock products were consumed by the farmers themselves with very little income being derived from sales of these products.

* Most expenditure was related to living expenses. The purchase of food accounted for approximately 10% of all expenditure.

* The gross income of farmers with a high land use ratio was high.
* In Pigourou and Wessene, farmer income from the sale of livestock products was high.

(4) Income from Cotton Growing

The per hectare gross income for cotton farming in the five settlements (consisting of the net profit calculated by subtracting farm material expenses from the total value of production volumes) was 164,000 FCFA. Details regarding this can be found in Appendix 32.

3.4.3 Livestock Raising

(1) Numbers of Main Livestock

The main types of livestock in the Intensive Study Area are cows, sheep and goats. Cows are mainly a cross between Borgu and Zebu that are resistant to trypanosoma. Although poultry includes chickens and guinea fowl, these are usually limited to what can be raised in front of the farmer's home. The numbers of livestock by settlement as estimated by the Stock Raising Bureau are shown in Table 3-4-7.

Table 3-4-7 Numbers of Main Livestock by Settlement

(unit: tête)

Settlement / Livestock	Zougou-Kpantrossi	Wesséné	Pigourou	Kabanou	Mani-Boké
Cows	1,437	2,275	755	1,250	2,100
Sheep	660	886	299	720	980
Goats	298	483	153	680	910
Total	2,395	3,644	1,207	2,650	3,990

Source : Direction de l'Elevage, CARDER-Borgou (1999)

(2) Livestock Raising Systems

The aim of livestock farmers is to increase the number of livestock and little thought is given to securing and introducing superior breeds, or improving the existing feeding environment or feeding techniques with the aim of increasing productivity.

① Breeding

Breeding techniques within the settlement consist of natural mating alone. As the rearing environment is relatively harsh, the most appropriate time to have the animals coming into heat is at the end of the wet season, with nothing taking place during the dry season. That means that the young are born during the period from May through to August.

② Rearing Techniques

Herds are divided into cows and bulls and they are allowed to drink in the morning and are allowed to graze during the afternoon. During the rainy season they graze in the area around the settlement (natural pasture) or are allowed to feed in formerly cultivated fields.

③ Nomadic Grazing

Although nomadic grazing is carried out during the dry season when there is a shortage of waterholes and natural feed, such grazing can be divided into short-term nomadic grazing and long-term nomadic grazing. Short-term nomadic grazing is carried out within the Intensive Study Area by the Fulbe tribe who live there during September and October and the scope of such

grazing also includes the area around the Trois-Rivières Classified Forest. By contrast, long-term nomadic grazing is not only carried out by established Fulbe tribes but by Fulbe tribes from areas outside Benin, such as Niger and Nigeria and stretches from November through to June. Fulbe tribes from outside use the Trois-Rivières Classified Forest area for grazing and during the dry season a large number of livestock camps are established within the classified forest.

④ Sources of Livestock Feed

During the rainy season, livestock obtain enough to eat from the grass in grazing areas. During the dry season, herds graze in a particular area and feed on feed trees and the leaves from peanut vines and cowpea vines, etc. Wandering livestock are given the leaves of young trees to eat.

Sources of feed for livestock that are being utilized within the Intensive Study Area are shown in Table 3-4-8.

Table 3-4-8 Sources of Feed for Livestock in the Intensive Study Area

Classt	Dry Season		Rainy Season	
	Local Name	Scientific Name	Local Name	Scientific Name
Grass	Monri	*Oryza barthii*	Kombossou	*Andropogon gayanus var. bisquamulatus*
	Kabanou	*Andropogon gayanus*	Saka Wenou	*Pennisetum polystachion*
			Winyan	*Brachiaria jubata*
			Kpedi	Unknown
			Ke	Unknown
			Wougbaou	Unknown
Trees	Gbebou	*Afzelia africana*		
	Tona	*Pterocarpus erinaceus*		
	Gbiribou	*Khaya senegalensis*		

3.5 Forest and Forestry

(1) Logging and Regeneration Methods

① Logging Methods

Logging of the natural forest within the classified forest in accordance with the improvement plan and logging of natural forest authorized by the DFRN in the free zone shall be carried out by means of selective logging. Even when developing land within the free zone, in accordance with the Forest Law, 25-40 trees per ha of protected species of trees must be retained.

Logging methods to be employed in man-made forest, most of which consists of *Tectona grandis*, include clear felling and thinning. As initial growth of *Tectona grandis* is rapid, in private forests clear felling is carried out every 5-10 years and the trees used for posts and fuelwood.

② Regeneration Methods

The regeneration of natural forest is carried out by regeneration renewal while man-made forests are replanted with seeds and seedlings. Forest is being created in order to clarify ownership of formerly cultivated land and to restore the productivity of the forest, etc. The acquisition, transportation, planting and raising of seedlings all costs money.

In man made forest *Tectona grandis* is mainly used with fast-growing species, such as *Gmelina arborea* and *Cassia siamea*, etc. being planted as boundary trees. In the enrichment (the planting of seedlings in areas of sparse native forest in order to increase the growth density of useful species) of native forest and the planting of trees within the settlements, native species, such as *Khaya senegalensis*, etc. are mainly used.

Planting spacing in man-made forest for *Tectona grandis* is 2 m × 2 m (2,500 trees/ha) or 2 m × 2.5 m, and 10 m × 10 m for cashews and mangoes. Furthermore, under the inprovement plan for the Toui Kilibo Classified Forest, planting of the native *Milicia excelsa* and *Khaya senegalensis* species shall be carried out at a spacing of 10 m × 10 m for enrichment purposes.

(2) Age at Maturity/Cutting Cycle

① Age at Maturity

Although the age at maturity has not been determined, under a presidential decree in 1974, when issuing logging permits it was determined that the girth at breast height (GBH), or 1.3 m, for *Khaya senegalensis* and *Afzelia africana* shall be more than 200 cm (DBH: 64 cm). However, no structured research has been carried out regarding the age at which trees reach that diameter and the growth rate of the natural forest is unknown.

The age at maturity of *Tectona grandis* in areas of man-made forest as used by the Forestry Corporation (ONAB) for classified forest in southern areas of Benin has been set at 40~50 years

(for timber) and it is known that the diameter of trees increases at an annual rate of 10 mm. In areas of private forest, a cutting cycle of 5-10 years is used for the production of posts.

② Cutting Cycle

For selective logging, a formula has been established using the stand growth rate and the selective cutting ratio, so although intensive forestry operations with a low selective logging ratio and a high cutting ratio are desirable, in reality a high selective logging ratio is more advantageous. However, it is difficult to set appropriate cutting cycles, etc. as the stand growth volume is unclear, as we have already seen. Under the improvement plan for the Toui Kilibo Classified Forest, the cutting age for selective logging operations (with enrichment) in natural forest is set at 50 years with a cutting cycle of 25 years.

(3) Forest Fires

Frequent wild fires and controlled burning result in the loss of young trees that have grown through natural regeneration and hinder sustainable forest management through the loss of forest floor vegetation. As organic matter cannot be supplied to the soil, this leads to a decrease in porosity, permeability and water holding capacity and a decrease in soil productivity, as well as various forms of overall forest deterioration, such as the loss of wildlife habitats, etc.

Although the DERN encourages early controlled burning (controlled burning at the beginning of the dry season) based on the Forest Law, the local inhabitants have their long-standing customs and have little respect for new concepts. Therefore, between 1990 and 1994 the Borgu DFRN established test sites in 10 locations where early controlled burning was carried out.

Such early controlled burning has been carried out on an experimental basis at the test site established in the village of Danganzi in the Kakake district. Results show that early controlled burning increases the fertility of the soil more than late controlled burning and provides good feed for livestock while proving to be effective at preventing the spread of wildfires (ground level fires) to the tree tops.

(4) Forest Management System

Although the on-site Forestry Officer located in each commune carries out the management of the classified forest and the free forest, as on-site Forestry Officers are not located in every commune, in many cases a Forestry Technology Specialist (TS/F) attached to the district office of the Agriculture Administration Bureau doubles as the on-site Forestry Officer.

3.6 Community Forest

(1) Fuelwood Production

Forest creation in the settlements shall be carried out using fast-growing trees in order to allow villagers to recoup their investment in forest creation as soon as possible. Species to be used for timber are *Tectona grandis* and Eucalyptus. Eucalyptus is not a strong building material and once planted inhibits the growth of undergrowth. It is more suitable for planting in areas of light rainfall.

Tectona grandis shall be planted at a planting density of 2,500 trees/ha (2 m × 2 m) or 2,000 trees/ha (2 m × 2.5 m) and shall be logged after 5-10 years. Initially, planting shall be carried out using seedlings with consequent planting being carried out by germination regeneration with bud pruning also being carried out at necessary times. As they lose their leaves during the dry season, the prevention of wild fires is important.

Cassia siamea, *Gmelina arborea* and *Acacia auriculiformis*, etc. are the trees of choice for fuelwood production. The planting density of fuelwood forest shall be 1,666 trees/ha (2 m × 3 m) or 1,111 trees/ha (3 m × 3 m) and they shall be logged in the fifth year.

(2) Seedling Production

As there are no village nurseries within the classified forest, *Tectona grandis*, cashews, mangoes, *Acacia auriculiformis* and *Gmelina arborea*, etc. seedlings have to be purchased from other areas and planted. In the future, in order to implement the forest improvement plan and to create new areas of forest, it will be necessary for nurseries to be newly established in the villages in order to produce seedlings of fast growing species, native species, fruit trees and trees and plants, etc. for medicinal use.

Furthermore, *Tectona grandis*, *Cassia siamea*, and *Gmelina arborea*, etc., seedlings can be raised on open land during the rainy season and if they are stamp planted during the latter half of the dry season for storage purposes, it is possible to vary planting times, making the transportation of seedlings easier and reducing the need for them to be watered. Whether or not the nurseries in the villages succeed will have a great impact on the promotion of the community forest.

(3) Fruit Trees

Fruit trees to be introduced in settlements include mangoes, cashews and citrus trees. Of these, as there is presently little possibility of carrying out secondary process of mangoes (dried mangoes or jam, etc.), they should be sold alongside State Highway 2 or used for personal consumption. Citrus trees are not exactly planted in the most suitable ground so they should be used for personal use as well.

With regard to cashews, ISHOKAN Project, an NGO, started work in 1992 together with the Agriculture Administration Bureau and with assistance from various overseas countries, including Japan, to promote the creation of cashew plantations with the nuts being collected and sold to supplement the income of farmers. At present, the district office of the Agriculture Administration Bureau has nurseries in 12 location and the settlements have nurseries in four locations that have a combined annual production of 150,000 seedlings (equivalent to 1,500 ha) which are distributed to farmers for planting.

Seedlings are planted in a zigzag fashion at a spacing of 10 m × 10 m. Seedlings start to produce nuts 18 months after planting and from that time harvest volumes continue to increase until the ninth or tenth year after which stable production will continue for approximately 60 years in good conditions. However, cashews are susceptible to fire and require relatively heavy maintenance, such as fertilizing, etc. Harvest volumes are approximately 2 tons per ha (a 100 kg bag can be filled from 5 trees) and supplement the income of farmers by approximately 400,000 FCFA per ton. Cashews are an export product and a promising item on the community forestry agenda.

(4) Bee-Keeping

On the outskirts of Parakou at the NGO Bee-Keeping Center, local inhabitants with an interest in bee-keeping are being trained in the single hive method in order to improve traditional bee-keeping techniques (both bees and hives are damaged as smoke is used to remove hives with traditional techniques). Follow-up is also being carried out by animators. A total of 11 settlements within Borgu have formed a Bee-Keeping Cooperative.

Three types of hive are available. A new improved round hive (2,800 FCFA), a simple hive made of wood and concrete, and a more serious model made of wood, wire, corrugated iron and concrete (15,000 FCFA). 12 individual hives can be located in every hectare of fallow ground.

Trees that can be planted as a source of nectar include *Khaya senegalensis*, *Vitellaria paradoxa*, *Parkia biglobosa*, *Pterocarpus sp.*, *Xanthexylum* sp., mangoes, cashews, *Azadirachta indica*, *Acacia auriculiformis* and new species such as *Moringa oleifera* and *Newboudia* laevis, etc.

The annual volume (average over 3 years) obtained from the improved round hives was 7-liters, with

9-liters being obtained from simple hives and 25-liters from the serious model. Bee-keepers are paid 1,500 FCFA per liter. Honey is collected at the headquarters of the Bee-Keeping Cooperative in Parakou (the Bee-Keeping Center provides technical guidance and quality management). Although the main markets for honey are the cities, as production is not able to keep up with demand at present, honey also appears to be a promising item on the community forestry agenda.

(5) Fish Breeding

Most of the Bouli River and its tributaries in the Intensive Study Area dry up during the dry season (over half of the area of the Bouli River is marked as dried up during the dry season on the 1:200,000 scale topographical maps). As the difference in water level between the rainy season and the dry season is incredible, and there are many other problems that need to be solved in the meantime, it is considered too early to do anything about this problem in order to make way for fish breeding.

(6) Processing of Forest Products

Processing currently being carried out in the settlements using machines and tools is basically limited to the milling of flour using flour mills. In the future, it will be difficult to handle the increase in population by means of stock farming alone. Therefore, it will be necessary to examine the possibility of adding the simple processing of timber using circular saws, the processing, etc. of *Vitellaria paradoxa* using an oil press and the in-house processing of farm products to the community forestry agenda.

3.7 Survey to Ascertain the Actual State of the Local Inhabitants (Second Part)

Part 2 of the Survey to Ascertain the State of the Local Inhabitants was carried out with the Intensive Study Area as the target area.

3.7.1 Survey Implementation

(1) Survey Aim

The aim of the Survey to Ascertain the State of the Local Inhabitants (Second Part) was to ascertain the lifestyle of people in settlements directly related to the Classified Forest in order to formulate a forest management plan with the participation of the local inhabitants.

(2) Survey Method

The main survey was divided up into four major components.

① Settlement Mapping

As there are no clearly defined political boundaries for the settlements, the local inhabitants themselves drew in the boundaries of the settlement on a mosaic of an enlarged aerial photograph.

② Key Informant Interviews

Interviews were carried out of traditional chiefs, administrative officers and representatives from the Fulbe tribe to gather information regarding the traditions, social customs, existing socioeconomic state and inter-tribe problems, etc. of the target settlement.

③ Seasonal Labor Calendar and Household Finances

Five couples were selected from each target settlement, a seasonal labor calendar created, and a survey of the state of the division of labor between men and women was carried out. Three to four villagers were then chosen at random and the income and expenditure of each household investigated.

④ Group Discussion

In each settlement, a group discussion attended by traditional chiefs, administrative officers, farming organization representatives, and the local inhabitants in general was held. The local inhabitants themselves first asked questions, an order of priority was then established, and existing and future solutions presented. In the group discussion, questions were not confined to the topic of forest improvement but included problems regarding the whole spectrum of life.

(3) Target Settlements

The target settlements involved in the Survey to Ascertain the State of the Local Inhabitants (Second Part) were the settlements located within the Intensive Study Area and settlements where it was thought that the local inhabitants were using the Classified Forest. These target villages are shown in Table 3-7-1.

Table 3-7-1 Target Settlements of the Survey to Ascertain the State of the Local Inhabitants

District	Commune	Settlement	Location
Gogounou	Zougou-Kpantrossi	Zougou-Kpantrossi (including Zougou-Peulh)	Inside the Buffer Zone of the ISA
	Sori	Gamagou (including Petit-Paris)	Outside the ISA
		Wessene (including Wessene Peulh)	Inside the Buffer Zone of the ISA
		Pigourou	inside the Buffer Zone of the ISA
Bembereke	Beroubouay	Beroubouay-Est	Outside the ISA
		Kabanou (including Boukomberou, Karakou Dassi, Koussine, Sanse, etc.)	Inside the Buffer Zone of the ISA or inside the Classified Forest
	Gamia	Mani-Boke	inside the Buffer Zone of the ISA
		Ganro	Outside the ISA
		Gamia-Est (including Bouay, Bereke)	Outside the ISA

Note: ISA=Intensive Study Area.

Of the settlements shown in Table 3-7-1 above, as it was discovered that the people or Ganro were not utilizing the Classified Forest due to the distance involved, mapping of the settlements was not carried out

3.7.2 Survey Results

(1) Settlement Mapping

Based on the boundaries of land for cultivated use in each settlement as indicated by the local inhabitants on aerial photographs, tentative settlement boundaries were established with consideration being given to clear topographical landmarks, such as waterways and roads, etc.

(2) Key Informant Interviews

① Settlement Origins

Although it is extremely difficult to pinpoint the dates and reasons for the establishment of the target settlements, the establishment dates according to the testimony of village elders are shown in Table 3-7-2.

Table 3-7-2 Settlement Establishment

Settlement	Establishment Dates
Zougou-Kpantrossi	Prior to French colonization at the end of the 19th century
Pigourou	During the Nikki Dynasty but dates are unclear.
Boke	Around 1916 although migration dates are unclear.
Kabanou	Around 1916 although migration dates are unclear.
Wessene	Around 1916 although migration dates are unclear.
Mani	Migration dates are unclear and the settlement has now combined with Boke.

The Trois-Rivières Classified Forest was designated as a state forest on September 6, 1949 by Order No.4524 of the Government-General. However, the 13 enclaves existing within the forest before it was designated as a state forest were excluded from the state forest. In this improvement plan, those settlements of the original 13 include Zougou-Kpantrossi, Wessene, Pigourou, Boke (including Mani), and Kabanou, which it is clear existed well before the order of the Government-General.

② Traditions and Customs

The Intensive Study Area is located within the cultural boundaries of the Baatombu tribe. Tribes within the area include the Baatombu, Boo and Fulbe tribes. The Baatombu and Boo tribes have much in common both socially and culturally and have tended to merge together over the years. The Fulbe tribe, which has been established in the area for a long time, are traditionally nomads although they have accepted some of the social customs of the Baatombu tribe.

(a) Land Ownership

In the Intensive Study Area, both the legally established modern land ownership system and the traditional land ownership system exist. Under the modern system, the land basically belongs to the state and legal entities and individuals have the right to use it while under the traditional system, the land is a jointly owned asset that reverts to the settlement and which all villagers have the right to use.

The present state of land ownership and land use within the Intensive Study Area is shown in Table 3-7-3.

Table 3-7-3 Types of Land Use, an Outline of Modern and Traditional Land Ownership Systems, and the Awareness of Local Inhabitants

Zoning	Land Use Type	Modern Land Ownership System	Traditional Land Ownership System	Awareness of the Local Inhabitants
Within the Classified Forest	Forest	State Owned	Jointly Owned	Although the local inhabitants are aware that the land is state-owned, as the use of the land has been permitted up until now the scope of use is steadily increasing.
	Land for individual use (cultivated land, fallow ground, land for planting, land for houses)	State Owned	Although it is jointly owned, as long as the original developers of the land are using it the right of ownership of the developer exists.	
Buffer Zone	Forest	Considered to be state owned	Jointly Owned	The local inhabitants have almost no awareness of the fact that the land is state owned but believe that it is jointly owned. As a rule, distribution of land is carried out in accordance with the traditional land ownership system.
	Land for individual use (cultivated land, fallow ground, land for planting, land for houses)	Considered to be state owned with the exception of areas of land considered to be owned jointly by the settlements	As long as the original developers of the land are using it the right of ownership of the developer exists.	

Although the local inhabitants are aware that the Classified Forest is state owned and that they are not able to use it for cultivation or dwellings, they strongly believe that the Buffer Zone is jointly owned and that it is land that anyone can use. That is, they understand that it is land with rights of ownership and use belonging to the original developer. Land use in the Buffer Zone, which is also referred to as the "free zone," is, as the name suggest, free. As the right of prior use is not limited to one generation, the right continues throughout successive generations and is, in reality, extremely close to ownership rights.

(b) Areas of Sacred and Taboo Land

Sacred land and taboo land was found in most of the settlements surveyed. Sacred land, where ceremonies for traditional religions (fetishism) are carried out, is often marked by rivers, trees, hills or rocks, etc. Taboo land is generally related to animals and plants and the use of it for eating or fuelwood, etc. is forbidden. Details regarding taboo trees can be found in Appendix 33.

③ Organizations of Local Inhabitants

(a) Existing Organizations of Local Inhabitants

Existing organizations that will be involved in settlement development include the Village Council (Comité de Concertation), the Farmers Groups (GV), the Women's Group (GF) and groups established for various projects, including the Deep Well and Pump Management Committee and the Solar System Management Committee, etc.

a) Village Council

The Agriculture Administration Bureau is encouraging the establishment of a Village Council (Comité de Concertation) in each settlement so that the local inhabitants themselves have a vehicle through which to make their needs known. This council is made up of the village chief, village councillors and representatives from various village groups, and considers and makes proposals on necessary matters regarding settlement development. However, these councils have only been established so far in Beroubouay-Est, Wessene and Zougou-Kpantrossi.

b) Women's Groups (Groupement des Femmes)

The establishment of women's groups (Groupement des Femmes) is an Agriculture Administration Bureau initiative that aims to promote the improvement of the place of women.

These groups receive support mainly from domestic and international NGOs, etc. and are carrying out projects such as vegetable cultivation and handcrafts, etc. Participation is on an individual basis.

c) Farmers Groups (Groupement Villageois)

Farmers Groups are also an initiative of the Agriculture Administration Bureau and are formed of farm producers (mostly cotton). Their aim is to supply agricultural materials, support the distribution of farm products and develop community infrastructure within the settlements, and is aimed mainly at cotton production management activities. Possessing somewhat of a farm cooperative nature, they are the most organized of community organizations and have an effect on the village as a whole. Participation is on an individual basis and anyone engaged in farming can register regardless of gender. The registration fee is 200FCFA and the annual fees are 1,000 FCFA.

d) Various Types of Management Committees for Projects

In order to be able to carry out continuous management of facilities after the completion of projects such as water supply facilities, etc., the people of the village form committees.

(b) Organizations for Forest Improvement

In order to carry out forest management together with the local inhabitants, it is essential to have an organization of local inhabitants that can effectively deal with conflicts of interest between them while cooperating with the government agencies with jurisdiction over the forest in order to make possible the sustainable use of forest resources. Judging from the state of operation of existing organizations and the degree of participation of the local inhabitants, it could be said that a foundation has already been formed on which to base organized activities for the improvement of the forest. Therefore, on the basis of this it is possible to consider the organization of forest improvement utilizing existing structures.

* As the village council is responsible for discovering the overall improvement needs of the settlement, it is not possible to limit their activities to a specific field such as forest improvement. However, it is possible that a member of a forest improvement-related organization could also be a member of the village council.
* With regard to women's groups, as membership is limited to women, one could be forgiven for thinking that this is not the kind of organization to generalize on overall forest improvement. However, it is feasible that women's groups can be utilized in forest improvement in such areas as planting activities, etc.
* As the activities of Farmers Groups are diametrically opposed to the basic principle of the forest improvement plan, which is the prohibition of cotton growing within the Classified Forest, it is possible that the parties concerned may have opposing interests. Therefore, it is not appropriate for them to be one of the organizations supervising forest improvement. However, it will be necessary to obtain the cooperation of Farmers Groups with regard to improving farming within the Village Forestry Zone established within the Classified Forest.

It is thought that it will be difficult for the above-mentioned existing organizations to carry out comprehensive forest management. Therefore, in this management plan the establishment of new organizations for carrying out forest management should be considered.

(3) Preparation of a Seasonal Labor Calendar

① Seasonal Labor Patterns

An examination of year-round work revealed that men carried out work requiring physical strength while both men and women carried out work other than that. Women not only carried

out a greater variety of work but worked longer hours both on a daily and on an annual basis.

It is possible to divide work into three patterns: work carried out by men, work carried out by women, and work carried out by both men and women.

* Work Carried Out by Men: Land improvement, mound creation, cultivation, hunting and construction.
* Work Carried Out by Women: Fruit picking, processing of farm and forest products, housework, and water carrying.
* Work Carried Out by Both Men and Women: Seed sowing, weeding, thinning, collection of fuelwood, ceremonies, harvesting, and the sale of farm and forest products (women usually sell products in markets).

An average seasonal labor calendar based on the state of labor for a single family throughout the year can be found in Appendix 34.

② Survey of Family Finances

Interviews were carried out in each of the settlements regarding family finances. A breakdown of the average income, farm income, and average income and expenditure can be found in Appendixes 35~37.

An examination of income revealed that farming income was the highest, with supplementary income being provided by from stock farming and forest products. Income derived from other sources was relatively high, with men being involved in wood-working, smithery, and various repair work while women were involved in the sale of clothes or containers made from bottle gourds. Women accounted for the highest proportion of income from forest products, mainly due to the fact that the sale of fruit and products from *Vitellaria paradoxa* and *Parkia biglobosa* is considered to be women's work.

An examination of farm income alone reveals that men are 80% reliant and women are 50% reliant on cotton. Cotton is used in promotion measures for the country and is highly organized right from the growing of crops through to harvesting and commercialization, which is the reason that farmers selected cotton as a reliable cash crop. However, on the contrary, to be reliant on a single crop for more than 90% of farm income is dangerous. The diversification of cash crops is necessary in order to reduce this danger. On the other hand, in addition to cotton, women obtain their income from a number of crops including maize, peanuts, and rice, etc.

An examination of expenditure revealed that farm materials and wages for farm workers, etc. accounted for the greatest proportion of farm-related expenditure. With cotton growing, as chemical fertilizer and pesticides must be used, the degree of reliance on cotton growing among men was proportionally higher then that of women. The next greatest in terms of expenditure was festival-related expenses, most notably festivals and ceremonies such as weddings and funerals, etc. In terms of food-related expenses, most people said that their greatest expense was maize. Under other expenses, a high proportion of men mentioned building repair costs while women mentioned the purchase of containers.

(4) Group Discussion

The main problems mentioned by the local inhabitants are shown below. These problems were classified under forest resources, farming, livestock farming and infrastructure facilities and can be found in Appendix 38.

Of the problems mentioned by the local inhabitants, those directly related to forest resources included the hunting of game or the reduction of *Vitellaria paradoxa* and *Parkia biglobosa*, revealing that villagers were aware of the fact that forest resources were deteriorating through observing such phenomena.

However, what was of greater interest to villagers than the deterioration of forest resources were problems regarding the decrease in fertility of cultivated land and the shortage of cultivated land. As extensive shifting cultivation-type farming techniques are being used at present, in order to maintain harvest volumes, it is necessary to seek more land for improvement and expand the area of cultivated land. Since the introduction of cotton, as the length of time that ground is left fallow has become shorter and as cotton is being grown continuously, a drop in the fertility of cultivated land has occurred.

On account of this, villagers have resorted to developing land within the Classified Forest where fertile land still exists, despite the fact that they know that this is illegal. As the area of cultivated land within the Classified Forest is already increasing, it is necessary to permit the local inhabitants to use the land they desire within the Classified Forest in order to ensure the effectiveness of the forest management plan.

It is possible to use the approval of cultivation within the Classified Forest, with certain restrictions through the formulation of the forest management plan, as a major incentive for local inhabitants. An important point is the transition from extensive shifting cultivation to intensive fixed cultivation and the improvement of commercial farming in order to achieve adequate harvest volumes from a certain area of land.

With regard to livestock farming, the local inhabitants would like paths for the passage of livestock and space for grazing to be created within the Classified Forest and reservoirs to be created in order to alleviate the shortage of water during the dry season. It is necessary to give adequate consideration to these points in the forest management plan.

The problems mentioned by the local inhabitants with regard to the improvement of infrastructure are rather important with regard to their lifestyle. However, they have no direct relationship to forest management, a different government agency has jurisdiction over them, and it is difficult to provide a solution within the framework of the forest management plan. However, if consideration can be given to the fact that settlement improvement can be treated as an aspect of forest management and that it is necessary to gain the cooperation of local inhabitants in order to carry out forest management, then it is possible to use the improvement of infrastructure as a major incentive for the local inhabitants.

3.8 Workshop With Villagers (First Part)

3.8.1 The Implementation of the Workshop With Villagers (First Part)

(1) The Aims of the Workshop With Villagers (First Part)

The aim of the Workshop With Villagers (First Part) was to present the basic concept of the forest management plan, to obtain the opinions of the local inhabitants with regard to such matters, and to ensure that their opinions were reflected in the Forest Management Plan Proposal. Another aim is to help the local inhabitants to become aware of the importance of forest conservation through dialogue with the local inhabitants and to help them to be aware of the fact that they themselves are important entities when it comes to forest management.

(2) Target Settlements for the Workshop With Villagers (First Part)

Table 3-8-1 shows the seven target settlements for the workshop with villagers (First Part).

Details regarding items covered at the workshop can be found in Appendix 39.

Table 3-8-1 Target Settlements for the workshop With villagers (First Part).

Settlement	Commune	District
Zougou-Kpantrossi	Zougou-Kpantrossi	Gogounou
Petit-Paris (including Gamagou)	Sori	
Wessene		
Pigourou		
Beroubouay-Est	Beroubouay	Bembereke
Kabanou		
Mani-Boke	Gamia	
Gamia-Est		

3.8.2 Presentation of the Basic Concept

(1) Explanation of the Necessity of a Forest Management plans.

The necessity of a forest management plan was explained to the local inhabitants with Appendix being given to the usefulness of trees and forest and the detrimental effect of reduced areas of forest. Details regarding this are shown below.

① Usefulness of Trees and Forest

* Use of Forest Resources by Local Inhabitants
* CO_2 Absorption Function
* Shade

② Detrimental Effect of Reduced Areas of Forest

* Changes in the Ecosystem
* Reduced Water Holding Capacity

③ Verification of the Necessity of Forest Management Plans

The fact that a properly structured management plan is essential in order to enjoy the sustainable use of the forest while conserving it was conveyed to the local inhabitants. While on one hand the local inhabitants said that they understood the importance of trees and forest and the fact that a management plan was necessary, their reaction was that they wanted their lifestyle to be treated with the same degree of importance.

(2) Presentation of the Basic Concept

The basic concept of the formulation of the forest management plan is as follows.

① Land is Limited

Although areas of forest still exist and there is land remaining that can be developed, if extensive shifting cultivation is continued then sooner or later there will be no more land left to develop. Therefore the importance of making the transition from extensive shifting cultivation to intensive fixed cultivation in order to achieve sustainable use of the limited amount of land was explained.

② Forest Conservation vs the Lifestyle of Local Inhabitants

Although forest conservation is important, maintaining the lifestyle of the local inhabitants is also important. The survey team formulated the forest management plan giving adequate consideration to the living conditions and opinions of the local inhabitants by means of carrying out a survey of the state of the local inhabitants and by holding a workshop with the local

inhabitants.

③ Verification of the Illegality of Land Use within the Classified Forest

Before presenting a detailed basic concept, it was confirmed to the local inhabitants that the use of land within the Classified Forest for dwellings or cultivation is forbidden under the existing Forest Law.

④ Presentation of the Basic Concept

Zoning of the Classified Forest was carried out and each zone was handled in the following manner.

* Zoning of the Classified Forest: The Classified Forest was divided up into the Forest Zone, Silvi-Pastoral Zone, and the Village Forestry Zone.
* While the cultivation of food crops, the planting of fruit trees and the planting of fuelwood forest is permitted in the Village Forestry Zone, cotton growing and new improvement is prohibited. Trees such as *Vitellaria paradoxa* and *Parkia biglobosa*, etc. shall be planted on the boundary of the Village Forestry Zone. The transition from extensive shifting cultivation to intensive fixed cultivation shall be carried out.
* Pasture may be improved and trees planted in the Silvi-Pastoral Zone in order to provide supplemental feed during the dry season. Thorough early controlled burning shall be carried out. Paths for the passage of livestock shall be established from areas outside the Classified Forest to areas within the Classified Forest.
* The gathering of fruit from *Vitellaria paradoxa* and *Parkia biglobosa*, etc. and the gathering of medicinal plants in the Forest Zone shall be permitted. Grazing shall not be permitted.

3.8.3 Discussions with the Local Inhabitants regarding the Basic Concept

After the basic concept had been explained, discussions were held with the local inhabitants. The main points of the discussion are shown below.

* The meaning of the workshop.
* The prohibition of cotton growing within the Classified Forest.
* The transition from extensive shifting cultivation to intensive fixed cultivation.
* The planting of fruit trees and forest trees.
* The planting of *Vitellaria paradoxa* and *Parkia biglobosa*.
* Controlled burning.
* The establishment of paths for the passage of livestock.
* The establishment of water holes for livestock.
* The allocated area of zones for cultivation.
* The improvement of settlement infrastructure.
* The logging of trees.
* The boundaries of the Classified Forest.
* Organizations of local inhabitants for the management of the Classified Forest.
* The concept of zoning.

Details regarding the content of the discussions can be found in Appendix 40.

3.8.4 Response to the Opinions of the Local Inhabitants

The response of the survey team, etc. to each of the discussion items is shown below.

(1) The Meaning of the Workshop

Although the formulation of Improvement Plans for the Trois-Rivières Classified Forest is still in the survey stage, at present a large proportion of the forest is being cultivated. As it is necessary to endeavor to effectively use the forest as a sustainable resource, the cooperation of the local inhabitants is essential. Therefore it is important to obtain the opinions of the local inhabitants right from the plan formulation stage. It was explained that this was the reason that the workshop with villagers was being held.

(2) The Prohibition of Cotton Growing within the Classified Forest

As part of measures to prohibit the growing of cotton within the Classified Forest, although there was the choice of providing replacement land, the DFRN decided not to present a policy of providing replacement land during the question and answer time of the workshop as the State has a policy of not providing replacement land.

From the standpoint of fostering water resources, flood prevention and the preservation of wildlife and the natural environment, the actual existence of the forest is extremely important. Therefore, although cotton growing, which requires the use of large volumes of pesticides and insecticides, is prohibited within the Classified Forest, which is a water resource forest, the local inhabitants were told that it was possible to grow cotton within the Buffer Zone.

If cotton growing within the Classified Forest is prohibited then the cash income of the local inhabitants will be reduced. The survey team encouraged the local inhabitants to see the formulation of the forest management plan as a chance to make the transition from extensive shifting cultivation to intensive fixed cultivation and to diversify from relying on a single crop as a source of income, etc. The local inhabitants were encouraged to survey consumption trends and distribution with a view to considering the commercialization of crops other than cotton.

(3) The Transition from Extensive Shifting Cultivation to Intensive Fixed Cultivation

The local inhabitants seemed enthusiastic about adopting new technology in order to make the transition from extensive shifting cultivation to intensive fixed cultivation. Measures to improve commercial farming in the plan including the improvement of crop systems, the improvement of planting systems, the improvement of growing techniques, the improvement of harvesting techniques and the removal of standing trees, etc. within cultivated land to ensure 100% utilization were explained.

(4) The Planting of Fruit Trees and Forest Trees

The establishment of nurseries in each of the settlements was encouraged in order to overcome the problem of the shortage of seedlings available for planting in the Village Forestry Zone and in the Buffer Zone. The Forest Improvement Fund of technology to preserve mangoes, etc. was encouraged in cooperation with the Agriculture Administration Bureau.

(5) The Planting of *Vitellaria Paradoxa* and *Parkia Biglobosa*

Although the logging of *Vitellaria paradoxa* and *Parkia biglobosa* in areas of cultivated land is possible, it was proposed that *Vitellaria paradoxa* and *Parkia biglobosa* first be planted around areas of cultivated land and that existing trees be felled after these trees had grown to the stage that it is possible to harvest fruit from them.

(6) Controlled Burning

Under the management plan, forest fire prevention measures shall be carried out as part of forest protection measures. Controlled burning is prohibited in the Forest Zone of the Classified Forest while in other areas only early controlled burning is permitted. The improvement of monitoring and fire-fighting systems to be carried out by community organizations is essential. The following measures should be implemented.

* The improvement of forest roads and work roads and their use as firebreaks to prevent forest fires. Belts of fire-resistant trees should also be planted to prevent fires from spreading.
* Early controlled burning shall be carried out in designated areas based on improvement plans.
* Watchtowers and fire fighting equipment shall also be developed.

(7) The Establishment of Grazing Zones and Paths for the Passage of Livestock

Grazing is possible within the Silvi-Pastoral Zone that is to be established within the Classified Forest. Mixed gazing and pasture improvement shall also be carried out within this zone. Paths for the passage of livestock shall be established within the Village Forestry Zone.

(8) The Establishment of Water Holes for Livestock

Water holes shall be established for livestock in the Bouli River and other waterways.

(9) The Allocated Area of Zones for Cultivation

Some of the local inhabitants wanted the area of the land allocated to the local inhabitants within the Village Forestry Zone to be made as large as possible.

The following points were clarified.

* It is necessary to retain the Classified Forest as forest and it is not possible to make it all into cultivated land.
* Not just the livelihood of the local inhabitants and farming in terms of self sufficiency should be considered but the diversification of income to include income from timber production, fuelwood production, fruit trees and bee-keeping, etc. and the formulation of plans regarding Forest Improvement Fund and training.

It was suggested that each farmer be allocated a total of 4.0 ha of land (2.0 ha for cultivating food crops and 2.0 ha for timber production, fuelwood production, and fruit tree production) in each improvement unit. It was also suggested that agroforestry be introduced and that commercial farming be improved in the Buffer Zone.

(10) The Development of the Infrastructure of the Settlements

It was explained that although the local inhabitants expressed their desire for the development of settlement infrastructure, such as the development of roads and bridges, the development of water supply facilities, the establishment of health centers, and the construction of schools, etc., there are things which can and things which cannot be included in the improvement plan.

(11) The Felling of Trees

It was explained that after the improvement plan for the Classified Forest has been formulated that logging for timber production shall be carried out under the control of organizations of local inhabitants based on the improvement plan. Such organizations will monitor illegal logging, etc.

(12) The Boundaries of the Classified Forest

As a rule, it is planned to set the boundaries of the Classified Forest, the improvement units and the forest sub-compartment levels at the time that the plan is implemented.

(13) Community Organizations for the Management of the Classified Forest

The implementation of the forest improvement plan is carried out mainly by the local inhabitants with the consent of both the government and the representatives of organizations of local inhabitants. It was proposed that forest management councils with jurisdiction over a multiple number of improvement units be established together with forest improvement and management committees, etc. for the management of the forest.

(14) The Concept of Zoning

During the Workshop With Villagers(First Part), the concept of zoning whereby the Classified Forest would be divided into the Forest Zone, the Silvi-Pastoral Zone, and the Village Forestry Zone was presented and approved by the farmers and livestock farmers. As the farmers wanted to legalize the use of cultivated land within the Classified Forest, the use of cultivated land within the Classified Forest will be permitted under certain conditions, which will be of great benefit to them. Furthermore, it will also be beneficial to livestock farmers as the establishment of the Silvi-Pastoral Zone and paths for the passage of livestock will mean a reduction in the number of disputes between themselves and the farmers.

3.9 Workshop With Villagers (Second Part)

During the Workshop with villagers(Second Part), the forest management plan proposal was explained to the local inhabitants of the area with the aim of obtaining their opinions and helping them to understand the proposal.

3.9.1 Data Related to the Survey of the Target Settlements

(1) Target Settlements

The Workshop with villagers(Second Part) was carried out twice for the people in the six settlements shown in Table 3-9-1. The first time was mainly to explain the plan proposal and to answer questions. The second time was to clarify the opinions of the local inhabitants, to enable the study Team to offer additional explanations, and to answer questions for the final time. The two workshops were carried out four days apart, during which time the local inhabitants themselves had time to consider the plan.

Table 3-9-1 Workshop With Villagers (Second Part): Locations and Target Settlements

District	Commune	Location	Target Settlement	Comments (Location)
Gogounou	Zougou-Kpantrossi	Zougou-Kpantrossi	Zougou-Kpantrossi	Buffer Zone
			Zougou-Peulh	Buffer Zone
	Sori	Wessene	Wessene	Buffer Zone
			Wessene-Peulh	Buffer Zone
		Pigourou	Pigourou	Buffer Zone
		Nanonrou	Petit Paris	Outside the Intensive Study Area
			Nanonrou	Buffer Zone
Bembereke	Beroubouay	Beroubouay-Est	Beroubouay-Est	Outside the Intensive Study Area *1
		Kabanou	Kabanou	On the Boundary of the Classified Forest and the Buffer Zone
			Karakou-Dassi	Buffer Zone
			Sanse	Within the Classified Forest
			Koussine	Within the Classified Forest
			Bokobouerou	Within the Classified Forest
			Gbepoa	Within the Classified Forest
	Gamia	Mani-Boke	Mani-Boke	Buffer Zone
			Fere	Within the Classified Forest
			Bafa	Within the Classified Forest
		Dononrou	Dononrou	Buffer Zone*2
			Nipouna	Buffer Zone*2
			Abidjan	Buffer Zone*3
			Gonrou Ga Yemia	Buffer Zone*3
			Sero Bagou Kparou	Within the Classified Forest*3

Note: ISA=Intensive Study Area.

In Table 3-9-1, settlements labeled *1 - 3 were removed from the target settlement list for the following reasons.

*1: Although there were people using cultivated land within the Classified Forest, their homes were not located within the Intensive Study Area.
*2: Cultivated land was within the Buffer Zone and there was no one using cultivated land within the Classified Forest.
*3: Cultivated land was within the Forest Zone and there was sufficient fertile undeveloped land within the neighboring Buffer Zone.

Nanonrou and Dononrou were selected as the location of the Workshop with villagers (Second Part) instead of Petit Paris and Gamia-Est which are located alongside RNIE 2 and which were used for the Workshop with villagers (First Part), as they were closer to the Classified Forest.

(2) Population Data

Of the settlement targeted at the Workshop with villagers (Second Part), population data for the target settlements that would benefit from this management plan is as shown in Table 3-9-2. Population data for settlements that would not benefit from this management plan can be found in Appendix 41.

Table 3-9-2 Population of Settlements that would Benefit from the Management Plan

District	Commune	Settlement	Total Population	Total No. of Households	Household Scale (people/ household)
Gogounou	Zougou-Kpantrossi	Zougou-Kpantrossi (Including Zougou-Peulh)	4,480	365	12.3
	Sori	Wessene (Including Wessene-Peulh)	2,261	390	5.8
		Pigourou (including Nanonrou)	1,865	205	9.1
Bembereke	Beroubouay	Kabanou (including Karakou-Dassi, Sanse, Koussine, Boko-bouerou and Gbepoa)	1,431	149	9.6
	Famia	Mani-Boke (including Fere and Bafa)	1,101	130	8.5
Total			11,138	1,239	9.0

(3) Allocated Land for Local Inhabitants within the Classified Forest

In order to ascertain the state of use of cultivated land within the Classified Forest by people from settlements that were the target of the Workshop with villagers (Second Part), a survey was carried out to determine the proportion of land users of only cultivated land within the Classified Forest, users of only cultivated land within the Buffer Zone, and users of both cultivated land within the Classified Forest and within the Buffer Zone.

The results of this survey are shown in Table 3-9-3 below.

Table 3-9-3 State of Utilization of Cultivated Land within the Classified Forest by Local Inhabitantws

Settlement	No. of Samples	User of Land Within the Classified Forest Alone		Users of Land both Within and Outside the Classified Forest		Users of Land Within the Buffer Zone Alone	
ZOUGOU-KPANTROSSI	11	8	73%	2	18%	1	9%
WESSÉNÉ	11	10	91%	0	0%	1	9%
PIGOUROU	10	10	100%	0	0%	0	0%
KABANOU	8	7	88%	1	12%	0	0%
MANI-BOKÉ	10	8	80%	0	0%	2	20%

3.9.2 Points Requiring Consideration with regard to the Formulation of Plans

The results of the discussion at the Workshop with villagers (Second Part) indicated that as a rule, the local inhabitants agreed with the forest management plan proposal. The main items of discussion were as shown below.

* The Allocated Area of the Village Forestry Zone
* Improving Commercial Farming
* The Commercialization of Products to Replace Cotton
* Disputes regarding Land (especially with regard to the Buffer Zone)
* Livestock Improvement
* The Control of Nomadic Grazing
* The Operation of the Forest Zone
* Organizations of Villagers Involved in Forest Improvement
* The Time of Implementation of the Forest Improvement Plan

* Development of the Infrastructure of the Settlements

The problems discussed during this workshop that were taken into consideration when formulating plans are shown below. The main problems discussed together with details regarding countermeasures can be found in Appendix 42.

① The Allocated Area of the Village Forestry Zone

Some people were of the opinion that the 4.0 ha (2.0 ha of land for cultivation and 2.0 ha for growing trees) allocated to each household (10 adults) was insufficient. However, considering that the average number of people per household in the settlements that will benefit (9 adults), the area allocated should be sufficient. In reality, even if the number of people in a household is less than 10, the area allocated is still 4.0 ha. When there are more than 10 people in a household, this shall be handled separately in order to alleviate with the concern of the local inhabitants regarding this matter.

② Improving Commercial Farming

As the transition to fixed farming on limited cultivated land is rather unsettling for the local inhabitants, the Forest Improvement Fund of farming techniques, such as crop rotation and compost making, etc. in order to maintain the productivity of the soil is planned with the cooperation the Agriculture Administration Bureau and NGOs, etc. Initially, farmers who want to cooperate will be selected to play a key role in forest improvement organizations or farmers groups, and model farms, etc. will be created.

③ The Commercialization of Products to Replace Cotton

Products under consideration to replace cotton include surplus food crops (maize, yams, and sorghum), surplus intercrops (peanuts), fruit (cashews and mangoes), posts (*Tectona grandis*), fuelwood, bee-keeping, and the fruit from *Vitellaria paradoxa*, etc. Therefore, the following measures are being considered.

* The construction of joint storage and shipping facilities for surplus farm products.

* The development of nurseries in each settlement to grow the seedlings necessary for planting fruit trees and forest trees.

* Technical training and guidance regarding tree-planting to be provided by the DFRN.

* The creation of a joint shipping system to provide fuelwood to potential areas of demand in northern areas, such as the urban areas of Kandi and Malanville, etc.

* The development of bee-keeping in cooperation with the producer's cooperative in Parakou.

* International trading of the fruit from *Vitellaria paradoxa* is already being carried out and there is a broker in Parakou. If stable supply volumes can be secured, then this could be a promising cash crop and the planting of *Vitellaria paradoxa* is therefore being encouraged.

④ Disputes regarding Land (especially with regard to the Buffer Zone)

Although there are farmers presently cultivating land within the Classified Forest who previously had cultivated land in the Buffer Zone, as the area of cultivated land that can be used will be limited as a result of the implementation of the Improvement Plan, there are some people who want to get the land back that they had previously. As a result, some people are of the opinion that there is the possibility that disputes may arise between previous owners and current owners.

Although this issue is something that should be settled by the parties concerned through discussions without government interference, issues such as this shall be mediated by the forest management organizations to be established to deal with problems regarding land, such as the allocation of land within each of the individual areas of the Village Forestry Zone.

⑤ Livestock Improvement

As grazing area will be limited with the implementation of the Improvement Plan it is necessary to make the transition to intensive farming of livestock as well. This all hinges on whether or not it will be possible to change the thinking of livestock farmers who have up until this stage relied on extensive farming.

Farmers who wish to cooperate will be selected and model farms, etc. created to show the economic benefits of intensive livestock farming, which, it is hoped, will help to change the thinking of the remaining farmers.

⑥ The Control of Nomadic Grazing

The local inhabitants pointed out that there is the possibility of disputes arising between established farmers and nomadic farmers from outside who ignore local rules. As the use of the Silvi-Pastoral Zone will be managed by the forest management organizations, it will be their responsibility to control problems regarding nomadic grazing, etc. A registration system will be established for users of this zone, with fees being collected according to the number of livestock, etc.

⑦ The Operation of the Forest Zone

There are those among the local inhabitants who are of the opinion that activities in the Forest Zone, especially within the production forest, have nothing at all to do with them. However, although the production of fuelwood and timber, etc. within the production forest will be carried out under the direction of the DFRN, part of the income will be used to form the basis of the Forest Improvement Fund, which will be used to promote the participation of the local inhabitants in forest management.

⑧ Organizations of Villagers Involved in Forest Improvement

While acknowledging the necessity of forest management organizations due to the fact that the operation of existing organizations of local inhabitants was unclear, the local inhabitants were concerned that forest management organizations would merely turn out to be another way of using the local inhabitants.

Detailed measures for the establishment of forest management organizations are shown below.

* During the implementation plan formulation stage, the form of the organizations shall be determined in detail through consultation with the local inhabitants.
* A land problem sub-committee shall be established on the forest management unit level and a register of local inhabitants created.
* The appointment of only a small number of people to the executive positions of the various village organizations should be avoided.
* An audit committee shall be established on the forest management council level to carry out transparent management of the funds of the Forest Improvement Fund and an audit of the books shall be required to be carried out at least once every year.
* Basically, financial records and audit documents shall be required to be open to the public.

⑨ The Time of Implementation of the Forest Improvement Plan

Although a number of the local inhabitants wanted the time of the implementation of the forest improvement plan to be clarified, the DFRN replied that this would be clarified at the time that the implementation plan was formulated. As it is not possible to clearly state the time of the implementation of the plan at the survey stage, it will be necessary to hold discussions with the local inhabitants at the implementation plan formulation stage and clarify the time of implementation as well as a grace period and the things that need to be done by the local inhabitants during the grace period.

Up until that time, it will be necessary for the DFRN to increase patrols of the area and issue warnings regarding the illegal activities of the local inhabitants in order to help the local inhabitants to understand that the area is part of the target area of the forest improvement plan.

⑩ Development of the Infrastructure of the Settlements

In response to the desires of the local inhabitants regarding the improvement of lifestyle-related infrastructure, although it is difficult to deal with this directly within the forest improvement plan, the DFRN should communicate the desires of the local inhabitants with regard to the construction of roads, schools, wells and health centers to the related government agencies and endeavor to have the priority of the area increased.

3.9.3 Causes of Social Restrictions on the Implementation of the Forest Improvement Plan

(1) The Apprehension of the Local Inhabitants with regard to Changing the Form of Production

As cultivation and grazing will be confined to certain areas after the forest improvement plan has been implemented, the intensification of farming and livestock farming and the diversification of sources of income, which have up until now relied solely on cotton, will be necessary. However, the local inhabitants feel apprehensive about such changes and it is thought that this may restrict the implementation of the plan.

As a means of overcoming this potential problem, further discussions will be held with the local inhabitants repeatedly in order to help them understand the various issues involved, making further Forest Improvement Fund and training activities essential. Furthermore, such Forest Improvement Fund and training activities should not be carried out by government agencies alone, but together with various NGOs which already have experience in such matters.

(2) Changes in Family Structure

With the permeation of the monetary economy, the fragmentation of the traditional extended family into smaller family units with their own individual sources of income has already begun within the cultural boundaries of the Baatombu tribe who live within the target area of the survey. Therefore, there is the possibility that if the extended family is used as the unit in determining the number of households to receive allotments within the each of the areas of the Village Forestry Zone, it may not then be possible to cope with the actual needs.

In order to carry out the allocation of land within the Village Forestry Zone fairly and precisely, at the implementation plan formulation stage it will be necessary to create a register of the local inhabitants within settlements which are beneficiaries and accurately ascertain the number of smaller family units.

(3) Changes in Group Awareness

When allocation of the individual areas is carried out, it is expected that the independence of smaller family units will increase and the authority of the heads of extended families will proportionally decrease. As a result, it is thought that overall group awareness will decrease, that the traditional discipline of the local society will deteriorate, and that it will be more difficult to obtain cooperation for group activities.

With regard to the implementation of the forest improvement plan, the local inhabitants should be enlightened with regard to the economic merits of working together and joint harvesting, and joint shipping should be organized, and a new group awareness developed based on the independence of individual families.

(4) The Growing Gap between Social Strata

Traditionally there has been discrimination between the Baatombu tribe, which has been the ruling class, and the half-farming/half-grazing Kandi tribe, which have been the labour class, with a balance

being maintained between both parties with regard to production.

However, the use of compost in farming and the creation of pasture for livestock farming scheduled under the forest improvement plan has the effect of fusing farming and livestock farming together, making it comparatively easier for the Kandi to cope with the changes as they have been already been involved in half-farming/half-grazing production. If the Kandi are able to quickly cope with the changes in production type and increase their economic power and influence, then that may possibly hinder the implementation of the plan as the balance between the two tribes will be altered.

In order to prevent this from becoming a problem, it is essential that representatives from every strata of society participate in forest management organizations and that any conflict of interest between them be settled through discussions.

3.10 Establishing the Boundaries of the Classified Forest

This was carried out with the aim of helping the local inhabitants to understand the existence of the Classified Forest and to realize the smooth implementation of the forest improvement plan. Although this is intended to clarify the boundaries of the Classified Forest, as records regarding the boundaries of the Classified Forest from the time at which the Classified Forest was established have been lost, therefore the boundaries were established based on the boundary lines indicated on the 1:200,000 scale topographical map released by the Geographical Survey Institute, as this is now the only remaining record available. The boundaries established on the ground are tentative and as they are only established at intervals, the DFRN will need to carry out final verification and establishment of the boundary lines sometime in the future.

(1) Target Area

Boundaries with a length of approximately 70km were established in the Trois-Rivières Classified Forest (also referred to as the Intensive Study Area), which is an area of approximately 51,600 ha to the west of the Bouli River, where it borders on the Classified Forest.

(2) Verification of Areas where Boundaries are to be Established

① Boundary Stones (Boundary Markers)

The selection of areas in which boundaries were to be established was carried out using aerial photographs or 1:50,000 scale topographical maps, and the coordinates of each location calculated. After verifying these locations through on-site GPS measurements, temporary points were established. Each of these points was then marked on contact prints or enlarged copies of aerial photographs.

