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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

« Improvement Plans »

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Japan Forest Technical Association (JAFTA)
Sanyu Consultants INC.
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Table of Contents

Zougou-Kpantrossi Improvement Plan

Forest Improvement Plan

Forest Improvement Plans are implementation plans for each improvement unit based on the Basic Plan for Forest Management for the Intensive Study Area.

Plans for each improvement unit were formulated with consideration being given to implementation efficiency and the location of areas to be used within each zone. Furthermore, as such improvement activities will be implemented individually, separate plans were prepared for each of the five units involved.

The five plans are as follows.

1. Zougou-Kpantrossi Improvement Plan
2. Wessene Improvement Plan
3. Pigourou Improvement Plan
4. Kabanou Improvement t Plan
5. Mani-Boke Improvement Plan

Zougou-Kpantrossi Improvement Plan

1. Forest Management Units

Details regarding the Zougou-Kpantrossi improvement unit are as follows.

Classified Forest:	Trowarivier Classified Forest
Province (Department):	Borgou (Note. Provinces are referred to as "Departments" in Benin.)
Forest and Natural Resources Department:	Borgou Forest Department
Forest Branch Office:	Kandi Forest Branch Office
District Forest Office:	Gogounou District Forest Office

2. Location and Area

The Zougou-Kpantrossi Improvement Unit Area consists of the northern area of the Trois Rivières Classified Forest west of the Bouli River and the associated buffer zone. The area of the classified forest is 11,518ha while the area of the buffer zone is 13,998ha.

3. General Conditions

3.1 Natural Conditions

(1) Climate

The temperature and rainfall of the Zougou-Kpantrossi Improvement Unit Area as measured by weather monitoring stations in the surrounding area are as follows.

In Kandi, the average temperature is 28.1℃, the minimum average temperature of 17.2℃ occurs in January, and the maximum average temperature of 38.7℃ occurs in April. Average annual rainfall is 949mm in Kandi, 1,147mm in Bembereke, 1,037mm in Segbana and 1,161mm in Kalale. The rainy season lasts from May to September while the dry season lasts from October to April. Semi-arid conditions are experienced at the beginning of both the wet and dry seasons during September/October and April/May.

Average Temperature and Rainfall

(Temperature: ℃)

Monitoring Station	Month	1	2	3	4	5	6	7	8	9	10	11	12	Average
Kandi	Average (℃)	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
	Maximum Average (℃)	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
	Minimum Average (℃)	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

Note: Figures shown are for the 1988~1997 period.

(Rainfall: mm)

Monitoring Station	1	2	3	4	5	6	7	8	9	10	11	12	Total
Kandi	0	11	30	51	110	138	186	237	143	34	1	7	949
Bembereke	1	0	17	58	117	186	212	273	203	71	8	1	1,147
Segbana	1	1	6	44	101	137	181	308	211	42	5	0	1,037
Kalale	0	17	28	58	125	159	210	225	241	58	30	10	1,161

Note: Figures shown for Kandi and Kalale are for the 1988~1997 period, while figures for Bembereke are for the 1986~1996 period and figures for Segbana are for the 1969~1990 period.

(2) Topography, Geology and Soil Type

The topography of the area consists of flat or gently rolling hills. There are also small plateaux with steep laterite slopes and small rises scattered about the area. The altitude of this area is in the 250m~360m range.

The geology of the area consists mainly of granite and gneiss with areas of sandstone and residual accumulated matter. The soil consists mainly of Sols Ferrugineaux Tropicaux with gneiss, granite and sandstone being the parent material. Soil type distribution condition is included in Appendix-1 at the end of this volume together with information regarding how to handle such soils for forestry purposes.

(3) River System

The area is drained by the Bouli River, a tributary of the Sota River which is itself the main tributary of the Niger River, and its network of streams, etc.

(4) Vegetation

Forests consist mainly of scrub savannah, tree savannah and mixed savannah of shrub and trees with areas of riparian forest visible alongside waterways. There are also areas of *Tectona grandis* plantations, orchards, cultivated land and fallow ground. Trees characteristic of the savannah include *Detarium microcarpun*, *Isoberlinia spp*, *Vitellaria paradoxa*, *Parkia biglobosa*, *Combretum spp*, etc. while trees characteristic of riparian forest areas alongside waterways include *Daniellia oliveri*, *Anogeissus leiocarpus*, *Khaya senegalensis*, *Vitex doniana* and *Diospyros mespiliformis*, etc.

3.2 Socioeconomic Conditions

(1) Population

The population of the villages belonging to the Zougou-Kpantrossi Improvement Unit is as follows.

Population

Village	Population (Persons)	Household Number (Household)	Population Size (Person/Household)
Zougou-Kpantrossi	2,540	216	11.8
Zougou-Peulh	1,940	149	13.0
Total	4,480	365	12.3

(2) Farming Population

The farming population derived from figures obtained through the Pre Farming Census based on the farming population ratio and the farm worker ratio (the proportion of the farming population over the age of 15 and under the age of 60 that were farm workers) is as follows.

Farming Population

Village	Population (Person)	Farming Population		Farm Workers		Household Number (Household)	Population /Household (Person)	Farm Workers /Household (Person)
		Person	Ratio (%)	Person	Ratio (%)			
Zougou-K	2,540	2,540	100.0	1,212	47.7	216	11.8	5.6
Zougou-P	1,940	1,940	100.0	1,059	54.6	149	13.0	7.1
Total	4,480	4,480	100.0	2,271	50.7	365	12.3	6.2

(3) Farm Size

① Farmland Area

The area of classified forest and farmland used as a buffer zone (cultivated land and fallow land) is as follows.

Farmland Area (Unit:ha)

Category	Classified Forest	Buffer Zone	Total
Cultivated Land	1,289	3,257	4,546
Fallow Land	1,117	1,383	2,500
Total	2,406	4,640	7,046

② Planted Area

The area within classified forest planted in cotton and other crops is as follows.

Planted Area

Cultivated Land	1,289	ha
Planted Land (a) (planted ratio)	748	ha (58%)
Cotton (b) (planted ratio)	173	ha (23%)
Non-Cotton Crops (a-b)	575	ha
Farming Households	365	Household
Planted Land/Household (apart from cotton)	1.57	ha

(4) Livestock

The main forms of livestock include cattle, sheep and goats while poultry includes chickens and guinea fowl, most of which are raised in farmyards.

Livestock

Cows	Sheep	Goats	Total	Livestock Units*
1,437	660	298	2,395	1,629

* 5 sheep or goats are counted as 1 cow.

4. Forest Divisions

4.1 Forest Compartments

Divisions with the inherent characteristics necessary for the management and operation of classified forests were established on the basis of political boundaries, village boundaries, and roads, and rivers, etc. while buffer zones were established on the basis of political boundaries and roads. Each of the forest compartments are assigned a number corresponding to each management unit.

The forest compartments and divisions of the Zougou-Kpantrossi Improvement Unit are as follows. The area by forest type of each forest compartment is shown in 6 zones. Area by forest type is shown in Appendix-2 at the end of this volume.

Land Area of Forest Compartments

Classified Forest				Buffer Zone	
Compart -ment	Area (ha)	Compart-ment	Area (ha)	Compart-ment	Area (ha)
1	558.27	21	948.23	①	10,006.36
2	955.12	22	707.84	②	3,991.32
3	652.45	23	1,030.54		
4	645.83	24	788.29		
19	1,365.24	25	2,709.27		
20	1,157.28				
Total			11,518.36	Total	13,997.68
Total					25,516.04

4.2 Sub-Compartments

In order to clarify present types of land use and the state of forests, and differences in forest management, forest compartments were sub-divided into smaller sub-compartments. These designated sub-compartments were those designated at the time that the Improvement Plan was formulated. Therefore, based on the results of each year's operations, such sub-compartments are divided up and assigned a sub-compartment number. (Refer to the Plan Register)

5. Improvement Aims

The main aim of Improvement Plans is the rapid restoration of the classified forests as state forest and their conservation. As the implementation of these plans is considered difficult without the cooperation of the local inhabitants, by permitting them to use areas within the classified forest, the conservation of the forest will be carried out by the people themselves. The improvement aims for the classified forest are as follows.

- The improvement of the forest through the implementation of measures for public benefit, including the improvement of the water resources of the forest, the conservation of national land, the protection of wildlife, and the preservation of genetic resources, etc.
- The fostering of a production forest in order to enrich and utilize forest resources sustainably.
- The establishment of an area within the classified forest for use by local inhabitants in order to conserve the forest through coexistence with the people.

6. Zoning

The area will be divided into three zones: the Forestry Zone, the Silviculture-Pastoral Zone, and the Village Forestry Zone.

6.1 Forestry Zone

The forestry zone consists of the Conservation Forest Zone, which is areas of forest that should be protected and preserved, and the Production Forest Zone which is for timber production.

(1) Consevation Forest Zone

The Conservation Forest Zone, which is designed to develop water resources and preserve forest areas, runs from the Bouli River on the eastern border of the Intensive Study Area for a distance of 3.5km, within which are Conservation Forest I and II.

① Conservation Forest I

- This forest runs from the Bouli River for a distance of 500m and is specially for the fostering of water resources.
- It is a pure forest consisting of *Anogeissus leiocarpus.*
- It is located on residual relief and tectonic relief.
- Soil conditions are bad and existing vegetation should be retained.

② Conservation Forest II

This area consists of the remaining area within the Conservation Forest Zone that is not part of Conservation Forest I.

(2) Production Forest Zone

With the exception of the Conservation Forest within the Forestry Zone, this is the area in which the production of timber and fuelwood and charcoal, etc. is carried out. However, the following areas within the production forest shall be part of 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.

6.2 Silvi-Pastoral Zone

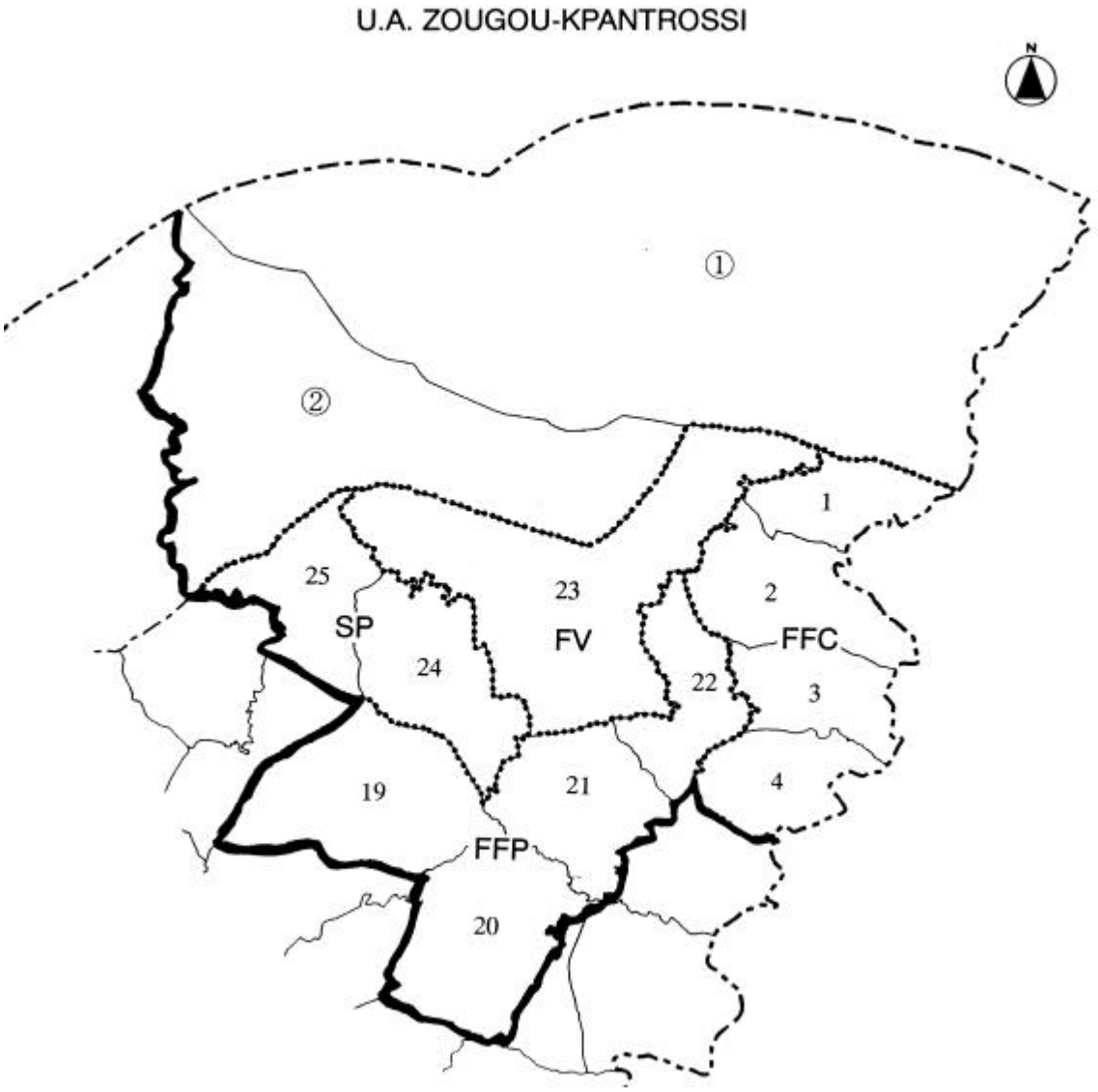
Located between the Forestry Zone and the Village Forestry Zone, this zone is an area in which grazing is carried out. Serving as a buffer zone, areas of forest with 50m either side of waterways shall be part of Conservation Forest II.

6.3 Village Forestry Zone

This is the zone 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 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.

The land area by forest compartment and forest type in each zone is as shown below.



Scale: 1:149,280

Legend	
②	Buffer Zone Compartment No.
2	Classified Forest Compartment No.
▬▬	Improvement Unit Boundary
▪▪▪▪▪	Zone Boundary
FFC	Conservation Forest Zone
FFP	Production Forest Zone
SP	Silvi-Pastoral Zone
FV	Village Forestry Zone

Zoning Map

Land Area by Forest Compartment and Forest Type (Zougou) (Unit:ha)

Zone	Compart-ment	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
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

7. Forest Land Use Classification

In order to implement forest improvement activities, forest land use classes shall be established according to proposed use based on improvement standards for basic plans for the forest within each zone and in order to formulate operating plans in accordance with forest land use classification. The types of forest classified under the forest land use classification shall be included in plans as follows.

7.1 Forestry Zone

(1) ConservationForest Zone

Conservation Forest I	Areas of forest within 500m of the western bank of the Bouli River that should be protected for the purpose of fostering water resources.
Conservation Forest II	Areas of forest within 3,500m of the western bank of the Bouli River (with the exception of Conservation Forest I) that should be maintained for the purpose of fostering water resources and preserving forest land.

(2) Production Forest Zone

Timber Forest	Forest for the production of ordinary timber.
Fuelwood Forest	Forest for the production of fuelwood (wood and charcoal for fuel).
Conservation Forest II	Forest that should be maintained due to location alongside waterways and on account of poor soil condition.
Left-Over Area	Non-forest areas designated as other land.

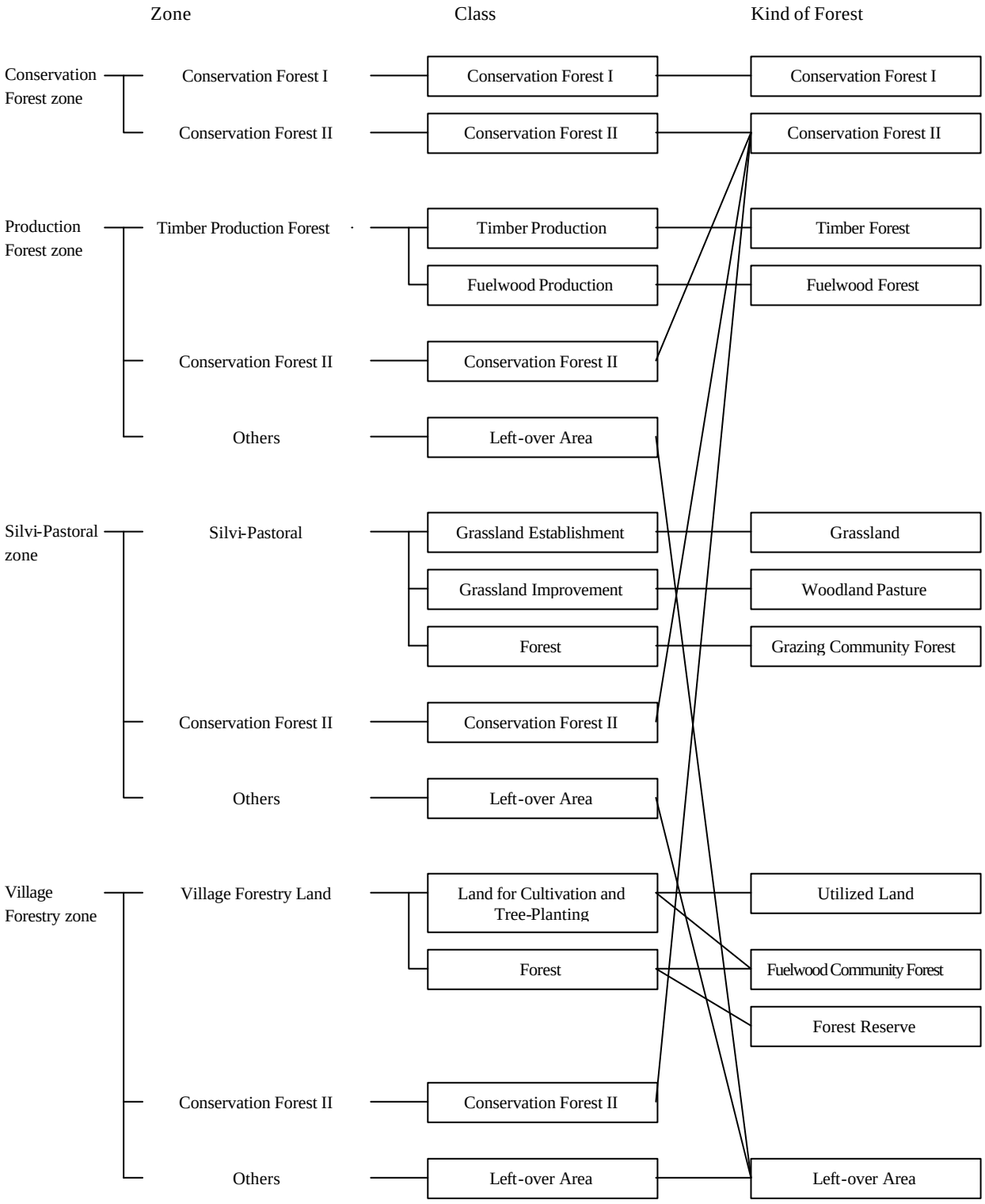
7.2 Silvi-Pastoral Zone

Grassland	Artificially created grassland.
Woodland Pasture	Forest improved by increasing the amount of grass that can be eaten by livestock within the forest.
Grazing Community Forest	Forest to be left in its present state other than Grassland and Woodland Pasture.
Conservation Forest II	Forest that should be maintained due to location alongside waterways and on account of poor soil condition.
Left-Over Area	Non-forest areas designated as other land.

7.3 Village Forestry Zone

Utilized Land	Land used by people for cultivation, tree planting and roads.
Fuelwood Forest	Areas of forest used as fuelwood forest within cultivated land or fallow land located within forests or Forest Reserve.
Forest Reserve	Forest other than Utilized Land, Fuelwood Forest and Conservation Forest II. Forest that should be set aside for future use as Utilized Land, livestock trails, and boundaries, etc.
Conservation Forest II	Forest that should be maintained due to its location alongside waterways or due to poor soil conditions, etc.
Left-over Area	Non-forest areas designated as other land.

Forest Land Use classes and kind of forest can be summarized as follows.


Zone
Class
Kind of Forest
Conservation Forest zone
Conservation Forest I
Conservation Forest II
Production Forest zone
Timber Production Forest
Conservation Forest II
Others
Silvi-Pastoral zone
Silvi-Pastoral
Conservation Forest II
Others
Village Forestry zone
Village Forestry Land
Conservation Forest II
Others
Conservation Forest I
Conservation Forest II
Timber Production
Fuelwood Production
Conservation Forest II
Left-over Area
Grassland Establishment
Grassland Improvement
Forest
Conservation Forest II
Left-over Area
Land for Cultivation and Tree-Planting
Forest
Conservation Forest II
Left-over Area
Conservation Forest I
Conservation Forest II
Timber Forest
Fuelwood Forest
Grassland
Woodland Pasture
Grazing Community Forest
Utilized Land
Fuelwood Community Forest
Forest Reserve
Left-over Area

8. Operation Standards

Improvement methods and operation methods by kind of forest are as follows.

Operation (Management) Standards (1)

Kind of Forest	Existing Forest Type	Improvement Methods	Operation Methods
Conservation Forest I	Gf, Fc, Sa, Sb, and St with a crown density of more than 50%	• Maintenance of existing areas of forest vegetation.	• These areas are not to be subject to management. • Felling of trees is prohibited and the removal of branches and leaves is also prohibited. • Controlled burning is totally prohibited. • Grazing and the passage of livestock is prohibited.
	Gf, Fc, Sa, Sb, and St with a crown density of up to 50%	• Enrichment through planting (mixed planting) of native species. Trees: *Khaya senegalensis, Pterocarpus erinaceus, Isoberlinia spp., Vitellaria paradoxa, and Parkia biglobosa.* Spacing: 10m x 10m (100 trees/ha) Supplementary Planting: Carried out after one year if no more than 80% of trees survive. Brush Cutting: Carried out evenly around planted trees once a year one year after planting.	
	Ch, Ja	• New mixed planting of native species. Trees: *Khaya senegalensis, Pterocarpus erinaceus, Isoberlinia spp., Vitellaria paradoxa, and Parkia biglobosa.* Spacing: 4m x 4m (625 trees/ha) Supplementary Planting: Carried out after one year if no more than 80% of trees survive. Brush Cutting: Carried out evenly around planted trees twice a year 2~3 years after planting.	
Conservation Forest II	Gf, Fc, Sa, Sb, and St with a crown density of more than 50%	• Maintenance of existing areas of forest vegetation.	• These areas are not to be subject to management. • Although thinning, pruning and sanitation cutting is permissible, the felling of trees and the removal of branches and leaves apart from such thinning, pruning and sanitation cutting is prohibited. • Controlled burning is totally prohibited. • Grazing and the passage of livestock is prohibited. (However, this shall exclude access by livestock to water holes in the Silvi-Pastoral Zone)
	Gf, Fc, Sa, Sb, and St with a crown density of up to 50%	• Enrichment through planting (mixed planting) of native species. Trees: *Khaya senegalensis, Pterocarpus erinaceus, Isoberlinia spp., Vitellaria paradoxa, Parkia biglobosa and Milicia excelsa.* Spacing: 10m x 10m (100 trees/ha) Supplementary Planting: Carried out after one year if no more than 80% of trees survive. Brush Cutting: Carried out evenly around planted trees once a year one year after planting.	

Operation (Management) Standards (2)

Kind of Forest	Existing Forest Type	Improvement Methods	Operation Methods
Conservation Forest II	Ch, Ja	• New mixed planting of native species (including group planting). Trees: *Khaya senegalensis, Pterocarpus erinaceus, Isoberlinia spp., Vitellaria paradoxa, Parkia biglobosa, and Milicia excelsa.* Spacing: 4m x 4m (625 trees/ha) Supplementary Planting: Carried out after one year if no more than 80% of trees survive. Brush Cutting: Carried out evenly around planted trees twice a year 2~3 years after planting.	
Timber Forest	Gf, Fc, Sa, Sb	• Fostering of the timber forest through planting seedlings, direct s owing of seeds and natural seeding of native species. Trees: *Khaya senegalensis, Pterocarpus erinaceus, Isoberlinia spp., Afzelia africana, Prosopis africana, and Milicia excelsa.* Spacing: One of the following will be adopted by taking into account crown density of each ferest,5m x 5m (400 trees/ha), 6m x 6m (276 trees/ha), 8m x 8m (156 trees/ha), 10m x 10m (100 trees/ha). Other: When planting, existing material of a usable size may be cut down and used.	• Selective logging shall be carried out. Cutting Cycle: 20 years Selective Logging Ratio: 33% of trees with a diameter at breast height (DBH) of no less than 35cm (girth at breast height of no less than 100cm). Age at Maturity: 30 years • Regeneration: Natural seeding. Direct sowing of seed and planting of seedlings will also be carried out as necessary. • Burning is totally prohibited. • Grazing and the passage of livestock is prohibited.
	Ch, Ja	• Planting of native species and direct planting of seeds. Trees: *Khaya senegalensis, Pterocarpus erinaceus, Isoberlinia spp., Afzelia africana, Prosopic africana, and Milicia excelsa.* Spacing: 4m x 4m (625 trees/ha). Mixed line planting of various species of trees. Supplementary Planting: Carried out after one year if no more than 80% of trees survive. Brush Cutting: Carried out evenly around planted trees twice a year 2~3 years after planting. Other: Land being cultivated may continue to be cultivated until after crops have been harvested at which time the timber production forest will be created.	

Operation (Management) Standards (3)

Kind of Forest	Existing Forest Type	Improvement Methods	Operation Methods
Fuelwood Forest	Sa, Sb, St	• Planting of native species and direct sowing of seed. Trees: *Detarium microcarpum, Isoberlinia spp., Terminalia avinnoides, Combretum spp., Crossopteryx febrifuga,* and *Piliostigma thonningii*. Other: Felling and harvesting of material with a diameter larger than the specified usable diameter within the existing forest may be carried out the year before planting of seedlings or direct sowing of seed is carried out. Material that is able to germinate should be left to germinate. Additional planting and direct sowing of seed shall be carried out depending on how well seeds etc. take root and the growth of seedlings.	• The area shall be used as a fuelwood forest with trees of not less than 7cm DBH (no less than 20cm GBH) being felled. Cutting Cycle: 7 years Regenevation: Germination and direct sowing of seeds. • Controlled burning shall be totally prohibited. • Grazing and the passage of livestock shall be prohibited.
	Ch, Ja	• Planting of exotic species, Planting using cuttings and direct sowing of seed. Trees: *Tectona grandis, Acacia auriculiformis, Gmelina arborea, and Cassia siamea*. Spacing: 2m x 2m (2,500 trees/ha), 2m x 2.5m (2,000 trees/ha) Brush Cutting: Brush cutting shall be carried out depending on the state of the grass beneath. Other: Existing standing trees (including withered and damaged trees) and shrubs shall be felled and removed for use. Land being cultivated may continue to be cultivated until after crops have been harvested at which time the fuelwood production forest will be created.	• The area shall be clear cut. However, the size of the area to be clear cut shall be reduced. Cutting Cycle: 7 years Regenevation: Germination, planting using cuttings and direct sowing of seeds. • Controlled burning shall be totally prohibited. • Grazing and the passage of livestock shall be prohibited.
Grassland	Sa, Sb, St	• The felling of standing trees (for sale as timber and fuel) and the removal of shrubs (for local fuel use) shall be carried out, after which the land will be ploughed and pasture sown or planted. • Feed trees, trees for fuel and trees which provide a source of nectar for bees shall be planted around this area as a surrounding fence and to form divisions within it.	• This area is designated as a grazing area for rotational grazing. • Pasture shall be harvested and used for livestock feed during the dry season. • Although the area shall be burnt off once every three years, as it is a grazing area this shall be carried out in a planned manner in accordance with grazing plans. A firebreak shall be established around all areas where controlled burning is to be carried out. • Grass other than pasture shall be removed and shrubs cleared and removed. • The leaves of feed trees shall be used to increase the volume of pasture feed and branches shall be used as fuelwood.
	Ch, Ja	• Standing trees and shrubs shall be removed (for use as fuel in local areas) and after ploughing pasture shall be sown or planted. • Feed trees, trees for fuel and trees which provide a source of nectar for bees shall be planted around this area as a surrounding fence and to form divisions within it.	
	Ag	• After ploughing pasture shall be sown or planted. • As the total area involved is relatively small, this shall be concentrated in Sa, Sb, St and Ch and Ja grasslands.	

Operation (Management) Standards (4)

Kind of Forest	Existing Forest Type	Improvement Methods	Operation Methods
Woodland Pasture	Sa, Sb, St	• Trees of larger diameter shall be felled and used (with the exception of *Vitellaria paradoxa*) and crown density reduced to no more than 10%. Shrubs shall be completely removed. • Feed trees shall be planted in rows and overall crown density reduced to approximately 20%. • In order to increase the volume of natural Gramineae grasses for livestock feed, weeds other than Gramineae will be removed and pasture seeds sown.	• Areas where controlled burning is to be carried out shall be established and such burning carried out at an early stage. Firebreaks shall be established around such areas to prevent fire from spreading to other areas. • Weeds not eaten by livestock shall be removed and seeds sown in areas with low grass density. • Management of crown density shall be carried out and shrubs shall be removed. • The leaves of feed trees shall be used to increase the volume of livestock feed and branches shall be used for fuel. • Dams shall be constructed in waterways in order to provide water for livestock during the dry season.
	Ch, Ja	• Shrubs shall be removed. • With the exception of Gramineae grasses eaten by livestock, all other grasses shall be removed. • Pasture seeds shall be sown. • Feed trees shall be planted in rows and overall crown density reduced to approximately 20%.	
	Ag	• After ploughing, pasture shall be sown and feed trees planted. • As the total area involved is relatively small, this shall be concentrated in Sa, Sb, St and Ch and Ja woodland pasture.	
Grazing Community Forest	Gf, Fc	• The existing forest shall be left in its present state and no special improvement of grassland shall be carried out.	• This area shall be used as Grazing Community Forest. • Although intensive management of this area shall not be carried out, timber production of Fc shall be carried out in accordance with timber forest management.
	Ag	• In order to allow the forest to recover, direct planting of native species shall be carried out after ploughing. After that, the area shall be included in Gf and Fc Grazing Community Forest.	

Operation (Management) Standards (5)

Kind of Forest	Existing Forest Type	Improvement Methods	Operation Methods
Utilized Land	Fc, Sa, Sb	• Users shall be permitted to use up to 4.0ha per household (2.0ha for cultivation and 2.0ha for tree-planting). • On land for cultivation, standing trees shall be felled (including withered and damaged trees) and sold as timber and fuelwood, and shrubs shall be removed to be used locally for fuel. After this has been carried out, the area shall be used for normal commercial farming activities. • On land for tree-planting, in order to make room for the planting of fruit trees, trees for fuel and posts, standing trees (including withered and damaged trees) shall be felled and sold as timber and fuelwood, and shrubs removed for use by the users. After this has been carried out, fruit trees and trees for fuel and posts shall be planted. Fruit Trees: *Anacardium occidentale*. Trees for Fuel and Posts: *Tectona grandis, Gmelina arborea, and Cassia siamea*. Spacing: Fruit trees 10m x 10m (100 trees/ha); Trees for Fuel and Posts 2m x 2m (2,500 trees/ha). However, when planting over a 1-2 year period, trees should be planted at 1.5m x 3m (2,222 trees/ha) or 1.5m x 4m (1,666 trees/ha). • A firebreak shall be established on the boundary between utilized land (land for cultivation and tree-planting) and other zones to mark the boundary and to prevent fire spreading to other areas. Trees such as *Khaya senegalensis, Acacia auricuriformis*, *Pterocarpus erinaceus and Parkia biglobosa*, etc., which are a source of nectar for bee-keeping, should be used.	• As a rule, users shall be those entities possessing cultivated land within presently classified forests (based on aerial photographs taken in 1998). • Controlled burning shall be prohibited. • Grazing and the passage of livestock shall be prohibited. • Cotton growing shall be prohibited. • Commercial farming shall be improved in order to establish farming. • *Vitellaria paradoxa* shall be regenerated in areas surrounding cultivated land and shall be replanted in present areas of cultivated land. • The cutting cycle shall be set at 5 years for trees for fuel and posts with 1/5 of the planted area being logged and replanted every year. • When the area is logged it shall be completely cleared and when it is replanted it shall be planted in both seeds and seedlings. • Bud pruning of *Tectona grandis* is also required. • In tree-planting areas, it is possible to carry out agroforestry (Taungya) 1~2 years after new planting and replanting.
	Ch, Ja	• With regard to cultivated land, Ch will be left as it is and normal commercial farming shall be carried out while standing trees and shrubs shall be felled and removed and the area turned into cultivated land. • Land for tree-planting shall be prepared for planting with fruit trees and trees for fuel and posts, with wood sold as fuelwood or used by the users. • Fruit trees and trees for fuel and posts shall be planted in the same way as for Fc, Sa and Sb. • Firebreaks shall be established on the boundary between this zone and other zones in the same way as for Fc, Sa and Sb.	

Operation (Management) Standards (6)

Kind of Forest	Existing Forest Type	Improvement Methods	Operation Methods
Forest for Community Fuelwood Use	Ch, Ja	• Fuelwood forest for village joint use shall be created in areas of Ch and Ja other than Utilized Land as a source of income for the village. • Fuelwood forest shall be created in accordance with creation techniques for tree-planting areas within Utilized Land. * Areas of Fc, Sa, Sb, Ch and Ja remaining after land has been distributed to the people of the area shall be designated as Forest for Community Fuelwood Use within Utilized Land.	• Operation Methods for this area shall be in accordance with those of tree-planting areas within areas of Utilized Land. • Controlled burning shall be prohibited. • Grazing and the passage of livestock shall be prohibited.
Forest Reserve	Gf, Fc, Sa, Sb, St, Ag	• Vegetation in Utilized Land, Forest for Community Fuelwood Use and forest apart from Left-Over Area within the Village Forestry Zone shall be left in its present condition. • Forest Reserve shall also include forest that can be transferred into Utilized Land in the future. • Vegetation in areas of Gf, Sb and St shall be left in its present condition and shall be used for the passage of livestock to the Silvi-Pastoral Zone from areas of classified forest. • Areas of Ag in forests shall be restored with native species.	• Forest operation shall not be implemented for areas of existing forest. • Controlled burning shall be prohibited. • Although grazing in this area shall be prohibited, grazing and the passage of livestock shall be permitted in remaining areas of the forest.
Left-over Area	Other (Tm, Td, Cl, Ar, Ce, Pe)	• This area shall be left in its present condition.	• Grazing shall be prohibited in the Conservation Forest Zone, Production Forest Zone, and Village Forestry Zone. • Silvi-Pastoral Zones shall be managed in the same way as Grazing Community Forest. • Controlled burning shall be prohibited.

9. Improvement Plans

9.1 Plan Duration

A sustainable forest management was aimed for when deciding plan period for classified forests. The duration required for the implementation of forestry operations to achieve the said sustainable forest management was set as the plan period for this plan.

The time required for forestry operations to be realized for each zone will differ from zone to zone.If the age at maturity for the timber forest is set at 40-60 years there will be 3 cutting cycles or 60 years.Trees in fuelwood forests take 7 years to mature and one year for regeneration, making a total of 8 years. It takes 3 years to fatten cows in silvi-pastoral zones, 5 years to establish a regular farming cycle in cultivated land, and it takes 5 years for trees for fuel and posts to reach maturity. In timber forest, as the time required to reach maturity is relatively long, the plan period shall be set at 10 years, targeting the fuelwood forest (the above-mentioned 8 years plus 2 years for preparation).

9.2 Management Plans

Management of each type of forest shall be carried out in accordance with the improvement methods and operation metheds outlined in 8. Operation Standards. The areas of existing forest type in each zone by improvement method for each Kind of forest are as follows.

Area of Improvement Methods by Forest Type (Zouhou-Kpantrossi)

Conservation Forest Zone

Unit:ha

Classification		Forest Type and Area								Total
		Gf	Fc	Sa	Sb	St	Ch	Ja	Other	
		204.20		934.57	1,027.57	184.40	299.26	108.70	52.93	2,811.67
Conservation Forest I	Planting						102.98	10.09		113.07
	Enrichment	5.12		146.68	194.99	75.36				422.15
	Original State	10.70		76.13	85.12	36.82				307.77
Conservation Forest II	Planting						196.28	98.62		294.90
	Enrichment	17.44		414.71	491.75	72.24				996.14
	Original State	71.95		297.05	255.71					624.71
Left-Over Area									52.93	52.93

Production Forest Zone

Unit:ha

Classification		Forest Type and Area								Total
		Gf	Fc	Sa	Sb	St	Ch	Ja	Other	
		151.20	4.23	1,762.03	1,408.03	384.60	226.00	230.10	12.46	4,178.59
Conservation Forest II	Planting						3.95	2.14		6.09
	Enrichment	16.04		52.13	53.79	21.61				143.57
	Present State	135.10		182.93	32.33					350.40
Timber Forest	Planting									
	Felling/ Rageneration		4.23	808.10	26.01	21.30				859.64
Fuelwood Forest	Planting						222.05	228.00		450.01
	Felling/ Rageneration			718.87	1,295.90	341.70				2,356.42
Left-over Area									12.46	12.46

Silvi-Pastoral Zone

Unit:ha

Classification		Forest Type and Area								Total
		Gf	Fc	Sa	Sb	St	Ch	Ja	Other	
		94.07	3.93	518.42	674.83	336.60	123.33	16.55	51.08	1,818.83
Conservation Forest II	Planting						1.17			1.17
	Enrichment	25.19		52.20	56.75	11.89				146.03
	Present State	47.06		69.79						116.85
Grassland				301.10	21.47	3.28	122.16	16.55		464.47
Woodland Pasture				95.42	596.61	321.50				1,013.48
Grazing Community Forest		21.82	3.93							25.75
Left-over Area									51.08	51.08

Village Forestry Zone

Unit:ha

Classification		Forest Type and Area								Total
		Gf	Fc	Sa	Sb	St	Ch	Ja	Other	
		137.7		451.59	524.9	166.9	640.71	761.4	26.08	2,709.27
Conservation Forest II	Planting						8.32	1.47		9.79
	Enrichment	23.8		46.28	45.15					115.23
	Present State	59.08		62.74						121.82
Utilized Land				220.43			602.13	746.6		1,569.18
Fuelwood Community Forest							30.26	13.28		43.54
Forest Reserve		54.85		122.14	479.75	166.9				823.63
Left-Over Area									26.08	26.08

(1) Conservation Forest I

Conservation Forest I has an area of 842.99ha of which 307.77ha is in original forest, 113.07ha is newly planted combined with 422.15ha undergoing enrichment for forest recovery, giving a total of 535.22ha.

① Annual Work Volume

The period has already been determined as 10 years. Planting, supplementary planting and brush cutting are actually carried out over a period of 7 years. The annual work volume is as follows.

Annual Work Volume (Unit: ha)

Activity	Area (ha)	Year							
		1-3	4	5	6	7	8	9	10
Planting	113	Preparation Period	*1	*1	37	38	38	-	-
Enrichment	422		89	89	52	51	51	90	-
Supplementary Planting	535		-	89	89	89	89	89	90
Brush Cutting	761		89	89	89	126	164	166	38
Total	1,831		178	267	267	304	342	345	128

*1 Planting is carried out along the boundaries of the classified forest to clarify boundaries.

② Implementation Methods

- Both planning and implementation are carried out directly by the Department of Forest and Natural ResourcesDFRN of Forst and Natural Resources(DFRN).
- Local inhabitants are employed as workers and are paid wages.
- Necessary nursery stock is purchased from private nurseries by the DFRN.

③ Nursery Stock

The required quantity of nursery stock for new planting, enrichment and supplementary planting in Conservation Forest I is as follows.

Required Nursery Stock Volume (Unit: ha)

Category		Year							
		1-3	4	5	6	7	8	9	10
New Planting	Planting	Preparation Period	-	-	23,125	23,750	23,750	-	-
	Supplementary Planting		-	-	-	4,625	4,750	4,750	-
	Sub-Total		-	-	23,125	28,375	28,500	4,750	-
Enrichment	Planting		8,900	8,900	5,200	5,100	5,100	9,000	-
	Supplementary Planting		-	1,780	1,780	1,040	1,020	1,020	1,800
	Sub-Total		8,900	10,680	6,980	6,140	6,120	10,020	1,800
Total			8,900	10,680	30,105	34,515	34,620	14,770	1,800

④ Tree Type and Planting Density, etc.

Tree types and planting density are as follows.

(a) Tree Type (The same tree types are used for both new planting and enrichment.)

Khaya senegalensis, Ptetocarpus erinaceus, Isoberlinia supp., Vitellaria paradoxa, and Parkia biglobosa.

(b) Planting Density

Planting density for areas of new planting is 625 trees/ha (4m x 4m) while for areas of enrichment it is 100 trees/ha (10m x 10m).

(c) Supplementary Planting (The same tree types are used for both new planting and enrichment.)

The supplementary planting ratio is 20%.

(2) Conservation Forest II

Although Conservation Forest II is found in every zone, as according to management standards the way these zones are handled is the same, the total area of Conservation Forest II is 2,926.70ha. Forest in its present state is 1,213.78ha while the total area for forest recovery includes 311.95ha for new planting and 1,400.97ha for enrichment, making a total of 1,712.92ha.

Land Area of Conservation Forest II (Zougou-Kpantrossi) (Unit: ha)

Operation Methods	Zone	Forest Type						Total
		Gf	Sa	Sb	St	Ch	Ja	
New Planting	Conservation Forest					196.28	98.62	294.90
	Production Forest					3.95	2.14	6.09
	Silvi-Pastoral Forest					1.17		1.17
	Village Forestry					8.32	1.47	9.79
	Sub-Total					209.72	102.23	311.95
Enrichment	Conservation Forest	17.44	414.71	491.75	72.24			996.14
	Production Forest	16.04	52.13	53.79	21.61			143.57
	Silvi-Pastoral Forest	25.19	52.20	56.75	11.89			146.03
	Village Forestry	23.80	46.28	45.15				115.23
	Sub-Total	82.47	565.32	647.44	105.74			1,400.97
Existing Forest	Conservation Forest	71.95	297.05	255.71				624.71
	Production Forest	135.14	182.93	32.33				350.40
	Silvi-Pastoral Forest	47.06	69.79					116.85
	Village Forestry	59.08	62.74					121.82
	Sub-Total	313.23	612.51	288.04				1,213.78
Total		395.70	1,177.83	935.48	105.74	209.72	102.23	2,926.70

① Annual Work Volume

The period has already been determined as 10 years. Planting, supplementary planting and brush cutting are actually carried out over a period of 7 years. The annual work volume is as follows.

Annual Work Volume (Unit: ha)

Activity	Area (ha)	Year							
		1-3	4	5	6	7	8	9	10
Planting	312	Preparation Period	*1	*1	104	104	104	-	-
Enrichment	1,401		286	286	181	181	181	286	-
Supplementary Planting	1,713		-	286	286	285	285	285	286
Brush Cutting	2,337		286	286	286	389	493	494	104
Tending	1,713		-	-	-	-	-	-	1,713
Total	7,476		572	858	856	959	1,063	1,065	2,103

*1 Planting is carried out along the boundaries of the classified forest to clarify boundaries.

② Implementation Methods

- Both planning and implementation shall be carried out directly by the DFRN.
- Local inhabitants shall be employed as workers and are paid wages.
- Necessary nursery stock shall be purchased from private nurseries by the DFRN.

③ Nursery Stock

The required quantity of nursery stock for new planting, enrichment and supplementary planting in Conservation Forest II shall be as follows.

Required Nursery Stock Quantity (Unit: ha)

Category		Year							
		1-3	4	5	6	7	8	9	10
New Planting	Planting	Preparation Period	-	-	65,000	65,000	65,000	-	-
	Supplementary Planting		-	-	-	13,000	13,000	13,000	-
	Sub-Total		-	-	65,000	78,000	78,000	13,000	-
Enrichment	Planting		28,600	28,600	18,100	18,000	18,100	28,600	-
	Supplementary Planting		-	5,720	5,720	3,620	3,620	3,620	5,720
	Sub-Total		28,600	34,320	23,820	21,720	21,720	32,220	5,720
Total			28,600	34,320	88,820	99,720	99,720	45,229	5,720

④ Tree Type and Planting Density etc.

Tree types and planting density are as follows.

(a) Tree Type (The same tree types are used for both new planting and enrichment.)

Khaya senegalensis, Ptetocarpus erinaceus, Isoberlinia supp., Vitellaria paradoxa, Parkia biglobosa and Milicia excelsa.

(b) Planting Density

Planting density for areas of new planting is 625 trees/ha (4m x 4m) while for areas of enrichment it is 100 trees/ha (10m x 10m).

(c) Supplementary Planting (The same tree types are used for both new planting and enrichment.)

The supplementary planting ratio is 20%.

(d) Tending

Clear-felling is carried out every 10 years.

(3) Timber Forest

The total area of timber forest is 859.64ha and felling is carried for timber production. Generally, systematic selective logging activities are carried out in order to achieve sustainable logging. This requires the existence of a forest with a certain structure. However, according to the results of forest survey, production forests are at present of low quality, making it impossible to carry out selective logging. Therefore, logging will be carried out for a certain period of time in order to improve forest content through enrichment activities.

Fc accounts for 4.23ha, Sa for 808.10ha, Sb for 26.01ha, and St for 21.30ha of the forest type.

① Annual Work Volume

The annual work area is determined in the following way based on maturity, cutting cycle and selective logging ratio.

- Maturity: Although different species of trees reach maturity at different times, *Khaya senegalensis*, *Afzeelia africana*, and *Milicia excalsa* reach maturity in 30 years.
- Cutting Cycle: 20 years.
- Selective Logging Ratio: 33% (1/3).

Selective logging of 43ha (42.98ha) or 1/20 of the 859.64ha total area of the timber forest shall be carried out annually with this being referred to as the selected logging area. 20 areas shall be established within the timber forest and given the numbers 1 to 20. The size of some of these sub-compartments may be smaller than 43ha.

② Logging/Rageneration

- As the forest is presently in bad condition at the first cutting cycle, enrichment shall be carried out with a view to transforming it into a selective logging forest. When felling trees in this area, the above-mentioned 33% shall not apply but rather standing trees (including withered and damaged trees) with a DBH of no less than 35cm (with a GBH of no less than 110cm) will be targeted.
- Under the improvement plan, from the second cutting cycle trees for logging shall have a DBH of no less than 35cm (GBH of no less than 110cm) and there shall be a selective logging ratio of 33%.
- From the 3rd year, the volume of timber from cutting blocks 1 through 8 shall be 206m^3.
- Regeneration shall be carried out through natural seeding. In areas where this is difficult, seedlings or seed shall be planted.

③ Implementation Methods

- Both planning and implementation shall be carried out directly by the DFRN.
- Local inhabitants shall be employed as workers and shall be paid wages.

- Although the DFRN shall formulate plans, these shall be implemented by local organizations.
- Necessary nursery stock shall be purchased from private nurseries by the DFRN.

④ Nursery Stock

The required quantity of nursery stock for new enrichment in Timber Forests shall be carried out for half of the annual logging area (1/3 of 1 logging block ;1 logging block is 43ha). These shall be planted at a density of 100 trees/ha (10m x 10m) with supplementary planting being carried out the following year at a ratio of 20%.

(Required Nursery Stock Quantities)

The annually required quantity of seedlings is 700 trees in the 3rd year and 840 trees/year from the 4th year through to the 10th year.

Timber Forest Work Area

Year	1-2	3	4	5	6	7	8	9	10
Selective Felling Block Area (ha)	Preparation Work	43	43	43	43	43	43	43	43
Logging Area (ha)		14	14	14	14	14	14	14	14
Logging Volume (m^3)		206	206	206	206	206	206	206	206
Enrichiment Area (ha)		7	7	7	7	7	7	7	7
Nursery Stock (tree)		700	840	840	840	840	840	840	840

(4) Fuelwood Forest

Fuelwood forest has a total area of 2,806.43ha. Fuelwood forest management and clear felling shall be carried out with the aim of fuelwood production. This fuelwood forest shall consist of 718.87ha of Sa, 1,295.90ha of Sb and 341.65ha of St, for a total of 2,356.42ha of species varieties and trees with a DBH of no less than 7cm shall be felled. The remaining 450.01ha, which consists of 222.05ha of Ch and 227.96ha of Ja, both introduced species, shall be clear felled.

① Trees

Native Spesies: *Detarium microcarpum, Terminalia avicennoides, and Isoberlinia spp.*
Introduced Species: *Tectona grandis, Gmelina arborea, and Acacia auriculiformis.*

② Annual Work Volume

In order to even out the village income of each improvement unit, under the Basic Plan the Fuelwood Forest area is determined as 2,720ha. As the trees reach maturity in 7 years, the annual work area is 340ha. Bearing in mind environmental considerations, each annual logging area shall be approximately 10ha with this area including both fuelwood forest management forest and clear felled management forest. The work area for 10 years is as follows.

Fuelwood Forest Work Area (Unit: ha)

Operations		Annual Area									
		1-2	3	4	5	6	7	8	9	10	11
Clear Felling (448ha)	Seedling Planting /Cutting Planting	Preparation	56	56	56	56	56	56	56	56	56
	Harvesting /Logging		-	-	-	-	-	-	-	56	56
Fuelwood Forest Management (2,272ha)	Regeneration (Direct Sowing)		-	284	284	284	284	284	284	284	284
	Harvesting /Logging		284	284	284	284	284	284	284	284	284

However, in the 10th year harvesting and logging for clear cutting management area shall be carried out in the area that was planted with seedlings and cuttings in the 3rd year and in the 11th year harvesting and logging shall be carried out in the area that was with seedlings and cuttings in the 4th year. Regeneration (direct sowing and planting) in fuelwood forest management areas shall be carried out in areas that were harvested/logged the previous year. Furthermore, harvesting and logging in the 11th year shall be carried out in the area that was regenerated (direct sowed and planted) in the 4th year.

③ Planting and Timber Production Volumes

In the above-mentioned fuelwood forest production plan area, the annual number of trees replanted in clear cutting management forests from the 3rd year through to the 10th year (when only seedlings are used) or the estimated timber production volume of the fuelwood forest (area of standing trees with a DBH of no less than 7cm for timber for use as firewood calculated based on forest survey records) is as follows.

Please note that although forest operation with regard to fuelwood forest will be regeneration of native species of trees, initially direct planting of desired species of trees is carried out in order to create the fuelwood forest.

(a) Number of Seedlings Planted in Clear Cutting Management Forests (2,500 trees are planted per ha)

From the 3rd year until the 10th year, 140,000 trees will be planted annually. From the 11th year, regeneration will take place through coppicing.

(b) Fuelwood Forest Estimated Timber Production Volumes

Fuelwood Management Forest	3rd~10th year	284ha/annum	4,913m^3
	From the 11th year	284ha/annum	
Clear Cutting Management Forest	From the 10th year	56ha/annum	1,232m^3

(5) Grassland

In order to achieve improved grazing capacity and change the form of livestock grazing, cultivated land and fallow land that had been abandoned was artificially created into grassland. This land has an area of 464.67ha and is currently planted in Sa (301.01ha), Sb (21.47ha), St (3.28ha), Ch (122.16ha) and Ja (16.55ha).

① Improvement of Land for Pastures Established

Standing trees shall be logged and shrubs removed in the target area. Standing trees shall be logged and sold as timber or fuelwood and the proceeds put into the Forest Improvement Fund. Shrubs shall be used locally for fuel or stock fences.

② Types of Pasture

Gramineae shall consist of *Andoropogon gayanus* and *Pennisetum purpureum* while *Leguminosal* shall consist of *Stylosanthes hamata. Andoropogon gayanus* and *Stylosanthes hamata* shall be planted together while *Pennisetum purpureum* shall be planted in the surrounding area or in vacant ground.

③ Stock Fences

Stock fences shall be established to confine domestic livestock to certain areas and to effectively utilize grasslands. Feed trees, fuelwood trees, trees which are a source of nectar for bee-keeping, and shrubs shall be utilized to establish fences which are to be constructed by the local inhabitants.

④ Utilization

Rotational grazing of grasslands is to be carried out in order to provide even feeding in terms of both quantity and nutrition. Three blocks are to be established within grassland areas, with rotational grazing of each block being carried out for 2 weeks after which it is given 4 weeks rest. Feed trees, fuelwood trees and trees which are a source of nectar for bee-keeping are to be planted in all grazing blocks.

⑤ Storage and Use of Grass

Hay is to be harvested and stored as much as possible during the dry season using what machinery is available. In order to keep the decrease in the nutritional value of the grass at a minimum, grass is to be cut and laid out thinly on the ground and turned once or twice every day in order to speed up the drying process.

⑥ Number of Breeding Stock

From the grassland production volume and the annual livestock feed requirements of mature cattle (250kg) (2,282kg), it can be calculated that 1,070 head of livestock can be reared on the grasslands. At the beginning of the plan only the existing number of livestock (mature cattle: 250kg) will be reared.

Number of Head of Stock on the Grasslands

Grasses	Area (ha)	Utilized Area (ha)	Dry Grass Production Volume (kg/ha)	Dry Grass Production Volume (ton)	Possible Number of Stock
Andoropogon gayanus	220	187	8,500	1,590	-
Stylosanthes hamata	220	187	3,630	679	-
Pennisetum purpureum	24	20	8,640	173	-
Total	464	394	-	2,442	1,070

(6) Woodland Pasture

In order to stabilize the number of stock grazing in the natural forest, the volume of grasses for domestic livestock to feed on shall be increased and the quality of pasture improved. This area consists of Sa (95.42ha), Sb (596.61ha), and St (321.45ha), giving a total of 1,013.48ha.

① Land Preparation

The crown density of standard trees in areas of Sa, Sb and St forest types shall be reduced to 10% and shrubs removed (for use and sale as timber and fuelwood). Feed trees shall be planted in rows and overall crown density established at approximately 20%. Controlled burning shall be carried out after standing trees and shrubs have been removed.

② Types of Pasture

Natural *Gramineae* Grasses shall be retained and all weeds removed. When there is a shortage of *Gramineae* grass in a particular area, pasture shall be planted with the aim of achieving 100% covering. Immediately after direct sowing grazing is to be carried out in order to establish it using the "hoof" method.

③ Utilization

Although it is possible to graze for a period of one year on fast-growing grass pasture, as it is difficult to graze during the first year with slow-growing *Leguminosae* pasture temporary stock fences should be established around the area and grazing delayed until root structure is adequately developed.

④ Number of Stock

From the Woodland Pasture production volume and the annual livestock feed requirements of mature cattle (250kg) (2,282kg), it can be calculated that 1,508 head of livestock can be reared on the Woodland Pasture. At the beginning of the plan only the existing number of livestock (mature cattle: 250kg) will be reared.

Number of Head of Stock in Woodland Pasture

Pasture	Area (ha)	Utilized Area (ha)	Dry Grass Production Volume (kg/ha)	Dry Grass Production Volume (ton)	Number of Stock
Wild Grass	1,013	810	4,250	3,443	1,508

(7) Grazing Community Forest

This area consists of forest in the silvi-pastoral zone other than Grassland, Woodland Pasture, and Conservation Forest II where improvement, etc. of grass is not being carried out. In areas of Fc, timber production shall be carried out in accordance with timber forest management. This includes areas of Gf (21.82ha) and Fc (3.93ha) for a total of 25.75ha. Grazing shall be permitted within Conservation Forest II inside the Silvi-Pastoral Zone.

(8) Utilized Land

In the Village Forestry Zone, each participating household (10.1 people: 6 adults/8 children) shall be permitted to use 2.0ha of cultivated land and 2.0ha of tree-planting land for a total of 4.0ha. (Households are permitted to use the land but the state retains ownership.) Based on aerial photographs taken during December 1998, residents participating in the Village Forestry Zone are those possessing cultivated land within the classified forest at that time. The total number of households in the village, the number of households in the Village Forestry Plan and the required area are as follows.

Village Population, Number of Households and Land Preparation Area

Population (persons)	Number of Households	Number of People per Household	Classified Forest Utilization Ratio	Number of Eligible Households	Utilized Land Area (ha)	Required Area for Land Pregaration(ha)
4,480	365	12.3	0.767	280	1,120	1,400

Utilized land consists of 23 compartment with a covering of Sa (220.43ha), Ch (602.13ha), and Ja (746.62ha) for a total of 1,569.18ha. 11 sub-compartments with an area of 1,437.05ha shall be used by 257 households, 32 sub-compartments with an area of 103.00ha shall be used by 18 households and 38 sub- compartment with an area of 29.13ha shall be used by 5 households.

① Commercial Farming

Commercial farming will be improved through extension activities regarding the improvement of crop-growing systems, cultivation methods, post-harvest processing, and through activities to enlighten farmers, including the necessity of a forest management plan.

(a) Improving Crop Growing Systems

a) Selection of Crops

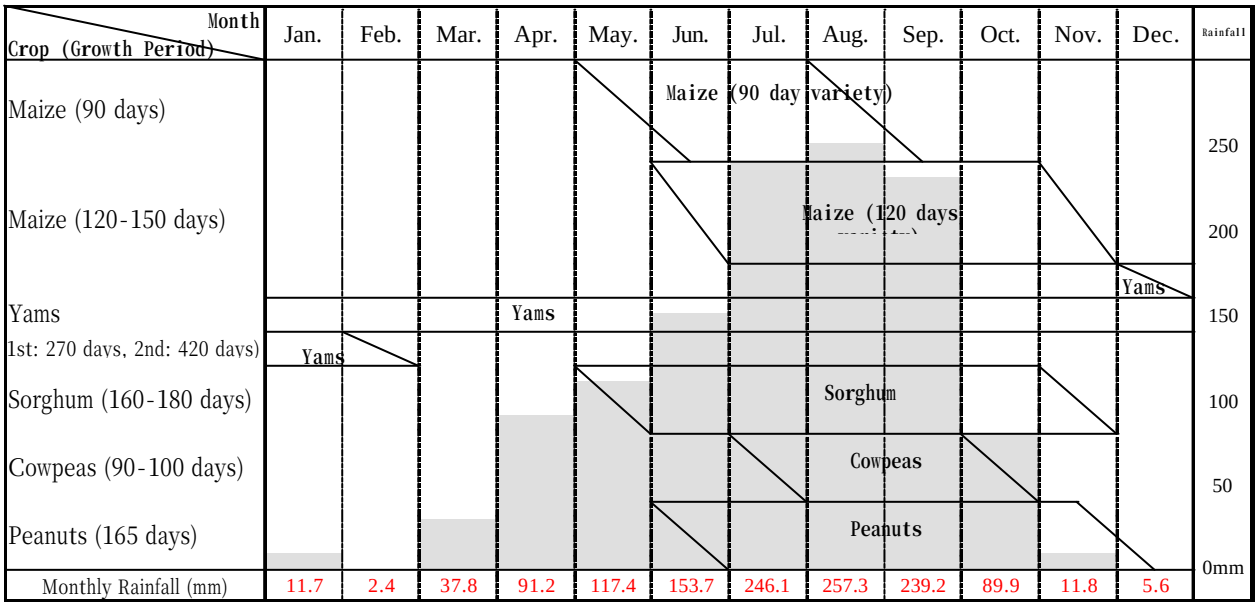
Under the terms of the Forest Management Plan, yams, maize and sorghum, shall be the main subsistence crops with peanuts and cowpeas being grown as intercrops.

b) Introduction of New Varieties (Improved Varieties)

As presently grown varieties are mainly native varieties, 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) varieties. However, as the introduction and popularization of new varieties takes time, farmers will be instructed to select reliable seeds for immediate use. Improved maize with a growth period of 90 days and native varieties with a growth period of 120 days shall both be introduced.

c) Improving Crop Growing Systems

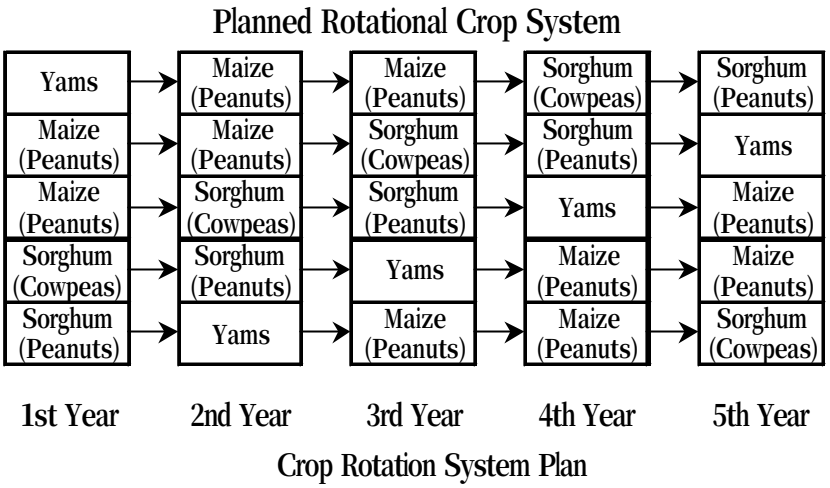
The above-mentioned improved crop growing system that gives consideration to crops and varieties is shown in the following diagram. Varieties of maize with growth periods of both 90 days and 120 days shall be introduced with two crops being grown each year. By using varieties with growing periods that are shorter than those of native varieties, this system enables the most effective utilization of the limited rainy season.



Crop Growing System Plan

d) Crop Rotation

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 rotational crop system is as shown below.



(b) Improved Growing Methods

a) Improvement of Cultivation Using Animal Power and Farming Tools

Cultivation using animal power will be introduced for joint use on condition that it will be used for contracted ploughing. Existing farming tools will be improved.

b) Materials for Agricultural Production

a. Seeds

New varieties of seeds will be introduced and sown in appropriate quantities.

b. Fertilizer

Locally obtainable organic fertilizer will be used. Where soil analysis reveals this supply to be insufficient, the use of chemical fertilizers, such as urea, will be considered. In order to expand the use of organic fertilizer, composting techniques will be taught. *Leguminosae* plants (green manure crops), such as *Mucuna pruriens*, which are a source of nitrogen, shall be ploughed in.

c) Improvement of Growing Techniques

Matters to bear in mind with regard to growing include the following.

- Deep ploughing 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.

d) 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.

- The introduction of disease and pest-resistant varieties.

- The introduction of crop rotation.
- The implementation of mixed planting and intercropping.
- Consideration of planting density.

(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 a 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.

With regard to storage, as *Leguminosae* cash crops, such as peanuts, etc., are susceptible to damage from pests while in storage, they should be mixed with wood ash and silica-seaweed soil mix, etc. and stored to prevent the breeding of pests.

② Afforestation Plan

The planting of forest and fruit trees within the 2.0ha of utilized land for the production of posts and fuelwood shall be planned in the following way. However, trees shall be selected individually by the local inhabitants themselves.

(a) Post and Fuelwood Production Forest

Trees to be planted in this area are *Tectona grandis* and *Gmelina arborea*. Planting density shall be 2,500 trees/ha (2m x 2m) with *Tectona grandis* being stamp planted and *Gmelina arborea* being either stamp planted or its cuttings planted. With stamp planting, as 4~5 sprouts appear, they shall be thinned out after 1 year with 3 straight seedlings being left.

The cutting cycle shall be 5 years with 0.4ha (1/5 of 2.0ha) being planted and felled each year. In planted areas, intercropping shall be carried out (Taungya System) for 2 years after planting. Spacing in this case shall be 3m x 1.5m (2,220 trees/ha). Annual plans shall be as follows.

Posts and Fuelwood Production Forest Plan

Year	Planting (ha)		Harvesting (ha)	Intercropping (ha)	Comments
1	0.4	Planting	—	2.0	Yams.
2	0.4	Planting	—	2.0	Yams or maize.
3	0.4	Planting	—	1.6	Maize (Intercropping of the 0.4ha of the 1st year is unnecessary.)
4	0.4	Planting	—	0.8	Maize (Intercropping of the 0.8ha of the 1st and 2nd years is unnecessary.)
5	0.4	Planting	—	0.8	Yams (Intercropping of the 1.2ha of the 1st, 2nd and 3rd years is unnecessary.)
6	0.4	1st year after Germina-tion	0.4 (1st year Forest)	0.8	Yams or maize (5th year reverts to 1st year.)
7	0.4	2nd year after Germina-tion	0.4 (2nd year Forest)	0.8	Yams or maize (Reverts to 1st and 2nd years.)
…	…	….	……	…….	

(b) Fruit Trees

Fruit trees to be planted in this area are cashews. Planting density shall be 100 trees/ha (10m x 10m). Although trees will start to bear fruit approximately 18 months after planting, from the 6th year to the 10th year only 1 ton shall be harvested per ha with 2 tons per ha being harvested from the 11th year onwards. As cashews easily catch fire, firebreaks or belts of fire-resistant trees shall be established to prevent fire from entering from the surrounding area.

③ Bee-Keeping

As honey production is a desirable way of providing a cash income to the local inhabitants, bee-keeping activities should be introduced and actively encouraged in the area in order to achieve stable production. Trees to be planted are *Acacia auriculiformis*, *Newboudia laevis*, *Detarium microcarpun* and *Burkea africana*.

④ *Vitellaria paradoxa*

Although *Vitellaria paradoxa* has been retained in cultivated areas, there are no young trees bearing fruit or for growing crops and as the trees are old, in many cases production volumes have decreased. After *Vitellaria paradoxa* has been newly planted around the perimeter of the cultivated land, it will be possible to raise replacement trees and to carry out harvesting.

(9) Fuelwood Community Forest

30.26ha of previously cultivated land apart from land for use by local inhabitants and 13.28ha of previously fallow ground making a total of 43.54ha of land within the Village Forestry Zone shall be used as a fuelwood forest for the production of fuelwood for sale by the village. This fuelwood forest is for joint use by the village and shall be managed by the organization in each improvement unit.

Species of trees to be planted in the fuelwood forest include *Prosopis sp.*, *Terminalia spp.*, and *Gmelina arborea*, etc. Of these species of trees, good quality charcoal can be obtained from *Prosopis sp.*, and *Gmelina arborea*. The planting density for this area is 2,500 trees/ha (2m x 2m). As the cutting cycle is 7 years, 6ha shall be felled and replanted each year with annual charcoal production volumes reaching 132m^3 (6ha x 22m^3/ha=132m^3).

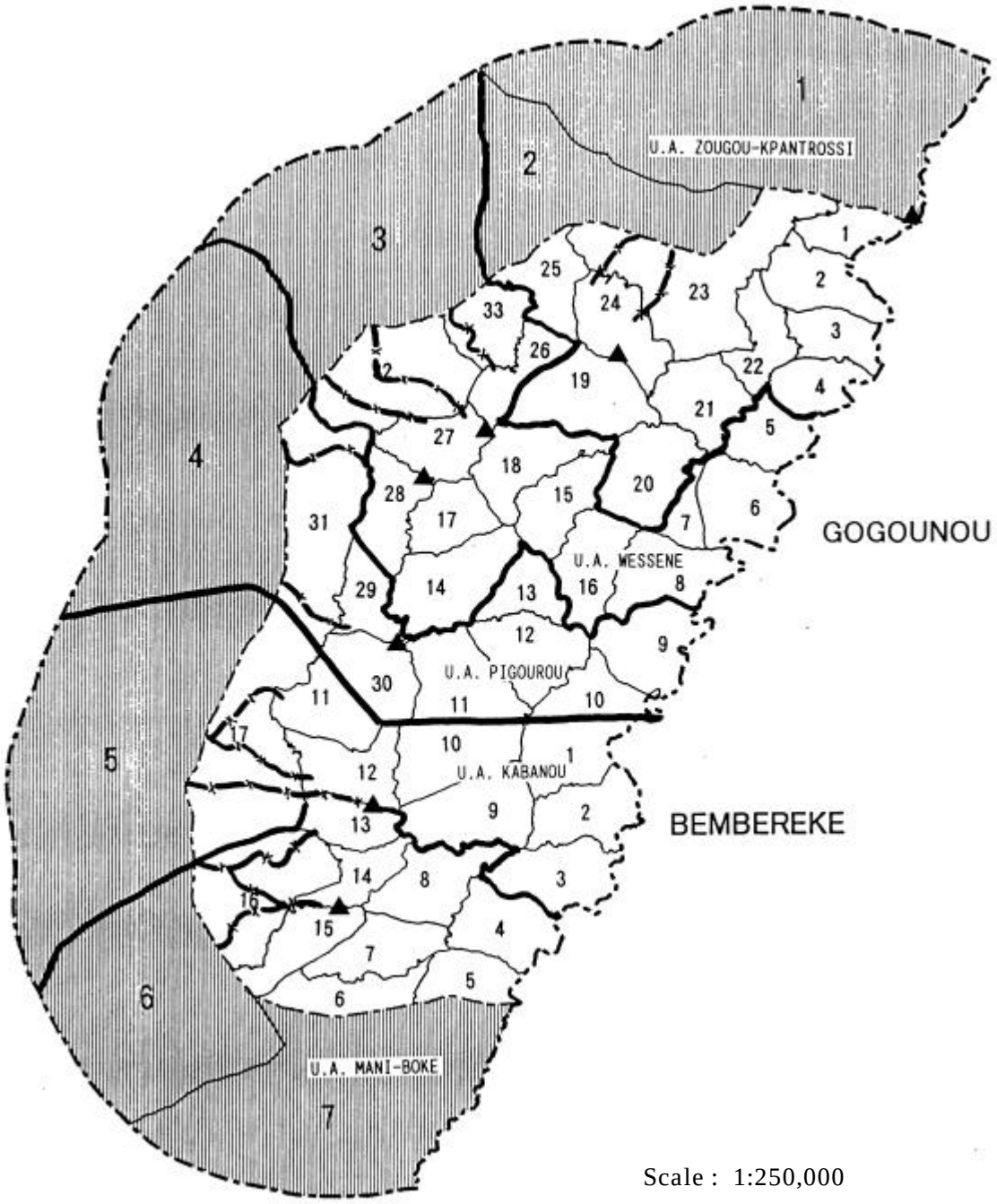
(10) Forest Reserve

Areas of forest in the Village Forestry Zone other than Conservation Forest Ⅱ, Utilized Land, Fuelwood Community Forest and Left-Over Area shall be retained as Forest Reserve. Forest Reserve contains 54.85ha of Gf, 122.14ha of Sa, 479.75ha of Sb and 166.89ha of St, making a total of 823.63ha. It is possible that the 122.14ha of Sa may be transferred to Utilized Land in the future.

Areas of Sb and St shall be transferred from outside the classified forest to the Silvi-Pastoral Zone within the classified forest without becoming part of Cultivated Land or Tree-planting Land to become paths for the passage of livestock. When such paths pass through Utilized Land, a path with a width of 50m shall be established and a 3m wide belt of *Gmelina arborea* and *Acacia auriculiformis* planted at a spacing of 1.5m x 1.5m on the boundary either side of the path. The planned livestock path shall be extended by 5,000m as shown in the following diagram.

(11) Left-Over Area

Left-Over Area is land other than forest (Gf, Fc, Sa, Sb and St) and cultivated and fallow ground that shall be retained in its present state and shall be outside the scope of management. Left-over area consists of 31.78ha of Ce, 82.60ha of Cl, 22.27ha of Tm and 5.90ha of Td for a total of 142.55ha.



Key	
1~7	Buffer Zone
1~33	Classified Forest
	Improvement Unit Boundary
U.A.	Improvement Unit
	Livestock Path
▲	Waterhole

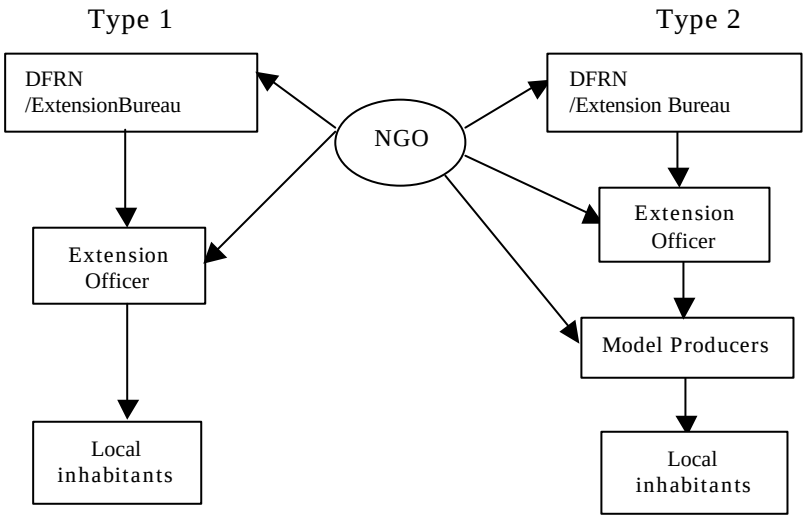
Livestock Paths

10 Extension and Training Plans

Existing extension activities are carried out under the jurisdiction of the Extension Bureau of the Ministry of Rural Denelopment 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.



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 specis, 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 seedlings for mountain areas, etc. Furthermore, training of nursery officers within local organizations will also be carried out.

(2) Bee-Keeping

Bee-keeping 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.

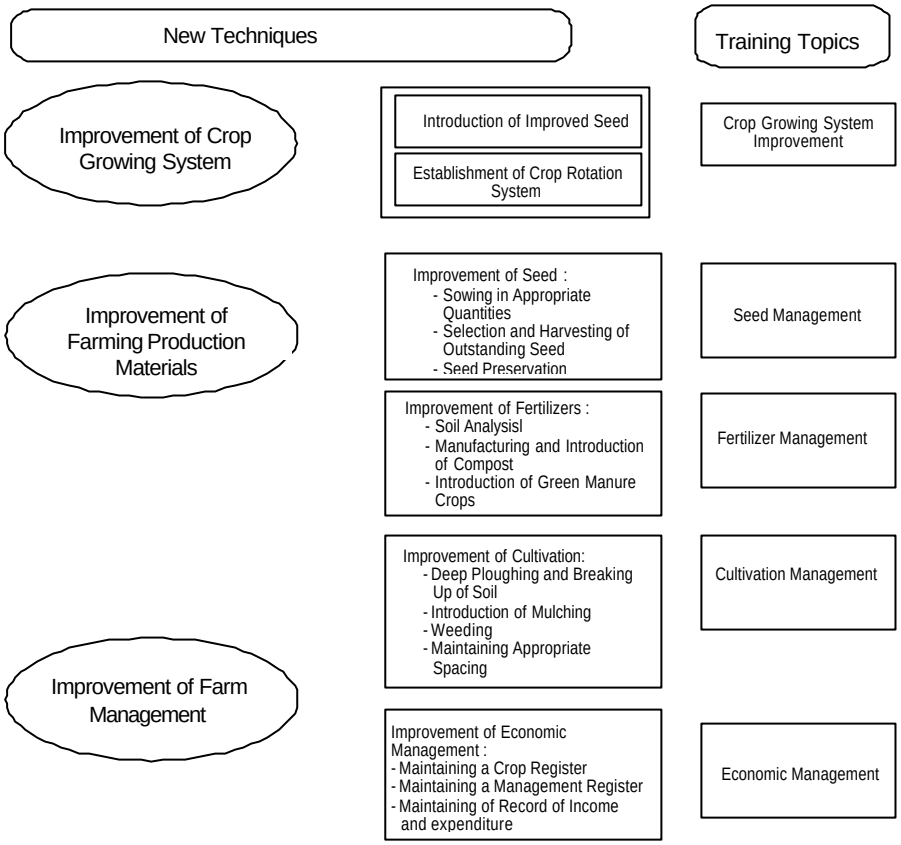
(3) Charcoal Production

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.

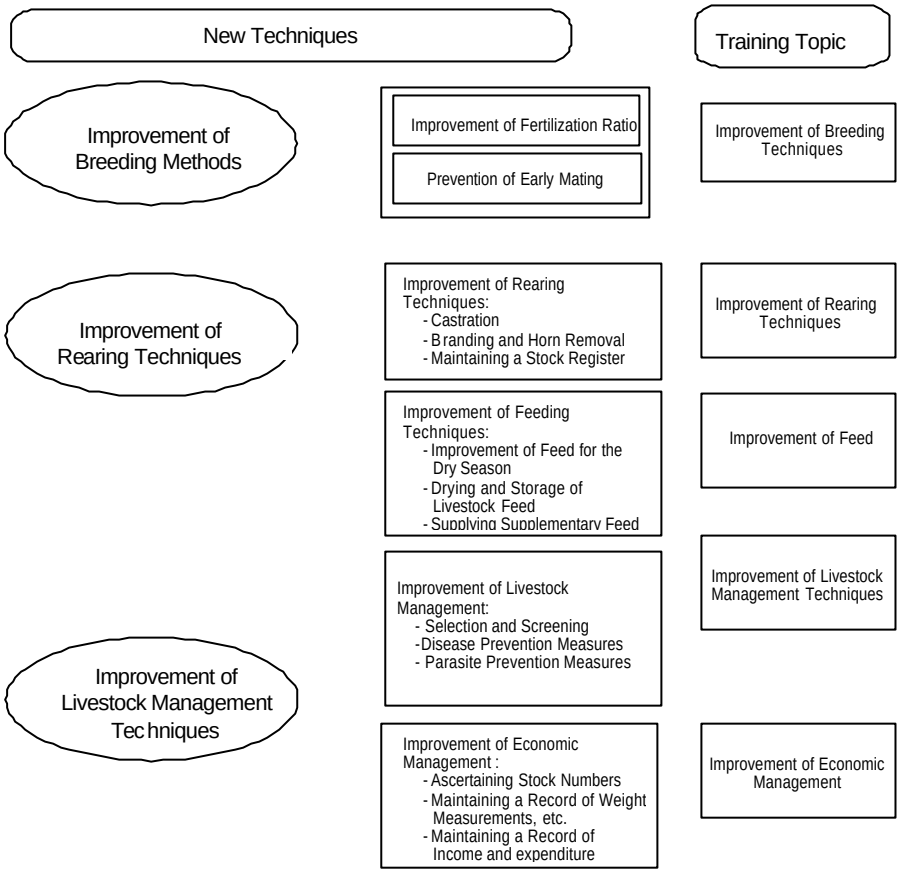
Details regarding new techniques and training topics for commercial farming improvement are as follows.



Training Topics for Commercial Farming Improvement

(5) Livestock Farming

Details regarding new techniques and training topics for the improvement of breeding techniques, rearing techniques and livestock management are as follows.



Livestock Farming Training Topics

11. Infrastructure Improvement Plan

(1) Forest Roads

The access road to the classified forest is the road running from Beroubouay on State Highway 2 via Kabanou~Koussine and forest roads for the management of production forest within the classified forest and the management of Conservation Forest shall join this access road. A main forest road will be established from the access road to the Bouli River with other minor roads being established from the main forestry road to production forests within each improvement unit. The length of the main forest road shall be 19.5km with the length of other minor roads in each improvement unit being as shown below. However, within Conservation Forest work roads will link up with the main forest road and other minor roads. The roads mentioned below are shown in the following map.

Zougou-Kpantrossi Improvement Unit	9.5km
Wessens Improvement Unit	5.5km
Pigourou Improvement Unit	7.4km
Kabanou Improvement Unit	5.1km
Mani-Boke Improvement Unit	7.9km

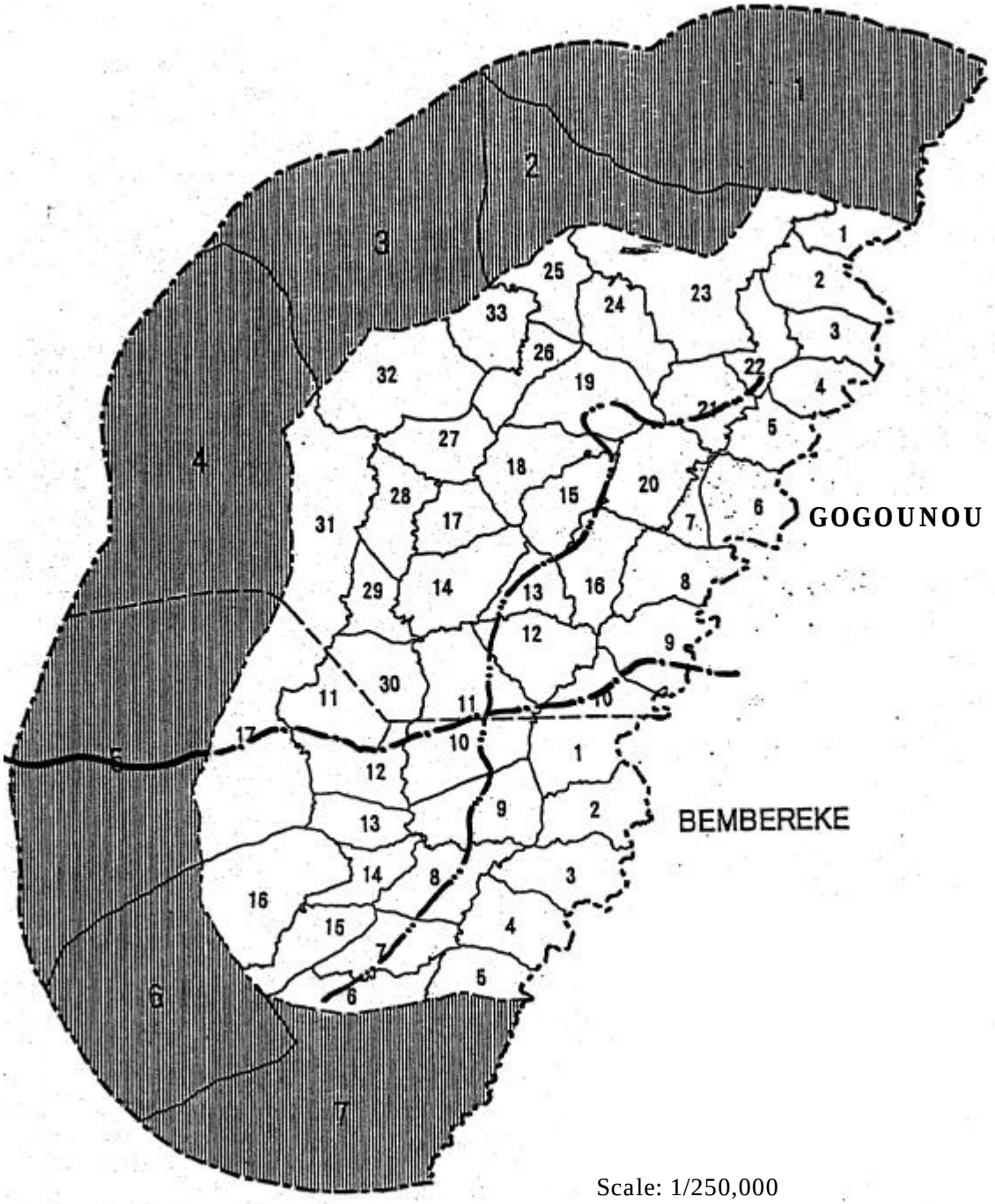
(2) Village Nursery

In order to produce seedlings in each improvement unit for planting in each zone of the classified forest, a nursery operated by the village shall be established in each village. Management, operation and maintenance of the nursery shall be carried out by the Forest Improvement unit Committee, which is an organization comprised of local inhabitants. All seedlings produced shall be for commercial sale with income from such sales going into a Forest Improvement Fund. Seedling production scale by improvement area is as shown below.

Seedling production Volume

Unit: Seedling

Improvement Unit	Year								
	3	4	5	6	7	8	9	10	Total
ZOUGOU-KPANTROSSI	140,700	178,340	185,840	259,765	275,075	275,180	200,839	148,360	1,664,099
WESSENE	53,400	92,680	100,500	131,675	137,910	138,435	102,740	60,580	817,920
PIGOUROU	60,800	83,860	90,940	90,940	91,040	91,060	91,060	68,060	667,760
KABAKOU	128,300	169,360	177,540	193,490	196,680	196,680	180,830	136,660	1,379,540
MANI-BOKE	56,000	81,300	86,320	108,770	112,760	112,760	92,710	63,700	714,320
Total	439,200	605,540	641,140	784,640	813,465	814,115	668,179	477,360	5,243,639



Key	
1~7	Buffer Zone
1~33	Classified Forest
	District Boundary
	Access Road
	Main Forest Road
	Spur Road

Forest Road Plan Map

(3) Forest Management Center

The main organization carrying out the implementation of Forest Improvement Plans is the Forest Improvement Committee, which is organized by the local inhabitants. However, as there are restrictions on the use of the classified forest by local inhabitants it is necessary to bring some form of stability to the lives of local inhabitants through regional promotion. Furthermore, a survey of local inhabitants revealed that there is a high proportion of women involved in the use of the classified forest, making their participation in the management of the classified forest essential. Therefore, a Forest Management Center will be established for forest improvement and to improve the place of women in society. Training to be carried out at the Forest Improvement Center includes literacy education for women using the center, which have a poor rate of literacy, and training, etc., which will provide a diversified means of income.

12. Buffer Zone Management Plan

A buffer zone running for 7km encircles the classified forest within which conservation forest will be established as part of the management plan of the classified forest. Such conservation forest will be handled in accordance with the management plans of the classified forest. The area of the buffer zone is 13,997.68ha and consists of the forest type shown in the table below.

Land Area by Improvement Unit, Land Use and Forest Type (Buffer Zone)

(Unit:ha)

Category	Forest Type Symbol	GOGONOU				BEMBEREKE			Total
		ZOUGOU-KPANTROSSI	WESSENE	PIGOROU	Sub-total	KABANOU	MANI-BOKE	Sub-total	
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
	Sub-total	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
	Sub-total	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

The buffer zone is a free zone which the local inhabitants are free to use for cultivation, livestock grazing, fruit harvesting, and other use. However, the felling or trimming, etc. of protected species of trees within the forest is prohibited.

Conservation forest shall be established in the following areas within the buffer zone and shall be handled in the same way as Conservation Forest II within the classified forest. However, areas considered by the local inhabitants to be areas of sacred forest shall be handled in the same way as Conservation Forest I.

Areas to be designated as conservation forest areas are as follows.

- Areas within 25m of either side of waterways which shall be preserved to protect water resources and prevent sediment from being washed into the waterways.
- Forest on residual relief and tectonic relief.
- Forest in savannah and laterite terraces.
- Areas of forest where soil conservation is required.
- Areas of forest preserved as sacred forest by villagers.

The location and scope of the above-mentioned conservation forest shall be clarified by the DFRN and recorded in the map register. As the productivity of the land in the buffer zone has decreased as a result of continuous slash and burn type agriculture it has become fallow land or is illegally cultivated within the classified forest. If the improvement plan for the classified forest can be successfully formulated, cultivation will be limited to established farming carried out in limited space. Consequently, established farming will also increase within the buffer zone allowing the effective utilization of cultivated land and fallow land where productivity has decreased. The introduction of agroforestry within the buffer zone will be actively encouraged.

(1) Agroforestry in Areas of Cultivated Land and Fallow Land

① 2ha 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 2~5ha Cultivated Land

2ha is used to grow food crops while the remaining 1~3ha shall be planted in trees and agroforestry undertaken with forest products being harvested and cash crops being grown as intercrops. 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 (10m x 10m).
- *Vitellaria paradoxa*: Limited production of fruit from *Vitellaria paradoxa* can be carried out. The planting density of these trees is 200 trees/ha (5m x 10m).
- 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 5ha

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 (4m x 2m). 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) Bee-Keeping

As cultivated land and the area surrounding cultivated land is unsuitable for bee-keeping, 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 bee-keeping 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 Coppice 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.

WESSENE Improvement Plan

Forest Improvement Plan

Forest Improvement Plans are implementation plans for each improvement unit based on the Basic Plan for Forest Management for the Intensive Study Area.

Plans for each improvement unit were formulated with consideration being given to implementation efficiency and the location of areas to be used within each zone. Furthermore, as such improvement activities will be implemented individually, separate plans were prepared for each of the five units involved.

The five plans are as follows.

1. Zougou-Kpantrossi Improvement Plan
2. Wessene Improvement Plan
3. Pigourou Improvement Plan
4. Kabanou Improvement Plan
5. Mani-Boke Improvement Plan

WESSENE Improvement Plan

1. Forest Management Units

Details regarding the WESSENE improvement unit are as follows.

Classified Forest:	Trois Rivières Classified Forest
Province (Department):	Borgou (Note. Provinces are referred to as "Departments" in Benin.)
Forest Department:	Borgou Forest Department
Forest Branch Office:	Kandi Forest Branch Office
District Forest Office:	Gogounou District Forest Office

2. Location and Area

The WESSENE Improvement Unit consists of the north-western area of the Trois Rivières Classified Forest west of the Bouli River and associated the buffer zone. The area of the classified forest is 13,179ha while the area of the buffer zone is 6,564ha.

3. General Conditions

3.1 Natural Conditions

(1) Climate

The temperature and rainfall of the WESSENE Unit as measured by weather monitoring stations in the surrounding area are as follows.

In Kandi, the average temperature is 28.1°C, the minimum average temperature of 17.2°C occurs in January, and the maximum average temperature of 38.7°C occurs in April. Average annual rainfall is 949mm in Kandi, 1,147mm in Bembereke, 1,037mm in Segbana and 1,161mm in Kalale. The rainy season lasts from May to September while the dry season lasts from October to April. Semi-arid conditions are experienced at the beginning of both the wet and dry seasons during September/October and April/May.

Average Temperature and Rainfall

(Temperature: °C)

Monbring Station	Month	1	2	3	4	5	6	7	8	9	10	11	12	Average
Kandi	Average (°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
	Maximum Average (°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
	Minimum Average (°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

Note: Figures shown are for the 1988~1997 period.

(Rainfall: mm)

Monitoring Station	1	2	3	4	5	6	7	8	9	10	11	12	Total
Kandi	0	11	30	51	110	138	186	237	143	34	1	7	949
Bembereke	1	0	17	58	117	186	212	273	203	71	8	1	1,147
Segbana	1	1	6	44	101	137	181	308	211	42	5	0	1,037
Kalale	0	17	28	58	125	159	210	225	241	58	30	10	1,161

Note: Figures shownfor Kandi and Kalale are for the 1988~1997 period, while figures for Bembereke are for the 1986~1996 period and figures for Segbana are for the 1969~1990 period.

(2) Topography, Geology and Soil Type

The topography of the area consists of flat or gently rolling hills. There are also small plateaux with steep laterite slopes and small rises scattered about the area. The altitude of this area is in the 260m~340m range.

The geology of the area consists mainly of granite and gneiss with areas of sandstone and residual accumulated material. The soil consists mainly of Sols Ferrugineaux Tropicaux with gneiss, granite and sandstone being the parent material. Soil type distribution candition is included in Appendix-1 at the end of this volume together with information regarding how to handle such soils for forestry purposes.

(3) River System

The area is drained by the Bouli River, a tributary of the Sota River which is itself the main tributary of the Niger River, and its network of streams, etc.

(4) Vegetation

Forests consist mainly of scrub savannah, tree savannah and mixed savannah of shrub and trees with areas of rigarian forest visible alongside waterways. There are also areas of *Tectona grandis* plantations, orchards, cultivated land and fallow land. Trees characteristic of the savannah include *Detarium microcarpun*, *Isoberlinia spp*, *Vitellaria paradoxa*, *Parkia biglobosa*, *Combretum spp*, etc. while trees characteristic of rigarian forest areas alongside waterways include *Daniellia oliveri*, *Anogeissus leiocarpus*, *Khaya senegalensis*, *Vitex doniana* and *Diospyros mespiliformis*, etc.

3.2 Socioeconomic Conditions

(1) Population

The population of the villages belonging to the WESSENE Improvement Unit is as follows.

Population

Village	Population (Person)	Household Number (Household)	Population Size (Person/Household)
WESSENE	1,506	284	5.3
WESSENE-Peulh	755	106	7.1
Total	2,261	390	5.8

(2) Farming Population

The farming population derived from figures obtained through the pre-Farming Census based on the farming population ratio and the farm worker ratio (the proportion of the farming population over the age of 15 and under the age of 60 that were farm workers) is as follows.

Farming Population

Village	Population (Person)	Farming Population		Farm Workers		Household Number (Household)	Population /Household (Person)	Farm Workers/Household (Person)
		Person	Ratio (%)	Person	Ratio (%)			
WESSENE	1,506	1,506	100.0	846	56.2	284	5.3	3.0
WESSENE-P	755	755	100.0	406	53.8	106	7.1	3.8
Total	2,261	2,261	100.0	1,252	55.4	390	5.8	3.2

(3) Farm Size

① Farmland Area

The area of classified forest and farmland in buffer zone (cultivated land and fallow land) is, as obtained through photo interpretation and forest type maps, as follows.

Farmland Area

(Unit:ha)

Category	Classified Forest	Buffer Zone	Total
Cultivated Land	1,967	2,085	4,052
Fallow Land	462	338	800
Total	2,429	2,423	4,852

② Planted Area

The area within classified forest planted in cotton and other crops is as follows.

Planted Area

Cultivated Land	1,967	Ha
Planted Land (a) (planted ratio)	1,574	Ha(80%)
Cotton (b) (planted ratio)	436	Ha(28%)
Non-Cotton Crops (a-b)	1,111	Ha
Farming Households	390	Household
Planted Land/Household (apart from cotton)	2.85	Ha

(4) Livestock

The main forms of livestock include cattle, sheep and goats while poultry includes chickens and guinea fowl, most of which are raised in farmyards.

Livestock

(Unit:Head)

Cows	Sheep	Goats	Total	Livestock Units*
2,275	886	483	3,644	2,549

* 5 sheep or goats are counted as 1 cow.

4. Forest Divisions

4.1 Forest Compartments

Divisions with the inherent characteristics necessary for the management and operation of classified forests were established on the basis of political boundaries, village boundaries, and roads, and rivers, etc. while buffer zones were established on the basis of political boundaries and roads. Each of the forest compartments are assigned a number corresponding to each management unit.

The forest compartments and divisions of the WESSENE Improvement unit are as follows. The area by forest covering of each forest compartment is shown in 6 zomes. Area by forest type is shown in Appendix-2 at the end of this volume.

Land Area of Forest Compartments

Classified Forest				Buffer Zone	
compartment	Area (ha)	compartment	Area (ha)	compartment	Area (ha)
5	714.41	17	713.82	③	6,563.68
6	1,004.58	18	1,039.99		
7	338.30	26	690.74		
8	1,046.85	27	861.63		
14	1,297.84	28	875.35		
15	865.66	32	1,985.97		
16	957.82	33	786.09		
Total			13,179.05	Total	6,563.68
Total					19,742.73

4.2 Sub-Compartments

In order to clarify present types of land use and the state of forests, and differences in forest management, forest compartments were divided up into smaller sub-compartments. These designated sub-compartments were those designated at the time that the Improvement Plan was formulated. Therefore, based on the results of each year's operations, such sub-compartments are divided up and assigned a sub-compartment number. (Refer to the Plan Register)

5. Improvement Aims

The main aim of Improvement Plans is the rapid restoration of the classified forests as state forest and their conservation. As the implementation of these plans is considered difficult without the cooperation of the local inhabitants, by permitting them to use areas within the classified forest, the conservation of the forest will be carried out by the people themselves. The improvement aims for the classified forest are as follows.

- The improvement of the forest through the implementation of measures for public benefit, including the development of the water resources of the forest, the conservation of national land, the protection of wildlife, and the preservation of genetic resources, etc.
- The fostering of a production forest in order to enrich and utilize forest resources sustainably.
- The establishment of an area within the classified forest for use by local inhabitants in order to conserve the forest through coexistence with the people.

6. Zoning

The area will be divided into three zones: the Forestry Zone, the Silvi-pastoral Zone, and the Village Forestry Zone.

6.1 Forestry Zone

The forestry zone consists of the Conservation Forest Zone, which is areas of classified forest that should be protected and conserved, and the Production Forest Zone which is for timber production.

(1) Conservation Forest Zone

The Conservation Forest Zone, which is designed to develop water resources and preserve forestry areas, runs from the Bouli River on the eastern border of the Intensive Study Area for a distance of 3.5km, within which are Conservation Forest I and II.

① Conservation Forest I

This forest runs from the Bouli River for a distance of 500m and is specially for the fostering of water resources.

It is a pure forest consisting of *Anogeissus leiocarpus*.

It is located on residual relief and tectonic relief.

Soil conditions are bad and existing vegetation should be retained.

② Conservation Forest II

This area consists of the remaining area within the Conservation Forest Zone that is not part of Conservation Forest I.

(2) Production Forest Zone

With the exception of the Conservation Forest within the Forestry Zone, this is the area in which the production of timber and fuelwood and charcoal, etc. is carried out. However, the following areas within the production forest shall be part of 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.

6.2 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 within 50m either side of waterways shall be part of Conservation Forest II.

6.3 Village Forestry Zone

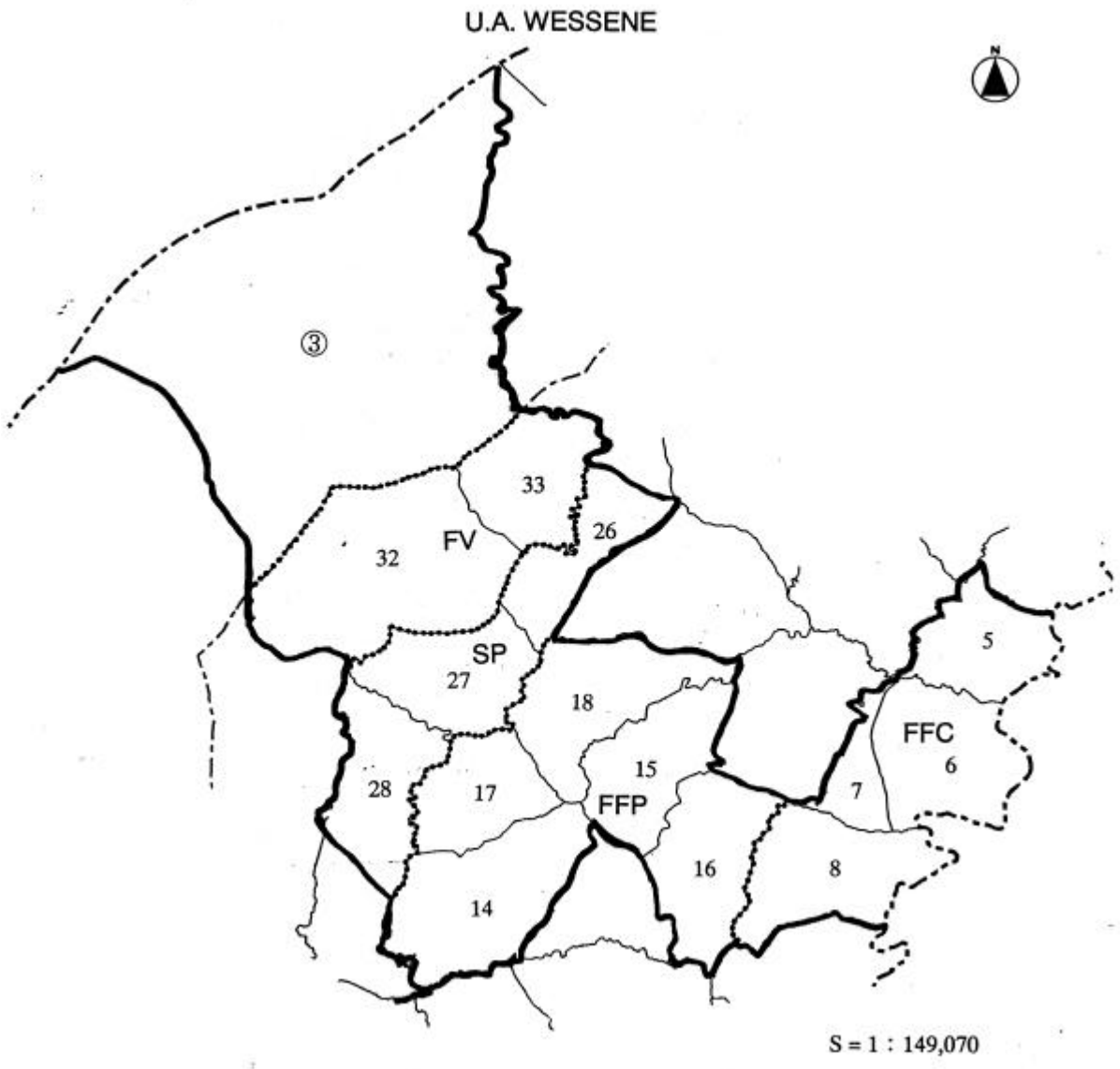
This is the zone in which the local inhabitants carry out farming and forestry activities. It is located on the boundary of the Classified Forest and adjoins the Buffer Zone. The following areas within the zone shall be part of Conservation Forest II.

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.

The land area by forest compartment and forest type in each zone is as shown below.



Legend	
②	Buffer Zone Compartment No.
2	Classified Forest Compartment No.
▬▬	Improvement Unit Boundary
- - - -	Zone Boundary
FFC	Conservation Forest Zone
FFP	Production Forest Zone
SP	Silvi-Pastoral Zone
FV	Village Forestry Zone

Zoning Map

Land Area by Forest Compartment and Forest Type (WESSENE) (Unit:ha)

Zone	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
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

7. Forest Land Use Classification

In order to implement forest improvement activities, forest land use classes shall be established according to proposed use based on improvement standards for basic plans for the forest within each zone and in order to formulate operating plans in accordance with forest land use classification divisions. The types of forest classified under the forest land use classification shall be included in plans as follows.

7.1 Forest Zone

(1) Conservation Forest Zone

Conservation Forest I	Areas of forest within 500m of the western bank of the Buri River that should be protected for the purpose of fostering water resources.
Conservation Forest II	Areas of forest within 3,500m of the western bank of the Bouli River (with the exception of Conservation Forest I) that should be maintained for the purpose of fostering water resources and conserving forest land.

(2) Production Forest Zone

Timber Forest	Forest for the production of ordinary timber.
Fuelwood Forest	Forest for the production of fuelwood (wood and charcoal for fuel).
Conservation Forest II	Forest that should be maintained due to location alongside waterways and on account of poor soil condition.
Left-over Area	Non-forest areas designated as other land.

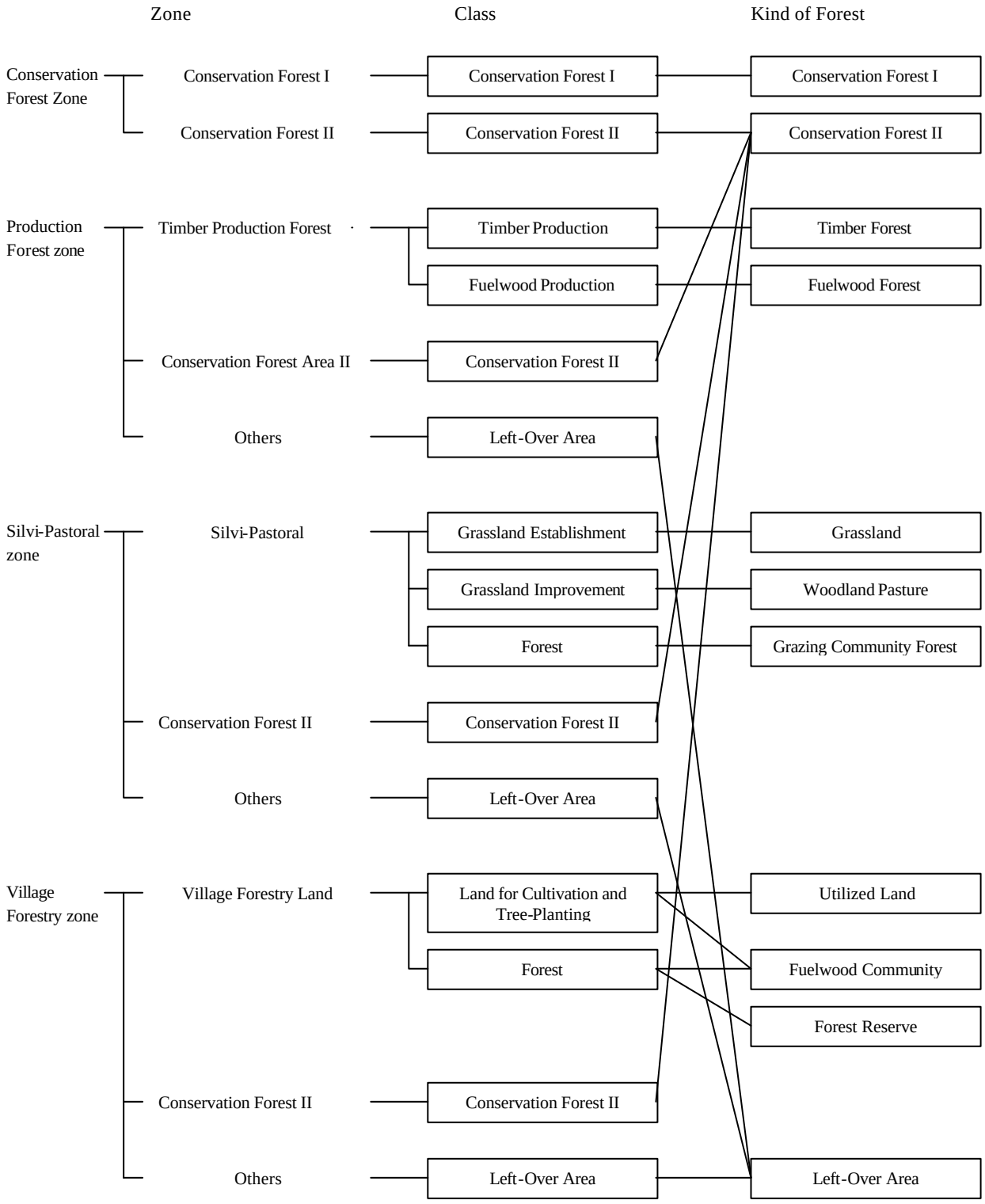
7.2 Silvi-pastoral Zone

Grassland	Artificially created grassland.
Woodland Pasture	Forest improved by increasing the amount of grass that can be eaten by livestock within the forest.
Grazing Community Forest	Forest to be left in its present state other than Grassland and Woodland Pasture.
Conservation Forest II	Forest that should be maintained due to location alongside waterways and on account of poor soil condition.
Left-over Area	Non-forest areas designated as other land.

7.3 Village Forestry Zone

Utilized Land	Land used by people for cultivation, tree planting and roads.
Fuelwood Forest	Areas of forest used as fuelwood forest within cultivated land or fallow land located within forests or Forest Reserve.
Forest Reserve	Forest other than Utilized Land, Fuelwood Forest and Conservation Forest II. Forest that should be set aside for future use as Utilized Land, livestock trails, and boundaries, etc.
Conservation Forest II	Forest than should be maintained due to its location alongside waterways or due to poor soil conditions, etc.
Left-over Area	Non-forest areas designated as other land.

Forest Land Use classes and kind of forest can be summarized as follows.


Zone
Class
Kind of Forest
Conservation Forest Zone
Conservation Forest I
Conservation Forest II
Production Forest zone
Timber Production Forest
Conservation Forest Area II
Others
Silvi-Pastoral zone
Silvi-Pastoral
Conservation Forest II
Others
Village Forestry zone
Village Forestry Land
Conservation Forest II
Others
Conservation Forest I
Conservation Forest II
Timber Production
Fuelwood Production
Conservation Forest II
Left-Over Area
Grassland Establishment
Grassland Improvement
Forest
Conservation Forest II
Left-Over Area
Land for Cultivation and Tree-Planting
Forest
Conservation Forest II
Left-Over Area
Conservation Forest I
Conservation Forest II
Timber Forest
Fuelwood Forest
Grassland
Woodland Pasture
Grazing Community Forest
Utilized Land
Fuelwood Community
Forest Reserve
Left-Over Area

8. Operation Standards

Improvement methods and operation (management) methods by kind of forest are as follows.

Operation (Management) Standards (1)

Kind of Forest	Existing Forest Type	Improvement Methods	Operation Methods
Conservation Forest I	Gf, Fc, Sa, Sb, and St with a crown density of more than 50%	• Maintenance of existing areas of forest vegetation.	• These areas are not to be subject to management. • Felling of trees is prohibited and the removal of branches and leaves is also prohibited. • Controlled burning is totally prohibited. • Grazing and the passage of livestock is prohibited.
	Gf, Fc, Sa, Sb, and St with a crown density of up to 50%	• Enrichment through planting (mixed planting) of native species. Trees: *Khaya senegalensis, Pterocarpus erinaceus, Isoberlinia spp., Vitellaria paradoxa, and Parkia biglobosa.* Spacing: 10m x 10m (100 trees/ha) Supplementary Planting: Carried out after one year if no more than 80% of trees survive. Brush Cutting: Carried out evenly around planted trees once a year one year after planting.	
	Ch, Ja	• New mixed planting of native species. Trees: Khaya senegalensis, Pterocarpus erinaceus, Isoberlinia spp., Vitellaria paradoxa, and Parkia biglobosa. Spacing: 4m x 4m (625 trees/ha) Supplementary Planting: Carried out after one year if no more than 80% of trees survive. Brush Cutting: Carried out evenly around planted trees twice a year 2~3 years after planting.	
Conservation Forest II	Gf, Fc, Sa, Sb, and St with a crown density of more than 50%	• Maintenance of existing areas of forest vegetation.	• These areas are not to be subject to management. • Although thinning, pruning and sanitation cutting is permissible, the felling of trees and the removal of branches and leaves apart from such thinning, pruning and sanitation cutting is prohibited. • Controlled burning is totally prohibited. • Grazing and the passage of livestock is prohibited. (However, this shall exclude access by livestock to water holes in the Silvi-pastoral Zone)
	Gf, Fc, Sa, Sb, and St with a crown density of up to 50%	• Enrichment through planting (mixed planting) of native species. Trees: *Khaya senegalensis, Pterocarpus erinaceus, Isoberlinia spp., Vitellaria paradoxa, Parkia biglobosa* and *Milicia excelsa.* Spacing: 10m x 10m (100 trees/ha) Supplementary Planting: Carried out after one year if no more than 80% of trees survive. Brush Cutting: Carried out evenly around planted trees once a year one year after planting.	

Operation (Management) Standards (2)

Kind of Forest	Existing Forest Type	Improvement Methods	Operation Methods
Conservation Forest II	Ch, Ja	• New mixed planting of native species (including group planting). Trees: *Khaya senegalensis, Pterocarpus erinaceus, Isoberlinia spp., Vitellaria paradoxa, Parkia biglobosa, and Milicia excelsa.* Spacing: 4m x 4m (625 trees/ha) Supplementary Planting: Carried out after one year if no more than 80% of trees survive. Brush Cutting: Carried out evenly around planted trees twice a year 2~3 years after planting.	
Timber Forest	Gf, Fc, Sa, Sb	• Fostering of the timber forest through planting seedlings, direct sowing and natural seeding of native species. Trees: *Khaya senegalensis, Pterocarpus erinaceus, Isoberlinia spp., Afzelia africana, Prosopis africana, and Milicia excelsa.* Spacing:One of the following will be adopted by taking into account crown density of each ferest, 5m x 5m (400 trees/ha), 6m x 6m (276 trees/ha), 8m x 8m (156 trees/ha), 10m x 10m (100 trees/ha). Other: When planting, existing material of a usable size may be cut down and used.	• Selective logging shall be carried out. Cutting Cycle: 20 years Selective Logging Ratio: 33% of trees with a diameter at breast height (DBH) of no less than 35cm (girth at breast height of no less than 100cm). Age at Maturity: 30 years • Regeneration: Natural seeding. Direct sowing of seed and planting of seedlings will also be carried out as necessary. • Burning is totally prohibited. • Grazing and the passage of livestock is prohibited.
	Ch, Ja	• Planting of native species and direct. Trees: *Khaya senegalensis, Pterocarpus erinaceus, Isoberlinia spp., Afzelia africana, Prosopic africana, and Milicia excelsa.* Spacing: 4m x 4m (625 trees/ha). Mixed line planting of various species of trees. Supplementary Planting: Carried out after one year if no more than 80% of trees survive. Brush Cutting: Carried out evenly around planted trees twice a year 2~3 years after planting. Other: Land being cultivated may continue to be cultivated until after crops have been harvested at which time the timber production forest will be created.	

Operation (Management) Standards (3)

Kind of Forest	Existing Forest Type	Improvement Methods	Operation Methods
Fuelwood	Sa, Sb, St	• Planting of native species and direct sowing of seed. Trees*: Detarium microcarpum, Isoberlinia spp., Terminalia avinnoides, Combretum spp., Crossopteryx febrifuga,* and *Piliostigma thonningii*. Other: Felling and harvesting of material with a diameter larger than the specified usable diameter within the existing forest may be carried out the year before planting of seedlings or direct sowing of seed is carried out. Material that is able to germinate should be left to germinate. Additional planting and direct sowing of seed shall be carried out depending on how well seeds etc. take root and the growth of seedlings.	• The area shall be used as a fuelwood forest with trees of not less than 7cm DBH (no less than 20cm GBH) being felled. Cutting Cycle: 7 years Regeneration:Germination and direct sowing of seeds. • Controlled burning shall be totally prohibited. • Grazing and the passage of livestock shall be prohibited.
	Ch, Ja	• Planting of exotic species, Planting using cuttings and direct sowing of seed. Trees: *Tectona grandis, Acacia auriculiformis, Gmelina arborea, and Cassia siamea*. Spacing: 2m x 2m (2,500 trees/ha), 2m x 2.5m (2,000 trees/ha) Brush Cutting: Brush cutting shall be carried out depending on the state of the grass beneath. Other: Existing standing trees (including withered and damaged trees) and shrubs shall be felled and removed for use. Land being cultivated may continue to be cultivated until after crops have been harvested at which time the fuelwood production forest will be created.	• The area shall be clear cut. However, the size of the area to be clear cut shall be reduced. Cutting Cycle: 7 years Regeneration: Germination, planting using cuttings sowing of seeds. • Controlled burning shall be totally prohibited. • Grazing and the passage of livestock shall be prohibited.
Grassland	Sa, Sb, St	• The felling of standing trees (for sale as timber and fuel) and the removal of shrubs (for local fuel use) shall be carried out, after which the land will be ploughed and pasture sown or planted. • Feed trees, trees for fuel and trees which provide a source of nectar for bees shall be planted around this area as a surrounding fence and to form divisions within it.	• This area is designated as a grazing area for rotational grazing. • Pasture shall be harvested and used for livestock feed during the dry season. • Although the area shall be burnt off once every three years, as it is a grazing area this shall be carried out in a planned manner in accordance with grazing plans. A firebreak shall be established around all areas where controlled burning is to be carried out. • Grass other than pasture shall be removed and shrubs cleared and removed. • The leaves of feed trees shall be used to increase the volume of pasture feed and branches shall be used as fuelwood.
	Ch, Ja	• Standing trees and shrubs shall be removed (for use as fuel in local areas) and after ploughing pasture shall be sown or planted. • Feed trees, trees for fuel and trees which provide a source of nectar for bees shall be planted around this area as a surrounding fence and to form divisions within it.	
	Ag	• After ploughing pasture shall be sown or planted. • As the total area involved is relatively small, this shall be concentrated in Sa, Sb, St and Ch and Ja grasslands.	