These points were established approximately every 500m and in areas other than those alongside roads, and as a rule stakes were driven into the ground wherever the boundaries intersected a road or path. The Classified Forest runs from the Intensive Study Area to the east of the Bouli River, and stakes were driven into both banks of the river to show that the boundary continues on the other side of the river. These stakes were eventually established in 120 locations and a 3-letter code was written on each.

A map showing the location of boundary stones can be found in Appendix 43 while a list of the coordinates of boundary stones can be found in Appendix 44.

② Notice Boards

Notice boards were established in 57 locations throughout settlements and the Classified Forest, mainly in places where the boundary crosses existing roads or at place where there is a bend in the boundary, with consideration being given to ensure that they are located in visible places.

These locations were selected by looking at aerial photographs or topographical maps and verified as being suitable by on-site observations. They were established after GPS measurements and marking was carried out.

(3) Establishment

① Boundary Stones (Boundary Markers)

Boundary stones shall be 1.5 m long and shall project 0.8 m from the ground. In order to make the job or erecting them on-site easier, 1.2 m lengths of PVC pipe with a diameter of 200 m shall be used to pour concrete. 6 mm and 8 mm diameter steel reinforcing shall be used in the foundation and the post to provide additional strength. The top of the post shall have a slant on which is written the boundary stone number and the pillar shall be oriented in such a way that the direction of the Classified Forest is clear.

② Notice Boards

Notice boards shall be made of steel and consist of two round posts with a height of 2.5 m (0.7 m below ground and 1.8 m above ground) with the foundation being laid in concrete.

The notice board itself shall be 1.2 m long and 0.8 m wide, and as a rule shall be written on on only one side. However, the two notice boards on the banks of the Bouli River shall be written on on both sides. Information to be written on the notice boards includes the name of the Classified Forest, the name of related agencies, the establishment date and Cabinet Order number, and the notice board number.

As a rule the notice board shall be located in the same direction as the boundary of the Classified Forest, and when they are located separately from boundary stones they shall be located in front of them.

(4) Installation Management

① Selection of Locations

* Attention shall be given to overall balance when selecting locations.
* Aerial photographs shall be used for on-site verification and temporary installation.
* GPS shall be used on-site to verify the coordinates on a topographical map and when there is any discrepancy surveys should be repeated.

② Installation

* The person responsible for installation shall be required to submit a weekly report on the state of installation and monitoring of progress shall be carried out.
* Verification shall be carried out of the depth of holes, the proportion of each of the ingredients of the concrete, and the direction of installation, etc. and when it is difficult to dig deep enough holes due to the presence of rocks, etc., the installation location shall be changed.
* The results of interim inspections shall be discussed among contractors and revised directions given with regard to location direction, boundary posts and notice board numbers, concrete quality, the thickness of the concrete foundation, the surface treatment of the top of the boundary post, and the paint used on the notice board, etc.
* After all revision work has been completed, a final inspection shall be carried out and all revisions inspected.
* After the final inspection has been carried out, a completion report including any resulting maps, shall be submitted by the contractor and a completion certificate issued.

(5) Created Maps

* Aerial photographs: Any aerial photographs showing the location of boundary stones and notice boards.
* Topographical Maps: Any topographical maps showing the location of boundary stones and notice boards.
* A list showing the coordinates of each boundary marker.
* Photographs showing the state of installation.

4. Forest Management Plan

4.1 The Concept of the Forest Management Plan

The functions of the forest are diverse and include ① the production of forest products, including timber, etc., ② the fostering of water resources, ③ the prevention of natural disasters, ④ the moderation of climate, ⑤ the protection of wildlife, ⑥ the preservation of genetic resources, ⑦ the provision of forest recreation areas, and ⑧ the preservation, etc. of the living environment.

Of these functions, ① is an economic function as the forest is logged and transported elsewhere to derive economic benefit, while ② - ⑧ are public benefit functions obtained through the sustaining of the forest. Generally, it takes more than 10 years for a tree to grow and have any degree of worth as timber. During that time it is possible to use the plantations for public benefit and if this pattern can be skillfully combined, then it is possible to benefit from both the economic function and the public benefit function. As the classified forest was established as a state forest operating for public benefit, it is necessary to improve this function.

However, the forest is being devastated through the random conversion of forest into farmland by the local inhabitants, the random felling of trees, livestock grazing and the harvesting of leaves, and wildfires, etc., which lead to a decrease in the public benefit functions of the forest and eventually invites the drying up of water sources, the weathering and runoff of soil in agricultural land, and the worsening of the living environment, etc. which, it is feared, will rebound to hit the local inhabitants.

Therefore, in order to deal with the present deterioration of the forest through its conversion into farm land by the local inhabitants, and through wildfires and grazing, etc., in 1994 the government of Benin released part of the classified forest to the local inhabitants, formulated the forest improvement plan in order to ease the pressure on farming, livestock farming, and forestry, and worked out forestry measures to carry out forest management with the participation of the local inhabitants.

In the Trois-Rivières Classified Forest, the Ouénou-Bénou Classified Forest, and the l'Alibori Supérieur Classified Forest, which were the target areas for this survey, incidents of illegal acts, such as the carrying out of farming, grazing, and unauthorized logging are not only still being carried out by the local inhabitants within the classified forest, but are, in fact, increasing.

The Intensive Study Area, which is the area where the formulation of a forest management plan is being scheduled, consists of approximately 51,600 ha of the western side of the Trois-Rivières Classified Forest (an area to the west of the Bouli River) with a buffer zone of 7 km or approximately 51,600 ha, giving a total of 103,200 ha. Considering the present state of the local inhabitants within the classified forest, as it will be extremely difficult to remove the local inhabitants from the classified forest, in 1994, in accordance with forest policy, it was decided to carry out rational management together with the cooperation of the local inhabitants.

This forest management plan was formulated by the government after negotiations with the local inhabitants regarding the classified forest and formed the basis of a government proposal for a forest improvement plan to be implemented by means of a contract with the local inhabitants, and as a prerequisite of this is the implementation of operations by means of this plan, it is necessary to encourage the participation of the local inhabitants in the plan formulation process, enable them to simply understand, allow them to become involved in programs that they are able to carry out, and gain their active support.

At the same time, as this is a forestry plan concerning a state-owned forest, from the long-term and overall perspective, the public benefit function, such as the fostering of the water resources of the forest, etc., and the economic function, such as the production of forestry products, etc. are to be carried out in a comprehensive and sustainable manner.

Based on the above-mentioned concept, the problems and solutions obtained from the results of the survey up until this time are as follows.

(1) The Conservation of Forests in Water Source Areas

The Trois-Rivières Classified Forest, which is located within the Intensive Study Area, is located in the upper reaches of the Sota River which is one of the main tributaries of the Niger River. Due to repeated controlled burning, the logging of natural forests, and shifting cultivation, etc., the low density and low growing stock savannah vegetation is predominant and the water source fostering capabilities of the forest are low. Furthermore, most of the rainfall is concentrated in the rainy season, while during the dry season most of the rivers dry up, and the difference in the water level of the Bouli River on the eastern boundary of the Intensive Study Area between the wet and dry seasons is up to 9 m.

Therefore, we should endeavor to improve the water holding capacity of the forest and secure the longest possible period of rainfall by protecting the forest from fires, etc. and improving the quality of the forest, establish an area of forest 3,500 m wide on the western bank of the Bouli River and 50 m to 100m wide on the tributaries of the Bouli River, totally prohibit the local inhabitants from using the area, and endeavor to preserve the forest through new planting and enrichment of cultivated land, fallow ground, and devastated and inferior forest with native species.

(2) Maintaining and Improving Forest Productivity

In Benin, the main form of forestry is rather destructive as only trees with a high economic value are logged. From the standpoint of forest management, examples of good forest management are rare, and of the state-owned classified forests good management is only being carried out in a few of the *Tectona grandis* forests. Maintaining and improving the reproductive capabilities of the forest in order to achieve sustainable use is a major challenge that is directly linked not only to the sustainable development of the area but to the fostering of forestry, which is a new industry in Benin.

It is possible to maintain and improve the reproductive capabilities of the forest in the area bordering the western side of the conservation forest and to achieve sustainable use. Therefore, this area should be established as a production forest, the reproductive capabilities of the forest maintained and improved through new planting and enrichment with high productivity species of tree, and timber and fuelwood production carried out by means of selective logging.

(3) The Transition from Shifting Cultivation to Intensive Fixed Cultivation

The cause of illegal use and expansion of cultivated land within the classified forest is extensive farming. In the same way as the stock farmers mentioned in the previous section, farmers, in their belief that land is limitless, have repeatedly carried out shifting cultivation. Therefore, the consideration of farming methods on the understanding that there is a limit to available land is extremely important for the local inhabitants. The Forest Improvement Fund of intensive farming on limited areas of land is an important factor in both the conservation of the forest and the future of the local inhabitants.

Bearing this in mind, areas for use by the local inhabitants should be established on the very outside of the classified forest, the shift to intensive fixed cultivation carried out, production of food for personal consumption and farmer income maintained for the approximately 1,000 households that have cultivated land within the classified forest and sources of income diversified.

(4) The Transition from Extensive Grazing to Intensive Grazing

One of the causes of forest devastation is the extensive grazing in the forest, with its reliance on natural pasture and the associated controlled burning which is carried out year after year. While on one hand the livestock farmers consider their livestock as assets, they seem to be of the opinion that pasture is limitless and take their livestock to graze outside the classified forest. Along with the future development of the monetary economy, if private ownership of land increases, the livestock farmers will be forced to effectively use the land that they possess.

A Silvi-Pastoral Zone of approximately 9,600 ha should be established between the Village Forestry Zone and the Forest Zone as at present there are approximately 8,000 head of livestock being reared. This should be fixed as grazing land and pasture should be created and improved and fattening methods improved to match grazing capacity.

4.2 Forest Management Units and Improvement Units

(1) Management Units of the Classified Forest

Classified forests are state forests under the management of the DFRN. Each classified forest is managed by a Provincial (Departmental) DFRN, which oversees Branch Offices, which in turn oversee district offices of specialized technical officers (Forest Offices). An on-site Forest Officer is located in every community and carries out direct on-site management. The management unit of the classified forest shall be placed under the jurisdiction of the district forest office. The management structure of classified forests is shown in Table 4-2-1.

As l'Alibori Supérieur Classified Forest straddles the boundary of Borgu Province (Department) and Atacora Province (Department), the area of the forest within Borgu shall be designated as l'Alibori Supérieur Classified Forest I and the area of the forest within Alibori shall be determined as l'Alibori Supérieur Classified Forest II.

Table 4-2-1 Management Structure and Area of the Classified Forest

Classified Forest	District	Forest Department (DFRN)	Forestry Branch Office	District Forestry Office	Area (ha)
Trois Rivières	Borgou	Borgou DFRN	PARAKOU	BEMBEREKE	37,651
				KALALE	107,213
			KANDI	GOGOUNOU	68,890
				SEGBANA	57,315
Ouénou Bénou	Borgou	Borgou DFRN	PARAKOU	BEMBEREKE	36,431
Upper Alibori River I	Borgou	Borgou DFRN	PARAKOU	SINENDE	44,319
			KANDI	GOGOUNOU	186,825
Upper Alibori River II	Atakora	Atakora DFRN	NATITINGOU	PEHONKO	18,547
				KEROU	11,678
Grand Total					568,869

* The area of land use and vegetation of the Intensive Study Area can be found in Appendix 9.

The classified forest of the Intensive Study Area for which this forest management plan is being formulated is under the jurisdiction of the Bembereke and Gogounou district forest offices.

(2) Improvement Unit

An improvement unit shall be established within the management unit of the district forest office and a forest improvement plan formulated and implemented for each improvement unit in order to improve classified forests. The improvement unit shall be established as an area of a certain size with overall consideration being given to the historical and socioeconomic conditions of the settlement that will use the classified forest, as well as natural conditions, such as stand rotation, etc.

Five improvement units shall be established as the people currently carrying out cultivation of the classified forest related to this forest management plan are from the five main settlements (collections of smaller settlements) of Zougou-Kpantrossi, Wessene, Pigourou, Kabanou, and Mani-Boke.

The five Improvement units are shown in Figure 4-2-1. The area of each improvement unit is shown in Table 4-2-2.

Table 4-2-2 Area of Improvement Units

(Unit: ha)

Management Unit	Improvement Unit	Classified Forest	Buffer Zone	Total
GOGOUNOU	ZOUGOU-KPANTROSSI	11,518	13,998	25,516
	WESSENE	13,179	6,563	19,742
	PIGOUROU	8,506	9,277	17,783
	Sous-total	33,203	29,838	63,041
BEMBEREKE	KABANOU	10,054	9,222	19,276
	MANI-BOKE	8,324	12,561	20,885
	Sous-total	18,378	21,783	40,161
Total		51,581	51,621	103,202

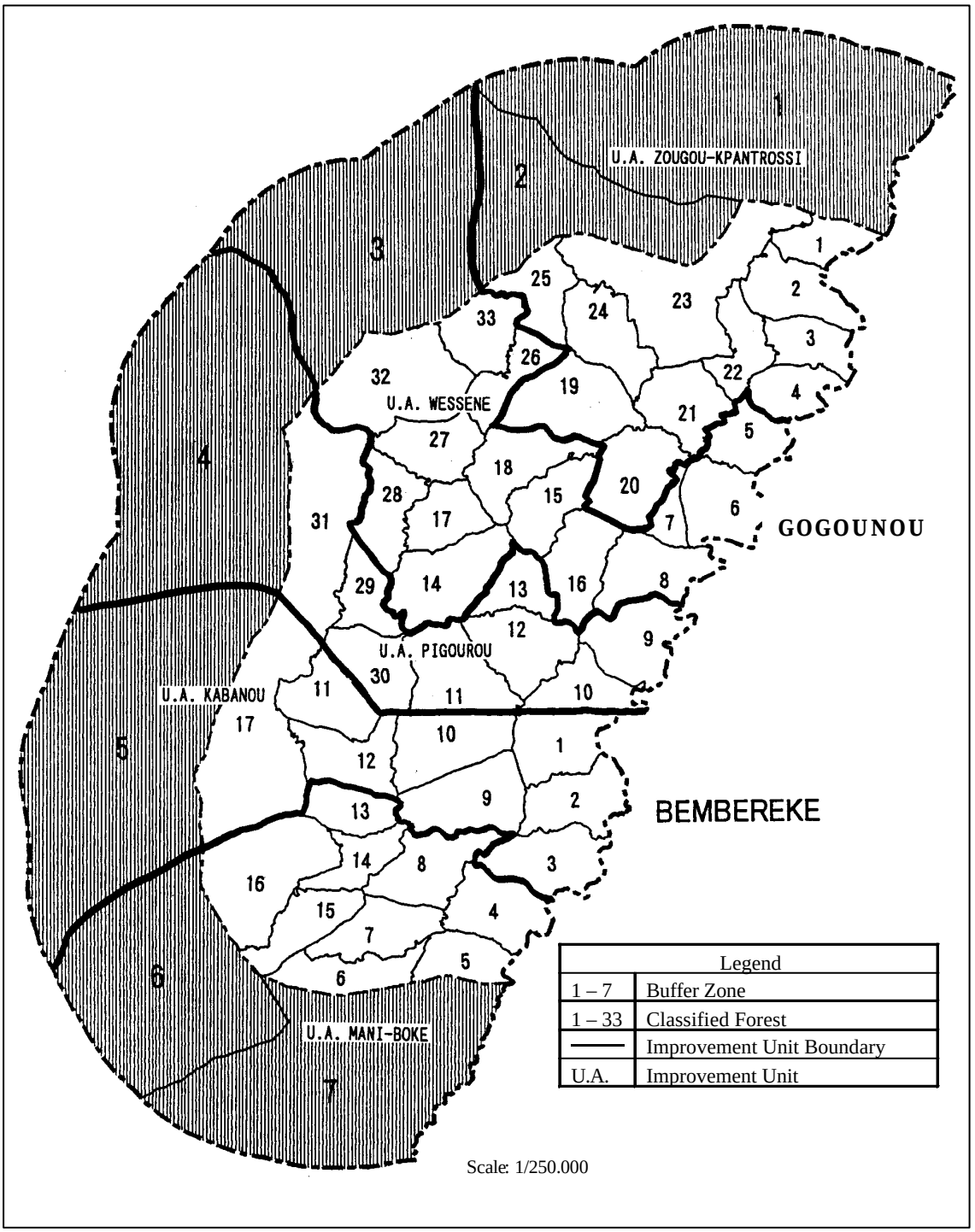


Figure 4-2-1 Improvement Units and Compartments of the Classified Forest

(3) Forest Division

In order to clarify the location of the forest and carry out activities such as planning, implementation and recording, etc., compartments and sub-compartments shall be established in the classified forest.

① Compartments

Compartments are areas with a fixed nature necessary for carrying out the management and activities of the classified forest and were established using political boundaries (provincial boundaries), the scale of settlement as obtained from the Survey to Ascertain the State of Local Inhabitants (Part II), roads, and waterways, etc. With regard to the buffer zone outside the classified forest, this was divided into 6 areas using political boundaries and roads.

A total of 57 compartments were created; 50 within the classified forest and seven within the buffer zone. Details regarding these compartments are shown in Table 4-2-3.

Table 4-2-3 Numbers of Compartments

Management Unit / Improvement Unit / Zoning	GOGOUNOU				BEMBEREKE			Total
	ZOUGOU-KPAN TROSSI	WESSENE	PIGOUROU	Subtotal	KABANOU	MANI-BOKE	Subtotal	
Classified Forest	11	14	8	33	8	9	17	50
Buffer Zone	2	1	1	4	1	2	3	7
Total	13	15	9	37	9	11	20	57

② Sub-Compartments

Sub-compartments are units used for forestry management in order to clarify present types of land use or the state of the forest and differences in the handling the forest and divide up compartments into smaller areas. Under this basic plan, the forest type units were used as sub-compartments. However, after the plan is actually implemented, new sub-compartments will be for selected according to differences in operations.

4.3 Classified Forest Plans

4.3.1 Improvement Goals

Although the classified forest was established as a state forest, as it has been used for many years as land for slash and burn cultivation, fallow ground and abandoned land, and grazing land, the forest has become somewhat reduced and devastated. Even now, the impact of illegal use of the classified forest by people from nearby settlements or concentrated grazing, etc. during the dry season is significant.

This improvement plan is being formulated as it is necessary to help the classified forest to recover quickly as state forest. Although the main aim of the improvement plan is the preservation of the classified forest, as the implementation of the plan without the cooperation of the local inhabitants is thought to be difficult, by allowing the local inhabitants to use cultivated land, etc. within the classified forest it may be possible to preserve the forest through the activities of the local inhabitants.

The improvement goals of the classified forest are shown below.

* To improve the public benefit functions of the forest through fostering the water sources of the

forest, preserving national land, protecting wildlife, and preserving genetic resources, etc.

* To endeavor to foster the production forest in order to improve and utilize sustainable forest resources.
* To establish areas within the classified forest for use by the local inhabitants in order to preserve the forest throughout coexistence with the local inhabitants.

4.3.2 Zoning

As the classified forest will be used for forest, grazing and farming, various zones shall be established according to use. In order to carry out adequate management and improvement of each area, uses shall be specified. The classified forest shall be divided up into three zones: the Forest Zone, the Silvi-Pastoral Zone and the Village Forestry Zone.

① Forest Zone

The Forest Zone is divided into the Conservation Forest Zone, which is areas of forest that should be protected and preserved as classified forest, and the Production Forest Zone, which is used for the production of timber.

(a) Conservation Forest Zone

A 3.5 km belt of forest stretching from the Bouli River, which is the boundary of the eastern side of the Intensive Study Area, and is to be used for public benefit functions, such as the fostering of water sources and the conservation of forest land, shall be made into the Conservation Forest Zone. Within this area Conservation Forest I and Conservation Forest II shall be established.

a) Conservation Forest I

* Areas of riverside forest within 500 m of the Bouli River, especially forest that should be protected in order to foster water sources.
* Areas of pure *Anogeissus leiocarpus* forest.
* Areas of forest on residual or tectonic relief.
* Areas of forest where soil conditions are bad and existing vegetation should be retained.

b) Conservation Forest II

Forest within the Conservation Forest Zone other than Conservation Forest Area I.

(b) Production Forest Zone

Forest for the production of timber, such as timber and fuelwood, etc., within the Forest Zone with the exception of the Conservation Forest Zone. However, the following types of forest within the Production Forest shall be designated as Conservation Forest II.

* Areas of forest within 50 m either side of waterways.
* Areas of pure *Anogeissus leiocarpus* forest.
* Areas of forest located on residual relief and tectonic relief.
* Areas of forest where soil conditions are bad and existing vegetation should be retained.

② Silvi-Pastoral Zone

Located between the Forestry Zone and the Village Forestry Zone, this zone is an area in which grazing is carried out. Serving as a buffer zone, areas of forest with 50 m either side of waterways shall be part of Conservation Forest II.

③ Village Forestry Zone

This is the area in which the local inhabitants carry out farming and forestry activities. It is located on the boundary of the Classified Forest and adjoins the Buffer Zone. The following areas within the Production Forest shall be part of Conservation Forest II.

* Areas of forest within 50 m either side of waterways.
* Areas of forest located on residual relief and tectonic relief.
* Areas of forest where soil conditions are bad and existing vegetation should be retained.

The area of each zone is shown in Table 4-3-1 while the zone divisions are shown in Figure 4-3-1.

Table 4-3-1 Classified Forest Area by Zone

(Unit: ha)

Zoning			GOGOUNOU				BEMBEREKE			Total
			ZOUGOU-KPAN TROSSI	WESSENE	PIGOUROU	Subtotal	KABANOU	MANI-BOKE	Subtotal	
Classified Forest	Forestry zone	Conservation Forest Zone	2,812	3,104	1,812	7,728	2,950	1,644	4,594	12,322
		Production Forest Zone	4,178	4,875	2,871	11,924	2,402	2,721	5,123	17,047
	Village Forestry Zone		2,709	2,772	2,312	7,793	2,893	1,912	4,805	12,598
	Silvi-Pastoral Zone		1,819	2,428	1,511	5,758	1,809	2,047	3,856	9,614
	Subtotal		11,518	13,179	8,506	33,203	10,054	8,324	18,378	51,581
Buffer Zone			13,998	6,563	9,277	29,838	9,222	12,561	21,783	51,581
Total			25,516	19,742	17,783	63,041	19,276	20,885	40,161	103,202

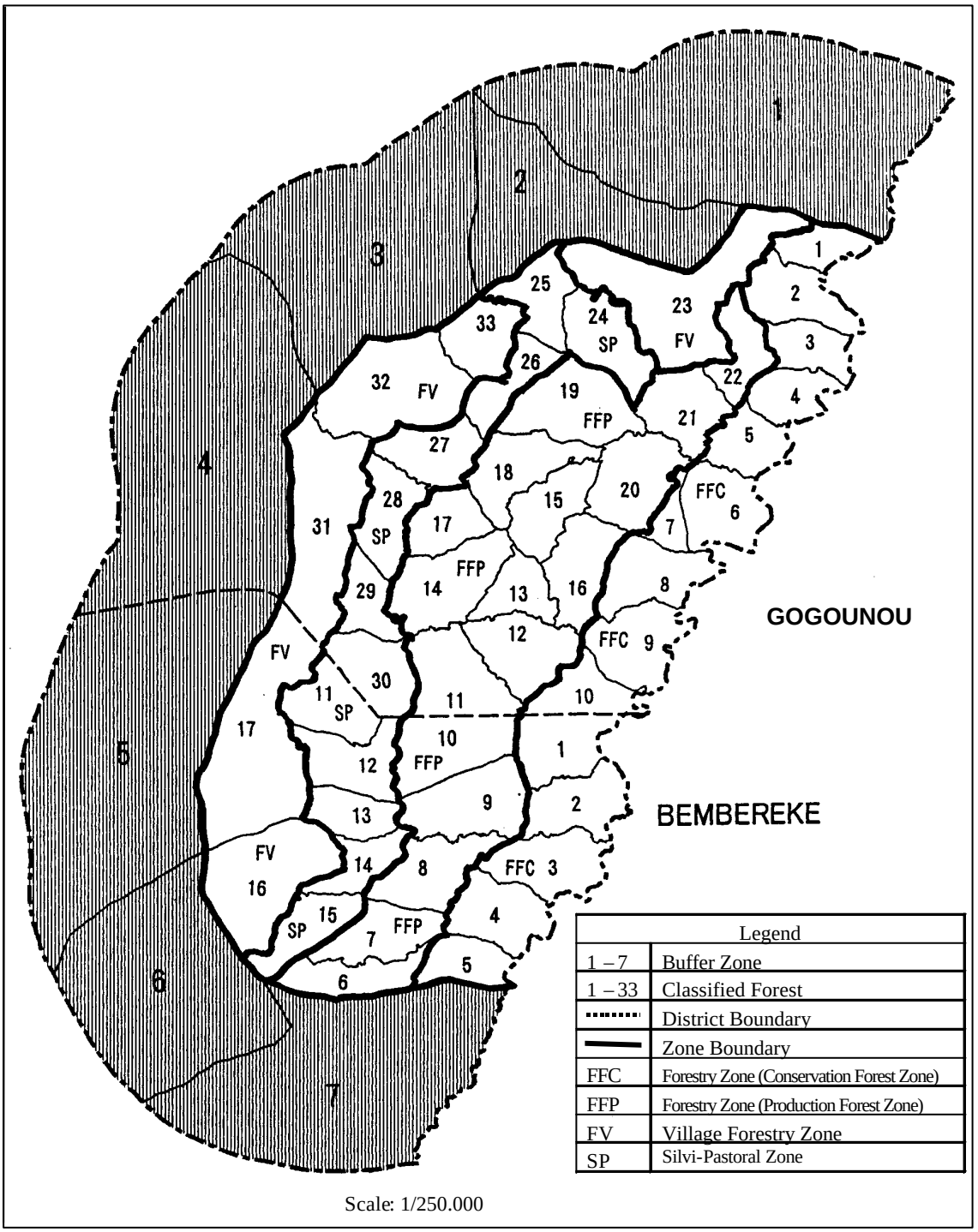


Figure 4-3-1 Zoning of Classified Forest

Figure 4-3-1 (1) Land Area by Forest Type and by Compartment (Zougou)

(Unit: ha)

Zoning	Compartment	Forest						Non-forest				Total
		Gf	Fc	Sa	Sb	St	Total	Ch	Ja	Total	Others	
Conservation Forest Zone	1	76.55	0.00	69.43	103.94	37.74	287.66	185.90	69.09	254.99	15.62	558.27
	2	56.78	0.00	376.51	362.80	38.35	834.44	68.92	39.62	108.54	12.14	955.12
	3	31.32	0.00	228.22	297.20	53.48	610.22	19.33	0.00	19.33	22.90	652.45
	4	39.56	0.00	260.41	263.63	54.85	618.45	25.11	0.00	25.11	2.27	645.83
	Total	204.21	0.00	934.57	1,027.57	184.42	2,350.77	299.26	108.71	407.97	52.93	2,811.67
Production Forest Zone	19	35.26	4.23	614.04	473.61	221.51	1,348.65	5.70	0.00	5.70	10.89	1,365.24
	20	37.87	0.00	562.88	448.73	74.16	1,123.64	32.07	0.00	32.07	1.57	1,157.28
	21	69.75	0.00	329.51	355.96	43.18	798.40	59.89	89.94	149.83	0.00	948.23
	22	8.30	0.00	255.60	129.73	45.71	439.34	128.34	140.16	268.50	0.00	707.84
	Total	151.18	4.23	1,762.03	1,408.03	384.56	3,710.03	226.00	230.10	456.10	12.46	4,178.59
Silvi-Pastoral Zone	24	79.24	3.93	261.71	377.06	176.71	898.65	84.42	16.55	100.97	30.92	1,030.54
	25	14.83	0.00	256.71	297.77	159.91	729.22	38.91	0.00	38.91	20.16	788.29
	Total	94.07	3.93	518.42	674.83	336.62	1,627.87	123.33	16.55	139.88	51.08	1,818.83
Village Forestry Zone	23	137.73	0.00	451.59	524.90	166.89	1,281.11	640.71	761.37	1,402.08	26.08	2,709.27
	Total	137.73	0.00	451.59	524.90	166.89	1,281.11	640.71	761.37	1,402.08	26.08	2,709.27
Grand total		587.19	8.16	3,666.61	3,635.33	1,072.49	8,969.78	1,289.30	1,116.73	2,406.03	142.55	11,518.36

Figure 4-3-1 (2) Land Area by Forest Type and by Compartment (WESSENE)

(Unit: ha)

Zoning	Compartment	Forest						Non-forest				Total
		Gf	Fc	Sa	Sb	St	Total	Ch	Ja	Total	Others	
Conservation Forest Zone	5	96.69	0.00	327.35	175.33	4.44	603.81	82.34	28.26	110.60	0.00	714.41
	6	78.08	0.00	528.35	357.06	34.99	998.48	0.00	0.00	0.00	6.10	1,004.58
	7	30.20	0.00	159.91	141.07	0.00	331.18	0.00	0.00	0.00	7.12	338.30
	8	52.44	0.00	371.25	436.01	152.26	1,011.96	0.00	0.00	0.00	34.89	1,046.85
	Total	257.41	0.00	1,386.86	1,109.47	191.69	2,945.43	82.34	28.26	110.60	48.11	3,104.14
Production Forest Zone	14	53.06	0.00	321.39	653.40	181.85	1,209.70	16.82	21.21	38.03	50.11	1,297.84
	15	35.94	0.00	277.30	390.31	90.14	793.69	18.77	17.00	35.77	36.20	865.66
	16	54.95	0.00	439.32	430.09	20.93	945.29	0.00	0.00	0.00	12.53	957.82
	17	22.32	0.00	165.78	363.87	71.23	623.20	75.07	6.35	81.42	9.20	713.82
	18	60.69	0.00	556.91	216.38	148.14	982.12	27.94	12.93	40.87	17.00	1,039.99
	Total	226.96	0.00	1,760.70	2,054.05	512.29	4,554.00	138.60	57.49	196.09	125.04	4,875.13
Silvi-Pastoral Zone	26	75.94	0.00	214.22	104.81	98.09	493.06	179.82	17.86	197.68	0.00	690.74
	27	44.45	0.00	112.07	284.49	51.72	492.73	299.77	56.96	356.73	12.17	861.63
	28	63.73	0.00	10.69	533.49	69.83	677.74	155.10	35.89	190.99	6.62	875.35
	Total	184.12	0.00	336.98	922.79	219.64	1,663.53	634.69	110.71	745.40	18.79	2,427.72
Village Forestry Zone	32	159.57	13.07	70.20	648.71	171.31	1,062.86	707.24	196.77	904.01	19.10	1,985.97
	33	33.25	0.00	16.63	154.69	108.05	312.62	404.61	68.86	473.47	0.00	786.09
	Total	192.82	13.07	86.83	803.40	279.36	1,375.48	1,111.85	265.63	1,377.48	19.10	2,772.06
Grand total		861.31	13.07	3,571.37	4,889.71	1,202.98	10,538.44	1,967.48	462.09	2,429.57	211.04	13,179.05

Figure 4-3-1 (3) Land Area by Forest Type and by Compartment (PIGOUROU)

(Unit: ha)

Zoning	Compartment	Forest						Non-forest				Total
		Gf	Fc	Sa	Sb	St	Total	Ch	Ja	Total	Others	
Conservation Forest Zone	9	124.39	0.00	490.81	359.97	92.64	1,067.81	0.00	0.00	0.00	23.69	1,091.50
	10	33.69	0.00	362.86	232.83	91.64	721.02	0.00	0.00	0.00	0.00	721.02
	Total	158.08	0.00	853.67	592.80	184.28	1,788.83	0.00	0.00	0.00	23.69	1,812.52
Production Forest Zone	11	35.28	0.00	170.31	634.61	92.84	933.04	182.91	36.84	219.75	31.66	1,184.45
	12	108.77	0.00	238.73	585.61	121.17	1,054.28	0.00	0.00	0.00	18.34	1,072.62
	13	101.81	0.00	241.71	178.59	89.17	611.28	0.00	0.00	0.00	2.16	613.44
	Total	245.86	0.00	650.75	1,398.81	303.18	2,598.60	182.91	36.84	219.75	52.16	2,870.51
Silvi-Pastoral Zone	29	63.44	0.00	0.00	453.62	76.13	593.19	0.00	23.71	23.71	8.55	625.45
	30	72.56	0.00	56.90	536.51	98.73	764.70	69.93	21.52	91.45	29.35	885.50
	Total	136.00	0.00	56.90	990.13	174.86	1,357.89	69.93	45.23	115.16	37.90	1,510.95
Village Forestry Zone	31	290.32	0.00	93.92	901.98	249.83	1,536.05	462.39	286.75	749.14	26.31	2,311.50
	Total	290.32	0.00	93.92	901.98	249.83	1,536.05	462.39	286.75	749.14	26.31	2,311.50
Grand total		830.26	0.00	1,655.24	3,883.72	912.15	7,281.37	715.23	368.82	1,084.05	140.06	8,505.48

Figure 4-3-1 (4) Land Area by Forest Type and by Compartment (KABANOU)

(Unit: ha)

Zoning	Compartment	Forest						Non-forest				Total
		Gf	Fc	Sa	Sb	St	Total	Ch	Ja	Total	Others	
Conservation Forest Zone	1	70.68	0.00	379.95	448.11	45.88	944.62	0.00	0.00	0.00	15.09	959.71
	2	34.86	0.00	520.47	253.47	66.72	875.52	50.27	4.30	54.57	10.16	940.25
	3	45.56	0.00	658.96	194.43	122.19	1,021.14	0.00	0.00	0.00	29.13	1,050.27
	Total	151.10	0.00	1,559.38	896.01	234.79	2,841.28	50.27	4.30	54.57	54.38	2,950.23
Production Forest Zone	9	57.46	0.00	470.96	311.49	117.69	957.60	213.70	9.85	223.55	49.87	1,231.02
	10	28.68	0.00	162.78	614.89	153.19	959.54	198.06	1.02	199.08	12.90	1,171.52
	Total	86.14	0.00	633.74	926.38	270.88	1,917.14	411.76	10.87	422.63	62.77	2,402.54
Silvi-Pastoral Zone	11	45.00	0.00	72.05	457.69	138.05	712.79	27.86	117.49	145.35	16.96	875.10
	12	176.85	7.71	183.96	355.57	76.40	800.49	69.30	42.82	112.12	20.90	933.51
	Total	221.85	7.71	256.01	813.26	214.45	1,513.28	97.16	160.31	257.47	37.86	1,808.61
Village Forestry Zone	17	248.72	45.81	88.77	1,031.38	490.27	1,904.95	803.96	159.02	962.98	24.75	2,892.68
	Total	248.72	45.81	88.77	1,031.38	490.27	1,904.95	803.96	159.02	962.98	24.75	2,892.68
Grand total		707.81	53.52	2,537.90	3,667.03	1,210.39	8,176.65	1,363.15	334.50	1,697.65	179.76	10,054.06

Figure 4-3-1 (5) Land Area by Forest Type and by Compartment (MANI-BOKE)

(Unit: ha)

Zoning	Compartment	Forest						Non-forest				Total
		Gf	Fc	Sa	Sb	St	Total	Ch	Ja	Total	Others	
Conservation Forest Zone	4	37.38	0.00	541.70	245.62	116.34	941.04	25.24	0.00	25.24	25.67	991.95
	5	56.54	0.00	183.38	230.02	96.17	566.11	80.95	4.90	85.85	0.00	651.96
	Total	93.92	0.00	725.08	475.64	212.51	1,507.15	106.19	4.90	111.09	25.67	1,643.91
Production Forest Zone	6	0.00	0.00	291.34	246.43	171.89	709.66	55.12	12.79	67.91	20.40	797.97
	7	11.87	6.15	253.71	466.52	71.95	810.20	40.72	22.28	63.00	13.32	886.52
	8	126.53	0.00	255.44	422.19	116.27	920.43	66.99	14.70	81.69	34.15	1,036.27
	Total	138.40	6.15	800.49	1,135.14	360.11	2,440.29	162.83	49.77	212.60	67.87	2,720.76
Silvi-Pastoral Zone	13	29.20	0.00	101.36	269.06	72.67	472.29	77.11	56.28	133.39	25.70	631.38
	14	59.98	0.00	92.15	165.21	123.21	440.55	107.89	46.41	154.30	0.00	594.85
	15	13.41	11.73	168.58	478.75	123.61	796.08	1.35	8.69	10.04	15.44	821.56
	Total	102.59	11.73	362.09	913.02	319.49	1,708.92	186.35	111.38	297.73	41.14	2,047.79
Village Forestry Zone	16	239.05	24.97	67.28	826.06	323.95	1,481.31	361.22	50.88	412.10	18.40	1,911.81
	Total	239.05	24.97	67.28	826.06	323.95	1,481.31	361.22	50.88	412.10	18.40	1,911.81
Grand total		573.96	42.85	1,954.94	3,349.86	1,008.55	5,635.52	816.59	216.93	1,033.52	153.08	8,324.27

4.3.3 Improvement Standards

(1) Forestry Zone

The Forest Zone shall be improved and handled as shown below.

① Conservation Forest Zone

(a) Conservation Forest I

* Logging and the removal of branches and leaves shall be prohibited.
* Controlled burning shall be totally prohibited.
* Grazing and the passage of livestock shall be prohibited.
* Planted, enrichment and direct planting of native species of trees shall be carried out in areas of cultivated land or fallow ground and areas of devastated forest in an endeavor to achieve rapid forest recovery.

(b) Conservation Forest II

* Controlled burning shall be totally prohibited.
* Grazing and the passage of livestock shall be prohibited.
* New planting shall be carried out in cultivated land and fallow ground in order to realize rapid forest recovery. Mixed planting shall be carried out of native species of trees.
* Enrichment shall be carried out in areas of devastated forest using native species of trees in order to help the forest to recover.
* Although thinning, improvement cutting and sanitation cutting may be carried out in order to help foster the forest, all other logging and the removal of branches and leaves shall be prohibited.
* Dense planting shall be carried out on the boundary with other zones in order to eliminate *Gramineae* plants which act as fuel for forest fires.

② Production Forest Zone

* Controlled burning shall be totally prohibited.
* Grazing and the passage of livestock shall be prohibited.
* Fuelwood forest shall be created through new planting and direct planting in cultivated land, fallow ground, Sa, Sb, and St. In addition to the planting of native species, such as *Terminalia avicennoides*, *Detarium microcarpum*, and *Combretum glutinosum*, etc., introduced species of trees, such as *Acacia auriculiformis*, *Tectona grandis*, *Gmelina arborea*, and *Cassia siamea*, etc., shall also be planted.
* Production forest for selective logging shall be created for timber production through enrichment and natural seeding in areas of natural forest outside Conservation Forest II and fuelwood production forest areas.
* Land being cultivated at the time of the implementation of the plan may continue to be cultivated until after crops have been harvested at which time the timber and fuelwood production forest shall be created.
* Forest that should be conserved shall be handled in the same way as Conservation Forest II.

(2) Silvi-Pastoral Zone

The Silvi-Pastoral Zone shall be improved and handled in the following way.

* Grazing techniques in the Silvi-Pastoral Zone shall be improved through formulating various grazing-related techniques, such as planned early controlled burning and the improvement of grazing capacity.
* Although the growth of trees is not good as the A horizon of the soil is shallow, in areas suitable for growing grass and shrubs, pasture improvement and the planting of feed trees shall be carried out.
* Man-made pasture shall be created in small areas of returned cultivated land and fallow ground scattered throughout the zone and feed produced for the dry season.
* Areas of early controlled burning shall be determined in each improvement unit and carried out in a planned manner. The area around those areas where early controlled burning is to be carried out shall be cut back to serve as firebreaks to prevent fire from spreading to the surrounding area.
* Grazing areas for the rainy season and the dry season shall be determined and grazing carried out according to the season.
* In order to provide water for livestock during the dry season, dams shall be made on the Bouli River or waterways in the Silvi-Pastoral Zone or the Village Forestry Zone as a means of storing water. The drilling of wells within the Silvi-Pastoral Zone shall also be planned.
* Areas of forest that should be preserved shall be treated in the same way as Conservation Forest II.
* The local inhabitants shall make payments to the Forest Improvement Fund according to the number of livestock using the zone.

(3) Village Forestry Zone

The Village Forestry Zone shall be improved and handled in the following way.

* Cultivated land in this zone shall be used for growing food for personal consumption and the growing of cotton is prohibited.
* As a rule, people using the land for cultivation within this zone shall be those people possessing land within the existing classified forest (based on aerial photographs taken in 1998).
* Each household shall be allocated the use of 2.0ha of land for cultivation and 2.0ha of land for fruit growing, fuelwood production and post production, making a total of 4ha.
* Accompanying the prohibition of cotton growing within the Village Forestry Zone, organic fertilizer, the planting of *Leguminosae*, and the introduction of new species shall be carried out to establish fixed cultivation.
* Agroforestry (Taungya) may be carried out in the 2.0ha of land for tree planting.
* *Vitellaria paradoxa* and *Parkia biglobosa*, etc. shall be planted around each area of cultivated land.
* Areas of forest that should be preserved shall be handling in the same manner as Conservation Forest II.
* Areas retained as forest shall be left in their natural state.
* Paths for the passage of livestock (50m wide) shall be established in the Village Forestry

Zone from areas within the classified forest to areas within the Silvi-Pastoral Zone and such areas of forest designated as Conservation Forest II. It is possible to log trees, etc. in order to make way for the use of the area as a path for the movement of livestock. Authorized early controlled burning is the only kind of controlled burning that shall be permitted.

* Belts of trees shall be planted on the Village Forestry Zone's boundary with both the Silvi-Pastoral Zone and the Forestry Zone both to mark the boundary and prevent the spread of fires. Species to be planted include *Khaya senegalensis*, *Acacia auriculiformis*, *Vitellaria paradoxa*, *Pterocarpus* sp., *Parkia biglobosa*, and *Daniellia oliveri*, etc., which are sources of nectar for bee-keeping. The planting of such species will help to develop the beekeeping industry for the local inhabitants.
* The local inhabitants shall make payments to the Forest Improvement Fund according to the are of cultivated land that they use.

The main reason that cotton growing within the classified forest is prohibited under this plan is that the Trois-Rivières Classified Forest is a water source forest. This is to prevent the large amounts of chemical fertilizer and pesticides, etc. used in cotton growing from further contaminating the area. However, the prohibition of the growing of cotton should be seen as a chance to make the transition from extensive shifting cultivation to intensive fixed cultivation and to reduce the danger of crop failure by diversifying the types of farm products grown and endeavoring to achieve long-term sustainable farm management.

4.3.4 Improvement Plans

(1) Conservation Forest Plan

This is the improvement plan for the Conservation Forest Zone which was established as an area of forest within the classified forest to be operated for public benefit functions, such as the fostering of water sources and forest conservation, etc. The Conservation Forest Zone is located on the western side of the Bouli River on the eastern boundary of the Intensive Study Area, has a width of 3,500m, and is divided into Conservation Forest I and Conservation Forest II.

Conservation Forest I consists of the following.

* Areas of riverside forest within 500m of the Bouli River.
* Pure forest of *Anogeissus leiocarpus*.
* Areas of forest on residual relief or tectonic relief.
* Areas of forest where soil conditions are bad and existing vegetation should be retained.
* Areas of forest other than Conservation Forest I are Conservation Forest II.

The state of the forest type within the Conservation Forest Zone is shown in Table 4-3-2.

Table 4-3-2 Area of Conservation Forest Zones

(Unit : ha)

Zoning	Management Unit	Improvement Unit	Forest Type and Land Use										Total
			Gf	Fc	Sa	Sb	St	Subtotal	Ch	Ja	Subtotal	Others	
Conservation Forest I	GOGOUNOU	ZOUGOU-KP ANTROSSI	115	0	223	280	75	693	103	10	113	40	846
		WESSENE	131	0	246	146	50	573	52	0	52	29	654
		PIGOUROU	111	0	170	154	22	457	0	0	0	17	474
		Subtotal	357	0	639	580	147	1,723	155	10	165	86	1,974
	BEMBEREKE	KABANOU	75	0	451	251	14	791	0	0	0	37	828
		MANI-BOKE	54	0	155	158	76	443	36	0	36	26	505
		Subtotal	129	0	606	409	90	1,234	36	0	36	63	1,333
	Total		486	0	1,245	989	237	2,957	191	10	201	149	3,307
Conservation Forest II	GOGOUNOU	ZOUGOU-KP ANTROSSI	89	0	712	748	109	1,658	196	99	295	13	1,966
		WESSENE	126	0	1,140	964	142	2,372	31	28	59	19	2,450
		PIGOUROU	47	0	684	439	162	1,332	0	0	0	6	1,338
		Subtotal	262	0	2,536	2,151	413	5,362	227	127	354	38	5,754
	BEMBEREKE	KABANOU	76	0	1,108	646	220	2,050	51	4	55	17	2,122
		MANI-BOKE	40	0	570	317	137	1,064	70	5	75	0	1,139
		Subtotal	116	0	1,678	963	357	3,114	121	9	130	17	3,261
	Total		378	0	4,214	3,114	770	8,476	348	136	484	55	9,015
Grand Total			864	0	5,459	4,103	1,007	11,433	539	146	685	204	12,322

① Conservation Forest I

This is an area of forest where the use of the forest is restricted and forest operations are not carried out. In order to fulfill its function as a forest conservation and to achieve the rapid restoration and recovery of the forest new planting of native species in reverted cultivated land and fallow ground shall be carried out together with enrichment of native species in areas of devastated forest (areas with a crown density of less than 50%).

(a) Area for Forest Restoration and Recovery

The area necessary for forest restoration and recovery is shown in Table 4-3-3.

Table 4-3-3 Areas of Recovered/Restored Forest

(Unit: ha)

Management Unit	Improvement Unit	Forest Type and Land Use									Total
		Gf	Fc	Sa	Sb	St	Subtotal	Ch	Ja	Subtotal	
GOGOUNOU	ZOUGOU-KPANTROSSI	5	0	147	195	75	422	103	10	113	535
	WESSENE	23	0	38	146	50	257	52	0	52	309
	PIGOUROU	0	0	126	132	22	280	0	0	0	280
	Sous-total	23	0	311	473	147	959	155	10	165	1,124
BEMBEREKE	KABANOU	0	0	323	237	15	575	0	0	0	575
	MANI-BOKE	27	0	86	158	75	346	36	0	36	382
	Subtotal	27	0	409	395	90	921	36	0	36	957
Total		55	0	720	868	237	1,880	191	10	201	2,081

(b) Tree Species for Planting

The following species of trees shall be planted.

Khaya senegalensis

Pterocarpus erinaceus

Isoberlinia spp.

Vitellaria paradoxa

Parkia biglobosa

(c) Planting Techniques

* In order to realize the rapid restoration and recovery of the forest planting shall be carried out using seedlings.
* Mixed planting of native species shall be carried out.
* Planting shall be carried out in cultivated land and fallow ground at a planting density of 625 trees/ha (4 m × 4 m).
* Enrichment shall be carried out in devastated and inferior areas of forest at a planting density of 100 trees/ha (10 m × 10 m).

(d) Tending

* Supplementary planting and brush cutting depending on the state of survival and the growth of planted trees.
* Supplementary planting after one year and brush cutting after 2 - 3 years for newly planted areas. Supplementary planting shall be carried out after one year if the survival rate is less than 80%.
* For areas of enrichment, supplementary planting shall be carried out after one year and brush cutting carried out one year after planting depending on the state of the undergrowth. Supplementary planting shall be carried out after one year if the survival rate is less than 80%.
* Brush cutting shall consist only of spot weeding around trees.

② Conservation Forest II

The active creation and improvement of these areas shall be carried out as a forest to foster the water source of the Bouli River. In the same way as for Conservation Forest I, in order to achieve the rapid restoration and recovery of the forest, new planting of native species in reverted cultivated land and fallow ground shall be carried out together with enrichment of native species in areas of devastated forest (areas of Gf, Sa, Sb, and St with a crown density of less than 50%).

(a) Area for Forest Restoration and Recovery

The area necessary for forest restoration and recovery is shown in Table 4-3-4.

Table 4-3-4 Areas of Recovered/Restored Forest

(Unit:ha)

Management Unit	Improvement Unit	Forest Type and Land Use									Total
		Gf	Fc	Sa	Sb	St	Subtotal	Ch	Ja	Subtotal	
GOGOUNOU	ZOUGOU-KPANTROSSI	17	0	415	492	109	1,033	196	99	295	1,328
	WESSENE	0	0	509	875	142	1,526	31	28	59	1,585
	PIGOUROU	3	0	281	359	162	805	0	0	0	805
	Subtotal	20	0	1,205	1,726	413	3,364	227	127	354	3,718
BEMBEREKE	KABANOU	0	0	420	604	220	1,244	51	4	55	1,299
	MANI-BOKE	22	0	135	313	137	607	70	5	75	682
	Subtotal	22	0	555	917	357	1,851	121	9	130	1,981
Total		42	0	1,760	2,643	770	5,215	348	136	484	5,699

(b) Tree Species

The following species of trees shall be planted.

Khaya senegalensis
Pterocarpus erinaceus
Isoberlinia spp.
Vitellaria paradoxa
Parkia biglobosa
Milicia excelsa

Other species mentioned in the attachments of the Washington Treaty which it is possible to plant for forest creation or species that can be direct planted may also be planted.

(c) Planting Techniques

* Planting shall be carried out using seedlings. Seedlings shall not be raised for species the seeds of which can be directly sown or their cuttings can be planted.
* Mixed planting of native species of seedlings or mixtures of groups of seedlings shall be carried out.
* New planting shall be carried out in cultivated land and fallow ground at a planting density of 625 trees/ha (4 m × 4 m).
* Enrichment shall be carried out in devastated and inferior areas of forest at a planting density of 100 trees/ha (10 m × 10 m).

(d) Tending

* Supplementary planting shall be carried out in areas of new planting and enrichment after one year in areas where the survival rate is less than 80%.
* Brush cutting shall be carried out after 2 - 3 years after planting for newly planted areas and one year after planting for enrichment areas.
* Thinning, improvement cutting and sanitation cutting shall be carried out as necessary in order to create and improve Conservation Forest area as healthy water sources.

③ Forest Restoration and Recovery Plans

(a) Period

Replanting, supplementary planting and brush cutting shall be carried out in both Conservation Forest I and Conservation Forest II for a period of five years. In Conservation Forest II, thinning, improvement cutting and sanitation cutting shall be carried out as necessary depending on the state of planted trees and depending on the effect of planted trees on other trees and whether or not they are hindering growth.

(b) Annual Work Volumes

The five-year plan for Conservation Forest I and Conservation Forest II is shown below.

* Both new planting and enrichment for forest restoration and recovery shall cease after four years and the annual work area shall remain the same. In this case, new planting shall be carried out during the first to third years with enrichment being carried out in the second and fourth years.
* Supplementary planting shall be carried out in the second through to the fourth year and enrichment activities carried out from the second through to the fifth year. Brush cutting shall be carried out in areas of new planting from the first through to the fifth year and during the second to fifth years for areas of enrichment.

The above-mentioned work volumes for Conservation Forest I and Conservation Forest II are shown below.

Table 4-3-5 Annual Work Volume for Conservation Forest I and II

(Unit: ha)

Category			1st year	2nd year	3rd year	4th year	5th year	Total
Conservation Forest I	Planting	New Planting	67	67	67			201
		Enrichment	453	453	453	521		1,880
	Supplementary Planting	New Planting		67	67	67		201
		New Planting		453	453	453	521	1,880
	Brush Cutting	Enrichment	67	134	201	134	67	603
		New Planting		453	453	453	521	1,880
Conservation Forest II	Planting	Enrichment	161	161	162			484
		New Planting	1,263	1,263	1,262	1,427		5,215
	Supplementary Planting	Enrichment		161	161	162		484
		New Planting		1,263	1,263	1,262	1,427	5,215
	Brush Cutting	Enrichment	161	322	484	323	162	1,452
		New Planting		1,263	1,263	1,262	1,427	5,215

(c) Implementation Method

* Both planning and implementation shall be carried out by the DFRN.
* The local inhabitants shall be employed as workers and paid a wage.
* Necessary seedlings shall be purchased by the DFRN from the village nurseries.

(2) Production Forest Plan

This is the improvement plan for the Production Forest Zone which was established as an area of forest for the production of timber. The Production Forest Zone is located outside the Conservation Forest Zone.

Areas of forest and land used in the timber production of the Production Forest Zone are areas other than forest handled as Conservation Forest. The area of areas of forest and land for timber production within the Production Forest Zone are shown in Table 4-3-6 while the area of Conservation Forest II within the Timber Production Forest Zone is shown in Table 4-3-7.