Operation (Management) Standards (4)

Kind of Forest	Existing Forest Type	Improvement Methods	Operation Methods
Woodland Pasture	Sa, Sb, St	• Trees of larger diameter shall be felled and used (with the exception of *Vitellaria paradoxa*) and crown density reduced to no more than 10%. Shrubs shall be completely removed. • Feed trees shall be planted in rows and overall crown density reduced to approximately 20%. • In order to increase the volume of natural *Gramineae* grasses for livestock feed, weeds other than *Gramineae* will be removed and pasture seeds sown.	• Areas where controlled burning is to be carried out shall be established and such burning carried out at an early stage. Firebreaks shall be established around such areas to prevent fire from spreading to other areas. • Weeds not eaten by livestock shall be removed and seeds sown in areas with low grass density. • Management of crown density shall be carried out and shrubs shall be removed. • The leaves of feed trees shall be used to increase the volume of livestock feed and branches shall be used for fuel. • Dams shall be constructed in waterways in order to provide water for livestock during the dry season.
	Ch, Ja	• Shrubs shall be removed. • With the exception of *Gramineae* grasses eaten by livestock, all other grasses shall be removed. • Pasture seeds shall be sown. • Feed trees shall be planted in rows and overall crown density reduced to approximately 20%.	
	Ag	• After ploughing, pasture shall be sown and feed trees planted. • As the total area involved is relatively small, this shall be concentrated in Sa, Sb, St and Ch and Ja woodland pasture.	
Grazing community Forest	Gf, Fc	• The existing forest shall be left in its present state and no special improvement of grassland shall be carried out.	• This area shall be used as Grazing community Forest. • Although intensive management of this area shall not be carried out, timber production of Fc shall be carried out in accordance with timber forest management.
	Ag	• In order to allow the forest to rec over, direct planting of native species shall be carried out after ploughing. After that, the area shall be included in Gf and Fc Grazing community Forest.	

Operation (Management) Standards (5)

Kind of Forest	Existing Forest Type	Improvement Methods	Operation Methods
Utilized Land	Fc, Sa, Sb	• Users shall be permitted to use up to 4.0ha per household (2.0ha for cultivation and 2.0ha for tree-planting). • On land for cultivation, standing trees shall be felled (including withered and damaged trees) and sold as timber and fuelwood, and shrubs shall be removed to be used locally for fuel. After this has been carried out, the area shall be used for normal commercial farming activities. • On land for tree-planting, in order to make room for the planting of fruit trees, trees for fuel and posts, standing trees (including withered and damaged trees) shall be felled and sold as timber and fuelwood, and shrubs removed for use by the users. After this has been carried out, fruit trees and trees for fuel and posts shall be planted. Fruit Trees: *Anacardium occidentale*. Trees for Fuel and Posts: *Tectona grandis, Gmelina arborea, and Cassia siamea.* Spacing: Fruit trees 10m x 10m (100 trees/ha); Trees for Fuel and Posts 2m x 2m (2,500 trees/ha). However, when planting over a 1-2 year period, trees should be planted at 1.5m x 3m (2,222 trees/ha) or 1.5m x 4m (1,666 trees/ha). • A firebreak shall be established on the boundary between utilized land (land for cultivation and tree-planting) and other zones to mark the boundary and to prevent fire spreading to other areas. Trees such as *Khaya senegalensis, Acacia auricuriformis, Pterocarpus erinaceus and Parkia biglobosa*, etc., which are a source of nectar for bee-keeping, should be used.	• As a rule, users shall be those entities possessing cultivated land within presently classified forests (based on aerial photographs taken in 1998). • Controlled burning shall be prohibited. • Grazing and the passage of livestock shall be prohibited. • Cotton growing shall be prohibited. • Commercial farming shall be improved in order to establish farming. • *Vitellaria paradoxa* shall be regenerated in areas surrounding cultivated land and shall be replanted in present areas of cultivated land. • The cutting cycle shall be set at 5 years for trees for fuel and posts with 1/5 of the planted area being logged and replanted every year. • When the area is logged it shall be completely cleared and when it is replanted it shall be planted in both seeds and seedlings. • Bud pruning of *Tectona grandis* is also required. • In tree-planting areas, it is possible to carry out agroforestry (Taungya) 1~2 years after new planting and replanting.
	Ch, Ja	• With regard to cultivated land, Ch will be left as it is and normal commercial farming shall be carried out while standing trees and shrubs shall be felled and removed and the area turned into cultivated land. • Land for tree-planting shall be prepared for planting with fruit trees and trees for fuel and posts, with wood sold as firewood or used by the users. • Fruit trees and trees for fuel and posts shall be planted in the same way as for Fc, Sa and Sb. • Firebreaks shall be established on the boundary between this zone and other zones in the same way as for Fc, Sa and Sb.	

Operation (Management) Standards (6)

Kind of Forest	Existing Forest Type	Improvement Methods	Operation Methods
Forest for Community fuelwood	Ch, Ja	• Fuelwood forest for village joint use shall be created in areas of Ch and Ja other than Utilized Land as a source of income for the village. • Fuelwood forest shall be created in accordance with creation techniques for tree-planting areas within Utilized Land. * Areas of Fc, Sa, Sb, Ch and Ja remaining after land has been distributed to the people of the area shall be designated as Fuelwood Community Forest within Utilized Land.	• Management techniques for this area shall be in accordance with those of tree-planting areas within areas of Utilized Land. • Controlled burning shall be prohibited. • Grazing and the passage of livestock shall be prohibited.
Forest Reserve	Gf, Fc, Sa, Sb, St, Ag	• Vegetation in Utilized Land, ppice Fuelwood Forest and forest apart from Left-over Area within the Village Forestry Zone shall be left in its present condition. • Forest Reserve shall also include forest that can be transferred into Utilized Land in the future. • Vegetation in areas of Gf, Sb and St shall be left in its present condition and shall be used for the passage of livestock to the Silvi-pastoral Zone from areas of classified forest. • Areas of Ag in forests shall be restored with native species.	• Forest operations shall not be implemented for areas of existing forest. • Controlled burning shall be prohibited. • Although grazing in this area shall be prohibited, grazing and the passage of livestock shall be permitted in remaining areas of the forest.
Left-Over Area	Other (Tm, Td, Cl, Ar, Ce, Pe)	• This area shall be left in its present condition.	• Grazing shall be prohibited in the Conservation Forest Zone, Production Forest Zone, and Village Forestry Zone. • Silvi-pastoral Zones shall be managed in the same way as Grazing Community Forest. • Controlled burning shall be prohibited.

9. Improvement Plans

9.1 Plan Duration

A sustainable forest management was aimed for when deciding plan period for classified forests. The duration required for the implementation of forestry operations to achieve the said sustainable forest management was set as the plan period for this plan.

The time required for forestry operations to be realized for each zone will differ from zone to zone. If the age at maturity for the timber forest is set at 40-60 years there will be 3 cutting cycles or 60 years. Trees in fuelwood forests take 7 years to mature and one year for regeneration, making a total of 8 years. It takes 3 years to fatten cows in silvi-pastoral zones, 5 years to establish a regular farming cycle in cultivated land, and it takes 5 years for trees for fuel and posts to reach maturity. In timber forest, as the time required to reach maturity is relatively long, the plan period shall be set at 10 years, targeting the fuelwood forest (the above-mentioned 8 years plus 2 years for preparation).

9.2 Management Plans

Management of each type of forest shall be carried out in accordance with the improvement methods and operation metheds outlined in 8. Operation Standards. The areas of existing forest type in each zone by improvement method for each Kind of forest are as follows.

Area of Improvement Methods by Forest Type (WESSENE)

Conservation Forest Zone (Unit:ha)

Classification		Forest Type and Area								Total
		Gf	Fc	Sa	Sb	St	Ch	Ja	Other	
		257.41		1,386.86	1,109.47	191.69	82.34	28.26	48.11	3,104.14
Conservation Forest I	Planting						51.82			51.82
	Enrichment	23.23		38.64	145.77	49.70				257.34
	Original State	107.75		207.99						315.74
Cinservation Forest II	Planting						30.52	28.26		58.78
	Enrichment			508.59	875.36	141.99				1,525.94
	Original State	126.43		631.64	88.34					846.41
Left-over Area									48.11	48.11

Production Forest Zone (Unit:ha)

Classification		Forest Type and Area								Total
		Gf	Fc	Sa	Sb	St	Ch	Ja	Other	
		226.96		1,760,70	2,054.05	512.29	138.60	57.49	125.04	4,875.13
Conservation Forest II	Planting						13.44	10.36		23.80
	Enrichment	21.87		73.34	161.40	32.14				288.75
	Present State	200.61		147.52	55.29					403.43
Timber Forest	Planting									
	Felling/ Regeneration	4.48		1,025.28	91.81	8.12				1,129.69
Fuelwood Forest	Planting						125.16	47.13		172.29
	Felling/ Regeneration			514.56	1,745.55	472.03				2,732.14
Left-over Area									125.04	125.04

Silvi-pastoral Zone (Unit:ha)

Classification		Forest Type and Area								Total
		Gf	Fc	Sa	Sb	St	Ch	Ja	Other	
		184.12		336.98	922.79	219.64	634.69	110.71	18.79	2,427.72
Conservation Forest II	Planting						30.23			30.23
	Enrichment	18.64			28.15	0.68				47.47
	Present State	157.70		23.07						180.77
Grassland				267.64	18.84		600.81	110.71		998.00
Woodland Pasture				46.27	875.80	218.96	3.65			1,144.68
Grazing Community Forest		7.78								7.78
Left-over Area									18.79	18.79

Village Forestry Zone (Unit:ha)

Classification		Forest Type and Area								Total
		Gf	Fc	Sa	Sb	St	Ch	Ja	Other	
		192.82	13.07	886.83	803.40	279.36	1,111.85	256.63	19.10	2,772.06
Conservation Forest II	Planting						13.03			13.03
	Enrichment	29.33		11.42	9.21	5.91				55.87
	Present State	16.74								16.74
Utilized Land			13.07	49.86	156.28		1,057.13	248.53		1,524.87
Fuelwood Community Forest							41.69	17.10		58.79
Forest Reserve		146.75		25.55	637.91	273.13				1,083.66
Left-over Area									19.10	19.10

(1) Conservation Forest I

Conservation Forest I has an area of 624.90ha of which 315.74ha is in original forest, 51.82ha is newly planted combined with 257.34ha undergoing enrichment for forest recovery, giving a total of 309.16ha.

① Annual Work Volume

The period has already been determined as 10 years. Planting, supplementary planting and brush cutting are actually carried out over a period of 7 years. The annual work volume is as follows.

Annual Work Volume (Unit: ha)

Activity	Area (ha)	Year							
		1-3	4	5	6	7	8	9	10
Planting	52	Preparation Period	*1	*1	17	17	18	-	-
Enrichment	257		51	51	35	35	34	51	-
Supplementary Planting	309		-	51	51	52	52	52	51
Brush Cutting	413		51	51	52	69	86	86	18
Total	1,031		102	153	155	173	190	189	69

*1 Planting is carried out along the boundaries of the classified forest to clarify boundaries.

② Implementation Methods

- Both planning and implementation are carried out directly by the DFRN.
- Local inhabitants are employed as workers and are paid wages.
- Necessary nursery stock is purchased from private nurseries by the DFRN.

③ Nursery Stock

The required quantity of nursery stock for new planting, enrichment and supplementary planting in Conservation Forest I is as follows.

Required Nursery Stock Volume (Unit: ha)

Category		Year							
		1-3	4	5	6	7	8	9	10
New Planting	Planting	Preparation Period	-	-	10,625	10,625	11,250	-	-
	Supplemen-tary Planting		-	-	-	2,125	2,125	2,250	-
	Sub-Total		-		10,625	12,750	13,375	2,250	-
Enrich-ment	Planting		5,100	5,100	3,500	3,500	3,400	5,100	-
	Supplementary Planting		-	1,020	1,020	700	700	680	1,020
	Sub-Total		5,100	6,120	4,520	4,200	4,100	5,780	1,020
Total			5,100	6,120	15,145	16,950	17,475	8,030	1,020

④ Tree Type and Planting Density, etc.

Tree types and planting density are as follows.

(a) Tree Type (The same tree types are used for both new planting and enrichment.)

Khaya senegalensis, Ptetocarpus erinaceus, Isoberlinia supp., Vitellaria paradoxa, and Parkia biglobosa.

(b) Planting Density

Planting density for areas of new planting is 625 trees/ha (4m x 4m) while for areas of enrichment it is 100 trees/ha (10m x 10m).

(c) Supplementary Planting (The same tree types are used for both new planting and enrichment.)

The supplementary planting ratio is 20%.

(2) Conservation Forest II

Although Conservation Forest II is found in every zone, as according to management standards the way these zones are handled is the same, the total area of Conservation Forest II is 3,491.21ha. Forest in its present state is 1,447.34ha while the total area for forest recovery includes 125.84ha for new planting and 1,918.03ha for enrichment, making a total of 2,043.87ha.

Land Area of Conservation Forest II (WESSENE) (Unit: ha)

Operation Methods	Zone	Forest Type						Total
		Gf	Sa	Sb	St	Ch	Ja	
New Planting	Conservation Forest					30.52	28.26	58.78
	Production Forest					13.44	10.36	23.80
	Silvi-pastoral Forest					30.23		30.23
	Village Forestry					13.03		13.03
	Sub-Total					87.22	38.62	125.84
Enrichment	Conservation Forest		508.59	875.36	141.99			1,525.94
	Production Forest	21.87	73.34	161.40	32.14			288.75
	Silvi-pastoral Forest	18.64		28.15	0.68			47.47
	Village Forestry	29.33	11.42	9.21	5.91			55.87
	Sub-Total	69.84	593.35	1,074.12	180.72			1,918.03
Existing Forest	Conservation Forest	126.43	631.64	88.34				846.41
	Production Forest	200.61	147.52	55.29				403.42
	Silvi-pastoral Forest	157.70	23.07					180.77
	Village Forestry	16.74						16.74
	Sub-Total	501.48	802.23	143.63				1,447.34
Total		571.32	1,395.58	1,217.75	180.72	87.22	38.62	3,491.21

① Annual Work Volume

The period has already been determined as 10 years. Planting, supplementary planting and brush cutting are actually carried out over a period of 7 years. The annual work volume is as follows.

Annual Work Volume (Unit: ha)

Activity	Area (ha)	Year							
		1-3	4	5	6	7	8	9	10
Planting	126	Preparation Period	*1	*1	42	42	42	-	-
Enrichment	1,918		340	340	299	299	299	341	-
Supplementary Planting	2,044		-	340	340	341	341	341	341
Brush Cutting	2,296		340	340	341	383	425	425	42
Tending	2,044		-	-	-	-	-	-	2,044
Total	8,428		680	1,020	1,022	1,065	1,107	1,107	2,427

*1 Planting is carried out along the boundaries of the classified forest to clarify boundaries.

② Implementation Methods

- Both planning and implementation shall be carried out directly by the DFRN.
- Local inhabitants shall be employed as workers and are paid wages.
- Necessary nursery stock shall be purchased from private nurseries by the DFRN.

③ Nursery Stock

The required quantity of nursery stock for new planting, enrichment and supplementary planting in Conservation Forest II shall be as follows.

Required Nursery Stock Quantity (Unit: ha)

Category		Year							
		1-3	4	5	6	7	8	9	10
New Planting	Planting	Preparation Period	-	-	26,250	26,250	26,250	-	-
	Supplementary Planting		-	-	-	5,250	5,250	5,250	-
	Sub-Total		-	-	26,250	31,500	31,500	5,250	-
Enrichment	Planting		34,000	34,000	29,900	29,900	29,900	29,900	-
	Supplementary Planting		-	6,800	6,800	5,980	5,980	5,980	5,980
	Sub-Total		34,000	40,800	36,700	35,880	35,880	35,880	5,980
Total			34,000	40,800	62,950	67,380	67,380	41,130	5,980

④ Tree Type and Planting Density, etc.

Tree types and planting density are as follows.

(a) Tree Type (The same tree types are used for both new planting and enrichment.)

Khaya senegalensis, Ptetocarpus erinaceus, Isoberlinia supp., Vitellaria paradoxa, Parkia biglobosa and Milicia excelsa.

(b) Planting Density

Planting density for areas of new planting is 625 trees/ha (4m x 4m) while for areas of enrichment it is 100 trees/ha (10m x 10m).

(c) Supplementary Planting (The same tree types are used for both new planting and enrichment.)

The supplementary planting ratio is 20%.

(d) Tending

Clear-felling is carried out every 10 years.

(3) Timber Forest

The total area of timber forest is 1,129.69ha and felling is carried for timber production. Generally, systematic selective logging activities are carried out in order to achieve sustainable logging. This requires the existence of a forest with a certain structure. However, according to the results of forest survey, production forests are at present of low quality, making it impossible to carry out selective logging Therefore, logging will be carried out for a certain period of time in order to improve forest content through enrichment activities.

Gf accounts for 4.48ha, Sa for 1,025.28ha, Sb for 91.81ha, and St for 8.12ha of the forest cover.

① Annual Work Volume

The annual work area is determined in the following way based on maturity, cutting cycle and selective logging ratio.

- Maturity: Although different species of trees reach maturity at different times, *Khaya senegalensis*, *Afzelia africana*, and *Milicia excalsa* reach maturity in 30 years.
- Cutting Cycle: 20 years.
- Selective Logging Ratio: 33% (1/3).

Selective logging of 57ha (56.48ha) or 1/20 of the 1,129.69ha total area of the timber forest shall be carried out annually with this being referred to as the selected logging area. 20 areas shall be established within the timber forest and given the numbers 1 to 20. The size of some of these sub-compartment may be smaller than 56ha.

② Logging/Regeneration

- As the forest is presently in bad condition at the first cutting cycle, enrichment shall be carried out with a view to transforming it into a selective logging forest. When felling trees in this area, the above-mentioned 33% shall not apply but rather standing trees (including withered and damaged trees) with a DBH of no less than 35cm (with a GBH of no less than 110cm) will be targeted.
- From the 3rd year, the volume of timber from cutting blocks 1 through 8 shall be 279m^3.
- Under the improvement plan, from the second cutting cycle trees for logging shall have a DBH of no less than 35cm (GBH of no less than 110cm) and there shall be a selective logging ratio of 33%.
- Regeneration shall be carried out through natural seeding. In areas where this is difficult, seedlings shall be planted or seeds shall be sown.

③ Implementation Methods

- Both planning and implementation shall be carried out directly by the DFRN. Local inhabitants shall be employed as workers and shall be paid wages.
- Although the DFRN shall formulate plans, these shall be implemented by local organizations.

• Necessary nursery stock shall be purchased from private nurseries by the DFRN.

④ Nursery Stock

The required quantity of nursery stock for new enrichment in Timber Forests shall be carried out for half of the annual logging area (1/3 of 1 logging block ; 1 logging block is 57ha). These shall be planted at a density of 100 trees/ha (10m x 10m) with supplementary planting being carried out the following year at a ratio of 20%.

(Required Nursery Stock Quantities)

The annually required quantity of seedlings is 900 trees in the 3rd year and 1,080 trees/year from the 4th year through to the 10th year.

Timber Forest Word Area

Year	1-2	3	4	5	6	7	8	9	10
Selective Felling Block Area (ha)	Preparation Work	57	57	57	57	57	57	57	57
Logging Area (ha)		19	19	19	19	19	19	19	19
Logging Volume (m^3)		279	279	279	279	279	279	279	279
Enrichiment Area (ha)		9	9	9	9	9	9	9	9
Nursery Stock (tree)		900	1,080	1,080	1,080	1,080	1,080	1,080	1,080

(4) Fuelwood Forest

Fuelwood forest has a total area of 2,904.43ha. Fuelwood forest management and clear felling shall be carried out with the aim of fuelwood production. This fuelwood forest shall consist of 514.56ha of Sa, 1,745.55ha of Sb and 427.03ha of St, for a total of 2,732.14ha of native species and trees with a DBH of no less than 7cm shall be felled. The remaining 172.29ha, which consists of 125.16ha of Ch and 47.13ha of Ja, both introduced species, shall be clear felled.

① Trees

Native Species: *Detarium microcarpum, Terminalia avicennoides, and Isoberlinia spp.*
Introduced Species: *Tectona grandis, Gmelina arborea, and Acacia auriculiformis.*

② Annual Work Volume

In order to even out the village income of each improvement unit, under the Basic Plan the Fuelwood Forest area is determined as 2,880ha. As the trees reach maturity in 7 years, the annual work area is 360ha. Bearing in mind environmental considerations, each annual logging area shall be approximately 10ha with this area including both fuelwood forest management forest and clear felled management forest. The work area for 10 years is as follows.

Fuelwood Forest Work Area (Unit: ha)

Operations		Year									
		1-2	3	4	5	6	7	8	9	10	11
Clear Felling (168ha)	Planting/Direct Grafting	Preparation	21	21	21	21	21	21	21	21	21
	Harvesting/ Logging		-	-	-	-	-	-	-	21	21
Fuelwood Forest Management (2,712ha)	Regeneration (Direct sowing /Planting)		-	339	339	339	339	339	339	339	339
	Harvesting/ Logging		339	339	339	339	339	339	339	339	339

However, in the 10th year harvesting and logging for clear cutting management area shall be carried out in the area that was planted with seedlings and cuttings in the 3rd year and in the 11th year harvesting and logging shall be carried out in the area that was planted with seedlings and cuttings in the 4th year. Regeneration (direct sowing and planting) in fuelwood forest management areas shall be carried out in areas that were harvested/logged the previous year. Furthermore, harvesting and logging in the 11th year shall be carried out in the area that was replanted (direct sowed and planted) in the 4th year.

③ Planting and Timber Production Volumes

In the above-mentioned fuelwood forest production plan area, the annual number of trees replanted in clear cutting management forests from the 3rd year through to the 10th year (when only seedlings are used) or the estimated timber production volume of the coppice forest (area of standing trees with a DBH of no less than 7cm for timber for use as firewood calculated based on forest survey records) is as follows.

Please note that although forest operation with regard to fuelwood forest will be natural regeneration of native species of trees, initially direct planting of desired species of trees is carried out in order to create the fuelwood forest.

(a) Number of Seedlings Planted in Clear Cutting Management Forests (2,500 trees are planted per ha)

From the 3rd year until the 10th year, 52,500 trees will be planted annually. From the 11th year, regeneration will take place through germination.

(b) Fuelwood Forest Estimated Timber Production Volumes

Fuelwood Management Forest	3rd~10th year	339ha/annum	6,814m^3
	From the 11th year	339ha/annum	
Clear Cutting Management Forest	From the 10th year	21ha/annum	462m^3

(5) Grassland

In order to achieve improved grazing capacity and change the form of livestock, grazing cultivated land and fallow land that had been abandoned was artificially created into grassland. This land has an area of 464.67ha and is currently planted in Sa (267.64ha), Sb (18.84ha), Ch (600.81ha) and Ja (110.71ha).

① Improvement of land for Pasture Established

Standing trees shall be logged and shrubs removed in the target area. Standing trees shall be logged and sold as timber or fuelwood and the proceeds put into the Forest Improvement Fund. Shrubs shall be used locally for fuel or stock fences.

② Types of Pasture

Gramineae Poaceae shall consist of *Andoropogon gayanus* and *Pennisetum purpureum* while *Leguminosae* shall consist of *Stylosanthes hamata*. *Andoropogon gayanus* and *Stylosanthes hamata* shall be planted together while *Pennisetum purpureum* shall be planted in the surrounding area or in vacant ground.

③ Stock Fences

Stock fences shall be established to confine domestic livestock to certain areas and to effectively utilize grasslands. Feed trees, fuelwood trees, trees which are a source of nectar for bee-keeping, and shrubs shall be utilized to establish fences which are to be constructed by the local inhabitants.

④ Utilization

Rotational grazing of grasslands is to be carried out in order to provide even feeding in terms of both quantity and nutrition. Three blocks are to be established within grassland areas, with rotational grazing of each block being carried out for 2 weeks after which it is given 4 weeks rest. Feed trees, fuelwood trees and trees which are a source of nectar for bee-keeping are to be planted in all grazing blocks.

⑤ Storage and Use of Grass

Hay is to be harvested and stored as much as possible during the dry season using what machinery is available. In order to keep the decrease in the nutritional value of the grass at a minimum, grass is to be cut and laid out thinly on the ground and turned once or twice every day in order to speed up the drying process.

⑥ Number of Breeding Stock

From the grassland production volume and the annual livestock feed requirements of mature cattle (250kg) (2,282kg), it can be calculated that 2,301 head of livestock can be reared on the grasslands. At the beginning of the plan only the existing number of livestock (mature cattle: 250kg) will be reared.

Number of Head of Stock on the Grasslands

Grasses	Area (ha)	Utilized Area (ha)	Dry Grass Production Volume (kg/ha)	Dry Grass Production Volume (ton)	Possible Number of Stock
Andoropogon gayanus	474	403	8,500	3,426	-
Stylosanthes hamata	474	403	3,630	1,463	-
Pennisetum purpureum	50	42	8,640	363	-
Total	998	848	-	5,252	2,301

(6) Woodland Pasture

In order to stabilize the number of stock grazing in the natural forest, the volume of grasses for domestic livestock to feed on shall be increased and the quality of pasture improved. This area consists of Sa (46.27ha), Sb (875.80ha), St (218.96) and Ch (3.65ha), giving a total of 1,144.68ha.

① Land Preparation

The crown density of standard trees in areas of Sa, Sb and St shall be reduced to 10% and shrubs removed (for use and sale as timber and fuelwood). Feed trees shall be planted in rows and overall crown density established at approximately 20%. Controlled burning shall be carried out after standing trees and shrubs have been removed.

② Types of Pasture

Natural *Gramineae* grasses shall be retained and all weeds removed. When there is a shortage of *Gramineae* grass in a particular area, pasture shall be planted with the aim of achieving 100% covering. Immediately after direct sowing grazing is to be carried out in order to establish it using the "hoof" method.

③ Utilization

Although it is possible to graze for a period of one year on fast-growing grass pasture, as it is difficult to graze during the first year with slow-growing *Leguminosae* pasture temporary stock fences should be established around the area and grazing delayed until root structure is adequately developed.

④ Number of Stock

From the Woodland Pasture production volume and the annual livestock feed requirements of mature cattle (250kg) (2,282kg), it can be calculated that 1,705 head of livestock can be reared on the Woodland Pasture. At the beginning of the plan only the existing number of livestock (mature cattle: 250kg) will be reared.

Number of Head of Stock in Woodland Pasture

Pasture	Area (ha)	Utilized Area (ha)	Dry Grass Production Volume (kg/ha)	Dry Grass Production Volume (ton)	Number of Stock
Wild Grass	1,145	916	4,250	3,893	1,705

(7) Grazing Community Forest

This area consists of forest in the silvi-pastoral zone other than Grassland, Woodland Pasture, and Conservation Forest II where improvement, etc. of grass is not being carried out. In areas of Fc, timber production shall be carried out in accordance with timber forest management. This includes areas of Gf (7.78ha) for a total of 25.75ha. Grazing shall be permitted within Conservation Forest II inside the Silvi-pastoral Zone.

(8) Utilized Land

In the Village Forestry Zone, each participating household (10.1 people: 6 adults/8 children) shall be permitted to use 2.0ha of cultivated land and 2.0ha of tree-planting land for a total of 4.0ha. (Households are permitted to use the land but the state retains ownership.) Based on aerial photographs taken during December 1998, residents participating in the Village Forestry Zone are those possessing cultivated land within the classified forest at that time. The total number of households in the village, the number of households in the Village Forestry Plan and the required area are as follows.

Village Population, Number of Households and Land Preparation Area

Population (persons)	Number of Households	Number of People per Household	Classified Forest Utilization Ratio	Number of Eligible Households	Utilized Land Area (ha)	Required Area (ha)
2,261	390	5.8	0.713	278	1,112	1,390

Utilized land consists of 32 compartments and 33 compartments with a covering of Fc (13.07 ha), Sa (49.86 ha), Sb (156.28 ha), Ch (1,057.13 ha), and Ja (248.53 ha) for a total of 1,524.87 ha. For 32 compartments, 2 sub-compartments with an area of 98.78 ha shall be used by 18 households, 5 sub-compartments with an area of 224.06 ha shall be used by 41 households, 12 sub-compartments with an area of 169.96 ha shall be used by 31 households, and 19 sub-compartments with an area of 566.99 ha shall be used by 104 households. For 33 compartment, 4 sub-compartments with an area of 407.35 ha shall be used by 74 households and 7 sub-compartments with an area of 57.73 ha shall be used by 10 households.

① Commercial Farming

Commercial farming will be improved through extension activities regarding the improvement of crop-growing systems, cultivation methods, post-harvest processing, and through activities to enlighten farmers, including the necessity of a forest management plan.

(a) Improving Crop Growing Systems

a) Selection of Crops

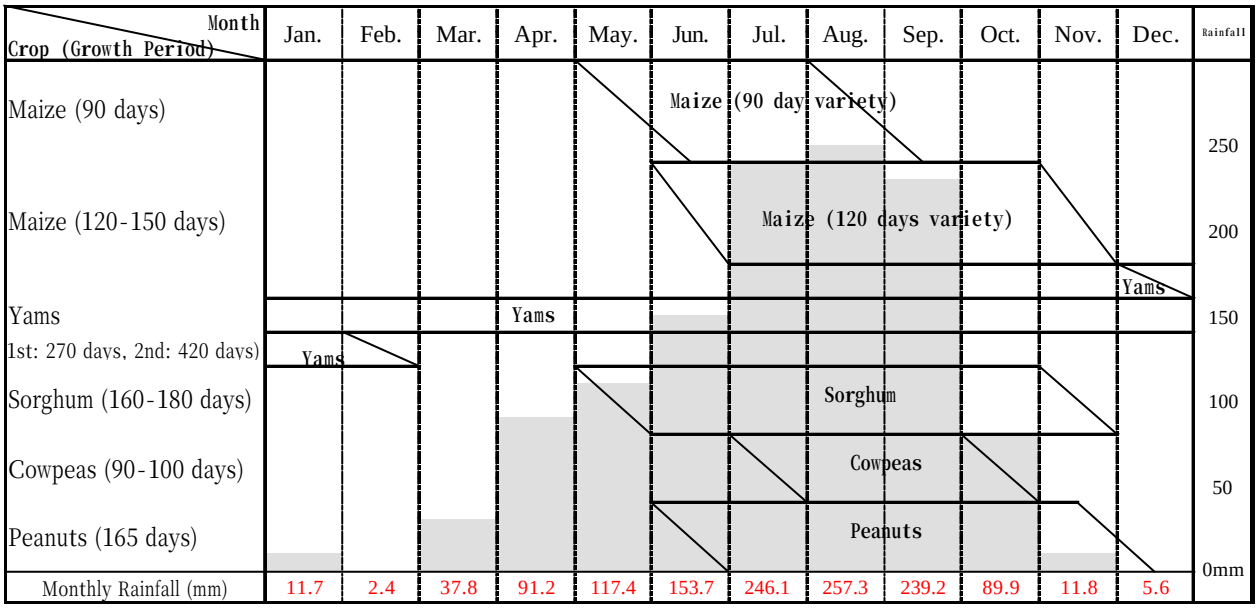
Under the terms of the Forest Management Plan, yams, maize and sorghum, shall be the main subsistence crops with peanuts and cowpeas being grown as intercrops.

b) Introduction of New Varieties (Improved Varieties)

As presently grown varieties are mainly native varieties, 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) varieties. However, as the introduction and extension of new varieties takes time, farmers will be instructed to select reliable seeds for immediate use. Improved maize with a growth period of 90 days and native varieties with a growth period of 120 days shall both be introduced.

c) Improving Crop Growing Systems

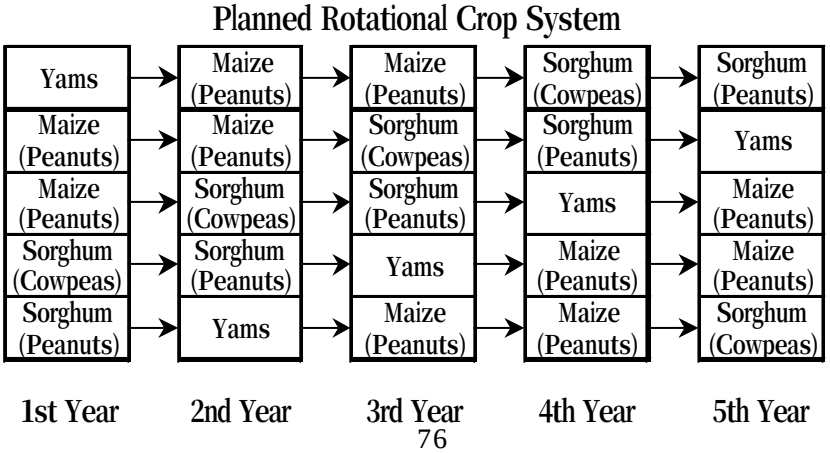
The above-mentioned improved crop growing system that gives consideration to crops and varieties is shown in the following diagram. Varieties of maize with growth periods of both 90 days and 120 days shall be introduced with two crops being grown each year. By using varieties with growing periods that are shorter than those of native varieties, this system enables the most effective utilization of the limited rainy season.



Crop Growing System

d) Crop Rotation

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 rotational crop system is as shown below.



(b) Improved Growing Methods

a) Improvement of Cultivation Using Animal Power and Farming Tools

Cultivation using animal power will be introduced for joint use on condition that it will be used for contracted ploughing. Existing farming tools will be improved.

b) Materials for Agricultural Production

a. Seeds

New varieties of seeds will be introduced and sown in appropriate quantities.

b. Fertilizer

Locally obtainable organic fertilizer will be used. Where soil analysis reveals this supply to be insufficient, the use of chemical fertilizers, such as urea, will be considered. In order to expand the use of organic fertilizer, composting techniques will be taught. *Leguminosae* plants (green manure crops), such as *Mucuna pruriens*, which are a source of nitrogen, shall be ploughed in.

c) Improvement of Growing Techniques

Matters to bear in mind with regard to growing include the following.

- Deep ploughing 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.

d) 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.

- The introduction of disease and pest-resistant varieties.
- The introduction of crop rotation.
- The implementation of mixed planting and intercropping.
- Consideration of planting density.

(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 a 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.

With regard to storage, as *Leguminosae* cash crops, such as peanuts, etc., are susceptible to damage from pests while in storage, they should be mixed with wood ash and silica-seaweed soil mix, etc. and stored to prevent the breeding of pests.

② Afforestation Plan

The planting of forest and fruit trees within the 2.0ha of utilized land for the production of posts and fuelwood shall be planned in the following way. However, trees shall be selected individually by the local inhabitants themselves.

(a) Post and Fuelwood Production Forest

Trees to be planted in this area are *Tectona grandis* and *Gmelina arborea*. Planting density shall be 2,500 trees/ha (2m x 2m) with *Tectona grandis* being stamp planted and *Gmelina arborea* being either stamp planted or its cutting planted. With stamp planting, as 4~5 sprouts appear, they shall be thinned out after 1 year with 3 straight seedlings being left.

The cutting cycle shall be 5 years with 0.4ha (1/5 of 2.0ha) being planted and felled each year. In planted areas, intercropping shall be carried out (Taungya System) for 2 years after planting. Spacing in this case shall be 3m x 1.5m (2,220 trees/ha). Annual plans shall be as follows.

Posts and Fuelwood Production Forest Plan

Year	Planting (ha)		Harvesting (ha)	Intercropping (ha)	Comments
1	0.4	Planting	—	2.0	Yams.
2	0.4	Planting	—	2.0	Yams or maize.
3	0.4	Planting	—	1.6	Maize (Intercropping of the 0.4ha of the 1st year is unnecessary.)
4	0.4	Planting	—	0.8	Maize (Intercropping of the 0.8ha of the 1st and 2nd years is unnecessary.)
5	0.4	Planting	—	0.8	Yams (Intercropping of the 1.2ha of the 1st, 2nd and 3rd years is unnecessary.)
6	0.4	1st year after Germination	0.4 (1st year Forest)	0.8	Yams or maize (5th year reverts to 1st year.)
7	0.4	2nd year after Germination	0.4 (2nd year Forest)	0.8	Yams or maize (Reverts to 1st and 2nd years.)
…	…	……	……	…….	

(b) Fruit Trees

Fruit trees to be planted in this area are cashews. Planting density shall be 100 trees/ha (10m x 10m). Although trees will start to bear fruit approximately 18 months after planting, from the 6th year to the 10th year only 1 ton shall be harvested per ha with 2 tons per ha being harvested from the 11th year onwards. As cashews easily catch fire, firebreaks or belts of fire-resistant trees shall be established to prevent fire from entering from the surrounding area.

③ Bee-Keeping

As honey production is a desirable way of providing a cash income to the local inhabitants, bee-keeping activities should be introduced and actively encouraged in the area in order to achieve stable production. Trees to be planted are *Acacia auriculiformis*, *Newboudia laevis*, *Detarium microcarpun* and *Burkea africana*.

④ *Vitellaria paradoxa*

Although *Vitellaria paradoxa* has been retained in cultivated areas, there are no young trees bearing fruit or for growing crops and as the trees are old, in many cases production volumes have decreased. After *Vitellaria paradoxa* has been newly planted around the perimeter of the cultivated land, it will be possible to raise replacement trees and to carry out harvesting.

(9) Fuelwood Community Forest

41.69ha of previously cultivated land apart from land for use by local inhabitants and 17.10ha of previously fallow ground making a total of 58.79ha of land within the Village Forestry Zone shall be used as a fuelwood forest for the production of fuelwood for sale by the village. This fuelwood forest is for joint use by the village and shall be managed by the organization in each improvement unit.

Species of trees to be planted in the fuelwood forest include *Prosopis sp*., *Terminalia spp*., and *Gmelina arborea*, etc. Of these species of trees, good quality charcoal can be obtained from *Prosopis sp.*, and *Gmelina arborea*. The planting density for this area is 2,500 trees/ha (2m x 2m). As the cutting cycle is 7 years, 8ha shall be felled and replanted each year with annual charcoal production volumes reaching 176m^3 (8ha x 22m^3/ha=176m^3).

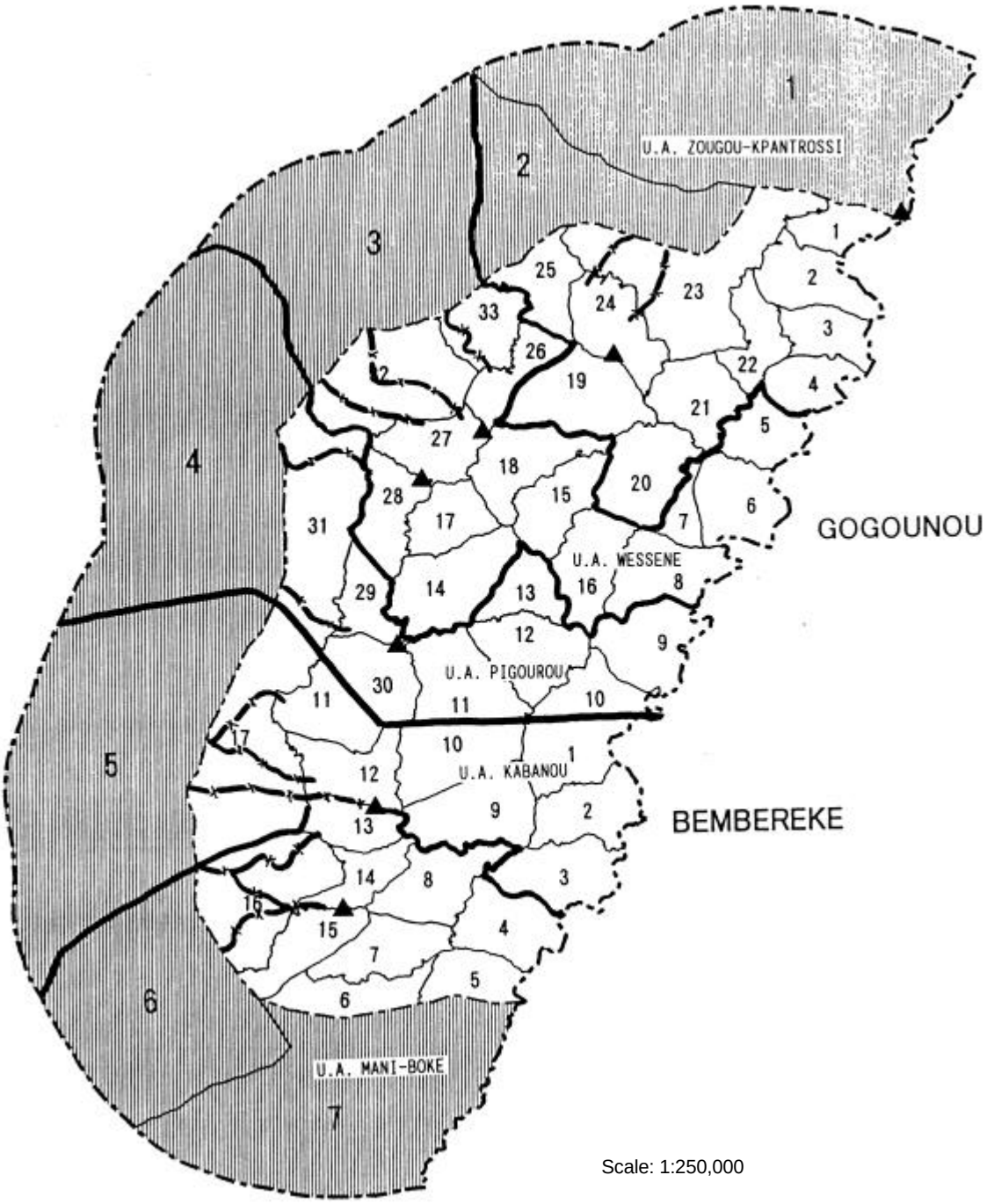
(10) Forest Reserve

Areas of forest in the Village Forestry Zone other than Conservation Forest II, Utilized Land, Fuelwood Community Forest and Left-over Area shall be retained as Forest Reserve. Forest Reserve contains 146.75ha of Gf, 25.55ha of Sa, 637.91ha of Sb and 273.13ha of St, making a total of 1,083.66ha. It is possible that the 25.55ha of Sa may be transferred to Utilized Land in the future.

Areas of Sb and St shall be transferred from outside the classified forest to the Silvi-pastoral Zone within the classified forest without becoming part of Cultivated Land or Tree-planting Land to become paths for the passage of livestock. When such paths pass through Utilized Land, a path with a width of 50m shall be established and a 3m wide belt of *Gmelina arborea* and *Acacia auriculiformis* planted at a spacing of 1.5m x 1.5m on the boundary either side of the path. The planned livestock path shall be extended by 12,600m as shown in the following diagram.

(11) Left-Over Area

Left-over Area is land other than forest (Gf, Fc, Sa, Sb and St) and cultivated and fallow land that shall be retained in its present state and shall be outside the scope of management. Left-over Area consists of 13.65ha of Ce, 141.37ha of Cl, 52.53ha of Tm and 3.49ha of Ar for a total of 211.04ha.



Key	
1~7	Buffer Zone
1~33	Classified Forest
	Improvement Unit Boundary
U.A.	Improvement Unit
X	Livestock Path
▲	Waterhole

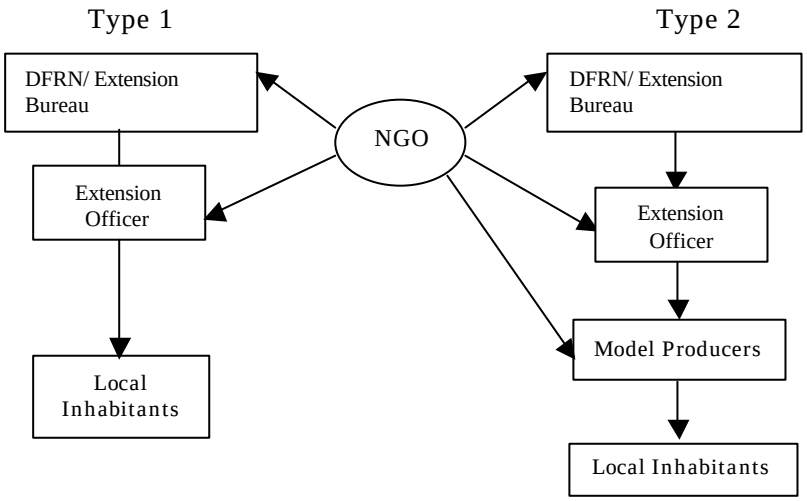
Livestock Paths

10 Extension and Training Plans

Existing extension activities are carried out under the jurisdiction of the Extension Bureau of the Ministry of Rural Development 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.



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 seedlings for mountain areas, etc. Furthermore, training of nursery officers within local organizations will also be carried out.

(2) Bee-Keeping

Bee-keeping 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.

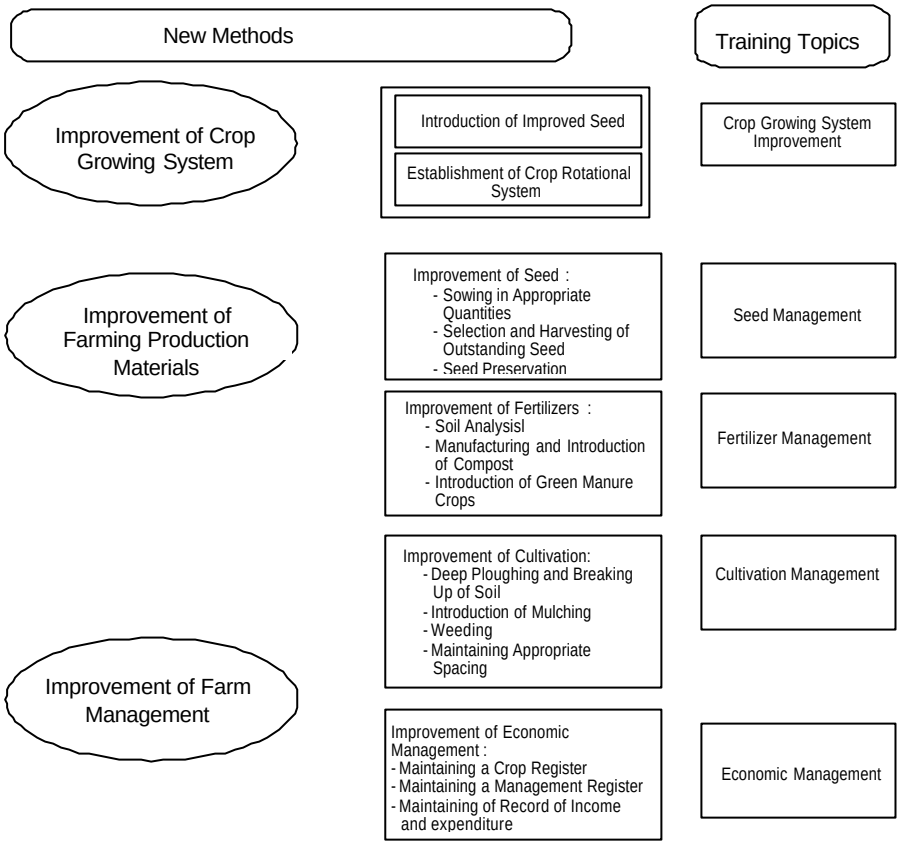
(3) Charcoal Production

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.

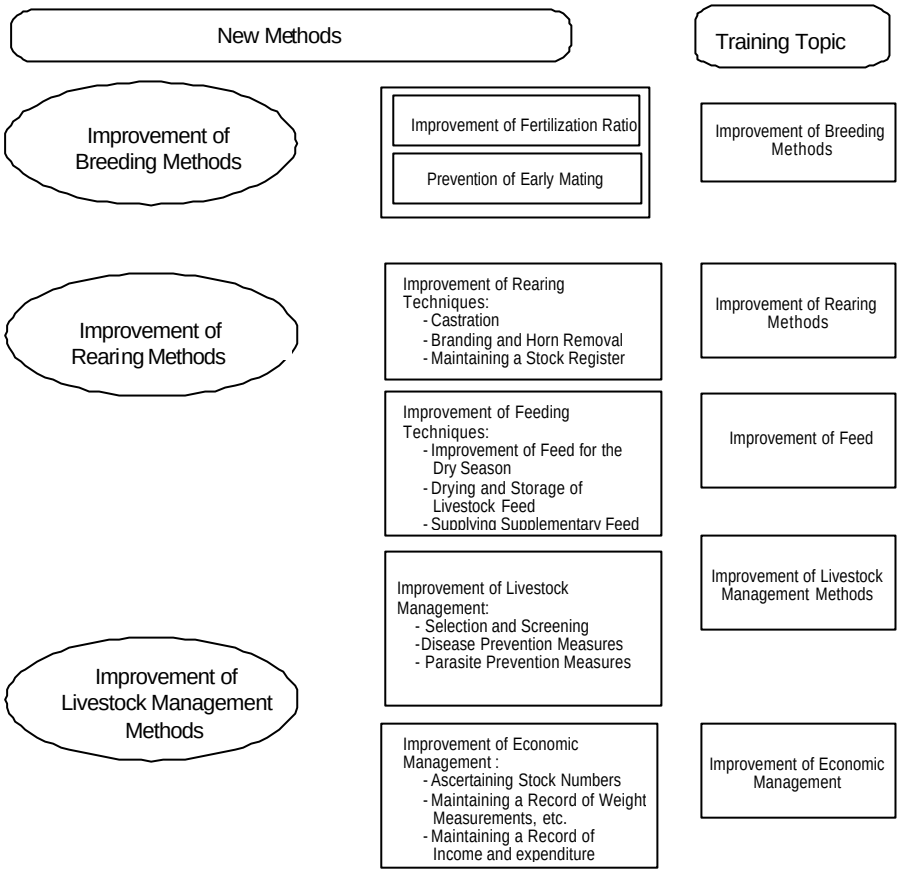
Details regarding new techniques and training topics for commercial farming improvement are as follows.



Training Topics for Commercial Farming Improvement

(5) Livestock Farming

Details regarding new techniques and training topics for the improvement of breeding techniques, rearing techniques and livestock management are as follows.



Livestock Farming Training Topics

11. Infrastructure Improvement Plan

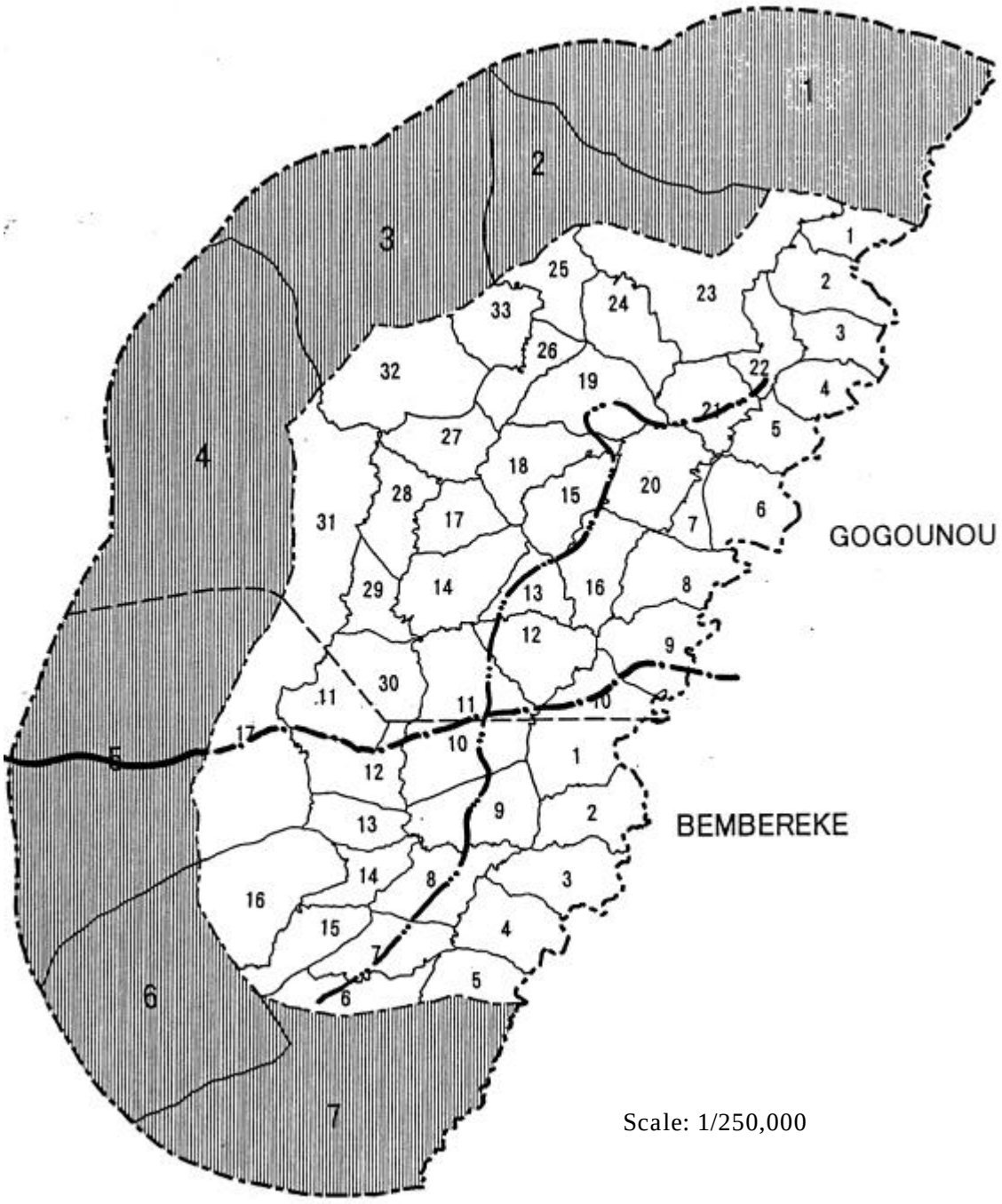
(1) Forest Roads

The access road to the classified forest is the road running from Beroubouay on State Highway 2 via Kabanou~Koussine and forest roads for the management of production forests within the classified forest and the management of Conservation Forest units shall join this access road. A main forest road will be established from the access road to the Buri River with other minor roads being established from the main forest road to production forests within each improvement unit. The length of the main forest road shall be 19.5km with the length of other minor roads in each improvement unit being as shown below. However, within Conservation Forest work roads will link up with the main forest road and other minor roads. The roads mentioned below are shown in the following map.

Zougou-Kpantrossi Improvement Unit	9.5km
Wessens Improvement Unit	5.5km
Pigourou Improvement Unit	7.4km
Kabanou Improvement Unit	5.1km
Mani-Boke Improvement Unit	7.9km

(2) Village Nursery

In order to produce seedlings in each improvement unit for planting in each zone of the classified forest, a nursery operated by the village shall be established in each village. Management, operation and maintenance of the nursery shall be carried out by the Forest Improvement Unit Committee, which is an organization comprised of local inhabitants. All seedlings produced shall be for commercial sale with income from such sales going into a Forest Improvement Fund. Seedling production scale by improvement unit is as shown below.



Key	
1~7	Buffer Zone
1~33	Classified Forest
	District Boundary
	Access Road
	Main Forest road
	Spur roads

Forest Road Plan Map

Seedling production Volume

Unit: Seedling

Improvement Unit	Year								
	3	4	5	6	7	8	9	10	Total
ZOUGOU-KPANTROSSI	140,700	178,340	185,840	259,765	275,075	275,180	200,839	148,360	1,664,099
WESSENE	53,400	92,680	100,500	131,675	137,910	138,435	102,740	60,580	817,920
PIGOUROU	60,800	83,860	90,940	90,940	91,040	91,060	91,060	68,060	667,760
KABAKOU	128,300	169,360	177,540	193,490	196,680	196,680	180,830	136,660	1,379,540
MANI-BOKE	56,000	81,300	86,320	108,770	112,760	112,760	92,710	63,700	714,320
Total	439,200	605,540	641,140	784,640	813,465	814,115	668,179	477,360	5,243,639

(3) Forest Management Center

The main organization carrying out the implementation of Forest Improvement plans is the Forest Improvement Committee, which is organized by the local inhabitants. However, as there are restrictions on the use of the classified forest by local inhabitants it is necessary to bring some form of stability to the lives of local inhabitants through regional promotion. Furthermore, a survey of local inhabitants revealed that there is a high proportion of women involved in the use of the classified forest, making their participation in the management of the classified forest essential. Therefore, a Forest Management Center will be established for forest improvement and to improve the place of women in society. Training to be carried out at the Forest Improvement Center includes literacy education for women using the center, which have a poor rate of literacy, and training, etc., which will provide a diversified means of income.

12. Buffer Zone Management Plan

A buffer zone running for 7km encircles the classified forest within which Conservation Forest will be established as part of the management plan of the classified forest. Such Conservation Forest will be handled in accordance with the management plans of the classified forest.

The area of the buffer zone is 6,563.33ha and consists of the forest type shown in the table below.

Land Area by Improvement Unit, Land Use and Forest Type (Buffer Zone)

(Unit:ha)

Cate-gory	Forest Type Symbol	GOGONOU				BEMBEREKE			Total
		ZOUGOU-KPANTROSSI	WESSENE	PIGOROU	Subtotal	KABANOU	MANI-BOKE	Subtotal	
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
	Sub-total	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
	Sub-total	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

The buffer zone is a free zone which the local inhabitants are free to use for cultivation, livestock grazing, fruit harvesting, and other use. However, the felling or trimming, etc. of protected species of trees within the forest is prohibited.

Conservation Forest shall be established in the following areas within the buffer zone and shall be handled in the same way as Conservation Forest II within the classified forest. However, areas considered by the local inhabitants to be areas of sacred forest shall be handled in the same way as Conservation Forest I.

Areas to be designated as Conservation Forest are as follows.

- Areas within 25m of either side of waterways which shall be preserved to protect water resources and prevent soil and sand from being washed into the waterways.
- Forest on residual relief and tectonic relief.
- Forest in savannah and laterite terraces.
- Areas of forest where soil protection is required.
- Areas of forest preserved as sacred forest by villagers.

The location and scope of the above-mentioned Conservation Forest shall be clarified by the DFRN and recorded in the map register. As the productivity of the land in butter zone has decreased as a result of continuous slash and burn type agriculture it has become fallow ground or is illegally cultivated within the classified forest. If the improvement plan for the classified forest can be successfully formulated, cultivation will be limited to established farming carried out in limited space. Consequently, established farming will also increase within the buffer zone allowing the effective utilization of cultivated land and fallow land where productivity has decreased. The introduction of agroforestry within the buffer zone will be actively encouraged.

(1) Agroforestry in Areas of Cultivated Land and Fallow Land

① 2ha 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 2~5ha Cultivated Land

2ha is used to grow food crops while the remaining 1~3ha shall be planted in trees and agroforestry undertaken with forest products being harvested and cash crops being grown as intercrops. 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 (10m x 10m).
- *Vitellaria paradoxa*: Limited production of fruit from *Vitellaria paradoxa* can be carried out. The planting density of these trees is 200 trees/ha (5m x 10m).
- 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 5ha

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 (4m x 2m). 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) Bee-Keeping

As cultivated land and the area surrounding cultivated land is unsuitable for bee-keeping, 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 bee-keeping in grassland or areas of low shrubs, 12 beehives shall be positioned in each hectare.

(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.

PIGUROU Improvement Plan

Forest Improvement Plan

Forest Improvement Plans are implementation plans for each improvement unit based on the Basic Plan for Forest Management for the Intensive Study Area.

Plans for each improvement unit were formulated with consideration being given to implementation efficiency and the location of areas to be used within each zone. Furthermore, as such improvement activities will be implemented individually, separate plans were prepared for each of the five units involved.

The five plans are as follows.

1. Zougou-Kpantrossi Improvement Plan
2. Wessene Improvement Plan
3. Pigourou Improvement Plan
4. Kabanou Improvement Plan
5. Mani-Boke Improvement Plan

Pigourou Improvement Plan

1. Forest Management Units

Details regarding the Pigourou improvement unit are as follows.

Classified Forest:	Tois Rivières Classified Forest
Province (Department):	Borgou (Note. Provinces are referred to as "Departments" in Benin.)
Forest Department:	Borgou Forest Department
Forest Branch Office:	Kandi Forest Branch Office
Regional Forest Office:	Gogounou District Forest Office

2. Location and Area

The Pigourou Improvement Unit consists of the west-central area of the Trois Rivières Classified Forest west of the Bouli River and the associated buffer zone. The area of the classified forest is 8505ha while the area of the buffer zone is 9,277ha.

3. General Conditions

3.1 Natural Conditions

(1) Climate

The temperature and rainfall of the Pigourou Improvement Unit as measured by weather monitoring stations in the surrounding area are as follows.

In Kandi, the average temperature is 28.1°C, the minimum average temperature of 17.2°C occurs in January, and the maximum average temperature of 38.7°C occurs in April. Average annual rainfall is 949mm in Kandi, 1,147mm in Bembereke, 1,037mm in Segbana and 1,161mm in Kalale. The rainy season lasts from May to September while the dry season lasts from October to April. Semi-arid conditions are experienced at the beginning of both the wet and dry seasons during September/October and April/May.

Average Temperature and Rainfall

(Temperature: °C)

Monitoring Station	Month	1	2	3	4	5	6	7	8	9	10	11	12	Average
Kandi	Average (°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
	Maximum Average (°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
	Minimum Average (°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

Note: Figures shown are for the 1988~1997 period.

(Rainfall: mm)

Monitoring Station	1	2	3	4	5	6	7	8	9	10	11	12	Total
Kandi	0	11	30	51	110	138	186	237	143	34	1	7	949
Bembereke	1	0	17	58	117	186	212	273	203	71	8	1	1,147
Segbana	1	1	6	44	101	137	181	308	211	42	5	0	1,037
Kalale	0	17	28	58	125	159	210	225	241	58	30	10	1,161

Note: Figures shown for Kandi and Kalale are for the 1988~1997 period, while figures for Bembereke are for the 1986~1996 period and figures for Segbana are for the 1969~1990 period.

(2) Topography, Geology and Soil Type

The topography of the area consists of flat or gently rolling hills. There are also small plateaux with steep laterite slopes and small rises scattered about the area. The altitude of this area is in the 260m~330m range.

The geology of the area consists mainly of granite and gneiss with areas of sandstone and residual accumulated material. The soil consists mainly of Sols Ferrugineaux Tropicaux with gneiss, granite and sandstone being the parent material. Soil type distribution condition is included in Appendix-1 at the end of this volume together with information regarding how to handle such soils for forestry purposes.

(3) River System

The area is drained by the Bouli River, a tributary of the Sota River which is itself the main tributary of the Niger River, and its network of streams, etc.

(4) Vegetation

Forests consist mainly of scrub savannah, tree savannah and mixed savannah of shrub and trees with areas of riparian forest visible alongside waterways. There are also areas of *Tectona grandis* plantations, orchards, cultivated land and fallow land. Trees characteristic of the savannah include *Detarium microcarpun*, *Isoberlinia spp*, *Vitellaria paradoxa*, *Parkia biglobosa*, *Combretum spp*, etc. while trees characteristic of riparian forest areas alongside waterways include *Daniellia oliveri*, *Anogeissus leiocarpus*, *Khaya senegalensis*, *Vitex doniana* and *Diospyros mespiliformis*, etc.

3.2 Socioeconomic Conditions

(1) Population

The population of the villages belonging to the Pigourou Improvement Unit is as follows.

Population

Village	Population (Person)	Household Number (Household)	Population Size (Person/Household)
PIGOUROU	981	128	7.7
NANONROU	884	77	11.5
Total	1,865	205	9.1

(2) Farming Population

The farming population derived from figures obtained through the Pre-Farming Census based on the farming population ratio and the farm worker ratio (the proportion of the farming population over the age of 15 and under the age of 60 that were farm workers) is as follows.

Farming Population

Village	Population (Person)	Farming Population		Farm Workers		Household Number (Household)	Population /Household (Person)	Farm Workers/Household (Person)
		Person	Ratio (%)	Person	Ratio (%)			
PIGUROU	1,865	1,865	100.0	1,212	65.0	205	9.1	5.9

(3) Farm Size

① Farmland Area

The area of classified forest and farmland in buffer zone (cultivated land and fallow land) is, as obtained through photo interpretation and forest type maps, as follows.

Farmland Area

(Unit:ha)

Category	Classified Forest	Buffer Zone	Total
Cultivated Land	715	3,914	4,629
Fallow Land	369	312	681
Total	1,084	4,226	5,310

② Planted Area

The area within classified forest planted in cotton and other crops is as follows.

Planted Area

Cultivated Land	715	Ha
Planted Land (a) (planted ratio)	393	Ha(55%)
Cotton (b) (planted ratio)	202	Ha(51%)
Non-Cotton Crops (a-b)	191	Ha
Farming Households	205	Household
Planted Land/Household (apart from cotton)	0.93	Ha

(4) Livestock

The main forms of livestock include cattle, sheep and goats while poultry includes chickens and guinea fowl, most of which are raised in farmyards.

Livestock

(Unit:Head)

Cows	Sheep	Goats	Total	Livestock Units*
755	299	153	1,207	845

* 5 sheep or goats are counted as 1 cow.

4. Forest Divisions

4.1 Forest Compartments

Divisions with the inherent characteristics necessary for the management and operation of classified forests were established on the basis of political boundaries, village boundaries, and roads, and rivers, etc. while buffer zones were established on the basis of political boundaries and roads. Each of the forest compartments are assigned a number corresponding to each management unit.

The forest compartments and divisions of the Pigourou Improvement unit are as follows. The area by forest covering of each forest compartment is shown in 6 zones. Area by forest type is shown in Appendix-2 at the end of this volume.

Land Area of Forest Compartments

Classified Forest				Buffer Zone	
compartment	Area (ha)	compartment	Area (ha)	compartment	Area (ha)
9	1,091.50	13	613.44	④	9,276.64
10	721.02	29	625.45		
11	1,184.45	30	885.50		
12	1,072.62	31	2,311.50		
Total			8,505.48	Total	9,276.64
Total					17,782.12

4.2 Sub-Compartments

In order to clarify present types of land use and the state of forests, and differences in forest management, forest compartments were divided up into smaller sub-compartments. These designated sub-compartments were those designated at the time that the Improvement Plan was formulated. Therefore, based on the results of each year's operations, such sub-compartments are divided up and assigned a sub-compartment number. (Refer to the Plan Register)

5. Improvement Aims

The main aim of Improvement Plans is the rapid restoration of the classified forests as state forest and their conservation. As the implementation of these plans is considered difficult without the cooperation of the local inhabitants, by permitting them to use areas within the classified forest, the conservation of the forest will be carried out by the people themselves. The improvement aims for the classified forest are as follows.

- The improvement of the forest through the implementation of measures for public benefit, including the development of the water resources of the forest, the conservation of national land, the protection of wildlife, and the preservation of genetic resources, etc.
- The fostering of a production forest in order to enrich and utilize sustainable forest resources.
- The establishment of an area within the classified forest for use by local inhabitants in order to conserve the forest through coexistence with the people.

6. Zoning

The area will be divided into three zones: the Forestry Zone, the Silvi-pastoral Zone, and the Village Forestry Zone.

6.1 Forestry Zone

The forestry zone consists of the Conservation Forest Zone, which is areas of classified forest that should be protected and conserved, and the Production Forest Zone which is for timber production.

(1) Conservation Forest Zone

The Conservation Forest Zone, which is designed to develop water resources and preserve forestry areas, runs from the Bouli River on the eastern border of the Intensive Study Area for a distance of 3.5km, within which are Conservation Forest I and II.

① Conservation Forest I

- This forest runs from the Bouli River for a distance of 500m and is specially for the fostering of water resources.
- It is a pure forest consisting of *Anogeissus leiocarpus*.
- It is located on residual relief and tectonic relief.
- Soil conditions are bad and existing vegetation should be retained.

② Conservation Forest II

This area consists of the remaining area within the Conservation Forest Zone that is not part of Conservation Forest I.

(2) Production Forest Zone

With the exception of the Conservation Forest within the Forestry Zone, this is the area in which the production of timber and fuelwood and charcoal, etc. is carried out. However, the following areas within the production forest shall be part of 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.

6.2 Silvi-pastoral Zone

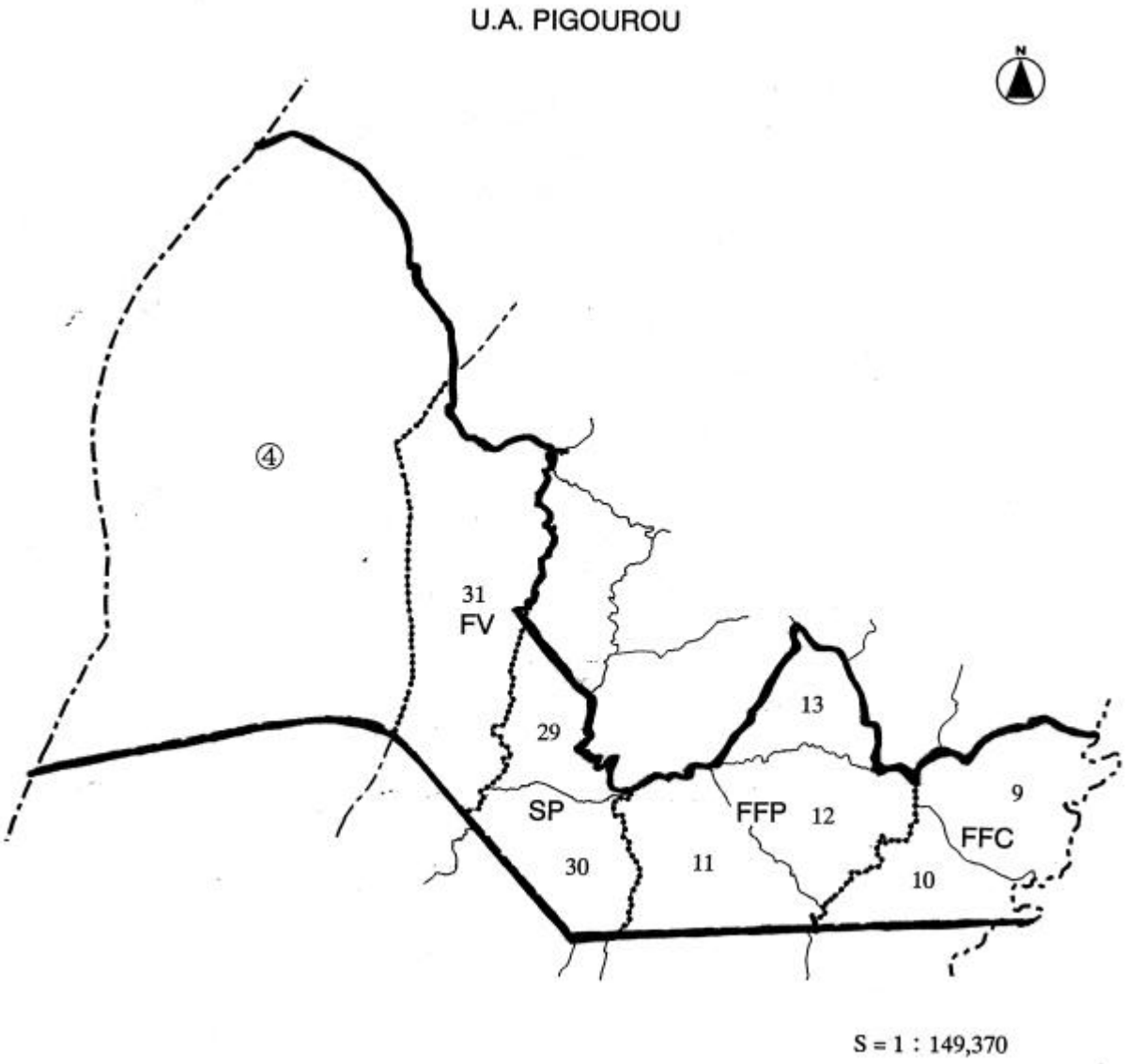
Located between the Forestry Zone and the Village Forestry Zone, this zone is an area in which grazing is carried out. Serving as a buffer zone, areas of forest within 50m either side of waterways shall be part of Conservation Forest II.

6.3 Village Forestry Zone

This is the zone 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 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.

The land area by forest compartment and forest type in each zone is as shown below.



Legend	
②	Buffer Zone Compartment No.
2	Classified Forest Compartment No.
▬▬	Improvement Unit Boundary
- - - -	Zone Boundary
FFC	Conservation Forest Zone
FFP	Production Forest Zone
SP	Silvi-Pastoral Zone
FV	Village Forestry Zone

Zoning Map

Land Area by Forest Compartment and Forest Type（Pigurou）

Zone	Compart-ment	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
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

7. Forest Land Use Classification

In order to implement forest improvement activities, forest land use classes shall be established according to proposed use based on improvement standards for basic plans for the forest within each zone and in order to formulate operating plans in accordance with forest land use classification. The types of forest classified under the forest land use classifications shall be included in plans as follows.

7.1 Forest Zone

(1) Conservation Forest Zone

Conservation Forest I	Areas of forest within 500m of the western bank of the Bouli River that should be protected for the purpose of fostering water resources.
Conservation Forest II	Areas of forest within 3,500m of the western bank of the Bouli River (with the exception of Conservation Forest I) that should be maintained for the purpose of fostering water resources and conserving forest land.

(2) Production Forest Zone

Timber Forest	Forest for the production of ordinary timber.
Fuelwood Forest	Forest for the production of fuelwood (wood and charcoal for fuel).
Conservation Forest II	Forest that should be maintained due to location alongside waterways and on account of poor soil condition.
Left-over Area	Non-forest areas designated as other land.

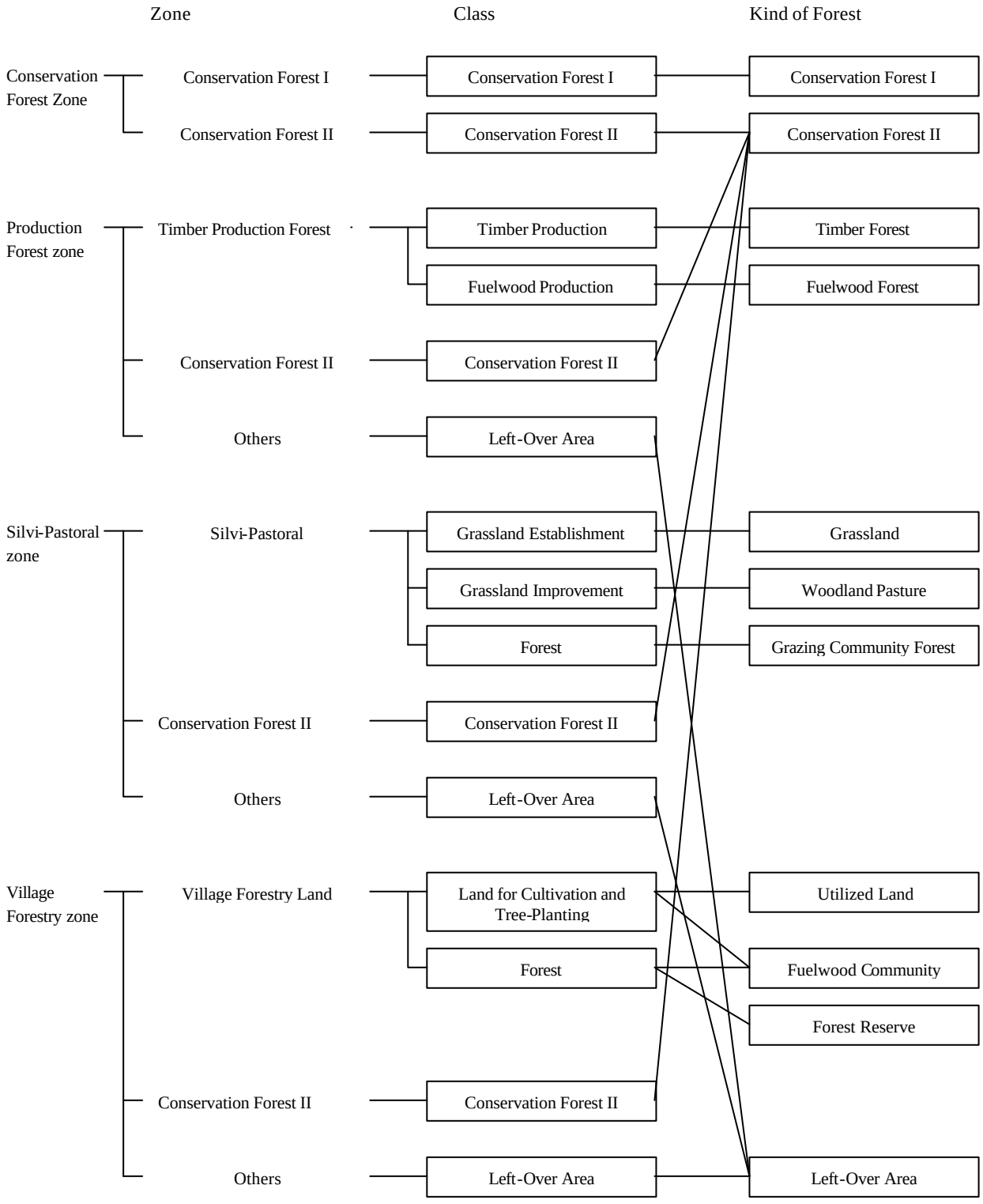
7.2 Silvi-pastoral Zone

Grassland	Artificially created grassland.
Woodland Pasture	Forest improved by increasing the amount of grass that can be eaten by livestock within the forest.
Grazing Community Forest	Forest to be left in its present state other than Grassland and Woodland Pasture.
Conservation Forest II	Forest that should be maintained due to location alongside waterways and on account of poor soil condition.
Left-over Area	Non-forest areas designated as other land.

7.3 Village Forestry Zone

Utilized Land	Land used by people for cultivation, tree planting and roads.
Fuelwood Forest	Areas of forest used as fuelwood forest within cultivated land or fallow land located within forests or Forest Reserve.
Forest Reserve	Forest other than Utilized Land, Fuelwood Forest and Conservation Forest II. Forest that should be set aside for future use as Utilized Land, livestock trails, and boundaries, etc.
Conservation Forest II	Forest that should be maintained due to its location alongside waterways or due to poor soil conditions, etc.
Left-over Area	Non-forest areas designated as other land.

Forest Land Use classes and kind of forest can be summarized as follows.


Zone
Class
Kind of Forest
Conservation Forest Zone
Conservation Forest I
Conservation Forest II
Production Forest zone
Timber Production Forest
Conservation Forest II
Others
Silvi-Pastoral zone
Silvi-Pastoral
Conservation Forest II
Others
Village Forestry zone
Village Forestry Land
Conservation Forest II
Others
Conservation Forest I
Conservation Forest II
Timber Production
Fuelwood Production
Conservation Forest II
Left-Over Area
Grassland Establishment
Grassland Improvement
Forest
Conservation Forest II
Left-Over Area
Land for Cultivation and Tree-Planting
Forest
Conservation Forest II
Left-Over Area
Conservation Forest I
Conservation Forest II
Timber Forest
Fuelwood Forest
Grassland
Woodland Pasture
Grazing Community Forest
Utilized Land
Fuelwood Community
Forest Reserve
Left-Over Area

8. Operation Standards

Improvement methods and operation (management) methods by kind of forest are as follows.

Operation (Management) Standards (1)

Kind of Forest	Existing Forest Cover Type	Improvement Methods	Operation Methods
Conservation Forest I	Gf, Fc, Sa, Sb, and St with a crown density of more than 50%	• Maintenance of existing areas of forest vegetation.	• These areas are not to be subject to management. • Felling of trees is prohibited and the removal of branches and leaves is also prohibited. • Controlled burning is totally prohibited. • Grazing and the passage of livestock is prohibited.
	Gf, Fc, Sa, Sb, and St with a crown density of up to 50%	• Enrichment through planting (mixed planting) of native species. Trees: *Khaya senegalensis, Pterocarpus erinaceus, Isoberlinia spp., Vitellaria paradoxa, and Parkia biglobosa.* Spacing: 10m x 10m (100 trees/ha) Supplementary Planting: Carried out after one year if no more than 80% of trees survive. Brush Cutting: Carried out evenly around planted trees once a year one year after planting.	
	Ch, Ja	• New mixed planting of native species. Trees: *Khaya senegalensis, Pterocarpus erinaceus, Isoberlinia spp.*, *Vitellaria paradoxa*, and *Parkia biglobosa.* Spacing: 4m x 4m (625 trees/ha) Supplementary Planting: Carried out after one year if no more than 80% of trees survive. Brush Cutting: Carried out evenly around planted trees twice a year 2~3 years after planting.	
Conservation Forest II	Gf, Fc, Sa, Sb, and St with a crown density of more than 50%	• Maintenance of existing areas of forest vegetation.	• These areas are not to be subject to management. • Although thinning, pruning and sanitation cutting is permissible, the felling of trees and the removal of branches and leaves apart from such thinning, pruning and sanitation cutting is prohibited. • Controlled burning is totally prohibited. • Grazing and the passage of livestock is prohibited. (However, this shall exclude access by livestock to water holes in the Silvi-pastoral Zone)
	Gf, Fc, Sa, Sb, and St with a crown density of up to 50%	• Enrichment through planting (mixed planting) of native species. Trees: *Khaya senegalensis, Pterocarpus erinaceus, Isoberlinia spp., Vitellaria paradoxa*, *Parkia biglobosa* and *Milicia excelsa.* Spacing: 10m x 10m (100 trees/ha) Supplementary Planting: Carried out after one year if no more than 80% of trees survive. Brush Cutting: Carried out evenly around planted trees once a year one year after planting.	

Operation (Management) Standards (2)

Kind of Forest	Existing Forest Type	Improvement Methods	Operation Methods
Conservation Forest II	Ch, Ja	• New mixed planting of native varieties (including group planting). Trees: *Khaya senegalensis, Pterocarpus erinaceus, Isoberlinia spp., Vitellaria paradoxa, Parkia biglobosa, and Milicia excelsa.* Spacing: 4m x 4m (625 trees/ha) Supplementary Planting: Carried out after one year if no more than 80% of trees survive. Brush Cutting: Carried out evenly around planted trees twice a year 2~3 years after planting.	
Timber Forest	Gf, Fc, Sa, Sb	• Fostering of the timber forest through planting seedlings, direct sowing and natural seeding of native species. Trees: *Khaya senegalensis, Pterocarpus erinaceus, Isoberlinia spp., Afzelia africana, Prosopis africana, and Milicia excelsa.* • Spacing: One of the following will be adopted by taking into account crown density of each forest, 5m x 5m (400 trees/ha), 6m x 6m (276 trees/ha), 8m x 8m (156 trees/ha), 10m x 10m (100 trees/ha). Other: When planting, existing material of a usable size may be cut down and used.	• Selective logging shall be carried out. Cutting Cycle: 20 years Selective Logging Ratio: 33% of trees with a diameter at breast height (DBH) of no less than 35cm (girth at breast height of no less than 100cm). Age at Maturity: 30 years • Regeneration: Natural seeding. Direct sowing of seed and planting of seedlings will also be carried out as necessary. • Burning is totally prohibited. • Grazing and the passage of livestock is prohibited.
	Ch, Ja	• Planting of native varieties and direct planting of seeds. Trees: *Khaya senegalensis, Pterocarpus erinaceus, Isoberlinia spp., Afzelia africana, Prosopic africana, and Milicia excelsa.* Spacing: 4m x 4m (625 trees/ha). Mixed line planting of various species of trees. Supplementary Planting: Carried out after one year if no more than 80% of trees survive. Brush Cutting: Carried out evenly around planted trees twice a year 2~3 years after planting. Other: Land being cultivated may continue to be cultivated until after crops have been harvested at which time the timber production forest will be created.	

Operation (Management) Standards (3)

Kind of Forest	Existing Forest Type	Improvement Methods	Operation Methods
Fuelwood Forest	Sa, Sb, St	• Planting of native species and direct sowing of seed. Trees: *Detarium microcarpum, Isoberlinia spp., Terminalia avinnoides, Combretum spp*., *Crossopteryx febrifuga*, and *Piliostigma thonningii*. Other: Felling and harvesting of material with a diameter larger than the specified usable diameter within the existing forest may be carried out the year before planting of seedlings or direct sowing of seed is carried out. Material that is able to germinate should be left to germinate. Additional planting and direct sowing of seed shall be carried out depending on how well seeds etc. take root and the growth of seedlings.	• The area shall be used as a fuelwood forest with trees of not less than 7cm DBH (no less than 20cm GBH) being felled. Cutting Cycle: 7 years Regeneration: Germination and direct sowing of seeds. • Controlled burning shall be totally prohibited. • Grazing and the passage of livestock shall be prohibited.
	Ch, Ja	• Planting of exotic species, planting using cuttings and direct sowing of seed. Trees: *Tectona grandis, Acacia auriculiformis, Gmelina arborea*, and *Cassia siamea*. Spacing: 2m x 2m (2,500 trees/ha), 2m x 2.5m (2,000 trees/ha) Brush Cutting: Brush cutting shall be carried out depending on the state of the grass beneath. Other: Existing standing trees (including withered and damaged trees) and shrubs shall be felled and removed for use. Land being cultivated may continue to be cultivated until after crops have been harvested at which time the fuelwood production forest will be created.	• The area shall be clear cut. However, the size of the area to be clear cut shall be reduced. Cutting Cycle: 7 years Regeneration: Germination, planting using cuttings and direct sowing of seeds. • Controlled burning shall be totally prohibited. • Grazing and the passage of livestock shall be prohibited.
Grassland	Sa, Sb, St	• The felling of standing trees (for sale as timber and fuel) and the removal of shrubs (for local fuel use) shall be carried out, after which the land will be ploughed and pasture sown or planted. • Feed trees, trees for fuel and trees which provide a source of nectar for bees shall be planted around this area as a surrounding fence and to form divisions within it.	• This area is designated as a grazing area for rotational grazing. • Pasture shall be harvested and used for livestock feed during the dry season. • Although the area shall be burnt off once every three years, as it is a grazing area this shall be carried out in a planned manner in accordance with grazing plans. A firebreak shall be established around all areas where controlled burning is to be carried out. • Grass other than pasture shall be removed and shrubs cleared and removed. • The leaves of feed trees shall be used to increase the volume of pasture feed and branches shall be used as fuelwood.
	Ch, Ja	• Standing trees and shrubs shall be removed (for use as fuel in local areas) and after ploughing pasture shall be sown or planted. • Feed trees, trees for fuel and trees which provide a source of nectar for bees shall be planted around this area as a surrounding fence and to form divisions within it.	
	Ag	• After ploughing pasture shall be sown or planted. • As the total area involved is relatively small, this shall be concentrated in Sa, Sb, St and Ch and Ja grasslands.	

Operation (Management) Standards (4)

Kind of Forest	Existing Forest Type	Improvement Methods	Operation Methods
Woodland Pasture	Sa, Sb, St	• Trees of larger diameter shall be felled and used (with the exception of *Vitellaria paradoxa*) and crown density reduced to no more than 10%. Shrubs shall be completely removed. • Feed trees shall be planted in rows and overall crown density reduced to approximately 20%. • In order to increase the volume of natural poaceae grasses for livestock feed, weeds other than *Gramineae* will be removed and pasture seeds sown.	• Areas where controlled burning is to be carried out shall be established and such burning carried out at an early stage. Firebreaks shall be established around such areas to prevent fire from spreading to other areas. • Weeds not eaten by livestock shall be removed and seeds sown in areas with low grass density. • Management of crown density shall be carried out and shrubs shall be removed. • The leaves of feed trees shall be used to increase the volume of livestock feed and branches shall be used for fuel. • Dams shall be constructed in waterways in order to provide water for livestock during the dry season.
	Ch, Ja	• Shrubs shall be removed. • With the exception of *Gramineae* grasses eaten by livestock, all other grasses shall be removed. • Pasture seeds shall be sown. • Feed trees shall be planted in rows and overall crown density reduced to approximately 20%.	
	Ag	• After ploughing, pasture shall be sown and feed trees planted. • As the total area involved is relatively small, this shall be concentrated in Sa, Sb, St and Ch and Ja woodland pasture.	
Grazing community Forest	Gf, Fc	• The existing forest shall be left in its present state and no special improvement of grassland shall be carried out.	• This area shall be used as Grazing community Forest. • Although intensive management of this area shall not be carried out, timber production of Fc shall be carried out in accordance with timber forest management.
	Ag	• In order to allow the forest to recover, direct planting of native species shall be carried out after ploughing. After that, the area shall be included in Gf and Fc Grazing community Forest.	

Operation (Management) Standards (5)

Kind of Forest	Existing Forest Type	Improvement Methods	Operation Methods
Utilized Land	Fc, Sa, Sb	• Users shall be permitted to use up to 4.0ha per household (2.0ha for cultivation and 2.0ha for tree-planting). • On land for cultivation, standing trees shall be felled (including withered and damaged trees) and sold as timber and fuelwood, and shrubs shall be removed to be used locally for fuel. After this has been carried out, the area shall be used for normal commercial farming activities. • On land for tree-planting, in order to make room for the planting of fruit trees, trees for fuel and posts, standing trees (including withered and damaged trees) shall be felled and sold as timber and fuelwood, and shrubs removed for use by the users. After this has been carried out, fruit trees and trees for fuel and posts shall be planted. Fruit Trees: *Anacardium occidentale*. Trees for Fuel and Posts: *Tectona grandis, Gmelina arborea*, and *Cassia siamea.* Spacing: Fruit trees 10m x 10m (100 trees/ha); Trees for Fuel and Posts 2m x 2m (2,500 trees/ha). However, when planting over a 1-2 year period, trees should be planted at 1.5m x 3m (2,222 trees/ha) or 1.5m x 4m (1,666 trees/ha). • A firebreak shall be established on the boundary between utilized land (land for cultivation and tree-planting) and other zones to mark the boundary and to prevent fire spreading to other areas. Trees such as *Khaya senegalensis, Acacia auricuriformis, Pterocarpus erinaceus* and *Parkia biglobosa*, etc., which are a source of nectar for bee-keeping, should be used.	• As a rule, users shall be those entities possessing cultivated land within presently classfied forests (based on aerial photographs taken in 1998). • Controlled burning shall be prohibited. • Grazing and the passage of livestock shall be prohibited. • Cotton growing shall be prohibited. • Commercial farming shall be improved in order to establish farming. • *Vitellaria paradoxa* shall be regenerate in areas surrounding cultivated land and shall be replanted in present areas of cultivated land. • The cutting cycle shall be set at 5 years for trees for fuel and posts with 1/5 of the planted area being logged and replanted every year. • When the area is logged it shall be completely cleared and when it is replanted it shall be planted in both seeds and seedlings. • Bud pruning of *Tectona grandis* is also required. • In tree-planting areas, it is possible to carry out agroforestry (Taungya) 1~2 years after new planting and replanting.
	Ch, Ja	• With regard to cultivated land, Ch will be left as it is and normal commercial farming shall be carried out while standing trees and shrubs shall be felled and removed and the area turned into cultivated land. • Land for tree-planting shall be prepared for planting with fruit trees and trees for fuel and posts, with wood sold as firewood or used by the users. • Fruit trees and trees for fuel and posts shall be planted in the same way as for Fc, Sa and Sb. • Firebreaks shall be established on the boundary between this zone and other zones in the same way as for Fc, Sa and Sb.	

Operation (Management) Standards (6)

Kind of Forest	Existing Forest Type	Improvement Methods	Operation Methods
Forest for Community Fuelwood	Ch, Ja	• Fuelwood forest for village community shall be created in areas of Ch and Ja other than Utilized Land as a source of income for the village. • Fuelwood forest shall be created in accordance with creation techniques for tree-planting areas within Utilized Land. * Areas of Fc, Sa, Sb, Ch and Ja remaining after land has been distributed to the people of the area shall be designated as Fuelwood Community Forest within Utilized Land.	• Management techniques for this area shall be in accordance with those of tree-planting areas within areas of Utilized Land. • Controlled burning shall be prohibited. • Grazing and the passage of livestock shall be prohibited.
Forest Reserve	Gf, Fc, Sa, Sb, St, Ag	• Vegetation in Utilized Land, Fuelwood Community Forest and forest apart from Left-over Area within the Village Forestry Zone shall be left in its present condition. • Forest Reserve shall also include forest that can be transferred into Utilized Land in the future. • Vegetation in areas of Gf, Sb and St shall be left in its present condition and shall be used for the passage of livestock to the Silvi-pastoral Zone from areas of classified forest. • Areas of Ag in forests shall be restored with native species.	• Forest operations shall not be implemented for areas of existing forest. • Controlled burning shall be prohibited. • Although grazing in this area shall be prohibited, grazing and the passage of livestock shall be permitted in remaining areas of the forest.
Left-Over Area	Other (Tm, Td, Cl, Ar, Ce, Pe)	• This area shall be left in its present condition.	• Grazing shall be prohibited in the Conservation Forest Zone, Production Forest Zone, and Village Forestry Zone. • Silvi-pastoral Zones shall be managed in the same way as Grazing Community Forest. • Controlled burning shall be prohibited.

9. Improvement Plans

9.1 Plan Duration

A sustainable forest management was aimed for when deciding plan period for classified forests. The duration required for the implementation of forestry operations to achieve the said sustainable forest management was set as the plan period for this plan.

The time required for forestry operations to be realized for each zone will differ from zone to zone. If the age at maturity for the timber forest is set at 40-60 years, there will be 3 cutting cycles or 60 years.Trees in fuelwood forests take 7 years to mature and one year for regeneration, making the duration of the improvement plan a total of 8 years. It takes 3 years to fatten cows in silvi-pastoral zones, 5 years to establish a regular farming cycle in cultivated land, and it takes 5 years for trees for fuel and posts to reach maturity. In timber forest, as the time required to reach maturity is relatively long, the plan perioed shall be set at 10 years, targeting the fuelwood forest (the above-mentioned 8 years plus 2 years for preparation).

9.2 Management Plans

Management of each type of forest shall be carried out in accordance with the improvement methods and operation methods outlined in 8. Operation Standards. The areas of existing forest type in each zone by improvement method for each kind of forest are as follows.

Area of Improvement Methods by Forest Type (PIGOUROU)

Conservation Forest Zone

(Unit : ha)

Classification		Forest Type and Area								Total
		Gf	Fc	Sa	Sb	St	Ch	Ja	Other	
		158.08		853.67	592.80	184.28			23.69	1,812.52
Conservation Forest I	Planting									0.00
	Enrichment			125.95	131.46	22.33				279,74
	Original State	111.12		43.91	22.01					177.04
Conservation Forest II	Planting									0.00
	Enrichment	3.09		281.22	358.65	161.95				804.91
	Original State	43.87		402.59	80.68					527.14
Left-over Area									23.69	23.69

Production Forest Zone

(Unit : ha)

Classification		Forest Type and Area								Total
		Gf	Fc	Sa	Sb	St	Ch	Ja	Other	
		245.86		650.75	1,398.81	303.18	182.91	36,84	125.04	2,870.51
Conservation Forest II	Planting									0.00
	Enrichment	123.94		2.40	15.9	32.44				142.24
	Present State	121.92		26.16	1.60					149.68
Timber Forest	Planting						5.26	16.28		21.54
	Felling/ Regeneration			569.48	339.49	63.74				972.71
Fuelwood Forest	Planting						177.65	20.56		198.21
	Felling/ Regeneration			52.71	1,041.82	239.44				1,333.97
Left-over Area									52.16	52.16

Silvi-pastoral Zone

(Unit : ha)

Classification		Forest Type and Area								Total
		Gf	Fc	Sa	Sb	St	Ch	Ja	Other	
		136.00		56.90	990.13	174.86	69.93	45.23	37.90	1,510.95
Conservation Forest II	Planting									0.00
	Enrichment	46.75			35.78					82.53
	Present State	78.23								78.23
Grassland				56.90			69.93	45.23		172.06
Woodland Pasture					954.35	174.86				1,129.21
Grazing Community Forest		11.02							2.71	13.73
Left-over Area									35.19	35.19

Village Forestry Zone (Unit : ha)

Classification		Forest Type and Area								Total
		Gf	Fc	Sa	Sb	St	Ch	Ja	Other	
		290.32		93.92	901.98	249.83	462.39	286.75	26.31	2,311.50
Conservation Forest II	Planting									0.00
	Enrichment	38.70		4.97	25.47					69.14
	Present State	162.22		5.56	35.28					203.06
Utilized Land				72.26	344.11		408.00	256.90		1,081.36
Fuelwood Community Forest							54.39	29.76		84.15
Forest Reserve		89.40		11.31	497.12	249.83				847.48
Left-over Area									26.31	26.31

(1) Conservation Forest I

Conservation Forest I has an area of 456.78 of which 177.04ha is in original forest, 0ha is newly planted combined with 279.74ha undergoing enrichment for forest recovery, giving a total of 279.74ha.

① Annual Work Volume

The period has already been determined as 10 years. Planting, supplementary planting and brush cutting are actually carried out over a period of 7 years. The annual work volume is as follows.

Annual Work Volume (Unit: ha)

Activity	Area (ha)	Year							
		1-3	4	5	6	7	8	9	10
Planting	0	Preparation Period	*1	*1	-	-	-	-	-
Enrichment	279		46	46	46	47	47	47	-
Supplementary Planting	279		-	46	46	46	47	47	47
Brush Cutting	279		46	46	46	47	47	47	-
Total	837		92	138	138	140	141	141	47

*1 Planting is carried out along the boundaries of the classified forest to clarify boundaries.

② Implementation Methods

- Both planning and implementation are carried out directly by the DFRN.
- Local inhabitants are employed as workers and are paid wages.
- Necessary nursery stock is purchased from private nurseries by the DFRN.

③ Nursery Stock

The required quantity of nursery stock for new planting, enrichment and supplementary planting in Conservation Forest I is as follows.

Required Nursery Stock Volume (Unit: ha)

Category		Year							
		1-3	4	5	6	7	8	9	10
New Planting	Planting	Preparation Period							
	Supplementary Planting								
	Sub-Total								
Enrichment	Planting		4,600	4,600	4,600	4,700	4,700	4,700	
	Supplementary Planting		-	920	920	920	940	940	940
	Sub-Total		4,600	5,520	5,520	5,620	5,640	5,640	940
Total			4,600	5,520	5,520	5,620	5,640	5,640	940

④ Tree Type and Planting Density, etc.

Tree types and planting density are as follows.

(a) Tree Type (The same tree types are used for both new planting and enrichment.)

Khaya senegalensis, Ptetocarpus erinaceus, Isoberlinia supp., Vitellaria paradoxa, and Parkia biglobosa.

(b) Planting Density

Planting density for areas of new planting is 625 trees/ha (4m x 4m) while for areas of enrichment it is 100 trees/ha (10m x 10m).

(c) Supplementary Planting (The same tree types are used for both new planting and enrichment.)

The supplementary planting ratio is 20%.

(2) Conservation Forest II

Although Conservation Forest II is found in every zone, as according to management standards the way these zones are handled is the same, the total area of Conservation Forest Area II is 2,056.93ha. Forest in its present state is 958.11ha while the total area for forest recovery includes 0ha for new planting and 1,098.82ha for enrichment, making a total of 1,098.82ha.

Land Area of Conservation Forest II (PIGOUROU) (Unit: ha)

Operation Methods	Zone	Forest Type						Total
		Gf	Sa	Sb	St	Ch	Ja	
New Planting	Conservation Forest							
	Production Forest							
	Silvi-pastoral Forest							
	Village Forestry							
	Sub-Total							
Enrichment	Conservation Forest	3.09	281.22	358.65	161.95			804.91
	Production Forest	123.94	2.40	15.90				142.24
	Silvi-pastoral Forest	46.75		35.78				82.53
	Village Forestry	38.70	4.97	25.47				69.14
	Sub-Total	212.48	288.59	435.80	161.95			1,098.82
Existing Forest	Conservation Forest	43.87	402.59	80.68				527.14
	Production Forest	121.92	26.16	1.60				149.68
	Silvi-pastoral Forest	78.23						78.23
	Village Forestry	162.22	5.56	35.28				203.06
	Sub-Total	406.24	434.31	117.56				958.11
Total		618.72	722.90	553.36	161.95			2,056.93

① Annual Work Volume

The period has already been determined as 10 years. Planting, supplementary planting and brush cutting are actually carried out over a period of 7 years. The annual work volume is as follows.

Annual Work Volume (Unit: ha)

Activity	Area (ha)	Year							
		1-3	4	5	6	7	8	9	10
Planting	312	Preparation Period	*1	*1	-	-	-	-	-
Enrichment	1,098		183	183	183	183	183	183	-
Supplementary Planting	1,098		-	183	183	183	183	183	183
Brush Cutting	1,098		183	183	183	183	183	183	-
Tending	1,098		-	-	-	-	-	-	1,098
Total	4,392		366	549	549	549	549	549	1,281

*1 Planting is carried out along the boundaries of the classified forest to clarify boundaries.

② Implementation Methods

- Both planning and implementation shall be carried out directly by the DFRN.
- Local inhabitants shall be employed as workers and are paid wages.
- Necessary nursery stock shall be purchased from private nurseries by the DFRN.

③ Nursery Stock

The required quantity of nursery stock for new planting, enrichment and supplementary planting in Conservation Forest II shall be as follows.

Required Nursery Stock Quantity (Unit: ha)

Category		Year							
		1-3	4	5	6	7	8	9	10
New Planting	Planting	Preparation Period	-	-	-	-	-	-	-
	Supplementary Planting		-	-	-	-	-	-	-
	Sub-Total		-	-	-	-	-	-	-
Enrichment	Planting		18,300	18,300	18,300	18,300	18,300	18,300	-
	Supplementary Planting		-	3,660	3,660	3,660	3,660	3,660	3,660
	Sub-Total		18,300	21,960	21,960	21,960	21,960	21,960	3,660
Total			18,300	21,960	21,960	21,960	21,960	21,960	3,660

④ Tree Type and Planting Density, etc.

Tree types and planting density are as follows.

(a) Tree Type (The same tree types are used for both new planting and enrichment.)

Khaya senegalensis, Ptetocarpus erinaceus, Isoberlinia supp., Vitellaria paradoxa, Parkia biglobosa and Milicia excelsa.

(b) Planting Density

Planting density for areas of new planting is 625 trees/ha (4m x 4m) while for areas of enrichment it is 100 trees/ha (10m x 10m).

(c) Supplementary Planting (The same tree types are used for both new planting and enrichment.)

The supplementary planting ratio is 20%.

(d) Tending

Clear-felling is carried out every 10 years.

(3) Timber Forest

The total area of timber forest is 994.25ha and felling is carried for timber production. Generally, systematic selective logging activities are carried out in order to achieve sustainable logging. This requires the existence of a forest with a certain structure. However, according to the results of forest survey, production forests are at present of low quality, making it impossible to carry out selective logging. Therefore, logging will be carried out for a certain period of time in order to improve forest content through enrichment activities.

Sa accounts for 569.48ha, Sb for 339.49ha, St for 63.74ha, and Ch for 5.26ha, Ja for 16.28ha of the forest type.

① Annual Work Volume

The annual work area is determined in the following way based on maturity, cutting cycle and selective logging ratio.

- Maturity: Although different species of trees reach maturity at different times, *Khaya senegalensis*, *Afzelia africana*, and *Milicia excalsa* reach maturity in 30 years.
- Cutting Cycle: 20 years.
- Selective Logging Ratio: 33% (1/3).

Selective logging of 50ha (49.71ha) or 1/20 of the 994.25ha total area of the timber forest shall be carried out annually with this being referred to as the selected logging area. 20 areas shall be established within the timber forest and given the numbers 1 to 20. The size of some of these sub-compartment may be smaller than 50ha.

② Logging/Regeneration

- As the forest is presently in bad condition at the first cutting cycle, enrichment shall be carried out with a view to transforming it into a selective logging forest. When felling trees in this area, the above-mentioned 33% shall not apply but rather standing trees (including withered and damaged trees) with a DBH of no less than 35cm (with a GBH of no less than 110cm).
- From the 3rd year, the volume of timber from cutting blocks 1 through 8 shall be 251m^3.
- Under the improvement plan, from the second cutting cycle trees for logging shall have a DBH of no less than 35cm (GBH of no less than 110cm) and there shall be a selective logging ratio of 33%.
- Regeneration shall be carried out through natural seeding. In areas where this is difficult, seedlings or seed shall be planted.

③ Implementation Methods

- Both planning and implementation shall be carried out directly by the DFRN. Local inhabitants shall be employed as workers and shall be paid wages.
- Although the DFRN shall formulate plans, these shall be implemented by local organizations.
- Necessary nursery stock shall be purchased from private nurseries by the DFRN.

④ Nursery Stock

The required quantity of nursery stock for new enrichment in Timber Forests shall be carried out for half of the annual logging area (1/3 of 1 logging block; 1 logging block is 50ha). These shall be planted at a density of 100 trees/ha (10m x 10m) with supplementary planting being carried out the following year at a ratio of 20%.

(Required Nursery Stock Quantities)

The annually required quantity of seedlings is 800 trees in the 3rd year and 960 trees/year from the 4th year through to the 10th year.

Timber Forest Work Area

Year	1-2	3	4	5	6	7	8	9	10
Selective Felling Block Area (ha)	Preparation Work	50	50	50	50	50	50	50	50
Logging Area (ha)		17	17	17	17	17	17	17	17
Logging Volume (m^3)		251	251	251	251	251	251	251	251
Enrichiment Area (ha)		8	8	8	8	8	8	8	8
Nursery Stock (seedling)		800	960	960	960	960	960	960	960

(4) Fuelwood Forest

Fuelwood forest has a total area of 1,532.18ha. Fuelwood forest management and clear felling shall be carried out with the aim of fuelwood production. This fuelwood forest shall consist of 52.71ha of Sa, 1,041.82ha of Sb and 239.44ha of St, for a total of 1,333.97ha of native species and trees with a DBH of no less than 7cm shall be felled. The remaining 198.21ha, which consists of 177.65ha of Ch and 20.56ha of Ja, both introduced species, shall be clear felled.

① Trees

Native Species: *Detarium microcarpum, Terminalia avicennoides, and Isoberlinia spp*.
Introduced Species: *Tectona grandis, Gmelina arborea, and Acacia auriculiformis*.

② Annual Work Volume

In order to even out the village income of each improvement unit, under the Basic Plan the Fuelwood Forest area is determined as 1,520ha. As the trees reach maturity in 7 years, the annual work area is 190ha. Bearing in mind environmental considerations, each annual logging area shall be approximately 10ha with this area including both fuelwood forest management forest and clear felled management forest. The work area for 10 years is as follows.

Fuelwood Forest Work Area (Unit: ha)

Operations		Year									
		1-2	3	4	5	6	7	8	9	10	11
Clear Felling (448ha)	Planting/Direct Grafting	Preparation	24	24	25	25	25	25	25	25	24
	Harvesting/ Logging		-	-	-	-	-	-	-	24	24
Fuelwood Forest Management (2,272ha)	Regeneration (Direct Sowing/ Planting)		-	166	165	165	165	165	165	165	166
	Harvesting/ Logging		166	165	165	165	165	165	165	166	166

However, in the 10th year harvesting and logging for clear cutting management area shall be carried out in the area that was planted with seedlings and cuttings in the 3rd year and in the 11th year harvesting and logging shall be carried out in the area that was planted and with seedlings and cuttings in the 4th year. Regeneration (direct sowing and planting) in fuelwood forest management areas shall be carried out in areas that were harvested/logged the previous year. Furthermore, harvesting and logging in the 11th year shall be carried out in the area that was replanted (direct sowed and planted) in the 4th year.

③ Planting and Timber Production Volumes

In the above-mentioned fuelwood forest production plan area, the annual number of trees replanted in clear cutting management forests from the 3rd year through to the 10th year (when only seedlings are used) or the estimated timber production volume of the fuelwood forest (area of standing trees with a DBH of no less than 7cm for timber for use as fuelwood calculated based on forest survey records) is as follows.

Please note that although forest operation with regard to fuelwood forest will be natural regeneration of native species of trees, initially direct planting of desired species of trees is carried out in order to create the fuelwood forest.

(a) Number of Seedlings Planted in Clear Cutting Management Forests (2,500 trees are planted per ha)

From the 3rd year until the 10th year, 60,000/62,500 trees will be planted annually. From the 11th year, regeneration will take place through germination.

(b) Fuelwood Forest Estimated Timber Production Volumes

Fuelwood Management Forest	3rd~10th year	165/166ha/annum	2,789/2,805m^3
	From the 11th year	165/166ha/annum	
Clear Cutting Management Forest	From the 10th year	24/25ha/annum	528/550m^3

(5) Grassland

In order to achieve improved grazing capacity and change the form of livestock grazing, cultivated land and fallow land that had been abandoned was artificially created into grassland. This land has an area of 172.06ha and is currently planted in Sa (56.90ha), Ch (69.93ha) and Ja (45.23ha).

① Improvement of Land for Pasture Establishment

Standing trees shall be logged and shrubs removed in the target area. Standing trees shall be logged and sold as timber or fuelwood and the proceeds put into the Forest Improvement Fund. Shrubs shall be used locally for fuel or stock fences.

② Types of Pasture

Gramineae shall consist of *Andoropogon gayanus* and *Pennisetum purpureum* while *Leguminosae* shall consist of *Stylosanthes hamata*. *Andoropogon gayanus* and *Stylosanthes hamata* shall be planted together while *Pennisetum purpureum* shall be planted in the surrounding area or in vacant ground.

③ Stock Fences

Stock fences shall be established to confine domestic livestock to certain areas and to effectively utilize grasslands. Feed trees, fuelwood trees, trees which are a source of nectar for bee-keeping, and shrubs shall be utilized to establish fences which are to be constructed by the local inhabitants.

④ Utilization

Rotational grazing of grasslands is to be carried out in order to provide even feeding in terms of both quantity and nutrition. Three blocks are to be established within grassland areas, with rotational grazing of each block being carried out for 2 weeks after which it is given 4 weeks rest. Feed trees, fuelwood trees and trees which are a source of nectar for bee-keeping are to be planted in all grazing blocks.

⑤ Storage and Use of Grass

Hay is to be harvested and stored as much as possible during the dry season using what machinery is available. In order to keep the decrease in the nutritional value of the grass at a minimum, grass is to be cut and laid out thinly on the ground and turned once or twice every day in order to speed up the drying process.

⑥ Number of Breeding Stock

From the grassland production volume and the annual livestock feed requirements of mature cattle (250kg) (2,282kg), it can be calculated that 1,070 head of livestock can be reared on the grasslands. At the beginning of the plan only the existing number of livestock (mature cattle: 250kg) will be reared.

Number of Head of Stock on the Grasslands

Grasses	Area (ha)	Utilized Area (ha)	Dry Grass Production Volume (kg/ha)	Dry Grass Production Volume (ton)	Possible Number of Stock
Andoropogon gayanus	82	70	8,500	595	-
Stylosanthes hamata	82	70	3,630	3,630	-
Pennisetum purpureum	8	6	8,640	52	-
Total	172	146	-	901	394

(6) Woodland Pasture

In order to stabilize the number of stock grazing in the natural forest, the volume of grasses for domestic livestock to feed on shall be increased and the quality of pasture improved. This area consists of Sb (954.35ha),St (174.86ha),giving a total of 1,129.21ha.

① Land Preparation

The crown density of standard trees in areas of Sb and St shall be reduced to 10% and shrubs removed (for use and sale as timber and fuelwood). Feed trees shall be planted in rows and overall crown density established at approximately 20%. Controlled burning shall be carried out after standing trees and shrubs have been removed.

② Types of Pasture

Natural *Gramineae* grasses shall be retained and all weeds removed. When there is a shortage of *Gramineae* grass in a particular area, pasture shall be planted with the aim of achieving 100% covering. Immediately after direct sowing grazing is to be carried out in order to establish it using the "hoof" method.

③ Utilization

Although it is possible to graze for a period of one year on fast-growing grass pasture, as it is difficult to graze during the first year with slow-growing *Leguminosae* pasture temporary stock fences should be established around the area and grazing delayed until root structure is adequately developed.

④ Number of Stock

From the Woodland Pasture production volume and the annual livestock feed requirements of mature cattle (250kg) (2,282kg), it can be calculated that 1,681 head of livestock can be reared on the Woodland Pasture. At the beginning of the plan only the existing number of livestock (mature cattle: 250kg) will be reared.

Number of Head of Stock in Woodland Pasture

Pasture	Area (ha)	Utilized Area (ha)	Dry Grass Production Volume (kg/ha)	Dry Grass Production Volume (ton)	Number of Stock
Wild Grass	1,129	903	4,250	3,838	1,681

(7) Grazing Community Forest

This area consists of forest in the silvi-pastoral zone other than Grassland, Woodland Pasture, and Conservation Forest II where improvement, etc. of grass is not being carried out. In areas of Fc, timber production shall be carried out in accordance with timber forest management. This includes areas of Gf (11.02ha) for a total of 11.02ha. Grazing shall be permitted within Conservation Forest II inside the Silvi-pastoral Zone.

(8) Utilized Land

In the Village Forestry Zone, each participating household (10.1 people: 6 adults/8 children) shall be permitted to use 2.0ha of cultivated land and 2.0ha of tree-planting land for a total of 4.0ha. (Households are permitted to use the land but the state retains ownership.) Based on aerial photographs taken during December 1998, residents participating in the Village Forestry Zone are those possessing cultivated land within the classified forest at that time. The total number of households in the village, the number of households in the Village Forestry Plan and the required area are as follows.

Village Population, Number of Households and Land Preparation

Population (persons)	Number of Households	Number of People per Household	Classified Forest Utilization Ratio	Number of Eligible Households	Utilized Land Area (ha)	Required Area (ha)
1,806	205	9.1	0.837	172	688	960

Utilized land consists of 31 compartments with a covering of Sa (72.26ha), Sb (344.11ha), Ch (408.00ha), and Ja (256.90ha) for a total of 1,081.36ha. 19 sub-compartments with an area of 1,002.53ha shall be used by 160 households, 23 sub-compartments with an area of 45.86 ha shall be used by 6 households and 33 sub-compartments with an area of 32.97 ha shall be used by 6 households.

① Commercial Farming

Commercial farming will be improved through extension activities regarding the improvement of crop-growing systems, cultivation methods, post-harvest processing, and through activities to enlighten farmers, including the necessity of a forest management plan.

(a) Improving Crop Growing Systems

a) Selection of Crops

Under the terms of the Forest Management Plan, yams, maize and sorghum, shall be the main subsistence crops with peanuts and cowpeas being grown as intercrops.