Table 4-3-6 Area of Target Forest and Land for Timber Production

(Unit: ha)

Management Unit	Improvement Unit	Forest Type and Land Use										Total
		Gf	Fc	Sa	Sb	St	Subtotal	Ch	Ja	Subtotal	Others	
GOGOUNOU	ZOUGOU-KPANT ROSSI	0	4	1,527	1,322	363	3,216	222	228	450	0	3,666
	WESSENE	5	0	1,540	1,837	480	3,862	125	47	172	3	4,037
	PIGOUROU	0	0	622	1,382	303	2,307	183	37	220	0	2,527
	Subtotal	5	4	3,689	4,541	1,146	9,385	530	312	842	3	10,230
BEMBEREKE	KABANOU	6	0	589	831	239	1,665	409	9	418	33	2,116
	MANI-BOKE	0	6	723	919	265	1,913	162	47	209	12	2,134
	Subtotal	6	6	1,312	1,750	504	3,578	571	56	627	45	4,250
Total		11	10	5,001	6,291	1,650	12,963	1,101	368	1,469	48	14,480

Table 4-3-7 Area of Conservation Forest II in Timber Production Forestry Zone

(Unit: ha)

Management Unit	Improvement Unit	Forest Type and Land Use										Total
		Gf	Fc	Sa	Sb	St	Sous total	Ch	Ja	Sous total	Autres	
GOGOUNOU	ZOUGOU-KPANT ROSSI	151	0	281	57	5	494	4	2	6	12	512
	WESSENE	222	0	221	217	32	692	14	10	24	122	838
	PIGOUROU	246	0	28	18	0	292	0	0	0	52	344
	Subtotal	619	0	530	292	37	1,478	18	12	30	186	1,694
BEMBEREKE	KABANOU	80	0	45	95	32	252	3	2	5	29	286
	MANI-BOKE	138	0	77	216	96	527	0	3	3	57	587
	Subtotal	218	0	122	311	128	779	3	5	8	86	873
Total		837	0	652	603	165	2,257	21	17	38	272	2,567

The production forest area shall be used for the production of timber and fuelwood. The Trois-Rivières Classified Forest within the Intensive Study Area has an annual rainfall of approximately 1,000mm and much of the existing vegetation is trees, mixed and shrub savannah (Sa, Sb, St). Furthermore, in Benin, which does not have a history of forest planting for large-scale timber production in the vicinity of the latitude of this classified forest (clear-felling and replanting techniques), native species are used as production forest for the production of timber for general construction. Areas of fuelwood forest are created using native species and introduced species with a history of use in forest creation.

① Timber Production Forest

Areas of Gf, Fc, Sa and Sb within the Production Forest Zone are used as timber forests for the production of timber. The areas of timber forest are shown in Table 4-3-8.

Table 4-3-8 Timber Production Forest Area

(unit: ha)

Management Unit	Improvement Unit	Forest Type						Total
		Gf	Fc	Sa (50%=<D)	Sa (D<50%)	Sb (50%=<D)	Sb (D<50%)	
GOGOUNOU	ZOUGOU-KPANTROSSI	0	4	896		0	0	900
	WESSENE	5	0	829	306	0	0	1,140
	PIGOUROU	0	0	235	387	215	123	960
	Subtotal	5	4	1,960	693	215	123	3,000
BEMBEREKE	KABANOU	6	0	272	317	4	361	960
	MANI-BOKE	0	6	479	244	286	125	1,140
	Subtotal	6	6	751	561	290	486	2,100
Total		11	10	2,711	1,254	505	609	5,100

Selective logging shall be carried out in the timber forest. In order to carry out structured selective logging operations, although it is necessary to have a forest with a certain structure, at present the forest cover of the production forest is extremely low, making the carrying out of selective logging operations impossible. We should therefore consider the structural parameters of a selective logging forest and work toward the realization of something similar to this structure.

(a) Parameters of the Target Structure

a) Target Growing Stock

Considering the present state of the forest, it is thought that promising results can be obtained through enrichment and that the target growing stock for the immediate future is estimated to be 100 m^3/ha.

b) Target Increment

Considering the increment rate of *Khaya senegalensis*, the target increment rate for the immediate future is estimated to be 2%.

c) Cutting Cycles and Logging Ratios

The following relationship exists between the selective cutting cycle r and the selective logging rate.

$$\text{Selective logging ratio} = \frac{(1+\text{Increment rate})^{r}-1}{(1+\text{Increment rate})^{r}}$$

From the standpoint of forest function and achieving regeneration and the possibility of carrying out such work, the cutting cycle r should be set in a comprehensive way for the immediate future at 20 years.

Using this formula with a increment rate of 2% and a cutting cycle of 20 years results in a selective logging ratio of 33%.

(d) The Parameters of Sustainable Selective Logging

The parameters of sustainable selective logging are shown below.

Growing Stock: 100 m^3/ha

Increment Rate: 2%/annum

Cutting Cycle: 20 years

Selective Logging Ratio: 33%

Stand Volume before Selective Logging: 121 m^3/ha

Selective Logging Volume: 40 m^3/ha

Stand Volume after Selective Logging: 81 m^3/ha

(b) Operations in the Immediate Future

a) Logging

Logging is carried out with the aim of removing standing trees that will hinder enrichment and the growth of succeeding trees. Logging shall be carried out with the aim of achieving a stand volume of 33% of the present stand volume. Trees to be logged shall be selected in the following order of priority.

* Withered and damaged trees (however these shall not be included in logging ratio calculations).
* Deformed trees.
* Species of trees with a low possibility of being used for timber in the future.
* Trees that have reached timber specifications.

b) Regeneration

Enrichment shall be carried out on half the logging area using species that are used for timber and are able to be grown in Benin, such as *Khaya senegalensis*, *Milicia excelsa*, *Isoberlinia* spp., *Pterocarpus erinaceus*, *Afzelia africana*, and *Prosopis africana*, etc. with the other half being left to natural regeneration.

Standard planting density shall be 100 trees/ha (10 m × 10 m).

The remaining half shall be natural regeneration l of useful species.

The age at maturity of these species is 30 years.

c) Estimated Stand Volumes

The increment rate for existing stands shall be 4% for the first 10 years, 3% for the following 10 years, 3% for the 10 years following the second logging, and 2% for the 10 years following that. Good growth is expected in enrichment areas, such as *Khaya senegalensis*. *Khaya senegalensis* is expected to grow in 60% of the area left to natural regeneration.

From the above estimates, the stand volume is expected to increase steadily from the current level of 27.39 m^3/ha to reach the target growing stock during the 13th year of the third cutting cycle.

d) Estimated Logging Volumes

Based on the estimates of c) above, the timber volume will increase steadily after the estimated volume of 8.50 m^3/ha during the first year, reaching 40 m^3/ha during the 13th year of the third cutting cycle.

(c) Work Plans

a) Logging Plans

Logging plans for a cutting cycle for each improvement unit are shown below.

Table 4-3-9 Logging Plans

Improvement Unit	Area (ha)	Annual Cutting Area (ha)	Logging Volume (m^3) per annum	
			1st half of cutting cycle(1～10year)	2nd half of cutting cycle(10～20year)
OUGOU-KPANTROSSI	900	45	510	720
WESSENE	1,140	57	646	912
PIGOUROU	960	48	544	768
KABANOU	960	48	544	768
MANI-BOKE	1,140	57	646	912
Total	5,100	255	2,890	4,080

b) Regeneration l Plans

Regeneration plans for each improvement unit are shown below.

Table 4-3-10 Regeneration Plans

Improvement Unit	Annual Logging Area (ha)	Annual Replanting Area (ha)		
		Enrichment	Natural Regeneration	Total
ZOUGOU-KPANTROSSI	45	0	15	15
WESSENE	57	5	14	19
PIGOUROU	48	12	4	16
KABANOU	48	12	4	16
MANI-BOKE	57	11	8	19
Total	255	40	45	85

② Fuelwood Forest

Cultivated land, fallow ground, Sa (with a crown density of less than 50%), Sb (other than timber forest), and St shall be made into fuelwood forest for the production of fuelwood.

Fuelwood forest areas are shown in Table 4-3-11.

Table 4-3-11 Land Area of Fuelwood Forest

(Unit: ha)

Management Unit	Improvement Unit	Forest Type and Land Use										Total
		Sb (50%=<D)	Sa (D< 50%)	Sb (50%=<D)	Sb (D< 50%)	St	Subtotal	Ch	Ja	Subtotal	Others	
GOGOUNOU	ZOUGOU-KPANTROSSI	195	436	314	1,008	363	2,316	222	228	450	0	2,766
	WESSENE	0	405	196	1,641	480	2,722	125	47	172	0	2,894
	PIGOUROU	0	0	0	1,044	303	1,347	183	37	220	0	1,567
	Subtotal	195	841	510	3,693	1,146	6,385	530	312	842	0	7,227
BEMBEREKE	KABANOU	0	0	0	466	239	705	409	9	418	0	1,123
	MANI-BOKE	0	0	0	508	265	773	162	47	209	0	982
	Subtotal	0	0	0	974	504	1,478	571	56	627	0	2,105
Total		195	841	510	4,667	1,650	7,863	1,101	368	1,469	0	9,332

(a) Implementation Method

a) Cultivated Land and Fallow Ground

Introduced species, such as *Acacia auriculiformis*, *Gmelina arborea*, *Tectona grandis*, *Cassia siamea*, etc. shall be planted in areas of cultivated land and fallow ground. Planting shall be carries out at a planting density of 2,500 trees/ha (2 m × 2 m) and 2,000 trees/ha (2 m × 2.5 m). Considering the profitability of operations in the fuelwood forest, clear felling shall be carried out. As the aim of the fuelwood forest is the production of fuelwood, regeneration shall be carried out by germination and direct grafting which are cheap forms of regeneration.

b) Sa, Sb, and St Forest

Standing trees (withered and damaged trees are all standing trees) with a DBH of more than 7 cm (GBH of more than 20cm) of the existing forest shall be logged and then direct planting of the seeds of native species, such as *Terminalia avicennoides*, *Detarium microcarpum*, *Camvretum* spp., *Crossopteryx febrifuga*, *Piliostigma thonningii* and *Isoberlinia* spp., etc. shall be carried out. Of these species, germinating seed shall be left to regeneration the area.

Logging of native tree species within the fuelwood forest shall be carried out as necessary of trees with a DBH of more than 7 cm (GBH of more than 20 cm).

Although regeneration shall take place through germination, direct planting of seed shall also be carried out depending on the state of regeneration.

(b) Disposal of Felled Trees

Standing trees and withered and damaged trees that have been logged shall be sold as timber or fuelwood with the income being channeled into the Forest Improvement Fund.

As the fuelwood forest is just being created and improved, the Forest Improvement Fund shall contribute to labor and material costs associated with land preparation, planting, direct planting, logging, raising of seedlings, the purchasing of seed and the collection of seeds, etc.

(c) Work Volume

Fuelwood production shall be carried out by the organizations in each settlement in each improvement unit. In order to equalize the income of each settlement, the area of the fuelwood production forest within each improvement unit shall be determined in proportion to the total number of households in each of the five settlements. The total area of fuelwood forest is 9,200 ha. The fuelwood forest area and annual logging volume for each settlement by improvement unit is shown in Table 43-12. The cutting cycle is seven years and the area of each block is 10 ha.

Table 4-3-12 Fuelwood Forest Area and Annual Logging Area

(Unit: ha)

Improvement Unit	Total Number of Households	Fuelwood Forest Area (ha)	Number of Blocks	Annual Cutting Area (ha)	
Zougou-Kpantrossi	365	2,720	272	340	10 ha×34 blocks
Wésséné	390	2,880	288	360	10 ha×36 blocks
Pigourou	205	1,520	152	190	10 ha×19 blocks
Kabanou	149	1,120	112	140	10 ha×14 sblocks
Mani-Boké	130	960	96	120	10 ha×12 blocks
Total	1,239	9,200	920	1,150	

The annual logging area is divided up into 10 ha lots with either clear felling or logging of standing trees with a DBH of no less than 7 cm being carried out by lot. Regeneration shall be carried out through germination, planting and direct planting.

Logging lots shall be located in such a way that they are not adjoining.

Fuelwood forest creation shall be carried out through planting and direct sowing in areas of cultivated land and fallow ground and through harvesting followed by planting and direct sowing in areas of Sa, Sb, and St. Both of these methods shall be used each year. Income is derived from sales of timber and fuelwood even during the forest cutting period.

Fuelwood forest creation in areas of cultivated land and fallow ground shall be carried out through planting and direct planting from the 1st through to the 8th year with harvesting of areas planting in the 1st year being carried out in the 8th year and harvesting of areas planting in the 2nd year being carried out in the 9th year, and so on.

Regeneration shall consist of low cost methods such as regeneration by coppice (repeated 5 times) and natural seeding. Supplementary planting (operations) such as direct sowing and planting by cutting shall be carried out depending on regeneration condition.

Fuelwood forest creation in areas of Sa, Sb, and St shall be carried out from the 1st through to the 8th year with harvesting of existing stands of trees being carried out. From the 2nd year, renewal shall be carried out in areas logged the previous year, and so on.

This process is shown in Figure 4-3-2.

Although no information is available regarding the age at maturity of species planted for fuelwood, judging from the state of growth of *Khaya senegalensis* and *Tectona grandis*, trees in the survey area appear to be growing at an annual rate of 1.0 cm. Therefore at a cutting cycle of 7 years the trees should reach a DBH or 7 cm (GBH of 20 cm).

A. Cultivated Land and Fallow Ground
Area: 1,469 ha
Cutting Cycle: 7 years
Species: Introduced Trees

Annual Work Area (ha)	Year															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
183	Plant-ing	→	→	→	→	→	→	Logg-ing	Plant-ing	→	→	→	→	→	→	Logg-ing
183		Plant-ing	→	→	→	→	→	→	Logg-ing	Plant-ing	→	→	→	→	→	→
183			Plant-ing	→	→	→	→	→	→	Logg-ing	Plant-ing	→	→	→	→	→
184				Plant-ing	→	→	→	→	→	→	Logg-ing	Plant-ing	→	→	→	→
184					Plant-ing	→	→	→	→	→	→	Logg-ing	Plant-ing	→	→	→
184						Plant-ing	→	→	→	→	→	→	Logg-ing	Plant-ing	→	→	→
184							Plant-ing	→	→	→	→	→	→	Logg-ing	Plant-ing	→
184								Plant-ing	→	→	→	→	→	→	Logg-ing	Plant-ing
1,469																

(Hereafter the same)

B. Sa, Sb, St Forest
Area: 7,731 ha
Cutting Cycle: 7 years (DBH of no less than 7cm or GBH no less than 20 cm)
Species: Native Trees

Annual Work Area 'ha)	Year																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
967	Logg-ing	Plant-ing	→	→	→	→	→	→	Logg-ing	Plant-ing	→	→	→	→	→	→	Coupe
967		Logg-ing	Plant-ing	→	→	→	→	→	→	Logg-ing	Plant-ing	→	→	→	→	→	→
967			Logg-ing	Plant-ing	→	→	→	→	→	→	Logg-ing	Plant-ing	→	→	→	→	→
966				Logg-ing	Plant-ing	→	→	→	→	→	→	Logg-ing	Plant-ing	→	→	→	→
966					Logg-ing	Plant-ing	→	→	→	→	→	→	Logg-ing	Plant-ing	→	→	→
966						Logg-ing	Plant-ing	→	→	→	→	→	→	Logg-ing	Plant-ing	→	→
966							Logg-ing	Plant-ing	→	→	→	→	→	→	Logg-ing	Plant-ing	→
966								Logg-ing	Plant-ing	→	→	→	→	→	→	Logg-ing	Logg-ing
7,731																	

(Hereafter the same)

Figure 4-3-2 Fuelwood Forest Operation

(3) Silvi-Pastoral Plans

Although grazing within the classified forest is prohibited under the Forest Law, illegal grazing is being carried out by the local inhabitants and people from other areas within the classified forest for which forest improvement plans have not yet been formulated. However, after the implementation of the forest improvement plan, grazing within the classified forest will be totally prohibited.

A Silvi-Pastoral Zone shall be established within the classified forest in the Intensive Study Area which is the target area of this survey, and settlements participating in the forest improvement plan shall carry out grazing within this zone. As a result, it will be necessary for the local inhabitants to make the transition from their present style of extensive grazing to intensive grazing as grazing land and the grazing numbers will be restricted. Therefore, pasture shall be improved and the livestock system improved in order to improve livestock profitability.

The introduction of this kind of intensive grazing is designed to help the local inhabitants to carry out the management of the classified forest for sustainable use.

The present state of forest cover within the Silvi-Pastoral Zone is shown in Table 4-3-13. The area of Conservation Forest II within the Silvi-Pastoral Zone is shown in Table 4-3-14.

Table 4-3-13 Areas of Silvi-Pastoral Zone

(Unit: ha)

Management Unit	Improvement Unit	Forest Type and Land Use										Total
		Gf	Fc	Sa	Sb	St	Subtotal	Ch	Ja	Subtotal	Others	
GOGOUNOU	ZOUGOU-KPANTROSSI	37	4	396	618	325	1,380	122	17	139	13	1,532
	WESSENE	8	0	314	895	219	1,436	604	111	715	0	2,151
	PIGOUROU	11	0	57	954	175	1,197	70	45	115	3	1,315
	Subtotal	56	4	767	2,467	719	4,013	796	173	969	16	4,998
BEMBEREKE	KABANOU	0	8	211	680	169	1,068	92	156	248	16	1,332
	MANI-BOKE	0	12	339	817	288	1,456	186	111	297	0	1,753
	Subtotal	0	20	550	1,497	457	2,524	278	267	545	16	3,085
Total		56	24	1,317	3,964	1,176	6,537	1,074	440	1,514	32	8,083

Table 4-3-14 Area of Conservation Forest II in Silvi-Pastoral Zone

(Unit: ha)

Management Unit	Improvement Unit	Forest Type and Land Use										Total
		Gf	Fc	Sa	Sb	St	Subtotal	Ch	Ja	Subtotal	Others	
GOGOUNOU	ZOUGOU-KPANTROSSI	57	0	122	57	12	248	1	0	1	38	287
	WESSENE	176	0	23	28	1	228	30	0	30	19	277
	PIGOUROU	125	0	0	36	0	161	0	0	0	35	196
	Subtotal	358	0	145	121	13	637	31	0	31	92	760
BEMBEREKE	KABANOU	222	0	45	134	45	446	5	4	9	22	477
	MANI-BOKE	103	0	23	96	31	253	0	0	0	41	294
	Subtotal	325	0	68	230	76	699	5	4	9	63	771
Total		683	0	213	351	89	1,336	36	4	40	155	1,531

① Pasture Improvement Plans

(a) Creation Plans

As the Silvi-Pastoral Zone is restricted to 8,051ha, it goes without saying that the number of livestock will also be restricted. Under this plan, the style of grazing will be changed and grazing capacity improved. In the Silvi-Pastoral Zone man-made pasture will be created, natural pasture improved, feed trees planted, and water holes for livestock created. Waterways will also be use as water holes for livestock. As it is anticipated that there will be water shortages during the dry season, the drilling of wells is also planned.

The creation of man-made pasture, the improvement of pasture, and the planting of feed trees shall be carried out as shown below.

* Man-made pasture shall be created in areas of cultivated land and fallow ground.
* Pasture seed shall be sown in cultivated land and fallow ground to create man-made pasture. Controlled burning shall be carried out or the land fertilized once every three years.
* Stock fences shall be constructed around areas of man-made pasture to stop livestock from entering.
* In areas of Sa, Sb, and St, shrubs shall be removed (used or sold as fuelwood) and natural pasture improved for use as feed. In areas of natural pasture, pasture seeds shall be sown as grass for feed and weeds which are not used as feed for livestock shall be removed in order to increase the proportion of grass for livestock feed.
* In areas of man-made pasture and natural pasture, feed trees shall be sown in rows. Man-made pasture shall also be planted alongside stock fences.
* Water holes shall be created by making dams on waterways or by digging out low-lying areas alongside waterways to create ponds.

The area of created pastures is shown in Table 4-3-15.

Table 4-3-15 Pasture Creation Land Area

(Unit: ha)

Management Unit	Improvement Unit	Present State						Pasture Type							
		Forest Type and Land Use						Man-made Pasture				Improved Pasture			
		Sa	Sb	St	Ch	Ja	Subtotal	Sa (D<50%)	Ch	Ja	Subtotal	Sa (50%≦D)	Sb	St	Subtotal
GOGOUNOU	ZOUGOU-KPAN TROSSI	396	618	325	122	17	1,478	325	122	17	464	71	618	325	1,014
	WESSENE	314	895	219	604	111	2,143	268	604	111	983	46	895	219	1,160
	PIGOUROU	57	954	175	70	45	1,301	57	70	45	172	0	954	175	1,129
	Subtotal	767	2,467	719	796	173	4,922	650	796	173	1,619	117	2,467	719	3,303
BEMBEREKE	KABANOU	211	680	169	92	156	1,308	65	92	156	313	146	680	169	995
	MANI-BOKE	339	817	288	186	111	1,741	139	186	111	436	200	817	288	1,305
	Subtotal	550	1,497	457	278	267	3,049	204	278	267	749	346	1,497	457	2,300
Total		1,317	3,964	1,176	1,074	440	7,971	854	1,074	440	2,368	463	3,964	1,176	5,603

(b) The Creation and Improvement of Pasture

a) Types of Pasture

Condition to consider when selecting includes weather and soil suitability, livestock palatability, high feed volumes, and easy regeneration. Generally *Leguminosae* and Gramineae pasture grasses are mixed as the nitrogen supplied to the soil by the *Leguminosae* pasture increases the productivity of the Gramine*ae* pasture.

The feed content of the main pasture grasses is shown in Table 4-3-16.

Table 4-3-16 Main Pasture Grasses

Family	Botanical Name	U.F.
LEGUMINOSAE	*Leucaena leucocephala (Lam.) deWit*	0.89
	Cajanus Cajan	0.69
	Stylosanthes hamata	0.77
	Glycine max (L.) Merrill	1.16
	Arachis hypogaea L.	0.75
GRAMINEAE	*Pennisetum purpureum*	0.46
	Andropogon gayanus	0.68
	Panicum maximum	0.66
	Barchiaria ruziziensis	0.72
	Oriza barthii	0.37

b) Creation of Man-made Pasture

Although the creation of man-made pasture is planned in areas of cultivated land or fallow ground and in some areas of Sa, as the land is relatively fertile it is easy to manage the soil.

In the rainy season, rotational grazing is carried out in order to make optimum use of man-made pasture in terms of both volume and nutrients. Three areas of man-made pasture shall be created, with grazing being carried out in each area for two weeks and then left for four weeks. With rotational grazing it is necessary to constantly monitor the state of pasture to prevent overgrazing from excessive concentrations of livestock. Pasture to be introduced into areas of man-made pasture includes the *Leguminosae* (*Pennisetum purpureum)* and *Andoropogon gayanus* and the Gramineae *(Stylosanthes hamata)*.

The volume and dry weight per hectare for introduced pasture are shown in Table 4-3-17.

Table 4-3-17 Pasture Yield and the Dry Weight

Item / Name of Crass	Yield (kg/ha)	Dry Weight (%)	Production Volume (Dry Weight) (kg/ha)
Pennisetum purpureum	48,000	18	8,640
Andoropogon gayanus	25,000	34	8,500
Stylosanthes hamata	11,000	33	3,630

c) Improvement of Natural Pasture

Although the nutrient content of wild grass is high during the rainy season, its

growing period is short (it withers in the dry season), its nutrient value is poor and its annual production volume is low. Furthermore, in grassland where repeated controlled burning is being carried out, as strong weeds actually delay the regeneration of the forest, both *Leguminosae* and *Gramineae* grasses should be sown to improve natural pasture. Fast growing *Leguminosae* takes root first and the nitrogen that it releases into the soil improves the productivity of the *Gramineae.*

Pasture to be introduced in areas of natural pasture include the *Gramineae (Stylosanthes hamata)* and the *Leguminosae (Pennisetum purpureum* and *Andoropogon gayanus)*.

In areas of natural pasture, as it is impossible to completely remove wild grass, it is necessary to carry out planting of these pasture grasses every three to four years.

(c) Planting of Feed Trees

Feed trees shall be planted in areas of man-made pasture and natural pasture in order to divide them up into smaller blocks and to provide shade, and in order to provide supplementary feed. Planting shall be carried out alongside stock fences and in rows within grazing areas.

Species of tress used for feed trees are shown in Table 4-3-18 and Table 4-3-19.

Table 4-3-18 Feed Trees (Native)

Family	Botanical Name	Characteristics
Leguminosae	*Acacia cafra*	The leaves are used as fodder.
	Acacia sieberiana	The pods fall off in the dry season and are used as feed.
	Dichrostachys sp.	The pods are uses as a source of protein for cows.
Euphorbiaceae	*Bridelia serrugines*	-
Combretaceae	*Pteleopsis suberosa*	-
	Terminalia avicennioides	-
Maliaceae	*Khaya senegalensis*	-

Table 4-3-19 Feed Trees (Introduced)

Family	Botanical Name	Characteristics
Leguminosae	*Albizia lebbeck*	Young leaves are used as a source of protein.
	Cajanus cajan	Excellent nitrogen fixation
	Leucaena leucocephala	High protein content in leaves and seeds.
	Parkinsonia aculeata	Seeds and the pods are used as feed.
	Prosopis juliflora	-
	Sesbania sesban	Leaves and the young branches are used as feed.
Capraridaceae	*Capparis tomentosa*	-

Source : Tropical Feed Trees (AICAF)

(d) Pasture Production Plans

a) Sowing Periods and Sowing Volumes

Planting shall be carried out at the beginning of the rainy season in June when a sufficient amount of moisture has accumulated in the topsoil. Sowing volumes are

5kg/ha for *Stylosanthes hamata* and 20kg/ha for *Andropogon gayanus*. *Pennisetum purpureum* shall be planted by separating the roots.

b) Fertilizer

In order to increase the fertility of the soil during a short period of time, fertilizer shall be sown during the first stage of pasture creation. This will allow *Leguminosae* pasture to grow and control the growth of weeds. As the nitrogen fixation volume increases, the growth of Gramineae pasture is promoted. The standard volume of fertilizer is 100kg/ha of superphosphate of lime.

The pasture yield and dry weight per hectare is shown in Table 4-3-20.

Table 4-3-20 Pasture Yield and the Dry Weight

Item / Crass Species		Yield (kg/ha)	Area (ha)	Pasture Production Volume (kg/ha)	Dry Weight (%)	Dry Weight (kg/ha)
Man-made Pasture	*Andoropogon gayanus*	25,000	0.5	12,500	34	4,250
	Stylosanthes hamata	11,000	0.5	5,500	33	1,815
	Pennisetum purpureum	48,000	(0.05)	2,400	18	432
	Total	-	1.0	20,400	-	6,497
Natural Pasture	*Andoropogon gayanus*	25,000	0.3	7,500	34	2,550
	Stylosanthes hamata	11,000	0.3	3,300	33	1,089
	Wild Grass	21,250	0.4	8,500	20	1,700
	Total	-	1.0	19,300	-	5,339

d) Pasture Storage

In order to store feed during the dry season, either the lactic fermentation method (silage) or haymaking is used to reduce the moisture content to less than 15%. Under this plan, haymaking shall be used to harvest and store feed for use during the dry season as it is possible to make optimum use of the scarce supply of machinery. In order to minimize nutrient loss, cut pasture is scattered over the ground, turned over once or twice a day to hastening drying and to sure that the grass dries evenly.

(e) Grazing Capacity

Through the creation of man-made pasture and the improvement of natural pasture within each improvement unit, it was possible to calculate the number of stock that are able to be raised. As the amount of feed consumed varies according to cow weight, the daily feed volumes (pasture with a UF per kg of no less than 0.45) of dried feed necessary for cows to maintain their body weight are 6.25kg for cows with a weight of 250kg and 5.00kg for cows with a weight of 200kg. Therefore, the annual volume of dry feed required is 2,281kg for cows with a weight of 250kg and 1,825kg for cows with a weight of 200kg.

Feed consumption by cow weight is shown in Table 4-3-21.

The utilization ratio of man-made pasture is 70%.
Natural pasture will be established in Sa, Sb and St forest types. While upper trees in these forest types will be felled shrubs will not be cut, thus, a 40% utilization rate as pasture could be achieved. Since the currently owned cows are assumed to be reared at the start of the plan, the grazing capacity of improvement units will reach to the level of supporting 9,963cows (each cow with a body weight of 250kg). Based on the improvements in the management of fodder, a body weight of 200kg shall be

aimed for in Silvi-Pastoral Zone within three years, and after all improvement worked are implemented the feeding of 12,458cows will become possible.

Table 4-3-21 Grazing Volume of Cows by Weight (unit: kg)

Cow Weight	200	250
Daily Grazing Volume	5.00	6.25
Annual Grazing Volume	1,825	2,282

Table 4-3-22 Number of Head of Cattle that can be Raised on Man-made Pasture and Natural Pasture

Improvement Unit		Pasture Type	Area (ha)		Unit Yield (kg/ha)	Yield (t)	No. of Livestock that can be Raised	
			Established Area	Grazing Area			250 kg	200 kg
GOGOUNOU	ZOUGOU-KPANTROSSI	Man-maid	464	325	6,497	2,111	925	115
		Natural	1,014	406	5,339	2,168	950	1,188
		Subtotal	1,478	731	-	4,279	1,875	2,345
	WESSENE	Man-maid	983	688	6,497	4,470	1,959	2,449
		Natural	1,160	464	5,339	2,477	1,085	1,357
		Subtotal	2,143	1,152	-	6,947	3,044	3,806
	PIGOUROU	Man-maid	172	120	6,497	780	342	428
		Natural	1,129	452	5,339	2,413	1,057	1,322
		Subtotal	1,301	572	-	3,193	1,399	1,750
BEMBEREKE	KABANOU	Man-maid	313	219	6,497	1,423	624	780
		Natural	995	398	5,339	2,125	931	1,164
		Subtotal	1,308	617	-	3,548	1,555	1,944
	MANI-BOKE	Man-maid	436	305	6,497	1,982	869	1,086
		Natural	1,305	522	5,339	2,787	1,221	1,527
		Subtotal	1,741	827	-	4,769	2,090	2,613
Total			7,971	3,899	-	22,736	9,963	12,458

(f) Creation of Water Holes

Waterways will be dammed and low-lying areas alongside waterways will be dug out to form water holes for livestock to utilize during the dry season. Wells will also be drilled according to the condition of ground water.

② Improving Feeding Techniques

In order to improve traditional feeding techniques and make efficient livestock management possible, the following three types of feeding techniques shall be improved.

* Improvement of Breeding Techniques
* Improvement of Rearing Management
* Improvement of Economic Management

(a) Improvement of Breeding Techniques

This includes improving fertility, observing mating seasons, and shortening the time between pregnancies.

a) Improving Fertility

Ensuring that cattle are in good condition at the time of delivery and that adequate nourishment is available for newborn calves, etc., are the conditions necessary for improving fertility. As pasture with low nutrient levels retards development and leads to a decrease in fertility, by feeding livestock on man-made pasture with high levels of nutrients after they have given birth it is possible to improve their condition. Furthermore, regular observation of bulls should be carried out and when external wounds or disease is discovered, which can cause a decrease in fertility, bulls should be replaced or screened.

b) Observing Mating Seasons

In many cases early mating with virgin cows can hinder subsequent development and lead to other problems, and can also lead to difficult births with high mortality rates. Therefore, weight standards shall be established to determine when virgin cows can be allowed to start mating. Although such cows are allowed to start mating at about 3 years (200~220kg), under this plan this shall be delayed until they are 3.5 to 4 years old with a target weight of 250kg for Borgu and 300kg for Zebu.

c) Shortening of Period between Calves

Although at present cows are left for 6 months to 1 year after giving birth, the time between calves should be shortened as much as possible. This shall be carried out by managing their state of nutrition and carrying out pregnancy tests. In the future, the introduction of artificial insemination should also be considered.

(b) Improvement of Livestock Management

Livestock management methods can be improved by making the transition from extensive livestock farming which is presently carried out in the forest to intensive livestock farming. At the moment, there is a strong traditional awareness that livestock are assets and the number of cows is a symbol of the status of the family. Therefore, it is expected that people will be very cautious regarding the introduction of new techniques. As the number of livestock shall be limited, guidance and training shall be given to model farmers who are willing to make the transition to intensive farming in order to propagate such farming. Guidance and training shall include the following topics.

a) Promotion of Branding

A calf of 3months old shall be branded on its hip after being separation from its mother. This brand shall contain the seal of the owner and an ID number, which makes stock management easier.

b) Disease Prevention Measures

Vaccination shall be thoroughly carried out to prevent disease. Sick cows shall be isolated in order to stop the spread of infectious diseases among other livestock.

c) Prevention of Parasites

Regular spraying of medicine shall be encouraged in order to prevent parasites. A dustbag shall be fixed in the place where cows often gather so that medicine can be sprayed onto them automatically.

d) Promotion of Horn Removal

Long horns do not only cause fighting among cows over the feed, but also harm people and could cause damage to the meat at the time of shipment. Therefore, the removal of horns shall be promoted.

e) Promotion of Castration

Castration shall be carried out when cattle are 2 to 3 months old in order to improve the quality of the meat.

f) Encouragement to Measure the Weight

The weight of cattle shall be measured and a record kept of their growth. Cattle shall be weighed when separated from their mothers, when they are 12 month old and when they are 36 month old.

Together with above-mentioned training programs, cattle fattening plans shall also be

implemented as a practical program.

g) Cattle Fattening Plan (3-year Rearing Plan)

Cattle shall be reared with their mothers on the farm until they are up to 6 months old (nursing period). Bulls shall be castrated after this period, and be grazed on man-made pasture until they are shipped. The production goal is to raise cattle to a weight of 200kg in 3 years.

(c) Improvement of Farm Management

The names of farmers using the Silvi-pastoral Zone shall be entered in the livestock management book and the economic management book.

a) Livestock Management Book

The recording of livestock ID numbers shall be thoroughly propagated as this enables farmers to understand the growth rate of livestock and makes the selection of livestock easy.

b) Economic Management Book

Data regarding the economic management of the farm shall be recorded in this book. This enables farmers to set annual management goals and estimate profits.

c) Training and Forest Improvement Fund

Training of model farmers for the preparation and recording of both books shall be carried out at the time of introduction in order to propagate this among other farmers.

d) Competitive Exhibitions

A fair shall be planned once a year for farmers to bring fattened cattle. Prize shall be given to an excellent farmer from the forest improvement committee in order to encourage and promote the improvement of rearing techniques.

③ Improvement of Livestock Management Systems

The awareness of farmers regarding livestock can be summarized as follows.

a) Status Symbol: The number of livestock is regarded as a symbol of social status and economic power.

b) Financial Guarantee: Livestock are sold when cash is needed urgently.

c) Food Stock: Milk and eggs are for personal consumption and cash income.

d) Celebration: Livestock are an essential item as a gift on occasions such as weddings, etc.

e) Work Purpose: Cattle are reared for cultivation power.

Bearing these things in mind, people only make an effort to increase the number of livestock. When they sell their livestock, they sell goats and sheep first if cash is needed urgently, then sell cattle last. Sick cattle are sold first and old milking cows are rarely sold because people have formed an attachment to them. Even at the market, the price of cattle is decided by what they look like, not by the quality of the meat. If the local inhabitants can recognize the benefit of having cattle as resources, then even though livestock are a status symbol to them, it is believed that the management plan can be implemented smoothly.

In this plan, the establishment of a stockbreeders co-op shall be proposed as part of improvement measures for the livestock fattening method.

The activities of the stockbreeders co-op and the distribution of cattle are shown in Figure 4-3-3.

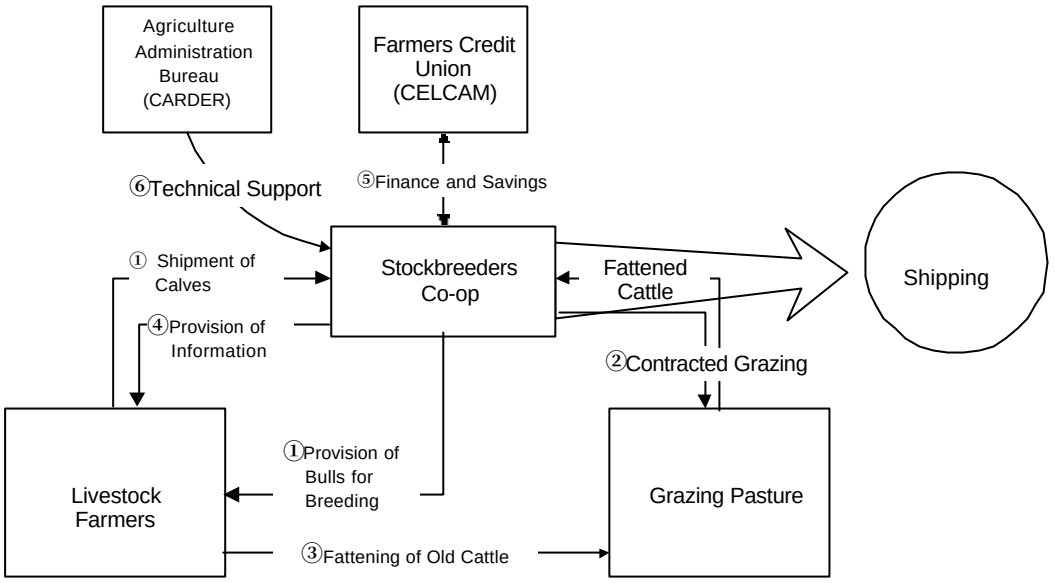


Figure 4-3-3 Stockbreeders Co-op and the Transportation of Cattle

① A female calf shall be reared until six months old at a farm and a male calf shall be purchased by the co-op at a certain price. It can be exchanged for a seed bull at the request of the farmer.

② Contract Grazing: The co-op shall send the purchased livestock to a contract farmer with the aim of castration in 6 months and shipment in 3 years as beef.

③ Fattening of old cattle: Cattle selected by farmers or old milking cows shall be grazed in man-made pasture, and shall be sold when the market price is high.

④ Provision of Information: The co-op shall provide livestock related market information in order for farmers to sell livestock and make a profit.

⑤ Financing and Savings: Farmers can withdraw money when they need cash urgently or receive loans by saving money from the sales of calves in CLCAM. It is also possible to convert some livestock into cash.

⑥ Technical Support: The co-op shall give technical support to the farmers regarding maters such as vaccinations, the Forest Improvement Fund of fattening techniques and the distribution of pasture seed, etc.

(4) Village Forestry Plan

① Land Preparation Plan

Forest improvement plans for the preservation and utilization of classified forests cannot be implemented without the cooperation of the local inhabitants in each of the five settlements, who are currently illegally cultivating the land within such forests. Therefore, the Village Forestry Zone was established for the use of local inhabitants in order to encourage their participation in the management of the forest. In this zone, cultivation, tree planting, the moving of livestock from areas outside the classified forests to areas within the Silvi-pastoral Zone within the classified forest, and beekeeping, including the planting of species of trees that are a source of nectar shall be carried out by

the local inhabitants. Land for cultivation and tree planting shall be created in areas of presently cultivated land and fallow ground, and forest of Fc and Sa. Paths for the passage of livestock shall be created in areas of forest in Sb and St.

The present state of forest type in the Village Forestry Zone is as follows.

Table 4-3-23 Present State of Forest Type within the Village Forestry Zone

(Unit: ha)

Management Unit	Improvement Unit	Forest Type and Land Use										Total
		Gf	Fc	Sa	Sb	St	Subtotal	Ch	Ja	Subtotal	Others	
GOGOUNOU	ZOUGOU-KPANTROSSI	55	0	342	480	167	1,044	632	760	1,392	0	2,436
	WESSENE	147	13	76	794	273	1,303	1,099	265	1,364	3	2,670
	PIGOUROU	89	0	84	842	250	1,265	462	287	749	20	2,034
	Sous-total	291	13	502	2,116	690	3,612	2,193	1,312	3,505	23	7,140
BEMBEREKE	KABANOU	67	39	89	922	476	1,593	785	156	941	13	2,547
	MANI-BOKE	15	12	67	775	324	1,193	361	51	412	8	1,613
	Subtotal	82	51	156	1,697	800	2,786	1,146	207	1,353	21	4,160
Total		373	64	658	3,813	1,490	6,398	3,339	1,519	4,858	44	11,300

Table 4-3-24 Area of Conservation Forest II within the Village Forestry Zone

(Unit: ha)

Management Unit	Improvement Unit	Forest Type and Land Use										Total
		Gf	Fc	Sa	Sb	St	Subtotal	Ch	Ja	Subtotal	Others	
GOGOUNOU	ZOUGOU-KPANTROSSI	83	0	109	45	0	237	8	2	10	26	273
	WESSENE	46	0	12	9	6	73	13	0	13	16	102
	PIGOUROU	201	0	10	61	0	272	0	0	0	6	278
	Sous-total	330	0	131	115	6	582	21	2	23	48	653
BEMBEREKE	KABANOU	182	7	0	109	14	312	19	3	22	12	346
	MANI-BOKE	182	14	0	51	0	289	0	0	0	10	299
	Subtotal	406	21	0	160	14	601	19	3	22	22	645
Total		736	21	131	272	20	1,183	40	5	45	70	1,298

(a) Cultivated Land and Land for Tree Planting

One household (10.1 people: 6 adults and 8 children) is allocated a total of 4.0ha of land in the Village Forestry Zone (2.0ha of land for cultivating food crops and 2.0ha of land for tree planting) (the state retains the ownership of the land). Tree planting areas shall be created around this 4.0ha area with a width of 5m.

At present, 40 trees per ha must be retained in cultivated land and these trees are one of the major causes of hindrance to the growth of agricultural crops. Therefore, these trees shall be removed when the trees planted around these areas grow to the point where they can be harvested in order to increase crop yield. However, the same number of trees shall be planted in the tree planting area around the cultivated area.

The land for cultivation and tree planting for a single household, including the 5m wide surrounding area, shall be designated as a single area as shown in Figure 4-3-4.

Roads with a width of 4m shall be established around the perimeter of five plots for the transportation of farm products and forestry products. In order to improve transportation efficiency, cultivated land and land for tree planting shall be grouped together alongside the road. This layout is shown in Figure 4-3-5.

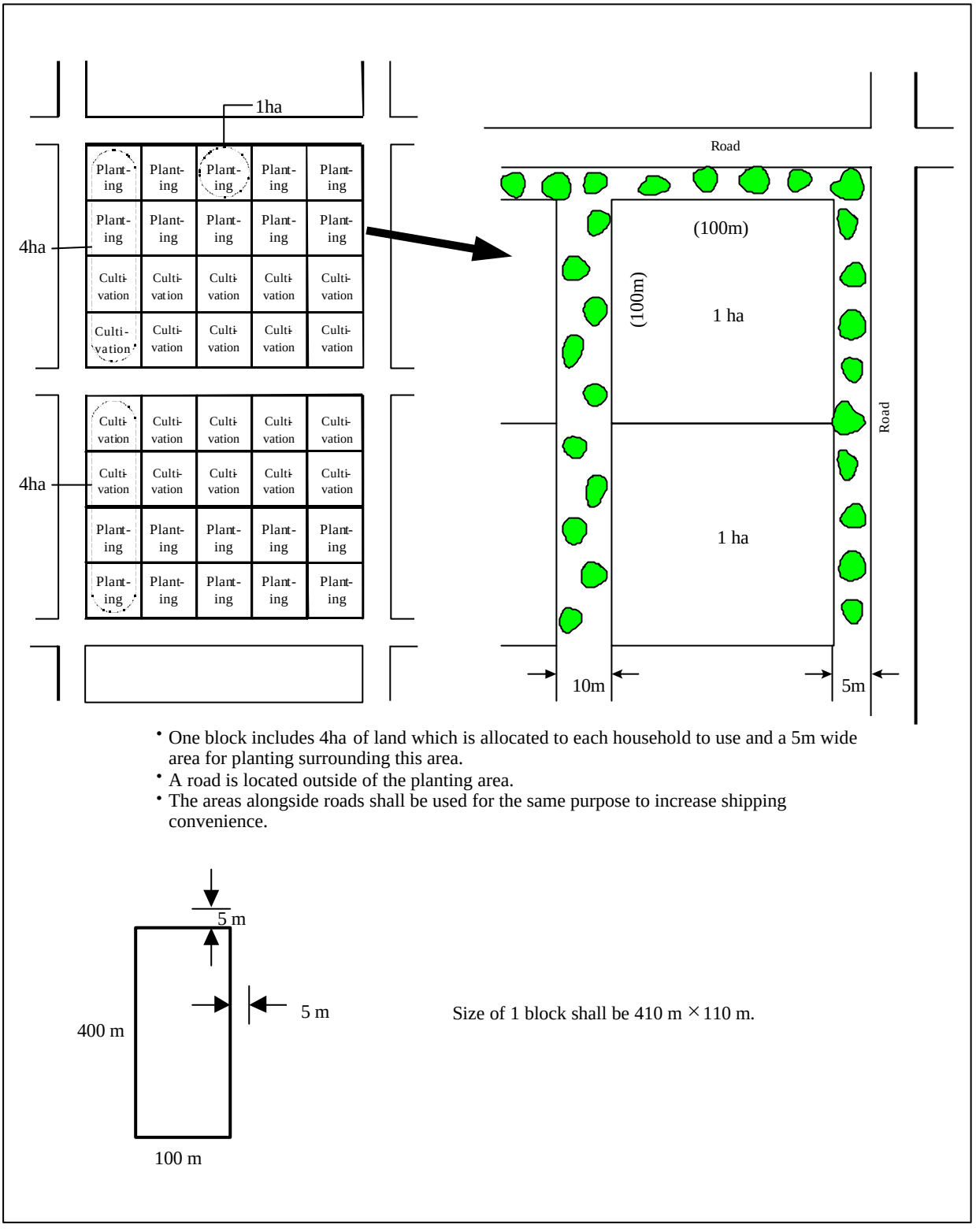


Figure 4-3-4 Location of Land for Cultivation and Planting

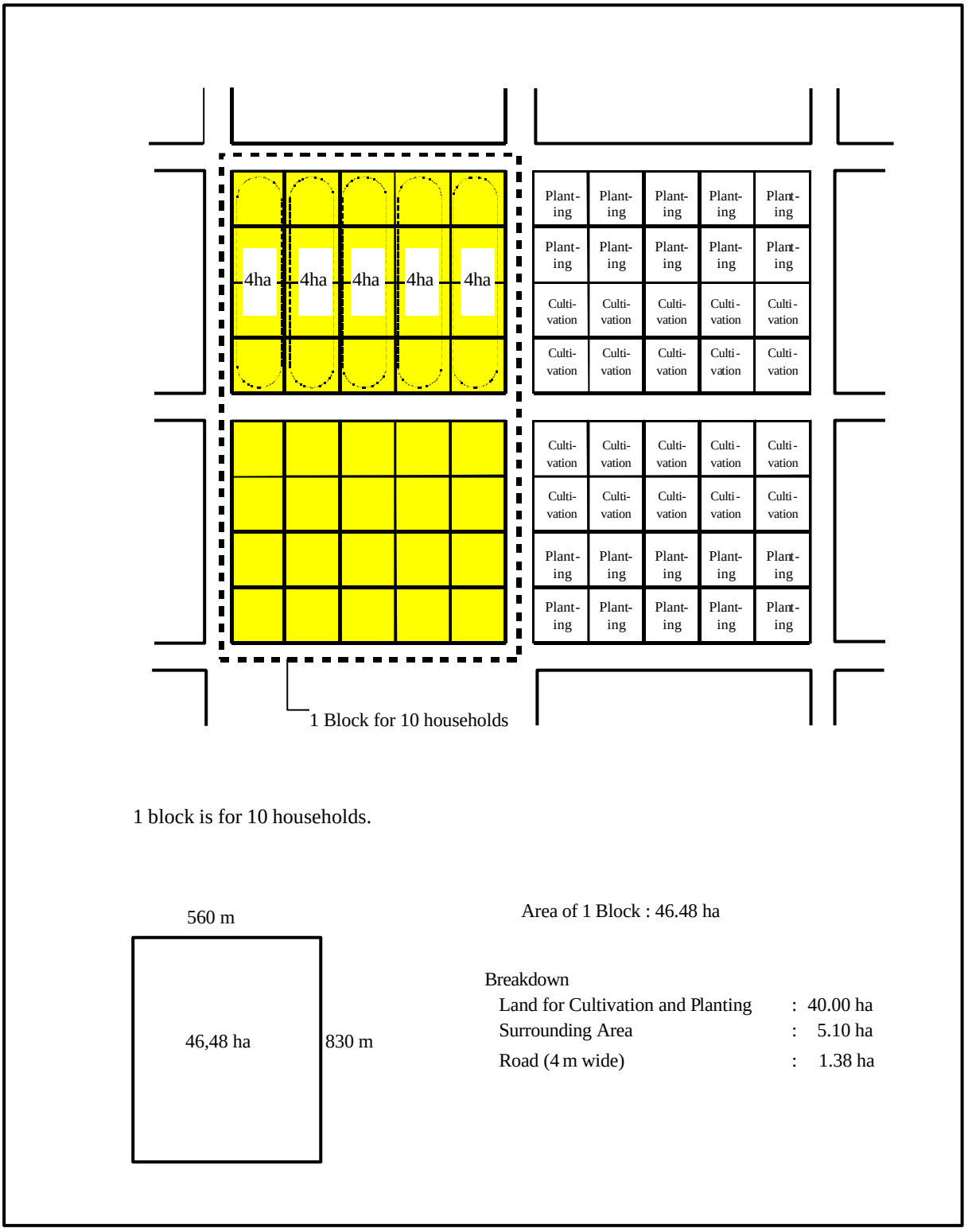


Figure 4-3-5 Location of Blocks

The people who may use the land in the Village Forestry Zone are those people who were cultivating land within the classified forest at the time when the aerial

photographs were taken in December 1998.

The total number of households in each of the five settlements, the target households for the village forestry plan, and the area required for the plan are as follows.

Table 4-3-25 Number of Households in 5 Settlements, Number of Target Households included in the Village Forestry Plan, and the Required Land Area

Management Unit	Improvement Unit	Total Population	Number of Households	Number of People per Household	Proportion of the Land Utilized within the Classified Forest	Number of Target Household	Area of Land for Cultivation and Planting	Land Required to be Established
GOGOUNOU	ZOUGOU-KPANTROSSI	4,480	365	12.3	0.767	280	1,120	1,400
	WESSENE	2,261	390	5.8	0.713	278	1,112	1,390
	PIGOUROU	1,806	205	9.1	0.837	172	688	960
	Sous-total	8,606	960	9.0		730	2,920	3,750
BEMBEREKE	KABANOU	1,431	149	9.6	0.926	138	552	680
	MANI-BOKE	1,101	130	8.5	0.863	112	448	565
	Sous-total	2,532	279	9.1		250	1,000	1,255
Total		11,138	1,239	9.0		980	3,920	5,005

* Land required to be established includes land for cultivation, planting and roads, etc.

The area of land area required to be created in each improvement unit is shown in Table 4-3-27. Sufficient area is available within the Village Forestry Zone.

Table 4-3-26 Land Area to be Established in each Improvement Unit

(Unit: ha)

Management Unit	Improvement Unit	Forest Type and Land Use				
		Ch	Ja	Sa	Sb	Subtotal
GOGOUNOU	ZOUGOU-KPANTROSSI	632	760	58	1,392	1,450
	WESSENE	1,199	265	83	1,364	1,448
	PIGOUROU	462	287	89	749	1,000
	Sous-total	2,193	1,312	230	3,505	3,898
BEMBEREKE	KABANOU	785	156		941	945
	MANI-BOKE	361	51	67	412	600
	Subtotal	1,146	207	67	353	1,545
Total		3,339	1,519	297	4,858	5,443

(b) Paths for the Passage of Livestock

Paths for the passage of livestock shall be established for moving livestock from areas outside the classified forest to areas within the Silvi-pastoral Zone within classified forest without allowing them to get into cultivated land or land for tree planting. As a rule, established roads and areas of forest shall be used for this purpose, but when establishing this zone in cultivated land or in land for tree planting, the width of the zone shall be 50m and the path must be marked.

Planned paths for the passage of livestock are shown in Figure 4-3-6 with the length of these being shown Table 4-3-28.