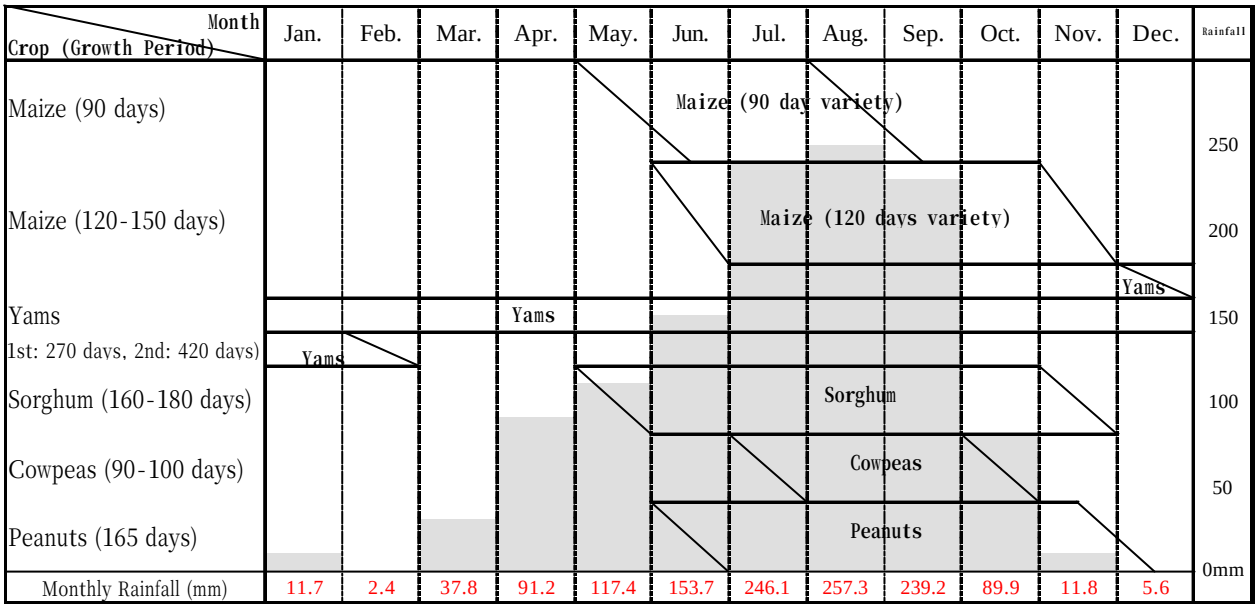
b) Introduction of New Varieties (Improved Varieties)

As presently grown varieties are mainly native varieties, 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) varieties. However, as the introduction and extension of new varieties takes time, farmers will be instructed to select reliable seeds for immediate use. Improved maize with a growth period of 90 days and native varieties with a growth period of 120 days shall both be introduced.

c) Improving Crop Growing Systems

The above-mentioned improved crop growing system that gives consideration to crops and varieties is shown in the following diagram. Varieties of maize with growth periods of both 90 days and 120 days shall be introduced with two crops being grown

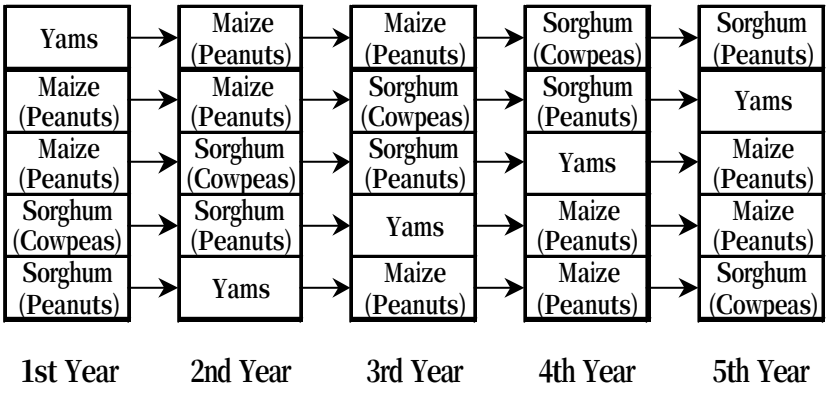
each year. By using varieties with growing periods that are shorter than those of native varieties, this system enables the most effective utilization of the limited rainy season.



Crop Growing System

d) Crop Rotation

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 rotational crop system is as shown below.



(b) Improved Growing Methods

a) Improvement of Cultivation Using Animal Power and Farming Tools

Cultivation using animal power will be introduced for joint use on condition that it will be used for contracted ploughing. Existing farming tools will be improved.

b) Materials for Agricultural Production

a. Seeds

New varieties of seeds will be introduced and sown in appropriate quantities.

b. Fertilizer

Locally obtainable organic fertilizer will be used. Where soil analysis reveals this supply to be insufficient, the use of chemical fertilizers, such as urea, will be considered. In order to expand the use of organic fertilizer, composting techniques will be taught. *Leguminosae* plants (green manure crops), such as *Mucuna pruriens*, which are a source of nitrogen, shall be ploughed in.

c) Improvement of Growing Techniques

Matters to bear in mind with regard to growing include the following.

- Deep ploughing 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.

d) 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.

- The introduction of disease and pest-resistant varieties.
- The introduction of crop rotation.
- The implementation of mixed planting and intercropping.
- Consideration of planting density.

(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 a 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.

With regard to storage, as *Leguminosae* cash crops, such as peanuts, etc., are susceptible to damage from pests while in storage, they should be mixed with wood ash and silica-seaweed soil mix, etc. and stored to prevent the breeding of pests.

② Afforestation Plan

The planting of forest and fruit trees within the 2.0ha of utilized land for the production of posts and fuelwood shall be planned in the following way. However, trees shall be selected individually by the local inhabitants themselves.

(a) Post and Fuelwood Production Forest

Trees to be planted in this area are *Tectona grandis* and *Gmelina arborea*. Planting density shall be 2,500 trees/ha (2m x 2m) with *Tectona grandis* being stamp planted and *Gmelina arborea* being either stamp planted or its cuttings planted. With stamp planting, as 4~5 sprouts appear, they shall be thinned out after 1 year with 3 straight seedlings being left.

The cutting cycle shall be 5 years with 0.4ha (1/5 of 2.0ha) being planted and felled each year. In planted areas, intercropping shall be carried out (Taungya System) for 2 years after planting. Spacing in this case shall be 3m x 1.5m (2,220 trees/ha). Annual plans shall be as follows.

Posts and Fuelwood Production Forest Plan

Year	Planting (ha)		Harvesting (ha)	Intercropping (ha)	Comments
1	0.4	Planting	—	2.0	Yams.
2	0.4	Planting	—	2.0	Yams or maize.
3	0.4	Planting	—	1.6	Maize (Intercropping of the 0.4ha of the 1st year is unnecessary.)
4	0.4	Planting	—	0.8	Maize (Intercropping of the 0.8ha of the 1st and 2nd years is unnecessary.)
5	0.4	Planting	—	0.8	Yams (Intercropping of the 1.2ha of the 1st, 2nd and 3rd years is unnecessary.)
6	0.4	1st year after Germination	0.4 (1st year Forest)	0.8	Yams or maize (5th year reverts to 1st year.)
7	0.4	2nd year after Germination	0.4 (2nd year Forest)	0.8	Yams or maize (Reverts to 1st and 2nd years.)
…	…	……	……	…….	

(b) Fruit Trees

Fruit trees to be planted in this area are cashews. Planting density shall be 100 trees/ha (10m x 10m). Although trees will start to bear fruit approximately 18 months after planting, from the 6th year to the 10th year only 1 ton shall be harvested per ha with 2 tons per ha being harvested from the 11th year onwards. As cashews easily catch fire, firebreaks or belts of fire-resistant trees shall be established to prevent fire from entering from the surrounding area.

③ Bee-Keeping

As honey production is a desirable way of providing a cash income to the local inhabitants, bee-keeping activities should be introduced and actively encouraged in the area in order to achieve stable production. Trees to be planted are *Acacia auriculiformis*, *Newboudia laevis*, *Detarium microcarpun* and *Burkea africana*.

④ *Vitellaria paradoxa*

Although *Vitellaria paradoxa* has been retained in cultivated areas, there are no young trees bearing fruit or for growing crops and as the trees are old, in many cases production volumes have decreased. After *Vitellaria paradoxa* has been newly planted around the perimeter of the cultivated land, it will be possible to raise replacement trees and to carry out harvesting.

(9) Fuelwood Community Forest

54.39ha of previously cultivated land apart from land for use by local inhabitants and 29.76ha of previously fallow ground making a total of 84.15ha of land within the Village Forestry Zone shall be used as a fuelwood forest for the production of fuelwood for sale by the village. This fuelwood forest is for joint use by the village and shall be managed by the organization in each improvement unit.

Species of trees to be planted in the fuelwood forest include *Prosopis sp*., *Terminalia spp*., and *Gmelina arborea*, etc. Of these species of trees, good quality charcoal can be obtained from *Prosopis sp.*, and *Gmelina arborea*. The planting density for this area is 2,500 trees/ha (2m x 2m). As the cutting cycle is 7 years, 12ha shall be felled and replanted each year with annual charcoal production volumes reaching 264m^3 (12ha x 22m^3/ha=264m^3).

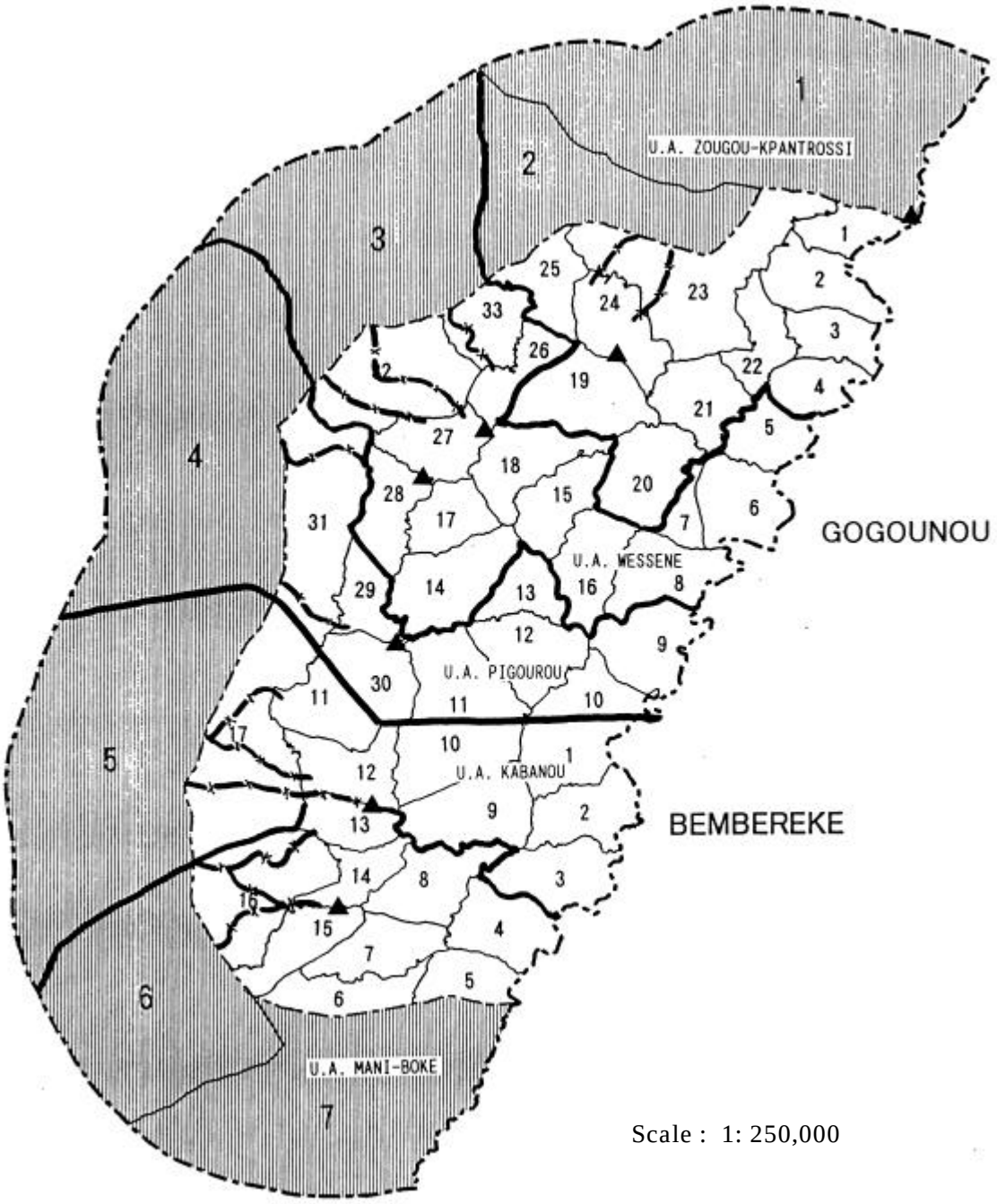
(10) Forest Reserve

Areas of forest in the Village Forestry Zone other than Conservation Forest II, Utilized Land, Fuelwood Community Forest and Left-over Area shall be retained as Forest Reserve. Forest Reserve contains 89.40ha of Gf, 11.31ha of Sa, 497.12ha of Sb and 249.83ha of St, making a total of 847.48ha. It is possible that the 11.31ha of Sa may be transferred to Utilized Land in the future.

Areas of Sb and St shall be transferred from outside the classified forest to the Silvi-pastoral Zone within the classified forest without becoming part of Cultivated Land or Tree-planting Land to become paths for the passage of livestock. When such paths pass through Utilized Land, a path with a width of 50m shall be established and a 3m wide belt of *Gmelina arborea* and *Acacia auriculiformis* planted at a spacing of 1.5m x 1.5m on the boundary either side of the path. The planned livestock path shall be extended by 5,600m as shown in the following diagram.

(11) Left-Over Area

Left-over Area is land other than forest (Gf, Fc, Sa, Sb and St) and cultivated and fallow land that shall be retained in its present state and shall be outside the scope of management. Left-over Area consists of 30.84ha of Ce, 9.23ha of Cl, 97.28ha of Tm, for a total of 137.35ha.



Scale : 1: 250,000

Key	
1~7	Buffer Zone
1~33	Classified Forest
▬▬	Improvement Unit Boundary
U.A.	Improvement Unit
—x—	Livestock Path
▲	Waterhole

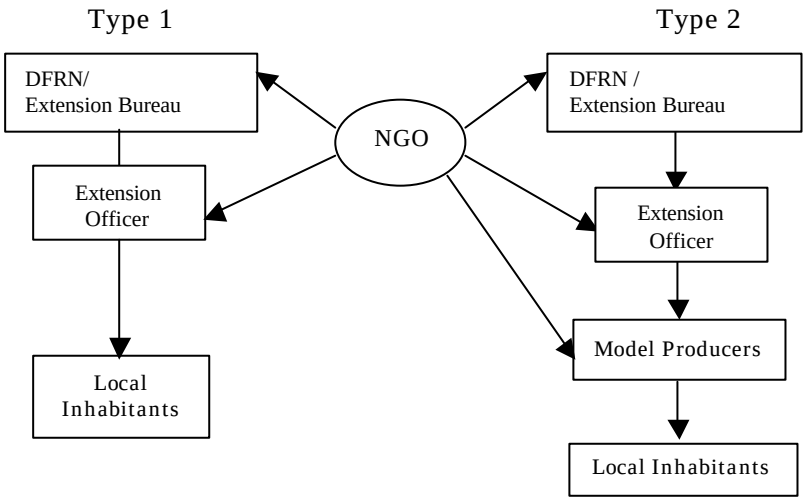
Livestock Paths

10 Extension and Training Plans

Existing extension activities are carried out under the jurisdiction of the Extension Bureau of the Ministry of Rural Development 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.



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 sepecies, introduced sepecies 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 seedlings for mountain areas, etc. Furthermore, training of nursery officers within local organizations will also be carried out.

(2) Bee-Keeping

Bee-keeping 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.

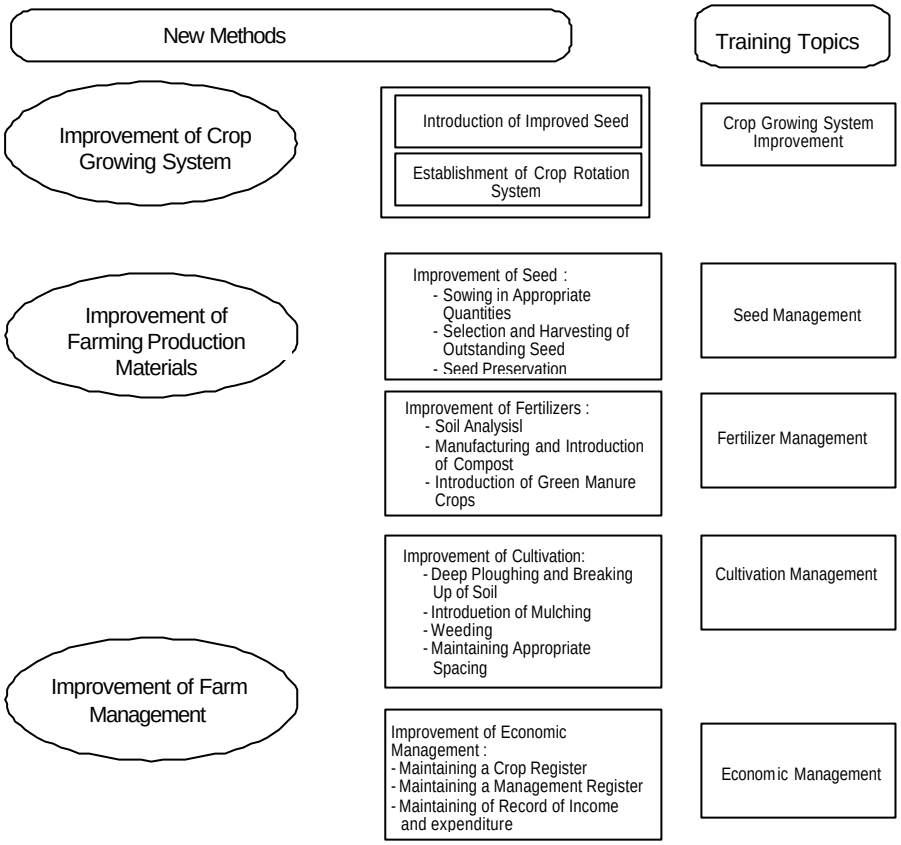
(3) Charcoal Production

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.

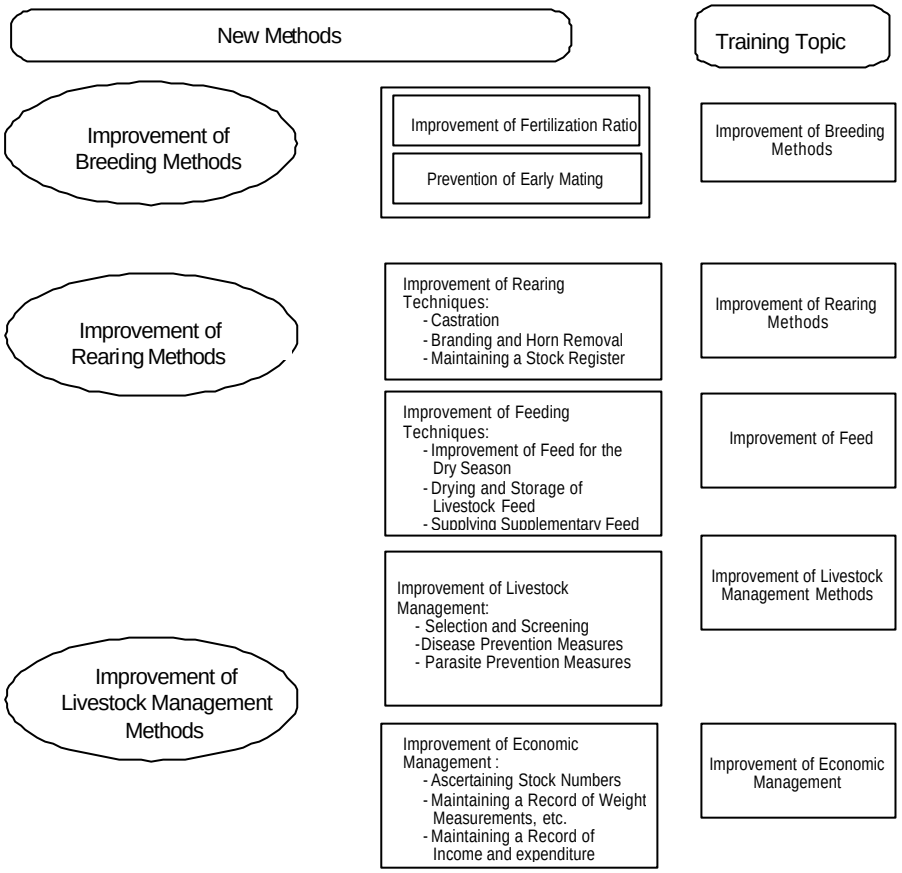
Details regarding new techniques and training topics for commercial farming improvement are as follows.



Training Topics for Commercial Farming Improvement

(5) Livestock Farming

Details regarding new techniques and training topics for the improvement of breeding techniques, rearing techniques and livestock management are as follows.



Livestock Farming Training Topics

11. Infrastructure Improvement Plan

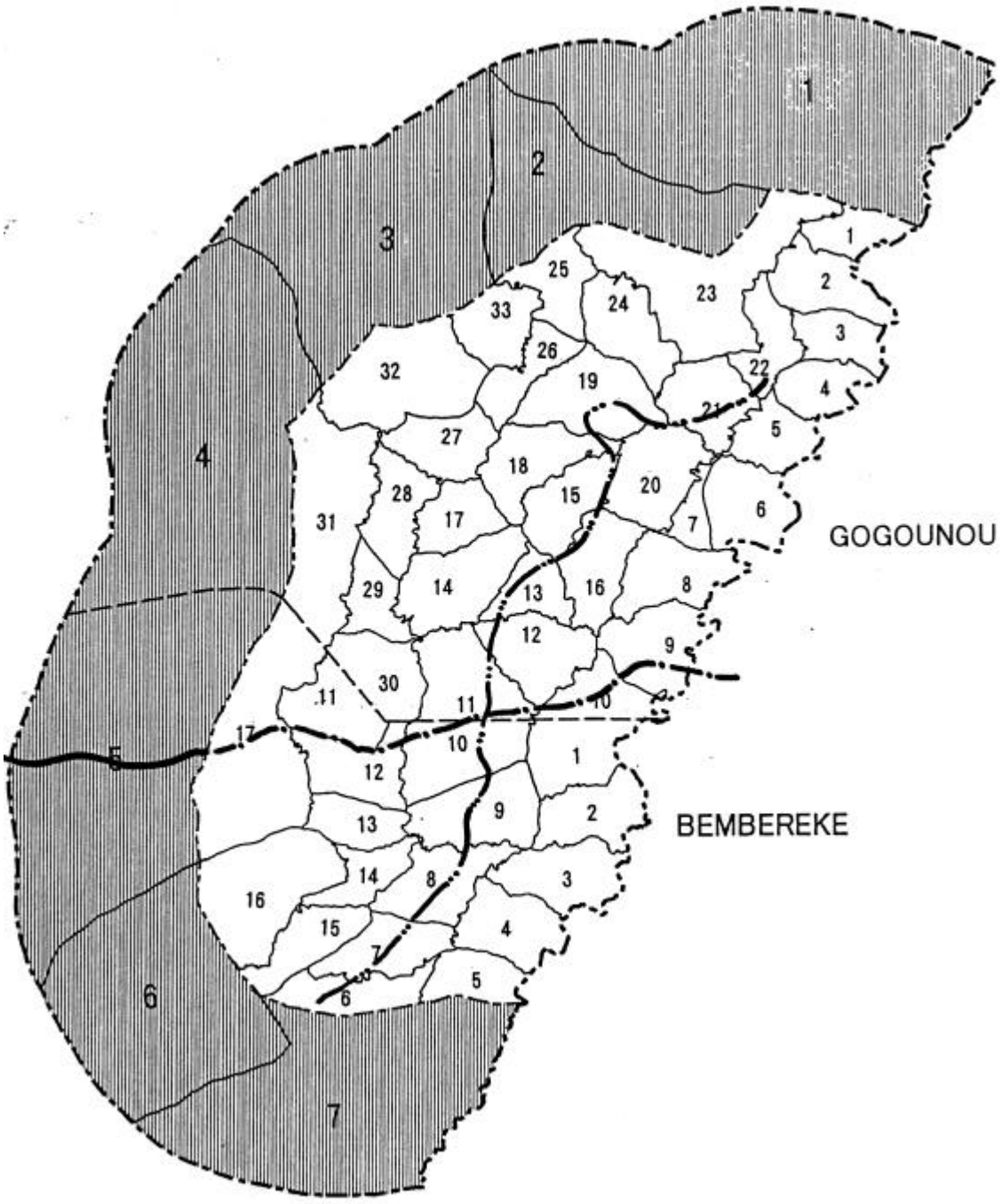
(1) Forest Roads

The access road to the classified forest is the road running from Beroubouay on State Highway 2 via Kabanou~Koussine and forest roads for the management of production forests within the classified forest and the management of Conservation Forest shall join this access road. A main forest road will be established from the access road to the Bouli River with other minor roads being established from the main forest road to production forests within each improvement unit. The length of the main forest road shall be 19.5km with the length of other minor roads in each improvement unit being as shown below. However, within Conservation Forest work roads will link up with the main forest road and other minor roads. The roads mentioned below are shown in the following map.

Zougou-Kpantrossi Improvement Unit	9.5km
Wessens Improvement Unit	5.5km
Pigourou Improvement Unit	7.4km
Kabanou Improvement Unit	5.1km
Mani-Boke Improvement Unit	7.9km

(2) Village Nursery

In order to produce seedlings in each improvement unit for planting in each zone of the classified forest, a nursery operated by the village shall be established in each village. Management, operation and maintenance of the nursery shall be carried out by the Forest Improvement Unit Committee, which is an organization comprised of local inhabitants. All seedlings produced shall be for commercial sale with income from such sales going into a Forest Improvement Fund. Seedling production scale by improvement unit is as shown below.



Scale: 1:250,000

Key	
1~7	Buffer Zone
1~33	Classified Forest
	District Boundary
	Access Road
	Main Forest road
	Spur roads

Forest Road Plan Map

Seedling production Volume

Unit: Seedling

Improvement Unit	Year								
	3	4	5	6	7	8	9	10	Total
ZOUGOU-KPANTROSSI	140,700	178,340	185,840	259,765	275,075	275,180	200,839	148,360	1,664,099
WESSENE	53,400	92,680	100,500	131,675	137,910	138,435	102,740	60,580	817,920
PIGOUROU	60,800	83,860	90,940	90,940	91,040	91,060	91,060	68,060	667,760
KABAKOU	128,300	169,360	177,540	193,490	196,680	196,680	180,830	136,660	1,379,540
MANI-BOKE	56,000	81,300	86,320	108,770	112,760	112,760	92,710	63,700	714,320
Total	439,200	605,540	641,140	784,640	813,465	814,115	668,179	477,360	5,243,639

(3) Forest Management Center

The main organization carrying out the implementation of Forest Improvement plans is the Forest Improvement Committee, which is organized by the local inhabitants. However, as there are restrictions on the use of the classified forest by local inhabitants it is necessary to bring some form of stability to the lives of local inhabitants through regional promotion. Furthermore, a survey of local inhabitants revealed that there is a high proportion of women involved in the use of the classified forest, making their participation in the management of the classified forest essential. Therefore, a Forest Management Center will be established for forest improvement and to improve the place of women in society. Training to be carried out at the Forest Improvement Center includes literacy education for women using the center, which have a poor rate of literacy, and training, etc., which will provide a diversified means of income.

12. Buffer Zone Management Plan

A buffer zone running for 7km encircles the classified forest within which Conservation Forest will be established as part of the management plan of the classified forest. Such Conservation Forest Areas will be handled in accordance with the management plans of the classified forest.

The area of the buffer zone is 9,276.64ha and consists of the forest cover type shown in the chart below.

Land Area by Improvement Unit, Land Use and Forest Type (Buffer Zone)

(Unit:ha)

Cate-gory	Forest Type Symbol	GOGONOU				BEMBEREKE			Total
		ZOUGOU-KPANTROSSI	WESSENE	PIGOROU	Subtotal	KABANOU	MANI-BOKE	Subtotal	
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
	Sub-total	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
	Sub-total	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

The buffer zone is a free zone which the local inhabitants are free to use for cultivation, livestock grazing, fruit harvesting, and other use. However, the felling or trimming, etc. of protected species of trees within the forest is prohibited.

Conservation Forest shall be established in the following areas within the buffer zone and shall be handled in the same way as Conservation Forest II within the classified forest. However, areas considered by the local inhabitants to be areas of sacred forest shall be handled in the same way as Conservation Forest I.

Areas to be designated as Conservation Forest are as follows.

- Areas within 25m of either side of waterways which shall be preserved to protect water resources and prevent soil and sand from being washed into the waterways.
- Forest on residual relief and tectonic relief.
- Forest in savannah and laterite terraces.
- Areas of forest where soil protection is required.
- Areas of forest preserved as sacred forest by villagers.

The location and scope of the above-mentioned Conservation Forest shall be clarified by the DFRN and recorded in the map register. As the productivity of the land in buffer zone has decreased as a result of continuous slash and burn type agriculture it has become fallow ground or is illegally cultivated within the classified forest.
If the improvement plan for the classified forest can be successfully formulated, cultivation will be limited to established farming carried out in limited space. Consequently, established farming will also increase within the buffer zone allowing the effective utilization of cultivated land and fallow land where productivity has decreased. The introduction of agroforestry within the buffer zone will be actively encouraged.

(1) Agroforestry in Areas of Cultivated Land and Fallow Land

① 2ha 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 2~5ha Cultivated Land

2ha is used to grow food crops while the remaining 1~3ha shall be planted in trees and agroforestry undertaken with forest products being harvested and cash crops being grown as intercrops. 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 (10m x 10m).
- *Vitellaria paradoxa*: Limited production of fruit from *Vitellaria paradoxa* can be carried out. The planting density of these trees is 200 trees/ha (5m x 10m).
- 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 5ha

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 (4m x 2m). 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) Bee-Keeping

As cultivated land and the area surrounding cultivated land is unsuitable for bee-keeping, 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 bee-keeping in grassland or areas of low shrubs, 12 beehives shall be positioned in each hectare.

(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.

KABANOU Improvement Plan

Forest Improvement Plan

Forest Improvement Plans are implementation plans for each improvement unit based on the Basic Plan for Forest Management for the Intensive Study Area.

Plans for each improvement unit were formulated with consideration being given to implementation efficiency and the location of areas to be used within each zone. Furthermore, as such improvement activities will be implemented individually, separate plans were prepared for each of the five units involved.

The five plans are as follows.

1. Zougou-Kpantrossi Improvement Plan
2. Wessene Improvement Plan
3. Pigourou Improvement Plan
4. Kabanou Improvement Plan
5. Mani-Boke Improvement Plan

Kabanou Improvement Plan

1. Forest Management Units

Details regarding the Kabanou improvement unit are as follows.

Classified Forest:	Tois Rivières Classified Forest
Province (Department):	Borgou (Note. Provinces are referred to as "Departments" in Benin.)
Forest Department:	Borgou Forest Department
Forest Branch Office:	Parakou Forest Branch Office
District Forest Office:	Bembereke District Forest Office

2. Location and Area

The Kabanou Improvement Unit consists of the central area of the Tois Rivières Classified Forest west of the Bouli River and the associated buffer zone. The area of the classified forest is 10,054ha while the area of the buffer zone is 9,222ha.

3. General Conditions

3.1 Natural Conditions

(1) Climate

The temperature and rainfall of the Kabanou Improvement Unit as measured by weather monitoring stations in the surrounding area are as follows.

In Kandi, the average temperature is 28.1°C, the minimum average temperature of 17.2°C occurs in January, and the maximum average temperature of 38.7°C occurs in April. Average annual rainfall is 949mm in Kandi, 1,147mm in Bembereke, 1,037mm in Segbana and 1,161mm in Kalale. The rainy season lasts from May to September while the dry season lasts from October to April. Semi-arid conditions are experienced at the beginning of both the wet and dry seasons during September/October and April/May.

Average Temperature and Rainfall

(Temperature: °C)

Monitoring Station	Month	1	2	3	4	5	6	7	8	9	10	11	12	Average
Kandi	Average (°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
	Maximum Average (°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
	Minimum Average (°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

Note: Figures shown are for the 1988~1997 period.

(Rainfall: mm)

Monitoring Station	1	2	3	4	5	6	7	8	9	10	11	12	Total
Kandi	0	11	30	51	110	138	186	237	143	34	1	7	949
Bembereke	1	0	17	58	117	186	212	273	203	71	8	1	1,147
Segbana	1	1	6	44	101	137	181	308	211	42	5	0	1,037
Kalale	0	17	28	58	125	159	210	225	241	58	30	10	1,161

Note: Figures shown for Kandi and Kalale are for the 1988~1997 period, while figures for Bembereke are for the 1986~1996 period and figures for Segbana are for the 1969~1990 period.

(2) Topography, Geology and Soil Type

The topography of the area consists of flat or gently rolling hills. There are also small plateaux with steep laterite slopes and small rises scattered about the area. The altitude of this area is in the 260m~340m range.

The geology of the area consists mainly of granite and gneiss with areas of sandstone and residual accumulated material. The soil consists mainly of Sols Ferrugineaux Tropicaux with gneiss, granite and sandstone being the parent material. Soil type distribution condition is included in Appendix-1 at the end of this volume together with information regarding how to handle such soils for forestry purposes.

(3) River System

The area is drained by the Bouli River, a tributary of the Sota River which is itself the main tributary of the Niger River, and its network of streams, etc.

(4) Vegetation

Forests consist mainly of scrub savannah, tree savannah and mixed savannah of shrub and trees with areas of riparian forest visible alongside waterways. There are also areas of *Tectona grandis* plantations, orchards, cultivated land and fallow land. Trees characteristic of the savannah include *Detarium microcarpun*, *Isoberlinia spp*, *Vitellaria paradoxa*, *Parkia biglobosa*, *Combretum spp*, etc. while trees characteristic of riparian forest areas alongside waterways include *Daniellia oliveri*, *Anogeissus leiocarpus*, *Khaya senegalensis*, *Vitex doniana* and *Diospyros mespiliformis*, etc.

3.2 Socioeconomic Conditions

(1) Population

The population of the villages belonging to the Kabanou Improvement Unit is as follows.

Population

Village	Population (Person)	Household Number (Household)	Population Size (Person/Household)
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
Total	1,431	149	9.6

(2) Farming Population

The farming population derived from figures obtained through the Pre Farming Census based on the farming population ratio and the farm worker ratio (the proportion of the farming population over the age of 15 and under the age of 60 that were farm workers) is as follows.

Farming Population

Village	Population (Person)	Farming Population		Farm Workers		Household Number (Household)	Population /Household (Person)	Farm Workers/Household (Person)
		Person	Ratio (%)	Person	Ratio (%)			
KABANOU	1,431	1,431	100.0	691	48.3	149	9.6	4.6

(3) Farm Size

① Farmland Area

The area of classified forest and farmland in buffer zone (cultivated land and fallow land) is, as obtained through photo interpretation and forest type maps, as follows.

Farmland Area (Unit:ha)

Category	Classified Forest	Buffer Zone	Total
Cultivated Land	1,363	3,297	4,660
Fallow Ground	335	438	773
Total	1,698	3,735	5,433

② Planted Area

The area within classified forest planted in cotton and other crops is as follows.

Planted Area (Unit:ha)

Cultivated Land	1,363	Ha
Planted Land (a) (planted ratio)	818	Ha(58%)
Cotton (b) (planted ratio)	355	Ha(23%)
Non-Cotton Crops (a-b)	463	Ha
Farming Households	149	Household
Planted Land/Household (apart from cotton)	3.11	Ha

(4) Livestock

The main forms of livestock include cattle, sheep and goats while poultry includes chickens and guinea fowl, most of which are raised in farmyards.

Livestock (Unit:Head)

Cows	Sheep	Goats	Total	Livestock Units*
1,250	720	680	2,650	1,530

* 5 sheep or goats are counted as 1 cow.

4. Forest Divisions

4.1 Forest Compartments

Divisions with the inherent characteristics necessary for the management and operation of classified forests were established on the basis of political boundaries, village boundaries, and roads, and rivers, etc. while buffer zones were established on the basis of political boundaries and roads. Each of the forest compartments are assigned a number corresponding to each management unit.

The forest compartments and divisions of the Kabanou Improvement unit are as follows. The area by forest covering of each forest compartment is shown in 6 zones. Area by forest type is shown in Appendix-2 at the end of this volume.

Land Area of Forest Compartments

Classified Forest				Buffer Zone	
compartment	Area (ha)	compartment	Area (ha)	compartment	Area (ha)
1	959.71	10	1,171.52	⑤	9,222.33
2	940.25	11	875.10		
3	1,050.27	12	933.51		
9	1,231.02	17	2,892.68		
Total			10,054.06	Total	9,222.33
Total					19,276.39

4.2 Sub-Compartments

In order to clarify present types of land use and the state of forests, and differences in forest management, forest compartment were divided up into smaller sub-compartments. These designated sub-compartments were those designated at the time that the Improvement Plan was formulated. Therefore, based on the results of each year's operations, such sub-compartments are divided up and assigned a sub-compartment number. (Refer to the Plan Register)

5. Improvement Aims

The main aim of Improvement Plans is the rapid restoration of the classified forests as state forest and their conservation. As the implementation of these plans is considered difficult without the cooperation of the local inhabitants, by permitting them to use areas within the classified forest, the preservation of the forest will be carried out by the people themselves. The improvement aims for the classified forest are as follows.

- The improvement of the forest through the implementation of measures for public benefit, including the development of the water resources of the forest, the conservation of national land, the protection of wildlife, and the preservation of genetic resources, etc.
- The fostering of a production forest in order to enrich and utilize sustainable forest resources.
- The establishment of an area within the classified forest for use by local inhabitants in order to conserve the forest through coexistence with the people.

6. Zoning

The area will be divided into three zones: the Forestry Zone, the Silvi-pastoral Zone, and the Village Forestry Zone.

6.1 Forestry Zone

The forestry zone consists of the Conservation Forest Zone, which is areas of classified forest that should be protected and conserved, and the Production Forest Zone which is for timber production.

(1) Conservation Forest Zone

The Conservation Forest Zone, which is designed to develop water resources and preserve forestry areas, runs from the Bouli River on the eastern border of the Intensive Study Area for a distance of 3.5km, within which are Conservation Forest I and II.

① Conservation Forest I

- This forest runs from the Bouli River for a distance of 500m and is specially for the fostering of water resources.
- It is a pure forest consisting of *Anogeissus leiocarpus*.
- It is located on residual relief and tectonic relief.
- Soil conditions are bad and existing vegetation should be retained.

② Conservation Forest II

This area consists of the remaining area within the Conservation Forest Zone that is not part of Conservation Forest I.

(2) Production Forest Zone

With the exception of the Conservation Forest within the Forestry Zone, this is the area in which the production of timber and fuelwood and charcoal, etc. is carried out. However, the following areas within the production forest shall be part of 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.

6.2 Silvi-pastoral Zone

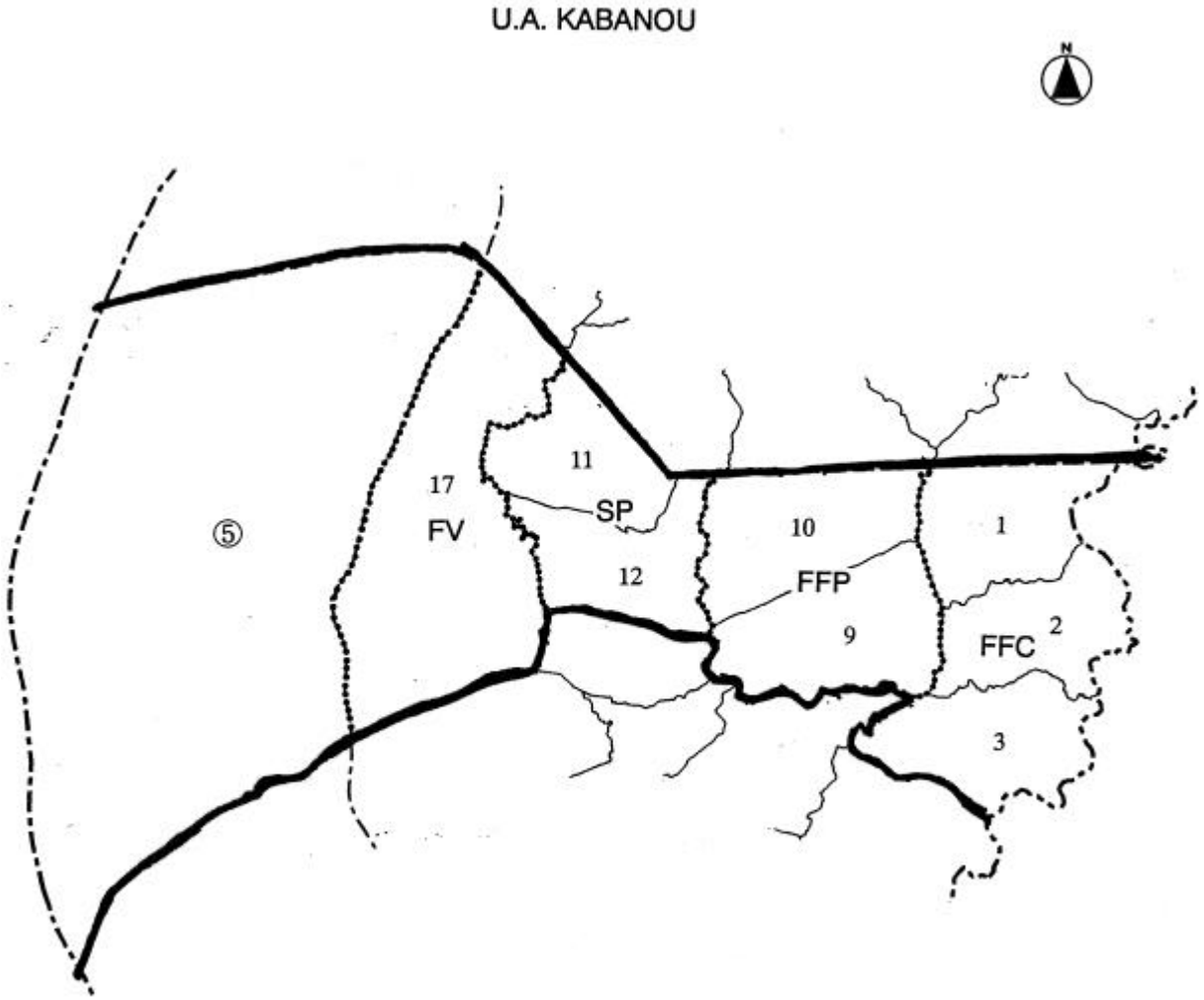
Located between the Forestry Zone and the Village Forestry Zone, this zone is an area in which grazing is carried out. Serving as a buffer zone, areas of forest within 50m either side of waterways shall be part of Conservation Forest II.

6.3 Village Forestry Zone

This is the zone 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 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.

The land area by forest compartment and forest type in each zone is as shown below.



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Legend	
②	Buffer Zone Compartment No.
2	Classified Forest Compartment No.
▬▬	Improvement Unit Boundary
- - - -	Zone Boundary
FFC	Conservation Forest Zone
FFP	Production Forest Zone
SP	Silvi-Pastoral Zone
FV	Village Forestry Zone

Zoning Map

Land Area by Forest Compartment and Forest Type (KABANOU)

(Unit:ha)

Zone	Compart-ment	Forest						Non-Forest				Total
		Gf	Fc	Sa	Sb	St	Total	Ch	Ja	Total	Autres	
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	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

7. Forest Land Use Classification

In order to implement forest improvement activities, forest land use classes shall be established according to proposed use based on improvement standards for basic plans for the forest within each zone and in order to formulate operating plans in accordance with forest land use classification. The types of forest classified under the forest land use classification shall be included in plans as follows.

7.1 Forest Zone

(1) Conservation Forest Zone

Conservation Forest I	Areas of forest within 500m of the western bank of the Buri River that should be protected for the purpose of fostering water resources.
Conservation Forest II	Areas of forest within 3,500m of the western bank of the Bouli River (with the exception of Conservation Forest I) that should be maintained for the purpose of fostering water resources and conserving forest land.

(2) Production Forest Zone

Timber Forest	Forest for the production of ordinary timber.
Fuelwood Forest	Forest for the production of fuelwood (wood and charcoal for fuel).
Conservation Forest II	Forest that should be maintained due to location alongside waterways and on account of poor soil condition.
Left-over Area	Non-forest areas designated as other land.

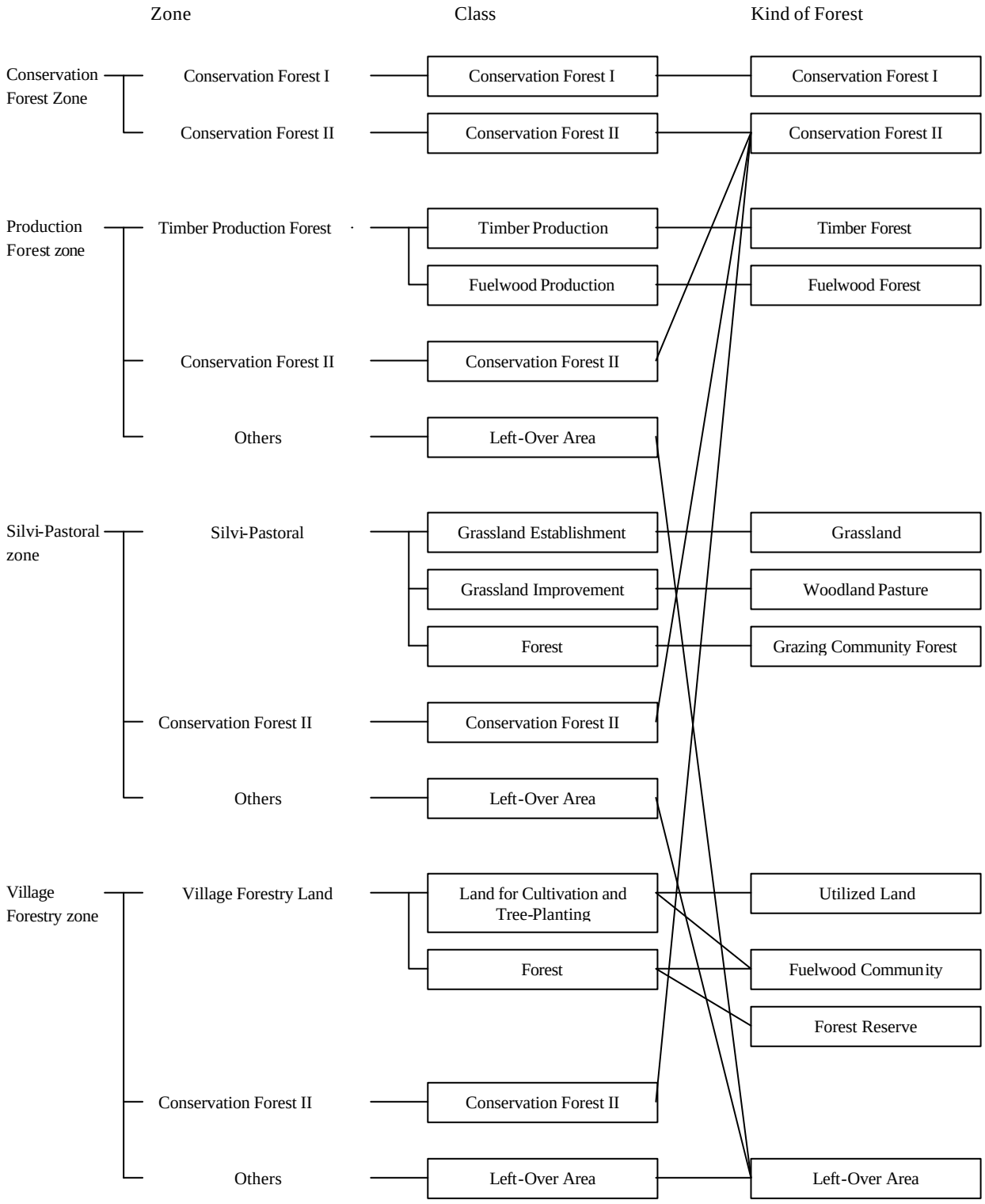
7.2 Silvi-pastoral Zone

Grassland	Artificially created grassland.
Woodland Pasture	Forest improved by increasing the amount of grass that can be eaten by livestock within the forest.
Grazing Community Forest	Forest to be left in its present state other than Grassland and Woodland Pasture.
Conservation Forest II	Forest that should be maintained due to location alongside waterways and on account of poor soil condition.
Left-over Area	Non-forest areas designated as other land.

7.3 Village Forestry Zone

Utilized Land	Land used by people for cultivation, tree planting and roads.
Fuelwood Forest	Areas of forest used as fuelwood forest within cultivated land or fallow land located within forests or Forest Reserve.
Forest Reserve	Forest other than Utilized Land, Fuelwood Forest and Conservation Forest II. Forest that should be set aside for future use as Utilized Land, livestock trails, and boundaries, etc.
Conservation Forest II	Forest that should be maintained due to its location alongside waterways or due to poor soil conditions, etc.
Left-over Area	Non-forest areas designated as other land.

Forest Land Use classes and kind of forest can be summarized as follows.


Zone
Class
Kind of Forest
Conservation Forest Zone
Conservation Forest I
Conservation Forest II
Production Forest zone
Timber Production Forest
Conservation Forest II
Others
Silvi-Pastoral zone
Silvi-Pastoral
Conservation Forest II
Others
Village Forestry zone
Village Forestry Land
Conservation Forest II
Others
Conservation Forest I
Conservation Forest II
Timber Production
Fuelwood Production
Conservation Forest II
Left-Over Area
Grassland Establishment
Grassland Improvement
Forest
Conservation Forest II
Left-Over Area
Land for Cultivation and Tree-Planting
Forest
Conservation Forest II
Left-Over Area
Conservation Forest I
Conservation Forest II
Timber Forest
Fuelwood Forest
Grassland
Woodland Pasture
Grazing Community Forest
Utilized Land
Fuelwood Community
Forest Reserve
Left-Over Area

8. Operation Standards

Improvement methods and operation (management) methods by kind of forest are as follows.

Operation(Management)Standards (1)

Kind of Forest	Existing Forest Type	Improvement Methods	Operation Methods
Conservation Forest I	Gf, Fc, Sa, Sb, and St with a crown density of more than 50%	• Maintenance of existing areas of forest vegetation.	• These areas are not to be subject to management. • Felling of trees is prohibited and the removal of branches and leaves is also prohibited. • Controlled burning is totally prohibited. • Grazing and the passage of livestock is prohibited.
	Gf, Fc, Sa, Sb, and St with a crown density of up to 50%	• Enrichment through planting (mixed planting) of native species. Trees: *Khaya senegalensis, Pterocarpus erinaceus, Isoberlinia spp., Vitellaria paradoxa,* and *Parkia biglobosa.* Spacing: 10m x 10m (100 trees/ha) Supplementary Planting: Carried out after one year if no more than 80% of trees survive. Brush Cutting: Carried out evenly around planted trees once a year one year after planting.	
	Ch, Ja	• New mixed planting of native species. Trees: *Khaya senegalensis, Pterocarpus erinaceus, Isoberlinia spp., Vitellaria paradoxa,* and *Parkia biglobosa.* Spacing: 4m x 4m (625 trees/ha) Supplementary Planting: Carried out after one year if no more than 80% of trees survive. Brush Cutting: Carried out evenly around planted trees twice a year 2~3 years after planting.	
Conservation Forest II	Gf, Fc, Sa, Sb, and St with a crown density of more than 50%	• Maintenance of existing areas of forest vegetation.	• These areas are not to be subject to management. • Although thinning, pruning and sanitation cutting is permissible, the felling of trees and the removal of branches and leaves apart from such thinning, pruning and sanitation cutting is prohibited. • Controlled burning is totally prohibited. • Grazing and the passage of livestock is prohibited. (However, this shall exclude access by livestock to water holes in the Silvi-pastoral Zone)
	Gf, Fc, Sa, Sb, and St with a crown density of up to 50%	• Enrichment through planting (mixed planting) of native species. Trees: *Khaya senegalensis, Pterocarpus erinaceus, Isoberlinia spp., Vitellaria paradoxa, Parkia biglobosa* and *Milicia excelsa.* Spacing: 10m x 10m (100 trees/ha) Supplementary Planting: Carried out after one year if no more than 80% of trees survive. Brush Cutting: Carried out evenly around planted trees once a year one year after planting.	

Operation(Management) Standards (2)

Kind of Forest	Existing Forest Type	Improvement Methods	Operation Methods
Conservation Forest II	Ch, Ja	• New mixed planting of native species (including group planting). Trees: *Khaya senegalensis, Pterocarpus erinaceus, Isoberlinia spp., Vitellaria paradoxa, Parkia biglobosa, and Milicia excelsa.* Spacing: 4m x 4m (625 trees/ha) Supplementary Planting: Carried out after one year if no more than 80% of trees survive. Brush Cutting: Carried out evenly around planted trees twice a year 2~3 years after planting.	
Timber Forest	Gf, Fc, Sa, Sb	• Fostering of the timber forest through sowing seedlings, direct sow ing of seeds and natural seeding of native species. Trees: *Khaya senegalensis, Pterocarpus erinaceus, Isoberlinia spp., Afzelia africana, Prosopis africana, and Milicia excelsa.* • Spacing: One of the following will be adopted by taking into account crow n density of each forest,5m x 5m (400 trees/ha), 6m x 6m (276 trees/ha), 8m x 8m (156 trees/ha), 10m x 10m (100 trees/ha). Other: When planting, existing material of a usable size may be cut down and used.	• Selective logging shall be carried out. Cutting Cycle: 20 years Selective Logging Ratio: 33% of trees with a diameter at breast height (DBH) of no less than 35cm (girth at breast height of no less than 100cm). Age at Maturity: 30 years • Regeneration: Natural seeding. Direct sowing of seed and planting of seedlings will also be carried out as necessary. • Burning is totally prohibited. • Grazing and the passage of livestock is prohibited.
	Ch, Ja	• Planting of native species and direct sowing of seeds. Trees: *Khaya senegalensis, Pterocarpus erinaceus, Isoberlinia spp., Afzelia africana, Prosopic africana, and Milicia excelsa.* Spacing: 4m x 4m (625 trees/ha). Mixed line planting of various species of trees. Supplementary Planting: Carried out after one year if no more than 80% of trees survive. Brush Cutting: Carried out evenly around planted trees twice a year 2~3 years after planting. Other: Land being cultivated may continue to be cultivated until after crops have been harvested at which time the timber production forest will be created.	

Operation(Management) Standards (3)

Kind of Forest	Existing Forest Type	Improvement Methods	Operation Methods
Fuelwood Forest	Sa, Sb, St	• Planting of native species and direct sowing of seed. *Trees: Detarium microcarpum, Isoberlinia spp., Terminalia avinnoides,Combretum spp., Crossopteryx febrifuga*, and *Piliostigma thonningii.* Other: Felling and harvesting of material with a diameter larger than the specified usable diameter within the existing forest may be carried out the year before planting of seedlings or direct sowing of seed is carried out. Material that is able to germinate should be left to germinate. Additional planting and direct sowing of seed shall be carried out depending on how well seeds etc. take root and the growth of seedlings.	• The area shall be used as a fuelwood forest with trees of not less than 7cm DBH (no less than 20cm GBH) being felled. Cutting Cycle: 7 years Regeneration: Germination and direct sowing of seeds. • Controlled burning shall be totally prohibited. • Grazing and the passage of livestock shall be prohibited.
	Ch, Ja	• Planting of exotic species, planting using cutting and direct sowing of seed. Trees: *Tectona grandis, Acacia auriculiformis, Gmelina arborea*, and *Cassia siamea*. Spacing: 2m x 2m (2,500 trees/ha), 2m x 2.5m (2,000 trees/ha) Brush Cutting: Brush cutting shall be carried out depending on the state of the grass beneath. Other: Existing standing trees (including withered and damaged trees) and shrubs shall be felled and removed for use. Land being cultivated may continue to be cultivated until after crops have been harvested at which time the fuelwood production forest will be created.	• The area shall be clear cut. However, the size of the area to be clear cut shall be reduced. Cutting Cycle: 7 years Regeneration: Germination, planting using cutting and direct sowing of seeds. • Controlled burning shall be totally prohibited. • Grazing and the passage of livestock shall be prohibited.
Grassland	Sa, Sb, St	• The felling of standing trees (for sale as timber and fuel) and the removal of shrubs (for local fuel use) shall be carried out, after which the land will be ploughed and pasture sown or planted. • Feed trees, trees for fuel and trees which provide a source of nectar for bees shall be planted around this area as a surrounding fence and to form divisions within it.	• This area is designated as a grazing area for rotational grazing. • Pasture shall be harvested and used for livestock feed during the dry season. • Although the area shall be burnt off once every three years, as it is a grazing area this shall be carried out in a planned manner in accordance with grazing plans. A firebreak shall be established around all areas where controlled burning is to be carried out. • Grass other than pasture shall be removed and shrubs cleared and removed. • The leaves of feed trees shall be used to increase the volume of pasture feed and branches shall be used as fuelwood.
	Ch, Ja	• Standing trees and shrubs shall be removed (for use as fuel in local areas) and after ploughing pasture shall be sown or planted. • Feed trees, trees for fuel and trees which provide a source of nectar for bees shall be planted around this area as a surrounding fence and to form divisions within it.	
	Ag	• After ploughing pasture shall be sown or planted. • As the total area involved is relatively small, this shall be concentrated in Sa, Sb, St and Ch and Ja grasslands.	