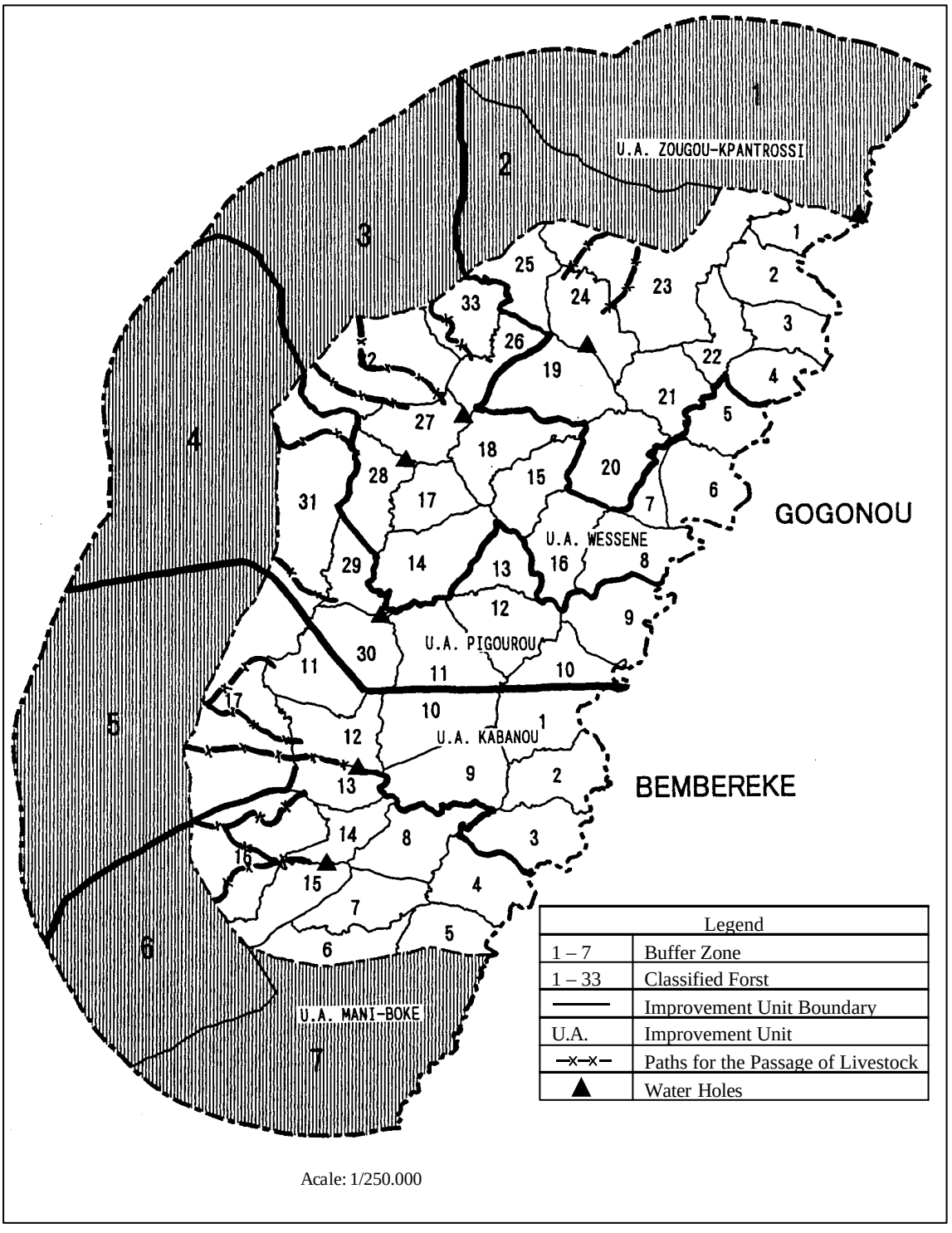


Figure 4-3-6 Paths for the Passage of Livestock

Table 4-3-27 Length of Paths for the Passage of Livestock

Improvement Unit	Length (m)
ZOUGOU-KPANTROSSI	5,000
WESSENE	12,600
PIGOUROU	5,600
KABANOU	12,300
MANI-BOKE	12,500

② Commercial Farming

(a) Selection of Crops and Planting

a) Selection of Crops

Conditions to be considered when selecting crops are whether or not a particular crop is suitable for the weather and soil conditions of the area, if it has a record of being cultivated in the area, if it is included in the traditional diet of the local inhabitants, or if the distribution system of the crop is established. Whether the growing technique of the crop is easily propagated, or how much the crop can affect the diet or lifestyle of the local inhabitants are also important points to take into consideration. In this plan, yams, maize and sorghum were selected as the main crops for personal consumption, with peanuts and cowpeas being used as intercrops. Results from this study are shown in Table 4-3-29.

Table 4-3-28 Possible Crops for Introduction

Conditions for Introduction		Crops	Maize	Sorghum	Yam	Tapioca	Sweet Potato	Peanuts	Cowpeas	Tomato	Cayenne Pepper	Okura
Natural Conditions	Weather	Growing Temperature	○	○	○	○	○	○	○	○	○	○
	Soil	Resistance to Acidity	○	○	○	●	●	○	○	○	○	○
Commercial Farming Conditions		Intention of Farmers	○	○	○	△	△	△	△	○	○	○
		Cultivation Techniques	●	●	●	○	○	○	△	△	△	△
		Forest Improvement Fund Guidance	○	○	○	○	△	○	△	△	△	△
		Prevention of Damage from Disease and Pests	○	○	○	△	△	△	△	△	△	△
Distribution Conditions		Marketability	○	○	○	○	○	●	△	△	△	△
		Marketing System	○	○	●	△	△	●	△	△	△	△
		Storage and Processing Facilities	○	○	○	○	△	●	△	△	△	△
		Processing	●	○	○	●	△	●	△	△	△	△
Overall Assessment			◎	◎	◎	△	△	◎	◎	△	△	△

Symbol : ● -- Excellent ○ -- Possibly Good △ -- Slightly Bad and Requires Consideration ◎ -- Selected for Introduction

b) Introduction of New Species (Improved Species)

As presently grown species are mainly native species, in order to increase individual harvests, improve the value of cash crops and realize more stable crop production, it is necessary to introduce new (improved) species. However, as the introduction and Forest Improvement Fund of new species takes time, farmers will be instructed to select reliable seeds for immediate use. Improved species of maize with growing periods of 75 days and 90 days were selected at an agricultural testing institute within INA in Benin. Improved maize with a growth period of 90 days and native species with a growth period of 120 days shall both be introduced in this plan.

c) Improving Crop Growing Systems

The above-mentioned improved crop growing system that gives consideration to crops and species is shown in Figure 4-3-7. Species of maize with growth periods of both 90 days and 120 days shall be introduced with two crops being grown each year. The 90-day maize shall be grown in place of cotton. By using species with growing periods that are shorter than those of native species, this system enables the most effective utilization of the limited rainy season, reducing the risk of low yield that is affected by unpredictable rainfall, dispersing the risk of damage by disease and pests, and spreading the labor force. It should be easy to propagate 90-day maize cultivation which shall be done during the period where they used to grow cotton.

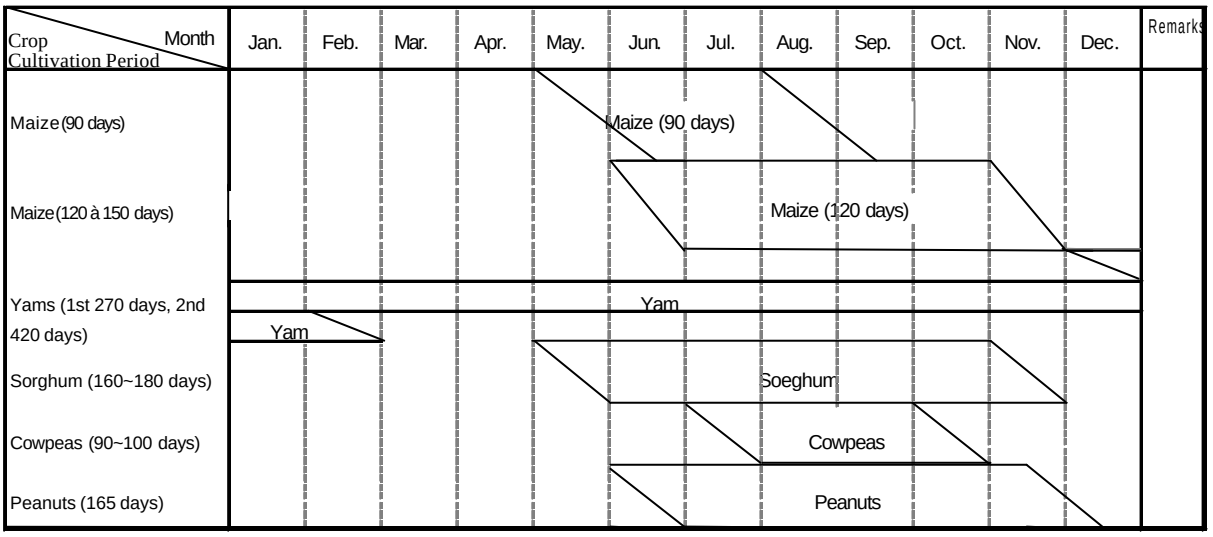


Figure 4-3-7 Crop Cultivation Plan (Main Crop: Maize)

d) Crop Rotation

Crop rotation growing shall be carried out on the land for producing food for personal consumption (fixed farming), instead of nomadic farming where the unproductive land is abandoned to seek for new, fertile land. Maize and sorghum shall be the main rotational crops with *Leguminosae* to be sown as an intercrop. *Leguminosae* crops fix nitrogen from the air and increase the fertility of the soil. The aim of utilizing rotational crops is to introduce a degree of crop diversity. The planned crop rotation system is shown in Figure 4-3-8.

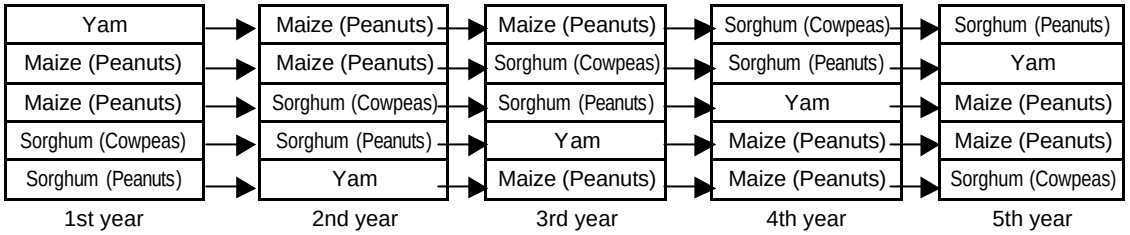


Figure 4-3-8 Crop Rotation Crop Cultivation Plan

(b) Improved Growing Methods

a) Stable Use of Rainwater

In order to stabilize farming using rainwater, it is necessary to divert in as much run-off water as possible into the causeway which leads into the field. Water drainage control facilities and furrows along the contour lines shall be established to best utilize rainwater.

b) Improvement of Animal-Powered Cultivation and Farming Tools

Animal-powered cultivation will be introduced for joint use on condition that it will be used for contracted plowing. Existing farming tools such as hoes, sickles and spades, etc. will be improved and hand-operated weeders will be introduced and propagated.

The advantages of animal-powered cultivation are as follows.

* The soil will be properly plowed so that stable yield can be expected.

* Heavy labor such as plowing will be reduced.

* Improvements in labor productivity can by expected.

c) Materials for Agricultural Production

a. Seeds

As the volume of seeds to be sown has not yet been established, standards for seed sowing shall be established and appropriate quantities shall be sown.

b. Fertilizer

It is important to introduce organic fertilizer to improve crop yields in fixed farming. Judging from the present economic level of the farmers, compost-making techniques using locally obtainable crop remains and livestock manure should be propagated. *Leguminosae* such as *Mucuna Pruriens* etc. (green manure crops) shall be ploughed in as a source of nitrogen. Simple soil diagnosis shall be carried out by the Forest Improvement Fund Officer of each district. If this reveals that the soil has not obtained sufficient quantities of nitrogen from the green manure crop and compost, then chemical fertilizers, such as urea, will be applied.

d) Improvement of Growing Techniques

Matters to bear in mind with regard to growing include the following.

* Deep plowing and conscientious breaking up of the soil to allow seeds to take root.

* Mulching with cut wild grass to control weed growth.

* Weeding.

* Cultivating to allow roots to develop.

* Thinning out to raise strong seedlings.

* Avoiding over-planting and maintaining appropriate spacing between plants.

e) Prevention of Damage from Pests and Disease

In order to prevent incredibly decreased yields on account of damage from pests and disease, the use of the following ecological and comprehensive control measures should be considered rather than relying on pesticides.

a. Corn and Sorghum

At present, damage is caused by smut, sesame blight and storigar. Smut is a type of mould that is spread by spore. Sesame blight hinders the photosynthesis of the plant with black spots appearing on the leaves. Storigar is a semi-parasitic plant. The general prevention measures are as follows.

* The introduction of disease and pest-resistant species.

* The introduction of crop rotation.

* The implementation of mixed planting and intercropping.

* Consideration of planting density.

* Early discovery and incineration of diseased plants.

b. Yams

At present, damage is caused by pests, such as chafers, termites and eelworms. Measures to be taken are as follows.

* The introduction of crop rotation.

* The implementation of mixed planting and intercropping.

* Consideration of planting density.

* Prevention of hatching of pests through deep plowing.

* Disinfecting of seeds.

* Planting of Marigolds as an accompanying plant.

(c) Improvement of Post-Harvest Processing

After harvesting maize and sorghum, as it is threshed in the area surrounding homes, it is poorly threshed and earth and sand become mixed in with the grain which leads to deterioration in quality. Bearing this in mind, the introduction of a foot-operated threshing machine for maize and a hand-operated threshing machine for sorghum should be considered. As it is expensive for individual farmers to introduce such equipment, they shall jointly be used. With regard to storage, as the crops are stored all together, they should be treated with chemicals to prevent damage caused by pests.

(d) Distribution of Agricultural Products

a) Present Distribution System

There are two methods of distribution. With one, the price of the item is set by the government who exclusively purchases it, while with the other, the item is traded in the regular market. In the exclusive distribution system, which is represented by cotton distribution, the distribution channel is established and the market price is guaranteed. Therefore, farmers have been actively involved in cotton growing.

However, there are some problems associated with cotton, such as late payment from the government or reductions of the purchase price by the government.

In settlements, surplus major crops, such as yams and maize, are traded at the regular market. This is an important source of cash income for the farmers. Although they used to trade only surplus crops, since the currency system has been introduced, crops are traded whenever the farmers have the need for urgent cash. There are private merchants who buy the crop directly from individual farmers, keep them in nearby storehouses, and sell them when the price goes up. Farmers face many disadvantages in price negotiations for major crops because there are no established distribution systems, such as agricultural co-ops, etc. A typical distribution system for major crops is shown in Figure 4-3-9.

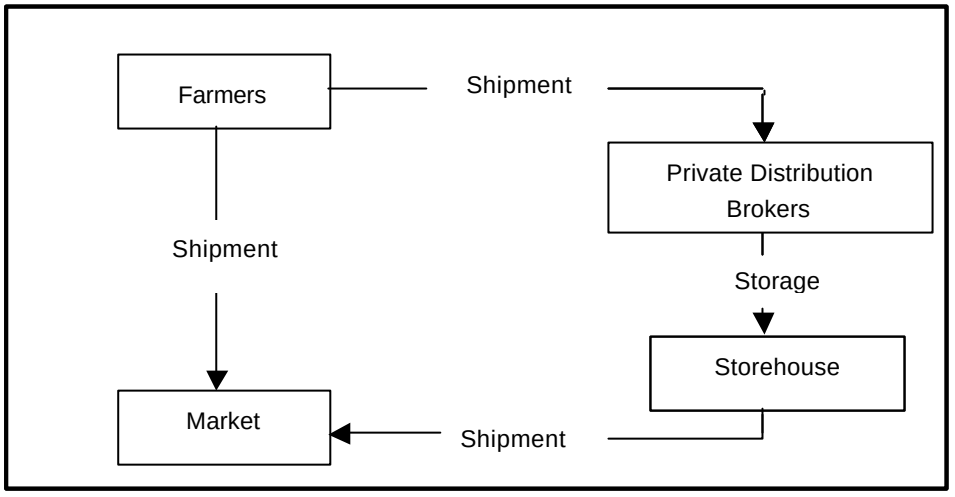


Figure 4-3-9 Distribution Route for Main Farm Produce

b) Strategy for Distribution

Concepts for strategies to overcome distribution problems can be summarized as follows.

* Production plans shall be formulated by using market information to scale production to meet the needs of the market in order to stop the reliance on cotton growing.
* Strong distribution organizations shall be formed by seeking a merit of scale through joint production and joint shipment.
* High value-added products (cashews, mangoes and other fruit, honey, and processed farm products, such as dried mango, etc.) shall be introduced in order to diversify the range of products available to buyers.

③ Plan of Planting by Local Inhabitants

Under this plan, cotton growing in the classified forest, which accounts for a major part of the income of the local inhabitants, shall be totally prohibited. Therefore, the following activities shall be introduced in the Village Forestry Zone of classified forests.

(a) Planting

Within the 4.0ha of land which is allocated to the local inhabitants to use, 2.0ha is for planting trees for post/fuelwood production and for fruit growing. Fuelwood forests and fruit plantations shall be planned in 1ha unit as follows. However, choice of tree species is up to the individual.

a) Fuelwood Forest

Although the possible species are *Tectona grandis, Gmelina arborea, Cassia siamea*, etc., the first choice shall be teak, which is easy and inexpensive to regenerate by germination.

Planting density shall be 2,500/ha (2 m × 2 m) using stamp seedlings. The logging cycle shall be 5 years and planting and logging shall be carried out every year for 1/5 of 1 ha, which is 0.2 ha.

This shall be introduced in teak plantations, as 2-year intercropping (Taungya System) is possible after planning.

Planning for each year is shown in Table 4-3-30.

Table 4-3-29 Post and Fuelwood Production Forest Plan (In the case of one ha)

Year	Planted Area (ha)		Harvest (ha)	Intercropping (ha)	Remarks
1	0.2	Planting	—	1.0	Yams
2	0.2	Planting	—	1.0	Yams or Maize
3	0.2	Planting	—	0.8	Maize (Intercropping impossible in 1st year 0.2ha)
4	0.2	Planting	—	0.6	Maize (Intercropping impossible in 1st/2nd year 0.4ha)
5	0.2	Planting	—	0.4	Yams (Intercropping impossible in 1st/2nd/3rd year 0.6ha)
6	0.2	Germination 1st year	0.2 (Planted Forest 1st year)	0.4	Yams or Maize (Reverts to 5th and 1st Year)
7	0.2	Germination 2nd year	0.2 (Planted Forest 2nd year)	0.4	Yams or Maize (Reverts to 1st/2nd year of a new cycle)
…	…	…..	……	…….	

4 to 5 seedlings will grow as stamp seedlings are used. Bud pruning shall be carried out after 1 year of germination to leave 3 straight seedlings.

b) Fruit Trees

Mangoes and cashews are presently grown. Mangoes are mainly used for personal consumption or are sold alongside State Highway 2. As the classified forest is a long way away from the State Highway, most of the time the things produced there are consumed by the people producing them. The planting of cashew shall be promoted in this plan. A planting density of 100 trees/ha (10m × 10m) shall be adopted.

Although trees will start producing fruit 18 months after planting, harvesting will not be carried out until the 6th year. Stable harvests can be expected after the 11th year, by which time production volumes will have reached approximately 2t/ha. However, harvest volumes from the 6th to the 10th year shall be 50% of the harvest volume of the 11th year. As cashew trees are very susceptible to fire, it is necessary to take measures to prevent fire from spreading to these areas from other areas.

(b) Fuelwood Forest

After the land for local inhabitants has been established in the Village Forestry Zone, fuelwood forest shall be created in areas of cultivated land and fallow ground which are not used by the local inhabitants so that each settlement can produce fuelwood to sell. This fuelwood forest shall be jointly used by settlements and managed by each

improvement unit organization.

Species of trees that shall be planted in such areas of forest shall include *Prosopis sp.*, *Acacia auriculiformis*, *Terminalia spp*. and *Gmelina arborea* etc. Excellent charcoal can be produced from *Prosopis* sp., Acacia *auriculiformis*, and *Gmelina arborea*. A planting density of 2,500/ha (2 m × 2 m) and the logging cycle shall be 5~6 years shall be adopted.

(c) Beekeeping

Although beekeeping is gradually being propagated in Borgu Province (Department), production volumes are still too low to adequately meet demand. As beekeeping is a very promising source of cash income for the local inhabitants, the stable production of honey should be greatly encouraged. Trees that are a source of nectar shall be planted in areas surrounding cultivated areas and on boundaries. As honey yields may vary greatly depending on beekeeping techniques, the introduction of new techniques shall be encouraged.

(d) Fruit of *Vitellaria paradoxa*, *Parkia biglobosa*, etc.

Although *Vitellaria paradoxa* still remains on cultivated land, there are no young trees due to fruit picking and crop growing in the area. Most trees are old and produce small amounts, meaning that people have to go a long way to collect adequate quantities of fruit. Planting *Vitellaria paradoxa* and *Parkia biglobosa* around cultivated areas will help the growth of successive trees and make fruit collection easier.

(5) Forest Roads

Forest roads shall be established in order to carry out operations in the production forest and to manage conservation forest.

The Trois-Rivières Classified Forest contains an area of 219,488 ha on the eastern side of the Bouli River, which is the eastern boundary of Intensive Study Area, where no forest improvement plan has been formulated. As the forest improvement plan for this area will be formulated in the future, a network of forest roads is planned in the improvement plan, with the idea of joining these two areas together in the future.

The Forestry Zone (production forest/conservation forest) can be accessed from Beroubouay along State Highway 2 only via Kabanou and Koussine. No other access to this area shall be created. Work roads shall be created in the production forest within the Forestry Zone. There are roads between surrounding settlements and classified forests for the transportation of cotton. However, these will be closed down and forests will be restored according to the improvement standards of each zone.

The length of the planned forest roads and related specifications are shown in Table 4-3-31 and Table 4-3-32 respectively. A forest road map and diagram are shown in Figure 4-3-10 and Figure 4-3-11 respectively.

Table 4-3-30 Length of Forest Roads

Road Type	Length (m)	Remarks
Access Road	9,000	Beroubouay~Classified Forest Boundary
Major Forest Road	19,500	
Work Road	35,400	

Table 4-3-31 Forest Road Specifications

Item	Major Forest Road	Work Road
Design Speed	20km/h	10km/h
Minimum Curve Radius	30m	20m
Sight Distance	40m	20m
Maximum Longitudinal Grade	7%	10%
Maximum Longitudinal Grade for Rugged Areas	9%	12%
Surface Material/Thickness	Sand, 30 cm	Sand, 20 cm
Crossing of Rivers	Corrugated Pipe or Ford	Corrugated Pipe or Ford

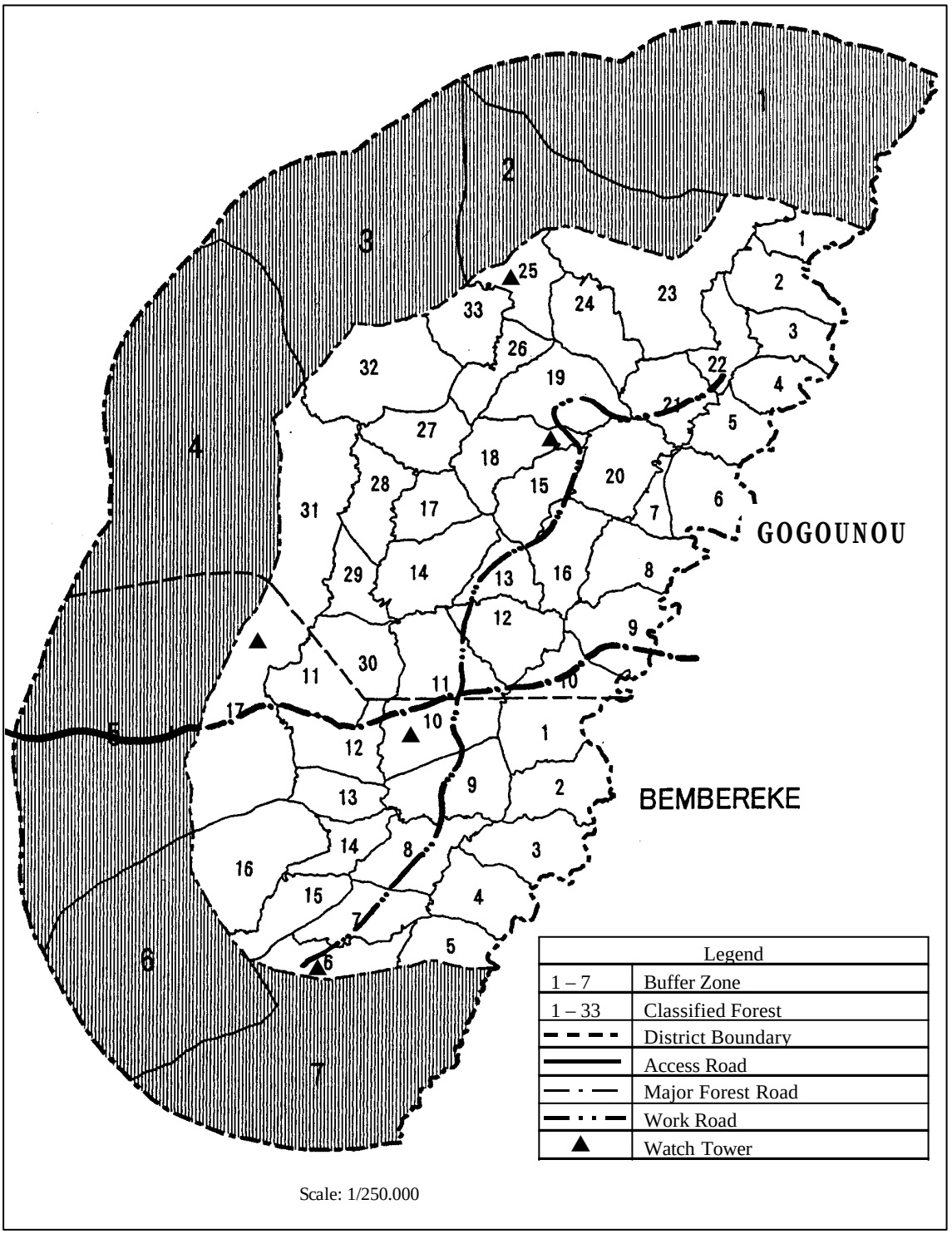


Figure 4-3-10 Maps of Planned Forest Roads

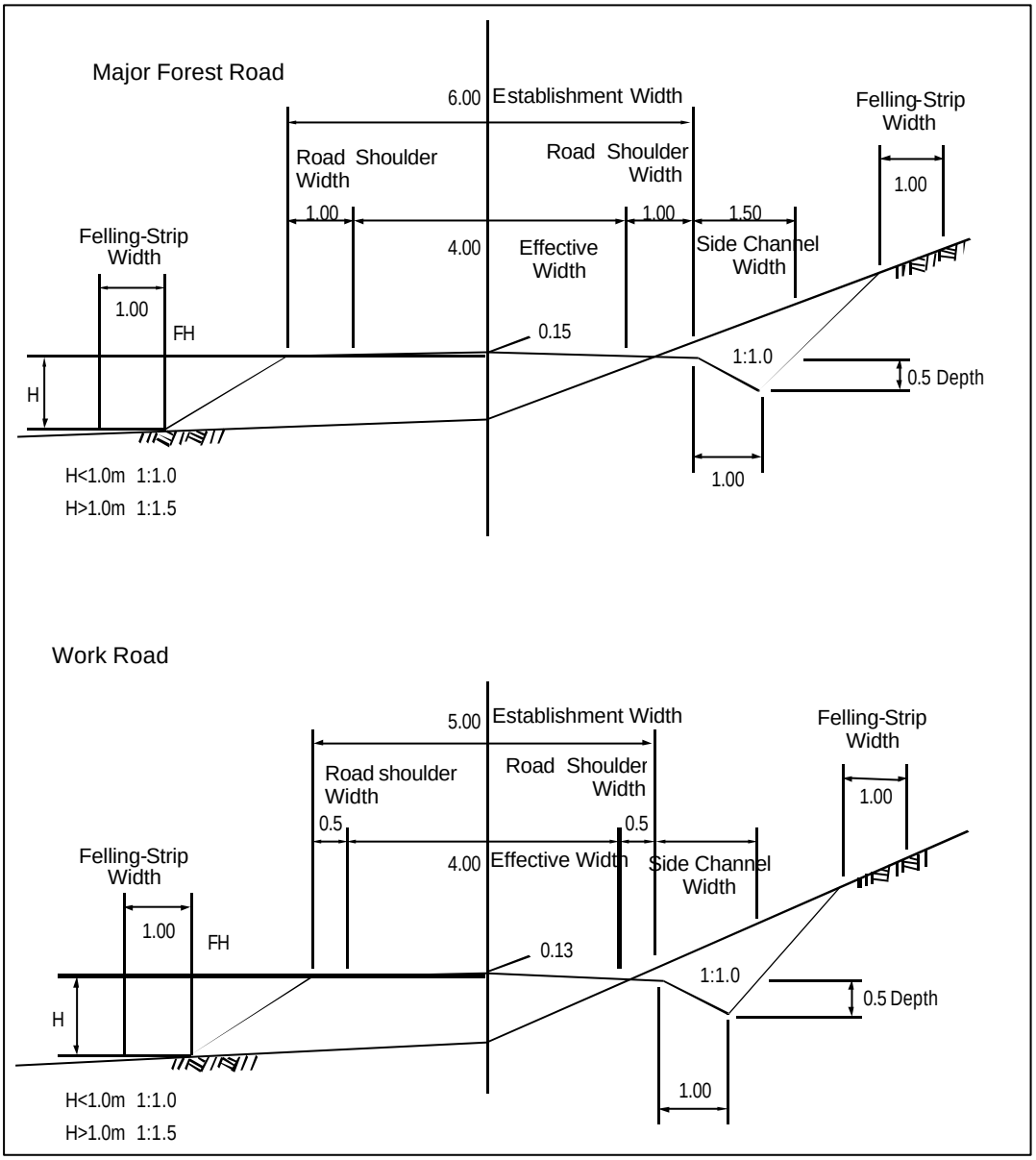


Figure 4-3-11 Road Construction Specifications

(6) Nurseries

Nurseries are necessary for the production of seedlings to be planted in areas of production forest, conservation forest, and boundary area. As the government of Benin is promoting privatization in many fields, the DFRN shall purchase seedlings from private nurseries. In this plan, village-operated nurseries shall be established in each improvement area in order to meet the demand for seedlings based on the improvement plan or according to the demand for seedlings for use in the free zone.

Village-operated nurseries shall be managed and administrated in each improvement unit. The location, size, management and operation of such nursery shall be determined through consultation with the Forest Improvement Committee.

(7) Forest Protection

Measures for controlling forest fires are important for the protection of the forest. In Benin, early controlled burning is permitted. Although controlled burning in the Forestry Zone within the classified forests is prohibited in this plan, early controlled burning in the Silvi-pastoral Zone is permitted. It is expected that forest fires may occur in the Forestry Zone as a result of such controlled burning. Controlled burning must be carried out under the management of the DFRN, with adequate attention being paid to preventing the fire from spreading. Firebreaks shall also be established.

Elimination of flammable *Gramineae* plants is an effective means of preventing fire from spread to the area from outside the classified forests. Therefore, evergreen fire-resistant species of trees should be closely planted on the boundaries of the classified forest in order to close the canopy quickly.

Watchtowers shall be also built for the early discovery of forest fires. These shall be built in 5 locations on higher hills in the Intensive Study Area within the classified forests and the buffer zone in order to cover the whole area. (Refer to Fig. 4-3-10)

(8) Forest Improvement Center

A multi-purpose Forest Improvement Center shall be established in each improvement unit as a base for the promotion of forest improvement, with the purpose of encouraging forest management cooperation between the DFRN and the local inhabitants. As training and Forest Improvement Fund is an essential part of this plan, the center shall also be used as a training facility.

4.4 Buffer Zone Management Plan

Under the Forest Law, land adjoining the classified forest and within 5 km of it shall be designated as a buffer zone and at the request of the local inhabitants, a forest improvement plan may be formulated for forest within the buffer zone together with the classified forest improvement plan.

However, for classified forests where no management plan has been formulated, the 5 km buffer zone around the classified forest is as good as nonexistent. The buffer zone shall be made a free zone and can be used freely by the local inhabitants for cultivation, livestock grazing, fruit harvesting, forestry, and for the use and distribution of forest products. However, the felling of and the removal of branches from protected species of trees is prohibited. The felling of species of trees other than protected species of trees and the clearing of new areas of land requires the authorization of the DFRN. Furthermore, when clearing new areas of land for cultivation, there is the number of trees to be retained is

restricted (40 trees/ha).

Under this study, areas of forest within 7 km surrounding the classified forest were designated as a buffer zone and conservation forest established within the buffer zone based on the management plan for the classified forest which are to be handled in accordance with management plans for classified forest.

Areas of forest that should be designated as Conservation Forest Preservation Areas include the following.

* Areas of riverside forest within 25 m of waterways that should be protected in order to foster water sources and prevent sediment discharge into rivers shall be handled in the same way as Conservation Forest II.
* Areas of Conservation Forest II on residual relief or tectonic relief.
* Forest on shrub savannah and laterite terraces that should be maintained in its present condition shall be designated as Conservation Forest II.
* Areas of forest where soil conservation is necessary shall be designated as Conservation Forest II.
* Areas of forest preserved as sacred forest by each of the settlements shall be handled in the same way as Conservation Forest I.

The DFRN shall clarify the location of each of the areas of forest mentioned above and enter them in the Map Register.

As continued extensive shifting cultivation involving slash and burn techniques in these areas results in a decrease in the fertility of the land, such areas have been left as fallow ground, which led to illegal cultivation in the classified forest.

If the management plan for the classified forest is formulated, cultivation within the classified forest will have to be carried out within limited areas of land using fixed cultivation. At the same time, the transition to fixed farming will also be encouraged within the buffer zone in order to make effective use of cultivated land and fallow ground where productivity has decreased. Agroforestry shall be actively promoted, especially within the buffer zone.

(1) Agroforestry in Areas of Cultivated Land and Fallow Ground

① 2 ha Cultivated Land

This is where food crops (yams, maize and sorghum, etc.) for personal use are grown. Although a specific number of existing trees are required to be left in cultivated areas (40 trees/ha), these actually reduce the area of land that is able to be cultivated, reduce work efficiency and reduce overall yields. As replacements for these trees *Vitellaria paradoxa* and *Parkia biglobosa*, etc. shall be planted around cultivated areas and when *Vitellaria paradoxa* and *Parkia biglobosa* are able to be harvested, such existing trees within the field shall be felled. In addition, fuelwood trees shall be planted in between these trees surrounding cultivated areas to prevent the entry of livestock.

② 2~5 ha Cultivated Land

2 ha is used to grow food crops while the remaining 1~3 ha shall be planted in trees and agroforestry undertaken with forest products being harvested and cash crops being grown as intercrops (Agroforestry-Taungya System). The various possible combinations are shown below.

(a) Tree-planting

* Fruit trees: Although both mangoes and cashews can be grown, cashews are considered to be more advantageous from the standpoint of sales. The planting

density of such trees shall be 100 trees/ha (10 m × 10 m).

* *Vitellaria paradoxa*: Limited production of fruit from *Vitellaria paradoxa* can be carried out. The planting density of these trees is 200 trees/ha (5 m × 10 m).

* Teak: Post production is the reason for planting teak. Trimmed branches, etc. shall be used for fuelwood. Post production is possible after 4~5 years and germination is possible after the 2nd cutting. Depending on planting density, intercropping can be carried out for 1~2 years.

(b) Intercropping

Intercropping of cash crops such as peanuts and maize shall be carried out. However, as this reduces the productivity of the land, measures to address this issue are necessary.

③ Cultivated Land of no less than 5 ha

Stable income from trees replaces income from farm crops which are susceptible to the effects of the weather. Food is supplemented by intercropping through agroforestry (Taungya). Income from trees is obtained from post production in teak plantations. Intercropping is carried out with the main food crop, which is yams. As intercropping is carried out for a period of 2 years after teak is planted, planting density for teak shall be 1,250 trees/ha (4 m × 2 m).

2ha of yams shall be grown each year and from the 6th year onwards income will be derived from the sale of at least 1ha of teak posts.

(2) Beekeeping

As cultivated land and the area surrounding cultivated land is unsuitable for beekeeping, trees which are a source of nectar shall be planted in the area surrounding remaining areas of forest and on the boundaries between areas. Furthermore, tall trees which are a source of nectar shall be planted in grasslands and areas of low shrubs that are owned by the local inhabitants. As the planting of such tall trees reduces the volume of grass which can be burned by wildfires, they in effect prevent the spread of such wildfires. When carrying out beekeeping in grassland or areas of low shrubs, 12 beehives shall be positioned in each ha.

(3) Charcoal Production

Charcoal is not commonly used by families. The reason for this is that fuelwood, such as trees and branches, is available in the immediate area and that even though cooking is carried out outside, smoke does not appear to have a significant effect on people, especially the women.

Although according to the Forest Law there are to be 40 trees per ha in cultivated areas, the local inhabitants burn off around the base of the trees and use it as fuel. This shows that they are not, in fact, abiding by the rules of the Forest Law.

By establishing the Fuelwood Forest as a source of fuel, this ensures that areas of forest apart from that are not decimated by people and by encouraging the use of charcoal, which has a better thermal efficiency as a fuel, a simple charcoal kiln will initially be established in each village and villagers encouraged to produce charcoal for their own personal use. Furthermore, the local inhabitants themselves will be encouraged to preserve areas of forest apart from fuelwood forest.

4.5 Living Environment Improvement Plan

Although improving the living environment for the local inhabitants no direct relationship on the implementation of forest improvement plan, it is intended to preserve the classified forests through promoting the local society as a means of improving the living environment.

The following living environment shall be improved.

(1) Facilities for Livestock

① Water Holes for Livestock

As the rivers other than the Bouli River dry up during the dry season, livestock have to go all the way to the Bouli River to get water. After the implementation of the improvement plan, grazing within the classified forest shall be prohibited, with the exception of Silvi-Pastoral Zone. That means that stretches of the Bouli River located within the classified forest cannot be used as water holes.

As a countermeasure to the prohibition of grazing in the classified forest, water holes shall be formed by creating dams on the Bouli River and by digging out low-lying areas alongside waterways on the northern boundary of the classified forest and in the buffer zone near the southern boundary of the classified forest.

② Health Care Facilities for Livestock

Although it is necessary to sustain the health of livestock in order to promote livestock farming, veterinarians are in strong demand. To secure veterinarians and to promote the easy diagnosis of livestock health, health care facilities for livestock shall be developed.

(2) Facilities for Local Promotion

Facilities requested by local inhabitants in the Survey to Ascertain the State of Local Inhabitants and in the workshop with villagers local people are as follows.

① Road

The roads between State Highway 2 and each settlements are not yet improved. There are no bridges for vehicles and there is no way to get to the settlements by vehicle during the rainy season. This is a major hindrance to the life of the local inhabitants, especially when it comes to the transportation of patients and agricultural products etc. Therefore, the following roads and bridges shall be developed. The lengths of the roads are shown below. Kabanou village is excluded from the list as there is an access road to the classified forest.

Settlement on State Highway	Settlement	Length
Gogounou	Zougou-Kpantrossi	21.0 km
Sori	Wessene	7.5 km
Sori	Pigourou	7.3 km
State Highway Intersection	Mani-Boke	12.7 km

② Storage Facilities for Agricultural Products

With the implementation of the forest improvement plan, both surplus food that is not required for personal consumption and food grown to be sold for cash income shall be produced. These products shall be collected, shipped and sold jointly as a group by the

local inhabitants. Storage facilities for keeping collected products shall be constructed in each of the settlements.

③ Wells

Although water is essential for human survival, there are no wells in some settlements. Water from rivers is used for drinking and cooking in such places. As this can lead to a variety of problems caused by contaminated water and a lack of hygiene, the development of wells is extremely important.

④ Health Care Center

There is one district health care center in Bembereke, one district health care center in Gogounou, and four commune health centers in Bembereke. Due to the tight budgets imposed by the government, some staff positions are vacant while other staff are employed by the local inhabitants. There are no health centers in settlements within the Intensive Study Area with the exception of Zougou-Kpantrossi. The local inhabitants are extremely wary of sickness and disease and strongly desire the establishment of health care centers in each of the settlements.

⑤ Schools

In settlements within the Study Area, the local inhabitants presently bear the cost of the construction of schools and pay the salaries of the teachers. They strongly desire that the government construct schools, increase the number of classrooms, and assign teachers, etc.

⑥ Women's Centers

According to the Survey to Ascertain the State of the Local Inhabitants, school attendance ratios and literacy ratios are low because of the shortage of schools and use of children for labor. This tendency is especially prominent among women.

In daily life, cooking, washing, mending, fuelwood collection, water collection, fruit picking, agricultural/forestry product processing and sales are all thought of as women's jobs. The burden being placed on women is extremely large.

A Women's Center shall be constructed in each settlement with the purpose of teaching women how to read and sow. Machines for the processing of fruit (*Vitellaria paradoxa* and *Parkia biglobosa*) and produce (maize, sorghum, and millet) shall be installed in order to reduce the workload of women and to improve their social status.

4.6 Plans for Management, Administration and Maintenance

The management unit for the classified forests is the district, which has jurisdiction over the Forestry Offices. Improvement units to be placed under management units for the implementation of the plan were determined on the basis of the boundary of the cultivated land in each settlement within the present classified forest, with consideration being given to the natural conditions of such classified forests and the social conditions in each of the settlements.

Under this plan, in addition to the establishment of two management units (Gogounou and Bembereke), five improvement units were established (Zougou-Kpantrossi, Wessene, and Pigourou in Gogounou and Kabanou and Mani-Boke in Bembereke). Settlements included in each improvement unit are as follows.

Table 4-6-1 Settlements included in the Management Unit and Improvement Unit

Forest Management Unit	Forest Improvement Unit	Settlement
GOGOUNOU	ZOUGOU-KPANTROSSI	ZOUGOU-KPANTROSSI
		ZOUGOU PEULH
	WESSENE	WESSENE
		WESSENE PEULH
	PIGOUROU	PIGOUROU
		NANONROU
BEMBEREKE	KABANOU	KABANOU
		KARAKOU DASSI
		SANSE
		KOUSSINE
		BOKOBOUEROU
		GBEPOA
	MANI-BOKE	MANI-BOKE
		FERE
		BAFA

The process from the formulation to the implementation of the forest improvement plan is as follows.

* A draft plan is formulated by the DFRN.
* Villagers form organizations.
* Workshops are held to clarify problems and work out solutions following the presentation of the concept of the improvement plan.
* The activities of the various committees to be involved in the implementation of the plan are determined and the plan proposal formulated.
* The plan proposal is shown to the local inhabitants, after which corrections are made and the plan formulated.
* The completed forest improvement plan is submitted to the cabinet.
* After the approval of the cabinet, a contract will be signed between the Minister of Rural Development, the DFRN and the representative of the local inhabitants.

The classified forest is a state-owned forest and is managed by the DFRN. As the improvement plan will be formulated in accordance with the Forest Law, the main management body shall be the DFRN with a single technician being located in each settlement for the implementation of this plan. However, management, operation and maintenance shall be carried out by organizations of local inhabitants based on the enacted improvement plan.

With regard to these organizations of local inhabitants, after discussions between the Study Team and the DFRN, the original proposal was formulated detailing the establishment of the Forest Management Communication Council at the provincial level, the establishment of the Forest Management Council at the district level, the establishment of the Forest Improvement Unit Committee on the settlement level, and the establishment of Zone Groups in each Improvement Unit.
Based on this proposal, meetings were held with the local inhabitants in each settlement and carried out directly regarding the roles of each organization and zone group and their constituent members, etc.
Based on the results of such meetings, partial amendments were made to the proposal based

on the opinions of the local inhabitants and organizations of local inhabitants to be involved in forest improvement are as follows.

(1) Organizations of Local Inhabitants

① Forestry Management Communication Council

The province (Department), under the jurisdiction of the DFPRN (Forest Natural Resources Protection Bureau), shall act as a monitoring unit with the Forestry Management Communication Council being established on this level. This council exists merely for the purpose of consultation and although it does not hold the right to determine it does hold the right to approve.

This council consists of the chairmen of the forestry management councils (1 from each council), the Chief of the DFPRN (1), representatives from the Provincial (Departmental) government (1), and the Chief of the Agriculture Administration Bureau's Farmers' Organization Support Bureau (1).

The roles of this council are as follows.

* Collation of the annual work plans for each forest management unit into a single classified area and giving approval to such plans.
* Following up of planned activities and the giving of necessary advice.
* The arbitration of disputes among forest management units.

In the model project which is targeted at the Intensive Study Area, both Gogounou and Bembereke forest management units shall be improvement operation monitoring units at the province level.

② Forest Management Council

Forest Management Councils are established with in each of the forest management units. With regard to the Intensive Study Area, the Forest Management Council of Gogounou has jurisdiction over three forest improvement units (Zougou-Kpantrossi, Wessene, and Pigourou), and while the Forest Management Council of Bembereke has jurisdiction over two forest improvement units (Kabaou and Mani-Boke).

The Forest Improvement Fund shall be established on the forest management unit level in order to provide resources for independent activities at the forest management unit level. Each forest management council bears the responsibilities of managing and administrating this fund. In the intensive study area, the Gogounou Forestry Management Council and the Bembereke Forestry Management Council shall open their own accounts for management and administration purposes.

Forest Management Councils consist of a representative from each Forest Management Unit Committee (2), a representative from each commune (1), a representative from the District Level DFRN (1), a representative from the district (1), and a representative from the Agriculture Administration Bureau District Office (1).

The role of this council is as follows.

* Collating the annual work plans of each improvement unit to formulate annual work plans for the forest management unit level and submitting them to them Forest Management Communication Council.
* Following up and controlling the activities planned in the annual work plans as well as giving advice as necessary.
* Financial management of the Forest Improvement Fund.

* Arbitrating disputes between forest improvement units.

Executives of Forest Management Councils shall be selected from among the members of the committee other than government related persons. They shall be appointed for a period of 3 years with no compensation. The executive includes the following: Chairman (1), Secretary (1), Accountant (1), Forest Management Fund Officer (1) and Activity officer (1).

A standing audit committee shall not be established at the forest management unit level. Audits shall be carried out once every six months by a contracted outside specialized NGO. As a rule, accounting documents and audit documents are to be made public.

③ Forest Improvement Unit Committee

Forest Improvement Unit Committees shall be established at the forest improvement unit level for dealing with the practical side of forest improvement. These committees consist of 12 members: 2 representatives from each of the four zone blocks (total 8), an elderly representative (traditional village chief or land chief) (1), Delege (1), On-site Forestry Office (1) and the Agricultural Administration Bureau Forest Improvement Fund Officer (1). This may vary according to the situation at the time.

The role of this committee is as follows.

* Preparation of users' register by zone and revision of such as necessary.
* Formulation of annual work plans based on forest improvement plan. The annual work plan states who does the work and when they should be done.
* Organization and implementation of planned activities and follow-up surveys.
* Collection and payment of charges for the forest improvement fund and other practical work related to the finance management including receiving activity cost from the forest improvement fund.
* Function as a go-between between government organizations, NGOs and villagers with regard to Forest Improvement Fund and training.
* Arbitration of disputes between zones.

The executives for this committee shall be selected from among the members of the committee other than government related personnel. They shall be appointed for a period of 3 years and receive payment if a profit has been made at the end of the financial year. The executives include: Chairman (1), Secretary (and Forest Improvement Fund/Training Officer) (1), Accountant (1), Dispute Officer (1), Forestry Development Officer (1), Forest Preservation Officer (1), Commercial Farming Improvement Officer (1), Livestock Farming Improvement Officer (1) and Income Improvement Activity Officer (1).

As the result of consultations with the DFRN, the Land Problem Sub-committee and Distribution Sub-committee shall not be established on the forest improvement unit level. These problems shall be handled by the Forest Improvement Unit Committee.

④ Zone Group

As the buffer zone may be designated as an area to be placed under the forest improvement plan at the request of the local inhabitants, it shall be divided into 4 zones: Forestry Zone, Silvi-Pastoral Zone, Village Forestry Zone and Buffer Zone. Users shall form groups in each zone. People who used multiple zones can be a member of each zone.

The activities of each of the zone groups are as follows.

* Forestry Zone Group: Work to be carried out within the Forestry Zone, such as production, planting, and nurturing, etc. Only people who are registered in the Forestry Zone Group can engaged in such work.

* Silvi-Pastoral Zone Group: Work to improve livestock farming, including the management of early controlled burning and the maintenance of water holes for livestock. Unregistered grazing shall be also monitored.

* Village Forestry Zone Group: Preparation of the land for cultivation and improvement activities for commercial farming shall be carried out. Management of Conservation Forest Preservation Areas within the Buffer Zone shall be also carried out. Only people who have registered in the Buffer Zone Group can receive training regarding the improvement of commercial farming.

An executive team shall be formed with 3 persons selected from among the members of the group, and they shall be appointed for the period of 3 years. This team consists of a Representative, a Representative Assistant and a Disputes Officer. The Representative and Representative Assistant shall be members of the Forest Improvement Unit Committee. At least one of these two people has to be a woman. People who are members of multiple zones are not allowed to be in the executive teams of multiple zones.

The role of this executive team shall be as follows.

* Preparation of users' registers by zone in cooperation with someone assigned by the Forest Improvement Unit Committee.

* Function as a go-between between users and Forest Improvement Unit Committees.

* Organization and implementation of work.

* Arbitration of small disputes among users.

With regard to the collection of levies for the Forest Improvement Fund in the Village Forestry Zone and the Silvi-Pastoral Zone, a person whom people trust other than the above mentioned personnel shall be appointed in each zone group for a period of one year to collect such levies. That person shall carry out the collection of levies under the direction of the Forest Improvement Unit Committee Accountant.

Although the executive team shall receive no compensation, the levy collector shall receive a certain portion of collected funds as a reward. The executive teams for each zone group shall be selected at a general assemble of the villagers at the same time that Forest Improvement Unit Committee members are selected.

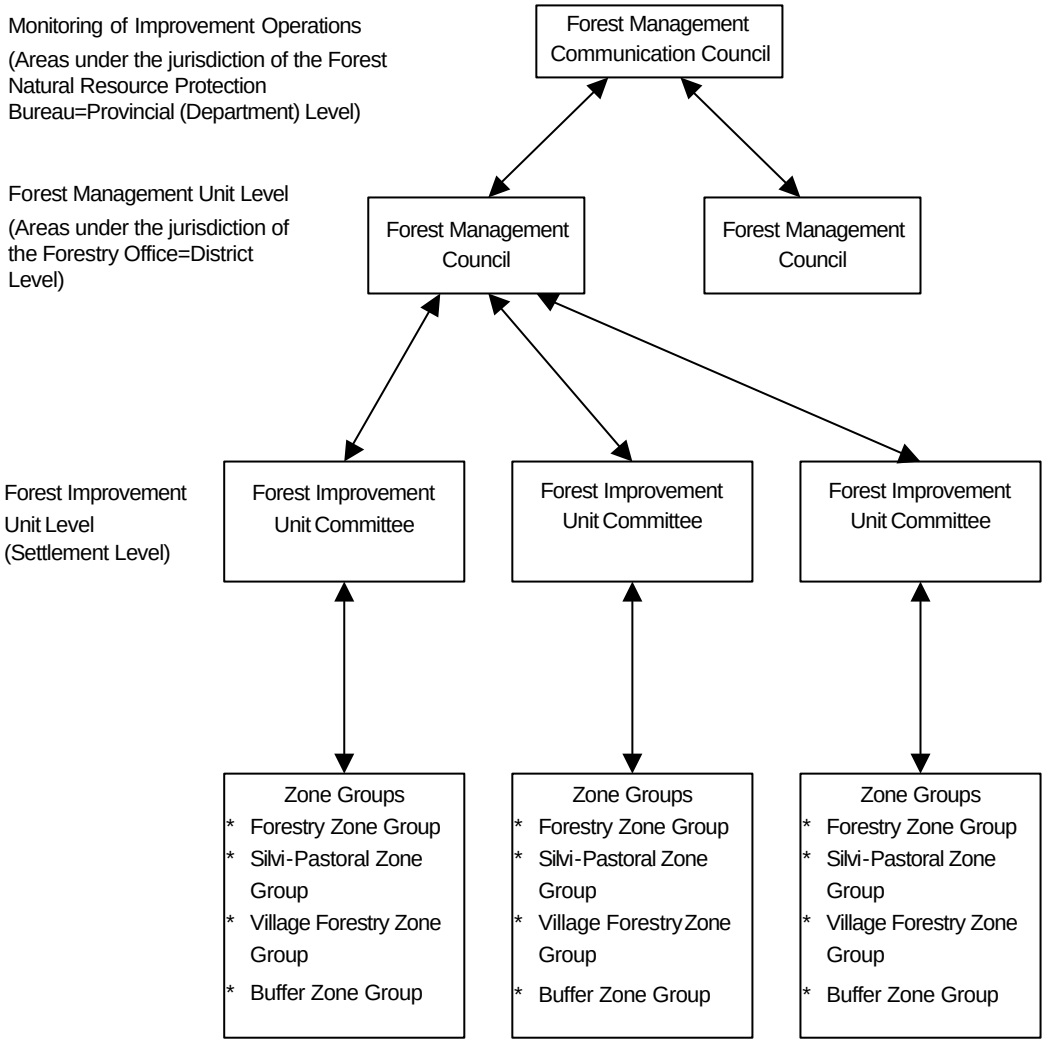


Figure 4-6-1 Forest Improvement Organizations

(2) Forest Improvement Fund

In order to administer forest improvement operations independently, a Forest Improvement Fund shall be established in each forest management unit as a source of finance. Details regarding this fund are shown below. However, the allocation ratio of income, and the amount and proportion of levies per unit are only tentative figures. The final figures shall be determined at the time of the formulation of the implementation plan.

Furthermore, in order to promote forest improvement activities on a national level, 10% of the sales profit from these improvement activities shall be input into the National Forest Fund established in accordance with the Forest Law.

① Income from Timber Production at the Production Forest

The production of timber, posts and fuelwood in the Production forest within the Forestry zone shall be carried out by each improvement unit, with villagers being hired from the

Forestry Zone Group. The income from sales shall be distributed as shown below after forest development tax and labor costs, etc. have been deducted.

* 90% Forest Improvement Fund

* 10% National Forest Fund

② Income from Nurturing the Conservation Forest

Sales from the timber produced as a result of thinning, improvement cutting and sanitation cutting in the Conservation Forest shall be distributed as follows after the deduction of tax and labor costs, etc.

* 90% Forest Improvement Fund

* 10% National Forest Fund

③ Income from Timber Production in the Village Forestry Zone and Silvi-Pastoral Zone

In the Village Forestry Zone, income is expected from timber produced through improving formerly cultivated land before allocation and from timber produced outside the allocated area after allocation. Furthermore, income is also expected in the Silvi-Pastoral Zone from timber produced as a result of establishing man-made pasture. Such income from sales shall be distributed as follows after the deduction of tax and labor costs, etc.

* 90% Forest Improvement Fund

* 10% National Forest Fund

④ Income from Levies from Beneficiaries

Beneficiaries using the Village Forestry Zone, Silvi-Pastoral Zone, etc. in the Classified Forests shall pay the following levies to the Forest improvement fund.

* Cultivation in the Village Forestry Zone: 2000FCFA/ha/year (No difference between newly cultivated land and formerly cultivated land).
* Production and Sale of Fuelwood in the Allocated Area within the Village Forestry Zone: 150FCFA/ cord (stale)
* Production and Sale of Charcoal in the Allocated Area within the Village Forestry Zone: 100 FCFA/100kg bag. (kintal)(1bag) (No levies for personal consumption.)
* Production and Sale of Posts in the Allocated Area within the Village Forestry Zone: 20% of sales.
* Production and Sale of Fruit in the Allocated Area within the Village Forestry Zone: 20% of sales.
* Grazing in the Silvi-Pastoral Zone: 300FCFA/year/cattle. (No charge for goats and sheep.)
* Hunting: No charge for personal consumption.
* Fishing:

  Large-scale Fishing by persons from Outside the Area: 2000 FCFA/person/season.

  Small-scale Fishing: 5000 FCFA/person/season

  Traditional Fishing: No charge.
* Beekeeping: 20% of sales.
* Buffer Zone Forest Improvement Fund (People using the Buffer Zone and wishing to receive training in order to improve commercial farming and forestry techniques in accordance with the Forest improvement plan): 1,000 FCFA/year/person.

4.7 Plans for the Implementation of Operations

Based on the forest management plan which shall be formulated in this study, the forest improvement activities shall be implemented by Benin as follows.

Prerequisite for the implementation plan is as follows.

* The target area shall be the Intensive Study Area of this study. This project shall be implemented with the participation of local inhabitants.
* This project shall be implemented by the government of Benin (DFRN) and the local inhabitants.
* An order of priority shall be set on each activity in order to avoid the concentration of costs in a short period of time.
* The duration of this project shall be ten years.

(1) Formulation, Signing of Contract and Effectuation of Forest improvement Plan

After this study is completed, the DFRN shall notify the local inhabitants with regard to the implementation of forest improvement activities. At that stage, as the local inhabitants should have organizations for forest improvement established, these organizations shall consult with the DFRN. The DFRN shall prepare a residents register for the target settlements for the allocation of the land within the Village Forestry Zone. The preparation of the residents' register shall be contracted to an NGO, which will create the register with the cooperation of the organizations of local inhabitants.

After consultation with the organizations of local inhabitants, the DFRN shall conclude the contract with such organizations. After obtaining the approval of parliament, this plan shall be brought into effect and the project will be commenced.

(2) Implementation of Forest Improvement Projects

Two programs are necessary for the Implementation of forest improvement projects: the Preparation of the classified forest and the stabilization of the lives of the local inhabitants.

Preparation of the classified forest is aimed at sustainable forest management. The initial stage of this project is a preparation period, where the participation of the local inhabitants in the improvement activities for the improvement of their own lifestyles shall be promoted. The interim stage is where full-scale activities start in each zone. These activities shall be stabilized and run independently during the final stage.

Women are directly involved in the work in the classified forest, such as collection of fuel and fruit (*Vitellaria paradoxa, Parkia biglobosa*), and crop growing as a part of women's group. However, as the use of the classified forest will be limited in the improvement plan, sources of income other than agriculture should be promoted to stabilize the lives of the local inhabitants. Programs to promote the independence of women are necessary to encourage their positive participation in these activities, because that will eventually stabilize the lives of the local inhabitants and contribute to the preservation of the classified forest.

Details of classified forest improvement activities during the initial stage (1st~10th year) are as follows.

① First and Second Years

Presently, the local inhabitants cultivate the land and produce food, etc. in the classified forest. Zone boundaries and compartment boundaries according to the plan are not yet

seen on the site. Therefore, the first and second years shall be set aside as a preparation period, during which the area of the classified forest shall be clarified and the boundaries of zones and compartments which are directly related to the people shall be marked. Areas of cultivated land scattered throughout the classified forest and used by the local inhabitants shall be replaced with areas within the Village Forestry Zone.

Village nurseries shall be created to produce seedlings for planting. The Forest Improvement Center shall be constructed for the management of the forest and also to function as the Women's Center.

② Third Year

Regular commercial farming by local inhabitants shall be carried out in the Village Forestry Zone. The creation of man-made pasture, the improvement of natural pasture and the creation of reservoirs and dams shall be commenced.

Production of timber and fuelwood shall be commenced in order to generate finance for forest improvement activities. Trees shall be planted on the boundaries of the classified forest.

③ Fourth Year

In the Production Forest Zone, the Silvi-Pastoral Zone and the Village Forestry Zone, activities based on the plan shall be carried out. Enrichment in the Conservation Forest shall also be commenced.

④ Fifth Year Onward

Activities based on the plan for each zone shall be implemented.

Activity plans are shown is Table 4-7-1.

Table 4-7-1 Activity Implementation Plans

Activity		Work	Implementing Body			YEAR								
			DERN	Local Inhabitants	Others	Prepa -ration Period	1-3 (Prepa -ration)	4	5	6	7	8	9	10
All Zones	Establishment of Forest Improvement Committee			○		△								
	Preparation of Resident7s Register			○	○	△								
	Formulation,Contracting & Issuance of Plans		○	○		△								
	Establishment of Classified Forest Boundaries	64.7 km	○		○									
	Establishment of Boundaries of Zones and Improvement Units	150.4 km	○		○									
	Timber Production inVillage Forestry & Silvi-Pastoral Zone	3,119 ha	○											
	Establishment of Compartment Boundaries		○											
	Access Road	9 km	○		○									
	Establishment of Forest Road	54.9 km	○		○									
	Village Nurseries	5	○	○										
	Seedling Production in Village Nurseries			○										
	Construction of Watchtowers	5	○		○									
	Forest Improvement Centers	5	○		○									
	Simple Charcoal Kilns	10	○		○		(2)						(8)	
	Planting for Firebreak Belt and Along Classified Forest Boundaries	107 ha	○		○									
Conservation Forest Zone	Transfer of People Carrying out Cultivation			○										
	New Planting	685 ha	○		○									
	Enrichment	7,095 ha	○		○									
Production Forest Zone	Transfer of People Carrying out Cultivation			○										
	Timber Forest (Felling,Regeneration,Enrichment)	5,100 ha												
	Fuelwood Production Forest: New Planting, Direct Sowing	1,464 ha	○											
	Fuelwood Production Forest: Felling, Regeneration	7,731 ha	○											
Silvi-Pastoral Zone	Transfer of People Carrying out Cultivation			○										
	Creation of Pasture	2,368 ha		○										
	Improvement of Pasture	5,603 ha		○										
	Creation of Reservoirs and Dams	6 locations		○										
Village Forestry Zone	Establishment of Areas for Cultivation	5,005 ha	○		○									
	Improvement of Land for Cultivation	1,960 ha		○										
	Improvement of Land for Cultivation for Transferred			○										
	Planting(Fuelwood/Fruit)	1,960 ha		○										
	Planting of Trees Around Cultivated Areas	502 ha		○										
	Planting of Bells of Fire Resistant Trees and Boundaries	2,000 ha		○										
Living Environment Improvement	Road	48.5 km	○		○									
	Storage for Crops	5 unit	○		○									
	Creation of Reservoirs/Dams on Bouli	2 locations	○		○									
Extension and Training	Extension		○		○									
	Education/Trainings		○		○									
	Literacy Education				○									
Regional Promotion	Beekeeping			○										
	Charcoal Production			○										

(3) Outline of Costs for Operations (Activities)

The matters mentioned below are prerequisites with regard to the calculation of costs involved in the implementation of the activities related to this plan.

- The duration of this plan shall be 10 years. From the 11th year (from the second period of the first cutting cycle), with the exception of timber production, other operations shall continue based on this plan.
- Operating costs shall be divided into three major categories: infrastructure improvement costs, classified forest improvement costs, and forest improvement activity costs.
- Initial investment shall be made in infrastructure improvement and classified forest improvement.
- With regard to forest improvement activities costs, even after the completion of this project, organizations of local inhabitants shall continue to utilize the Forest Improvement Fund and income from the sale of timber and fees from beneficiaries.
- Of forest improvement activities costs, although the majority of costs for the planting of production forest are associated with the creation of fuelwood forest, from the second cutting cycle in the fuelwood forest (from the eleventh year), planting costs shall be greatly reduced by allowing regeneration through germination. Outside investment will be used for costs associated with the planting of production forest, which is a priority. Income from the sale of timber shall be used to repay loans, after which it shall be used to cover replanting costs.
- These calculations are only estimates and it is necessary for detailed calculations to be carried out at the time of the formulation of the improvement plan itself.

① Infrastructure Improvement Costs

(a) Access Roads and Forest Roads

The 9.0km access road shall be an all-weather road and shall be constructed during the first year. Major forest roads shall cross the four zones (Village Forestry Zone, Silvi-Pastoral Zone, Production Forest Zone, and Conservation Forest Zone) in the central area covered by the plan, shall have a total length of 19.5km, and shall be constructed during the second year. Forest work roads shall branch off from the major forest roads and shall be constructed during the third year in the first period of the first cutting cycle in each improvement unit (1~10 years) in accordance with timber forest production plans.

(b) Watchtowers

Forest fires are one of the causes of the degradation of the classified forest. In order to be able to quickly detect forest fires, five watchtowers shall be constructed during the third year to cover the area designated by the plan.

(c) Forest Improvement Center

Forest Improvement Centers shall be constructed in each improvement unit during the second year to act as a base from which training regarding forest management and improvement techniques can be carried out, as well as seminars to encourage the participation of women by improving their social status.

(d) Simple Charcoal Kilns

Two simple charcoal kilns for training and practice purposes shall be established during the third year with the aim of propagating the use of charcoal and introducing charcoal production businesses.

The above-mentioned infrastructure improvement costs are shown in Table 4-7-2.

Table 4-7-2 Infrastructure Improvement costs

Activity	Scale	Amount (1,000FCFA)
Access Roads	9.0km	253,125
Major Forest Roads	19.5km	548,438
Forest Work Roads	35.4km	885,000
Watchtowers	5	50,000
Forest Improvement Centers	5	156,250
Simple Charcoal Kilns	2	37,500
Total	-	1,930,313

② Classified Forest Improvement Costs

(a) Planting of Classified Forest Boundaries and Belts of Fire-Resistant Trees

Planting of 107ha (length: 215.1km x 5m) of classified forest boundaries and belts of fire-resistant trees shall be carried out in the third year at a cost of 47,600FCFA per hectare.

Table 4-7-3 Planting of Classified Forest Boundaries and Belts of Fire-Resistant Trees

Zone	Activity	Area/Costs	3rd Year
Conservation Forest	New Planting	Area (ha)	107
		Costs (1,000FCFA)	5,093

(b) Restoration of Conservation Forest

New planting and enrichment of the conservation forest zone shall be carried out during the 4th to the 7th years. Enrichment shall be carried out at a planting density of 100 trees/ha at a cost of 47,600FCFA per hectare while new planting shall be carried out at a planting density of 625 trees/ha at a cost of 148,700FCFA per hectare.

Table 4-7-4 Restoration of Conservation Forest (Unit: Area (ha), Cost (1,000FCFA))

Activity	Area/Costs	4th Year	5th Year	6th Year	7th Year
Enrichment	Area	1,716	1,716	1,715	1,948
	Cost	81,682	81,682	81,634	92,725
New Planting	Area	228	228	229	-
	Cost	33,904	33,904	34,052	-
Total Cost		115,586	115,586	115,686	92,725

(c) Establishment of Boundaries

Costs associated with the establishment of the boundaries of the classified forest, the establishment of the boundaries of improvement units and zones and the establishment of the divisions for use by the local inhabitants within the Village Forestry Zone to be carried out in the preparation period during first and second years are shown in Table 4-7-5.

Table 4-7-5 Establishment of Boundaries (Unit: 1,000FCFA)

Item	Length/Area	1st Year	2nd Year
Establishment of the Boundaries of the Classified Forest	64.7km	5,823	5,823
Establishment of the Boundaries of Improvement Units and Zones	150.4km	13,536	13,536
Establishment of the Divisions within the Village Forestry Zone and Utilized Land	5,005ha	31,532	13,513
Total	-	50,891	32,872

③ Forest Improvement Activity Costs

(a) Timber Production Costs

a) Improvement of the Village Forestry Zone and Silvi-Pastoral Zone through Timber Production

Costs associated with the improvement of the Village Forestry Zone and Silvi-Pastoral Zone through timber production to be carried out in the preparation period during first and second years are shown in Table 4-7-6.

Table 4-7-6 Timber Production Costs in the Village Forestry Zone and Silvi-Pastoral Zone

Item	Volume/Costs	1st Year	2nd Year
Timber Production (3,119ha)	Production Volume (m^3)	17,241	17,241
	Production Costs (1,000FCFA)	172,410	172,410

b) Timber Production in the Production Forest

Volumes and costs associated with timber production to be carried out in the production forest during the third to the tenth year are shown in Table 4-7-7.

Table 4-7-7 Timber Production Costs

Item	Volume/Costs	3rd~5th Year	6th~9th Year	10th Year
Timber (natural forest)	Production Volume (m^3)	8,358	8,351	8,351
	Production Costs (1,000FCFA)	83,580	83,510	83,510
Fuelwood (natural forest)	Production Volume (m^3)	12,538	12,526	12,526
	Production Costs (1,000FCFA)	125,380	125,260	125,260
Fuelwood (man-made forest)	Production Volume (m^3)	-	-	4,026
	Production Costs (1,000FCFA)	-	-	4,026
Total Production Costs (1,000FCFA)		208,960	208,770	212,796

Note. 1. The proportion of logging volumes in areas of natural forest is 40% for timber and 60% for fuelwood.
2. Logging costs in areas of natural forest are 10,000FCFA per m^3 for both timber and fuelwood.
3. Logging costs in areas of man-made forest are 1,000FCFA per m^3.

(b) Production Forest Planting Costs

The area and planting costs for the Production Forest Zone are shown in Table 4-7-8.

Table 4-7-8 Production Forest Planting Costs (Unit: area (ha), cost (1,000FCFA))

Category	Activity	Area/Costs	3rd Year	4th Year	5th Year	6th Year	7th Year	8th Year	9th Year	10th Year
Fuelwood Forest	Enrich-ment	Area		967	967	967	966	966	966	966
		Cost		9,670	9,670	9,670	9,660	9,660	9,660	9,660
	New Planting	Area	183	183	183	183	183	183	183	183
		Cost	108,885	108,885	108,885	108,885	108,885	108,885	108,885	108,885
Timber Forest	Enrich-ment	Area		40	40	40	40	40	40	40
		Cost		1,904	1,904	1,904	1,904	1,904	1,904	1,904
Total Cost			108,885	120,459	120,459	120,459	120,449	120,449	120,449	120,449

Note. 1. New planting of fuelwood forest shall be carried out at a planting density of 2,500 trees/ha at a cost of 595,000FCFA per hectare. Although regeneration through germination shall be carried out five times, planting costs shall be calculated in the first cutting period. Enrichment through the direct planting of seed shall be carried out in the first cutting period with regeneration taking place through germination. The cost of direct sowing is 10,000FCFA per hectare.

2. Enrichment shall be carried out on half of the cutting area of the timber forest.

(c) Management Costs

Management costs include labor costs for one specialist technician and one technical assistant, as well as vehicle-related costs. On an annual basis this equates to 12 million FCFA for the specialist technician and 2.4 million FCFA for the technical assistant.

Table 4-7-9 Annual Management Costs

(Unit: 1,000FCFA)

Item	1st~10th Years
Labor Costs	14,400
Vehicle-related Costs	8,160
Total	22,560

④ Income

(a) Income from the Sale of Timber

Income is obtained from the sale of timber and fuelwood. Timber is sold as logs at a price of 26,800FCFA per m^3. Fuelwood is sold at a price of 5,000FCFA per m^3. Annual income from the sale of timber and fuelwood is shown in Table 4-7-10.

Table 4-7-10 Income from the Sale of Timber

Category		1st~2nd Year	3rd~5th Year	6th~9th Year	10th Year
Timber	Volume (m^3)	6,896	8,358	8,351	8,351
	Price (1,000FCFA)	184,813	223,994	223,807	223,807
Fuelwood	Volume (m^3)	10,345	12,538	12,526	12,526
	Price (1,000FCFA)	51,725	62,690	62,630	62,630
Fuelwood (man-made forest)	Volume (m^3)				4,026
	Price (1,000FCFA)				20,130
Total		236,538	286,684	286,437	306,567

(b) Collection of Levies from Beneficiaries

a) Fees for the Use of Cultivated Land within the Village Forestry Zone

Three years after improvement activities have been completed, cultivation activities will commence on half of the 3,920ha of land for use by the local inhabitants within the Village Forestry Zone. As annual fees per head of cattle are 300FCFA, this will amount to a total of 3.92 million FCFA.

b) Fees for Grazing in the Silvi-Pastoral Zone

Grazing will be commenced in the Silvi-Pastoral Zone from the fourth year after improvement activities have been completed. If a maximum of 9,963 head of cattle are able to graze in the Silvi-Pastoral Zone, as the annual grazing fee per head of cattle is 300FCFA, this will amount to an annual total of 2,988,900FCFA.

c) Income from the Sale of Posts

Half of the 3,920ha of land for use by local inhabitants within the Village Forestry Zone will be used for post production. Post production will commence from the eighth year with an annual production volume of 980,000 posts. As the price per post is 150FCFA this will amount to annual sales of 14,700,000FCFA. As there is a levy on income from sales of 20%, this will amount to an annual total of 29,400,000FCFA.

⑤ Table showing Overall Activity Costs

The above-mentioned activity costs and income are shown in Table 4-7-11. This table is divided into initial investment, which includes infrastructure improvement costs and classified forest improvement costs, and the Forest Improvement Fund which will be implemented and operated in the future by the local inhabitants and includes forest improvement costs, etc.

The following is an explanation of the Forest Improvement Fund.

(a) Loans and Repayments

Loans will be taken out to cover production forest planting costs during the third to tenth years.

As regeneration through germination shall be conducted a total of five times in fuelwood forest from the eleventh year, 1/5 of annual planting costs will be repaid each year. Since this is a rough estimate the interest is not calculated.

(b) Planting Preparation Fund

In order to carry out enrichment of timber forest and fuelwood forest on a continual basis, an enrichment preparation fund shall be formed each year after the start of activities in the fourth year for the implementation of such activities from the eleventh year. Furthermore, as it will be necessary to again carry out new planting after the fifth regeneration through germination in newly planted areas of fuelwood forest, 1/5 of annual planting costs will be set aside each year as a fuelwood forest planting preparation fund after the start of activities in the third year.

(c) National Forest Fund

After production costs and tax have been deducted from the income from sale of timber produced, 90% of profit shall be paid to the Forest Improvement Fund with the remaining 10% being paid to the National Forest Fund.

In Table 4-7-11, 10% of the profit after forest improvement activity costs (timber production costs, production forest planting costs, planting preparation fund, planting cost repayments, and management and operation costs) have been deducted from income from the sale of timber and loans is paid to the National Forest Fund. No payment shall be made to the National Forest Fund when there is no profit.

(d) Management Costs associated with Organizations of Local Inhabitants

a) Preparation Fund

A preparation fund shall be established to cover necessary expenses arising from activities carried out mainly by organizations of local inhabitants in the Village Forestry Zone and the Silvi-Pastoral Zone and to cover expenses arising from related infrastructure improvement, etc.

b) Fee Collection Costs

20% of the fees collected from beneficiaries shall be paid to the collectors of such fees.

Table 4-7-11 Operation (Activity) Costs

(Unit: 1,000FCFA)

Fiscal Year					1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year	8th Year	9th Year	10th Year	Total
Initial Investment	Infrastructure Improvement Costs				253,125	704,688	198,125	110,625	110,625	110,625	110,625	110,625	110,625	110,625	1,930,313
	Classified Forest Improvement Costs	Conservation Forest Restoration						115,586	115,586	115,686	92,725				439,583
		Planting of Boundaries and Belts of Fire-Resistant Trees					5,093								5,093
		Establishment of Boundaries			50,891	32,872									83,763
	Total				304,016	737,560	203,218	226,211	226,211	226,311	203,350	110,625	110,625	110,625	2,458,752
Forest Improvement Fund	Income	Income from the Sale of Timber			236,538	236,538	286,684	286,684	286,684	286,437	286,437	286,437	286,437	306,567	2,785,443
		Fees from Beneficiaries					3,920	6,909	6,909	6,909	6,909	36,309	36,309	36,309	140,483
		Loans					108,885	120,459	120,459	120,459	120,449	120,449	120,449	120,449	952,058
		Total Income			236,538	236,538	399,489	414,052	414,052	413,805	413,795	443,195	443,195	463,325	3,877,984
	Expenditure	Forest Improvement Activity Costs	Timber Production Costs	Village Forestry Zone/Silvi-Pastoral Zone	172,410	172,410									344,820
				Production Forest			208,960	208,960	208,960	208,770	208,770	208,770	208,770	212,796	1,674,756
			Production Forest Planting Costs	Enrichment				11,574	11,574	11,574	11,564	11,564	11,564	11,564	80,978
				New Planting in Fuelwood Forest			108,885	108,885	108,885	108,885	108,885	108,885	108,885	108,885	871,080
				Subtotal			108,885	120,459	120,459	120,459	120,449	120,449	120,449	120,449	952,058
			Enrichment Preparation Fund					11,574	11,574	11,574	11,564	11,564	11,564	11,564	80,978
			Fuelwood Forest New Planting Preparation Fund				21,777	21,777	21,777	21,777	21,777	21,777	21,777	21,777	174,216
			Planting Cost Repayments				21,777	24,091	24,091	24,091	24,091	24,091	24,091	24,091	190,414
			Management/Operating Costs		22,560	22,560	22,560	22,560	22,560	22,560	22,560	22,560	22,560	22,560	225,600
			Subtotal		194,970	194,970	383,959	409,421	409,421	409,231	409,211	409,211	409,211	413,237	3,642,842
		National Forest Fund			4,157	4,157	1,161	0	0	0	0	0	0	1,378	10,853
		Management Costs for Organizations of Local Inhabitants		Preparation Fund	37,411	37,411	13,585	3,249	3,249	3,192	3,202	26,722	26,722	41,448	196,191
				Fee Collection Costs			784	1,382	1,382	1,382	1,382	7,262	7,262	7,262	28,098
				Total	37,411	37,411	14,369	4,631	4,631	4,574	4,584	33,984	33,984	48,710	224,289
		Total Expenditure			236,538	236,538	399,489	414,052	414,052	413,805	413,795	443,195	443,195	463,325	3,877,984
	Balance				0	0	0	0	0	0	0	0	0	0	0

4.8 Extension and Training Plans

Existing extension activities are carried out under the jurisdiction of the Extension Bureau of the CARDER and are focussed around commercial farming techniques. Under this system the relevant officer from the branch office of each region (Extension Officer) trains groups of farmers (GV), women (GF) and outstanding farmers regarding knowledge and techniques, after which the GV and GF share the techniques with other farmers.

Under this plan, new techniques for forest improvement are introduced through local organizations, with extension and training basically being carried out in one of the following two ways.

The first is through direct individual training of local inhabitants by Extension Officers of the DFRN or the Extension Bureau (Type 1).

The other is through the initial selection of model producers with an interest in new techniques by the DFRN or the Extension Bureau, followed by priority training after which the concepts involved spread to the local inhabitants through the model producer (Type 2).

With regard to nurseries, bee-keeping and charcoal production, as the number of people and the area involved is somewhat limited, Type 1 training is mainly used. However, with commercial farming and livestock, due to the large number of people involved and the fact that the introduction of new techniques is essential for the preservation of the forest, which is the main purpose of these plans, training is carried out using both types of training.

The two basic types of extension and training are shown below.

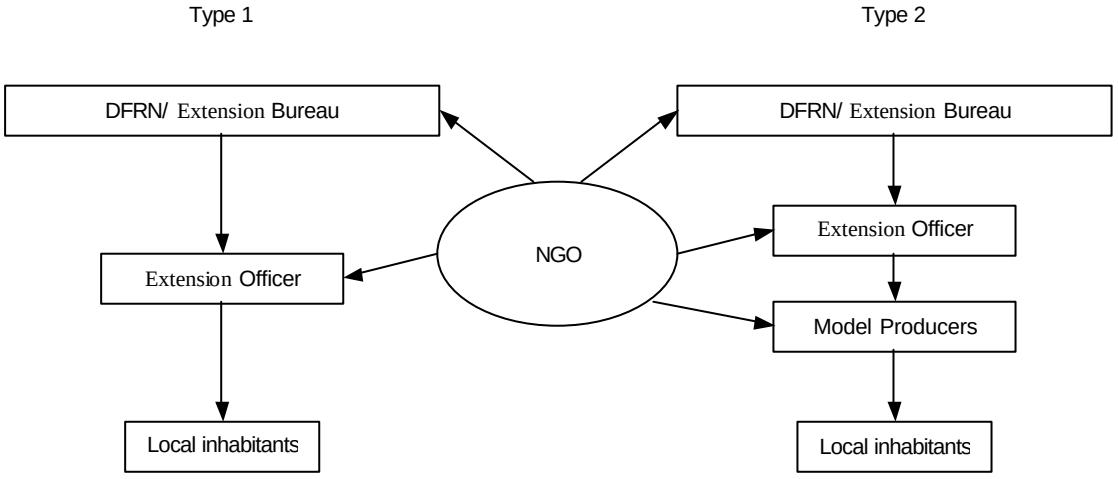


Figure 4-8-1 Main Types of Extension and Training

In order to overcome the shortage of staff in the DFRN and the Extension Bureau, extension officers will be trained in various types of new technology. Extension officers will train the representatives and leaders of local organizations and model producers after which the representatives and leaders of local organizations and the model producers will become the direct means of extension to the next generation.

(1) Nurseries

Seedlings for planting in the classified forest and buffer zones shall all be produced by local inhabitants in newly established village nurseries growing native species, introduced species and a diverse range of fruit trees. As local inhabitants have little experience with regard to seedling production, technicians from the DFRN will give instructions when land for nurseries

is selected in each of the villages where the establishment of such nurseries is planned. Hands-on training and instruction of local inhabitants will be carried out with regard to such areas of nursery operation as the preparation of seedbeds, the raising of seedlings, and the production of seedbeds for mountain areas, etc. Furthermore, training of nursery officers within local organizations will also be carried out.

(2) Bee-Keeping

Beekeeping will be introduced and actively encouraged in the Village Forestry Zone and the Buffer Zone as a means of diversifying the income of local inhabitants. In order to achieve this goal, it is necessary to improve traditional collection methods, plant trees which are a source of nectar, and introduce modern bee-keeping systems.

Extension and training of local inhabitants will be carried out with the assistance of the NGO Bee-Keeping Center in Parakou. Firstly the usefulness of modern bee-keeping systems will be introduced after which more specialized training of interested people will be carried out.

(3) Charcoal Production

With the exception of metropolitan areas the use of charcoal is limited and it is necessary to propagate the idea of using charcoal as a fuel in place of fuelwood. Therefore, a simple charcoal kiln will be introduced into a typical village as a pilot scheme, charcoal produced, and the use of locally produced charcoal encouraged. In addition, if fuelwood can be produced in the Village Forestry Zone, in addition to local consumption it can also be used to produce charcoal for sale elsewhere.

(4) Commercial Farming

Pilot farms will be established by model farmers, training carried out in the various types of commercial farming, the effect of improvements shown on-site, appropriate techniques developed and then propagated throughout the entire local area. Furthermore, the network of NGOs, etc. will be used in order to enable farmers in each improvement unit to exchange techniques with farmers in leading areas.

Details regarding new techniques and training topics for commercial farming improvement are as follows.

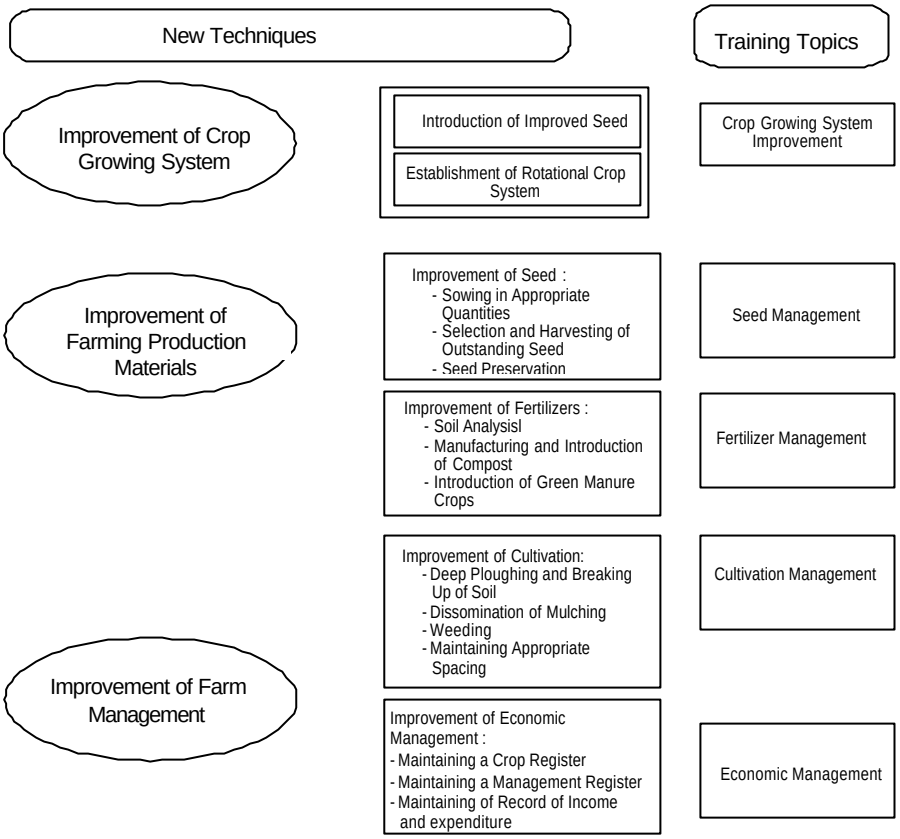


Figure 4-8-2 Training Topics for Commercial Farming Improvement

(5) Livestock Raising

Details regarding new techniques and training topics for the improvement of breeding techniques, rearing techniques and livestock management are as follows.

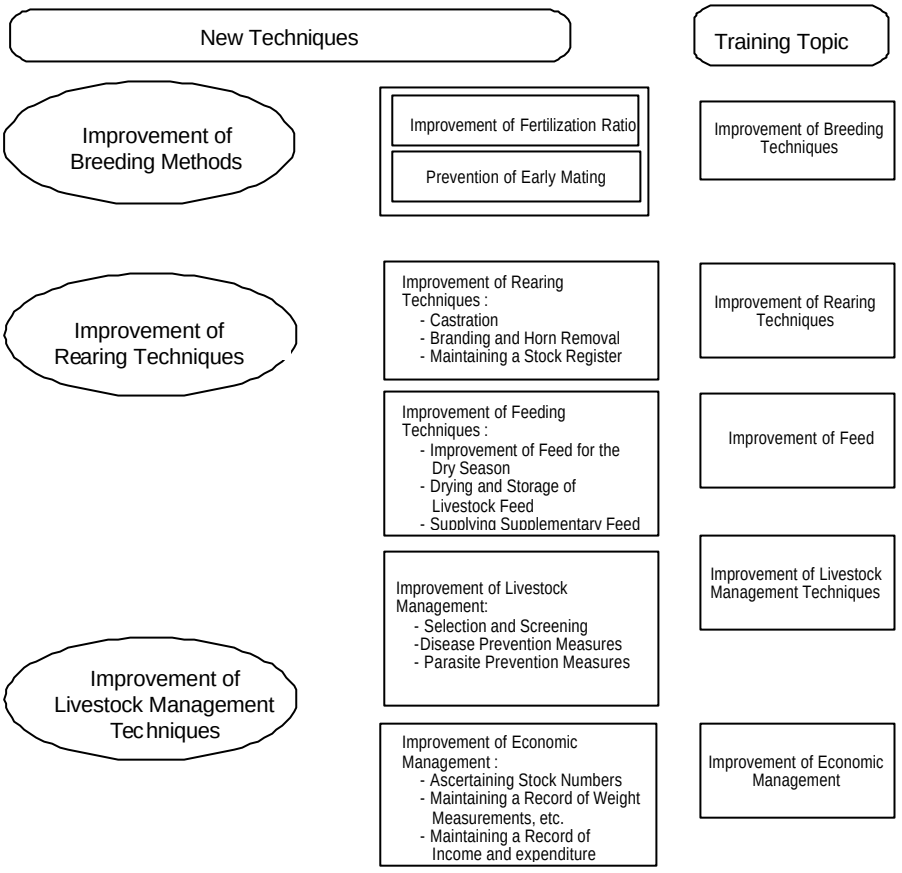


Figure 4-8-3 Livestock Raising Training Topics

RECOMMENDATIONS

Recommendations

Forest improvement activities based on forest management plans shall be implemented in accordance with the contract signed by the Department of Forest and Natural Resources(DFRN) of the Ministry of Rural Development, and organizations of local inhabitants. Although the aim of forest improvement activities, whereby organizations of local inhabitants carry out the management, operation and maintenance of forest management activities, is to eventually see such organizations become independent, this will require the total support of the Ministry of Rural Development, the DFRN and related institutions until sustainable management and operations can be achieved. Matters that the Republic of Benin should give attention to with regard to the implementation of these improvement activities are as follows.

1. The Forest Law determines that forest improvement plans for areas of classified forest shall be carried out with the assistance of the local inhabitants. Therefore, the implementation of forest improvement activities shall be carried out mainly by the local inhabitants themselves. Under the provisions of this plan, a Forest Management Communications Council shall be established at the provincial level, a Forest Management Council established at the district level, and a Forest Improvement Unit Committee established on the settlement level, with Forest Development Community Groups and zone groups being established at the settlement level. Although there are many organizations of local inhabitants already existing within the target settlements, as nobody has any experience in operating an organization with the aim of forest conservation, the DFRN shall assign a full-time technician. The technician shall provide organizations of local inhabitants with overall guidance and advice with regard to the formulation and implementation of annual work plans based on forest improvement plans, and with regard to the collection of payments to the Forest Improvement Fund, the management of savings and the preparation of budgets, etc.

2. Under the forest management plan, a Village Forestry Zone for use by the local inhabitants and a Silvi-Pastoral Zone were established. In the Village Forestry Zone, areas are designated for use by the local inhabitants and a transition shall be made from shifting cultivation to fixed cultivation. In the Silvi-Pastoral Zone, land for grazing has been determined and managed grazing and feed shall be introduced. With both farming and livestock raising, the local inhabitants will be forced to make the transition from the extensive production methods, which they have relied on in the past, to intensive production methods. As this intensification is something new to the local inhabitants, there is the urgent and essential need for extension and training to be carried out for organizations of local inhabitants and individual producers to ensure the rapid, smooth and successful transition to intensive production methods. Therefore, the DFRN and the Agriculture Administration Bureau shall carry out extension Improvement Fund and training regarding the implementation of new technology, such as the introduction of fertilizer, the use of improved species, the improvement of pasture, and the stall feeding, etc. NGOs, etc. shall be utilized for areas that the DFRN and Agriculture Administration Bureau are unable to cover, such as beekeeping and charcoal production. The cost of carrying out such extension activities and training shall be paid by the government of Benin until the Forest Improvement Fund is able to support such activities.

3. In order to stabilize the lifestyle of the local inhabitants, it is necessary to improve the systems that they have relied on in the past and to help them to diversify their income. Therefore, although the development of sources of income such as beekeeping, livestock raising, soap production, and karitè butter, etc. is being planned, especially for women, small amounts of money are needed to buy the equipment necessary to carry out such production activities. Means of providing such small-scale loans include the introduction of micro-credit or the existing CLCAM. Micro-credit is not funded by the government but a fund is created through

the investment of supporters endorsed by the village investing in the fund. However, in order to the local inhabitants to improve access to and use of the Village Forestry Zone for the implementation of these improvement activities, it is difficult for them to gather micro-credit supporters and secure investments. Therefore, the government of Benin shall provide financial support for micro-credit for at least the first cutting cycle until such activities are up and running. The local farmers' credit union requires deposits as security for loans, which make the system difficult for the low-income bracket to use. Therefore, the government of Benin shall implement a support system that is able to be easily used even by the low income bracket in order to provide loans of small amounts.

4. Existing GVs are currently acting as the focus for the activities and operation of organizations of local inhabitants. However, as the organizations of local inhabitants proposed by this plan act as the vehicle for comprehensive settlement development, such as the improvement, etc. of commercial farming and livestock raising that aims to preserve the forest, an animator from an NGOs, etc., with experience in the field of settlement development shall be assigned to work with each full-time technician from the DFRN to provide support to enable the local inhabitants themselves to be able to carry out the operation of organizations.

5. In order to successfully carry out improvement activities, it is important to stabilize the economic foundation of the local inhabitants who will be the major vehicle through which such activities will be carried out. The first step is to move local inhabitants with cultivated land in the existing Forestry Zone and Silvi-Pastoral Zone to their designated areas within the Village Forestry Zone and to establish them there and help them to grow food crops as soon as possible. That means that the very first priority is to establish areas of land for use by the local inhabitants, establish the boundaries of the classified forest, establish the boundaries of each improvement unit and zone, and carry out activities such as the logging, etc. of land for improvement within the Village Forestry Zone and the Silvi-Pastoral Zone in order for the local inhabitants to be able to move and establish themselves. This in turn means that the government of Benin must budget sufficient funds to be able to cover such improvement expenses.

6. The aim of the forest management plan is the conservation of the classified forest. As improvement activities are to be implemented with the participation of the local inhabitants, it is first necessary to stabilize the lifestyles of the local inhabitants. However, although not directly related to the local inhabitants themselves, infrastructure improvement activities need to be carried out, such as the planting of trees on the boundary of the classified forest, the creation of fire-resistant belts of trees, the restoration and recovery of areas of forest within the classified forest, and the construction of watchtowers, roads and the Forest Improvement Center, etc. The development and improvement of such facilities, etc. is the first activity that will require initial investment and requires the raising of separate funds. Means of acquiring such funds include incorporating of this amount within the budget of the government of Benin or the appropriation of funds from the State Forest Fund. Another possibility is to seek the assistance of foreign aid institutions.

7. It could be said that the basic data regarding forest activities (livestock rearing, planting, growth and regeneration), commercial farming improvement and silvi-pastoral, etc. required for the formulation and implementation of improvement plans for the classified forest in Benin is inadequate. The collection of such data requires long period of time and continuous experiment and research and the accumulation of basic data from the establishment of local permanent experimental sites as part of the implementation of this forest improvement plan is necessary.

TRANSFER OF TECHNOLOGY

1. Acceptance of Trainees

During the time that this survey was being carried out the following trainees were brought to Japan and trained.

Name	Training Topic	Training Period
Emmanuel TONI	Forest Management Plan	March 1, 1999~March 27, 1999
Latifou LEFFI SALIFOU	Forest Management Plan	March 1, 1999~March 27, 1999
Coffi Roger HESSOU	Social Forestry	August 30, 1999~October 2, 1999
Joseph Vincent MAMA	Forest Management Plan	September 15, 1999~October 2, 1999

2. On-the-Job Training (OJT)

During the time that the field survey was being carried out in Benin, OJT was carried out of the following counterparts. Details regarding the transfer of technology can be found in the OJT Implementation Table.

Name	Affiliation
Alioune Sylla ALADJI BONI	Directeur des Forêts et des Ressources Naturelles (DFRN)
Emmanuel BOSSOU	Directeur adjoint de la DFRN
Vincent Joseph MAMA	Directeur du CENATEL(Centre National de Télédétection et de Surveillance du Couvert Forestier)
Comlan HESSOU	Chef Unité de Suivi Ecologique, CENATEL
Emmanuel TONI	Assistant Chef Unité Suivi Ecologique, CENATEL
Félix TOSSOU	Chef Unité Production et Laboratoire Photographique, CENATEL
Chabi Yarou BAGUIDI	Chef Unité Traitement d'Image et Système d'Information Géographique, CENATEL
Latifou S. LEFFI	Assistant Chef Unité Géographique et Cartographique, CENATEL
Pascal AKPASSONOU	Unité Géographique et Cartographique, CENATEL
Félix HOUETO	Unité Géographique et Cartographique, CENATEL
Raphaël TETE	Unité Géographique et Cartographique, CENATEL
Pierre ALLE	Service Gestion et Reconstitution des Ressources Naturelles(SGRRN), DFRN
Béri N'Douro OROU GNABE	Directeur des Forêts et de la Protection des Ressources Naturelles-Borgou
Coffi Roger HESSOU	Chef Service Etude des Ressources Naturelles, DFPRN-Borgou
Gauthier OLONI	Chef Service Suivi et Protection des Ressources Naturelles, DFPRN-Borgou
François FADJEBE	Chef Cantonnement KANDI
Yaou Basile COFFI	Chef Cantonnement KANDI
Isidore A. AKPAKI	Technicien Spécialisé en Foresterie du Secteur de GOGOUNOU, DFPRN, CARDER-Borgou
Ibrahim Y. GATTA	Technicien Spécialisé en Foresterie du Secteur de BEMBEREKE, DFPRN, CARDER-Borgou

OJT Implementation

Category	Details	Important Matters	Period
Forest Management Plan	1. Basic concept, procedures and methods for the formulation of a forest management plan to be implemented together with the local inhabitants.	· Concept of the forest management plan. · Land use and zoning. · Forest operation and utilization plans. · Forest management and implementation structures.	Oct. 1998 ~ Nov. 2000
Social Forestry	1. Methods for surveys and analysis of social forestry. 2. Procedures and methods for the formulation of a forest management plan to be implemented together with the local inhabitants.	· Mixed farming, grazing and forestry methods · Hunting, fish farming and bee-keeping methods. · Improvement and operation of village nurseries. · Zoning from the standpoint of social forestry. · Social forestry plans.	Dec. 1998 ~ Nov. 2000
Forest Survey/Environment	1. Methods of interpreting aerial photographs and creating maps showing land use and vegetation. 2. Methods of surveying and analyzing forests using aerial photographs. 3. Environmental survey. 4. Methods of establishing boundaries.	· Aerial photograph interpretation techniques. · Methods of transferring the results of photo interpretation to maps. · Forest survey methods. · Zoning from the standpoint of protecting the forest environment. · Methods of plotting local pricking points on aerial photographs.	Nov. 1998 ~ Aug. 2000
Socioeconomic/Participation of Local Inhabitants	1. Methods of carrying out and analyzing surveys of the local inhabitants (questionnaire, RRA, PRA). 2. Procedures and methods for the formulation of a forest management plan to be implemented together with the local inhabitants.	· Methods of surveying the state of the local inhabitants. · Zoning from the standpoint of the needs of the local inhabitants. · Organization of the local inhabitants. · Plans for supporting the lives of local inhabitants.	Oct. 1998 ~ Nov. 2000
Farming	1. Methods of carrying out surveys and analysis regarding farming and livestock rearing. 2. Procedures and methods for the formulation of a forest management plan (farming) to be implemented together with the local inhabitants.	· Methods of surveying the farming and livestock industries. · Methods of cultivation and grazing. · Zoning from the standpoint of the farming and livestock industries. · Plans for the farming and livestock industries.	Oct. 1998 ~ Nov. 2000
Soil Survey	1. Methods of carrying out soil surveys and analysis. 2. Methods of creating soil maps.	· Soil and land productivity.	May ~ July 1999
Aerial Photographs	1. Methods of taking and processing aerial photographs. 2. Methods of creating mosaic photographs.		Oct. 1998 ~Jan. 1999
Surveying/Cartography	1. Methods of carrying out land-based surveying.		Jan. ~ May 1999
GIS	1. Consideration of the specifications of the GIS system. 2. Methods of managing, operating and administrating the GIS system.		Dec. 1998 ~ July 2000

3. Technical Training Seminars

During the time in which the 2nd Field Survey was being carried out, a technical training seminar was held by the Survey Team in Parakou from May 3~4, 1999.

(1) Training Topics

Theme	Details
Forest Survey	Survey design, the implementation of field surveys and methods of collating survey results.
Interpretation of Aerial Photographs	Interpretation methods for land use/vegetation and forest type. Methods of transferring the results of photo interpretation to maps.
Surveys regarding the Lives of the Local Inhabitants	The participation approach to surveys to ascertain the state of the local inhabitants in order to formulate forest improvement plans.

(2) Participants

Name	Affiliation
Vincent Joseph MAMA	Directeur du CENATEL
Comlan HESSOU	Chef Unité de Suivi Ecologique, CENATEL
Emmanuel TONI	Assistant Chef Unité de Suivi Ecologique, CENATEL
Béri N'Douro OROU GNABE	Directeur des Forêts et de la Protection des Ressources Naturelles-Borgou
Coffi Roger HESSOU	Chef Service Etude des Ressources Naturelles, DFPRN-Borgou
Gauthier OLONI	Chef Service Suivi et Protection des Ressources Naturelles, DFPRN-Borgou
Yaou Basile COFFI	Chef Cantonnement Kandi
Augustin SINA BIO	Chef Cantonnement Parakou
Isidore A. AKPAKI	Technicien Spécialisé en Foresterie du Secteur de Gogounou, DFPRN, CARDER-Borgou
Ibrahim Y. GATTA	Technicien Spécialisé en Foresterie du Secteur de Bembéréké, DFPRN, CARDER-Borgou
Mahouna B. TCHIWANOU	Responsable du VAF du PGRN

4. Technology Transfer Seminar

A seminar for the transfer of technology was held in both Cotonou and Parakou during the 5th Field Survey.

(1) Cotonou Seminar

① Date: October 31, 2000
② Location: Hotel Sheraton
③ Theme:
- The classified forest improvement policies of the government of Benin.
- The formulation of forest management plans.
- Forest surveys and GIS.
- The participatory approach through socioeconomic surveys.
- The improvement of commercial farming and livestock rearing.

④ Participants

A total of 40 people from the Ministry of Planning, the Ministry of Foreign Affairs and Cooperation, the Ministry of Environment, Housing and Urban Planning, the Ministry of Rural Development,

Benin National University, the United Nations Development Plan (UNDP), and the UN's Food and Agriculture Organization (FAO) attended the seminar.

(2) Parakou Seminar

① Date: November 3, 2000
② Location: Borgu Province Agricultural Administration Bureau
③ Theme:
- Improvement measures for the Trois-Rivières Classified Forest.
- Participatory forest management.
- Participatory approach through socioeconomic surveys.
- The results of Trois-Rivières Classified Forest Management Plans.
- The content of Trois-Rivières Classified Forest Village Forestry Zone and Silvi-Pastoral Zone Improvement Plans.

④ Participants

A total of 46 people from the Borgou Province Agricultural Administration Bureau, the Ministry of Housing and Urban Planning, the Atacora Province Agricultural Administration Bureau, the UNSO Project, SONAPRA, NGOs, and Swiss assistance institutions attended the seminar.

PRINCIPAL RELATED PERSONS AND ORGANIZATIONS

Principal Related Persons and Organizations

1. Japanese Side

Study Team

Name	Responsibility	1	2	3	4	5
Suehiko FUJIMORI	Team Leader／Forest Management Plan	○	○			
Yutaka TAGUCHI	Team Leader／Forest Management Plan			○	○	○
Tadao OHARA	Social Forestry	○	○	○	○	○
Tsutomu YOSHIMURA	Forest Survey／Environment	○	○	○	○	
Shu MIZUSHINA	Socio-economy／Peaple's Participation	○	○	○	○	○
Ken KOZAI	Agriculture	○	○	○	○	○
Misao KAWAMURA	Forest Survey	○				
Jiro YOSHIOKA	Soil Survey		○			
Yasuhiko TSUKAMOTO	Aerial Photography	○				
Katsuhiko YAMASHITA	Surveying/Mapping	○				
Kiichiro NISHIOKA	GIS	○			○	
Takayuki OOKUBO	Study Coordination	○				
Tomoyuki OTANI	Interpreter	○	○	○	○	○

1: First Field Survey (12 October, 1998 ~ 8 March, 1999)
2: Second Field Survey (26 April, 1999 ~ 11 July, 1999)
3: Third Field Survey (31 October, 1999 ~ 24 December, 1999)
4: Fourth Field Survey (4 June, 2000 ~ 11 August, 2000)
5: Fifth Field Survey (26 October, 2000 ~ 10 November, 2000)

Advisory Team

Name	Responsibility	1	2	3	4	5
Yoshio HIRONAKA	Advisory Team Leader	○				
Takashi KATO	Advisory Team Member			○		○
Yukihide KATSUTA	Study Supervision					○
Jun YOKOYAMA	Study Supervision	○			○	

1: First Field Survey: (12 October, 1998 ~ 25 October, 1998)
3: Third Field Survey: (4 November, 1999 ~ 17 November, 1999)
4: Fourth Field Survey:(4 June, 2000 ~ 15 June, 2000)
5:Fifth Field Survey: (26 October, 2000 ~ 10 November, 2000)

Benin Side

Name	Organization	1	2	3	4	5
Alioune Sylla ALADJI BONI	Directeur des Forêts et des Ressources Naturelles (DFRN)	○	○	○	○	
Emmanuel BOSSOU	Directeur adjoint de la DFRN	○	○	○		
Joseph Vincent MAMA	Directeur du CENATEL(Centre National de Télédétection et de Surveillance du Couvert Forestier)	○	○	○	○	
Comlan HESSOU	Chef Unité de Suivi Ecologique, CENATEL	○	○	○	○	
Emmanuel TONI	Assistant Chef Unité Suivi Ecologique, CENATEL	○	○	○	○	
Félix TOSSOU	Chef Unité Production et Laboratoire Photographique, CENATEL		○			
Chabi Yarou BAGUIDI	Chef Unité Traitement d'Image et Système d'Information Géographique, CENATEL	○	○		○	
Latifou S. LEFFI	Assistant Chef Unité Géographique et Cartographique, CENATEL	○			○	
Pascal AKPASSONOU	Unité Géographique et Cartographique, CENATEL				○	
Félix HOUETO	Unité Géographique et Cartographique, CENATEL				○	
Raphaël TETE	Unité Géographique et Cartographique, CENATEL				○	
Pierre ALLE	Service Gestion et Reconstitution des Ressources Naturelles(SGRRN), DFRN	○				
Béri N'Douro OROU GNABE	Directeur des Forêts et de la Protection des Ressources Naturelles	○	○	○	○	
Coffi Roger HESSOU	Chef Service Etude des Ressources Naturelles, DFPRN	○	○	○	○	
Gauthier OLONI	Chef Service Suivi et Protection des Ressources Naturelles, DFPRN		○			
François FADJEBE	Chef Cantonnement KANDI	○				
Yaou Basile COFFI	Chef Cantonnement KANDI		○	○	○	
Isidore A. AKPAKI	Technicien Spécialisé en Foresterie du Secteur de GOGOUNOU, DFPRN, CARDER	○	○	○		
Ibrahim Y. GATTA	Technicien Spécialisé en Foresterie du Secteur de BEMBEREKE, DFPRN, CARDER	○	○	○		

1: First Field Survey
2: Second Field Survey
3: Third Field Survey
4: Fourth Field Survey
5: Fifth Field Survey

Persons Contacted/Interviewed in Benin

Ministry of Foreign Affers and Cooperation	
Coffi Mamert RANDOLPH	Directeur du Département Asie et Océanie
Moussa SALIFOU	Directeur adjoint du Département Asie et Océanie
Kouessopa Victor TCHOROMI	Département Asie et Océanie
Naïm AKIBOU	Chef de Service de la Coopération avec le Japon du Département Asie et Océanie
MINISTERE DU DEVELOPPEMENT RURAL	
Saley SAKA	Ministre
Saley IMOROU	Sécrétaire Général
Soulé MANIGUI	Directeur de la Programmation et de la Prospective
Sanni DOKO ALLOU	Direction de la Programmation et de la Prospective
Mahouna B. TCHIWANOU	Responsible du Volet Aménagement Forestier du Projet de Gestion des Ressources Naturelles (PGRN)
DEPARTEMENT DU BORGOU	
Zourkarneyni TOUNGOUH	Préfet
Eualie SAGBO	Secrétaire Général
Orou Gabé OROU SEGO	Directeur Général du CARDER
Nathaniel ADJAOKE	Directeur de l'Aménagement et l'Equipement Rural, CARDER (Intérimaire du Directeur Général)
Gounou N'gobi Orou	Directeur de la Vulgarisation et l'Appui aux Organisations Paysanes, CARDER (Intérimaire du Directeur Général)
Pierre YAKPON	Agent Spécialisé en Recherche-Dévelopement, Direction Vulgarisation et Appui aux Organisations Paysanes, CARDER
Koffi VISSOH	Chef Service Contrôle Vétérinaire et Denrées Animales, Direction du Contrôle Vétérinaire et Phytosaniaitre, CARDER
Césaire P. GNANGLE	Responsable du Développement Rural du Secteur de BEMBEREKE
Sabi FERI BAH-SARE	Responsable du Développement Rural du Secteur de GOGOUNOU
Issa GUIMA	Sous-Préfet de GOGOUNOU
Abdouaye A. BAKARI	Sous-Préfet de BEMBEREKE
Alazi GOUDA	Sous-Préfet de MALANVILLE
Oumarou ZIKA	Responsable du Dévelopement Rural du Secteur de MALANVILLE
Emmanuel GABA	Technicien Spécialisé en Foresterie du Secteur de MALANVILLE
Léon Yaou ZOUNDOH	Responsable du Projet UNSO
DEPARTEMENT DE L'ATACORA	
Edouard A. OUIN-OURO	Préfet

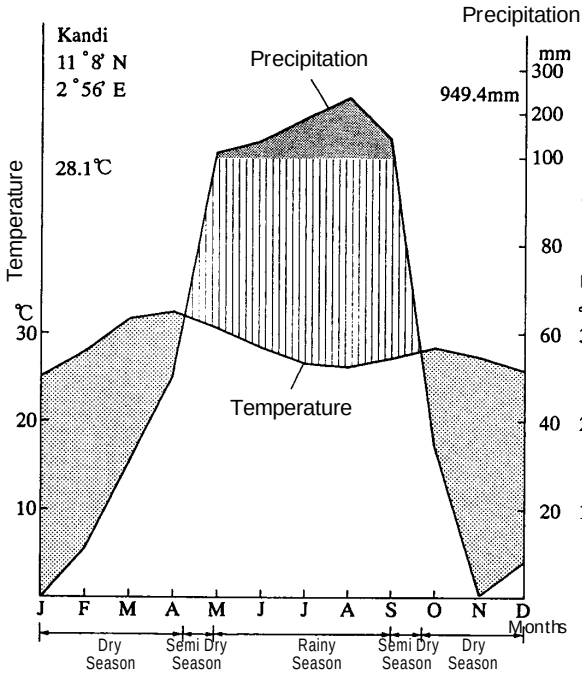
Tiomoko DJAFAROU	Directeur des Forêts et de la Protection des Ressources Naturelles, CARDER
Rogatien C. AFFOUDA	Respnsable du Développement Rural du Secteur de KEROU
Jean HAGNIKOU	Agent forestier du Secteur de KEROU
Sarre DJORI WOROU	Sous-Préfet de KEROU
Narou N'GOBI CHA-TOKO	Sous-Préfet de PEHUNCO

Embassy of Japan, Ivory Coast	
Masaki NOKE	Counsellor
Kiyomi TONESAKU	Second Secretary
Yoshifumi HIMENO	Second Secretary

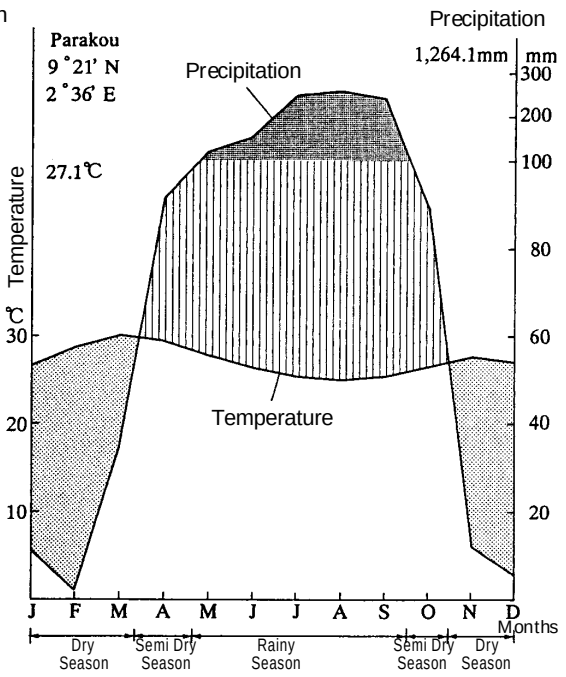
JICA Office, Ivory Coast	
Noriko ABE	Resident Representative
Seiichi KANAI	Resident Representative
Masamichi AOKI	Deputy Res. Rep
Koichi SASADATE	Staff
Aki MATSUNAGA	Staff
Kaori SANJO	Staff

APPENDIX

Contents



Appendix-1: Weather Diagram for Kandi



Appendix-2: Weather Diagram for Parakou

Appendix-3: Population by District

District	Population (person)			Number of households (household)	Household Size (pers./household)
	Male	Female	Total		
Bembéréké	30,377	29,432	59,809	6,540	9.1
Gogounou	25,039	25,006	50,045	5,600	8.9
Kalalé	31,467	31,338	62,805	6,269	10.0
Segbana	16,154	16,117	32,271	3,666	8.8
Sinendé	20,670	20,099	40,769	3,887	10.5
Total	123,707	121,992	245,699	25,962	9.5

Source: Second General Census of the Population and the Habitat, February 1992 -- Population of Borgou

Appendix-4: Ratio of Working Population by District and by Industry

(unit: %)

Industry Sector	Bembéréké	Gogounou	Kalalé	Segbana	Sinendé	Average of 5 Districts
Agriculture, hunting, fishing	56.6	61.7	75.8	85.2	78.1	71.5
Manufacturing industry	6.6	8.7	4.8	2.0	2.3	4.9
Construction industry	2.5	3.0	1.4	1.0	0.1	1.6
Commerce-hotels	10.2	15.9	6.9	5.3	16.8	11.0
Transport-communication	2.1	2.4	1.2	0.9	0.4	1.4
Other services*	22.0	8.3	9.9	5.6	2.3	9.6

Note: Source is "Atlas Monogrpahique." Figures for "Other services" were rounded off to obtain a total of 100%.