Operation(Management) Standards (4)

Kind of Forest	Existing Forest Type	Improvement Methods	Operation Methods
Woodland Pasture	Sa, Sb, St	• Trees of larger diameter shall be felled and used (with the exception of *Vitellaria paradoxa*) and crown density reduced to no more than 10%. Shrubs shall be completely removed. • Feed trees shall be planted in rows and overall crown density reduced to approximately 20%. • In order to increase the volume of natural *Gramineae* grasses for livestock feed, weeds other than *Gramineae* will be removed and pasture seeds sown.	• Areas where controlled burning is to be carried out shall be established and such burning carried out at an early stage. Firebreaks shall be established around such areas to prevent fire from spreading to other areas. • Weeds not eaten by livestock shall be removed and seeds sown in areas with low grass density. • Management of crown density shall be carried out and shrubs shall be removed. • The leaves of feed trees shall be used to increase the volume of livestock feed and branches shall be used for fuel. • Dams shall be constructed in waterways in order to provide water for livestock during the dry season.
	Ch, Ja	• Shrubs shall be removed. • With the exception of *Gramineae* grasses eaten by livestock, all other grasses shall be removed. • Pasture seeds shall be sown. • Feed trees shall be planted in rows and overall crown density reduced to approximately 20%.	
	Ag	• After ploughing, pasture shall be sown and feed trees planted. • As the total area involved is relatively small, this shall be concentrated in Sa, Sb, St and Ch and Ja woodland pasture.	
Grazing community Forest	Gf, Fc	• The existing forest shall be left in its present state and no special improvement of grassland shall be carried out.	• This area shall be used as Grazing community Forest. • Although intensive management of this area shall not be carried out, timber production of Fc shall be carried out in accordance with timber forest management.
	Ag	• In order to allow the forest to recover, direct planting of native species shall be carried out after ploughing. After that, the area shall be included in Gf and Fc Grazing community Forest.	

Operation(Management) Standards (5)

Kind of Forest	Existing Forest Type	Improvement Methods	Operation Methods
Utilized Land	Fc, Sa, Sb	• Users shall be permitted to use up to 4.0ha per household (2.0ha for cultivation and 2.0ha for tree-planting). • On land for cultivation, standing trees shall be felled (including withered and damaged trees) and sold as timber and fuelwood, and shrubs shall be removed to be used locally for fuel. After this has been carried out, the area shall be used for normal commercial farming activities. • On land for tree-planting, in order to make room for the planting of fruit trees, trees for fuel and posts, standing trees (including withered and damaged trees) shall be felled and sold as timber and fuelwood, and shrubs removed for use by the users. After this has been carried out, fruit trees and trees for fuel and posts shall be planted. Fruit Trees: *Anacardium occidentale*. Trees for Fuel and Posts: *Tectona grandis*, *Gmelina arborea*, and *Cassia siamea*. Spacing: Fruit trees 10m x 10m (100 trees/ha); Trees for Fuel and Posts 2m x 2m (2,500 trees/ha). However, when planting over a 1-2 year period, trees should be planted at 1.5m x 3m (2,222 trees/ha) or 1.5m x 4m (1,666 trees/ha). • A firebreak shall be established on the boundary between utilized land (land for cultivation and tree-planting) and other zones to mark the boundary and to prevent fire spreading to other areas. Trees such as *Khaya senegalensis, Acacia auricuriformis, Pterocarpus erinaceus* and *Parkia biglobosa*, etc., which are a source of nectar for bee-keeping, should be used.	• As a rule, users shall be those entities possessing cultivated land within presently classified forests (based on aerial photographs taken in 1998). • Controlled burning shall be prohibited. • Grazing and the passage of livestock shall be prohibited. • Cotton growing shall be prohibited. • Commercial farming shall be improved in order to establish farming. • *Vitellaria paradoxa* shall be regenerated in areas surrounding cultivated land and shall be replanted in present areas of cultivated land. • The cutting cycle shall be set at 5 years for trees for fuel and posts with 1/5 of the planted area being logged and replanted every year. • When the area is logged it shall be completely cleared and when it is replanted it shall be planted in both seeds and seedlings. • Bud pruning of *Tectona grandis* is also required. • In tree-planting areas, it is possible to carry out agroforestry (Taungya) 1~2 years after new planting and replanting.
	Ch, Ja	• With regard to cultivated land, Ch will be left as it is and normal commercial farming shall be carried out while standing trees and shrubs shall be felled and removed and the area turned into cultivated land. • Land for tree-planting shall be prepared for planting with fruit trees and trees for fuel and posts, with wood sold as fuelwood or used by the users. • Fruit trees and trees for fuel and posts shall be planted in the same way as for Fc, Sa and Sb. • Firebreaks shall be established on the boundary between this zone and other zones in the same way as for Fc, Sa and Sb.	

Operation(Management) Standards (6)

Kind of Forest	Existing Forest Type	Improvement Methods	Operation Methods
Forest for Fuelwood Community	Ch, Ja	• Fuelwood forest for village community shall be created in areas of Ch and Ja other than Utilized Land as a source of income for the village. • Fuelwood forest shall be created in accordance with creation techniques for tree-planting areas within Utilized Land. * Areas of Fc, Sa, Sb, Ch and Ja remaining after land has been distributed to the people of the area shall be designated as Fuelwood Community Forest within Utilized Land.	• Management techniques for this area shall be in accordance with those of tree-planting areas within areas of Utilized Land. • Controlled burning shall be prohibited. • Grazing and the passage of livestock shall be prohibited.
Forest Reserve	Gf, Fc, Sa, Sb, St, Ag	• Vegetation in Utilized Land, Fuelwood Community Forest and forest apart from Left-over Area within the Village Forestry Zone shall be left in its present condition. • Forest Reserve shall also include forest that can be transferred into Utilized Land in the future. • Vegetation in areas of Gf, Sb and St shall be left in its present condition and shall be used for the passage of livestock to the Silvi-pastoral Zone from areas of classified forest. • Areas of Ag in forests shall be restored with native species.	• Forest operations shall not be implemented for areas of existing forest. • Controlled burning shall be prohibited. • Although grazing in this area shall be prohibited, grazing and the passage of livestock shall be permitted in remaining areas of the forest.
Left-Over Area	Other (Tm, Td, Cl, Ar, Ce, Pe)	• This area shall be left in its present condition.	• Grazing shall be prohibited in the Conservation Forest Zone, Production Forest Zone, and Village Forestry Zone. • Silvi-pastoral Zones shall be managed in the same way as Grazing Community Forest. •

9. Improvement Plans

9.1 Plan Duration

A sustainable forest management was aimed for when deciding plan period for classified forests. The duration required for the implementation of forestry operations to achieve the said sustainable forest management was set as the plan period for this plan.

The time required for forestry operations to be realized for each zone will differ from zone to zone.If the age at maturity for the timber forest is set at 40-60 years there will be 3 cutting cycles or 60 years.Trees in fuelwood forests take 7 years to mature and one year for regeneration, making the duration of the improvement plan a total of 8 years. It takes 3 years to fatten cows in silvi-pastoral zones, 5 years to establish a regular farming cycle in cultivated land, and it takes 5 years for trees for fuel and posts to reach maturity. In timber forests, as the time required to reach maturity is relatively long, the plan period shall be set at 10 years, targeting the fuelwood forest (the above-mentioned 8 years plus 2 years for preparation).

9.2 Management Plans

Management of each type of forest shall be carried out in accordance with the improvement methods and operation methods outlined in 8. Operation Standards. The areas of existing forest type in each zone by improvement method for each Kind of forest are as follows.

Area of Improvement Methods by Forest Type (Kabanou)

Conservation Forest Zone

(Unit:ha)

Classification		Forest Type and Area								Total
		Gf	Fc	Sa	Sb	St	Ch	Ja	Other	
		151.1		1,559.38	896.01	234.79	50.27	4.30	54.38	2,950.23
Conservation Forest I	Planting									
	Enrichment			322.61	237.447	14.76				574.84
	Original State	75.01		128.31	13.12					216.44
Conservation Forest II	Planting						50.27	4.30		54.57
	Enrichment			420.32	603.38	220.03				1,243.73
	Original State	76.09		688.14	42.04					806.27
Left-over Area									54.38	54.38

Production Forest Zone

(Unit:ha)

Classification		Forest Type and Area								Total
		Gf	Fc	Sa	Sb	St	Ch	Ja	Other	
		86.14		633.74	926.38	270.88	411.76	10.87	62.77	2,402.54
Conservation Forest II	Planting						3.03	1.84		4.87
	Enrichment	21.84		33.87	89.03	32.20				176.94
	Present State	58.02		10.72	6.45					75.19
Timber Forest	Planting						3.67	2.34		6.01
	Felling/ Replanting	6.28		584.45	327.85	19.58				938.16
Fuelwood Forest	Planting						405.06	6.69		411.75
	Felling/ Regeneration			4.70	503.05	219.10				726.85
Left-over Area									62.77	62.77

Silvi-pastoral Zone

(Unit:ha)

Classification		Forest Type and Area								Total
		Gf	Fc	Sa	Sb	St	Ch	Ja	Other	
		221.85	7.71	256.01	813.26	214.45	97.16	160.31	37.86	1,808.61
Conservation Forest II	Planting						4.94	4.38		9.32
	Enrichment	22.68		44.92	116.05	45.05				228.7
	Present State	199.17			17.77					216.94
Grassland				60.44	94.30	18.41	88.47	142.00	12.85	416.47
Woodland Pasture				150.65	585.14	150.99	3.75	13.93	2.68	907.14
Grazing Community Forest			7.71							7.71
Left-over Area									22.33	22.33

Village Forestry Zone (Unit:ha)

Classification		Forest Type and Area								Total
		Gf	Fc	Sa	Sb	St	Ch	Ja	Other	
		248.72	45.81	88.77	1,031.38	490.27	803.96	159.02	24.75	2,892.68
Conservation Forest II	Planting						19.43	2.55		21.98
	Enrichment	23.89			109.44	14.23				147.56
	Present State	157.97	6.40							164.37
Utilized Land			2.07	29.09	342.47		651.58	122.30		1,147.51
Fuelwood Community Forest							132.95	34.17		167.12
Forest Reserve		66.86	37.34	59.68	579.47	476.04			7.33	1,226.72
Left-over Area									17.42	17.42

(1) Conservation Forest I

Conservation Forest I has an area of 791.28ha of which 216.44ha is in original forest, 0ha is newly planted combined with 574.84ha undergoing enrichment for forest recovery, giving a total of 574.84ha.

① Annual Work Volume

The period has already been determined as 10 years. Planting, supplementary planting and brush cutting are actually carried out over a period of 7 years. The annual work volume is as follows.

Annual Work Volume (Unit: ha)

Activity	Area (ha)	Year							
		1-3	4	5	6	7	8	9	10
Planting	0	Preparation Period	*1	*1	-	-	-	-	-
Enrichment	574		95	95	96	96	96	96	-
Supplementary Planting	574		-	95	95	96	96	96	96
Brush Cutting	574		95	95	96	96	96	96	-
Total	1,722		190	285	287	288	288	288	96

*1 Planting is carried out along the boundaries of the classified forest to clarify boundaries.

② Implementation Methods

- Both planning and implementation are carried out directly by the DFRN.
- Local inhabitants are employed as workers and are paid wages.
- Necessary nursery stock is purchased from private nurseries by the DFRN.

③ Nursery Stock

The required quantity of nursery stock for new planting, enrichment and supplementary planting in Conservation Forest I is as follows.

Required Nursery Stock Volume (Unit: ha)

Category		Year							
		1-3	4	5	6	7	8	9	10
New Planting	Planting	Preparation Period	-	-	-	-	-	-	-
	Supplementary Planting		-	-	-	-	-	-	-
	Sub-Total		-	-	-	-	-	-	-
Enrichment	Planting		9,500	9,500	9,600	9,600	9,600	9,600	-
	Supplementary Planting		-	1,900	1,900	1,920	1,920	1,920	1,920
	Sub-Total		9,500	11,400	11,500	11,520	11,520	11,520	1,920
Total			8,900	9,500	11,400	11,500	11,520	11,520	1,920

④ Tree Type and Planting Density,etc.

Tree types and planting density are as follows.

(a) Tree Type (The same tree types are used for both new planting and enrichment.)

Khaya senegalensis, Ptetocarpus erinaceus, Isoberlinia supp., Vitellaria paradoxa, and Parkia biglobosa.

(b) Planting Density

Planting density for areas of new planting is 625 trees/ha (4m x 4m) while for areas of enrichment it is 100 trees/ha (10m x 10m).

(c) Supplementary Planting (The same tree types are used for both new planting and enrichment.)

The supplementary planting ratio is 20%.

(2) Conservation Forest II

Although Conservation Forest II is found in every zone, as according to management standards the way these zones are handled is the same, the total area of Conservation Forest II is 3,150.44ha. Forest in its present state is 1,262.77ha while the total area for forest recovery includes 90.74ha for new planting and 1,796.93ha for enrichment, making a total of 1,887.67ha.

Land Area of Conservation Forest II (KABANOU) (Unit: ha)

Operation Methods	Zone	Forest Type						Total
		Gf	Sa	Sb	St	Ch	Ja	
New Planting	Conservation Forest					50.27	4.30	54.57
	Production Forest					3.03	1.84	4.87
	Silvi-pastoral Forest					4.94	4.38	9.32
	Village Forestry					19.43	2.55	21.98
	Sub-Total					77.67	13.07	90.74
Enrichment	Conservation Forest		420.32	603.38	220.03			1,243.73
	Production Forest	21.84	33.87	89.03	32.20			176.94
	Silvi-pastoral Forest	22.68	44.92	116.05	45.05			228.70
	Village Forestry	23.89		109.44	14.23			147.56
	Sub-Total	68.41	499.11	917.9	311.51			1,796.93
Existing Forest	Conservation Forest	76.09	688.14	42.04				806.27
	Production Forest	58.02	10.72	6.45				75.19
	Silvi-pastoral Forest	199.17		17.77				216.94
	Village Forestry	157.97	Fc 6.40					164.37
	Sub-Total	491.25	705.26	66.26				1,262.77
Total		559.66	1,204.37	984.16	311.51	77.67	13.07	3,150.44

① Annual Work Volume

The period has already been determined as 10 years. Planting, supplementary planting and brush cutting are actually carried out over a period of 7 years. The annual work volume is as follows.

Annual Work Volume (Unit: ha)

Activity	Area (ha)	Year							
		1-3	4	5	6	7	8	9	10
Planting	90	Preparation Period	*1	*1	30	30	30	-	-
Enrichment	1,797		314	314	285	285	285	314	-
Supplementary Planting	1,887		-	314	314	315	315	315	314
Brush Cutting	2,067		314	314	315	345	375	374	30
Tending	1,887		-	-	-	-	-	-	1,887
Total	7,728		628	942	944	975	1,005	1,003	2,231

*1 Planting is carried out along the boundaries of the classified forest to clarify boundaries.

② Implementation Methods

- Both planning and implementation shall be carried out directly by the DFRN.
- Local inhabitants shall be employed as workers and are paid wages.
- Necessary nursery stock shall be purchased from private nurseries by the DFRN.

③ Nursery Stock

The required quantity of nursery stock for new planting, enrichment and supplementary planting in Conservation Forest II shall be as follows.

Required Nursery Stock Quantity (Unit: ha)

Category		Year							
		1-3	4	5	6	7	8	9	10
New Planting	Planting	Preparation Period	-	-	18,750	18,750	18,750	-	-
	Supplementary Planting		-	-	-	3,750	3,750	3,750	-
	Sub-Total		-	-	18,750	22,500	22,500	3,750	-
Enrichment	Planting		31,400	31,400	28,500	28,500	28,500	31,400	-
	Supplementary Planting		-	6,280	6,280	5,700	5,700	5,700	6,280
	Sub-Total		31,400	37,680	34,780	34,200	34,200	37,100	6,280
Total			31,400	37,680	53,530	56,700	56,700	40,850	6,280

④ Tree Type and Planting Density, etc.

Tree types and planting density are as follows.

(a) Tree Type (The same tree types are used for both new planting and enrichment.)

Khaya senegalensis, Ptetocarpus erinaceus, Isoberlinia supp., Vitellaria paradoxa, Parkia biglobosa and Milicia excelsa.

(b) Planting Density

Planting density for areas of new planting is 625 trees/ha (4m x 4m) while for areas of enrichment it is 100 trees/ha (10m x 10m).

(c) Supplementary Planting (The same tree types are used for both new planting and enrichment.)

The supplementary planting ratio is 20%.

(d) Tending

Clear-felling is carried out every 10 years.

(3) Timber Forest

The total area of timber forest is 944.17ha and felling is carried for timber production. Generally, systematic selective logging activities are carried out in order to achieve sustainable logging. This requires the existence of a forest with a certain structure. However, according to the results of forest survey, production forests are at present of low quality, making it impossible to carry out selective logging Therefore, logging will be carried out for a certain period of time in order to improve forest content through enrichment activities.

Gf accounts for 6.28ha, Sa for 584.45ha, Sb for 327.85ha, St for 19.58ha, Ch for 3.67ha and Ja for 2.34ha of the forest type.

① Annual Work Volume

The annual work area is determined in the following way based on maturity, cutting cycle and selective logging ratio.

- Maturity: Although different species of trees reach maturity at different times, *Khaya senegalensis*, *Afzelia africana*, and *Milicia excalsa* reach maturity in 30 years.
- Cutting Cycle: 20 years.
- Selective Logging Ratio: 33% (1/3).

Selective logging of 47ha (47.21ha) or 1/20 of the 944.17ha total area of the timber forest shall be carried out annually with this being referred to as the selected logging area. 20 areas shall be established within the timber forest and given the numbers 1 to 20. The size of some of these sub-compartment may be smaller than 47ha.

② Logging/Regeneration

- As the Sa, Sb and St forest type are presently in bad condition at the first cutting cycle, enrichment shall be carried out and in Ch and Ja forest types native tree species shall be planted with a view to transforming them into selective logging forests. When felling trees in this area, the above-mentioned 33% shall not apply but rather standing trees (including withered and damaged trees) with a DBH of no less than 35cm (with a GBH of no less than 110cm).
- From the 3rd year, the volume of timber from cutting blocks 1 through 8 shall be 235m^3.
- Under the improvement plan, from the second cutting cycle trees for logging shall have a DBH of no less than 35cm (GBH of no less than 110cm) and there shall be a selective logging ratio of 33%.
- Regeneration shall be carried out through natural seeding. In areas where this is difficult, seedlings or seed shall be planted.

③ Implementation Methods

- Both planning and implementation shall be carried out directly by the DFRN. Local inhabitants shall be employed as workers and shall be paid wages.
- Although the DFRN shall formulate plans, these shall be implemented by local organizations.
- Necessary nursery stock shall be purchased from private nurseries by the DFRN.

④ Nursery Stock

The required quantity of nursery stock for new enrichment in Timber Forests shall be carried out for half of the annual logging area (1/3 of 1 logging block;1 logging block is 47ha). These shall be planted at a density of 100 trees/ha (10m x 10m) with supplementary planting being carried out the following year at a ratio of 20%.

(Required Nursery Stock Quantities)

The annually required quantity of seedlings is 800 trees in the 3rd year and 960 trees/year from the 4th year through to the 10th year.

Timber Forest Work Area

Year	1-2	3	4	5	6	7	8	9	10
Selective Felling Block Area (ha)	Preparation Work	47	47	47	47	47	47	47	47
Logging Area (ha)		16	16	16	16	16	16	16	16
Logging Volume (m^3)		235	235	235	235	235	235	235	235
Enrichiment Area (ha)		8	8	8	8	8	8	8	8
Nursery Stock (Seedling)		800	960	960	960	960	960	960	960

(4) Fuelwood Forest

Fuelwood forest has a total area of 1,136.60ha. Fuelwood forest management and clear felling shall be carried out with the aim of fuelwood production. This fuelwood forest shall consist of 4.70ha of Sa, 503.05ha of Sb and 219.10ha of St, for a total of 726.85ha of native species and trees with a DBH of no less than 7cm shall be felled. The remaining 411.75ha, which consists of 405.06ha of Ch and 6.69ha of Ja, both introduced species, shall be clear felled.

① Trees

Native Species: *Detarium microcarpum, Terminalia avicennoides, and Isoberlinia spp*.
Introduced Species: *Tectona grandis, Gmelina arborea, and Acacia auriculiformis*.

② Annual Work Volume

In order to even out the village income of each improvement unit, under the Basic Plan the Fuelwood Forest area is determined as 1,120ha. As the trees reach maturity in 7 years, the annual work area is 140ha. Bearing in mind environmental considerations, each annual logging area shall be approximately 10ha with this area including both fuelwood forest management forest and clear felled management forest. The work area for 10 years is as follows.

Fuelwork Forest Work Area (Unit: ha)

Operations		Year									
		1-2	3	4	5	6	7	8	9	10	11
Clear Felling (448ha)	Planting/Direct Grafting	Preparation	51	51	51	51	51	51	51	51	51
	Harvesting/ Logging		-	-	-	-	-	-	-	51	51
Fuelwork Forest Management (2,272ha)	Regeneration (Direct Sowing/Planting)		-	89	89	89	89	89	89	89	89
	Harvesting/ Logging		89	89	89	89	89	89	89	89	89

However, in the 10th year harvesting and logging for clear cutting management area shall be carried out in the area that was planted with seedlings and cuttings in the 3rd year and in the 11th year harvesting and logging shall be carried out in the area that was planted and with seedlings and cuttings in the 4th year. Regeneration (direct sowing and planting) in fuelwood forest management areas shall be carried out in areas that were harvested/logged the previous year. Furthermore, harvesting and logging in the 11th year shall be carried out in the area that was replanted (direct sowed and planted) in the 4th year.

③ Planting and Timber Production Volumes

In the above-mentioned fuelwood forest production plan area, the annual number of trees replanted in clear cutting management forests from the 3rd year through to the 10th year (when only seedlings are used) or the estimated timber production volume of the fuelwood forest (area of standing trees with a DBH of no less than 7cm for timber for use as fuelwood calculated based on forest survey records) is as follows.

Please note that although forest operations with regard to fuelwood forests is carried out by natural regeneration of native species of trees, initially direct planting of desired species of trees is carried out in order to create the fuelwood forest.

(a) Number of Seedlings Planted in Clear Cutting Management Forests (2,500 trees are planted per ha)

From the 3rd year until the 10th year, 127,500 trees will be planted annually. From the 11th year, regeneration will take place through germination.

(b) Fuelwood Forest Estimated Timber Production Volumes

Fuelwood Management Forest	3rd~10th year	89ha/annum	1,647m^3
	From the 11th year	89ha/annum	
Clear Cutting Management Forest	From the 10th year	51ha/annum	1,122m^3

(5) Grassland

In order to achieve improved grazing capacity and change the form of livestock grazing, cultivated land and fallow land that had been abandoned was artificially created into grassland. This land has an area of 416.47ha and is currently planted in Sa (60.44ha), Sb (94.30ha), St (18.41ha), Ch (88.47ha), Ja (142.00ha) and others Ag(12.85ha).

① Improvement of Land for Pasture Establishment

Standing trees shall be logged and shrubs removed in the target area. Standing trees shall be logged and sold as timber or fuelwood and the proceeds put into the Forest Improvement Fund. Shrubs shall be used locally for fuel or stock fences.

② Types of Pasture

Gramineae shall consist of *Andoropogon gayanus* and *Pennisetum purpureum* while *Leguminosae* shall consist of *Stylosanthes hamata*. *Andoropogon gayanus* and *Stylosanthes hamata* shall be planted together while *Pennisetum purpureum* shall be planted in the surrounding area or in vacant ground.

③ Stock Fences

Stock fences shall be established to confine domestic livestock to certain areas and to effectively utilize grasslands. Feed trees, fuelwood trees, trees which are a source of nectar for bee-keeping, and shrubs shall be utilized to establish such fences which are to be established by the local inhabitants.

④ Utilization

Rotational grazing of grasslands is to be carried out in order to provide even feeding in terms of both quantity and nutrition. Three blocks are to be established within grassland areas, with rotational grazing of each block being carried out for 2 weeks after which it is given 4 weeks rest. Feed trees, fuelwood trees and trees which are a source of nectar for bee-keeping are to be planted in all grazing blocks.

⑤ Storage and Use of Grass

Hay is to be harvested and stored as much as possible during the dry season using what machinery is available. In order to keep the decrease in the nutritional value of the grass at a minimum, grass is to be cut and laid out thinly on the ground and turned once or twice every day in order to speed up the drying process.

⑥ Number of Breeding Stock

From the grassland production volume and the annual livestock feed requirements of mature cattle (250kg) (2,282kg), it can be calculated that 957 head of livestock can be reared on the grasslands. At the beginning of the plan only the existing number of livestock (mature cattle: 250kg) will be reared.

Number of Head of Stock on the Grasslands

Grassland	Area (ha)	Utilized Area (ha)	Dry Grass Production Volume (kg/ha)	Dry Grass Production Volume (ton)	Possible Number of Stock
Andoropogon gayanus	198	168	8,500	1,428	-
Stylosanthes hamata	198	168	3,630	610	-
Pennisetum purpureum	20	17	8,640	147	-
Total	416	353	-	2,185	957

(6) Woodland Pasture

In order to stabilize the number of stock grazing in the natural forest, the volume of grasses for domestic livestock to feed on shall be increased and the quality of pasture improved. This area consists of Sa (150.65ha), Sb (585.14ha), St (150.99ha), Ch (3.75ha), Ja (13.93ha), and others (Ag) (2.68ha), giving a total of 907.14ha.

① Land Preparation

The crown density of standard trees in areas of Sa, Sb and St shall be reduced to 10% and shrubs removed (for use and sale as timber and fuelwood). Feed trees shall be planted in rows

and overall crown density established at approximately 20%. Controlled burning shall be carried out after standing trees and shrubs have been removed.

② Types of Pasture

Natural *Gramineae* grasses shall be retained and all weeds removed. When there is a shortage of *Gramineae* grass in a particular area, pasture shall be planted with the aim of achieving 100% covering. Immediately after direct sowing grazing is to be carried out in order to establish it using the "hoof" method.

③ Utilization

Although it is possible to graze for a period of one year on fast-growing grass pasture, as it is difficult to graze during the first year with slow-growing Leguminosae pasture temporary stock fences should be established around the area and grazing delayed until root structure is adequately developed.

④ Number of Stock

From the Woodland Pasture production volume and the annual livestock feed requirements of mature cattle (250kg) (2,282kg), it can be calculated that 1,351 head of livestock can be reared on the Woodland Pasture. At the beginning of the plan only the existing number of livestock (mature cattle: 250kg) will be reared.

Number of Head of Stock in Woodland Pasture

Pasture	Area (ha)	Utilized Area (ha)	Dry Grass Production Volume (kg/ha)	Dry Grass Production Volume (ton)	Number of Stock
Wild Grass	907	726	4,250	3,084	1,351

(7) Grazing Community Forest

This area consists of forest in the silvi-pastoral zone other than Grassland, Woodland Pasture, and Conservation Forest II where improvement, etc. of grass is not being carried out. In areas of Fc, timber production shall be carried out in accordance with timber forest management. This includes areas of Fc (7.71ha) for a total of 7.71ha. Grazing shall be permitted within Conservation Forest II inside the Silvi-pastoral Zone.

(8) Utilized Land

In the Village Forestry Zone, each participating household (10.1 people: 6 adults/8 children) shall be permitted to use 2.0ha of cultivated land and 2.0ha of tree-planting land for a total of 4.0ha. (Households are permitted to use the land but the state retains ownership.) Based on aerial photographs taken during December 1998, residents participating in the Village Forestry Zone are those possessing cultivated land within the classified forest at that time. The total number of households in the village, the number of households in the Village Forestry Plan and the required area are as follows.

Village Population, Number of Households and Land Preparation

Population (persons)	Number of Households	Number of People per Household	Classified Forest Utilization Ratio	Number of Eligible Households	Utilized Land Area (ha)	Required Area (ha)
1,431	149	9.6	0.926	138	552	680

Utilized land consists of 17 compartments with a covering of Fc(2.07ha), Sa (29.09ha), Sb (342.47 ha, Ch (651.58 ha), and Ja (122.30 ha) for a total of 1,147.51ha. 1 sub-compartment with an area of 41.52ha shall be used by 7 households, 11 sub-compartments with an area of 410.39ha

shall be used by 49 households, 25 sub-compartments with an area of 107.34ha shall be used by 11 households, 29 sub-compartments with an area of 546.11ha shall be used by 66 households, 46 sub-compartments with an area of 42.15ha shall be used by 5 households.

① Commercial Farming

Commercial farming will be improved through extension activition regarding the improvement of crop-growing systems, cultivation methods, post-harvest processing, and through activities to enlighten farmers, including the necessity of a forest management plan.

(a) Improving Crop Growing Systems

a) Selection of Crops

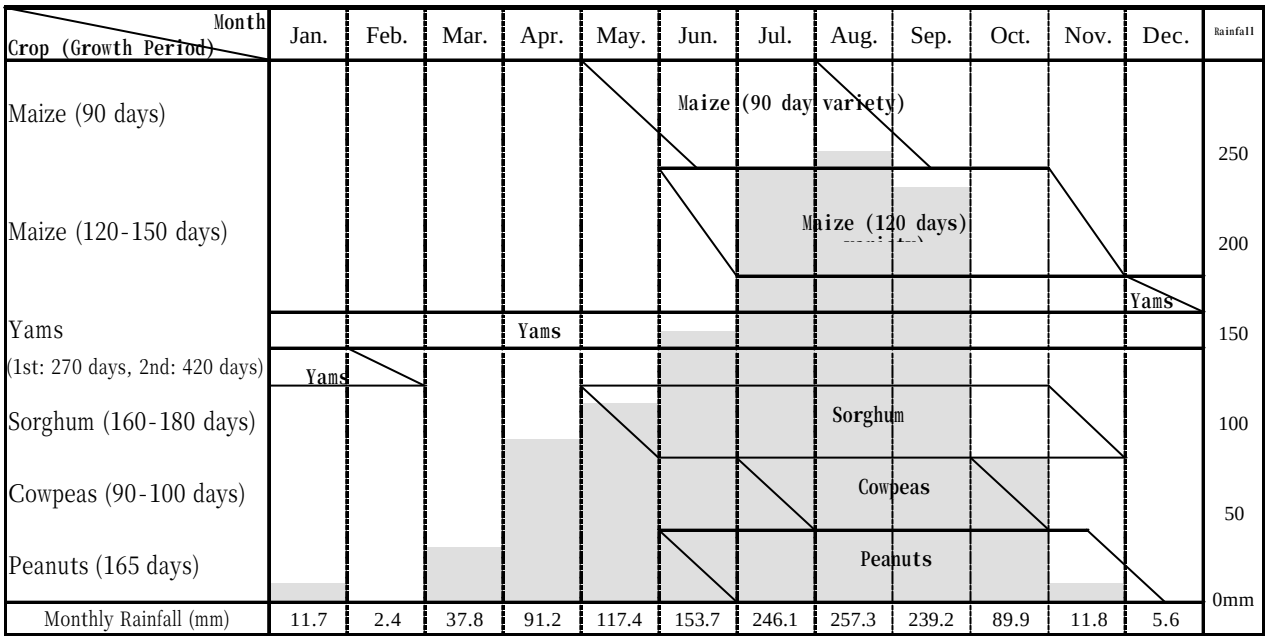
Under the terms of the Forest Management Plan, yams, maize and sorghum, shall be the main subsistence crops with peanuts and cowpeas being grown as intercrops.

b) Introduction of New Varieties (Improved Varieties)

As presently grown varieties are mainly native varieties, 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) varieties. However, as the introduction and extension of new varieties takes time, farmers will be instructed to select reliable seeds for immediate use. Improved maize with a growth period of 90 days and native varieties with a growth period of 120 days shall both be introduced.

c) Improving Crop Growing Systems

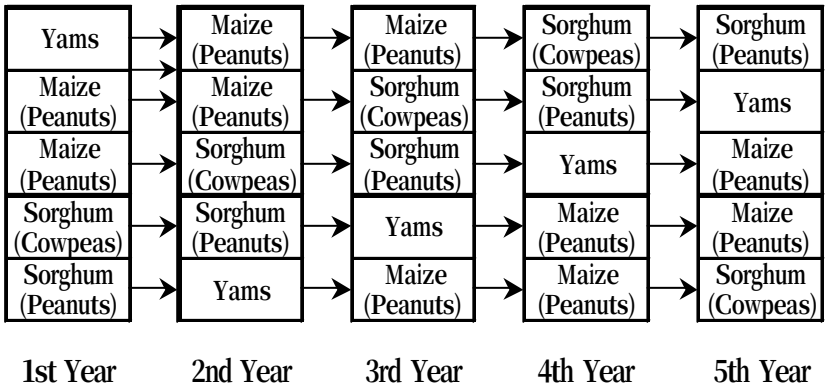
The above-mentioned improved crop growing system that gives consideration to crops and varieties is shown in the following diagram. Varieties of maize with growth periods of both 90 days and 120 days shall be introduced with two crops being grown each year. By using varieties with growing periods that are shorter than those of native varieties, this system enables the most effective utilization of the limited rainy season.



Crop Growing System Plan

d) Crop Rotation

Maize and sorgh um 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 rotational crop system is as shown below.



(b) Improved Growing Methods

a) Improvement of Cultivation Using Animal Power and Farming Tools

Cultivation using animal power will be introduced for joint use on condition that it will be used for contracted ploughing. Existing farming tools will be improved.

b) Materials for Agricultural Production

a. Seeds

New varieties of seeds will be introduced and sown in appropriate quantities.

b. Fertilizer

Locally obtainable organic fertilizer will be used. Where soil analysis reveals this supply to be insufficient, the use of chemical fertilizers, such as urea, will be considered. In order to expand the use of organic fertilizer, composting techniques will be taught. *Leguminosae* plants (green manure crops), such as *Mucuna pruriens*, which are a source of nitrogen, shall be ploughed in.

c) Improvement of Growing Techniques

Matters to bear in mind with regard to growing include the following.

- Deep ploughing 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.

d) 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.

- The introduction of disease and pest-resistant varieties.
- The introduction of crop rotation.
- The implementation of mixed planting and intercropping.
- Consideration of planting density.

(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 a 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.

With regard to storage, as *Leguminosae* cash crops, such as peanuts, etc., are susceptible to damage from pests while in storage, they should be mixed with wood ash and silica-seaweed soil mix, etc. and stored to prevent the breeding of pests.

② Afforestation Plan

The planting of forest and fruit trees within the 2.0ha of utilized land for the production of posts and fuelwood shall be planned in the following way. However, trees shall be selected individually by the local inhabitants themselves.

(a) Post and Fuelwood Production Forest

Trees to be planted in this area are *Tectona grandis* and *Gmelina arborea*. Planting density shall be 2,500 trees/ha (2m x 2m) with *Tectona grandis* being stamp planted and *Gmelina arborea* being either stamp planted or direct grafted.

With stamp planting, as 4~5 sprouts appear, they shall be thinned out after 1 year with 3 straight seedlings being left.

The cutting cycle shall be 5 years with 0.4ha (1/5 of 2.0ha) being planted and felled each year. In planted areas, intercropping shall be carried out (Taungya System) for 2 years after planting. Spacing in this case shall be 3m x 1.5m (2,220 trees/ha). Annual plans shall be as follows.

Posts and Fuelwood Production Forest Plan

Year	Planting (ha)		Harvesting (ha)	Intercropping (ha)	Comments
1	0.4	Planting	—	2.0	Yams.
2	0.4	Planting	—	2.0	Yams or maize.
3	0.4	Planting	—	1.6	Maize (Intercropping of the 0.4ha of the 1st year is unnecessary.)
4	0.4	Planting	—	0.8	Maize (Intercropping of the 0.8ha of the 1st and 2nd years is unnecessary.)
5	0.4	Planting	—	0.8	Yams (Intercropping of the 1.2ha of the 1st, 2nd and 3rd years is unnecessary.)
6	0.4	1st year after Germination	0.4 (1st year Forest)	0.8	Yams or maize (5th year reverts to 1st year.)
7	0.4	2nd year after Germination	0.4 (2nd year Forest)	0.8	Yams or maize (Reverts to 1st and 2nd years.)
…	…	……	……	…….	

(b) Fruit Trees

Fruit trees to be planted in this area are cashews. Planting density shall be 100 trees/ha (10m x 10m). Although trees will start to bear fruit approximately 18 months after planting, from the 6th year to the 10th year only 1 ton shall be harvested per ha with 2 tons per ha being harvested from the 11th year onwards. As cashews easily catch fire, firebreaks or belts of fire-resistant trees shall be established to prevent fire from entering from the surrounding area.

③ Bee-Keeping

As honey production is a desirable way of providing a cash income to the local inhabitants, bee-keeping activities should be introduced and actively encouraged in the area in order to achieve stable production. Trees to be planted are *Acacia auriculiformis*, *Newboudia laevis*, *Detarium microcarpun* and *Burkea africana*.

④ *Vitellaria paradoxa*

Although *Vitellaria paradoxa* has been retained in cultivated areas, there are no young trees bearing fruit or for growing crops and as the trees are old, in many cases production volumes have decreased. After *Vitellaria paradoxa* has been newly planted around the perimeter of the cultivated land, it will be possible to raise replacement trees and to carry out harvesting.

(9) Fuelwood Community Forest

132.95ha of previously cultivated land apart from land for use by local inhabitants and 34.17ha of previously fallow ground making a total of 167.12ha of land within the Village Forestry Zone

shall be used as a fuelwood forest for the production of fuelwood for sale by the village. This fuelwood forest is for joint use by the village and shall be managed by the organization in each improvement unit.

Species of trees to be planted in the fuelwood forest include *Prosopis sp*., *Terminalia spp*., and *Gmelina arborea*, etc. Of these species of trees, good quality charcoal can be obtained from *Prosopis sp*., and *Gmelina arborea*. The planting density for this area is 2,500 trees/ha (2m x 2m). As the cutting cycle is 7 years, 24ha shall be felled and replanted each year with annual charcoal production volumes reaching 528m^3 (24ha x 22m^3/ha=528m^3).

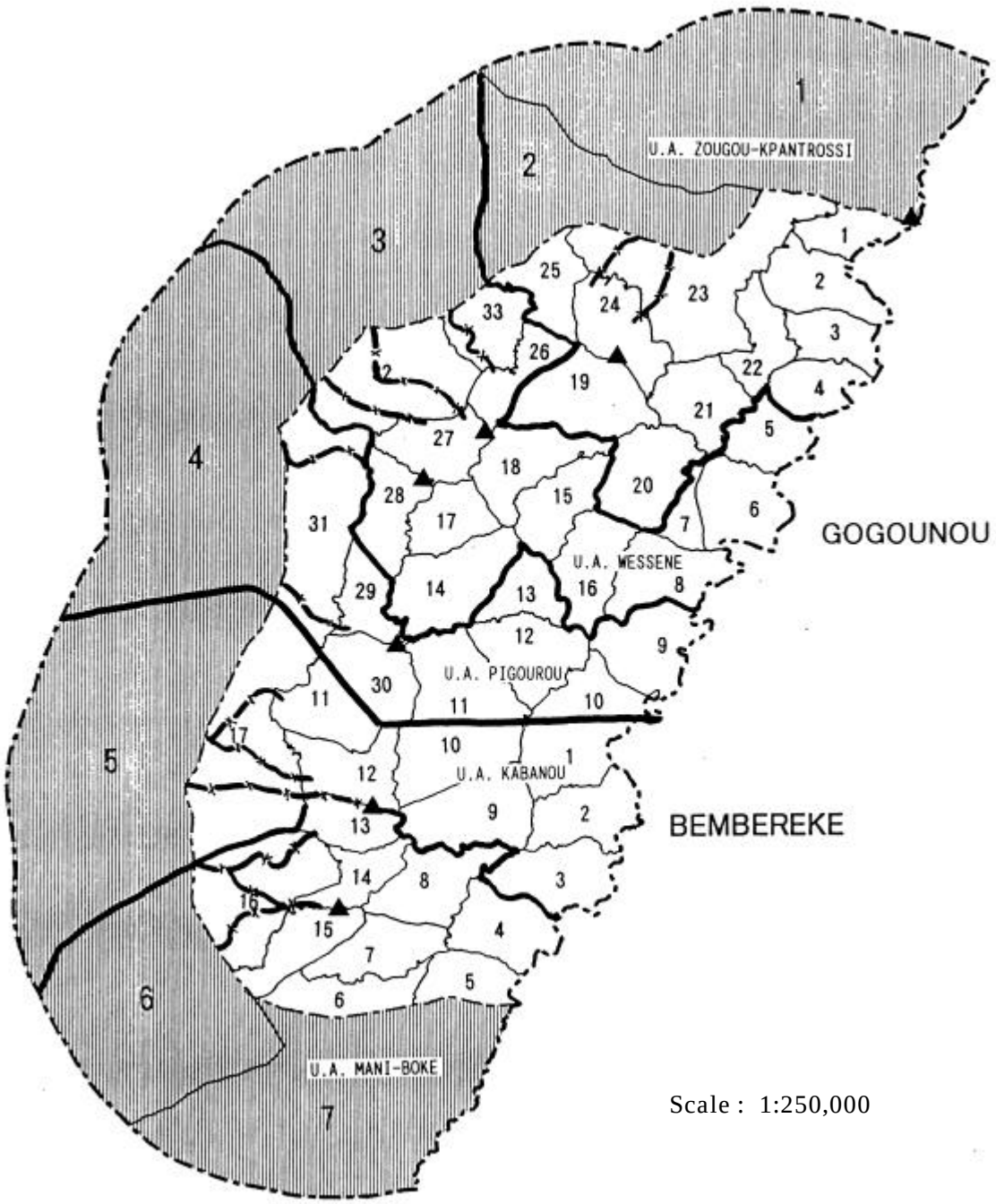
(10) Forest Reserve

Areas of forest in the Village Forestry Zone other than Conservation Forest II, Utilized Land, Fuelwood Community Forest and Left-over Area shall be retained as Forest Reserve. Forest Reserve contains 66.86ha of Gf, 37.34ha of Fc 59.68ha of Sa, 579.47ha of Sb, 476.04ha of St and 7.33ha of others, making a total of 1,226.72ha. It is possible that the 59.68ha of Sa may be transferred to Utilized Land in the future.

Areas of Sb and St shall be transferred from outside the classified forest to the Silvi-pastoral Zone within the classified forest without becoming part of Cultivated Land or Tree-planting Land to become paths for the passage of livestock. When such paths pass through Utilized Land, a path with a width of 50m shall be established and a 3m wide belt of *Gmelina arborea* and *Acacia auriculiformis* planted at a spacing of 1.5m x 1.5m on the boundary either side of the path. The planned livestock path shall be extended by 5,300m as shown in the following diagram.

(11) Left-Over Area

Left-over Area is land other than forest (Gf, Fc, Sa, Sb and St) and cultivated and fallow land that shall be retained in its present state and shall be outside the scope of management. Left-over Area consists of 63.76 ha of Cl, 91.14ha of Tm and 2.00 ha of Ar for a total of 156.90 ha.



Key	
1~7	Buffer Zone
1~33	Classified Forest
	Improvement Unit Boundary
U.A.	Improvement Unit
x	Livestock Path
▲	Waterhole

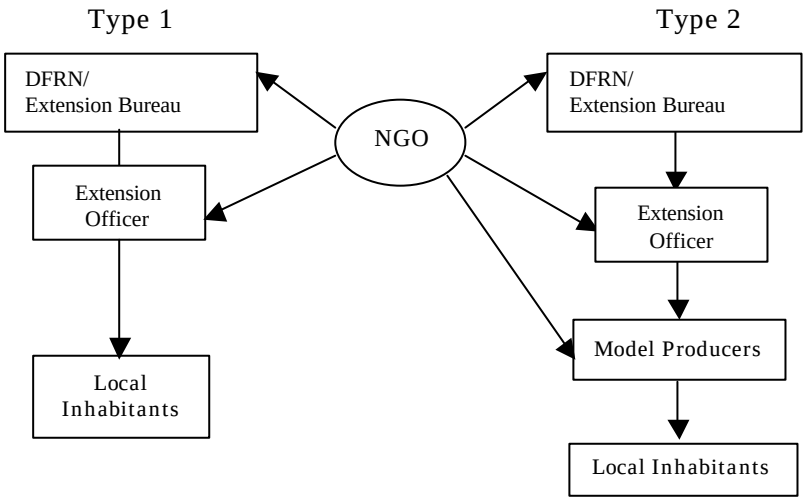
Livestock Paths

10 Extension and Training Plans

Existing extension activities are carried out under the jurisdiction of the Extension Bureau of the Ministry of Rural Development 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.



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 seedlings for mountain areas, etc. Furthermore, training of nursery officers within local organizations will also be carried out.

(2) Bee-Keeping

Bee-keeping 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.

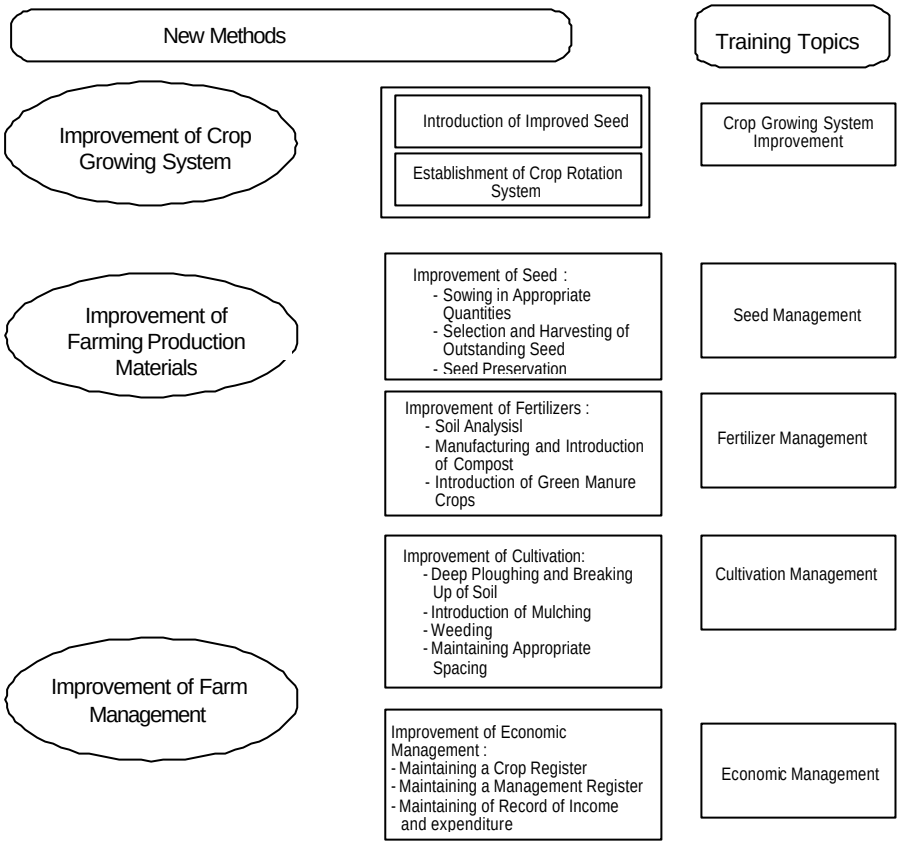
(3) Charcoal Production

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.

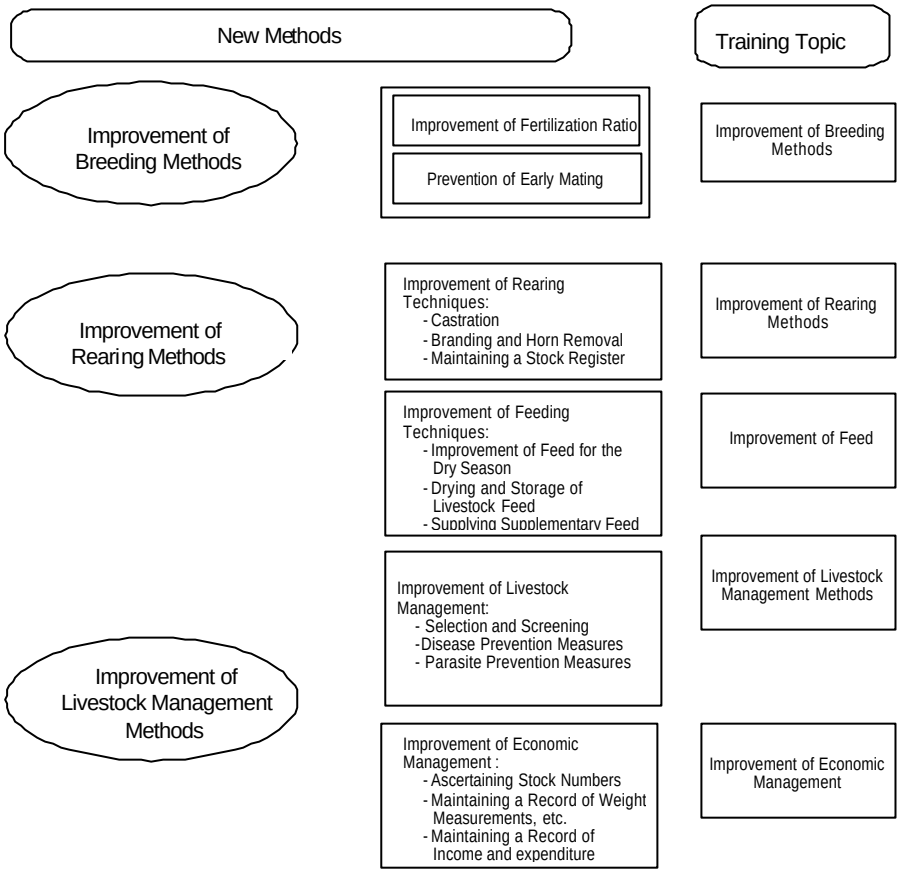
Details regarding new techniques and training topics for commercial farming improvement are as follows.



Training Topics for Commercial Farming Improvement

(5) Livestock Farming

Details regarding new techniques and training topics for the improvement of breeding techniques, rearing techniques and livestock management are as follows.



Livestock Farming Training Topics

11. Infrastructure Improvement Plan

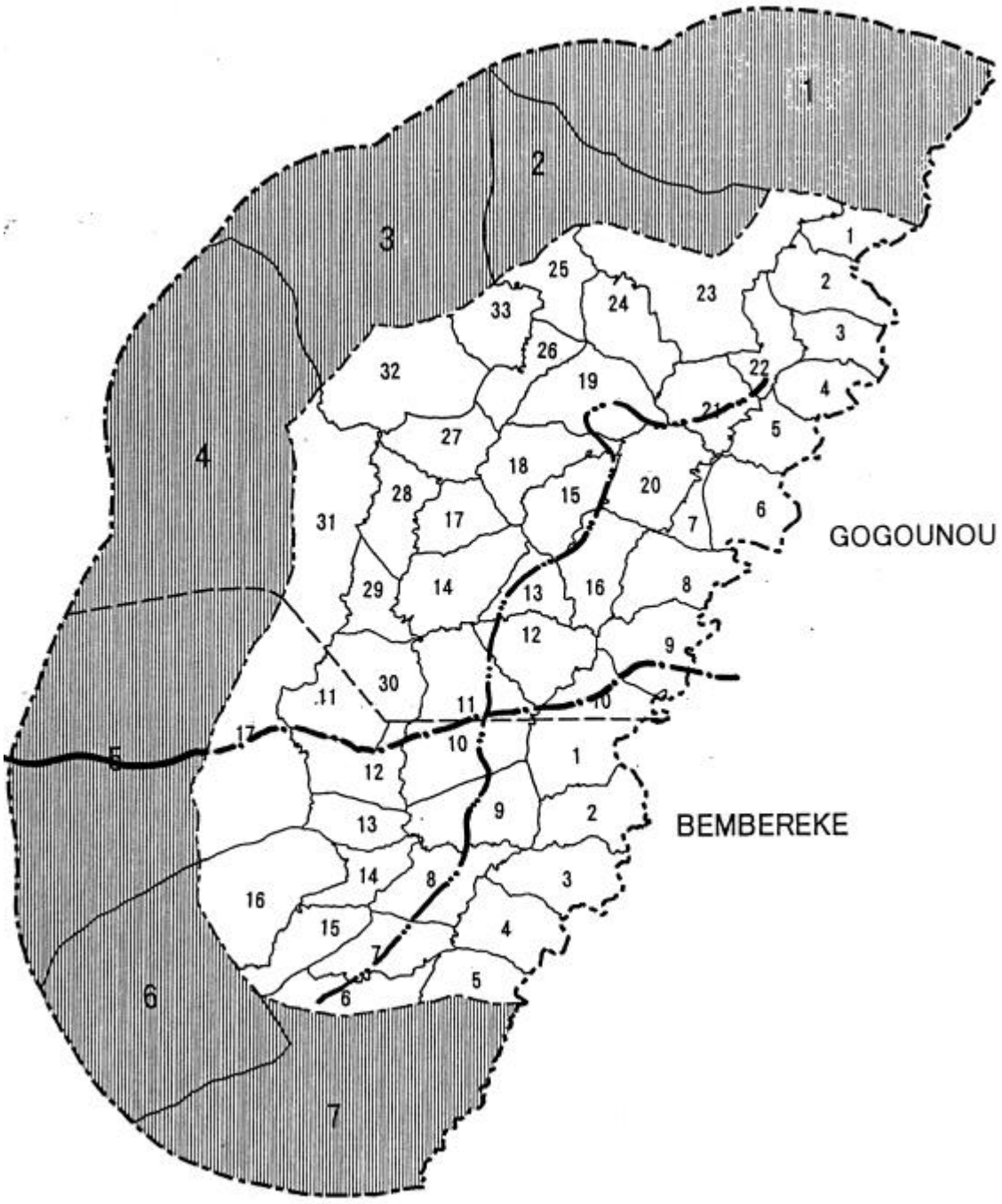
(1) Forest Roads

The access road to the classified forest is the road running from Beroubouay on State Highway 2 via Kabanou~Koussine and forest roads for the management of production forests within the classified forest and the management of Conservation Forest shall join this access road. A main forest road will be established from the access road to the Bouli River with other minor roads being established from the main forest road to production forests within each improvement unit. The length of the main forest road shall be 19.5km with the length of other minor roads in each improvement unit being as shown below. However, within Conservation Forest work roads will link up with the main forest road and other minor roads. The roads mentioned below are shown in the following map.

Zougou-Kpantrossi Improvement Unit	9.5km
Wessens Improvement Unit	5.5km
Pigourou Improvement Unit	7.4km
Kabanou Improvement Unit	5.1km
Mani-Boke Improvement Unit	7.9km

(2) Village Nursery

In order to produce seedlings in each improvement unit for planting in each zone of the classified forest, a nursery operated by the village shall be established in each village. Management, operation and maintenance of the nursery shall be carried out by the Forest Improvement unit Committee, which is an organization comprised of local inhabitants. All seedlings produced shall be for commercial sale with income from such sales going into a Forest Improvement Fund. Seedling production scale by improvement unit is as shown below.



Scale: 1:250,000

Key	
1~7	Buffer Zone
1~33	Classified Forest
	District Boundary
	Access Road
	Main Forest road
	Spur roads

Forest road Plan Map

Seedling production Volume

Unit: Seedling

Improvement Unit	Year								
	3	4	5	6	7	8	9	10	Total
ZOUGOU-KPANTROSSI	140,700	178,340	185,840	259,765	275,075	275,180	200,839	148,360	1,664,099
WESSENE	53,400	92,680	100,500	131,675	137,910	138,435	102,740	60,580	817,920
PIGOUROU	60,800	83,860	90,940	90,940	91,040	91,060	91,060	68,060	667,760
KABAKOU	128,300	169,360	177,540	193,490	196,680	196,680	180,830	136,660	1,379,540
MANI-BOKE	56,000	81,300	86,320	108,770	112,760	112,760	92,710	63,700	714,320
Total	439,200	605,540	641,140	784,640	813,465	814,115	668,179	477,360	5,243,639

(3) Forest Management Center

The main organization carrying out the implementation of Forest Improvement plans is the Forest Improvement Committee, which is organized by the local inhabitants. However, as there are restrictions on the use of the classified forest by local inhabitants it is necessary to bring some form of stability to the lives of local inhabitants through regional promotion. Furthermore, a survey of local inhabitants revealed that there is a high proportion of women involved in the use of the classified forest, making their participation in the management of the classified forest essential. Therefore, a Forest Management Center will be established for forest improvement and to improve the place of women in society. Training to be carried out at the Forest Improvement Center includes literacy education for women using the center, which have a poor rate of literacy, and training, etc., which will provide a diversified means of income.

12. Buffer Zone Management Plan

A buffer zone running for 7km encircles the classified forest within which Conservation Forest will be established as part of the management plan of the classified forest. Such Conservation Forest will be handled in accordance with the management plans of the classified forest.

The area of the buffer zone is 9,222.33ha and consists of the forest cover type shown in the chart below.