Appendix-5: Current Situation of Water Supply Source by District

Water Supply Source	Bembéréké	Gogounou*	Kalalé	Segbana	Sinendé
River		-	1	1	1
Spring	1	-	4		3
Pump	71	-	37	40	22
Improved wells	45	-	66	61	9
Unimproved wells	51	-	70	23	126
Tank	4	-			
Running water	13 km	-		8 km	

Source: Atlas Monographique

* There are no data for the Gogounou District.

Appendix-6: Situation of Various Public Facilities by District

Facility	Bémbéréké	Gogounou	Kalalé	Segbana	Sinendé
Primary school	25	22	25	21	16
Secondary school	2	1	1	1	1
Center for elimination of illiteracy		1		15	
Hospital	1				
District health center (CSSP)	1	1	1	1	1
Commune health center (CCS)	4		5	4	3
Pharmacy	4	1	3		1
Center for social advancement (CPS)	1		1	1	
Cultural facilities*	2	1	1	6	1

Source: Atlas Monographique

Note*: Except Segbana, the facilities are houses of young people.
For Segbana, 5 centers of reading and 1 village center.

Appendix-7: Land Area of the Plantations (1996-1998)

(Unit：ha, %)

District / Tree species	GOGOUNOU			BEMBEREKE			SINENDE			SEGBANA			KALALE			Total of 5 Districts				
	96	97	98	96	97	98	96	97	98	96	97	98	96	97	98	96	97	98	Total	Ratio
Teak	2.6	13.0	11.2	1.1	12.6	5.0	0.3	7.1	10.5	2.1	0.6	3.0	0.7	12.7	6.1	6.8	46.0	35.8	88.6	3.4
Acacia		1.0	22.0		1.4	9.0		0.3	6.1		2.5	5.9	1.9	0.5	12.0	1.9	5.7	55.0	62.6	2.4
Gmelina		2.5	0.2	0.9	1.2	1.0	0.3	0.6	4.5		0.3	1.6	2.6	9.7	11.1	3.8	14.3	18.4	36.5	1.4
Eucalyptus	0.2	1.0	3.2	0.4	2.2	1.0	0.3	1.8	1.5	0.7	1.5	1.0		0.7	0.8	1.6	7.2	7.5	16.3	0.6
Leucaena	0.5	3.6		0.9	6.2		0.4	5.0	16.3		2.2	2.0	0.5	6.0	2.3	2.3	23.0	20.6	45.9	1.8
Cassia	0.3	1.2	2.0		1.4	1.5		3.6	1.0		12.7			0.5	1.3	0.3	19.4	5.8	25.5	1.0
Cashew tree	30.0	24.3	186.0	76.3	53.3	406.3	32.1	5.7	280.0	5.4	15.9	214.5	21.6	32.8	188.0	165.4	132.0	1,274.8	1,572.2	60.8
Mango tree	11.6	17.6	19.0	65.5	42.1	11.0	31.3	32.4	12.0	7.2	3.8	6.0	19.1	29.3	11.3	134.7	125.2	59.3	319.2	12.3
Citrus fruits	1.4	2.8	0.1	5.0	3.2	0.8	2.2	5.0	1.0	2.3	2.9	0.2	4.2	8.6	1.1	15.1	22.5	3.2	40.8	1.6
Caicedrat	0.8	4.3	38.4	1.8	10.9	11.0	4.2	7.9	51.3	0.7	4.5	40.7	6.6	3.3	18.3	14.1	30.9	159.7	204.7	7.9
Lingué		4.3	1.5		2.6	8.8		4.1	20.0		1.2	2.1		0.6	8.8	0.0	12.8	41.2	54.0	2.1
Others	1.7	8.2	7.4	1.2	9.7	8.6	2.1	9.7	4.7	1.8	3.5	41.3	1.6	5.7	14.5	8.4	36.8	76.5	121.7	4.7
Total	49.1	83.8	291.0	153.1	146.8	464.0	73.2	83.2	408.9	20.2	51.6	318.3	58.8	110.4	275.6	354.4	475.8	1,757.8	2,588.0	100.0

Note: The share of Kandi district is included in the share of Gogounou district.

Source: CARDER-Borgou

Appendix-8: Land Area of Burnt Plantations

(Unit: ha)

District/ Tree species	GOGOUNOU			BEMBEREKE			SINENDE			SEGBANA			KALALE			Total of 5 Districts			
	Teak	Cashew tree	Mango tree	Teak	Cashew tree	Mango tree	Teak	Cashew tree	Mango tree	Teak	Cashew tree	Mango tree	Teak	Cashew tree	Mango tree	Teak	Cashew tree	Mango tree	Total
1996	36	31	22	25	105	15	24	112	10	21	8	10	75	210	55	181	466	112	759
1997	12	8	12	10	55	14	15	107	5	12	15	9	41	160	31	90	345	71	506
1998	2	9	5	12	10	6	3	100	1	4	2		10	95	12	31	216	24	271

Note: 1 ha of the Eucalyptus in Sinendé district burnt in 1996 is not included.

Source: The Forest Department of Borgou

Appendix-9: List of Aerial Photographs

Photography line	Number of photographs	Volume of photographs	Photography line	Number of photographs	Volume of photographs	Photography line	Number of photographs	Volume of photographs
L-1	1-12	12	L-18	1-67	67	L-29	1-56	56
L-2	1-15	15	L-18A	1-38	38	L-29	56A-95	40
L-3	1-15	15	L-18AA	1-12	12	L-29A	1-8	8
L-4	1-15	15	L-19	1-90	90	L-30	1-92	92
L-5	1-17	17	L-19A	1-14	14	L-30A	1-7	7
L-6	1-21	21	L-19B	1-6	6	L-30B	1-10	10
L-6A	1-5	5	L-19C	1-6	6	L-31A	1-48	48
L-7	1-8	8	L-20	1-91	91	L-31AA	1-8	8
L-7	7A-25	19	L-20A	1-10	10	L-31B	1-34	34
L-8	1-27	27	L-21	1-99	99	L-31BA	1-8	8
L-8A	1-7	7	L-21A	1-6	6	L-31BB	1-10	10
L-9	1-28	28	L-22	1-92	92	L-32A	1-19	19
L-9A	1-8	8	L-22A	1-6	6	L-32A	19-46	28
L-10	1-31	31	L-22B	1-7	7	L-32B	1-32	32
L-11	1-35	35	L-22C	1-7	7	L-33A	1-16	16
L-12	1-37	37	L-23	1-22	22	L-33B	1-22	22
L-13	1-36	36	L-23	22A-106	85	L-33BA	1-8	8
L-13A	1-7	7	L-23A	1-8	8	L-33C	1-25	25
L-14A	1-35	35	L-24	1-32	32	L-34A	1-23	23
L-14B	1-9	9	L-24	28A-92	65	L-34B	1-13	13
L-15A	1-34	34	L-24A	1-7	7	L-35A	1-20	20
L-15AA	1-7	7	L-25	1-103	103	L-35B	1-5	5
L-15B	1-14	14	L-26	1-52	52	L-36	1-19	19
L-16A	1-59	59	L-26	49-93	45	L-37	1-17	17
L-16B	1-18	18	L-27	1-56	56	L-38	1-13	13
L-17A	1-54	54	L-27	53A-100	48	L-38A	1-6	6
L-17A	53-62	10	L-27A	1-10	10	Sub-total		587
L-17AA	1-8	8	L-28	1-95	95			
L-17B	1-20	20	L-28A	1-19	19			
Sub-total		611	Sub-total		1,198	Grand-total		2,396

Appendix-10: Index Map of Aerial Photographs

Appendix-11: Legislations on the Environment

<Natifonal Legislation>

The principal laws on the environment are as follows:

Law 65-025	:	Land Ownership Law
Law 93-009	:	Forest Law
Decree 96-271	:	Decree on Forest Law Enforcement
Law 87-013	:	Transhumance Law
Law 87-014	:	Hunting Law (September21, 1987)
Decree 90-366	:	Decree on Hunting Law Enforcement (December 4, 1990)
Decree 98 No. 463	:	Prescription of Hunting for the Fiscal Year Concerned (Ministerial Ordinance)

<International Conventions >

The International Conventions on the environment are as follows:

Convention on the Protection of the World Cultural and Natural Heritage (Benin joined in 1982)
Washington Convention on the International Trade of the Endangered Species of Fauna and Flora (CITES) (Benin joined in 1984)
Convention on the Conservation of the Migratory Wild Fauna Species (Benin joined in 1983)
Convention on Bio-Diversity (ratified in 1993)

Appendix-12: Wildlife Species Published in the Appendix of Washington Convention

Animal species

1. Mammals

Note*	Appendix	Scientific name	Common name
	I	Acinonyx jubatus	Guepard
	I	Bocoercus euryceros	Bongo
○	I	Cephalophus sylvicultor	Cephalophe has back yellow
○	I	Colobus polykomos	Colobe magistrate
	I	Damaliscus korrigum	Damalisque
	I	Dugong dugon	Dugong
	I	Felis aurata	Cat gilds
	I	Felis caracal	Caracal
○	I	Fossa tigrina	Chive tigrine
	I	Gazella rufifrons	Gazelle has russet-red
	I	Hespectinae spp.	Mongeese (all species)
	I	Hyemoschus aquaticus	Watery cheorotin
○	I	Hyracoidea spp.	Pangolins (all species)
	I	Limnotragus spekei	Situtunga
●	I	Loxodonta africana	Elephant
○	I	Lycaon pictus	Lycaon ou Cynhyene
○	I	Manis temminckii	Pangolin
○	I	Mellivora capensis	Ratel
○	I	Orycteropus afer	Orycterope
○	I	Panthera pardus	Leopard
	I	Perodicticus potto	Potto
○	I	Procavia capensis	Daman of rock
	I	Trichechus senegalensis	Manatee
○	II	Alcelaphus buselaphus	Bubale
○	II	Cercopithecidae	Pttas, Baboins, Vervet
○	II	Cetacea spp.	Dolphins, Crques, Rorqual
○	II	Felidae spp.	Wildcats
○	II	Galago spp.	Galago
●	II	Hippopotamus amphibius	Hippopotame
○	II	Hippotragus equinus	Hippotrague
○	II	Kobus defassa	Cobe defassa
○	II	Kobus kob	Cobe de Buffon
●	II	Panthera leo	Lion
○	II	Pteropus spp.	Dog fish
○	II	Redunca redunca	Cobe redunca
○	II	Synceros spp.	Buffalo
○	II	Tragelaphus scriptus	Guib hanarche
○	III	Hystrix cristata	Pig epic
○	III	Thryonomys swinderianus	Aulacode, Agouti

Note *: ●: The existence of these species is confirmed in the Study Area.

○: These species may exist in the Study Area.

Appendix-12: Wildlife Species Published in the Appendix of Washington Convention

2. Birds

Note*	Appendix	Scientific name	Common name
○	I	Aegypiridae spp.	Vultures (all species)
○	I	Balaeniceps rex	Nozzle in shoe
○	I	Balearica pavonina	Crane couronnee
○	I	Bucorvus abyssinicus	Large Calao d'Abyssinie
○	I	Ciconia episcopus	Bigogne episcopal
	I	Comatibis spp.	Hairly Comatibis
○	I	Ephippiorhynchus senegalensis	Jabiru of Senegal
○	I	Falco peregrinus	Falcon
○	I	Leptoptilos crumeniferus	Marabout
○	I	Otidadae spp.	Bustards (all species)
	I	Picathartes spp.	Picatharte
○	I	Sagittarius serpentarius	Measager serpentiere
○	I	Strigidae spp.	Dukes, Owls, Chouttes
○	I	Threskiorniyhidae	Ibis and spatules
○	II	Aquila spp.	Eagle
○	II	Ardea spp.	Herons
○	II	Egretta spp.	Brushes
○	II	Pelecanus refescens	Pelican
○	II	Phalacrocorax africanus	Cormorant
	II	Poicephalus senegalus	Dinghy
	II	Porphyrio porphyrio	Hen sultana
	II	Psittacula krameri	Parakeet
	II	Psittanus erithacus	Jacko
○	II	Tauraco persa	Green Touraco
	III	Alopochen aegyotiaca	Goose of Egypt
	III	Anas acuta	Pintail
	III	Anas clypeata	Shoveler duck
	III	Anas querquedula	Sarcelle of ete
	III	Ardea goliath	Heron Goliath
○	III	Bubulcus ibis	Heron buff-backed heron
	III	Casmerodius albus	Large brush
	III	Corythaeola oristata	Geant Touraco
	III	Coturnix spp.	Curdle
○	III	Dendrocygna viduata	Widowed Dendrocyne
	III	Lagonosticta spp.	Amaranth
	III	Nettapus auritus	Shoveler duck has oreilon
○	III	Numida meleagris	Guinea fowl
	III	Plectropterus gambensis	Goose deGambie
	III	Serinus spp.	Canary
	III	Streptopelia spp	Turtle-dove
	III	Tauraco macrorhychus	Touraco has large nozzle
○	III	Treron spp.	Pigeon
	III	Turtur spp.	Turtle-dove

Note *: ●: The existence of these species is confirmed in the Study Area.

○: These species may exist in the Study Area.

Appendix-12: Wildlife Species Published in the Appendix of Washington Convention

3. Reptiles

Note*	Appendix	Scientific name	Common name
	I	Cheloniidae spp.	Tortoise geante
○	I	Crocodylus niloticus	Caiman
○	I	Osteolaemus tetrapis	Crocodile
	I	Python molurus molurus	Boa
	II	Calabaria rheinhaeltii	Python calabaria
	II	Clemnys insculpta	Terrapin
	II	Dermatemys mawii	Terrapin
○	II	Gekko gecko	Gecko
○	II	Python regius	Royal Python
○	II	Python sebae	Large Python
	II	Testudinidae spp.	Terrapin
○	II	Varanus enanthematicus	Varan of savannas
○	II	Varanus niloticus	Water Varan

Note *: ●: The existence of these species is confirmed in the Study Area.
○: These species may exist in the Study Area.

4. Amphibians

Note*	Appendix	Scientific name	Common name
	I	Bufo superciliaris	
	II	Bufo retiformis	Clamping plate
	II	Dendrobate spp.	Clamping plate
	II	Phyllobates spp.	Clamping plate

Note *: ●: The existence of these species is confirmed in the Study Area.
○: These species may exist in the Study Area.

Appendix-12: Wildlife Species Published in the Appendix of Washington Convention

5. Plant species

Note*	Appendix	Scientific name	Common name
○	I	Acacia albida	Gao
●	I	Afzelia africana	Lingue
○	I	Albizzia spp.	Albizzia
●	I	Anogeissus leiocarpus	Anogeissus
	I	Antiaris africana	Antiaris
	I	Antiaris taxicaria	Antiaris
	I	Avicennia africana	Paleturier
○	I	Bambusa vulgaris	Bamboo
	I	Berlinia grandiflora	Berlinia
○	I	Blighia sapida	Linsan
○	I	Bombax buonopozense	Kapokier
●	I	Bombax costatum	Kapokier
●	I	Borassus aethiopum	Ronier
●	I	Ceiba pentandra	Cheese-making
	I	Cola nitida	Colatier
	I	Connocarpus spp.	Paleturier
	I	Daniellia ogea	Daniellia
●	I	Daniellia oliveri	Daniellia
	I	Dialium guineense	Dialium
●	I	Diospyros mespilliformis	False ebene
○	I	Elaeis guineensis	Palm tree has oil
○	I	Encephalartos brteri	Encephalartos
	I	Holoptelea grandis	Holoptelea
	I	Hyphaene thebaica	Doumb palm tree
●	I	Isoberlinia doka	Isoberlinia
●	I	Isoberlinia tomentosa	Isoberlinia
○	I	Khaya grandifoliola	Mahogany tree has large fauille
●	I	Khaya senegalensis	Cailcedra
	I	Laguncularia racemosa	Paleturier
	I	Mansonia altissima	Bete
	I	Milicia(Chlorophora) excelsa	Iroko
○	I	Milicia(Chlorophora) regia	Iroko
	I	Mitragyna ciliata	Mytragina
●	I	Mitragyna inermis	Mytragina
	I	Nesogorgonia papaverifera	Nesogordonia
	I	Oxytenanthera abyssinica	Oxythenanthera
●	I	Parkia biglobosa	Nere ou Nete
	I	Pentaclethera macrophylla	Dingouin
	I	Phoenix dactylifera	Phoenix

Note *: ●: The existence of these species is confirmed in the Study Area.

○: These species may exist in the Study Area.

Appendix-12: Wildlife Species Published in the Appendix of Washington Convention

5. Plant species

Note*	Appendix	Scientific name	Common name
	I	Phoenix reclinata	Phoenix
	I	Piptadeniastrum africanum	Dabena
●	I	Prosopis africana	Prosopis
●	I	Pterocarpus erinaceus	Vene
	I	Rizophora spp.	Paleturier
	I	Spondias mombin	Plum tree mombin
	I	Syzygium guineense	Syzygium
	I	Terminalia superba	Frake
	I	Tetrapleura tetraptera	Lindja
○	I	Triplochiton scleroxylon	Samba
●	I	Vitellaria paradoxum	Karite
●	I	Vitex doniana	Vitex
	II	Aloe spp.	-
○	II	Cactaceae	Clamping plate
○	II	Euphorbia spp.	Euphorbium
	II	Orchidaceae	Orchide

Note *: ●: The existence of these species is confirmed in the Study Area.

○: These species may exist in the Study Area.

Appendix-13: Checklist of Environmental Items

Environmental item (Main item) (Medium item) (Elementary item)	Degree of impact					Influence		Effective measures to minimize the negative influences
	A	B	C	D	P	Negative influence	Positive influence	
1. Social life								
(1) Life of the inhabitants								
1. Planned migration			○					• No planned migration
2. Nonspontaneous migration			○					• No nonspontaneous migration
3. Change in the way of life			○					
4. Friction between inhabitants		○				• Friction between inhabitants due to the unequal distribution of cultivable land because of prohibition of grubbing and arbitrary fixing of the current state of the agricultural land.	• Disappearance of friction between farmers and stockbreeders with the separation of the agricultural and grazing lands	• Coordination of the interests by inhabitants organization • Securing of agricultural land for the wandering stockbreeders • Preliminary explanations to inhabitants • Participation of the inhabitants in the process of planning, execution and management
5. Aborigines, minorities and nomads			○					
(2) Population								
1. Population increase			○					• No population increase due to the execution of the plan
2. Abrupt changes in the population composition			○					
(3) Economic activities of the inhabitans								
1. Transfer of the base of economic activity		○				• Transfer of production base through prevention of the expansion of agricultural land		• Supply of substitute land • Agro-forestry use of the forest • Availability of grazing land
2. Conversion of economic activities and unemployment					○	• Reduction in income due to the prohibition of the raw cotton cultivation	• Increase in employment due to forest production • Increase in cash income by extension activities concerning beekeeping and production of charcoal	• Promotion of employment for the local labour force • Securing of land for cotton cultivation

A. Very great negative influence B. Possibility of large negative influences C. No significant negative influence D. Unclear
P. Positive influence

Appendix-13: Checklist of Environmental Items (continuation)

Environmental item (Main item) (Medium item) (Elementary item)	Degree of impact					Influence		Effective measures to minimize the negative influences
	A	B	C	D	P	Negative influence	Positive influence	
3. Increase in the differences in income		○				• Increase in the differences in income because of an unequal distribution of allotted farmlands		• Ensuring cash income from crops other than cotton through extension activities
(4) Customs								
1. Revision of the right of use of the forests		○				• Constraints on the traditional right to use classified forests		• Ensuring land for livestock breeding, hunting, fishing and food supply, and management of these lands
2. Change of the social structures (creating organizations)		○				• Distress generated by the collapse of traditional organizations centered on the village mayor, because of the newly created organizations of the inhabitants		• Participation of the traditional village head in the organization of the inhabitants
3. Reform of existing customs and system		○				• Distress generated by the collapse of the traditional systm of land ownership	• To grasp the problems of transition to a modern land ownership system	• Progressive transition towards a modern land ownership system
2. Hygiene and health								
1. Increase in the volume of use of agricultural chemicals			○			• Use of agricultural chemicals in forest nurseries • Use of agricultural chemicals in the raw cotton fields and other agricultural land		• To avoid the use of residual agricultural chemicals
2. Transmission of contagious diseases			○					• No local disease recorded
3. Increase in waste and excrements								
3. Historic sites, cultural heritage and sceneries								
1. Damage and destruction of the historic sites or the cultural heritage			○					
2. Loss of sceneries			○					

A. Very great negative influence B. Possibility of large negative influences C. No significant negative influence D. Unclear
P. Positive influence

Appendix-13: Checklist of Environmental Items (continuation)

Environmental item (Main item) (Medium item) (Elementary item)	Degree of impact					Influence		Effective measures to minimize the negative influences
	A	B	C	D	P	Negative influence	Positive influence	
4. Areas with rare wildlife and ecology								
1. Change of vegetation		○				• Loss of natural vegetation due to felling and regeneration	• Recovery of vegetation through forest restoration in the fallow lands	• Establishment of protection and conservation zones • Adoption of block and selective fellings • Application of natural regeneration
2. Influence on the habitat of the animals		○				• Reduction and parceling out of the habitats of the animals because of felling, regeneration and opening due to forest roads	• Expansion of the habitat of the animals by forest establishment in the fallow lands	• Establishment of protection and conservation zones • A felling plan which does not create isolated forest • Planning of appropriate road network
3. Influence on the rate of indigenous plants and animals		○				• Destruction of the habitat of plants and animals by felling and regeneration		• Establishment of protection and conservation zones • Control of illegal felling, gathering and hunting
4. Reduction in bio-diversity		○				• Reduction in genetic resources because of the felling of the useful species		• Establishment of protection and conservation zones • Diversification of regeneration species • Prevention of forest fires
5. Invasion by harmful species			○					
5. Soil and Land (1) Soil								
1. Erosion		○				• Sediment discharge due to felling and forest road construction	• Reduction of lands threatened by erosion through imposition of limitations on the expansion of agricultural land	• Early regeneration after the felling • Installation of water draining facilities and maintenance of forest roads
2. Reduction in land fertility			○			• Temporary loss of the soil organic substances because of the felling • Disappearance of soil insects and microbial organisms because of forest fires	• Improvement of the soils through forest rehabilitation	• To avoid felling in large areas and change of land surface • Quick regeneration after the felling • Diversification of the species to be regenerated • To avoid repeating fellings with reduced intervals
3. Pollution of the soil			○					

A. Very great negative influence B. Possibility of large negative influences C. No significant negative influence D. Unclear
P. Positive influence

Appendix-13: Checklist of Environmental Items (continuation)

Environmental item	Degree of impact					Influence		Effective measures to minimize the negative influences
(Main item) (Medium item) (Elementary item)	A	B	C	D	P	Negative influence	Positive influence	
(2) Land								
1. Land degradation					○	• Drying of forest land as the result of felling		• Establishment of buffer and protection zones • Prevention of forest fire • Prevention of expansion of agricultural land • Introduction of agroforestry
2. Reduction of such functions as wind prevention, sand prevention and fire prevention					○		• Rational management of the forest and improvement of the public benefit functions of forest through establishment of windbreak belts around agricultural land	
6. Hudrology and Water Quality								
(1) Hydrology								
1. Changes in surface water and ground water flows		○				• Changes in the surface water flow because of the felling and forest road construction		• To avoid large scale felling • Quick regeneration after felling • Planning of an appropriate forest road network
2. Occurrence of drought and flood			○			• Forest land exposed by felling		• To avoid large scale felling • Quick regeneration after felling • Planning of an appropriate forest road network
3.Sediment deposition			○			• Sediment by erosion		• To avoid large scale felling • Quick regeneration after felling • Planning of an appropriate forest road network
(2) Water quality and water temperature								
1. Pollution and degradation of water quality		○				• Influence of felling and forest road construction on the quality of water • Discharge of agricultural chemicals from nurseries		• Prohibition of felling during the rainy season • Limiting of felling in the neighbourhoods of the water sources • Appropriate management of forest road construction sites close to the rivers • Appropriate selection of the sites for nurseries and conducting extension activities on the use of organic manures and green manures
2. Change of water temperature			○					

A. Very great negative influence B. Possibility of large negative influences C. No significant negative influence D. Unclear
P. Positive influence

Appendix-13: Checklist of Environmental Items (continuation)

Environmental item	Degree of impact					Influence		Effective measures to minimize the negative influences
(Main item) (Medium item) (Elementary item)	A	B	C	D	P	Negative influence	Positive influence	
(3) Air								
1. Air pollution			○					
2. Carbon dioxide emission					○	• Carbon dioxide emission because of the charcoal burning	• Increase in the carbon reserves by creating forest plantation • Maintenance of the biomass due to forestfire prevention • Slow carbon dioxide emission due to the production of coal	

A. Very great negative influence B. Possibility of large negative influences C. No significant negative influence D. Unclear
P. Positive influence

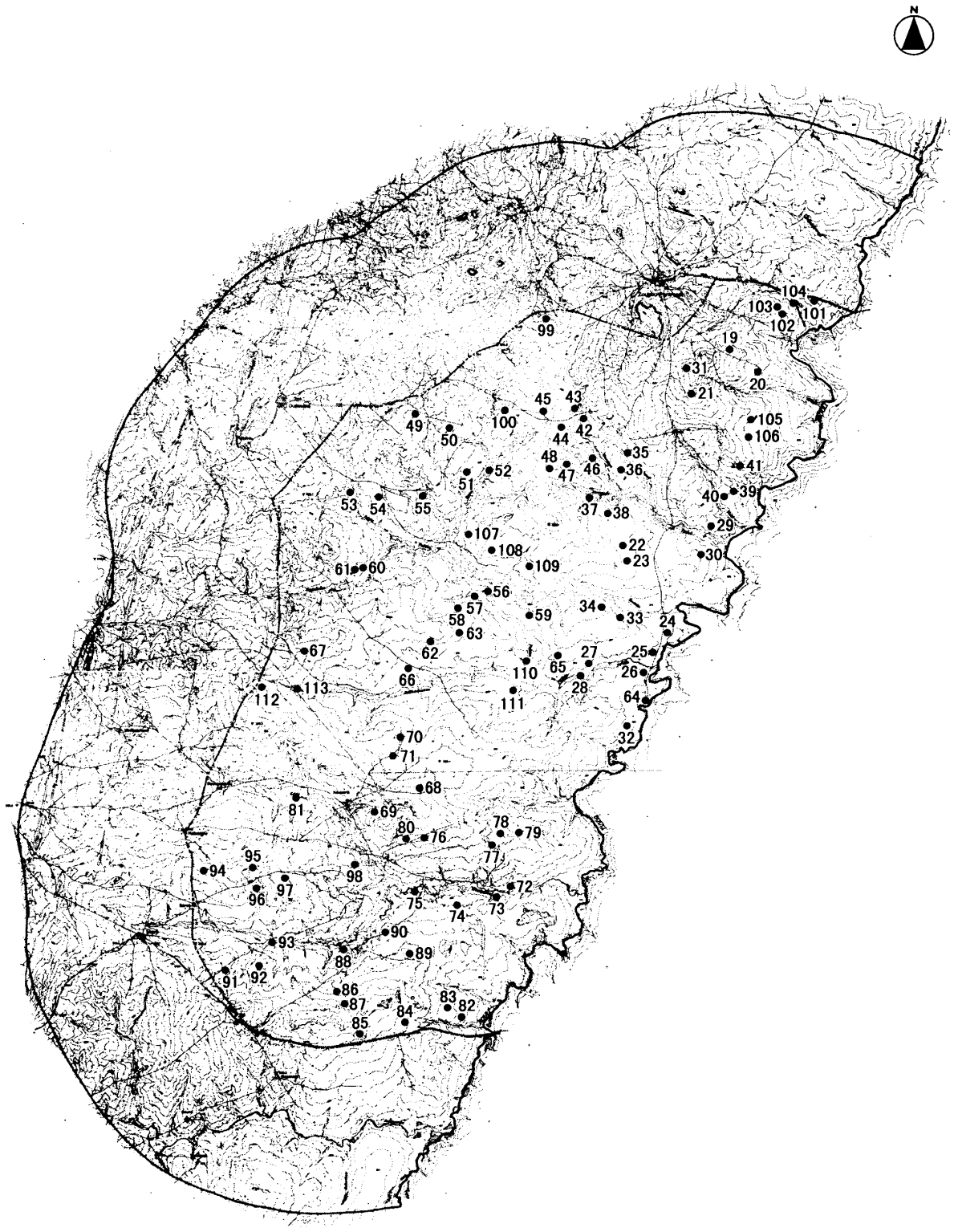
Appendix-14: Result of Preliminary Forest Inventory (plot survey)

No. of plot	Commune	Orientation	Slope (□)	Forest type symbol	No. of trees /ha	Average DBH (cm)	Average total tree height (m)	Volume/ha (m^3)	Undergrowth
1	ZOUGOU	-	-	Sa	380	14	6	35	Gramineae
2	ZOUGOU	N	1	Gf	690	14	7	65	Gramineae
3	ZOUGOU	-	-	Sa	1,120	9	5	18	Gramineae
4	ZOUGOU	-	-	St	340	11	5	10	Gramineae
5	ZOUGOU	-	-	Sb	580	13	7	34	Gramineae
6	ZOUGOU	-	-	Sb	500	13	6	31	Gramineae
7	ZOUGOU	NE	12	Gf	270	31	10	160	Gramineae
8	ZOUGOU	W	4	Sb	250	23	10	57	Gramineae
9	BEROUBOUAY	NE	5	Sa	760	12	6	48	Gramineae
10	BEROUBOUAY	NE	2	Fc	1,180	11	7	98	Others
11	BEROUBOUAY	-	-	St	1,050	10	5	22	Gramineae
12	SORI	-	-	Sa	120	25	9	29	Gramineae
13	SORI	-	-	Sa	410	16	6	46	Gramineae
14	SORI	-	-	St	590	11	5	16	Gramineae
15	SORI	-	-	St	790	11	5	30	Gramineae
16	GAMIA	-	-	St	650	6	4	4	Gramineae
17	GAMIA	-	-	Sa	630	11	5	30	Gramineae
18	GAMIA	-	-	St	1,530	8	5	30	Gramineae

Plot	Commune	Undergrowth Plant	Forest Type	Sol.No	10cm<=DBH Number of Trees	DBH(cm)	TH(m)	V(m3)
19	ZOUGOU	Gramineae-Shrub	Sb	-	18	14	7	0.86
20	ZOUGOU	Herbaceous+Ligneous	Sa	-	29	17	8	2.256
21	ZOUGOU	Herbaceous+Ligneous	St	-	20	11	5	0.324
22	ZOUGOU	Herbaceous+Ligneous	Sb	-	39	15	7	2.733
23	ZOUGOU	Herbaceous+Ligneous	Sa	40	29	17	7	2.002
24	ZOUGOU	Herbaceous+Ligneous	Sb	-	34	15	6	1.928
25	ZOUGOU	Herbaceous+Ligneous	St	-	18	15	6	0.845
26	ZOUGOU	Herbaceous+Ligneous	Sb	-	17	17	8	1.434
27	ZOUGOU	Herbaceous+Ligneous	Sb	-	47	14	6	1.569
28	ZOUGOU	A few Herbaceous+Ligneous	Gf	-	26	23	10	11.188
29	ZOUGOU	Herbaceous+Ligneous	Sa	-	27	20	8	3.335
30	ZOUGOU	Herbaceous+Ligneous	Sb	-	32	14	6	1.602
31	ZOUGOU	Herbaceous+Ligneous	Sb	-	33	18	8	3.024
32	ZOUGOU	Herbaceous+Ligneous	Sa	-	23	19	7	3.374
33	ZOUGOU	Herbaceous+Ligneous	Sb	-	27	20	9	3.307
34	ZOUGOU	Herbaceous+Ligneous	Sb	-	47	17	7	3.3
35	ZOUGOU	Discontinous Hervaceous+Ligneous	Gf	-	27	33	15	20.492
36	ZOUGOU	Continuous Heracous+Ligneous	Sa	-	27	17	8	2.334
37	ZOUGOU	Herbaceous+Ligneous	Sa	-	30	20	7	5.625
38	ZOUGOU	Herbaceous+Abundant Ligneous	St	-	4	21	6	0.434
39	ZOUGOU	Herbaceous+Ligneous	Sa	-	20	20	9	3.534
40	ZOUGOU	Herbaceous+Ligneous	Sb	-	53	14	6	2.13
41	ZOUGOU	Herbaceous+Ligneous	Sa	-	16	20	8	1.704
42	ZOUGOU	Discontinous Hervaceous+Ligneous	Sb	-	9	19	7	0.688
43	ZOUGOU	Continuous Herbaceous+Ligneous	St	-	6	18	5	0.327
44	ZOUGOU	Herbaceous+Ligneous	St	-	8	21	6	0.73
45	ZOUGOU	Continuous Herbaceous+Ligneous	Sa	-	19	22	8	2.565
46	ZOUGOU	Herbaceous+Ligneous	Sa	-	38	17	9	3.279
47	ZOUGOU	Discontinous Hervaceous+Ligneous	Fc	-	48	19	10	5.535
48	ZOUGOU	Continuous Herbaceous+Ligneous	St	-	6	13	6	0.161
49	SORI	Herbaceous+Ligneous	Sb	-	25	17	8	2.212
50	SORI	Herbaceous+Ligneous	Sb	-	20	14	7	0.869
51	SORI	Herbaceous+Ligneous	Sb	-	20	14	7	0.859

52	SORI	Herbaceous+Ligneous	Gf	-	28	22	10	6.324
53	SORI	Herbaceous+Ligneous	Sa	-	28	17	7	1.934
54	SORI	Herbaceous+Ligneous	Sb	-	26	16	7	1.454
55	SORI	Herbaceous+Ligneous	Sb	-	31	13	5	0.8
56	SORI	Ligneous	Gf	-	10	47	14	20.298
57	SORI	Continuous Herbaceous+Ligneous	Sa	-	15	19	7	1.072
58	SORI	Continuous Herbaceous+Ligneous	Sa	-	24	21	9	3.557
59	SORI	Herbaceous+Ligneous	Sb	-	30	16	7	1.68
60	SORI	Herbaceous+Ligneous	Sb	-	45	14	6	2.228
61	SORI	Herbaceous+Ligneous	Sa	-	29	12	6	0.846
62	SORI	Herbaceous+Ligneous	Sb	-	47	14	8	2.485
63	SORI	Continuous Herbaceous+Ligneous	Sa	-	22	21	8	2.677
64	ZOUGOU	Herbaceous+Ligneous	Gf	1	32	22	10	6.02
65	SORI	Continuous Herbaceous+Ligneous	Sa	2	22	22	9	3.052
66	SORI	Herbaceous+Ligneous	Sb	3	22	20	7	3.269
67	SORI	Herbaceous+Abundant Ligneous	Sb	6	44	14	6	1.772
68	BEROUBOUAY	Herbaceous+Ligneous	Sb	7	43	13	6	1.497
69	BEROUBOUAY	Herbaceous+Ligneous	Sa	8	22	25	10	4.833
70	BEROUBOUAY	Herbaceous+Ligneous	Sb	9	40	18	8	3.546
71	BEROUBOUAY	Herbaceous+Ligneous	Sa	10	23	17	7	1.784
72	BEROUBOUAY	Herbaceous+Ligneous	Gf	11	14	28	11	6.758
73	BEROUBOUAY	Herbaceous+Ligneous	Sa	12	11	21	8	1.552
74	BEROUBOUAY	Herbaceous+Ligneous	Sa	13	30	21	10	5.13
75	BEROUBOUAY	Herbaceous+Ligneous	Sb	14	48	14	6	2.361
76	BEROUBOUAY	Herbaceous+Ligneous	St	15	46	13	5	1.44
77	BEROUBOUAY	Herbaceous+Ligneous	Sa	16	15	20	7	2.071
78	BEROUBOUAY	Herbaceous+Ligneous	Sb	17	36	20	8	4.33
79	BEROUBOUAY	Herbaceous+Ligneous	Sa	18	23	23	10	4.472
80	BEROUBOUAY	Herbaceous+Ligneous	St	19	6	21	7	0.622
81	BEROUBOUAY	Herbaceous+Abundant Ligneous	Gf	20	37	16	8	4.112
82	GAMIA	Herbaceous+Ligneous	Sb	21	31	16	7	2.072
83	GAMIA	Continuous Herbaceous+Ligneous	Sa	22	22	21	9	3.08
84	GAMIA	Herbaceous+Ligneous	St	23	6	12	5	0.138
85	GAMIA	Continuous Herbaceous+Ligneous	Sa	24	29	22	10	5.372
86	GAMIA	Herbaceous+Ligneous	Sa	25	19	23	9	3.754
87	GAMIA	Herbaceous+Ligneous	Sb	26	49	16	7	3.775

88	GAMIA	Herbaceous+Ligneous	Sb	27	37	15	6	1.597
89	GAMIA	Herbaceous+Ligneous	Sb	28	41	18	6	3.853
90	GAMIA	Herbaceous+Ligneous	St	29	22	18	7	1.937
91	GAMIA	Herbaceous+Abundant Ligneous	St	30	6	12	4	0.098
92	GAMIA	Abundant Ligneous	Sb	31	41	15	7	2.524
93	GAMIA	Herbaceous+Abundant Ligneous	Gf	32	39	16	10	4.579
94	BEROUBOUAY	Herbaceous+Abundant Ligneous	Sb	33	38	14	6	1.592
95	BEROUBOUAY	Abundant Ligneous	Sb	34	35	16	7	2.238
96	BEROUBOUAY	Ligneous	Fc	35	25	23	15	8.078
97	BEROUBOUAY	Herbaceous+Ligneous	St	36	19	12	5	0.552
98	BEROUBOUAY	Herbaceous+Abundant Ligneous	Sb	37	64	13	6	2.537
99	ZOUGOU	Herbaceous+Ligneous	Sb	38	45	16	7	2.406
100	ZOUGOU	Herbaceous+Ligneous	Sa	39	13	22	7	1.495
101	ZOUGOU	Continuous Herbaceous+Ligneous	St	-	0			0
102	ZOUGOU	Herbaceous+Ligneous	Sa	-	19	18	8	2.744
103	ZOUGOU	Herbaceous+Ligneous	Sb	-	16	14	6	0.763
104	ZOUGOU	Herbaceous+Ligneous	Gf	42	11	25	11	3.225
105	ZOUGOU	Herbaceous+Ligneous	Sb	43	19	19	8	2.458
106	ZOUGOU	Continuous Herbaceous+Ligneous	Sa	44	13	22	9	2.309
107	SORI	Herbaceous+Ligneous	Sb	45	17	17	6	1.076
108	SORI	Herbaceous+Ligneous	Sb	46	23	17	8	2.003
109	SORI	Herbaceous+Ligneous	Sb	-	14	18	6	1.038
110	SORI	Herbaceous+Ligneous	Sb	47	33	16	7	2.146
111	SORI	Continuous Herbaceous+Ligneous	Sa	-	24	21	9	3.354
112	SORI	Herbaceous+Ligneous	Sb	49	37	16	6	2.191
113	SORI	Herbaceous+Ligneous	Gf	50	38	21	12	6.984



Appendix-16: Map Showing the Location of Forest Inventory Plots

Appendix-17: A List of Plant Species Appeared in Forest Inventory Plots

Speies	N/T	Speies	N/T
Acacia cafra	1	Khaya senegalensis	3
Acacia dudjeoni	10	Kigelia africana	1
Acacia gourmaensis	34	Lannea acida	119
Acacia siberiana	2	Lannea egregia	3
Afzelia africana	12	Lannea kerstingii	7
Annona senegalensis	282	Lannea microcarpa	2
Anogeissus leiocarpus	81	Lannea sp.	1
Antidesma membranacea	5	Lonchocarpus laxiflorus	3
Bombax costatum	6	Lophira lanceolata	4
Borassus aethiopum	7	Marantes polyandra	82
Bridelia ferruginea	30	Maytenus senegalensis	39
Bridelia scleroneura	76	Mitragyna inermis	24
Burkea africana	315	Monotes kerstingii	101
Cola laurifolia	1	Morelia senegalensis	1
Combretum ghasalense	15	Nauclea latifolia	46
Combretum ghasalense×glutinosum	1	Ochna schweinfurthiana	1
Combretum glutinosum	206	Oncoba spinoza	5
Combretum hypopilinum	160	Parinari congensis	9
Combretum molle	80	Parinari curatellifolia	29
Combretum nigricans	31	Parkia biglobosa	10
Combretum sp.	2	Paveta crassipes	2
Crossopteryx febrifuga	573	Pericopsis laxiflora	150
Cussonia arborea	3	Piliostigma thonningii	207
Cussonia djalonensis	15	Prosopis africana	8
Cussonia sp	14	Pseudodcedrela kotschyi	7
Daniellia oliveri	59	Pteleopsis suberosa	198
Detarium microcarpum	1152	Pterocarpus erinaceus	76
Dichrostachys cinerea sub.sp. glomerat	79	Rhus natalensis	15
Diospyros mespiliformis	49	Securidaca longepedunculata	7
Dombeya quinqueseta	104	Securinega virosa	9
Entada africana	105	Sterculia tomentosa	28
Feretia apodanthera	110	Stereospermum kunthianum	41
Ficus capensis	7	Strychnos innocua	42
Ficus glumosa	19	Strychnos spinosa	261
Ficus ingens	2	Swartzia madagascariensis	14
Ficus platiphylla	1	Syzygium guineense var. littorale	5
Gardenia aqualla	29	Syzygium guineense var. macrocarpun	3
Gardenia erubescens	45	Tamarindus indica	54
Gardenia sp.	5	Terminalia avicennioides	500
Gardenia ternifolia	19	Terminalia glaucescens	46
Grewia lasiodiscus	9	Terminalia laxiflora	11
Grewia mollis	42	Terminalia macroptera	22
Grewia sp.	6	Trichilia emetica	5
Grewia venusta	7	Uapaca toboensis	2
Hannoa undulata	5	Vernonia colorata	1
Hexalobus monopetalus	22	Vitellaria paradoxa	553
Holarrhena floribunda	4	Vitex doniana	11
Hymenocardia acida	40	Xeroderris stuhlmannii	20
Irvingia smithii	2	Xylopia paviflora	27
Isoberlinia doca/tomentosa	67	Xymenia americana	29
Isoberlinia doka	269	Ziziphus micronata	2
Isoberlinia tomentosa	65	Total	7131

Appendix-18: Number of Trees Found by Forest Type

Species	Number of trees found in all plots						Number of trees found in a single plot					
	Fc	Gf	Sa	Sb	St	Total	Fc	Gf	Sa	Sb	St	Total
Detarium microcarpum		2	149	858	143	1,152		0.2	5.1	20.9	11.0	12.1
Crossopteryx febrifuga		26	45	469	33	573		2.6	1.6	11.4	2.5	6.0
Vitellari a paradoxa		12	97	391	53	553		1.2	3.3	9.5	4.1	5.8
Terminalia avicennioides		5	24	257	214	500		0.5	0.8	6.3	16.5	5.3
Burkea africana		4	9	99	3	315		0.4	0.3	2.4	0.2	3.3
Annona senegalensis		29	26	168	59	282		2.9	0.9	4.1	4.5	3.0
Isoberlinia doka	9	13	182	65		269	4.5	1.3	6.3	1.6		2.8
Strychnos spinosa	4	6	66	177	8	261	2.0	0.6	2.3	4.3	0.6	2.7
Piliostigma thonningii	1	16	37	107	46	207	0.5	1.6	1.3	2.6	3.5	2.2
Combretum glutinosum		3	16	134	53	206		0.3	0.6	3.3	4.1	2.2
Pteleopsis suberosa			28	72	98	198			1.0	1.8	7.5	2.1
Combretum hypopilinum	1	22	25	79	33	160	0.5	2.2	0.9	1.9	2.5	1.7
Pericopsis laxiflora	2	6	56	83	3	150	1.0	0.6	1.9	2.0	0.2	1.6
Lannea acida	5	4	43	60	7	119	2.5	0.4	1.5	1.5	0.5	1.3
Feretia apodanthera	55	17	22	8	8	110	27.5	1.7	0.8	0.2	0.6	1.2
Entada africana			34	57	14	105			1.2	1.4	1.1	1.1
Dombeya quinqueseta		3	3	96	2	104		0.3	0.1	2.3	0.2	1.1
Monotes kerstingii		1	23	77		101		0.1	0.8	1.9		1.1
Marantes polyandra		10	9	60	3	82		1.0	0.3	1.5	0.2	0.9
Anogeissus leiocarpus	20	50	6	5		81	10.0	5.0	0.2	0.1		0.9
Others	47	281	455	633	187	1,603	23.5	28.1	15.7	15.4	14.4	16.9
Grand total	144	510	1,425	4,055	997	7,131	72.0	51.0	49.1	98.9	76.7	75.1

Appendix-19: Twenty Tree Species Most Frequently Found
With a Diameter Equal or Higher than 10 cm

Species	10cm<DBH	DBH<10cm	Total Number	Share (%) of trees with DBH > 10cm
Vitellaria paradoxa	357	196	553	65
Detarium microcarpum	311	841	1,152	27
Crossopteryx febrifuga	204	369	573	36
Burkea africana	196	119	315	62
Isoberlinia doka	195	74	269	72
Pericopsis laxiflora	97	53	150	65
Terminalia avicennioides	80	420	500	16
Lannea acida	77	42	119	65
Monotes kerstingii	64	37	101	63
Anogeissus leiocarpus	62	19	81	77
Pterocarpus erinaceus	61	15	76	80
Isoberlinia tomentosa	57	8	65	88
Isoberlinia doka/tomentosa	54	13	67	81
Marantes polyandra	53	29	82	65
Entada africana	47	58	105	45
Daniellia oliveri	42	17	59	71
Tamarindus indica	30	24	54	56
Combretum glutinosum	29	177	206	14
Diospyros mespiliformis	27	22	49	55
Pteleopsis suberosa	27	171	198	14

DBH : Diameter at Breast Height

Appendix-20: Preparation of Stand Volume Tables Using Aerial Photographs

An equation relating factors of photo interpretation of the classified forests in the Intensive Study Area and the actual volume obtained through forest inventory plots was established, and stand volume tables using aerial photographs were prepared. Two type of volume tables were prepared: Volume tables for riprian forests (Gf) and volume table for other forests (FC, Its, Sb and St).

a) Survey on factors of photo interpretation

Crown density of the overstorey trees in the forest inventory plots (D) was surveyed using a dot template. Measurement range of crown density was set at 5% as shown in the table below.

b) Regression equation

The relation between crown density (D) measured in a) above and the actual volume (V) obtained from inventory plots was determined by regression analysis. The formula volume thus obtained (regression equation) is indicated in the table below.

Aerial Photograph Stand Volume Equation

Forest type	Regression equation	No. of sample plots	Correlation coefficient	Standard error rate (%)
Riparian forest (Gf)	log V=1.8482×log D−1.3745	10	0.9097	26.54
Other forests (Fc, Sa, Sb, St)	log V=0.9329×log D−0.0359	84	0.8264	29.92

V: Actual volume (m^3/ha) D: Crown density of overstorey trees (%)

c) Aerial photograph stand volume table

On the basis of aerial photograph stand volume equation mentioned in b) above, aerial photograph stand volume table as mentioned in the table below was prepared.

Aerial Photograph Stand Volume Table

Tree crown density (%)	Stand volume (m^3/ha)	
	Reparian forest	Others
5	1	5
10	3	9
15	6	14
20	11	18
25	16	22
30	23	26
35	30	30
40	39	34
45	48	38
50	58	42
55	70	46
60	82	50
65	95	53
70	109	57
75	123	61
80	139	65
85	155	69
90	173	72
95	191	76
100	210	80

Appendix-21: Simple Stand Volume Table (for reference)

A simple stand volume table is designed to easily evaluate stand volume in the areas for which newly taken aerial photographs are not available. Method of preparing a simple stand volume table is the same as for the aerial photograph stand volume table, but the factors used in this case are the average diameter, the average height of tree and the number of trees per hectare which can be measured at the site. We thus established relation between these factors and actual volume.

The following regression equation was established from the data obtained through forest inventory (plot survey) conducted under the Study.

Equation for Simple Stand Volume Preparation

Stand type	Regression equation	No. of sample plots	Correlation coefficient	Standard error rate (%)
Riparian forest (Gf)	V=0.4268×D×H+0.2036×N−88.6658	10	0.9214	31.25
Other forests (Fc, Sa, Sb, St)	V=0.2329× D×H+0.0529×N−21.3767	85	0.908	27.24

V: Actual volume (m^3/ha) D: Average stand diameter (cm)

H: Average stand height (m) N : Numbers of trees per hectare

The simple stand volume tables established on the basis of the equation are shown below.

Simple Stand Volume Table for Riparian Forest (Gf)

Gf volume: V= 0.4268 *D*H+ 0.2036 *N -88.6658

Coefficient-1 0.4268
Coefficient-2 0.2036
Constant: -88.6658
n: 10
mcc: 0.9214
E(%): 31.25

Data range	min	max
D*H	126	483
N	100	390

Number of Trees per ha	D(cm)*H(m)																
	100	**125**	**150**	**175**	**200**	**225**	**250**	**275**	**300**	**325**	**350**	**375**	**400**	**425**	**450**	**475**	**500**
100				6	17	28	38	49	60	70	81	92	102	113	124	134	145
120				10	21	32	42	53	64	74	85	96	106	117	128	138	149
140			4	15	25	36	47	57	68	79	89	100	111	121	132	143	153
160			8	19	29	40	51	61	72	83	93	104	115	125	136	147	157
180		1	12	23	33	44	55	65	76	87	97	108	119	129	140	151	161
200		5	16	27	37	48	59	69	80	91	101	112	123	133	144	155	165
220		9	20	31	41	52	63	73	84	95	106	116	127	138	148	159	170
240	3	14	24	35	46	56	67	78	88	99	110	120	131	142	152	163	174
260	7	18	28	39	50	60	71	82	92	103	114	124	135	146	156	167	178
280	11	22	32	43	54	64	75	86	96	107	118	128	139	150	160	171	182
300	15	26	36	47	58	68	79	90	100	111	122	132	143	154	164	175	186
320	19	30	41	51	62	73	83	94	105	115	126	137	147	158	169	179	190
340	23	34	45	55	66	77	87	98	109	119	130	141	151	162	173	183	194
360	27	38	49	59	70	81	91	102	113	123	134	145	155	166	177	187	198
380	31	42	53	63	74	85	95	106	117	127	138	149	159	170	181	191	202
400	35	46	57	67	78	89	99	110	121	131	142	153	163	174	185	196	206

Simple Stand Volume Table for Other Forests

Fc,Sa,Sb,St: V= 0.2329 *D*H+ 0.0529 *N -21.3767

Coefficient-1: 0.2329 n: 85
Coefficient-2: 0.0529 mcc: 0.9081
Constant: -21.3767 E(%): 27.24

Data range	min	max
D*H	0	354
N	0	640

Number of Trees per ha	D(cm)*H(m)																			
	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400
20				3	8	12	17	22	26	31	36	40	45	50	54	59	64	68	73
40				4	9	13	18	23	27	32	37	41	46	51	55	60	65	69	74
60				5	10	14	19	24	28	33	38	42	47	52	56	61	66	70	75
80			1	6	11	15	20	25	29	34	39	43	48	53	57	62	67	71	76
100			3	7	12	17	21	26	30	35	40	44	49	54	58	63	68	72	77
120			4	8	13	18	22	27	32	36	41	46	50	55	59	64	69	73	78
140			5	9	14	19	23	28	33	37	42	47	51	56	61	65	70	75	79
160		1	6	10	15	20	24	29	34	38	43	48	52	57	62	66	71	76	80
180		2	7	11	16	21	25	30	35	39	44	49	53	58	63	67	72	77	81
200		3	8	12	17	22	26	31	36	40	45	50	54	59	64	68	73	78	82
220		4	9	14	18	23	28	32	37	41	46	51	55	60	65	69	74	79	83
240	1	5	10	15	19	24	29	33	38	43	47	52	57	61	66	71	75	80	84
260	2	6	11	16	20	25	30	34	39	44	48	53	58	62	67	72	76	81	86
280	3	7	12	17	21	26	31	35	40	45	49	54	59	63	68	73	77	82	87
300	4	8	13	18	22	27	32	36	41	46	50	55	60	64	69	74	78	83	88
320	5	10	14	19	23	28	33	37	42	47	51	56	61	65	70	75	79	84	89
340	6	11	15	20	25	29	34	39	43	48	53	57	62	66	71	76	80	85	90
360	7	12	16	21	26	30	35	40	44	49	54	58	63	68	72	77	82	86	91
380	8	13	17	22	27	31	36	41	45	50	55	59	64	69	73	78	83	87	92
400	9	14	18	23	28	32	37	42	46	51	56	60	65	70	74	79	84	88	93
420	10	15	19	24	29	33	38	43	47	52	57	61	66	71	75	80	85	89	94
440	11	16	21	25	30	35	39	44	48	53	58	62	67	72	76	81	86	90	95
460	12	17	22	26	31	36	40	45	50	54	59	64	68	73	77	82	87	91	96
480	13	18	23	27	32	37	41	46	51	55	60	65	69	74	79	83	88	93	97
500	14	19	24	28	33	38	42	47	52	56	61	66	70	75	80	84	89	94	98
520	15	20	25	29	34	39	43	48	53	57	62	67	71	76	81	85	90	95	99
540	17	21	26	30	35	40	44	49	54	58	63	68	72	77	82	86	91	96	100
560	18	22	27	32	36	41	46	50	55	59	64	69	73	78	83	87	92	97	101
580	19	23	28	33	37	42	47	51	56	61	65	70	75	79	84	88	93	98	102
600	20	24	29	34	38	43	48	52	57	62	66	71	76	80	85	90	94	99	104
620	21	25	30	35	39	44	49	53	58	63	67	72	77	81	86	91	95	100	105
640	22	26	31	36	40	45	50	54	59	64	68	73	78	82	87	92	96	101	106
660	23	28	32	37	41	46	51	55	60	65	69	74	79	83	88	93	97	102	107
680	24	29	33	38	43	47	52	57	61	66	70	75	80	84	89	94	98	103	108
700	25	30	34	39	44	48	53	58	62	67	72	76	81	86	90	95	99	104	109

Appendix-22: Preparation of Forest Inventory Books and Entry Items

Forest inventory books were prepared by entering the data from compartments (established based on forest type maps in the forest management units and forest improvement units, as presented in 4.2) and the data from sub-compartments..

Forest Inventory books were prepared for classified froest and for the buffer zone separately. Forest inventory books contain the following information.

① Classified Forest

a. Management unit (District)
   GO: Gogounou
   BE: Bembéréké
b. Improvement unit
   GO1: ZOUGOU - KPANTROSSI
   GO2: WESSENE
   GO3: PIGOUROU
   BE1: KABANOU
   BE2: MANI-BOKE
c. Number of compartment
d. Number of sub-compartment
e. Zone
   FV : Village forestry zone
   SP : Silvo-pastorale zone
   FFP: Production forest zone
   FFC: Conservation forest zone
f. Land use and vegetation and forest type categories
   Gf : Riparian forest
   Fc : High forest
   Sa : Tree savanna
   Sb : Mixed savanna
   St : Shrub savanna
   Pf : Forest plantation
   Td : Bare land
   Tm : Marsh land
   Cl : Lateritic cuirasses
   Ar : Rock outcrop
   Pr : Orchard
   Ch : Farmland
   Ja : Fallow land
   Ag : Settlement
   Ce : Waterways
   Pe : Lakes and Marshes
   Au : Others
g. Land area (ha)

(Forest conditions)

h. Tree height class
   H1 : up to 9 m
   H2 : 10 to 19 m
   H3 : 20 m and more
i. Crown density (%)
j. Crown density class
   D1 : up to 24%
   D2 : 25 to 49%
   D3 : 50 to 74%
   D4 : 75% and more
k. Volume per ha (m^3/ha)
l. Stand volume (m^3)

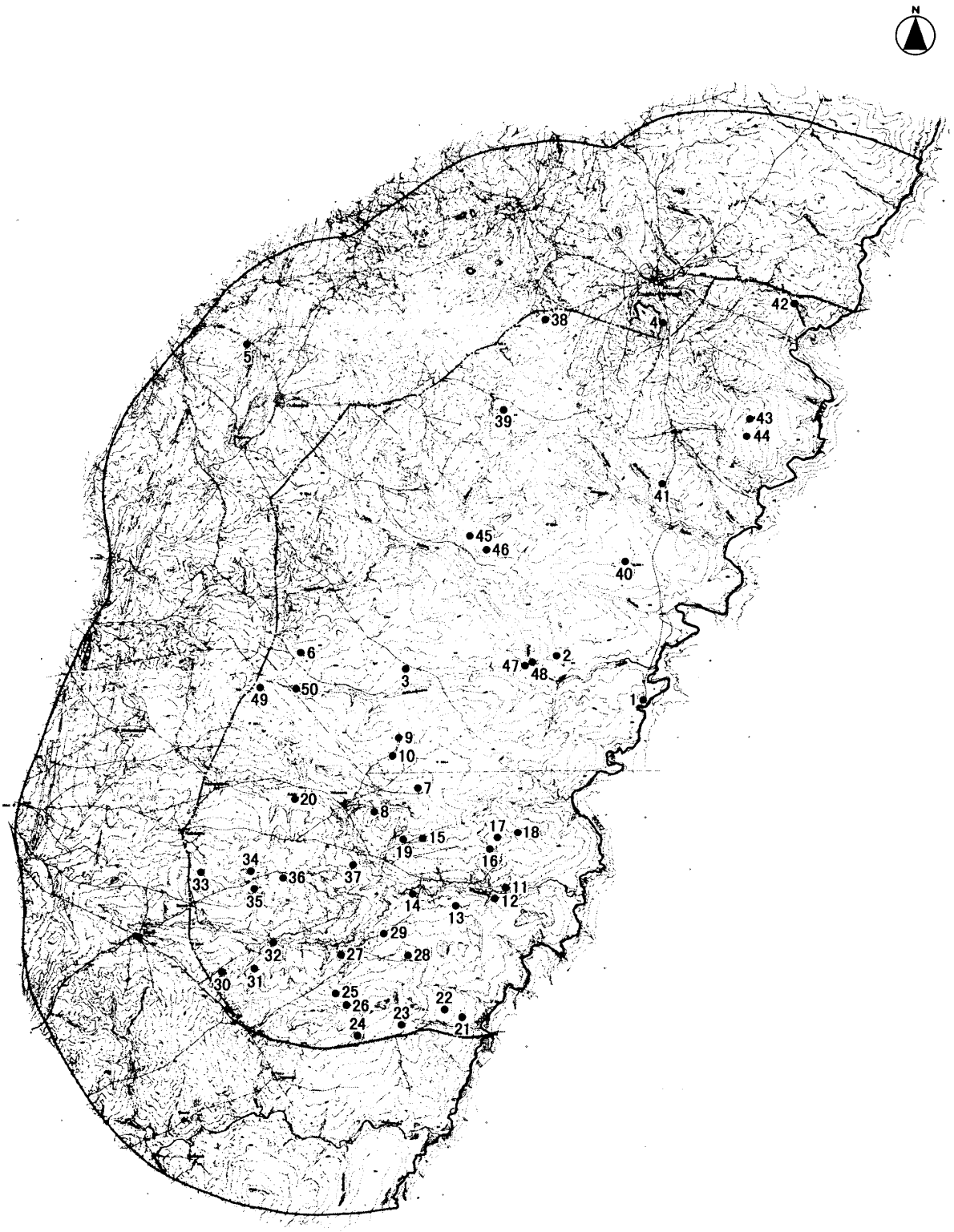
(Site condition)

m. Altitude (m)
n. Slope direction (9 directions)
o. Slope class
   P1 : 0° - 9°
   P2 : 10° - 19°
   P3 : 20° - 29°
   P4 : 30° and more
p. Unique topography
q. Soil unit
   FL-GL : Fluviosols/Gleysols
   GLd : Dystric Gleysols
   GLe : Eutric Gleysols
   LPd : Dystric Leptosols
   LPe : Eutric Leptosols
   LPu : Umbric Leptosols
   REd : Dystric Regosols
   PZh : Haplic Podzols
   PZg : Gleyic Podzols
   FRh : Haplic Ferralsols
   FRx : Xanthic Ferralsols
   FRr : Rhodic Ferralsols
r. Remarks

② Buffer zone

a. Management unit (district)
b. Number of compartment
c. Number of sub-compartment
d. Land use and vegetation and forest type (same as classified forest)
e. Land area (ha)

f. Tree height class (same as classified forest)
g. Crown density class (same as classified forest)
h. Altitude (m) (same as classified forest)
i. Slope direction (9 directions) (same as classified forest)
j. Slope class (same as classified forest)
k. Unique topography (same as classified forest)
l. Soil unit (same as classified forest)
m. Remarks



Appendix-23: Map Showing the Location of Surveyed Soil Profiles

Appendix-24: Results of the Soil Profile Survey

No. 1

No. of Profile	1) Soil classification Soil unit	2) Topography	3) Land use and vegetation	Gradient	Direction	4) Parent material	5) Mode of slope	6) Soil horizon	Horizon thickness (cm)	7) Distinctness of horizon boundary	Color	8) Humus content	9) Rock fragments	10) Texture	11) Degree of hardness	12) Soil sturucture	13) Moisture condition	14) Mycorhizes/ Mycelium	15) Root	Degree of acidity (H_2O)	16) Leaching/ Accumulation/ Mottling/ Nodule	Remarks
1	FRh	P•BO	Gf	<2 °	S	Gg	Re	A	10	C	7.5YR3/3	R-C	N	SL	H•20	GR	M	N	FC/MF	7.49		
								B	19	C	5YR4/6	F	N	SL	H•24	NM	M	N	FM	6.84		
								BC	17	C	2.5YR4/6-8	N	N	SL	H•33	NM	M	N	FV	6.62	Acc:clay	
								C	24+		2.5YR4/8	N	N	SL	H•33	NM	M	N	FV/CV	6.62	Acc:clay	
2	FRh	P•IN	Sa	<2 °	S10 ° W	Gg	Re	L	+		-						D	N	—	—		
								A	12	A	7.5YR3/3	R-C	N	S	H•21	GR	M	N	FV	7.41		
								AB	6	C	5YR4/6	F	N	S-SL	H•20	NS	M	N	FV	7.03		
								B	18	A	2.5YR4/6	N	N	SCL	H•24	NS	M	N	MC	7.09	Mot:Fe	
								C	34+		5YR4/6	N	N	S-SL	H•34	NS	M	N	FV	6.97		
3	FRh	P•LO	Sb	<2 °	E	Gg	Re	L	+		-						D	N				
								A	12	A	7.5YR4-3/2	R-C	N	SL	H•25	LG•GR	sD	N	FF/CV	6.84		
								B_1	13	G	5YR4/4	F	N	S-SL	H•19	NS	M	N	FF/MV	6.67		
								B_2	17	C	5YR5/6	N	N	SL-S	H•28	NS	M	N	FF/MV	6.28		
								C_1	18	VC	2.5YR4-5/6	N	N	SCL	H•35	NM	sD	N	N	6.19		
								C_2	20+		2.5YR5/6	N	N	CL	H•35	NM	sD	N	N	5.98	Mot:Fe	
4	FRh	P•IN	Sb	<2 °	E	Gg	Re	L	+									N				
								AB	13	C	7.5YR6/4	F	N	SL	M•18	GR	D	N	FC/MF	5.94		
								B_1	12	C	7.5YR6/8	N	N	SL	M•16	GR	M	N	FV	5.59		
								B_2	19	G	5YR5/8	N	C•C•S	SL	H•22	NM	M	N	FV/MV	5.56		
								C_1	11	C	5YR5/8	N	A•F•A•W	SL	H•31	NM	sD	N	FV	5.56		
								C_2	25+		5YR5/8	N	N	SL	H•34	NM	sD	N	N	5.78		
5	RGd	P•HI•	Sb	9 °	SE	Gg	Co	L	+		-							N				
		S						A	16	A	5YR5/2	F	M•FC•A	S	H•24	GR	D	N	F•C/MV	6.82		
								B_1	24	G	5YR4/6	N	A•FCS•A	S	M•16	NS	sD	N	FC	6.35		
								B_2	38	G-C	5YR3/6	N	M•F•A	LS	H•22	NS	M	N	FF	5.78		
								C	23+		5YR4/6	N	M•FC•A	LS	H•27	NS	M	N	N	5.92		

Appendix-24: Results of the Soil Profile Survey

No. 2

No. of Profile	1) Soil classification Soil unit	2) Topography	3) Land use and vegetation	Gradient	Direction	4) Parent material	5) Mode of slope	6) Soil horizon	Horizon thickness (cm)	7) Distinctness of horizon boundary	Color	8) Humus content	9) Rock fragments	10) Texture	11) Degree of hardness	12) Soil sturucture	13) Moisture condition	14) Mycorhizes/ Mycelium	15) Root	Degree of acidity (H_2O)	16) Leaching/ Accumulation/ Mottling/ Nodule	Remarks
6	FRr	P・IN	Sb	<1 °	SE	Gg	Re	LF	+	-	-							-				
								A	10	A	5YR3/2	R	N	SL	H・24	GR	M	-	FC	5.08		
								B	13	C	5YR4/4	C	C・F・S	SCL	H・28	NS	M	-	FF/MV	5.94		
								C_1	19	G	2.5YR5/8	N	N	CL	H・27	NS	M	-	FV	4.58		
								C_2	43+		2.5YR5/8	N	N	SCL	H・30	NM	M	-	FV	5.32		
7	FRx	P	Sb	<1 °	S70 ° E	Gg	Re	L	+									-				
								A	12	C	7.5YR3/4	C	A・F・S	LS	H・20	LG	M	-	FC	6.37		
								B_1	10	C	7.5YR4/6	F	A・F・C/CM	S	H・21	(LG)	sD	-	FF	5.43		
								B_2	23	A	7.5YR5/6	N	A・F・S	S	H・26	NS	sD	-	FC	5.11		concretion
								C	15+		2.5YR4/6	N		S	H・38		D～sD	-	N	5.50		
9	LPd	P・H1	Sb	15 °	N60 ° E	Gg	Re	L	+		—							-				
								A	14	C	7.5YR3/2	R	N	SL	H・24	GR(SA)	sD	-	FF/MV	7.13	Nod:A・F	
								B	22	A	2.5YR4/4	F	N	SC	H・26	GR	sD	-	MV/CV	6.31	Nod:A・F	
								C	49+		2.5YR4/8	N		-	H・35	-	D	-		5.95		concretion
10	PZh	P・IN	Sa	<1 °	N50 ° E	Gg	Re	L	+									-				
								A	16	C	5YR3/1	R	M・F・S	SL	M・17	LG	M	-	FC	6.30		
								B	20	A	7.5YR6/4	N	A・F・S	LS	H・24	(LG)	sD	-	FF/CV	6.17		
								C	19+		2.5YR4/6	N		LS	H・36	NM	sD	-	FV	5.33		concretion
11	GLe	P・BO	Gf	2 °	S	Gg	Re	L	+		—							-				
								A	17	A	7.5YR1.7/1	R	N	CL	M・15	CR	sW	-	FF/MV	6.98		
								B	35	C	7.5YR4/6	N	N	L	H・28	NM	M	-	FF/CV	7.00		
								C	33+		7.5YR5/6	N	N	LS	H・30	NM	M	-	FV	5.65	Mot:Mn	
12	LPu	P・LO	Sa	<2 °	E	Gg	Re	A	14	A	7.5YR3/2	R	C・F・A	SL	M・14	CR	sW	-	FF	7.68		
								B	18	A	7.5YR5/6	N	C・F・A	LS	H・29	NS	sD	-	MF/CV	6.56		
								C														concretion

Appendix-24: Results of the Soil Profile Survey

No. 3

No. of Profile	1) Soil classification Soil unit	2) Topography	3) Land use and vegetation	Gradient	Direction	4) Parent material	5) Mode of slope	6) Soil horizon	Horizon thickness (cm)	7) Distinctness of horizon boundary	Color	8) Humus content	9) Rock fragments	10) Texture	11) Degree of hardness	12) Soil sturucture	13) Moisture condition	14) Mycorhizes/ Mycelium	15) Root	Degree of acidity (H_2O)	16) Leaching/ Accumulation/ Mottling/ Nodule	Remarks
13	GLd	P•LO	Sa	<1 °	N30 ° E	Gg	Re	A	11	C	7.5YR2/2	R	N	L	M•16	CR(GR)	sW	Mm+	FF	6.67		
								B_1	13	G	5YR4/4	F	N	CL	M•18	(GR)	M	Mm+	FV/MF	5.55		
								B_2	36	G	7.5YR6/8	N	N	CL	H•27	NM	sD	-	FV/MF	4.44		
								C	15+		7.5YR6/6	N	N	C	H•30	NM	sD	-	FF	4.31		
14	LPe	P.LO	Sb	3 °	N	Gg	Re	O_1	2	A	5YR2/1	V	N	-	-	-		-	-	8.04		
								A	15	C	7.5YR3/3	R	V•C•S•W	SL	M•12	CR	sW	-	FC	7.24	Nod:FM	
								B	29	A	7.5YR3/4	C	C•F•S•W	LS	M•15	LG	M	-	FF	6.87	Nod.AF	
								R			2.5YR4/3	N		-						5.50		concretion
15	LPu	P•IN	St	<1 °	S10 ° W	Gg	Re	L	+													
								A	12	C	5YR3/2	R	N	SL	M•18	CR	sW	-	FF/MV	5.78	Nod:CF	
								B	9	A	5YR4/4	C	N	LS	M•13	NS	M	-	FC/MV	5.68	Nod:MF	
								R			5YR5/6									5.22		concretion
16	PZh	P•IN	Sa	<1 °	E	Gg	Re	L	+													
								A	10	C	7.5YR3/2	R	N	LS	M•16	CR	sW	-	FF	6.50		
								BE	15	C	7.5YR5/4	F	N	S	M•15	NS	sW	-	FF/MV	5.24	Lea:Fe•Al	
								E	13	A	10YR6/6	N	N	S	M•16	NS	M	-	FV/MV	5.14	Lea:Fe•Al	
								B_2	10+		2.5YR3/6	N			H•30		D	-	MV	5.15		concretion
17	PZh	P•IN	Sb	<2 °	E	Gg	Re	A	16	C	7.5YR3/1	R	V•F•S	SL	M•15	CR/(N)	sW	-	FC	7.39		
								B	21	C	7.5YR3/4	C	V•F•S	LS	M•18	NS	M	-	FV/CV	6.41		
								E	31	A	7.5YR5/4	N	V•C•S	LS	H•25	NS	D	-	FV	5.52		
								B_2	19+		2.5YR5/6	N			H•34		D	-	-	5.16		concretion
18	PZh	P•IN	Sa	<1 °	N52 ° E	Gg	Re	A	15	C	7.5YR3/2	R	N	LS	M•14	CR	sW	-	FF/CV	6.24		
								B	11	C	7.5YR4/4	C	N	S/LS	M•17	NS	M	-	FV/CV	6.25	Nod:FF	
								E	12	A	7.5YR6/6	N	N	S	H•26	NS	D	-	FV	6.32	Nod:FA	
								B_2	28		2.5YR5/8	N			H•35		D	-		5.94		concretion

Appendix-24: Results of the Soil Profile Survey

No. 4

No. of Profile	1) Soil classification Soil unit	2) Topography	3) Land use and vegetation	Gradient	Direction	4) Parent material	5) Mode of slope	6) Soil horizon	Horizon thickness (cm)	7) Distinctness of horizon boundary	Color	8) Humus content	9) Rock fragments	10) Texture	11) Degree of hardness	12) Soil sturucture	13) Moisture condition	14) Mycorhizes/ Mycelium	15) Root	Degree of acidity (H_2O)	16) Leaching/ Accumulation/ Mottling/ Nodule	Remarks
19	GLd	P•IN	St	<1 °	S	Gg	Re	Ag	14	C	10YR4/2	F	N	SL	H•24	Pl	sD	-	FV	5.72	Mot:FeV	
								Bg	16	G	10YR6/2	N	N	CL	H•26	NM	D	-	FV	5.28	Mot:FeF	
								C_1g	20	C	10YR6/3	N	N	SC	H•30	NM	D	-	N	5.90	Mot:FeC	
								C_2g	25+		7.5YR6/6	N	N	C	H•33	NM	D	-	N	6.09	Mot:FeC	
20	GLd	P.LO	Gf	<2 °	N65 ° E	Gg	Re	A	12	A	5YR3/1	R	N	CL	H•25	(SA)	M	-	FC	6.51		
								Bg	20	C	10YR5/2	F	N	SCL	H•30	NM	M	-	MV	5.95	Mot:FeA	
								Cg	28+		10YR5/2	N	N	SCL	H•33	NM	M	-	CV	8.38	Mot:FeA	
21	LPd	P•LO	Sb	<2 °	N60 ° E	Gg	Re	A	10	C	7.5YR3/2	R	V•F•S	CL	H•20	SA(GR)	M	-	FF	7.25	Nod:FV	
								B	10	A	5YR3/4	C	V•C•S	SL	H•25	(GR)	M	-	FV	5.67	Nod:FA	
								R	15+		2.5YR3/6	N			H•35		M	-	N	5.22		concretion
22	FRh	P•LO	Sa	<1 °	S45 ° E	Gg	Re	L	+	-	-							-				
								A	5	C	7.5YR4/2	C	N	LS	M•18	PL,GR	sD	-	FF	7.76		
								B_1	11	G	7.5YR5/4	F	N	SL	H•23	NS	M	-	FV	6.56		
								B_2	24	G	10YR6/6	N	N	SCL	H•29	NM	M	-	N	5.60	Mot:FeV	
								C	30+		10YR6/6	N	N	SCL	H•32	NM	M	-	N	5.53	Mot:FeV	
23	GLd	P•LO	St	<1 °	S55 ° E	Gg	Re	A	13	G	7.5YR4/2	C	N	SL	H•20	LG/(PL)	M	-	FC/CV	7.20		
								B_1	13	G	7.5YR4/3	F	N	LS	H•20	NS	M	-	FF	5.59	Mot:FeV	
								B_2	17	C	10YR5/6	N	N	SCL	H•29	NM	M	-	FV	6.30	Mot:FeM	
								C	27+		10YR5/8	N	N	C	H•34	NM	M	-	FV	6.60	Mot:FeA	
24	FRx	P•IN	Sa	<1 °	N75 ° E	Gg	Re	L	+													
								A	15	G	10YR5/3	C	N	LS	M•21	GR(LG)	sD	-	FC	6.56		
								B	18	G	10YR6/4	F	N	LS	H•30	NS	M	-	FV	4.80	Nod:FeF	
								C_1	27	C	10YR6/6	N	N	SCL	H•31	NM	M	-	FV	5.85	Nod:FeC	
								C_s	15+		10YR7/6	N	N	SC	H•33	NM	M	-	N	5.90	Nod:FeM	

Appendix-24: Results of the Soil Profile Survey

No. 5

No. of Profile	1) Soil classification Soil unit	2) Topography	3) Land use and vegetation	Gradient	Direction	4) Parent material	5) Mode of slope	6) Soil horizon	Horizon thickness (cm)	7) Distinctness of horizon boundary	Color	8) Humus content	9) Rock fragments	10) Texture	11) Degree of hardness	12) Soil sturucture	13) Moisture condition	14) Mycorhizes/ Mycelium	15) Root	Degree of acidity (H_2O)	16) Leaching/ Accumulation/ Mottling/ Nodule	Remarks
25	FRr	P•IN	Sa	<1 °	N40 ° E	Gg	Re	L	2	A								-				
								A	12	A	10YR3/2	R	VF•M•S•W	LS	H•21	LG,GR	M	-	FC	7.18		
								B_1	14	G	5YR4/6	F	VF•M•S•W	SL	H•24	NS	M	-	FV/MF	5.82		
								B_2	22	C	2.5YR4/6	N	C•F•S•W	SC	H•28	NS	M	-	FV/MF	6.11		
								C_1	22	C	2.5YR4/6	N	C•F•S•W	C	H•32	NM	M	-	FV/MV	5.64		
								C_2	15+		2.5YR4/8	N	M•F•S•W	C	H•34	NM	M	-	N	5.40		
26	FRx	P•IN	Sb	<1 °	N70 ° E	Gg	Re	L	2	A								-				
								A	15	A	7.5YR3/2	R	N	LS	H•24	CR,GR	M	-	FF/MF	7.63		
								B	17	G	7.5YR4/4	C	N	SL	M•18	NS	M	-	FF/MV	6.45		
								C_1	32	C	7.5YR5/6	N	C•F•S•W	SC	H•31	NS	M	-	FV/MV/CV	5.87		
								C_2	15+		2.5YR3/6	N			H•36		sD	-	N	5.08		concretion
27	FRr	P•LO	Sb	3 °	N60 ° E	Gg	Re	L	+									-				
								A_1	4	G	10YR3/2	R	N	SL	H•22	SA,GR	sD	-	FF	6.44		
								A_2	5	A	7.5YR4/3	C	N	SL	H•26	LG	sD	-	FC/MV	5.74	Nod:FeCF	
								B_1	23	C	5YR5/6	N	N	SC	H•28	NS	sD	-	FV/CV	5.24	Nod:FeAF	
								B_2	18	C	2.5YR4/8	N	N	SC	H•30	NM	D	-	FV	5.31	Nod:FeAF	
								C	15+		5YR4/6	N			H•33		D	-	N	5.30		concretion
28	LPd	P•HI	Sb	6 °	N55 ° E	Gg	Re	A	15	A	7.5YR3/1	R	A•F•S•W	SL	M•12	LG	D	-	FC	7.19	Nod:FeFF	
								R									D					concretion
29	FRh	P•IN	St	<1 °	N10 ° E	Gg	Re	L	+									-				
								A	15	C	10YR5/2	F	VF•S	SL	H•21	LG,GR	sD	-	FC	6.20		
								B	9	A	10YR5/3	F	N	SL	H•22	NS	M	-	FF	5.12		
								C	22	A	2.5YR5/8	N	N	SCL	H•24	NS	M	-	FV	4.41		
								R	9+		2.5YR4/8				H•33			-		5.55		concretion

Appendix-24: Results of the Soil Profile Survey

No. 6

No. of Profile	1) Soil classification Soil unit	2) Topography	3) Land use and vegetation	Gradient	Direction	4) Parent material	5) Mode of slope	6) Soil horizon	Horizon thickness (cm)	7) Distinctness of horizon boundary	Color	8) Humus content	9) Rock fragments	10) Texture	11) Degree of hardness	12) Soil sturucture	13) Moisture condition	14) Mycorhizes/ Mycelium	15) Root	Degree of acidity (H_2O)	16) Leaching/ Accumulation/ Mottling/ Nodule	Remarks
30	FRx	P•IN	St	<2 °	S60 ° E	Gg	Re	L	+									-				
								A	12	C	7.5YR3/1	R	N	SL	H•21	GR,SA	M	-	FF	6.62		
								B_1	20	C	10YR4/4	F	N	LS	H•25	NS	M	-	FF/MV	5.71		
								B_2t	22	A	10YR5/6	N	V•F•S	SC	H•28	NM	M	-	FV/MF	5.65	Mot:FeV	
								C	20+		7.5YR5/4	N	M•F•S	SC	H•30	NM	sD	-	N	5.89		
31	FRx	P•LO	Sb	<1 °	N40 ° E	Gg	Re	A	14	C	7.5YR2/1	V	N	SL	M•16	CR,PL	M	-	FF	7.28		
								B_1	22	C	7.5YR3/3	R	N	LS	H•21	NS	M	-	FF/MV	6.17		
								B_2	19	A	5YR4/6	F	N	LS	H•25	NS	M	-	FV/MV	5.43		
								R	10+		2.5YR4/6	N			H•32			-	N	6.59		concretion
32	FLg	P•BO	Gf	<1 °	N85 ° E	Gg	Re	L	3	A								-				
								A	8	A	7.5YR2/1	A	N	L	H•20	SR,GR	M	-	FC	6.59		
								B_1g	22	C	7.5YR3/3	R	N	SiL	H•25	NS	M	-	FF/CV	5.45	Mot:FeF	
								B_2g	30	G	10YR5/3	F	N	SiL	H•28	NS	M	-	FV/CF	5.37	Mot:FeC	
								Cg	15+		10YR5/3	F	N	LS	H•28	NM	M	-	FV	5.34	Mot:FeM	
33	FRx	P•IN	Sb	<2 °	S70 ° W	Gg	Re	L	2	A								-				
								A	20	C	10YR3/2	R	N	SL	H•28	GR,SA	D	-	FF/MV/CV	6.21		
								B_1	15	G	7.5YR6/6	N	N	LS	H•30	NS	D	-	FV/MV	5.17		
								B_2t	15	G	5YR5/6	N	N	SC	H•33	NM	sD	-	FV	5.06		
								C	35+		5YR5/8	N	N	C	H•34	NM	sD	-	FV	5.52		
34	FRx	P•IN	Sb	2 °	N75 ° E	Gg	Re	L	1	A								-				
								A	13	C	7.5YR4/2	C	V•F•S	SL	H•26	GR,CR	sD	-	FF	6.37		
								B_1	8	G	7.5YR3/4	F	C•F•S	SL	H•26	NS	sD	-	FC/MV	5.36	Nod:VF	
								B_2	24	A	7.5YR5/4	N	M•F•S	S	H•26	NS	D	-	FF/MV	5.16	Nod:VF	
								R	25+		2.5YR3/6	N		CON	H•35	-	sD	-	FV	4.45		concretion

Appendix-24: Results of the Soil Profile Survey

No. 7

No. of Profile	1) Soil classification Soil unit	2) Topography	3) Land use and vegetation	Gradient	Direction	4) Parent material	5) Mode of slope	6) Soil horizon	Horizon thickness (cm)	7) Distinctness of horizon boundary	Color	8) Humus content	9) Rock fragments	10) Texture	11) Degree of hardness	12) Soil sturucture	13) Moisture condition	14) Mycorhizes/ Mycelium	15) Root	Degree of acidity (H_2O)	16) Leaching/ Accumulation/ Mottling/ Nodule	Remarks
35	FRx	P•LO	FC	<1 °	S55 ° W	Gg	Re	L	1	A								-				
								A	14	A	7.5YR3/3	R	N	LS	H•28	SA,LG	sD	-	FF/MV/CV	6.91		
								B_1	9	G	5YR4/4	C	V•F•S•W	SCL	H•33	NS	sD	-	FF/MV/CV	6.33	Nod:FeV	
								B_2t	28	C	5YR4/6	N	V•F•S•W	SC	H•33	NM	D	-	FV	5.48	Nod:FeF	
								Ct	24+		7.5YR4/6	N	V•F•S•W	C	H•34	NM	D	-	FV	5.69	Nod:FeF	
36	FRh	P•IN	St	<1 °	N30 ° E	Gg	Re	L	+	A								-				
								A	8	A	7.5YR3/1	V	VFS	LS	M•12	GR,SA	sW	-	FC	6.56		
								B_1	15	C	7.5YR3/3	R	VFS	LS	M•13	NS	M	-	FC	5.59		
								B_2	27	A	5YR5/6	N	VFS	SC	H•32	NM	D	-	FF	5.29	Nod:FeV	
								R	10+		5YR4/8	N			H•33		D	-	FV	5.70	Nod:FeC	concretion
37	FRx	P•IN	Sb	<1 °	N50 ° W	Gg	Re	L	+									-				
								A	8	C	10YR3/2	R	VFS	SL	M•18	PL	M	-	FF	7.28		
								B	8	A	10YR5/3	N	MFS	SCL	H•24	NS	D	-	FF	6.42		
								BC	20	A	10YR5/3	N	VFS	SC	H•28	NM	D	-	FF/MV	6.19	Nod:FeV	
								R	12+		2.5YR4/6	N			H•37		D	-	N	6.08	Nod:FeC	concretion
38	FRx	P•IN	Sb	<2 °	S10 ° E	Gg	Re	L	1	A								-				
								A	12	C	5YR3/1	R	VFS	SL	H•25	LG,SA	M	-	FM	6.84		
								B_1	16	C	5YR4/2	C	VFS	SL	H•23	LG	sD	-	FC/MF/CF	6.51		
								B_2	9	A	7.5YR4/3	F	N	SCL	H•27	NS	D	-	FV/MV	6.53		
								R	13+		2.5YR4/4	N			H•33		D	-	N	7.03		concretion
39	FRx	P•IN	Sa	<2 °	S70 ° W	Gg	Re	L	1	A												
								A	8	A	7.5YR3/3	R	N	CL	M•17	LG	M	-	FV	7.29		
								B_1	8	C	7.5YR5/4	F	AFW	SL	H•23	NS	D	-	FC	6.09		
								B_2	9	C	7.5YR4/6	N	AF • CW	CL	H•27	NS	D	-	FF	6.90	Nod:FeC	
								C	35+		5YR4/6	N	AF • CW	C	H•30	NS	D	-	FV	6.72	Nod:FeC	

Appendix-24: Results of the Soil Profile Survey

No. 8

No. of Profile	1) Soil classification Soil unit	2) Topography	3) Land use and vegetation	Gradient	Direction	4) Parent material	5) Mode of slope	6) Soil horizon	Horizon thickness (cm)	7) Distinctness of horizon boundary	Color	8) Humus content	9) Rock fragments	10) Texture	11) Degree of hardness	12) Soil sturucture	13) Moisture condition	14) Mycorhizes/ Mycelium	15) Root	Degree of acidity (H_2O)	16) Leaching/ Accumulation/ Mottling/ Nodule	Remarks
40	FRx	P•HI	Sa	<1 °	S60 ° E	Gg	Re	L	+	A								-				
								A	13	A	10YR3/2	R	N	SL	M•13	CR	sW	-	VF	7.02		
								B	15	A	7.5YR5/4	F	N	S	M•18	NS	M	-	VV/FV	6.55		
								C	22	A	7.5YR6/6	N	CF • CS	LS	H•24	NS	M	-	VV	5.72	Nod:FA	
								R	5+		2.5YR3/4	N			H•33			-	N	-		concretion
41	FRr	P•IN	Sa	<2 °	S10 ° E	Gg	Re	L	+									-				
								A	14	A	7.5YR3/2	R	N	SL	M•18	CR	M	-	FF	7.80		
								B_1	16	G	2.5YR4/6	N	N	SC	H•31	NS	M	-	FV/MV/CV	6.82		
								B_2t	30	C	2.5YR4/6	N	VFSW	C	H•31	NM	M	-	FF	6.36		
								Ct	15+		2.5YR4/8	N	N	C	H•31	NM	M	-	FV	6.18	Nod:FeFC	
42	FRr	P•LO	Gf	6 °	N20 ° W	Sr	Re	L	1									-				
								A	9	A	7.5YR3/3	R	N	SL	H•21	SA	M	-	FF	6.86		
								B1	12	A	5YR4/6	F	N	SC	H•25	NM	M	-	FV/MV	5.58		
								B_2t	19	G	2.5YR4/8	N	N	C	H•30	NM	M	Mm+	FV	5.65		
								Ct	30+		2.5YR4/8	N	N	C	H•34	NM	sD	-	N	5.28		
43	LPd	P•IN	Sb	<2 °	S	Sr	Re	L	+									-				
								A	10	A	7.5YR3/3	R	VFSW	L	H•20	LG,PL	M	-	VC	6.54		
								B	20	A	5YR5/6	N	MFSW	CL	H•25	NS	sD	-	V•FV/MV	6.39		
								R	15+		2.5YR4/6	N			H•34		sD	-	N	5.77		concretion
44	PZg	P•IN	Sa	<1 °	S	Sr	Re	A	12	A	10YR3/2	R	N	L	H•21	(LG)	sD	-	VF	7.65		
								E	10	A	10YR6/3	N	N	SL	H•28	NS	D	-	FV	5.85	Mot:FeV	
								Bts	15	C	7.5YR6/4	N	N	C	H•32	NM	sD	-	FV	5.22	S•FeC, 2.5YR5/6	
								Bs	38+		7.5YR6/4	N	N	C	H•33	NM	M	-	N	5.38		

Appendix-24: Results of the Soil Profile Survey

No. 9

6) Soil zone	Horizon depth	2) Topography	3) Land use and vegetation	Gradient	Direction	4) Parent material	5) Mode of slope	6) Soil horizon	Horizon thickness (cm)	7) Distinctness of horizon boundary	Color	8) Humus content	9) Rock fragments	10) Texture	11) Degree of hardness	12) Soil sturucture	13) Moisture condition	14) Mycorhizes/ Mycelium	15) Root	Degree of acidity (H_2O)	16) Leaching/ Accumulation/ Mottling/ Nodule	Remarks
45	GLd	P•IN	Sb	<1 °	N65 ° W	Gg	Re	A	10	C	10YR4/2	C	N	SL	H•24	SA	sD	-	FF	7.03		
								B_1	10	C	10YR5/4	F	N	SC	H•30	NS	sD	-	VV/FV	5.72	Mot:FeV	
								B_2t	19	C	10YR6/4	N	N	C	H•33	NM	D	-	VV/FV	5.38	Mot:FeF	
								Ct	26+		10YR6/6	N	N	C	H•35	NM	D	-	N	5.71	Mot:FeM	
46	GLd	P•IN	Sb	<1 °	S50 ° E	Gg	Re	L	1													
								A	10	C	7.5YR3/2	C	N	SL	M•16	CR	M	Mm+	VF	7.11		
								B_1	10	G	5YR5/8	G	N	SCL	H•22	NS	M	-	FV/MV	6.50	FeV MnV	
								B_2t	16	C	5YR5/6	C	N	SC	H•31	NM	M	-	FV	5.18	FeF MnF	
								Ct	34+		5YR4/8		N	C	H•34	NM	M	-	FV	5.43	FeC MnV	
47	FRh	P•IN	Sb	<2 °	N10 ° E	Gg	Re	L	1									-				
								A	7	C	7.5YR3/2	R	N	LS	H•21	(GR)	M	-	VC	6.07		
								B	23	A	5YR4/4	F	CFS	LS	H•23	(LG)	sD	-	FC/MV/CV	6.18	Nod:FA	
								R	22+		2.5YR4/4	N			H•35		D	-	VV	5.79		concretion
48	GLe	P•LO	Gf	<2 °	S50 ° E	Gg	Tp	L	2									-				
								A	15	C	5YR3/1	V	N	CL	H•26	NS	M	-	FF	7.71		
								B_1	25	G	7.5YR4/3	C	N	CL	H•23	(SA)	M	-	FV/MV	7.02	FeF MnF	
								B_2	15	C	10YR5/4	N	N	ℓ C	H•30	NM	M	-	FV	6.80	FeM MnV	
								C	20+		10YR5/2	N	N	C	H•30	NM	M	-	FV/CV	6.49	Mot:FeA	
49	GLd	P•LO	Sb	<1 °	N50 ° E	Gg	Re	L	+									-				
								A	13	C	10YR3/2	R	VFS	SL	H•22	(PL,GR)	M	-	FF	6.27		
								B_1	10	G	7.5YR5/6	F	N	SL	H•30	NS	M	-	FF/MC	5.35	Mot:FeV	
								B_2	23	C	7.5YR5/8	N	N	SC	H•32	NM	M	-	FV	5.26	Mot:FeC	
								C	9+		7.5YR6/6	N	N	C	H•34	NM	sD	-	N	5.37	Mot:FeA	

Appendix-24: Results of the Soil Profile Survey

No. 10

No. of Profile	1) Soil classification Soil unit	2) Topography	3) Land use and vegetation	Gradient	Direction	4) Parent material	5) Mode of slope	6) Soil horizon	Horizon thickness (cm)	7) Distinctness of horizon boundary	Color	8) Humus content	9) Rock fragments	10) Texture	11) Degree of hardness	12) Soil sturucture	13) Moisture condition	14) Mycorhizes/ Mycelium	15) Root	Degree of acidity (H_2O)	16) Leaching/ Accumulation/ Mottling/ Nodule	Remarks
50	GLd	P•BO	Gf	<2 °	N60 ° E	Gg	Tp	L	+									-				
								A	12	C	2.5YR4/2	C	N	LS	H•23	NS	sD	-	FF	7.99		
								B_1g	17	C	10YR5/4	F	N	LS	H•29	NS	D	-	FV/MV	5.67	Mot:FeV	
								B_2g	21	G	7.5YR6/6	N	N	LS	H•30	NM	D	-	FV	5.38	Mot:FeV	
								Cg	20+		5YR5/6	N	N	SC	H•33	NM	D	-	N	5.39	Mot:FeM	

Legend of Records on the Soil Profile Survey Described in Appendix-24

1. Soil classification/Soil unit
   - FL : Fluiviosols
     - FLd : Distric Fluviosols
     - Flu : Umbric Fluviosols
   - RG : Regosols
     - RGd: Dystric Regosols
   - LP : Leptosols
     - LPd : Distric Leptosols
     - LPu : Umbric Leptosols
   - LV : Luvisols
     - LVx : Chromic Lusvisols
     - LVh: Haplic Lusvisols
     - LVa: Albic Lusvisols
   - FR : Ferralsols
     - FRh : Haplic Ferralsols
     - FRx : Xanthic Ferralsols
     - FRr : Rhodic Ferralsols
     - FRu : Humic Ferralsols
   - GL : Gleysols
     - GLu: Umbric Gleysols
     - GLd: Dystric Gleysols
   - PZ : Podzols
     - PZh: Haplic Podzols

2. Topography
   1) Landform
      - H : Hilly
      - P : Plain
   2) Position
      - HI : Higher part
      - IN : Intermediate part
      - LO : Lower part
      - BO : Bottom (drainage line)
   3) Form
      - S : Straight
      - C : Concave
      - X : Convex
      - s : Steep
      - g : Gentle

3. Vegtation/Land use
   - Gf : Galerie forestiere
   - Fc : Foret claire
   - Sa : Savane arboree
   - Sb : Savane boisee
   - St : Savane arbustive
   - Pf : Plantation forestiere
   - Td : Terrain denude
   - Tm : Terrain marecageux
   - Cl : Cuirasse lateritique
   - Ar : Affleurement rocheux
   - Pr : Plantation fruitiere
   - Ch : Champ
   - Ja : Jacheres
   - Ag : Agglomerations
   - Ce : Cours d'eau
   - Pe : Plan d'eau
   - Au : Autres

4. Parent material
   - Sr : Sadimentary rock (Sanstone/Conglomerate)
   - Gg : Granite gneiss

5. Mode of slope
   - Re : Residual
   - Cr : Creeping
   - Co : Colluvial
   - Tp : Transportation

6. Horizon
   1) Master horizons and layers
      - H : Organic materila at the soil surface
      - O : Organic material, undecomposed litter as leaves, needles, twigs, moss and lichens
        - L : Fallen leaves, undecomposed
        - F : Decomposed leaves, originals tissue is distinct
        - H : Humus, Organics are decomposed completely
      - A : A_1, A_2, A_3 ; Mineral horizons, , accumulation accumulation of organic matter (humus)
      - E : Ea, Eb ; Leaching and loss of clay mineral
      - B : B_1, B_2, B_3 ; Mineral horizons are formed below H, O or A horizon
      - C : C_1, C_2 ; Mineral horizons, parent material of soils originated from be rock or sediments
      - R : Bedrock

   2) Suffixes of symbolic letters of subordinate characteristics with master horizons
      - c : Concretions or nodules
      - f : Frozen soil
      - g : Gleying
      - h : Accumulation of organic matter
      - j : Jarosite mottles
      - k : Accumulation of carbonates
      - m : Cementation or induration
      - n : Accumulation of sodium
      - o : Residual accumulation of sesquioxides
      - p : Ploughing or other disturbance
      - q : Accumulation of silica
      - r : Strong reduction
      - s : Illuvial accumulation of sesquioxides
      - t : Accumulation of silicate clay
      - v : Occurrence of plinthite
      - w : Development of colour or structure

7. Distinctness of horizon boundary
   - A : Abrupt (0 - 2 cm)
   - C : Clear (2 - 5 cm)
   - G : Graduel (5 – 15 cm)
   - D : Diffuse (> 15 cm)

8. Humus content
   - V : Very rich
   - R : Rich
   - C : Common
   - F : Few
   - N : None

9. Rock fragment (gravels)
   1) Content
      A : Abundant
      M : Many
      C : Common
      F : Few
      V : Very few
      N : None
   2) Size
      F : Fine (< 2 cm)
      C : Coarse (2 - 6 cm)
      S : Stones (6 - 20 cm)
      B : Boulders (> 20 cm)
   3) Shape
      A : Angular
      S : Subangular
      R : Rounded
   4) Weathering
      F : Fresh (not recorded symbo letter)
      W : Weathered

10. Texture
      C : Clay
      CL : Clay loam
      L : Loam
      SiC : Silty clay
      SiCL: Silty caly loam
      Sil : Silt loam
      Si : Silt
      SC : Sandy clay
      SCL: Sandy clay loam
      SL : Sandy loam
      LS : Loamy sand
      S : Sand

11. Hardness
      H : Hard (> 21 mm)
      M : Medium (11 - 18 mm)
      S : Soft (< 10 mm)

12. Structure
      PL : Platy
      LG : Loose granular
      GR : Glanular
      SA : Subangular
      N : Non structure
      NS : Non structure, single grain
      NM : Non structure, massive

13. Moisture condition
      D : Dry
      M : Moderately moist
      W : Wet
      S : Slightly
      O : Over wet

14. Mycorrhiza and Mycelium
   1) My : Mycorrhiza
      Mm : Mycelium
   2) Development level
      N : None
      + : Very few
      ++ : Few
      +++ : Medium
      ++++ : Many

15. Root
   1) Size
      V : Very fine (< 0.5 mm)
      F : Fine (0.5 - 2 mm)
      M : Medium (2 - 20 mm)
      C : Coarse (> 20 mm)
   2) Development
      N : None
      V : Very few
      F : Few
      C : Common
      M : Many

16. Leaching/Accumulation
    Mottling/Nodule
   1) Kind
      Lea : Leaching
      Acc : Accumulation
      Mot : Mottling
      Nod : Nodule
         Content
            A : Abundant
            M : Many
            C : Common
            F : Few
            V : Very few
            N : None
         Size
            V : Very fine
            F : Fine
            M : Medium
            C : Coarse
   2) Mineral
      Fe : Iron
      Al : Aluminium
      Mn : Manganese

Appendix-25: Charcteristics of Soil Classes

The soil classification was carried out in accordance with the soil classification criteria of FAO (FAO/UNESCO, World Soil Resources Report 60, SOIL MAP OF THE WORLD, revised Legened by Food and Agriculture Organization of the United Nations – Rome, 1990)

The soils distributed in the Study Area were classifed into 6 major grouping and 12 soil units based on the morphological characteristics of the soil profiles, which were determined as the result of soil profile description.

Morphological Characteristics of Major Soil Grouping and Soil Units

Major soil groupings, soil unit	Principal morphological characteristics
1. Fluvisols(FL)	Immature soils consisting of alluvial deposits or relatively recent deposits of sand, gravel and clay brought by the rivers.
1) Distric Fluvisols (FLd)	Fluvisols of low fertility and very little base and organic matter
2. Regosols (RE)	Immature soils made of unconsolidaed sand and gravel parent material. No soil horizon developed except for the organic matter containing A horizon.
1) Dystric Regosols (Red)	Regosols of low fertility containing very little base and other nutritive elements
3. Gleysols (GL)	Soils made up of unconsolidated sediments and showing gleyic properties to within 50 cm of the surface horizon
1) Dystric Gleysols (GLd)	Unfertile Gleysols containing very little base and other nutritive elements
2) Eutric Gleysols (GLe)	Fertile Gleysols which contin much base and other nutritive elements.
4. Leptosols (LP)	Shallow soils of some 10 cm depth below which hard rocks or continuous consolidated layers exist, soils of sandy coarse grain of more than 75 cm in which except A horizon no other distict horizons had developed.
1) Dystric Leptosols (LPd)	Leptosols of low fertility and containing little base and other nutritive elements
2) Eutric Leptosols (LPe)	Fertile Leptosols which contain much base and other nutritive elements
3) Umbric Leptosols (Lpu)	Leptosols rich in organic matter having a Umbric A horizon
5. Podzols (PZ)	Spodio B horizon: Soils which contain organic matter and iron or aluminium, or a consolidated continuous sub-horizon containing a combination of the two, under A horizon.
1) Haplic Podzols (PZh)	Podzols comprising a continuous albic horizon of more than 2 cm thickness
2) Gleyic Podzols (PZg)	Podzols having gleyic properties to within 100 cm of the surface horizon
6. Ferralsols (FR)	Soils containing Ferralic B horizon (B horizon containing a high density of sesquioxides)
1) Haplic Ferralsols (FRh)	Ferralsols slightly reddish and not containing much organic matter
2) Xanthic Ferralsols (FRx)	Ferralsols having a strongly yellowish ferralic B horizon and not containing much organic matter
3) Rhodic Ferralsols (FRr)	Ferralsols having a quite reddish ferralic B horizon and not containing much organic matter

① Fluvisols (FL)

This soil group is composed of the alluvial deposits and is mainly located along the drainage ways. In general, this group of soil is deep and soft but with less developed horizons and immature aspects. As the sediments discharged in the catchment area constitute the parent material of the soil, the properties of the weatherin of base rock and the effect of sediment transport in water are reflected on texture and there are many silty and sandy soils in the area. As the soil moisture environment is suitable, the soil thus has a sufficient amount of moisture except during the floods in the rainy season. Since various soil elements are being provided by the sediments or the run-off water, this area presents the most productive group of soils.

The soil unit most distributed in this group is the Dystric Fluvisols. This unit has a relatively small degree of base saturation but its deep soil had formed a relatively soft deposit with an abundant moisture, which is suitable for the growth of various tree species.