Land Area by Impronement Unit, Land Use and Forest Type (Buffer Zone)

(Unit:ha)

Cate-gory	Forest Type Symbol	GOGONOU				BEMBEREKE			Total
		ZOUGOU-KPANTROSSI	WESSENE	PIGOROU	Subtotal	KABANOU	MANI-BOKE	Subtotal	
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
	Sub-total	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
	Sub-total	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

The buffer zone is a free zone which the local inhabitants are free to use for cultivation, livestock grazing, fruit harvesting, and other use. However, the felling or trimming, etc. of protected species of trees within the forest is prohibited.

Conservation Forest shall be established in the following areas within the buffer zone and shall be handled in the same way as Conservation Forest II within the classified forest. However, areas considered by the local inhabitants to be areas of sacred forest shall be handled in the same way as Conservation Forest I.

Areas to be designated as Conservation Forest are as follows.

- Areas within 25m of either side of waterways which shall be preserved to protect water resources and prevent soil and sand from being washed into the waterways.
- Forest on residual relief and tectonic relief.
- Forest in savannah and laterite terraces.
- Areas of forest where soil protection is required.
- Areas of forest preserved as sacred forest by villagers.

The location and scope of the above-mentioned Conservation Forest shall be clarified by the DFRN and recorded in the map register. As the productivity of the land in buffer zone has decreased as a result of continuous slash and burn type agriculture it has become fallow ground or is illegally cultivated within the classified forest.
If the improvement plan for the classified forest can be successfully formulated, cultivation will be limited to established farming carried out in limited space. Consequently, established farming will also increase within the buffer zone allowing the effective utilization of cultivated land and fallow land where productivity has decreased. The introduction of agroforestry within the buffer zone will be actively encouraged.

(1) Agroforestry in Areas of Cultivated Land and Fallow Land

① 2ha 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 2~5ha Cultivated Land

2ha is used to grow food crops while the remaining 1~3ha shall be planted in trees and agroforestry undertaken with forest products being harvested and cash crops being grown as intercrops. 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 (10m x 10m).
- *Vitellaria paradoxa*: Limited production of fruit from *Vitellaria paradoxa* can be carried out. The planting density of these trees is 200 trees/ha (5m x 10m).
- Teak: Post production is the reason for planting teak. Trimmed branches, etc. shall be used for firewood. 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 5ha

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 (4m x 2m). 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) Bee-Keeping

As cultivated land and the area surrounding cultivated land is unsuitable for bee-keeping, 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 bee-keeping in grassland or areas of low shrubs, 12 beehives shall be positioned in each hectare.

(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.

MANI-BOKE Improvement Plan

Forest Improvement Plan

Forest Improvement Plans are implementation plans for each improvement unit based on the Basic Plan for Forest Management for the Intensive Study Area.

Plans for each improvement unit were formulated with consideration being given to implementation efficiency and the location of areas to be used within each zone. Furthermore, as such improvement activities will be implemented individually, separate plans were prepared for each of the five units involved.

The five plans are as follows.

1. Zougou-Kpantrossi Improvement Plan
2. Wessene Improvement Plan
3. Pigourou Improvement Plan
4. Kabanou Improvement Plan
5. Mani-Boke Improvement Plan

MANI-BOKE Improvement Plan

1. Forest Management Units

Details regarding the MANI-BOKE improvement unit are as follows.

Classified Forest:	Tois Rivères Classified Forest
Province (Department):	Borgou (Note. Provinces are referred to as "Departments" in Benin.)
Forest Department:	Borgou Forest Department
Forest Branch Office:	PARAKOU Forest Branch Office
District Forest Office:	BAMBEREKE District Forest Office

2. Location and Area

The MANI-BOKE Improvement Unit consists of the southern area of the Tois Rivères Classified Forest west of the Bouli River and associated the buffer zone. The area of the classified forest is 8,324ha while the area of the buffer zone is 12,561ha.

3. General Conditions

3.1 Natural Conditions

(1) Climate

The temperature and rainfall of the MANI-BOKE Improvement Unit as measured by weather monitoring stations in the surrounding area are as follows.

In Kandi, the average temperature is 28.1°C, the minimum average temperature of 17.2°C occurs in January, and the maximum average temperature of 38.7°C occurs in April. Average annual rainfall is 949mm in Kandi, 1,147mm in Bembereke, 1,037mm in Segbana and 1,161mm in Kalale. The rainy season lasts from May to September while the dry season lasts from October to April. Semi-arid conditions are experienced at the beginning of both the wet and dry seasons during September/October and April/May.

Average Temperature and Rainfall

(Temperature: °C)

Monitoring Station	Month	1	2	3	4	5	6	7	8	9	10	11	12	Average
Kandi	Average (°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
	Maximum Average (°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
	Minimum Average (°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

Note: Figures shown are for the 1988~1997 period.

(Rainfall: mm)

Monitoring Station	1	2	3	4	5	6	7	8	9	10	11	12	Total
Kandi	0	11	30	51	110	138	186	237	143	34	1	7	949
Bembereke	1	0	17	58	117	186	212	273	203	71	8	1	1,147
Segbana	1	1	6	44	101	137	181	308	211	42	5	0	1,037
Kalale	0	17	28	58	125	159	210	225	241	58	30	10	1,161

Note: Figures shown for Kandi and Kalale are for the 1988~1997 period, while figures for Bembereke are for the 1986~1996 period and figures for Segbana are for the 1969~1990 period.

(2) Topography, Geology and Soil Type

The topography of the area consists of flat or gently rolling hills. There are also small plateaux with steep laterite slopes and small rises scattered about the area. The altitude of this area is in the 270m~340m range.

The geology of the area consists mainly of granite and gneiss with areas of sandstone and residual accumulated material. The soil consists mainly of Sols Ferrugineaux Tropicaux with gneiss, granite and sandstone being the parent material. Soil type distribution condition is included in Appendix-1 at the end of this volume together with information regarding how to handle such soils for forestry purposes.

(3) River System

The area is drained by the Bouli River, a tributary of the Sota River which is itself the main tributary of the Niger River, and its network of streams, etc.

(4) Vegetation

Forests consist mainly of scrub savannah, tree savannah and mixed savannah of shrub and trees with areas of riparian forest visible alongside waterways. There are also areas of *Tectona grandis* with plantations, orchards, cultivated land and fallow land. Trees characteristic of the savannah include *Detarium microcarpun*, *Isoberlinia spp*, *Vitellaria paradoxa*, *Parkia biglobosa*, *Combretum spp*, etc. while trees characteristic of riparian forest areas alongside waterways include *Daniellia oliveri*, *Anogeissus leiocarpus*, *Khaya senegalensis*, *Vitex doniana* and *Diospyros mespiliformis*, etc.

3.2 Socioeconomic Conditions

(1) Population

The population of the villages belonging to the MANI-BOKE Improvement Unit is as follows.

Population

Village	Population (Person)	Household Number (Household)	Population Size (Person/Household)
MANI-BOKE	500	90	5.6
FERE	84	7	12.0
BAFA	517	33	15.7
Total	1,101	130	8.5

(2) Farming Population

The farming population derived from figures obtained through the Pre Farming Census based on the farming population ratio and the farm worker ratio (the proportion of the farming population over the age of 15 and under the age of 60 that were farm workers) is as follows.

Farming Population

Village	Population (Person)	Farming Population		Farm Workers		Household Number (Household)	Population /Household (Person)	Farm Workers/Household (Person)
		Person	Ratio (%)	Person	Ratio (%)			
MANI-BOKE	1,101	1,101	100.0	710	64.5	130	8.5	5.5

(3) Farm Size

① Farmland Area

The area of classified forest and farmland in buffer zone (cultivated land and fallow land) is, as obtained through photo interpretation and forest type maps, as follows.

Farmland Area (Unit:ha)

Category	Classified Forest	Buffer Zone	Total
Cultivated Land	816	2,735	3,551
Fallow Ground	217	826	1,043
Total	1,033	3,561	4,594

② Planted Area

The area within classified forest planted in cotton and other crops is as follows.

Planted Area

Cultivated Land	816 Ha
Planted Land (a) (planted ratio)	490 Ha (60%)
Cotton (b) (planted ratio)	236 Ha (48%)
Non-Cotton Crops (a-b)	254 Ha
Farming Households	130 Household
Planted Land/Household (apart from cotton)	1.95 Ha

(4) Livestock

The main forms of livestock include cattle, sheep and goats while poultry includes chickens and guinea fowl, most of which are raised in farmyards.

Livestock (Unit:Head)

Cows	Sheep	Goats	Total	Livestock Units*
2,100	980	910	3,990	2,478

* 5 sheep or goats are counted as 1 cow.

4. Forest Divisions

4.1 Forest Compartments

Divisions with the inherent characteristics necessary for the management and operation of classified forests were established on the basis of political boundaries, village boundaries, and roads, and rivers, etc. while buffer zones were established on the basis of political boundaries and roads. Each of the forest compartments are assigned a number corresponding to each management unit.

The forest compartments and divisions of the Zougou-Kpantrossi Improvement unit are as follows. The area by forest covering of each forest compartment is shown in 6 zones. Area by forest type is shown in Appendix-2 at the end of this volume.

Land Area of Forest Compartments

Classified Forest				Buffer Zone	
Compartment	Area (ha)	compartment	Area (ha)	compartment	Area (ha)
4	991.95	13	631.38	⑥	5,467.71
5	651.96	14	594.85	⑦	7,092.83
6	797.97	15	821.56		
7	886.52	16	1,911.81		
8	1,036.27				
Total			8,324.27	Total	12,560.54
Total					20,884.81

4.2 Sub-Compartments

In order to clarify present types of land use and the state of forests, and differences in forest management, forest compartment were divided up into smaller sub-compartments. These designated sub-compartments were those designated at the time that the Improvement Plan was formulated. Therefore, based on the results of each year's operations, such sub-compartments are divided up and assigned a sub-compartment number. (Refer to the Plan Register)

5. Improvement Aims

The main aim of Improvement Plans is the rapid restoration of the classified forests as state forest and their conservation. As the implementation of these plans is considered difficult without the cooperation of the local inhabitants, by permitting them to use areas within the classified forest, the preservation of the forest will be carried out by the people themselves. The improvement aims for the classified forest are as follows.

- The improvement of the forest through the implementation of measures for public benefit, including the development of the water resources of the forest, the conservation of national land, the protection of wildlife, and the preservation of genetic resources, etc.
- The fostering of a production forest in order to enrich and utilize sustainable forest resources.
- The establishment of an area within the classified forest for use by local inhabitants in order to conserve the forest through coexistence with the people.

6. Zoning

The area will be divided into three zones: the Forestry Zone, the Silvi-pastoral Zone, and the Village Forestry Zone.

6.1 Forestry Zone

The forestry zone consists of the Conservation Forest Zone, which is areas of classified forest that should be protected and conserved, and the Production Forest Zone which is for timber production.

(1) Conservation Forest Zone

The Conservation Forest Zone, which is designed to develop water resources and preserve forestry areas, runs from the Bouli River on the eastern border of the Intensive Study Area for a distance of 3.5km, within which are Conservation Forest I and II.

① Conservation Forest I

- This forest runs from the Bouli River for a distance of 500m and is specially for the fostering of water resources.
- It is a pure forest consisting of *Anogeissus leiocarpus*.
- It is located on residual relief and tectonic relief.
- Soil conditions are bad and existing vegetation should be retained.

② Conservation Forest II

This area consists of the remaining area within the Conservation Forest Zone that is not part of Conservation Forest I.

(2) Production Forest Zone

With the exception of the Conservation Forest within the Forestry Zone, this is the area in which the production of timber and fuelwood and charcoal, etc. is carried out. However, the following areas within the production forest shall be part of 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.

6.2 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 within 50m either side of waterways shall be part of Conservation Forest II.

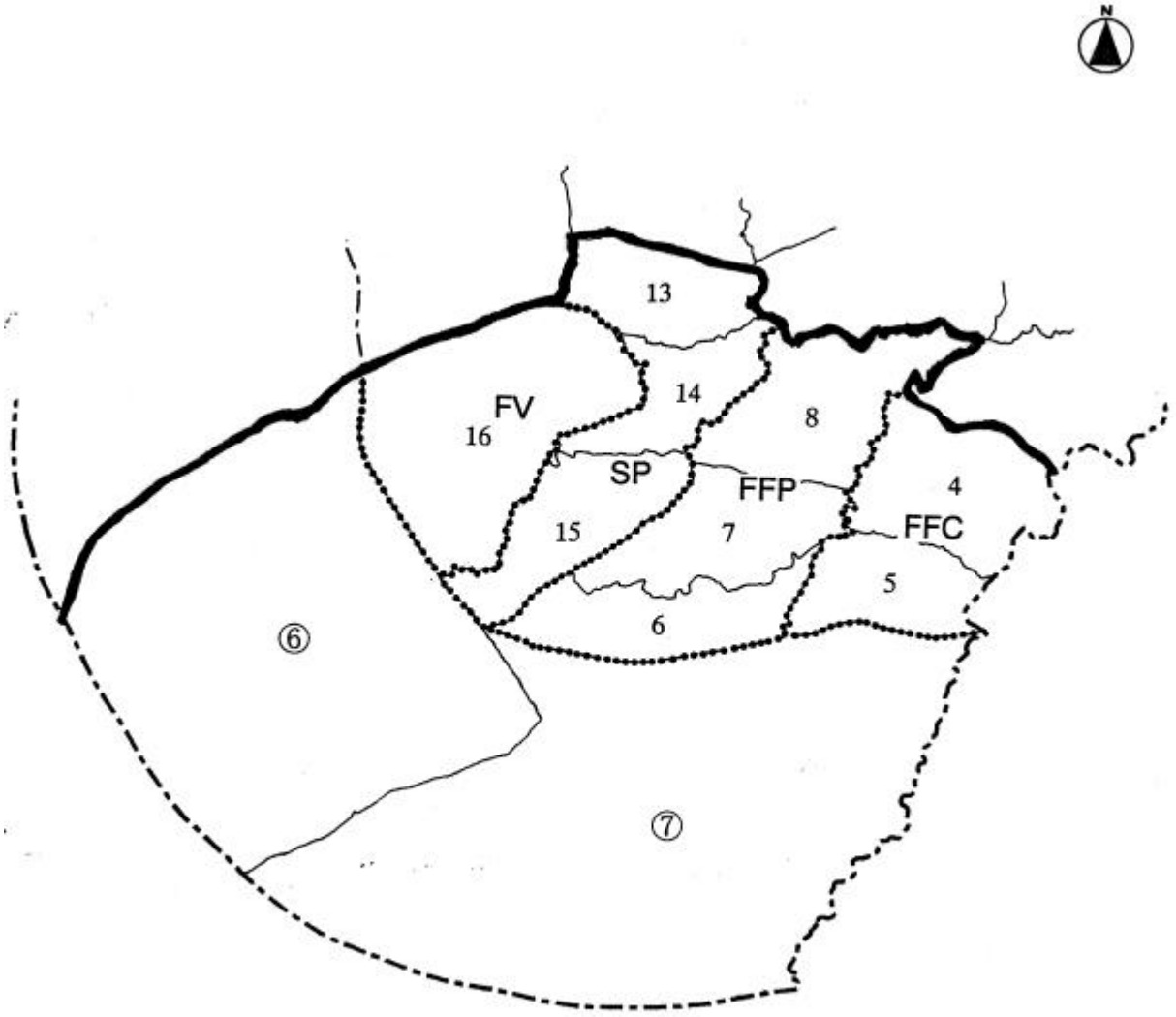
6.3 Village Forestry Zone

This is the zone 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 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.

The land area by forest compartment and forest type in each zone is as shown below.

U.A. MANI-BOKE



S = 1 : 150,370

Legend	
②	Buffer Zone Compartment No.
2	Classified Forest Compartment No.
▬▬	Improvement Unit Boundary
- - - -	Zone Boundary
FFC	Conservation Forest Zone
FFP	Production Forest Zone
SP	Silvi-Pastoral Zone
FV	Village Forestry Zone

Zoning Map

Land Area by Forest Compartment and Forest Type (MANI-BOKE) (Unit:ha)

Zone	Compart-ment	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
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

7. Forest Land Use Classification

In order to implement forest improvement activities, forest land use classes shall be established according to proposed use based on improvement standards for basic plans for the forest within each zone and in order to formulate operating plans in accordance with forest land use classification. The types of forest classified under the forest land use classification shall be included in plans as follows.

7.1 Forest Zone

(1) Conservation Forest Zone

Conservation Forest I	Areas of forest within 500m of the western bank of the Bouli River that should be protected for the purpose of fostering water resources.
Conservation Forest II	Areas of forest within 3,500m of the western bank of the Bouli River (with the exception of Conservation Forest I) that should be maintained for the purpose of fostering water resources and conserving forest land.

(2) Production Forest Zone

Timber Forest	Forest for the production of ordinary timber.
Fuelwood Forest	Forest for the production of fuelwood (wood and charcoal for fuel).
Conservation Forest II	Forest that should be maintained due to location alongside waterways and on account of poor soil condition.
Left-over Area	Non-forest areas designated as other land.

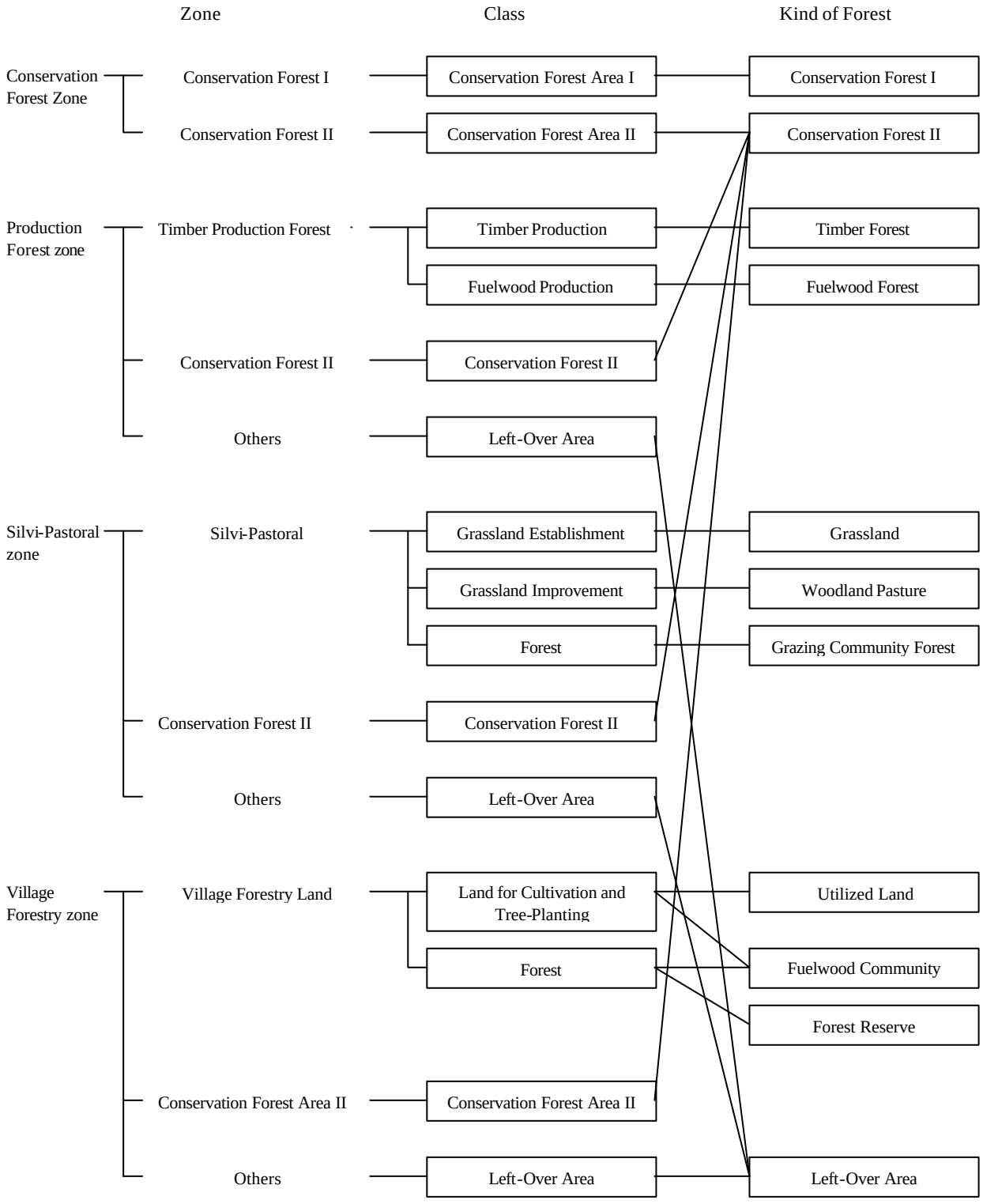
7.2 Silvi-pastoral Zone

Grassland	Artificially created grassland.
Woodland Pasture	Forest improved by increasing the amount of grass that can be eaten by livestock within the forest.
Grazing Community Forest	Forest to be left in its present state other than Grassland and Woodland Pasture.
Conservation Forest II	Forest that should be maintained due to location alongside waterways and on account of poor soil condition.
Left-over Area	Non-forest areas designated as other land.

7.3 Village Forestry Zone

Utilized Land	Land used by people for cultivation, tree planting and roads.
Fuelwood Forest	Areas of forest used as fuelwood forest within cultivated land or fallow land located within forests or Forest Reserve.
Forest Reserve	Forest other than Utilized Land, Fuelwood Forest and Conservation Forest II. Forest that should be set aside for future use as Utilized Land, livestock trails, and boundaries, etc.
Conservation Forest II	Forest that should be maintained due to its location alongside waterways or due to poor soil conditions, etc.
Left-over Area	Non-forest areas designated as other land.

Forest Land Use Classes and kind of Forest can be summarized as follows.


Zone
Class
Kind of Forest
Conservation Forest Zone
Conservation Forest I
Conservation Forest II
Production Forest zone
Timber Production Forest
Conservation Forest II
Others
Silvi-Pastoral zone
Silvi-Pastoral
Conservation Forest II
Others
Village Forestry zone
Village Forestry Land
Conservation Forest Area II
Others
Conservation Forest Area I
Conservation Forest Area II
Timber Production
Fuelwood Production
Conservation Forest II
Left-Over Area
Grassland Establishment
Grassland Improvement
Forest
Conservation Forest II
Left-Over Area
Land for Cultivation and Tree-Planting
Forest
Conservation Forest Area II
Left-Over Area
Conservation Forest I
Conservation Forest II
Timber Forest
Fuelwood Forest
Grassland
Woodland Pasture
Grazing Community Forest
Utilized Land
Fuelwood Community
Forest Reserve
Left-Over Area

8. Operation Standards

Improvement methods and operation (management) methods by kind of forest are as follows.

Operation (Management) Standards (1)

Kind of Forest	Existing Forest Type	Improvement Methods	Operation Methods
Conservation Forest Area I	Gf, Fc, Sa, Sb, and St with a crown density of more than 50%	• Maintenance of existing areas of forest vegetation.	• These areas are not to be subject to management. • Felling of trees is prohibited and the removal of branches and leaves is also prohibited. • Controlled burning is totally prohibited. • Grazing and the passage of livestock is prohibited.
	Gf, Fc, Sa, Sb, and St with a crown density of up to 50%	• Enrichment through planting (mixed planting) of native species. Trees: *Khaya senegalensis, Pterocarpus erinaceus, Isoberlinia spp., Vitellaria paradoxa, and Parkia biglobosa.* Spacing: 10m x 10m (100 trees/ha) Supplementary Planting: Carried out after one year if no more than 80% of trees survive. Brush Cutting: Carried out evenly around planted trees once a year one year after planting.	
	Ch, Ja	• New mixed planting of native species. Trees: *Khaya senegalensis*, *Pterocarpus erinaceus, Isoberlinia spp*., *Vitellaria paradoxa*, and *Parkia biglobosa.* Spacing: 4m x 4m (625 trees/ha) Supplementary Planting: Carried out after one year if no more than 80% of trees survive. Brush Cutting: Carried out evenly around planted trees twice a year 2~3 years after planting.	
Conservation Forest Area II	Gf, Fc, Sa, Sb, and St with a crown density of more than 50%	• Maintenance of existing areas of forest vegetation.	• These areas are not to be subject to management. • Although thinning, pruning and sanitation cutting is permissible, the felling of trees and the removal of branches and leaves apart from such thinning, pruning and sanitation cutting is prohibited. • Controlled burning is totally prohibited. • Grazing and the passage of livestock is prohibited. (However, this shall exclude access by livestock to water holes in the Silvi-pastoral Zone)
	Gf, Fc, Sa, Sb, and St with a crown density of up to 50%	• Enrichment through planting (mixed planting) of native species. Trees: *Khaya senegalensis, Pterocarpus erinaceus, Isoberlinia spp*., *Vitellaria paradoxa, Parkia biglobosa* and *Milicia excelsa.* Spacing: 10m x 10m (100 trees/ha) Supplementary Planting: Carried out after one year if no more than 80% of trees survive. Brush Cutting: Carried out evenly around planted trees once a year one year after planting.	

Operation (Management) Standards (2)

Kind of Forest	Existing Forest Type	Improvement Methods	Operation Methods
Conservation Forest Area I	Ch, Ja	• New mixed planting of native species (including group planting). Trees: *Khaya senegalensis, Pterocarpus erinaceus, Isoberlinia spp., Vitellaria paradoxa, Parkia biglobosa, and Milicia excelsa.* Spacing: 4m x 4m (625 trees/ha) Supplementary Planting: Carried out after one year if no more than 80% of trees survive. Brush Cutting: Carried out evenly around planted trees twice a year 2~3 years after planting.	
Timber Forest	Gf, Fc, Sa, Sb	• Fostering of the timber forest through planting seedlings, direct planting of seeds and natural seeding of native species. Trees: *Khaya senegalensis, Pterocarpus erinaceus, Isoberlinia spp., Afzelia africana, Prosopis africana, and Milicia excelsa.* Spacing: One of the following will be adopted by taking into account crown density of each ferest,5m x 5m (400 trees/ha), 6m x 6m (276 trees/ha), 8m x 8m (156 trees/ha), 10m x 10m (100 trees/ha). Other: When planting, existing material of a usable size may be cut down and used.	• Selective logging shall be carried out. Cutting Cycle: 20 years Selective Logging Ratio: 33% of trees with a diameter at breast height (DBH) of no less than 35cm (girth at breast height of no less than 100cm). Age at Maturity: 30 years • Regeneration: Natural seeding. Direct sowing of seed and planting of seedlings will also be carried out as necessary. • Grazing and the passage of livestock is prohibited.
	Ch, Ja	• Planting of native varieties and direct sowing of seeds. Trees: *Khaya senegalensis, Pterocarpus erinaceus, Isoberlinia spp., Afzelia africana, Prosopic africana, and Milicia excelsa.* Spacing: 4m x 4m (625 trees/ha). Mixed line planting of various species of trees. Supplementary Planting: Carried out after one year if no more than 80% of trees survive. Brush Cutting: Carried out evenly around planted trees twice a year 2~3 years after planting. Other: Land being cultivated may continue to be cultivated until after crops have been harvested at which time the timber production forest will be created.	

Operation (Management) Standards (3)

Kind of Forest	Existing Forest Type	Improvement Methods	Operation Methods
Fuelwood Forest	Sa, Sb, St	• Planting of native species and direct sowing of seed. Trees: *Detarium microcarpum, Isoberlinia spp*., *Terminalia avinnoides, Combretum spp*., *Crossopteryx febrifuga*, and *Piliostigma thonningii*. Other: Felling and harvesting of material with a diameter larger than the specified usable diameter within the existing forest may be carried out the year before planting of seedlings or direct sowing of seed is carried out. Material that is able to germinate should be left to germinate. Additional planting and direct sowing of seed shall be carried out depending on how well seeds etc. take root and the growth of seedlings.	• The area shall be used as a fuelwood forest with trees of not less than 7cm DBH (no less than 20cm GBH) being felled. Cutting Cycle: 7 years Regeneration: Germination and direct sowing of seeds. • Controlled burning shall be totally prohibited. • Grazing and the passage of livestock shall be prohibited.
	Ch, Ja	• Planting of exotic varieties, planting using cuttings and direct sowing of seed. Trees: *Tectona grandis, Acacia auriculiformis, Gmelina arborea*, and *Cassia siamea.* Spacing: 2m x 2m (2,500 trees/ha), 2m x 2.5m (2,000 trees/ha) Brush Cutting: Brush cutting shall be carried out depending on the state of the grass beneath. Other: Existing standing trees (including withered and damaged trees) and shrubs shall be felled and removed for use. Land being cultivated may continue to be cultivated until after crops have been harvested at which time the fuelwood production forest will be created.	• The area shall be clear cut. However, the size of the area to be clear cut shall be reduced. Cutting Cycle: 7 years Regeneration: Germination, direct grafting and direct planting of seeds. • Controlled burning shall be totally prohibited. • Grazing and the passage of livestock shall be prohibited.
Grassland	Sa, Sb, St	• The felling of standing trees (for sale as timber and fuel) and the removal of shrubs (for local fuel use) shall be carried out, after which the land will be ploughed and pasture sown or planted. • Feed trees, trees for fuel and trees which provide a source of nectar for bees shall be planted around this area as a surrounding fence and to form divisions within it.	• This area is designated as a grazing area for rotational grazing. • Pasture shall be harvested and used for livestock feed during the dry season. • Although the area shall be burnt off once every three years, as it is a grazing area this shall be carried out in a planned manner in accordance with grazing plans. A firebreak shall be established around all areas where controlled burning is to be carried out. • Grass other than pasture shall be removed and shrubs cleared and removed. • The leaves of feed trees shall be used to increase the volume of pasture feed and branches shall be used as fuelwood.
	Ch, Ja	• Standing trees and shrubs shall be removed (for use as fuel in local areas) and after ploughing pasture shall be sown or planted. • Feed trees, trees for fuel and trees which provide a source of nectar for bees shall be planted around this area as a surrounding fence and to form divisions within it.	
	Ag	• After ploughing pasture shall be sown or planted. • As the total area involved is relatively small, this shall be concentrated in Sa, Sb, St and Ch and Ja grasslands.	

Operation (Management) Standards (4)

Kind of Forest	Existing Forest Type	Improvement Methods	Operation Methods
Woodland Pasture	Sa, Sb, St	• Trees of larger diameter shall be felled and used (with the exception of *Vitellaria paradoxa*) and crown density reduced to no more than 10%. Shrubs shall be completely removed. • Feed trees shall be planted in rows and overall crown density reduced to approximately 20%. • In order to increase the volume of natural poaceae grasses for livestock feed, weeds other than *Gramineae* will be removed and pasture seeds sown.	• Areas where controlled burning is to be carried out shall be established and such burning carried out at an early stage. Firebreaks shall be established around such areas to prevent fire from spreading to other areas. • Weeds not eaten by livestock shall be removed and seeds sown in areas with low grass density. • Management of crown density shall be carried out and shrubs shall be removed. • The leaves of feed trees shall be used to increase the volume of livestock feed and branches shall be used for fuel. • Dams shall be constructed in waterways in order to provide water for livestock during the dry season.
	Ch, Ja	• Shrubs shall be removed. • With the exception of *Gramineae* grasses eaten by livestock, all other grasses shall be removed. • Pasture seeds shall be sown. • Feed trees shall be planted in rows and overall crown density reduced to approximately 20%.	
	Ag	• After ploughing, pasture shall be sown and feed trees planted. • As the total area involved is relatively small, this shall be concentrated in Sa, Sb, St and Ch and Ja woodland pasture.	
Grazing community Forest	Gf, Fc	• The existing forest shall be left in its present state and no special improvement of grassland shall be carried out.	• This area shall be used as Grazing community Forest. • Although intensive management of this area shall not be carried out, timber production of Fc shall be carried out in accordance with timber forest management.
	Ag	• In order to allow the forest to recover, direct planting of native species shall be carried out after ploughing. After that, the area shall be included in Gf and Fc Grazing community Forest.	

Operation (Management) Standards (5)

Kind of Forest	Existing Forest Type	Improvement Methods	Operation Methods
Utilized Land	Fc, Sa, Sb	• Users shall be permitted to use up to 4.0ha per household (2.0ha for cultivation and 2.0ha for tree-planting). • On land for cultivation, standing trees shall be felled (including withered and damaged trees) and sold as timber and fuelwood, and shrubs shall be removed to be used locally for fuel. After this has been carried out, the area shall be used for normal commercial farming activities. • On land for tree-planting, in order to make room for the planting of fruit trees, trees for fuel and posts, standing trees (including withered and damaged trees) shall be felled and sold as timber and fuelwood, and shrubs removed for use by the users. After this has been carried out, fruit trees and trees for fuel and posts shall be planted. Fruit Trees: *Anacardium occidentale*. Trees for Fuel and Posts*: Tectona grandis, Gmelina arborea*, and *Cassia siamea.* Spacing: Fruit trees 10m x 10m (100 trees/ha); Trees for Fuel and Posts 2m x 2m (2,500 trees/ha). However, when planting over a 1-2 year period, trees should be planted at 1.5m x 3m (2,222 trees/ha) or 1.5m x 4m (1,666 trees/ha). • A firebreak shall be established on the boundary between utilized land (land for cultivation and tree-planting) and other zones to mark the boundary and to prevent fire spreading to other areas. Trees such as *Khaya senegalensis, Acacia auricuriformis, Pterocarpus erinaceus* and *Parkia biglobosa,* etc., which are a source of nectar for bee-keeping, should be used.	• As a rule, users shall be those entities possessing cultivated land within presently classified forests (based on aerial photographs taken in 1998). • Controlled burning shall be prohibited. • Grazing and the passage of livestock shall be prohibited. • Cotton growing shall be prohibited. • Commercial farming shall be improved in order to establish farming. • *Vitellaria paradoxa* shall be renewed in areas surrounding cultivated land and shall be replanted in present areas of cultivated land. • The cutting cycle shall be set at 5 years for trees for fuel and posts with 1/5 of the planted area being logged and replanted every year. • When the area is logged it shall be completely cleared and when it is replanted it shall be planted in both seeds and seedlings. • Bud pruning of *Tectona grandis* is also required. • In tree-planting areas, it is possible to carry out agroforestry (Toungya) 1~2 years after new planting and replanting.
	Ch, Ja	• With regard to cultivated land, Ch will be left as it is and normal commercial farming shall be carried out while standing trees and shrubs shall be felled and removed and the area turned into cultivated land. • Land for tree-planting shall be prepared for planting with fruit trees and trees for fuel and posts, with wood sold as fuelwood or used by the users. • Fruit trees and trees for fuel and pos ts shall be planted in the same way as for Fc, Sa and Sb. • Firebreaks shall be established on the boundary between this zone and other zones in the same way as for Fc, Sa and Sb.	

Operation (Management) Standards (6)

Kind of Forest	Existing Forest Type	Improvement Methods	Operation Methods
Forest for Fuel and Community	Ch, Ja	• Fuelwood forest for village community shall be created in areas of Ch and Ja other than Utilized Land as a source of income for the village. • Fuelwood forest shall be created in accordance with creation techniques for tree-planting areas within Utilized Land. * Areas of Fc, Sa, Sb, Ch and Ja remaining after land has been distributed to the people of the area shall be designated as Fuelwood Community Forest within Utilized Land.	• Management techniques for this area shall be in accordance with those of tree-planting areas within areas of Utilized Land. • Controlled burning shall be prohibited. • Grazing and the passage of livestock shall be prohibited.
Forest Reserve	Gf, Fc, Sa, Sb, St, Ag	• Vegetation in Utilized Land, Fuelwood Community Forest and forest apart from Left-over Area within the Village Forestry Zone shall be left in its present condition. • Forest Reserve shall also include forest that can be transferred into Utilized Land in the future. • Vegetation in areas of Gf, Sb and St shall be left in its present condition and shall be used for the passage of livestock to the Silvi-pastoral Zone from areas of classified forest. • Areas of Ag in forests shall be restored with native species.	• Management techniques shall not be implemented for areas of existing forest. • Controlled burning shall be prohibited. • Although grazing in this area shall be prohibited, grazing and the passage of livestock shall be permitted in remaining areas of the forest.
Left-Over Area	Other (Tm, Td, Cl, Ar, Ce, Pe)	• This area shall be left in its present condition.	• Grazing shall be prohibited in the Conservation Forest Zone, Production Forest Zone, and Village Forestry Zone. • Silvi-pastoral Zones shall be managed in the same way as Grazing Community Forest. •

9. Improvement Plans

9.1 Plan Duration

A sustainable forest management was aimed for when deciding plan period for classified forests. The duration required for the implementation of forestry operations to achieve the said sustainable forest management was set as the plan period for this plan.

The time required for forest operations to be realized for each zone will differ from zone to zone. If the age at maturity for the timber forest is 20 set at 40-60 years there will be will be 3 cutting cycles or 60 years.Trees in fuelwood forests take 7 years to mature and one year for regeneration, making the duration of the improvement plan a total of 8 years. It takes 3 years to fatten cows in silvi-pastoral zones, 5 years to establish a regular farming cycle in cultivated land, and it takes 5 years for trees for fuel and posts to reach maturity. In timber forests, as the time required to reach maturity is relatively long, the plan period shall be set at 10 years, targeting the fuelwood forest (the above-mentioned 8 years plus 2 years for preparation).

9.2 Management Plans

Management of each type of forest shall be carried out in accordance with the improvement methods and operation methods outlined in 8. Operation Standards. The areas of existing forest type in each zone by improvement method for each kind of forest are as follows.

Area of Improvement Methods by Forest Type (MANI-BOKE)

Conservation Forest Zone

(Unit: ha)

Classification		Forest Type and Area								
		Gf	Fc	Sa	Sb	St	Ch	Ja	Other	Total
		93.92		725.08	475.64	212.51	106.19	4.90	25.67	1,643.91
Conservation Forest I	Planting						35.80			35.80
	Enrichment	26.58		85.55	158.26	75.40				345.79
	Original State	27.47		69.68						97.15
Conservation Forest II	Planting						70.39	4.90		75.29
	Enrichment	21.47		134.72	313.15	137.11				606.45
	Original State	18.40		435.13	4.23					457.76
Left-over Area									25.67	25.67

Production Forest Zone

(Unit: ha)

Classification		Forest Type and Area								
		Gf	Fc	Sa	Sb	St	Ch	Ja	Other	Total
		138.04	6.15	800.49	1,135.14	360.11	162.83	49.77	67.87	2,720.76
Conservation Forest II	Planting							3.04		3.04
	Enrichment	11.87		38.88	163.42	95.49				309.66
	Present State	126.53		38.35	52.86					217.75
Timber Forest	Planting						0.81	27.64		28.45
	Felling/ Regeneration		6.15	646.92	467.81	12.62				1,133.50
Fuelwood Forest	Planting						162.02	19.09		181.11
	Felling/ Regeneration			76.34	451.14	252.00				779.38
Left-over Area									67.87	67.87

Silvi-pastoral Zone

(Unit: ha)

Classification		Forest Type and Area								
		Gf	Fc	Sa	Sb	St	Ch	Ja	Other	Total
		102.59	11.73	362.09	913.02	319.49	186.35	111.38	41.14	2,047.79
Conservation Forest II	Planting									
	Enrichment	6.00		6.15	50.89	31.22				94.26
	Present State	96.59		17.36	44.9					158.85
Grassland				158.03	6.75	3.67	180.83	86.81		436.09
Woodland Pasture				180.55	810.48	284.60	5.52	24.57		1,305.72
Grazing Community Forest			11.73							11.73
Left-over Area									41.14	41.14

Village Forestry Zone

(Unit: ha)

Classification		Forest Type and Area								
		Gf	Fc	Sa	Sb	St	Ch	Ja	Other	Total
		239.05	24.97	67.28	826.06	323.95	361.22	50.88	18.40	1,911.81
Conservation Forest II	Planting									
	Enrichment	17.51			18.74					36.25
	Present State	206.82	13.58		32.31					252.71
Utilized Land				43.88	222.06		322.46	41.16		629.56
Coppice Community Forest							38.76	9.72		48.48
Forest Reserve		14.72	11.39	23.40	552.95	323.95			8.59	935.00
Left-over Area									9.81	9.81

(1) Conservation Forest I

Conservation Forest I has an area of 478.74ha of which 97.15ha is in original forest, 35.80 ha is newly planted combined with 345.79ha undergoing enrichment for forest recovery, giving a total of 381.59ha.

① Annual Work Volume

The period has already been determined as 10 years. Planting, supplementary planting and brush cutting are actually carried out over a period of 7 years. The annual work volume is as follows.

Annual Work Volume (Unit: ha)

Activity	Area (ha)	Year							
		1-3	4	5	6	7	8	9	10
Planting	36	Preparation Period	*1	*1	12	12	12	-	-
Enrichment	345		63	63	52	52	52	63	-
Supplementary Planting	381		-	63	63	64	64	64	63
Brush Cutting	453		63	63	64	76	88	87	12
Total	1,215		126	189	191	204	216	214	75

*1 Planting is carried out along the boundaries of the classified forest to clarify boundaries.

② Implementation Methods

- Both planning and implementation are carried out directly by the DFRN.
- Local inhabitants are employed as workers and are paid wages.
- Necessary nursery stock is purchased from private nurseries by the DFRN.

③ Nursery Stock

The required quantity of nursery stock for new planting, enrichment and supplementary planting in Conservation Forest I is as follows.

Required Nursery Stock Volume (Unit: ha)

Category		Year							
		1-3	4	5	6	7	8	9	10
New Planting	Planting	Preparation Period	-	-	7,500	7,500	7,500	-	-
	Supplementary Planting		-	-	-	1,500	1,500	1,500	-
	Sub-Total		-	-	7,500	9,000	9,000	1,500	-
Enrichment	Planting		6,300	6,300	5,200	5,200	5,200	6,300	-
	Supplementary Planting		-	1,260	1,260	1,040	1,040	1,040	1,260
	Sub-Total		6,300	7,560	6,460	6,240	6,240	7,340	1,260
Total			6,300	7,560	13,960	15,240	15,240	8,840	1,260

④ Tree Type and Planting Density, etc.

Tree types and planting density are as follows.

(a) Tree Type (The same tree types are used for both new planting and enrichment.)

Khaya senegalensis, Ptetocarpus erinaceus, Isoberlinia supp., Vitellaria paradoxa, and Parkia biglobosa.

(b) Planting Density

Planting density for areas of new planting is 625 trees/ha (4m x 4m) while for areas of enrichment it is 100 trees/ha (10m x 10m).

(c) Supplementary Planting (The same tree types are used for both new planting and enrichment.)

The supplementary planting ratio is 20%.

(2) Conservation Forest II

Although Conservation Forest II is found in every zone, as according to management standards the way these zones are handled is the same, the total area of Conservation Forest II is 2,212.02ha. Forest in its present state is 1,087.07ha while the total area for forest recovery includes 78.33ha for new planting and 1,046.62ha for enrichment, making a total of 1,124.95ha.

Conservation Forest II (MANI-BOKE) (Unit: ha)

Management Methods	Zone	Forest Cover						Total
		Gf	Sa	Sb	St	Ch	Ja	
New Planting	Conservation Forest					70.39	4.90	75.29
	Production Forest						3.04	3.04
	Silvi-pastoral Forest							
	Village Forestry							
	Sub-Total					70.39	7.94	78.33
Enrichment	Conservation Forest	21.47	134.72	313.15	137.11			606.45
	Production Forest	11.87	38.88	163.42	95.49			309.66
	Silvi-pastoral Forest	6.00	6.15	50.89	31.22			94.26
	Village Forestry	17.51		18.74				36.25
	Sub-Total	56.85	179.75	546.2	263.82			1,046.62
Existing Forest	Conservation Forest	18.40	435.13	4.23				457.76
	Production Forest	126.53	38.35	52.87				217.75
	Silvi-pastoral Forest	96.59	17.36	44.90				158.85
	Village Forestry	206.82	Fc 13.58	32.31				252.71
	Sub-Total	448.34	504.42	134.31				1,087.07
Total		505.19	684.17	680.51	263.82	70.39	7.94	2,212.02

① Annual Work Volume

The period has already been determined as 10 years. Planting, supplementary planting and brush cutting are actually carried out over a period of 7 years. The annual work volume is as follows.

Annual Work Volume (Unit: ha)

Activity	Area (ha)	Year							
		1-3	4	5	6	7	8	9	10
Planting	78	Preparation Period	*1	*1	26	26	26	-	-
Enrichment	1,046		188	188	161	161	161	187	-
Supplementary Planting	1,124		-	188	188	187	187	187	187
Brush Cutting	1,280		188	188	187	213	239	239	26
Tending	1,124		-	-	-	-	-	-	1,124
Total	4,652		376	564	562	587	613	613	1,337

*1 Planting is carried out along the boundaries of the classified forest to clarify boundaries.

② Implementation Methods

- Both planning and implementation shall be carried out directly by the DFRN.
- Local inhabitants shall be employed as workers and are paid wages.
- Necessary nursery stock shall be purchased from private nurseries by the DFRN.

③ Nursery Stock

The required quantity of nursery stock for new planting, enrichment and supplementary planting in Conservation Forest II shall be as follows.

Required Nursery Stock Quantity (Unit: ha)

Category		Year							
		1-3	4	5	6	7	8	9	10
New Planting	Planting	Preparation Period	-	-	16,250	16,250	16,250	-	-
	Supplementary Planting		-	-	-	3,250	3,250	3,250	-
	Sub-Total		-	-	16,250	19,500	19,500	3,250	-
Enrichment	Planting		18,800	18,800	16,100	16,100	16,100	18,700	-
	Supplementary Planting		-	3,760	3,760	3,220	3,220	3,220	3,740
	Sub-Total		18,800	22,560	19,860	19,320	19,320	21,920	3,740
Total			18,800	22,560	36,110	38,820	38,820	25,170	3,740

④ Tree Type and Planting Density, etc.

Tree types and planting density are as follows.

(a) Tree Type (The same tree types are used for both new planting and enrichment.)

Khaya senegalensis, Ptetocarpus erinaceus, Isoberlinia supp., Vitellaria paradoxa, Parkia biglobosa and Milicia excelsa.

(b) Planting Density

Planting density for areas of new planting is 625 trees/ha (4m x 4m) while for areas of enrichment it is 100 trees/ha (10m x 10m).

(c) Supplementary Planting (The same tree types are used for both new planting and enrichment.)

The supplementary planting ratio is 20%.

(d) Tending

Clear-felling is carried out every 10 years.

(3) Timber Forest

The total area of timber forest is 1,161.95ha and felling is carried for timber production. Generally, systematic selective logging activities are carried out in order to achieve sustainable logging. This requires the existence of a forest with a certain structure. However, according to the results of forest survey, production forests are at present of low quality, making it impossible to carry out selective logging Therefore, logging will be carried out for a certain period of time in order to improve forest content through enrichment activities.

Fc accounts for 6.15ha, Sa for 646.92ha, Sb for 467.81ha, St for 12.61ha, Ch for 0.81ha, and Ja for 27.64ha of the forest type.

① Annual Work Volume

The annual work area is determined in the following way based on maturity, cutting cycle and selective logging ratio.

- Maturity: Although different species of trees reach maturity at different times, *Khaya senegalensis*, *Afzelia africana*, and *Milicia excalsa* reach maturity in 30 years.
- Cutting Cycle: 20 years.
- Selective Logging Ratio: 33% (1/3).

Selective logging of 58ha (58.10ha) or 1/20 of the 1,161.95ha total area of the timber forest shall be carried out annually with this being referred to as the selected logging area. 20 areas shall be established within the timber forest and given the numbers 1 to 20. The size of some of these sub-compartment may be smaller than 58ha.

② Logging/Regeneration

- As the Sa, Sb and St forest types are presently in bad condition at the first cutting cycle, enrichment shall be carried out, and in Ch and Ja forest types native tree species shall be planted, with a view to transforming them into a selective logging forest. When felling trees in this area, the above-mentioned 33% shall not apply but rather standing trees (including withered and damaged trees) with a DBH of no less than 35cm (with a GBH of no less than 110cm).
- From the 3rd year, the volume of timber from cutting blocks 1 through 8 shall be 279m^3.
- Under the improvement plan, from the second cutting cycle trees for logging shall have a DBH of no less than 35cm (GBH of no less than 110cm) and there shall be a selective logging ratio of 33%.
- Regeneration shall be carried out through natural seeding. In areas where this is difficult, seedlings or seed shall be planted.

③ Implementation Methods

- Both planning and implementation shall be carried out directly by the DFRN. Local inhabitants shall be employed as workers and shall be paid wages.
- Although the DFRN shall formulate plans, these shall be implemented by local organizations.
- Necessary nursery stock shall be purchased from private nurseries by the DFRN.

④ Nursery Stock

The required quantity of nursery stock for new enrichment in Timber Forests shall be carried out for half of the annual logging area (1/3 of 1 logging block; 1 logging block is 58ha). These shall be planted at a density of 100 trees/ha (10m x 10m) with supplementary planting being carried out the following year at a ratio of 20%.

(Required Nursery Stock Quantities)

The annually required quantity of seedlings is 1,000 trees in the 3rd year and 1,200 trees/year from the 4th year through to the 10th year.

Tiber Forest Work Area

Year	1-2	3	4	5	6	7	8	9	10
Selective Felling Block Area (ha)	Preparation Work	58	58	58	58	58	58	58	58
Logging Area (ha)		19	19	19	19	19	19	19	19
Logging Volume (m^3)		279	279	279	279	279	279	279	279
Enrichiment Area (ha)		10	10	10	10	10	10	10	10
Nursery Stock (Seedling)		1,000	1,200	1,200	1,200	1,200	1,200	1,200	1,200

(4) Fuelwood Forest

Fuelwood forest has a total area of 960.49ha. Fuelwood forest management and clear felling shall be carried out with the aim of fuelwood production. This fuelwood forest shall consist of 76.34ha of Sa, 451.14ha of Sb and 252.00ha of St, for a total of 779.38ha of native species and trees with a DBH of no less than 7cm shall be felled. The remaining 181.11ha, which consists of 162.02ha of Ch and19.09ha of Ja, both introduced species, shall be clear felled.

① Trees

Native Species: *Detarium microcarpum, Terminalia avicennoides, and Isoberlinia spp.*
Introduced Species: *Tectona grandis, Gmelina arborea, and Acacia auriculiformis.*

② Annual Work Volume

In order to even out the village income of each improvement unit, under the Basic Plan the Fuelwood Forest area is determined as 960ha. As the trees reach maturity in 7 years, the annual work area is 120ha. Bearing in mind environmental considerations, each annual logging area shall be approximately 10ha with this area including both fuelwood forest management forest and clear felled management forest. The work area for 10 years is as follows.

Fuelwood Forest Work Area (Unit: ha)

Operations		Year									
		1-2	3	4	5	6	7	8	9	10	11
Clear Felling (181ha)	Planting/Direct Grafting	Preparation	22	22	22	23	23	23	23	23	22
	Harvesting/ Logging		-	-	-	-	-	-	-	22	22
Coppice Forest Management (779ha)	Replanting (Direct Planting/Planting)		-	98	98	97	97	97	97	97	98
	Harvesting/ Logging		98	98	97	97	97	97	97	98	98

However, in the 10th year harvesting and logging for clear cutting management area shall be carried out in the area that was planted with seedlings and cuttings in the 3rd year and in the 11th year harvesting and logging shall be carried out in the area that was planted and with seedlings and cuttings in the 4th year. Regeneration (direct sowing and planting) in fuelwood forest management areas shall be carried out in areas that were harvested/logged the previous year. Furthermore, harvesting and logging in the 11th year shall be carried out in the area that was replanted (direct sowed and planted) in the 4th year.

③ Planting and Timber Production Volumes

In the above-mentioned fuelwood forest production plan area, the annual number of trees replanted in clear cutting management forests from the 3rd year through to the 10th year (when only seedlings are used) or the estimated timber production volume of the fuelwood forest (area of standing trees with a DBH of no less than 7cm for timber for use as firewood calculated based on forest survey records) is as follows.

Please note that although forest operations with regard to fuelwood forests is carried out by natural regeneration of native species of trees, initially direct planting of desired species of trees is carried out in order to create the fuelwood forest.

(a) Number of Seedlings Planted in Clear Cutting Management Forests (2,500 trees are planted per ha)

From the 3rd year until the 10th year, 55,000/57,500 trees will be planted annually. From the 11th year, regeneration will take place through germination.

(b) Coppice Forest Estimated Timber Production Volumes

Fuelwood Management Forest	3rd~10th year	97/98ha/annum	1,969/1,989m^3
	From the 11th year	97/98ha/annum	
Clear Cutting Management Forest	From the 10th year	22/23ha/annum	484/506m^3

(5) Grassland

In order to achieve improved grazing capacity and change the form of livestock grazing, cultivated land and fallow land that had been abandoned was artificially created into grassland. This land has an area of 436.09ha and is currently planted in Sa (158.03ha), Sb (6.75ha), St (3.67ha), Ch (180.83ha) and Ja (86.81ha).

① Improvement of Land for Pasture Establishment

Standing trees shall be logged and shrubs removed in the target area. Standing trees shall be logged and sold as timber or fuelwood and the proceeds put into the Forest Improvement Fund. Shrubs shall be used locally for fuel or stock fences.

② Types of Pasture

Gramineae shall consist of *Andoropogon gayanus* and *Pennisetum purpureum* while *Leguminosae* shall consist of *Stylosanthes hamata*. *Andoropogon gayanus* and *Stylosanthes hamata* shall be planted together while *Pennisetum purpureum* shall be planted in the surrounding area or in vacant ground.

③ Stock Fences

Stock fences shall be established to confine domestic livestock to certain areas and to effectively utilize grasslands. Feed trees, fuelwood trees, trees which are a source of nectar for bee-keeping, and shrubs shall be utilized to establish such fences which are to be established by the local inhabitants.

④ Utilization

Rotational grazing of grasslands is to be carried out in order to provide even feeding in terms of both quantity and nutrition. Three blocks are to be established within grassland areas, with rotational grazing of each block being carried out for 2 weeks after which it is given 4 weeks rest. Feed trees, fuelwood trees and trees which are a source of nectar for bee-keeping are to be planted in all grazing blocks.

⑤ Storage and Use of Grass

Hay is to be harvested and stored as much as possible during the dry season using what machinery is available. In order to keep the decrease in the nutritional value of the grass at a minimum, grass is to be cut and laid out thinly on the ground and turned once or twice every day in order to speed up the drying process.

⑥ Number of Breeding Stock

From the grassland production volume and the annual livestock feed requirements of mature cattle (250kg) (2,282kg), it can be calculated that 1,007 head of livestock can be reared on the grasslands. At the beginning of the plan only the existing number of livestock (mature cattle: 250kg) will be reared.

Number of Head of Stock on the Grasslands

Grassland	Area (ha)	Utilized Area (ha)	Dry Grass Production Volume (kg/ha)	Dry Grass Production Volume (ton)	Possible Number of Stock
Andoropogon gayanus	207	176	8,500	1,496	-
Stylosanthes hamata	207	176	3,630	639	-
Pennisetum purpureum	22	19	8,640	164	-
Total	436	371	-	2,299	1,007

(6) Woodland Pasture

In order to stabilize the number of stock grazing in the natural forest, the volume of grasses for domestic livestock to feed on shall be increased and the quality of pasture improved. This area consists of Sa (180.55ha), Sb (810.48ha), St (284.60ha), Ch (5.52ha), and Ja (24.57ha), giving a total of 1,305.72ha.

① Land Preparation

The crown density of standard trees in areas of Sa, Sb and St shall be reduced to 10% and shrubs removed (for use and sale as timber and fuelwood). Feed trees shall be planted in rows and overall crown density established at approximately 20%. Controlled burning shall be carried out after standing trees and shrubs have been removed.

② Types of Pasture

Natural *Graminea* grasses shall be retained and all weeds removed. When there is a shortage of *Graminea* grass in a particular area, pasture shall be planted with the aim of achieving 100% covering. Immediately after direct sowing grazing is to be carried out in order to establish it using the "hoof" method.

③ Utilization

Although it is possible to graze for a period of one year on fast-growing grass pasture, as it is difficult to graze during the first year with slow-growing *Leguminosae* pasture temporary stock fences should be established around the area and grazing delayed until root structure is adequately developed.

④ Number of Stock

From the Woodland Pasture production volume and the annual livestock feed requirements of mature cattle (250kg) (2,282kg), it can be calculated that 1,946 head of livestock can be reared on the Woodland Pasture. At the beginning of the plan only the existing number of livestock (mature cattle: 250kg) will be reared.

Number of Head of Stock in Woodland Pasture

Pasture	Area (ha)	Utilized Area (ha)	Dry Grass Production Volume (kg/ha)	Dry Grass Production Volume (ton)	Number of Stock
Wild Grass	1,306	1,045	4,250	4,441	1,946

(7) Grazing Community Forest

This area consists of forest in the silvi-pastoral zone other than Grassland, Woodland Pasture, and Conservation Forest II where improvement, etc. of grass is not being carried out. In areas of Fc, timber production shall be carried out in accordance with timber forest management. This includes areas of Fc (11.73ha) for a total of 11.73ha. Grazing shall be permitted within Conservation Forest II inside the Silvi-pastoral Zone.

(8) Utilized Land

In the Village Forestry Zone, each participating household (10.1 people: 6 adults/8 children) shall be permitted to use 2.0ha of cultivated land and 2.0ha of tree-planting land for a total of 4.0ha. (Households are permitted to use the land but the state retains ownership.) Based on aerial photographs taken during December 1998, residents participating in the Village Forestry Zone are those possessing cultivated land within the classified forest at that time. The total number of households in the village, the number of households in the Village Forestry Plan and the required area are as follows.