② Regosols (RE)

This group of soils is formed by deposition of the coarse grain (sand and gravel) parent material on hard rocks and the horizons other than the surface horizon had developed slightly or not at all. That is to say, the soil is made of such parent materials as volcanic eruption material, eolian deposits and colluvial deposits and is immature. According to the properties of their parent material and the soil formation environment, the Regosols are made of Eutric Regosols which are fertile and rich in nutritive elements, Dystric Regosols which are low in nutritive elements and Calcaric Regosols which are rich in calcium.

In this area Regosols are found mainly on the small granite gneiss hills which scater on the North-South tape of the western part of the area. Although Regosols have a slightly developed A horizon, this soil is a Dystric Regosols which contain little organic matter and bases, many gravels and has relatively low fertility. Given the fact that the soil is relatively loosely deposited and contains many unweathered minerals which continuously provide soil elements, there is a relatively better vegetation growth where the soil is deep. However, in general, this soil group is not very deep, the base rock is often exposed on the ground surface and thus growth of the vegetation on this soil leaves something to be desired.

③ Gleysols (GL)

This group of soil is made up of unconsolidated sediments and have mottling concretion and hydromorphic properties or gleyic properties at a 50 cm depth from the land surface. This group is thus distributed in the wet lands along the drainage ways, in the concave shaped lands or in the hollows which remain soaked with water or are wet for a long period.

The Geysols found in the area can be classified in to the following 2 soil units according to parent material properties and such soil formation environment as the topographic position.

(a) Dystric Gleysols (GLd)

The shallow surface horizon does not contain organic matter and below B horizon is very hard and not very nutritive with reduction color and nodules. This soil unit is found in small areas in low lands in plateau flooded during the rainy season. The density of the trees in this soil group is relatively low with a bad growth.

(b) Eutric Gleysols (GLe)

This soil unit is very fertile and contains much base and other nuturitive elements. In general, it is destributed in combination with the Fluvisols in the depressions close to the drainage ways, which is covered with water during the floods. The trees grow well in this soil unit.

④ Leptosols (LP)

This group of soil is limited in-depth by the presence of continuous hard rock, parent material having a high percentage of calcium or a continuous pyroclastic deposit in 30 cm of the surface horizon. Moreover, it is a shallow and immature soil in the profile of which no specific diagnostic horizon except mollic, unbric and ochric A horizons had developed.

(a) Dystric Leptosols (LPd)

In fact these are leptosols of low fertility, contain little base and other nutritive elements and have a ochric A horizon. The soil is very hard and some 30 cm below the ground surface a thick and hard layer of iron rock is deposited. Tree growth is bad on this soil unit. This soil unit is widespread on the slope breaks in plateau where flat land changes to slightly inclined land, on the erosional convex topography and where the plateau contacts drainage ways.

The following 3 Leptosols are confirmed in this area.

(b) Eutric Leptosols (LPe)

These leptosols are quite fertile, contain many nutritive bases and other elements and have a Ochric A horizon. This soil unit is found in narrow bands close to the drainage network. No pyroclastic deposit is formed in a 10 cm below the land surface. The growth of the vegetation is not very good in this soil unit.

(c) Umbric Leptosols (LPu)

These leptosols have a Umbric A horizon rich in organic matter and are distributed in small areas close to the drainage networks. The density of the trees is low and the growth of the vegetation is not very good in this soil.

⑤ Podzols (PZ)

The most clearest characteristic of this group of soil is that it has a Spodic B horizon. The following 2 types fo podzols are found in the surveyed area.

(a) Haplic Podzols (PZh)

This soil unit constitutes the podzols comprising a reddish horizon continuous or visible with the naked eye and rich in organic matter. In the surveyed area one finds this soil unit on a relatively small areas in the continuously cultivated fields or in the fallow lands (old farmlands). The surface horizon of this unit is a brownish gray sandy albic horizon. This type of soil is generally not very fertile and one or two years after the suspension of the cultivation, some grases and shrubs will grow in the fields containing this soil unit.

(b) Gleyic Podzols (PZg)

This soil contains in some 100 cm depth below the surface horizon, spots, nodules and a color of reduction which have the characteristics of the Gleysols. In the area surveyed, one finds this unit in small areas in the forest having a concave topography. Below the surface arbic horizon there is a spodic horizon which contains many clay and iron spots and below it, one finds a sesquioxide pyroclastic deposit. Tree growth on this soil unit is average.

⑥ Ferralsols (FR)

This group of soil is one of the typical tropical soils having a Ferralic B horizon (Horizon containing iron and alumina). The B horizon has a depth of at least 30 cm, is poor in base and other element and is reddish or yellowish sandy loam. The following three types of ferralsols are found in the area.

(a) Haplic Ferralsols (FRh)

These ferralsols contain a Ferralic B horizon and are neither too reddish nor too yellowish and do not contain much organic matter. In the area surveyed, these soils are widely distributed on granite gneiss zone. In the 10 cm deep surface horizon there is a little organic matter and other base matter or elements are washed out. Below the B horizon of this soil unit, very often a cemented iron layer is found. This type of soil is one of the typical soil of the area surveyed and the vegetation growth on this soil type is medium to good.

(b) Xanthic Ferrralsols (FRx)

This unit has charcteristics very similar to the Haplic Ferralsols except that it is of strongly yellowish color. This soil unit is widely distributed in the area surveyed, is the representative soil unit of the area and plant growth is satisfactory in this soil unit.

(c) Rhodic Ferralsols (FRr)

This soil unit has a reddish to dark reddish Ferralsols are widespread on conglomerate sedimentary rocks in the North-East and in a part of the South of the Study Area. The tree growth is good on this soil unit.

Appendix-26: Farming Population

Area		Total population	Farmer population		Persons actually engaged in faming		Number of farming household	Household size	Number of farmers by household
			Number	Rate (%)	Number	Rate (%)			
Gogounou District	Zougou-Kpantrossi	2,001	2,001	100.0	955	47.7	138	14.5	6.9
	Zougou Peulh	877	877	100.0	479	54.6	64	13.7	7.5
	Gamagou	2,434	2,286	93.9	1,227	53.7	220	10.4	5.6
	Wesséné	990	990	100.0	556	56.2	115	8.6	4.8
	Wesséné Peulh	1,090	1,090	100.0	586	53.8	84	13.0	7.0
	Pigourou	902	902	100.0	586	65.0	97	9.3	7.4
	Sub-toal	7,392	7,244	98.0	4,389	60.6	718	10.1	6.1
Bembéréké District	Beroubouay-Est	2,894	2,788	96.3	1,452	52.1	279	10.0	5.2
	Beroubouay Peulh	2,455	2,455	100.0	1,414	57.6	280	8.8	5.1
	Kabanou	757	757	100.0	366	48.3	63	12.0	5.8
	Bouay	3,101	3,101	100.0	2,391	77.1	272	11.4	4.8
	Béréké	931	931	100.0	721	64.5	91	12.3	7.9
	Mani-Boké	1,117	1,117	100.0	721	64.5	91	12.3	7.9
		10,138	10,032	99.0	6,863	68.4	1,057	9.5	6.5
Grand total		17,530	17,276	98.6	11,252	65.1	1,775	9.7	6.3

Source: Inquiry at CARDER-Borgou (Results of Pre-census on agriculture)

Appendix-27: Output of the Principal Crops (unit: kg/ha)

District / village		Cotton	Corn	Millet	Sorghum	Rice	Yam	Cassava	Ground-nut	Niébé
Gogounou (Average of 3 years)	Zougou	1,151	1,487	819	752	0	8,859	4,719	1,037	759
	Gamagou	1,081	1,389	934	735	2,038	9,053	4,897	1,000	781
	Wesséné	1,126	1,457	890	863	1,988	9,404	5,018	995	685
	Pigourou	1,086	1,469	854	845	1,966	9,158	4,908	1,008	710
	Ave. of 4 villages	1,111	1,451	874	799	1,498	9,119	4,886	1,010	734
	Ave. of Gogounou*	1,541	1,080	685	538	-	4,272	5,346	775	767
Bembéréké (Average of 5 years)	Beroubouay	1,277	1,100	-	1,000	629	12,000	8,500	900	1,250
	Kabanou	1,248	1,269	-	941	1,977	9,704	7,729	969	849
	Mani-Boké	1,500	1,100	-	1,000	2,200	12,000	8,500	900	1,250
	Ganro	1,500	1,100	-	1,000	2,200	12,000	8,500	900	1,250
	Bouay	1,272	1,100	-	1,000	2,200	12,000	8,500	900	1,250
	Béréké	1,272	1,100	-	990	2,200	12,000	8,500	912	1,250
	Ave. of 6 villages	1,345	1,128	-	990	1,901	11,617	8,372	912	1,183
	Ave. of Bembéréké*	4,047	1,229	-	922	-	9,970	7,894	970	611
Average of 10 villages		1,251	1,257	874	914	1,740	10,618	6,977	951	1,003

* Average of 5 years

Source: Anuual report CARDER-Borgou (1998)

Appendix-28: Farming Calendar

Crops	Jan.		Feb.		Mar.		Apr.		May		June		July		Aug		Sept.		Oct.		Nov.		Dec.	
Yam	S	S							Sa			Sa			Pr Sa	R	Dr	D		B		R	S T	S
Corn								N	LS	Sa		Sa		Sa										
Sorghum	R									N		LS	Sa			Sa								
Niébé										N L S			Sa		Sa				R					
Groundnut									N	LS		Sa			Sa		R	R						
Cassava				R		N	LS	LS									Sa							
Cotton								N		L	S Sa	De	F	Tr	Tr F	Tr Sa	Tr	Tr	Tr	R	R T	T		

Legend: Pr = Preparation before cultivation Df = Cultivation D = Root removal L = Tilling
B = Ridging Sa = Weeding S = Sowing/planting R = Harvest
T = Transport N = Cleaning and removal of waste De = Weeding
F = Manure application Tr = Treatment

Appendix-29: Cost of the Main Crops

		Unit	Raw cotton			Corn			Groundnut			Yam		
			Unit price	Volume	Price	Unit price	Volume	Price	Unit price	Volume	Price	Unit price	Volume	Price
Seeds		Kg	-	-	-	180	20	3,600	180	0	0	180	0	0
Eertilizer	N	Bag (50kg)	9,500	1.0	9,500	9,500	0.0	0	9,500	0.0	0	9,500	0.0	0
	P	Bag (50kg)	9,500	1.0	9,500	9,500	1.0	9,500	9,500	0.0	0	9,500	0.0	0
	K	Bag (50kg)	9,500	1.0	9,500	9,500	1.0	9,500	9,500	0.0	0	9,500	0.0	0
	Urea	Bag (50kg)	9,500	1.0	9,500	9,500	1.0	9,500	9,500	0.0	0	9,500	0.0	0
Chemical	Insecticides	liters	3,600	6.0	21,600	-	6.0	-	-	0.0	-	-	0.0	-
	Weeding	liters	5,200	4.0	20,800	5,200	4.0	20,800	5,200	0.0	0	5,200	0.0	0
	Others	Bag	-	-	-	300	64.0	19,200	300	0.0	0	300	0.0	0
Labour	Elimination of wast	Person/day	834	6.0	5,000	834	6.0	5,000	834	6.0	5,000	854	6.0	5,000
	Tilling	Hiring	50,000	0.5	25,000	50,000	0.5	25,000	50,000	0.5	25,000	1,584	24	38,000
	Sowing	Person/day	1,250	4	5,000	-	1.0	-	-	5.0	-	4.0	-	-
	Weeding 1	Person/day	-	1	-	-	1.0	-	-	8.0	12,000	2,400	5.0	12,000
	Thinning out of plants	Person/day	3,000	1	3,000	-	1.0	-	-	0.0	-	-	-	-
	Fertilizer application	Person/day	1,250	2	2,500	625	4.0	2,500	-	0.0	-	-	-	-
	Transport	Person/day	-	3	-	-	-	-	-	-	-	-	-	-
	Weeding 2	Person/day	1,667	6	10,000	1,667	6.0	10,000	1,667	6.0	10,000	3,031	3.3	10,000
	Digging	Hiring	12,000	1	12,000	12,000	1	12,000	-	-	-	-	-	-
	Harvest	Person/day	834	30	25,000	-	117	-	-	12	-	1,167	12	14,000
	Transport	Person/day	7,500	1	7,500	15,385	1	15,385	5,000	1	5,000	100,000	1	100,000
	Grand Total				175,400			141,985			57,000			179,000

Appendix-30: Land Area of Cultivation

(unit: ha for area, % for rate)

Heading \ Village	Zougou-K	Wesséné	Pigourou	Kabanou	Mani-Boké	Total
Land area of farming	1,289	1,967	715	1,363	816	6,150
Rate of cultivation	58%	80%	55%	60%	60%	313%
Land area of cultivation (a)	748	1,547	393	818	490	3,996
Land area of cotton (b)	173	436	202	355	236	1,402
Cultivation area of crops other than cotton (a-b)	575	1,111	191	463	254	2,594
Number of farm households	365	390	205	149	130	1,239
Cultivation area of crops other than cotton per household	1.57	2.85	0.93	3.11	1.95	2.09

Appendix-31: Economic Balance sheet of the Agricultural Household

(unit: FCFA)

Village			zougou-K		Wesséné		Pigourou		Kabanou		Mani-Boké	
Management Scale (ha)			7.00		7.03		13.50		9.35		9.22	
Farmland utilisation ratio			58%		73%		81%		41%		70%	
Number of family members (persons)			17.50		14.25		19.75		14.3		19.8	
Population of the farmers (persons)			5.00		5.25		9		9		9	
Gross earnings			608,000		1,603,875		1,554,050		1,177,130		1,260,125	
Agricultural income			608,000	(100%)	1,498,875	(100%)	1,541,550	(100%)	1,177,130	(100%)	1,210,125	(100%)
	Aglicultural produce	Cotton	455,000	(75%)	1,156,250	(77.1%)	1,242,500	(80.6%)	1,050,000	(89.6%)	875,000	(72.3%)
		Others	15300%	(25%)	151,625	(10.1%)	73,750	(4.8%)	0	(0.0%)	232,500	(19,20/0
	Livestock product		0	(0%)	191,000	(12.7%)	225,300	(14.6%)	109,630	(9.4%)	102,625	(8.5%)
	Others		0	(0%)	0	(0%)	0	(0%)	12,500	(1.1%)	0	(0%)
Nonagricultural income			0		105,000		12,500		5,000		50,000	
Expenditure			625,450	(100%)	820,000	(100%)	667,925	(100%)	425,975	(100%)	662,925	(100%)
Production cost			55,000	(9%)	164,250	(20%)	102,300	(15.3%)	98,375	(23.1%)	100,125	(15%)
Cost of everyday life			500,450	(80)	643,250	(78%)	515,625	(77.2%)	327,600	(76.9%)	487,000	(74%)
	Food		50,700		122,000		59,250		155,250		80,600	
	Education		0		2,500		0		3,050		2,950	
	Others		449,750		518,750		456,375		169,300		404,250	
Saving			70,000	(11%)	12,500	(2%)	50,000	(7.5%)	0	(0%)	75,000	(11%)
Net income			-17,450		678,875		886,125		746,155		597,200	

Appendix-32: Balance of Cotton Cultivation (a rough estimate)

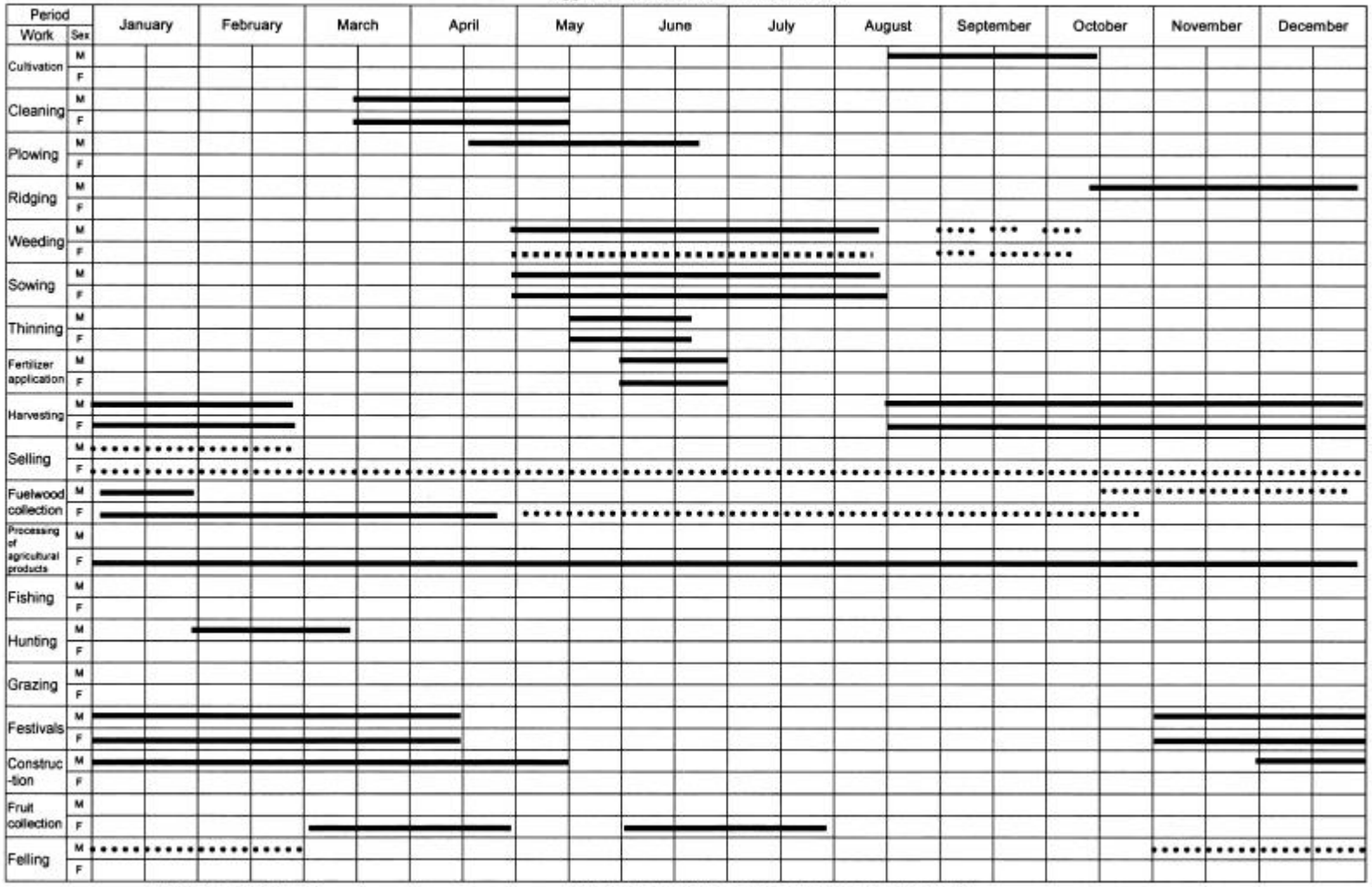
Village / Item	Production volume (A)		Aglicultural Input (B)									Net benifit A-B	Cultivated area	Net benefit per ha
	Cotton		NPK		UREA		Pesticide		Fumigator		Total			
	Production volume (T)	Price (FCFA)	Use volume (kg)	Price (FCFA)	Use volume (kg)	Price (FCFA)	Use volume (Liter)	Price (FCFA)	Use volume (Number)	Price (FCFA)	(FCFA)	(FCFA)	(ha)	(FCFA)
Zougou-K	675.0	151,875,000	110,000	20,900,000	26,000	4,940,000	3,000	10,800,000	0	0	36,640,000	115,235,000	750	153,647
Wesséné	706.5	158,962,000	92,600	17,594,000	50,000	9,500,000	1,800	6,480,000	0	0	33,574,000	125,388,500	785	159,731
Pigourou	427.5	96,187,500	34,000	6,460,000	24,000	4,560,000	610	2,196,000	0	0	13,216,000	82,971,500	475	174,677
Kabanou	436.1	98,128,575	60,000	11,400,000	10,000	1,900,000	2,350	8,460,000	9	314,100	22,074,100	76,054,475	440	172,851
Mani-Boké	338.8	75,107,925	41,000	7,790,000	15,000	2,850,000	1,340	4,824,000	4	139,600	15,603,600	59,504,325	341	174,499
Total	2578.9	580,261,500	337,600	64,144,000	125,000	23,750,000	9,100	32,760,000	13	453,700	121,107,700	459,153,800	2,791	164,512

Source: Inquiry at the SONAPRA

Appendix-33: Plants the Use of Which is Prohibited by the Local Customs

Local name	Scientific name	Village concerned
Bakourou	*Piliostigma thonningii*	Kabanou
Batoko	*Annona senegalensis*	Zougou-KpantrossI,Pigourou, Wesséné, Mani-Boké
Bounoubounou	*Pteleopsis suberosa*	Mani-Boké
Bwesen Bwèrou	(unknown)	Kabanou
Daan	*Milicia excelsa*	Zougou-Kpantrossi, Pigourou
Fon'don	*Cussonia djalonensis*	Mani-Boké
Gbiribou	*Khaya senegalensis*	Kabanou
Gbèssègbékou	(unknown)	Pigourou
Gbébou	*Afzelia africana*	Zougou-Kpantrossi
Gori yinka	(unknown)	Zougou-Kpantrossi
Gorokou	*Strychnos spinosa*	Kabanou
Monorou	*Bombax costatum*	Zougou-Kpantrossi, Wesséné
Monsosso	*Tamarindus indica*	Pigourou
Shikadanrou	(unknown)	Béroubouay-Est
Sonnouwan	*Securidaca longepedunculata*	Zougou-Kpantrossi, Pigourou, Béroubouay-Est, Mani-Boké
Tona	*Pterocarpus erinaceus*	Kabanou
Wimbou	*Diospyros mespiliformis*	Beroubouay-est, Wesséné, Kabanou

Appendix-34: Seasonal Work Calendar



Appendix-35: Annual Average Income (Unit: FCFA)

Category	Income from Agriculture	Income from Livestock Breeding	Forest Product Income	Others	Total
Man	423,373	76,750	1,656	104,125	605,905
Ratio	69.9%	12.7%	0.3%	17.1%	100.0%
Woman	161,500	8,750	66,275	75,750	312,275
Ratio	51.7%	2.8%	21.2%	24.3%	100.0%

Appendix-36: Detailed Agricultural Income per Annum (Unit: FCFA)

Category	Cotton	Corn	Peanut	Others	Income from Agriculture
Male average	391,311	9,500	16,500	6,062	423,373
Ratio	92.4%	2.2%	3.9%	1.5%	100.0%
Female average	73,375	38,750	14,375	35,000	161,500
Ratio	45.4%	24.0%	8.9%	21.7%	100.0%

Appendix-37: Average of the Expenditure Per Annum (Unit: FCFA)

Category	Agricultural expenses	Food	Heating and lighting	Clothing	Health	Ceremonies	Education	Others*	Total
Male average	132,081	47,500	39,136	24,769	15,956	94,494	9,630	41,094	399,330
Ratio	33.1%	11.9%	9.8%	6.2%	4.0%	23.7%	2.4%	8.9%	100.0%
Female average	37,688	20,050	9,600	25,625	4,375	5,875	2,000	68,713	173,925
Ratio	21.7%	11.5%	5.5%	14.7%	2.5%	3.4%	1.1%	39.6%	100.0%

* Note: The heading "Others" contains refundings, gifts, travelling expenses, expenses of constructions, royalties, etc.

Appendix-38: Principal Problems and Current and Possible Solutions

Category	Problem	Current solution	Possible solution
Forest Resources	Reduction of game	To supplement the lack of animal proteins per purchased food	No essential solution
	Abusive felling by outsiders using chain-saw	Objections by local inhabitants	Introduction of a control and monitoring system for felling by the neighbouring residents
	Natural environment degradation (deforestation, land degradation)	• Planting (lack of cashew seedlings) • Planting of pulse	To encourage planting for the restoration of the forest
	Reduction in the productivity of the useful plant species (shea trees and rérés)	No solution	No solution
Agriculture	Lower fertility and insufficiency of arable lands	• Long fallow • Use of artificial fertilisers and agricultural insecticides • Use of land in the classified forest • Incursion into the farm lands of another village	• Authorized use of the land in the classified forest • Introduction of the system of intensive agriculture
	Insect attack of cereals (in particular cotton)	• Early sowings • Fumigation by fuel oil burning	Provision of effective chemical agents
	System of incomplete loan (difficulty in receiving loans CLCAM) for production of crops other than cotton	Complement of cash income by the sale of the cattle	• To seek loan other than CLCAM • Ask to facilitate the appropriations • Widening of the system of credit
Livestock	A lack of water for livestock	Migration to the Bouli river during the dry season	Improvement of water reserves for livestock use
	A lack of pathways for cattle and reduction of the pastures	• To cross the fields • Grazing in the laterite hills • Use of absentee farmaer's abandoned farmlands for grazing	To establish formally the cattle grazing zones and the pathways for cattle
	Disease of the animals (in particular bovines and hens)	• To call the veterinarian • To give drugs (not very effective)	• To conceive a more suitable method of treatment • To make prevention campaingns of the diseases
Improvement of infrastructure	A lack of drinking water	Construction of shallow and deep wells (with the population shouldering the burden)	Construction of water supply facilities by the administration
	Construction and improvement of roads	Construction and improvement of roads and bridges with the population shouldering the burden	Improvement of roads and bridges by the administration
	A lack of health centers	Transfer patients to the health center in the large village administration	Installation of health centers (maternity center) and assignment of the personnel by the administration
	Lack of schools (lack of teachers)	Construction of school and recruiting of teachers with the population shouderding the burden	Construction of schools and recruiting of teachers by the administration

Appendix-39: Implementation of Workshop With Villagers (First Part)

The workshop was implemented as mentioned below:

① Timetable

The workshop was held one day per area. As it was the period of cotton sowing, the discussions started at around 8:00 am before the farmers go to the fields and finished before midday.

② Participants

From the Study Team members in charge of forest management plan, social forestry, socio-economy and the participation of local inhabitants and Japanese to French interpreter. From the Benin side: Representatives of the Department of Forest and Natural Resources (DFRN), representatives of the Forest Department of Borgou (DFPRN) and field forest officers, and in some places the District Office Chief of the Agriculture Department (RDR). For the local inhabitants: traditional chiefs, head of village (delegate) and members of the council (delegate) and members of the council (advisers), representatives of the village organization (GV, etc.), representatives of Gando, representatives of Fulbe tribe and villagers themselves.

③ Workshop Progress

The workshop (First Part) was conducted by members of the local NGO, GERED and translations were provided in Baatounou and French languages. The translations of Fulbe in Batounou were entrusted to Fulbe participants.

④ Records

The contents of the discussions were recorded by two members of the GERED on a notebook and kraft paper.

⑤ Program

During preliminary discussions between the Study Team, the representatives of the DFRN and the facilitators from GERED, the program of workshop of local inhabitants (First Part) was defined as follows:

- Opening ceremony (principal organizer)
- Presentation of the participants in the workshop (the Study Team, representatives of the Forest Department, representatives of the local inhabitants)
- Short speech of the representative of the local inhabitants (traditional or deputy head)
- A brief-explanation of the outline of the Study (representative of the DFRN)
- Enlightenment of the population on the importance of the forest (member of the Study Team)
- Summary explanations on the results of the surveys already carried out (member of the Study Team)
- Explanations on the basic ideas of the forest management plan (BEPAF) (member of the Study Team)
- Sum up (representative of the DFPRN)
- Question and answer sessions with local inhabitants
- Explanations on the future course of the Study (member of the Study Team)
- Speech of the representative of the villagers
- Closing of the workshop (Chairman)

⑥ Points to note in connection with the execution of the workshop

Attention has to be paid to the following points in connection with the implementation of the workshop with villagers (First Part).

(a) To obtain the confidence of the local inhabitants

The most significant point in the execution of the workshop of (First Part) was how to obtain the confidence of the people. There existed already between the local inhabitants, the local NGOs and the Study Team a certain degree of confidence obtained at the time of the study on the living conditions of the populations (first and second parts). But concerning the concrete items of the plan a more deeper level of confidence is necessary. For that, at the opening of the meeting we asked the traditional village head, who has a spiritual influence on the population, to make a speech as the representative of the village. Thus the Study Team could obtain the understanding and confidence of the local inhabitants.

(b) Clarification of the position of this study

At the time of the explanations on the outline of this Study, the representative of the DFRN specified that as provided by the Forest Law forest improvement plan will be decided through an agreement between the local inhabitants and the government and defined by the Forest Law, and that this study will prepare a preliminary forest improvement plan based on which (the plan) the said agreement will be concluded and the local inhabitants themselves will manage the forest (implement the plan).

(c) Sharing of information

"To share information" is an essential element to succeed in obtaining the participation of the population and the implementation of the workshop itself is one of the expressions of this will. Thus at the time of the workshop (First Part) information on aerial photographs, and land use and vegetation and summary of the problems mentioned by the villagers at the time of the study on the daily living conditions of the villagers (Second Part) were presented to the local inhabitants. The air photographs and the land use and vegetation maps, showing the farm land and the fallow land with different colors, were very effective to make the inhabitants understand the distribution of the cultivated lands. In addition, by presenting a summary of the problems mentioned by the villagers, we could show to the in habitants that the Study Team grasped their problems perfectly. This type of sharing of information is also significant from the point of view of obtaining the confidence of the population.

(d) Clarification of what can be or cannot be done

As the person in charge of the PGRN (Toui Kilibo Participatory Natural Resources Management Project) has said, it is significant in this type of workshop to clearly indicate what can be done and what cannot be done by the project considered. For example, we explained that it was in theory difficult within the framework of the forest management plan to deal with the wishes of the inhabitants concerning the improvement of the infrastructures which they had expressed. We explained that it is quite obvious that as long as the study is not finished, it is difficult to affirm what can or cannot be done.

Appendix-40 (1): Remarks of the Local Inhabitants and Answers of the Study Team

Discussed points	Remarks of the inhabitants	Answers of the Study Team
Significance of the workshop	Since the forest management plan (PAF) is already worked out, there will be little meaning in giving our opinions in this workshop.	If the PAF was already worked out, we would not have come here. We are currently only at the study stage and this workshop was organized to listen to your remarks which will be reflected in the development of this plan.
Prohibition of cotton cultivation in the classified forest	• It is too severe to prohibit cotton cultivation which forms a great part of our cash income. Are there other cash crops? • If the food crops are accepted, why prohibit the cultivation of cotton? • If you recommend the food crops rather than the cultivation of cotton, we then ask you to set up a sale network for com for example.	• We know that cotton represents most of your cash incom. But as long as cotton cultivation will be through shifting cultivation and extensive, you will continue to seek new land to clear and you will never have enough land. This is why we ask you to stop the cotton cultivation at least in the calssified forest and to practice a sedentary and intensive farming. Apar from the classified forest, you can continue cotton cultivation. • It is difficult to collect harvests if the corn fields in particular are dispersed. The middle men will have many difficulties to go to seek the corn you produce. The regrouping of the farms and securing production of a certain volume of corps will naturally bring a network of sale.
Transition from shifting cultivation to an intensive sedentary cultivation	• Does there exist techniques which make it possible to use the same field constantly without its productivity declining? • If you know techniques of improvement of farmland, please teach us. We are always ready to use all new techniques.	• It is possible to maintain land fertility by applying rotation, using organic manures and planting leguminous plants without only using artificial fertiliser. • Extension activities concerning this technique are currently carried out by CARDING.
Planting of fruit trees and forest trees	• We are very much interested in planting trees but there is a lack of seedlings. • We have orchards of mango tree but the fruits are difficult to preserve and rote quickly. We are often obliged to throw them.	• For the supply of the seedlings, you must speak with your forest officer. The PAF envisages a sufficient supply of seedlings. • There is a method to preserve mangos and we would like to ask you to obtain such information from CARDING.
Planting of shea trees and of nérés	• We are ready to plant provided that our men do not burn our plantations (woman). • We agree to plant shea trees and nérés in edge of the fields and to cut them as soon as they give fruits.	• We think that the planting of shea and nérés should be carried out energetically. • What do you think about our proposal?
Burning	Not only people from outside but also Baatombu and Fulbe tribes practise disorderly fires. We ask you to help us with preventing these fires.	The current legislation recommends early burning. The administration only cannot prevent disorderly fires. The population must become aware of the negative effects of the bush fire and itself come up with the countermeasures. We have already the example of a village where all the population was mobilized to prevent the bush fire.

Appendix-40 (2): Remarks of the Local Inhabitants and Answers of the Study Team

Discussed points	Remarks of the inhabitants	Answers of the Study Team
Establishment of the corridors for cattle	The wish of Fulbe is to insure corridors for the cattle	Establishment corridors for cattle movement from outside towards the interior of the classified forest.
Installaton of water points	We would like water reserves established for watering of our animals.	We will consider it sufficiently during the development of the PAF.
Assignment of the zone for farming	• We would like to have the land up to the Bouli river like zone of cultivation authorized in the classified forest. • Thinking of the population growth, we need sufficiently large land for cultivation.	The details are not fixed yet but we cannot decide on the land up to the Bouli river as cultivation zone.
Improvement of the village infrastructure	Solutions are not shown yet to the problems of infrastructure which we raised during the group discussion. Why did one ask us to speak about these problems if no solutions are shown?	Indeed all the problems of infrastructure could not be regulated within the framework of the PAF. However, to prepare this plan, it is necessary to know the needs of the population. We think it is necessary to specify which of these needs can be fulfilled and which needs can not be fulfilled.
Felling of forest trees	Outsiders come to cut the trees and the forest officer is their accomplice.	The current legislation is very precise with regard to the cutting of the trees. One cannot say that all the cuttings are illegal but in case of doubt, you should inform the forest officer immediately. If it is thought that the officer is in collusion with those involved in illegal felling, then inform his supervisors.
Boundaries of the classified forest	Since the boundaries of the classified forest are not clearly indicated, we do not know if the land that we use is part of it or not.	The boundaries of the classified forest are well fixed on the chart but indeed they are not indicated yet concretely on the ground. During the execution of the plan, they should be clearly indicated.
Village organizations for the management of the classified forest	• We want to choose representatives of the village to create a committee which will deal with the protection of the area. • We want to choose several people of the village and to form a committee charged to control the unplanned fellings, the bush fire, etc.	We think that for the realization of the PAF the village organizations are essential. What do you think about it?
Zoning concept	• We agree with the concept of dividing the classified forest in three zones for utilization purpose. • I also accept this concept as a leader of Fulbe.	

Appendix-41: Demographic Trends of the Villages and Hamlets Concerned (Second Part)

District	Commune	Village	Hamlet	Total population (person)	Total Number of households (household)	Household Size(Person /household)
GOGOUNOU	ZOUGOU-KPANTROSSI	ZOUGOU-KPANTROSSI	ZOUGOU-KPANTROSSI	2,540	216	11.8
			ZOUGOU-PEULH	1,940	149	13.0
	SORI	WESSENE		1,506	284	5.3
			WESSENE-PEULH	755	106	7.1
		PIGOUROU	PIGOUROU	981	128	7.7
			NANONROU	884	77	11.5
BEMBÉRÉKÉ	BEROUBOUAY	BEROUBOUAY	(BEROU-BOUAY-EST)*	(2,176)	(202)	(10.8)
		KABANOU	KABANOU	310	26	11.9
			KARAKOU DASSI	262	26	10.1
			SANSE	118	13	9.1
			KOUSSINE	324	33	9.8
			BOKO-BOUEROU	166	19	8.7
			GBEPOA	251	32	7.8
	GAMIA	MANI-BOKE	MANI-BOKE	500	90	5.6
			FERE	84	7	12.0
			BAFA	517	33	15.7
			(DONONROU)	(267)	(19)	(14.1)
			(ABIDJAN)	(77)	(6)	(12.8)
			(NIPOUNA)	(138)	(11)	(12.5)
			(GONROU GA YÊMIA)	(64)	(7)	(9.1)
			(SÉRO BAGOU KPAROU)	(18)	(1)	(18.0)
Grand Total				13,878	1,485	9.3
Total Number of villages profiting from classified forest				11,138	1,239	9.0

Note:
1) Villages in ( ) are outside the forestry zone.
2) The population data of the villages with * are from the agriculture pre-census data of 1998. The population data of the villages without * are the data that were collected in the field during this Study.

Appendix-42 (1): Principal Problems and their Countermeasures

Item	Principal problems	Countermeasures
Land allotted for the zone of village forestry	The population is not satisfied with 4 hectares per houshold (2 hectares for the food crops and 2 hectares for planting fruit trees, fuelwood trees and trees for use as pole.	Whereas the plan supposes that a household is composed on average of 10 adults, the profiting households are composed on average only of 9 adults, which enables us to conclude that as a whole the allotted land is sufficient. In reality, even if a household is composed of less than 10 peaple, it will always receive 4 hectares. If there is more than 10 people, exceptional considerations will be given to reassure the population.
Improvement of farming	The execution of forest improvement plan imposes limitations on the use of land for cultivation. From this fact the population must transfer themselves from an extensive agriculture based on shifting cultivation to an intensive and settled agriculture. However, the farmers who never practised the intensive agriculture, are a little disoriented and wonder whether they will succeed.	Agricultural extension techniques to maintain the productive capacity of the land, crop rotation and preparation of green manures) will be encouraged with co-operation of CARDING and NGOs. One of the concrete methods of extension is to choose through village organization for forest improvement or GV farmers who agree to cooperate and to become pilot farmers.
Marketing of the products replacing cotton	The prohibition of the cultivation of cotton (principal source of cash income) necessitates marketing of products to replace cotton. However, currently a suitable product other than cotton with marketing organization do not exist.	The surplus of the food crops (corn, yam, sorghum), the surplus of the crops used in intercropping (peanuts), the fruits (cashew nut, mango), the wood for stake (Teak), the fuelwood, the honey and the fruits of shea tree can become good products to replace cotton, by taking the following measures: • To build warehouses for the collection and the joint forwarding of the surplus of the agricultural produce. • To improve/establish village nurseries to guarantee the supply of fruit tree and forest tree seedlings. • The DFRN activity ensures the technical supervision relating to planting. • The present complementary study confirmed the potential demands for fuelwood in the cities in particular in Kandi and Malanville located in north. Therefore, a system of collecting and joint forwarding for this market has to be established in these areas. • For the bee-keeping, to study collaboration with the producers' cooperative of Parakou. • The fruit of shea tree is traded internationally and there are dealers in Parakou. Since this is an international product, it canbe affected by the sudden fluctuations of prices in international markets. If a stable supply of this product can be guaranteed, it can become a suitable source of revenue. Thus planting of shea trees is to be considered actively.

Appendix-42 (2): Principal Problems and their Countermeasures

Item	Principal problems	Countermeasures
Conflicts in connection with the land (in particular in the buffer zone)	Many farmers who currently cultivate land in the classifed forest were formerly using land in the buffer zone. As the execution of forest improvement plan will impose limitations on the use of cultivated land in classifed forest, these farmers try to recover the fields which they used formerly and this creates the possibility of confilicts between the formers and current owners of the land.	• The cultivated lands in the buffer zone either were transferred to the current users or were former users did not make a legal recording and the Administration cannot intervene in this conflict. The only possible way out is the discussion between the two interested parties to try to find a solution to this problem. • Thus subcommittee in charge of land problem as one of the village organizations relating to forest improvement has to be established. This committee shall be composed of chief of land, traditional village head, representing of Fulbe tribe, representative of Gandos, representatives of women and the prominent personalities of the village (people respected by the villagers). One can add to it the delegate, GV and the DFRN. This subcomittee will decide on the division of the individual patches of land in the zone of village forestry during the execution of the forest improvement. It will also mediate in disputes concerning the land ownership rights which could appear in the buffer zone.
Livestock breeding improvement	It is necessary to pass from an extensive and nomadic breeding to a sedentary and intensive breeding. To achieve this, the mentality of the stockbreeders must change and they should not regard the cattle as an asset but as merchandize. It is necessary that they regularly sell their cattle to be able to raise a stable number of animals. However, it is very difficult to change ideas which esixt for a long time.	The sale of cattle will be all the more frequently made when the cash economy gains ground and as the cash income gains importance. Under these circumstances, one must choose stockbreeders who agree to collaborate and make them model stockbreeders. Concrete extension activities will have to be carried out.
Control of transhumance	The nomadic stockbreeders of the Intensive Area come from outside the area. They are sometimes unaware of the local customs and habits, which result in conflicts with the local population.	In connection with the improvement of the stock breeding, the use of silvi-pastoral zone will be mainly under the control of the village organizations. Consequently, these organizations will also ensure the control of transhumance. The use of the silvi-pastoral zone will be subject to recording so as to be able to ensure the management of the suitable number of animals and cash contributions.
Activities in the forest zone	Local inhabitants think that the operations in the forest zone, in particular in the production zone, should be conducted by DRRN and consequently do not feel directly concerned.	It is certain that the production acitivities (fuelwood and log) in the production forest will be undertaken by the DFRN. But it is necessary to encourage the participation of the population in forest management by specifying that they will be paid from the funds for forest improvement which will be fed by part of the incomes from the introduction of the system of shared income.

Appendix-42 (3): Principal Problems and their Countermeasures

Item	Principal problems	Countermeasures
Village organizations for forest improvement	As the topic of the village organizations for forest improvement is closely connected with the execution of the improvement plan, it is difficult to deal with it in detail and in concrete terms at the study stage. Consequently, at the time of the workshops only the need and the structure of the village organizations in charge of forest management and improvement, their role, the creation of funds for forest improvement and contribution of the recipients to this funds were discussed. Among the existing village organizations, the GV in particular is an organization which has a certain weight in the village and which plays the principal role in the cultivation and marketing of cotton. It should be noted that since capital flow is unclear, this organization doe not have the total confidence of the villagers. Consequently, as regards the creation of an organization for forest improvement although the population recognizes the need for its creation, they worry that this organization is created only to use the population.	The village organization for forest improvement is a very significant element for the success of forest improvement plan. Thus, it is necessary to take measures to gain the inhabitant's full confidence. Possible measures are as follows: • At the development stage of the implementation plan, to make new specific proposals relating to the village organization for forest improvement and to set up various organizations while conducting discussions with population. • First of all, to create a sub-committee for dealing with land problem at the level of forest improvement unit and to establish a population register. • To ensure the participation of the greatest possible number of the inhabitants in various village organizations in order to prevent a small number of people accumulating significant positions. • To guarantee the transparency of the financial management of the fund for forest improvement by creating an inspection committee at the forest management council level which will have the task of examining the accounts of the fund at least once in a year. • The inspection committee will be composed of several experts from trusted NGOs, representatives of the DFRN and representatives of districts. • In theory, the book and documents of inspections will have to be made public.
Execution period of forest improvement plan	Despite several explanations by the Study Team and the DFRN to the effect that this study is only a study, the population always ask at the time of the workshop (second part), "when the improvement plan will be implemented?" As a clear answer could not be given to this question until now, this created some distrust among local inhabitants.	• At the development stage of the implementation plan, it is necessary to envisage new discussions with the population, to clearly define the period of implementation, the length of preparation period and to precisely tell the population what they should do during this period. • Until then, the DFRN must multiply its visits to the site, to announce the possible illegal acts committed by the population and to constantly remined them that this area is the subject of forest improvement plan.
Improvement of the village infrastructures	Local inhabitants ask for the improvement of village infrastructures in particular the improvement of the roads and the construction of well, schools and dispensaries. But forest improvement plan cannot cover all these requests.	The improvement of the village infrastructures is not directly related to forest improvement plan but these request cannot be ignored if the co-operation of the population in the execution of this plan has to be obtained. It should be recognized that in particular the improvement of the roads and the construction of well, schools and dispensaries are indispensable for improvement of the lives of the population. Thus it is absolutely necessary to transmit these requests to the authorities concerned.

Appendix-43 Boundary Stone Location Map

Appendix-44 (1): Summary of Boundary Marker Coordinates

Boundary maker No.	X-axis	Y-axis	Difference of X-axis	Difference of Y-axis	Azimuth (degree)	Corrected azimuth (degree)		Orientation of classified forest (degree)
						Indication at □	Indication at 360□	
1	490892	1154912	-107	-65	-121.3	-114.9	245.1	
2	490785	1154847	-516	-65	113	119.4	119.4	92.3
3	490269	1154782	-403	-33	-94.7	-88.3	271.7	105.6
4	489866	1154749	-550	74	-82.3	-75.9	284.1	7.9
5	489316	1154823	-416	80	-79.1	-72.7	287.3	15.7
6	488900	1154903	-515	139	-74.9	-68.5	291.5	19.4
7	488385	1155042	-390	24	-86.5	-80.1	279.9	15.7
8	487995	1155066	-524	-159	-106.9	-100.5	259.5	-0.3
9	487471	1154907	-348	-116	-108.4	-102.0	258.0	-11.3
10	487123	1154791	-575	-51	-95.1	-88.7	271.3	-5.3
11	486548	1154740	-426	-105	-103.8	-97.4	262.6	-3.0
12	486122	1154635	-505	-96	-100.8	-94.4	265.6	-5.9
13	485617	1154539	-403	-69	-99.7	-93.3	266.7	-3.8
14	485214	1154470	-536	-80	-98.5	-92.1	267.9	-2.7
15	484678	1154390	-394	-63	-99.1	-92.7	267.3	-2.4
16	484284	1154327	-535	-47	-95.0	-88.6	271.4	-0.6
17	483749	1154280	-417	13	-88.2	-81.8	278.2	4.8
18	483332	1154293	-530	105	-78.8	-72.4	287.6	12.9
19	482802	1154398	-384	73	-79.2	-72.8	287.2	17.4
20	482418	1154471	-536	106	-78.8	-72.4	287.6	17.4
21	481882	1154577	-379	90	-76.6	-70.2	289.8	18.7
22	481503	1154667	-491	215	-66.4	-60.0	300.0	24.9
23	481012	1154882	-362	132	-70.0	-63.6	296.4	28.2
24	480650	1155014	-158	48	-73.1	-66.7	293.3	24.9
25	480492	1155062	-853	1,053	-39.0	-32.6	327.4	40.4
26	479639	1156115	-689	1,063	-32.9	-26.5	333.5	60.5
27	478950	1157178	-426	714	-30.8	-24.4	335.6	64.6
28	478524	1157892	-248	403	-31.6	-25.2	334.8	65.2
29	478276	1158295	-162	365	-23.9	-17.5	342.5	68.7
30	478114	1158660	6	978	0.4	6.8	6.8	84.7
31	478120	1159638	21	442	2.7	9.1	9.1	98.0
32	478141	1160080	0	210	0.0	6.4	6.4	97.8
33	478141	1160290	-31	347	-5.1	1.3	1.3	93.9
34	478110	1160637	-63	571	-6.3	0.1	0.1	90.7
35	478047	1161208	36	438	4.7	11.1	11.1	95.6
36	478083	1161646	4	503	0.5	6.9	6.9	99.0
37	478087	1162149	-144	411	-19.3	-12.9	347.1	87.0
38	477943	1162560	-119	492	-13.6	-7.2	352.8	80.0
39	477824	1163052	-15	159	-5.4	1.0	1.0	86.9
40	477809	1163211	-29	185	-8.9	-2.5	357.5	89.3

Note: Deviation of magnetic needle is -6.4 degrees.

Appendix-44 (2): Summary of Boundary Marker Coordinates

Boundary maker No.	X-axis	Y-axis	Difference of X-axis	Difference of Y-axis	Azimuth (degree)	Corrected azimuth (degree)		Orientation of classified forest (degree)
						Indication at □	Indication at 360□	
41	477780	1163396	99	19	79.1	85.5	85.5	131.5
42	477879	1163415	255	384	33.6	40.0	40.0	152.8
43	478134	1163799	106	185	29.8	36.2	36.2	128.1
44	478240	1163984	201	716	15.7	22.1	22.1	119.2
45	478441	1164700	123	445	15.5	21.9	21.9	112.0
46	478564	1165145	157	535	16.4	22.8	22.8	112.4
47	478721	1165680	275	545	26.8	33.2	33.2	118.0
48	478996	1166225	324	663	26.0	32.4	32.4	122.8
49	479320	1166888	356	782	24.5	30.9	30.9	121.7
50	479676	1167670	274	587	25.0	31.4	31.4	121.2
51	479950	1168257	322	586	28.8	35.2	35.2	123.3
52	480272	1168843	492	599	39.4	45.8	45.8	130.5
53	480764	1169442	239	486	26.2	32.6	32.6	129.2
54	481003	1169928	277	626	23.9	30.3	30.3	121.5
55	481280	1170554	173	413	22.7	29.1	29.1	119.7
56	481453	1170967	198	539	20.2	26.6	26.6	117.9
57	481651	1171506	83	357	13.1	19.5	19.5	113.1
58	481734	1171863	-29	950	-1.7	4.7	4.7	102.1
59	481705	1172813	-61	1,268	-2.8	3.6	3.6	94.2
60	481644	1174081	27	419	3.7	10.1	10.1	96.9
61	481671	1174500	51	653	4.5	10.9	10.9	100.5
62	481722	1175153	19	697	1.6	8.0	8.0	99.5
63	481741	1175850	-64	483	-7.5	-1.1	358.9	93.5
64	481677	1176333	-118	540	-12.3	-5.9	354.1	86.5
65	481559	1176873	-135	414	-18.1	-11.7	348.3	81.2
66	481424	1177287	738	782	43.3	49.7	49.7	109.0
67	482162	1178069	526	719	36.2	42.6	42.6	136.2
68	482688	1178788	558	501	48.1	54.5	54.5	138.6
69	483246	1179289	370	443	39.9	46.3	46.3	140.4
70	483616	1179732	454	542	40.0	46.4	46.4	136.4
71	484070	1180274	398	459	40.9	47.3	47.3	136.9
72	484468	1180733	271	466	30.2	36.6	36.6	132.0
73	484739	1181199	511	-9	91.0	97.4	97.4	157.0
74	485250	1181190	441	-39	95.1	101.5	101.5	189.5
75	485691	1181151	492	87	80.0	86.4	86.4	184.0
76	486183	1181238	427	129	73.2	79.6	79.6	173.0
77	486610	1181367	468	130	74.5	80.9	80.9	170.3
78	487078	1181497	432	80	79.5	85.9	85.9	173.4
79	487510	1181577	427	200	64.9	71.3	71.3	168.6
80	487937	1181777	310	183	59.4	65.8	65.8	158.6

Note: Deviation of magnetic needle is -6.4 degrees.

Appendix-44 (3): Summary of Boundary Marker Coordinates

Boundary maker No.	X-axis	Y-axis	Difference of X-axis	Difference of Y-axis	Azimuth (degree)	Corrected azimuth (degree)		Orientation of classified forest (degree)
						Indication at □	Indication at 360□	
81	488247	1181960	481	329	55.6	62.0	62.0	153.9
82	488728	1182289	337	283	50.0	56.4	56.4	149.2
83	489065	1182572	361	341	46.6	53.0	53.0	144.7
84	489426	1182913	317	306	46.0	52.4	52.4	142.7
85	489743	1183219	406	290	54.5	60.9	60.9	146.7
86	490149	1183509	430	130	73.2	79.6	79.6	160.3
87	490579	1183639	433	212	63.9	70.3	70.3	165.0
88	491012	1183851	274	356	37.6	44.0	44.0	147.2
89	491286	1184207	388	311	51.3	57.7	57.7	140.9
90	491674	1184518	488	361	53.5	59.9	59.9	148.8
91	492162	1184879	288	198	55.5	61.9	61.9	150.9
92	492450	1185077	417	48	83.4	89.8	89.8	165.9
93	492867	1185125	506	125	76.1	82.5	82.5	176.2
94	493373	1185250	376	-67	100.1	106.5	106.5	184.5
95	493749	1185183	213	22	84.1	90.5	90.5	188.5
96	493962	1185205	1,174	-437	110.4	116.8	116.8	193.7
97	495136	1184768	583	-157	105.1	111.5	111.5	204.2
98	495719	1184611	767	-277	109.9	116.3	116.3	203.9
99	496486	1184334	1,449	-411	105.8	112.2	112.2	204.3
100	497935	1183923	265	145	61.3	67.7	67.7	180.0
101	498200	1184068	629	576	47.5	53.9	53.9	150.8
102	498829	1184644	331	380	41.1	47.5	47.5	140.7
103	499160	1185024	417	605	34.6	41.0	41.0	134.3
104	499577	1185629	307	513	30.9	37.3	37.3	129.2
105	499884	1186142	177	397	24.0	30.4	30.4	123.9
106	500061	1186539	451	-16	92.0	98.4	98.4	154.4
107	500512	1186523	444	-21	92.7	99.1	99.1	188.8
108	500956	1186502	490	-74	98.6	105.0	105.0	192.1
109	501446	1186428	441	-41	95.3	101.7	101.7	193.4
110	501887	1186387	476	-114	103.5	109.9	109.9	195.8
111	502363	1186273	413	-171	112.5	118.9	118.9	204.4
112	502776	1186102	451	-203	114.2	120.6	120.6	209.8
113	503227	1185899	443	-103	103.1	109.5	109.5	205.1
114	503670	1185796	501	-1	90.1	96.5	96.5	193.0
115	504171	1185795	421	-132	107.4	113.8	113.8	195.2
116	504592	1185663	478	-182	110.8	117.2	117.2	205.5
117	505070	1185481	374	-148	111.6	118.0	118.0	207.6
118	505444	1185333	485	-186	111.0	117.4	117.4	207.7
119	505929	1185147	89	-50	119.3	125.7	125.7	211.6
120	506018	1185097						

Note: Deviation of magnetic needle is -6.4 degrees.