Village Population, Number of Households and Land Preparation Area

Population (persons)	Number of Households	Number of People per Household	Classified Forest Utilization Ratio	Number of Eligible Households	Utilized Land Area (ha)	Required Area (ha)
1,101	130	8.5	0.863	112	448	565

Utilized land consists of 16 compartments with a covering of Sa (43.88 ha), Sb (222.06 ha), Ch (322.46 ha), and Ja (41.16 ha) for a total of 629.56 ha. 1 sub-compartments with an area of 33.90 ha shall be used by 6 households, 4 sub-compartments with an area of 52.68 ha shall be used by 9 households, 10 sub-compartments with an area of 193.67 ha shall be used by 36 households, 12 sub-compartments with an area of 33.72 ha shall be used by 6 households, 15 sub-compartments with an area of 61.50 ha shall be used by 11 households, 16 sub-compartments with an area of 23.86 ha shall be used by 4 households, 17 sub-compartments with an area of 25.40 ha shall be used by 4 households, 22 sub-compartments with an area of 94.37 ha shall be used by 17 households, 25 sub-compartments with an area of 23.84 ha shall be used by 4 households, 28 sub-compartments with an area of 27.15 ha shall be used by 5 households, 30 sub-compartments with an area of 31.62 ha shall be used by 5 households, and 32 sub-compartments with an area of 27.85 ha shall be used by 5 households.

① Commercial Farming

Commercial farming will be improved throuth extension activities regarding the improvement of crop-growing systems, cultivation methods, post-harvest processing, and through activities to enlighten farmers, including the necessity of a forest management plan.

(a) Improving Crop Growing Systems

a) Selection of Crops

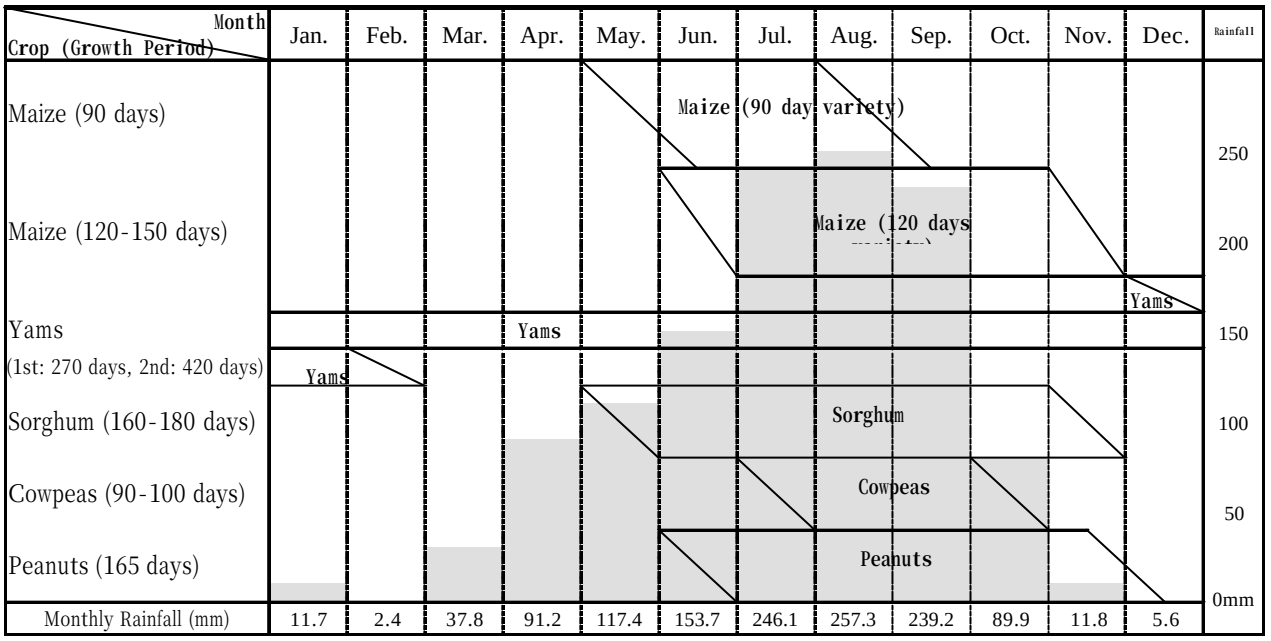
Under the terms of the Forest Management Plan, yams, maize and sorghum, shall be the main subsistence crops with peanuts and cowpeas being grown as intercrops.

b) Introduction of New Varieties (Improved Varieties)

As presently grown varieties are mainly native varieties, 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) varieties. However, as the introduction and extension of new varieties takes time, farmers will be instructed to select reliable seeds for immediate use. Improved maize with a growth period of 90 days and native varieties with a growth period of 120 days shall both be introduced.

c) Improving Crop Growing Systems

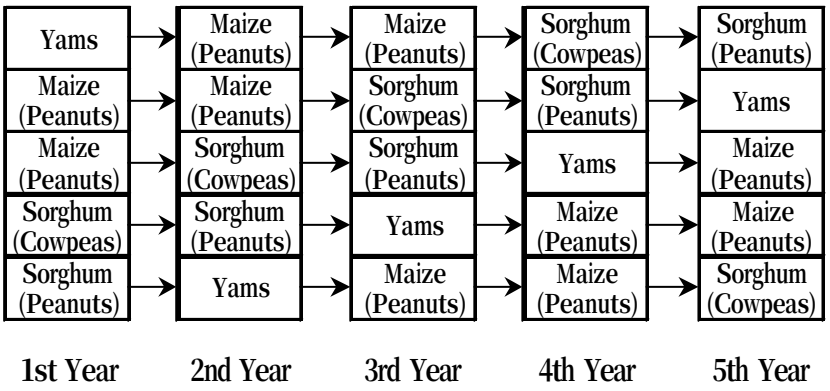
The above-mentioned improved crop growing system that gives consideration to crops and varieties is shown in the following diagram. Varieties of maize with growth periods of both 90 days and 120 days shall be introduced with two crops being grown each year. By using varieties with growing periods that are shorter than those of native varieties, this system enables the most effective utilization of the limited rainy season.



Crop Growing System Plan

d) Crop Rotation

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 rotational crop system is as shown below.



(b) Improved Growing Methods

a) Improvement of Cultivation Using Animal Power and Farming Tools

Cultivation using animal power will be introduced for joint use on condition that it will be used for contracted ploughing. Existing farming tools will be improved.

b) Materials for Agricultural Production

a. Seeds

New varieties of seeds will be introduced and sown in appropriate quantities.

b. Fertilizer

Locally obtainable organic fertilizer will be used. Where soil analysis reveals this supply to be insufficient, the use of chemical fertilizers, such as urea, will be considered. In order to expand the use of organic fertilizer, composting techniques will be taught. *Leguminosae* plants (green manure crops), such as *Mucuna pruriens*, which are a source of nitrogen, shall be ploughed in.

c) Improvement of Growing Techniques

Matters to bear in mind with regard to growing include the following.

- Deep ploughing 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.

d) 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.

- The introduction of disease and pest-resistant varieties.
- The introduction of crop rotation.
- The implementation of mixed planting and intercropping.
- Consideration of planting density.

(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 a 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.

With regard to storage, as *Leguminosae* cash crops, such as peanuts, etc., are susceptible to damage from pests while in storage, they should be mixed with wood ash and silica-seaweed soil mix, etc. and stored to prevent the breeding of pests.

② Afforestation Plan

The planting of forest and fruit trees within the 2.0ha of utilized land for the production of posts and fuelwood shall be planned in the following way. However, trees shall be selected individually by the local inhabitants themselves.

(a) Post and Fuelwood Production Forest

Trees to be planted in this area are *Tectona grandis* and *Gmelina arborea*. Planting density shall be 2,500 trees/ha (2m x 2m) with *Tectona grandis* being stamp planted and *Gmelina arborea* being either stamp planted or direct grafted.

With stamp planting, as 4~5 sprouts appear, they shall be thinned out after 1 year with straight seedlings being left for 3 years.

The cutting cycle shall be 5 years with 0.4ha (1/5 of 2.0ha) being planted and felled each year. In planted areas, intercropping shall be carried out (Taungya System) for 2 years after planting. Spacing in this case shall be 3m x 1.5m (2,220 trees/ha). Annual plans shall be as follows.

Posts and Fuelwood Production Forest Plan

Year	Planting (ha)		Harvesting (ha)	Intercropping (ha)	Comments
1	0.4	Planting	—	2.0	Yams.
2	0.4	Planting	—	2.0	Yams or maize.
3	0.4	Planting	—	1.6	Maize (Intercropping of the 0.4ha of the 1st year is unnecessary.)
4	0.4	Planting	—	0.8	Maize (Intercropping of the 0.8ha of the 1st and 2nd years is unnecessary.)
5	0.4	Planting	—	0.8	Yams (Intercropping of the 1.2ha of the 1st, 2nd and 3rd years is unnecessary.)
6	0.4	1st year after Germination	0.4 (1st year Forest)	0.8	Yams or maize (5th year reverts to 1st year.)
7	0.4	2nd year after Germination	0.4 (2nd year Forest)	0.8	Yams or maize (Reverts to 1st and 2nd years.)
…	…	……	……	…….	

(b) Fruit Trees

Fruit trees to be planted in this area are cashews. Planting density shall be 100 trees/ha (10m x 10m). Although trees will start to bear fruit approximately 18 months after planting, from the 6th year to the 10th year only 1 ton shall be harvested per ha with 2 tons per ha being harvested from the 11th year onwards. As cashews easily catch fire, firebreaks or belts of fire-resistant trees shall be established to prevent fire from entering from the surrounding area.

③ Bee-Keeping

As honey production is a desirable way of providing a cash income to the local inhabitants, bee-keeping activities should be introduced and actively encouraged in the area in order to achieve stable production. Trees to be planted are *Acacia auriculiformis*, *Newboudia laevis*, *Detarium microcarpun* and *Burkea africana*.

④ *Vitellaria paradoxa*

Although *Vitellaria paradoxa* has been retained in cultivated areas, there are no young trees bearing fruit or for growing crops and as the trees are old, in many cases production volumes have decreased. After *Vitellaria paradoxa* has been newly planted around the perimeter of the cultivated land, it will be possible to raise replacement trees and to carry out harvesting.

(9) Fuelwood Community Forest

38.76ha of previously cultivated land apart from land for use by local inhabitants and 9.72ha of previously fallow ground making a total of 48.48ha of land within the Village Forestry Zone shall

be used as a fuelwood forest for the production of fuelwood for sale by the village. This fuelwood forest is for joint use by the village and shall be managed by the organization in each improvement unit.

Species of trees to be planted in the fuelwood forest include *Prosopis sp*., *Terminalia spp*., and *Gmelina arborea*, etc. Of these fuelwood of trees, good quality charcoal can be obtained from *Prosopis sp.*, and *Gmelina arborea*. The planting density for this area is 2,500 trees/ha (2m x 2m). As the cutting cycle is 7 years, 7ha shall be felled and replanted each year with annual charcoal production volumes reaching 154m^3 (7ha x 22m^3/ha=154m^3).

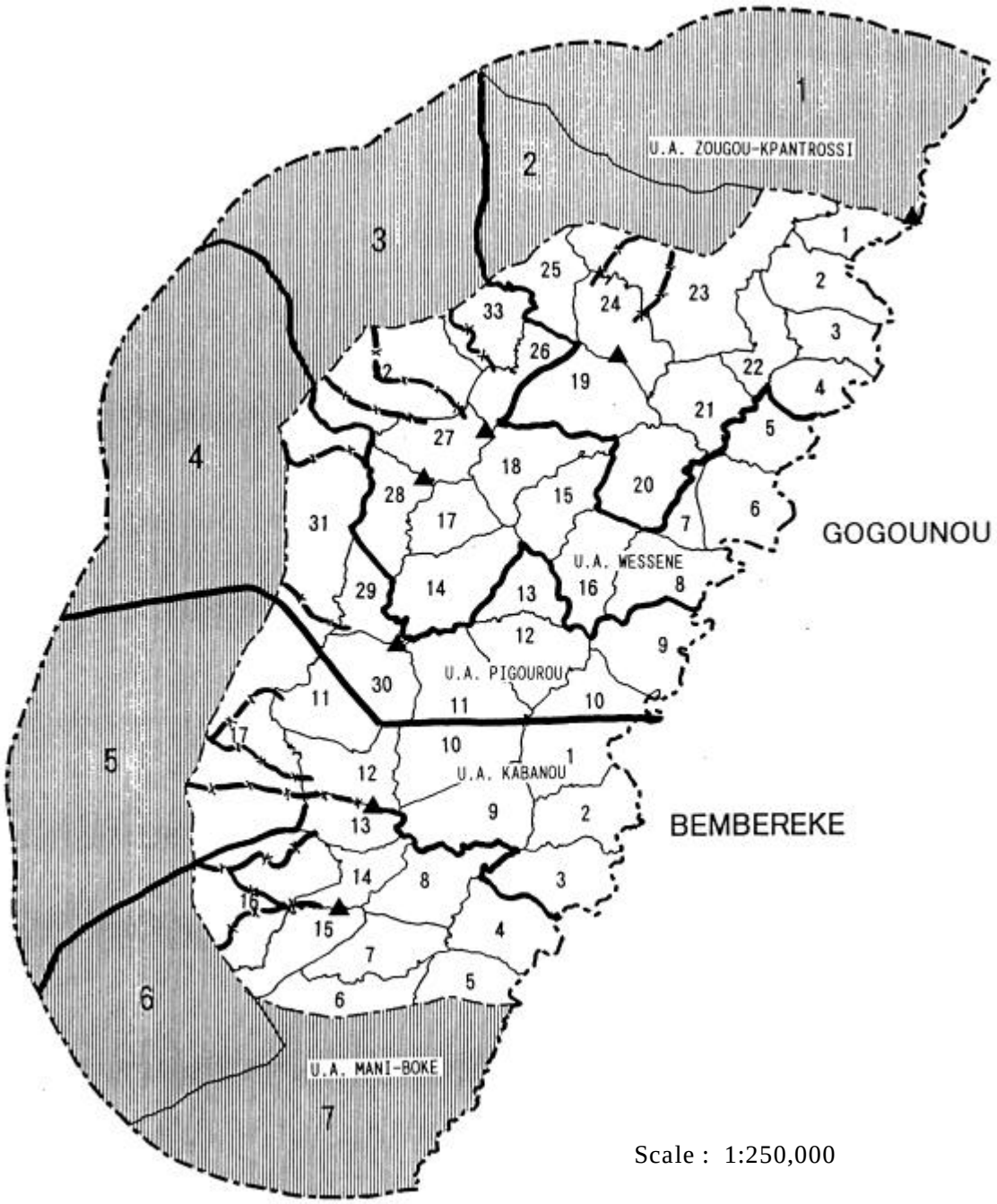
(10) Forest Reserve

Areas of forest in the Village Forestry Zone other than Conservation Forest II, Utilized Land, Fuelwood Community Forest and Left-over Area shall be retained as Forest Reserve. Forest Reserve contains 14.72ha of Gf, 11.39ha of Fc,23.40ha of Sa, 552.95ha of Sb, 323.95ha of St, and 8.59 ha of others (Ag) making a total of 935.00ha. It is possible that the 23.40ha of Sa may be transferred to Utilized Land in the future.

Areas of Sb and St shall be transferred from outside the classified forest to the Silvi-pastoral Zone within the classified forest without becoming part of Cultivated Land or Tree-planting Land to become paths for the passage of livestock. When such paths pass through Utilized Land, a path with a width of 50m shall be established and a 3m wide belt of *Gmelina arborea* and *Acacia auriculiformis* planted at a spacing of 1.5m x 1.5m on the boundary either side of the path. The planned livestock path shall be extended by 12,500m as shown in the following diagram.

(11) Left-Over Area

Left-over Area is land other than forest (Gf, Fc, Sa, Sb and St) and cultivated and fallow land that shall be retained in its present state and shall be outside the scope of management. Left-over Area consists of 18.69ha of Ce, 83.95ha of Cl and 41.85ha of Tm for a total of 144.49ha.



Key	
1~7	Buffer Zone
1~33	Classified Forest
	Improvement Unit Boundary
U.A.	Improvement Unit
x	Livestock Path
▲	Waterhole

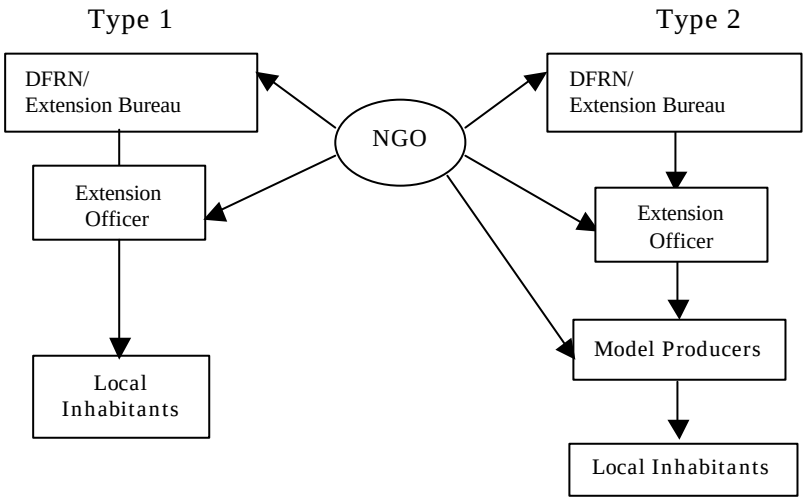
Livestock Paths

10 Extension and Training Plans

Existing extension activities are carried out under the jurisdiction of the Extension Bureau of the Ministry of Rural Development 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.



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 seedlings for mountain areas, etc. Furthermore, training of nursery officers within local organizations will also be carried out.

(2) Bee-Keeping

Bee-keeping 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.

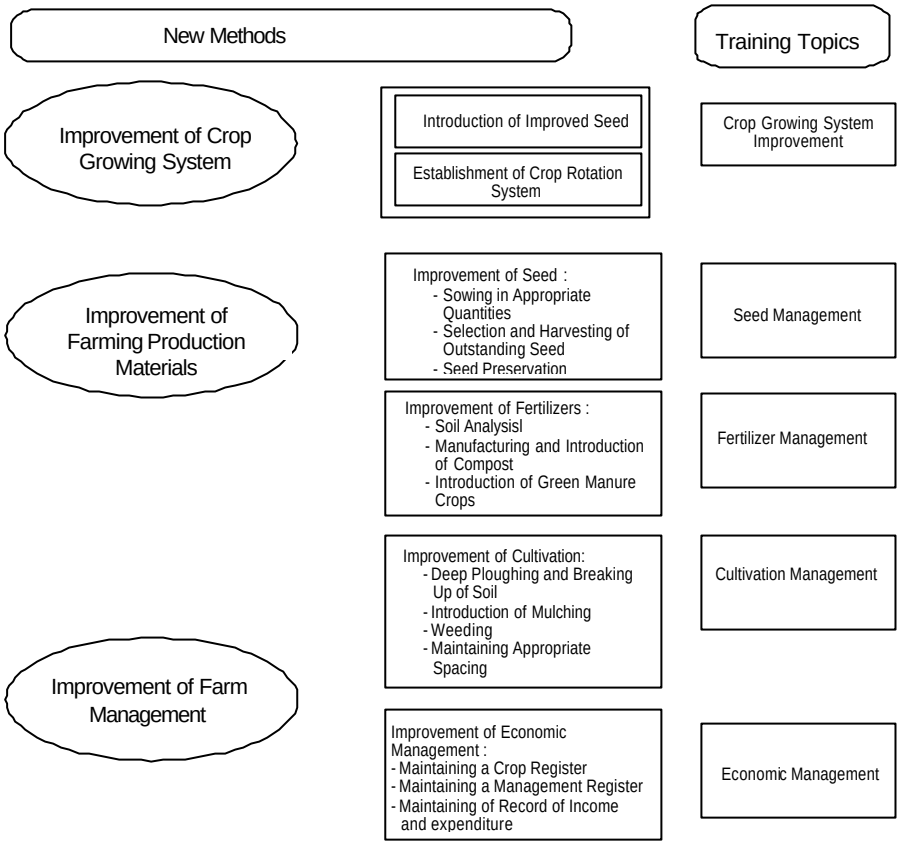
(3) Charcoal Production

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.

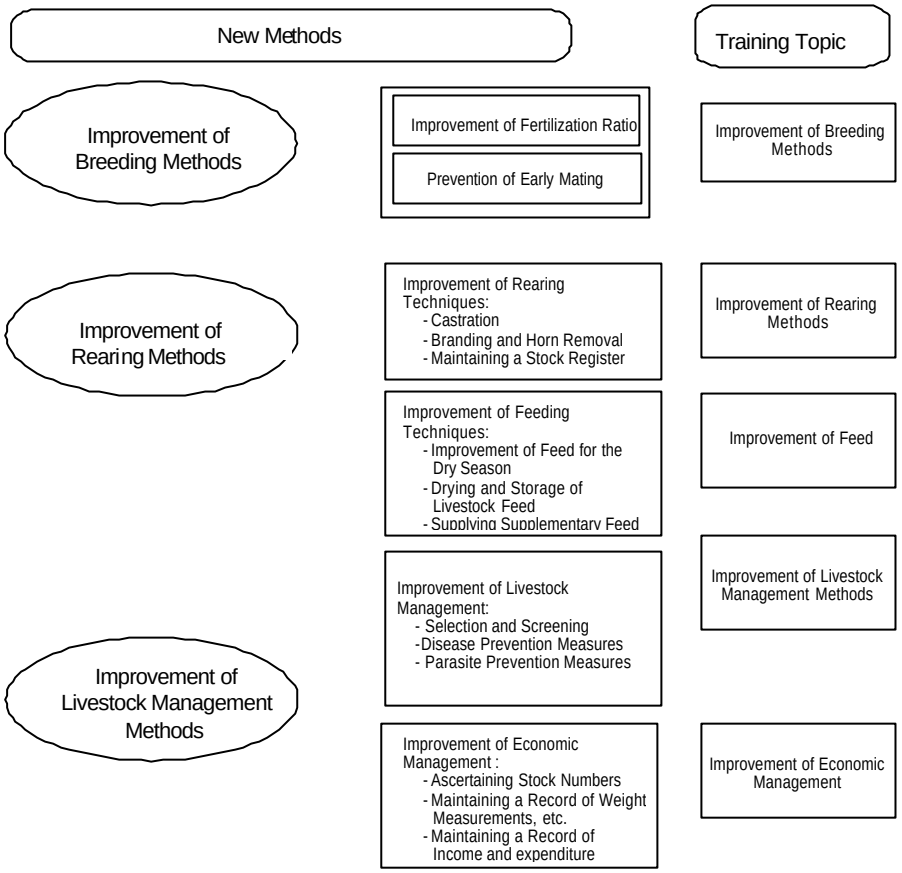
Details regarding new techniques and training topics for commercial farming improvement are as follows.



Training Topics for Commercial Farming Improvement

(5) Livestock Farming

Details regarding new techniques and training topics for the improvement of breeding techniques, rearing techniques and livestock management are as follows.



Livestock Farming Training Topics

11. Infrastructure Improvement Plan

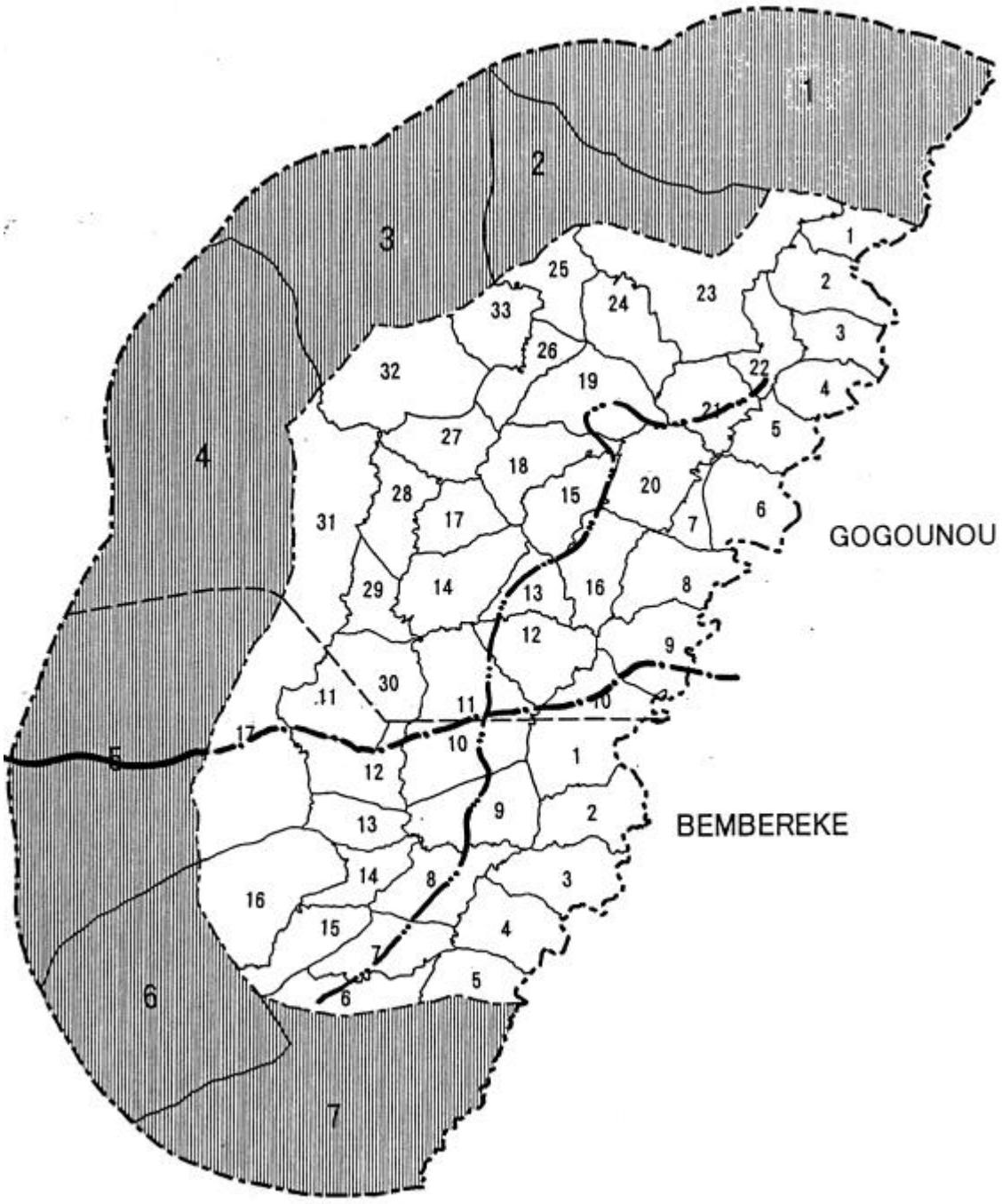
(1) Forest Roads

The access road to the classified forest is the road running from Beroubouay on State Highway 2 via Kabanou~Koussine and forest roads for the management of production forests within the classified forest and the management of Conservation Forest shall join this access road. A main forest road will be established from the access road to the Bouli River with other minor roads being established from the main forest road to production forests within each improvement unit. The length of the main forest road shall be 19.5km with the length of other minor roads in each improvement unit being as shown below. However, within Conservation Forest work roads will link up with the main forest road and other minor roads. The roads mentioned bolow are shown in the following map.

Zougou-Kpantrossi Improvement Unit	9.5km
Wessens Improvement Unit	5.5km
Pigourou Improvement Unit	7.4km
Kabanou Improvement Unit	5.1km
Mani-Boke Improvement Unit	7.9km

(2) Village Nursery

In order to produce seedlings in each improvement unit for planting in each zone of the classified forest, a nursery operated by the village shall be established in each village. Management, operation and maintenance of the nursery shall be carried out by the Forest Improvement Unit Committee, which is an organization comprised of local inhabitants. All seedlings produced shall be for commercial sale with income from such sales going into a Forest Improvement Fund. Seedling production scale by improvement unit is as shown below.



Scale: 1:250,000

Key	
1~7	Buffer Zone
1~33	Classified Forest
	District Boundary
	Access Road
	Main Forest road
	Spur roads

Forest road plan Map

Seedling production Volume

Unit: Seedling

Improvement Unit	Year								
	3	4	5	6	7	8	9	10	Total
ZOUGOU-KPANTROSSI	140,700	178,340	185,840	259,765	275,075	275,180	200,839	148,360	1,664,099
WESSENE	53,400	92,680	100,500	131,675	137,910	138,435	102,740	60,580	817,920
PIGOUROU	60,800	83,860	90,940	90,940	91,040	91,060	91,060	68,060	667,760
KABAKOU	128,300	169,360	177,540	193,490	196,680	196,680	180,830	136,660	1,379,540
MANI-BOKE	56,000	81,300	86,320	108,770	112,760	112,760	92,710	63,700	714,320
Total	439,200	605,540	641,140	784,640	813,465	814,115	668,179	477,360	5,243,639

(3) Forest Management Center

The main organization carrying out the implementation of Forest Improvement plans is the Forest Improvement Committee, which is organized by the local inhabitants. However, as there are restrictions on the use of the classified forest by local inhabitants it is necessary to bring some form of stability to the lives of local inhabitants through regional promotion. Furthermore, a survey of local inhabitants revealed that there is a high proportion of women involved in the use of the classified forest, making their participation in the management of the classified forest essential. Therefore, a Forest Management Center will be established for forest improvement and to improve the place of women in society. Training to be carried out at the Forest Improvement Center includes literacy education for women using the center, which have a poor rate of literacy, and training, etc., which will provide a diversified means of income.

12. Buffer Zone Management Plan

A buffer zone running for 7km encircles the classified forest within which Conservation Forest will be established as part of the management plan of the classified forest. Such Conservation Forest will be handled in accordance with the management plans of the classified forest.

The area of the buffer zone is 12,560.54ha and consists of the forest cover type shown in the chart below.

Land Area by Improvement Unit, Land Use and Forest Type (Buffer Zone)

(Unit:ha)

Cate-gory	Forest Type Symbol	GOGONOU				BEMBEREKE			Total
		ZOUGOU-KPANTROSSI	WESSENE	PIGOROU	Subtotal	KABANOU	MANI-BOKE	Subtotal	
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
	Sub-total	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
	Sub-total	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

The buffer zone is a free zone which the local inhabitants are free to use for cultivation, livestock grazing, fruit harvesting, and other use. However, the felling or trimming, etc. of protected species of trees within the forest is prohibited.

Conservation Forest shall be established in the following areas within the buffer zone and shall be handled in the same way as Conservation Forest II within the classified forest. However, areas considered by the local inhabitants to be areas of sacred forest shall be handled in the same way as Conservation Forest I.

Areas to be designated as Conservation Forest are as follows.

- Areas within 25m of either side of waterways which shall be preserved to protect water resources and prevent soil and sand from being washed into the waterways.
- Forest on residual relief and tectonic relief.
- Forest in savannah and laterite terraces.
- Areas of forest where soil protection is required.
- Areas of forest preserved as sacred forest by villagers.

The location and scope of the above-mentioned Conservation Forest shall be clarified by the Forest DFRN and recorded in the map register. As the productivity of the land in buffer zone has decreased as a result of continuous slash and burn type agriculture it has become fallow ground or is illegally cultivated within the classified forest.
If the improvement plan for the classified forest can be successfully formulated, cultivation will be limited to established farming carried out in limited space. Consequently, established farming will also increase within the buffer zone allowing the effective utilization of cultivated land and fallow land where productivity has decreased. The introduction of agroforestry within the buffer zone will be actively encouraged.

(1) Agroforestry in Areas of Cultivated Land and Fallow Land

① 2ha 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 2~5ha Cultivated Land

2ha is used to grow food crops while the remaining 1~3ha shall be planted in trees and agroforestry undertaken with forest products being harvested and cash crops being grown as intercrops. 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 (10m x 10m).
- *Vitellaria paradoxa*: Limited production of fruit from *Vitellaria paradoxa* can be carried out. The planting density of these trees is 200 trees/ha (5m x 10m).
- Teak: Post production is the reason for planting teak. Trimmed branches, etc. shall be used for firewood. 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 5ha

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 (4m x 2m). 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) Bee-Keeping

As cultivated land and the area surrounding cultivated land is unsuitable for bee-keeping, 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 bee-keeping in grassland or areas of low shrubs, 12 beehives shall be positioned in each hectare.

(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.

APPENDIXES

Appendix-1 Soil Survey

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 the table below according to soil profile characteristics from the results of soil profile description.

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 sediment 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 horizon 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 horizon 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.

2. Soil Distribution and Soil Characteristics

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. 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 the table below. 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 profile 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.

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

Appendix-2 Land Area by Forest Type

Management Unit	Gougounou
Improvement Unit	Zougou

(Unit: ha)

Forest Compartment	Zone	Current Forest Type		Conservation Forest I			Consevation Forest II			Timber Forest		Fuelwood Forest		Silvi-Pastral			Village Forestry			Left-Over Areas
		Symbole	Land Area	Planting	Enrichiment	Original State	Planting	Enrichiment	Original State	Planting	Felling and Regeneration	Planting	Felling and Regeneration	Grassland	Woodland Pasture	Grazing Community Forest	Utilized Land	Fuelwood Community Forest	Forest Reserve	
1	FFC	Gf	76.55			40.82		12.73	23.00											
		Sa	69.43		31.95			37.48												
		Sb	103.94		26.07			77.87												
		St	37.74		10.88			26.86												
		Ch	185.90	57.47			128.43													
		Ja	69.09	10.09			59.00													
		Ce	10.62																	10.62
		Cl	5.00																	5.00
	Total		558.27	67.56	68.90	40.82	187.43	154.94	23.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.62
2	FFC	Gf	56.78			27.49			29.29											
		Sa	376.51		45.36	42.70		271.95	16.50											
		Sb	362.80		40.95	53.01		259.71	9.13											
		St	38.35		19.09			19.26												
		Ch	68.92	15.59			53.33													
		Ja	39.62				39.62													
		Cl	12.14																	12.14
	Total		955.12	15.59	105.40	123.20	92.95	550.92	54.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.14
3	FFC	Gf	31.32			11.66			19.66											
		Sa	228.22		50.56			45.14	132.52											
		Sb	297.20		22.07	27.66		15.00	232.47											
		St	53.48		16.66	36.82														
		Ch	19.33	7.50			11.83													
		Ce	3.25																	3.25
		Cl	19.65																	19.65
	Total		652.45	7.50	89.29	76.14	11.83	60.14	384.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	22.90
4	FFC	Gf	39.56		5.12	29.73		4.71												
		Sa	260.41		18.81	33.43		60.14	148.03											
		Sb	263.63		105.90	4.45		139.17	14.11											
		St	54.85		28.73			26.12												
		Ch	25.11																	25.11
		Tm	2.27																	2.27
	Total		645.83	0.00	158.56	67.61	0.00	230.14	162.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27.38

Appendix-2 Land Area by Forest Type

Management Unit	Gougounou
Improvement Unit	Zougou

(Unit: ha)

Forest Compartment	Zone	Current Forest Type		Conservation Forest I			Consevation Forest II			Timber Forest		Fuelwood Forest		Silvi-Pastral			Village Forestry			Left-Over Areas
		Symbole	Land Area	Planting	Enrichiment	Original State	Planting	Enrichiment	Original State	Planting	Felling and Regeneration	Planting	Felling and Regeneration	Grassland	Woodland Pasture	Grazing Community Forest	Utilized Land	Fuelwood Community Forest	Forest Reserve	
19	FFP	Gf	35.26					11.32	23.94											
		Fc	4.23								4.23									
		Sa	614.04					52.13	50.64		128.35		382.92							
		Sb	473.61					8.29	13.07		5.62		446.63							
		St	221.51					4.75			14.17		202.59							
		Ch	5.70									5.70								
		Tm	10.89																	10.89
	Total		1365.24	0.00	0.00	0.00	0.00	76.49	87.65	0.00	152.37	5.70	1032.14	0.00	0.00	0.00	0.00	0.00	0.00	10.89
20	FFP	Gf	37.87					4.72	33.15											
		Sa	562.88						3.04		422.93		136.91							
		Sb	448.73					7.60	4.06		2.73		434.34							
		St	74.16					1.82			7.13		65.21							
		Ch	32.07									32.07								
		Tm	1.57																	1.57
	Total		1157.28	0.00	0.00	0.00	0.00	14.14	40.25	0.00	432.79	32.07	636.46	0.00	0.00	0.00	0.00	0.00	0.00	1.57
21	FFP	Gf	69.75						69.75											
		Sa	329.51						49.27		223.70		56.54							
		Sb	355.96					10.19	10.68		9.69		325.40							
		St	43.18					10.27					32.91							
		Ch	59.89									59.89								
		Ja	89.94									89.94								
	Total		948.23	0.00	0.00	0.00	0.00	20.46	129.70	0.00	233.39	149.83	414.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	FFP	Gf	8.30						8.30											
		Sa	255.60						79.98		33.12		142.50							
		Sb	129.73					27.71	4.52		7.97		89.53							
		St	45.71					4.77					40.94							
		Ch	128.34				3.95					124.39								
		Ja	140.16				2.14					138.02								
	Total		707.84	0.00	0.00	0.00	6.09	32.48	92.80	0.00	41.09	262.41	272.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Appendix-2 Land Area by Forest Type

Management Unit	Gougounou
Improvement Unit	Zougou

(Unit: ha)

Forest Compartment	Zone	Current Forest Type		Conservation Forest I			Consevation Forest II			Timber Forest		Fuelwood Forest		Silvi-Pastral			Village Forestry			Left-Over Areas
		Symbole	Land Area	Planting	Enrichiment	Original State	Planting	Enrichiment	Original State	Planting	Felling and Regeneration	Planting	Felling and Regeneration	Grassland	Woodland Pasture	Grazing Community Forest	Utilized Land	Fuelwood Community Forest	Forest Reserve	
24	SP	Gf	79.24					10.36	47.06							21.82				
		Fc	3.93													3.93				
		Sa	261.71					38.28	35.06					162.74	25.63					
		Sb	377.06					41.71						12.95	322.40					
		St	176.71					4.85							171.86					
		Ch	84.42				1.17							83.25						
		Ja	16.55											16.55						
		Ce	2.84																	2.84
		Cl	28.08																	28.08
	Total		1030.54	0.00	0.00	0.00	1.17	95.20	82.12	0.00	0.00	0.00	0.00	275.49	519.89	25.75	0.00	0.00	0.00	30.92
25	SP	Gf	14.83					14.83												
		Sa	256.71					13.92	34.73					138.27	69.79					
		Sb	297.77					15.04						8.52	274.21					
		St	159.91					7.04						3.28	149.59					
		Ch	38.91											38.91						
		Cl	6.72																	6.72
		Td	5.90																	5.90
		Tm	7.54																	7.54
	Total		788.29	0.00	0.00	0.00	0.00	50.83	34.73	0.00	0.00	0.00	0.00	188.98	493.59	0.00	0.00	0.00	0.00	20.16
23	FV	Gf	137.73					23.80	59.08										54.85	
		Sa	451.59					46.28	62.74								220.43		122.14	
		Sb	524.90					45.15											479.75	
		St	166.89																166.89	
		Ch	640.71				8.32										602.13	30.26		
		Ja	761.37				1.47										746.62	13.28		
		Ce	15.07																	15.07
		Cl	11.01																	11.01
	Total		2709.27	0.00	0.00	0.00	9.79	115.23	121.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1569.18	43.54	823.63	26.08

Appendix-2 Land Area by Forest Type

Management Unit	Gougounou
Improvement Unit	Wessene

(Unit: ha)

Forest Compartment	Zone	Current Forest Type		Conservation Forest I			Consevation Forest II			Timber Forest		Fuelwood Forest		Silvi-Pastral			Village Forestry			Left-Over Areas
		Symbole	Land Area	Planting	Enrichiment	Original State	Planting	Enrichiment	Original State	Planting	Felling and Regeneration	Planting	Felling and Regeneration	Grassland	Woodland Pasture	Grazing Community Forest	Utilized Land	Fuelwood Community Forest	Forest Reserve	
5	FFC	Gf	96.69		23.23	16.00			57.46											
		Sa	327.35			50.87		92.75	183.73											
		Sb	175.33		21.46			125.78	28.09											
		St	4.44					4.44												
		Ch	82.34	51.82			30.52													
		Ja	28.26				28.26													
	Total		714.41	51.82	44.69	66.87	58.78	222.97	269.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	FFC	Gf	78.08			64.85			13.23											
		Sa	528.35		38.64	115.04		137.89	236.78											
		Sb	357.06		62.21			236.81	58.04											
		St	34.99					34.99												
		Cl	6.10																	6.10
	Total		1004.58	0.00	100.85	179.89	0.00	409.69	308.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.10
7	FFC	Gf	30.20						30.20											
		Sa	159.91					35.19	124.72											
		Sb	141.07					138.86	2.21											
		Cl	7.12																	7.12
	Total		338.30	0.00	0.00	0.00	0.00	174.05	157.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.12
8	FFC	Gf	52.44			26.90			25.54											
		Sa	371.25			42.08		242.76	86.41											
		Sb	436.01		62.10			373.91												
		St	152.26		49.70			102.56												
		Cl	12.96																	12.96
		Tm	21.93																	21.93
	Total		1046.85	0.00	111.80	68.98	0.00	719.23	111.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	34.89
14	FFP	Gf	53.06					16.47	32.11		4.48									
		Sa	321.39						25.86		225.31		70.22							
		Sb	653.40					13.76			62.21		577.43							
		St	181.85										181.85							
		Ch	16.82									16.82								
		Ja	21.21									21.21								
		Cl	35.49																	35.49
		Tm	14.62																	14.62
	Total		1297.84	0.00	0.00	0.00	0.00	30.23	57.97	0.00	292.00	38.03	829.50	0.00	0.00	0.00	0.00	0.00	0.00	50.11

Appendix-2 Land Area by Forest Type

Management Unit	Gougounou
Improvement Unit	Wessene

(Unit: ha)

Forest Compartment	Zone	Current Forest Type		Conservation Forest I			Consevation Forest II			Timber Forest		Fuelwood Forest		Silvi-Pastral			Village Forestry			Left-Over Areas
		Symbole	Land Area	Planting	Enrichiment	Original State	Planting	Enrichiment	Original State	Planting	Felling and Regeneration	Planting	Felling and Regeneration	Grassland	Woodland Pasture	Grazing Community Forest	Utilized Land	Fuelwood Community Forest	Forest Reserve	
15	FFP	Gf	35.94						35.94											
		Sa	277.30						4.56		207.20		65.54							
		Sb	390.31					12.09			20.89		357.33							
		St	90.14										90.14							
		Ch	18.77									18.77								
		Ja	17.00									17.00								
		Cl	30.78																	30.78
		Tm	5.42																	5.42
	Total		865.66	0.00	0.00	0.00	0.00	12.09	40.50	0.00	228.09	35.77	513.01	0.00	0.00	0.00	0.00	0.00	0.00	36.20
16	FFP	Gf	54.95					5.40	49.55											
		Sa	439.32					13.60	2.88		219.50		203.34							
		Sb	430.09					59.69			1.25		369.15							
		St	20.93					3.99					16.94							
		Ar	3.49																	3.49
		Cl	3.07																	3.07
		Tm	5.97																	5.97
	Total		957.82	0.00	0.00	0.00	0.00	82.68	52.43	0.00	220.75	0.00	589.43	0.00	0.00	0.00	0.00	0.00	0.00	12.53
17	FFP	Gf	22.32						22.32											
		Sa	165.78					8.11	18.15		113.02		26.50							
		Sb	363.87						24.28				339.59							
		St	71.23										71.23							
		Ch	75.07				2.09					72.98								
		Ja	6.35									6.35								
		Ce	3.43																	3.43
		Cl	5.77																	5.77
	Total		713.82	0.00	0.00	0.00	2.09	8.11	64.75	0.00	113.02	79.33	437.32	0.00	0.00	0.00	0.00	0.00	0.00	9.20
18	FFP	Gf	60.69						60.69											
		Sa	556.91					51.63	96.07		260.25		148.96							
		Sb	216.38					75.86	31.01		7.46		102.05							
		St	148.14					28.15			8.12		111.87							
		Ch	27.94				11.35					16.59								
		Ja	12.93				10.36					2.57								
		Cl	15.01																	15.01
		Tm	1.99																	1.99
	Total		1039.99	0.00	0.00	0.00	21.71	155.64	187.77	0.00	275.83	19.16	362.88	0.00	0.00	0.00	0.00	0.00	0.00	17.00

Appendix-2 Land Area by Forest Type

Management Unit	Gougounou
Improvement Unit	Wessene

(Unit: ha)

Forest Compartment	Zone	Current Forest Type		Conservation Forest I			Consevation Forest II			Timber Forest		Fuelwood Forest		Silvi-Pastral			Village Forestry			Left-Over Areas
		Symbole	Land Area	Planting	Enrichiment	Original State	Planting	Enrichiment	Original State	Planting	Felling and Regeneration	Planting	Felling and Regeneration	Grassland	Woodland Pasture	Grazing Community Forest	Utilized Land	Fuelwood Community Forest	Forest Reserve	
26	SP	Gf	75.94					7.69	60.47							7.78				
		Sa	214.22											200.74	13.48					
		Sb	104.81												104.81					
		St	98.09												98.09					
		Ch	179.82				10.40							169.42						
		Ja	17.86											17.86						
	Total		690.74	0.00	0.00	0.00	10.40	7.69	60.47	0.00	0.00	0.00	0.00	388.02	216.38	7.78	0.00	0.00	0.00	0.00
27	SP	Gf	44.45						44.45											
		Sa	112.07						23.07					56.21	32.79					
		Sb	284.49					21.92							262.57					
		St	51.72					0.68							51.04					
		Ch	299.77											299.77						
		Ja	56.96											56.96						
		Cl	12.17																	12.17
	Total		861.63	0.00	0.00	0.00	0.00	22.60	67.52	0.00	0.00	0.00	0.00	412.94	346.40	0.00	0.00	0.00	0.00	12.17
28	SP	Gf	63.73					10.95	52.78											
		Sa	10.69											10.69						
		Sb	533.49					6.23						18.84	508.42					
		St	69.83												69.83					
		Ch	155.10				19.83							131.62	3.65					
		Ja	35.89											35.89						
		Cl	6.62																	6.62
	Total		875.35	0.00	0.00	0.00	19.83	17.18	52.78	0.00	0.00	0.00	0.00	197.04	581.90	0.00	0.00	0.00	0.00	6.62
32	FV	Gf	159.57					5.36	7.46										146.75	
		Fc	13.07														13.07			
		Sa	70.20					8.04									36.61		25.55	
		Sb	648.71					6.65									156.28		485.78	
		St	171.31																171.31	
		Ch	707.24														674.16	33.08		
		Ja	196.77														179.67	17.10		
		Ce	10.22																	10.22
		Cl	6.28																	6.28
		Tm	2.60																	2.60
	Total		1985.97	0.00	0.00	0.00	0.00	20.05	7.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1059.79	50.18	829.39	19.10

Appendix-2 Land Area by Forest Type

Management Unit	Gougounou
Improvement Unit	Wessene

(Unit: ha)

Forest Compartment	Zone	Current Forest Type		Conservation Forest I			Consevation Forest II			Timber Forest		Fuelwood Forest		Silvi-Pastral			Village Forestry			Left-Over Areas
		Symbole	Land Area	Planting	Enrichiment	Original State	Planting	Enrichiment	Original State	Planting	Felling and Regeneration	Planting	Felling and Regeneration	Grassland	Woodland Pasture	Grazing Community Forest	Utilized Land	Fuelwood Community Forest	Forest Reserve	
33	FV	Gf	33.25					23.97	9.28											
		Sa	16.63					3.38									13.25			
		Sb	154.69					2.56											152.13	
		St	108.05					5.91											102.14	
		Ch	404.61				13.03										382.97	8.61		
		Ja	68.86														68.86			
	Total		786.09	0.00	0.00	0.00	13.03	35.82	9.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	465.08	8.61	254.27	0.00

Appendix-2 Land Area by Forest Type

Management Unit	Gougounou
Improvement Unit	Pigourou

(Unit: ha)

Forest Compartment	Zone	Current Forest Type		Conservation Forest Ⅰ			Consevation Forest Ⅱ			Timber Forest		Fuelwood Forest		Silvi-Pastral			Village Forestry			Left-Over Areas
		Symbole	Land Area	Planting	Enrichiment	Original State	Planting	Enrichiment	Original State	Planting	Felling and Regeneration	Planting	Felling and Regeneration	Grassland	Woodland Pasture	Grazing Community Forest	Utilized Land	Fuelwood Community Forest	Forest Reserve	
9	FFC	Gf	124.39			77.43		3.09	43.87											
		Sa	490.81		94.64	26.15		162.24	207.78											
		Sb	359.97		105.50	22.01		151.78	80.68											
		St	92.64		21.12			71.52												
		Tm	23.69																	23.69
	Total		1091.50	0.00	221.26	125.59	0.00	388.63	332.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	23.69
10	FFC	Gf	33.69			33.69														
		Sa	362.86		31.31	17.76		118.98	194.81											
		Sb	232.83		25.96			206.87												
		St	91.64		1.21			90.43												
	Total		721.02	0.00	58.48	51.45	0.00	416.28	194.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	FFP	Gf	35.28					35.28												
		Sa	170.31					2.40			132.81		35.10							
		Sb	634.61					15.90			145.88		472.83							
		St	92.84								9.70		83.14							
		Ch	182.91							5.26		177.65								
		Ja	36.84							16.28		20.56								
		Tm	31.66																	31.66
	Total		1184.45	0.00	0.00	0.00	0.00	53.58	0.00	21.54	288.39	198.21	591.07	0.00	0.00	0.00	0.00	0.00	0.00	31.66
12	FFP	Gf	108.77					67.40	41.37											
		Sa	238.73						10.40		210.72		17.61							
		Sb	585.61						1.60		139.40		444.61							
		St	121.17								16.60		104.57							
		Tm	18.34																	18.34
	Total		1072.62	0.00	0.00	0.00	0.00	67.40	53.37	0.00	366.72	0.00	566.79	0.00	0.00	0.00	0.00	0.00	0.00	18.34
13	FFP	Gf	101.81					21.26	80.55											
		Sa	241.71						15.76		225.95									
		Sb	178.59								54.21		124.38							
		St	89.17								37.44		51.73							
		Tm	2.16																	2.16
	Total		613.44	0.00	0.00	0.00	0.00	21.26	96.31	0.00	317.60	0.00	176.11	0.00	0.00	0.00	0.00	0.00	0.00	2.16

Appendix-2 Land Area by Forest Type

Management Unit	Gougounou
Improvement Unit	Pigourou

(Unit: ha)

Forest Compartment	Zone	Current Forest Type		Conservation Forest Ⅰ			Consevation Forest Ⅱ			Timber Forest		Fuelwood Forest		Silvi-Pastral			Village Forestry			Left-Over Areas
		Symbole	Land Area	Planting	Enrichiment	Original State	Planting	Enrichiment	Original State	Planting	Felling and Regeneration	Planting	Felling and Regeneration	Grassland	Woodland Pasture	Grazing Community Forest	Utilized Land	Fuelwood Community Forest	Forest Reserve	
29	SP	Gf	63.44					15.25	48.19											
		Sb	453.62					19.94							433.68					
		St	76.13												76.13					
		Ja	23.71											23.71						
		Ag	2.71													2.71				
		Ce	4.32																	4.32
		Cl	1.52																	1.52
	Total		625.45	0.00	0.00	0.00	0.00	35.19	48.19	0.00	0.00	0.00	0.00	23.71	509.81	2.71	0.00	0.00	0.00	5.84
30	SP	Gf	72.56					31.50	30.04							11.02				
		Sa	56.90											56.90						
		Sb	536.51					15.84							520.67					
		St	98.73												98.73					
		Ch	69.93											69.93						
		Ja	21.52											21.52						
		Ce	6.20																	6.20
		Cl	1.72																	1.72
		Tm	21.43																	21.43
	Total		885.50	0.00	0.00	0.00	0.00	47.34	30.04	0.00	0.00	0.00	0.00	148.35	619.40	11.02	0.00	0.00	0.00	29.35
31	FV	Gf	290.32					38.70	162.22										89.40	
		Sa	93.92					4.97	5.56								72.26		11.13	
		Sb	901.98					25.47	35.28								344.11		497.12	
		St	249.83																249.83	
		Ch	462.39														408.00	54.39		
		Ja	286.75														256.99	29.76		
		Ce	20.32																	20.32
		Cl	5.99																	5.99
	Total		2311.50	0.00	0.00	0.00	0.00	69.14	203.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1081.36	84.15	847.48	26.31

Appendix-2 Land Area by Forest Type

Management Unit	Gougounou
Improvement Unit	Kananou

(Unit: ha)

Forest Compartment	Zone	Current Forest Type		Conservation Forest I			Consevation Forest II			Timber Forest		Fuelwood Forest		Silvi-Pastral			Village Forestry			Left-Over Areas
		Symbole	Land Area	Planting	Enrichiment	Original State	Planting	Enrichiment	Original State	Planting	Felling and Regeneration	Planting	Felling and Regeneration	Grassland	Woodland Pasture	Grazing Community Forest	Utilized Land	Fuelwood Community Forest	Forest Reserve	
1	FFC	Gf	70.68			39.22			31.46											
		Sa	379.95		33.27			183.94	162.74											
		Sb	448.11		64.89			383.22												
		St	45.88		1.69			44.19												
		Tm	15.09																	15.09
	Total		959.71	0.00	99.85	39.22	0.00	611.35	194.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.09
2	FFC	Gf	34.86			14.65			20.21											
		Sa	520.47		120.33	5.28		116.89	277.97											
		Sb	253.47		110.52			119.54	23.41											
		St	66.72		4.65			62.07												
		Ch	50.27				50.27													
		Ja	4.30				4.30													
		Tm	10.16																	10.16
	Total		940.25	0.00	235.50	19.93	54.57	298.50	321.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.16
3	FFC	Gf	45.56			21.14			24.42											
		Sa	658.96		169.01	123.03		119.49	247.43											
		Sb	194.43		62.06	13.12		100.62	18.63											
		St	122.19		8.42			113.77												
		Cl	13.30																	13.30
		Tm	15.83																	15.83
	Total		1050.27	0.00	239.49	157.29	0.00	333.88	290.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	29.13
9	FFP	Gf	57.46					3.17	54.29											
		Sa	470.96					2.72	10.72		454.52		3.00							
		Sb	311.49					26.73			83.05		201.71							
		St	117.69					12.85			5.58		99.26							
		Ch	213.70				1.50			3.67		208.53								
		Ja	9.85				1.84			2.34		5.67								
		Cl	14.93																	14.93
		Tm	32.94																	32.94
		Ar	2.00																	2.00
	Total		1231.02	0.00	0.00	0.00	3.34	45.47	65.01	6.01	543.15	214.20	303.97	0.00	0.00	0.00	0.00	0.00	0.00	49.87

Appendix-2 Land Area by Forest Type

Management Unit	Gougounou
Improvement Unit	Kananou

(Unit: ha)

Forest Compartment	Zone	Current Forest Type		Conservation Forest I			Consevation Forest II			Timber Forest		Fuelwood Forest		Silvi-Pastral			Village Forestry			Left-Over Areas
		Symbole	Land Area	Planting	Enrichiment	Original State	Planting	Enrichiment	Original State	Planting	Felling and Regeneration	Planting	Felling and Regeneration	Grassland	Woodland Pasture	Grazing Community Forest	Utilized Land	Fuelwood Community Forest	Forest Reserve	
10	FFP	Gf	28.68					18.67	3.73		6.28									
		Sa	162.78					31.15			129.93		1.70							
		Sb	614.89					62.30	6.45		244.80		301.34							
		St	153.19					19.35			14.00		119.84							
		Ch	198.06				1.53					196.53								
		Ja	1.02									1.02								
		Cl	7.81																	7.81
		Tm	5.09																	5.09
	Total		1171.52	0.00	0.00	0.00	1.53	131.47	10.18	0.00	395.01	197.55	422.88	0.00	0.00	0.00	0.00	0.00	0.00	12.90
11	SP	Gf	45.00					22.68	22.32											
		Sa	72.05					17.86						5.71	48.48					
		Sb	457.69					71.86	17.77					19.77	348.29					
		St	138.05					22.06						12.50	103.49					
		Ch	27.86				1.34							22.77	3.75					
		Ja	117.49				2.50							101.06	13.93					
		Cl	14.28																	14.28
		Ag	2.68												2.68					
	Total		875.10	0.00	0.00	0.00	3.84	134.46	40.09	0.00	0.00	0.00	0.00	161.81	520.62	0.00	0.00	0.00	0.00	14.28
12	SP	Gf	176.85						176.85											
		Fc	7.71													7.71				
		Sa	183.96					27.06						54.73	102.17					
		Sb	355.57					44.19						74.53	236.85					
		St	76.40					22.99						5.91	47.50					
		Ch	69.30				3.60							65.70						
		Ja	42.82				1.88							40.94						
		Cl	1.71																	1.71
		Ag	12.85											12.85						
		Tm	6.34																	6.34
	Total		933.51	0.00	0.00	0.00	5.48	94.24	176.85	0.00	0.00	0.00	0.00	254.66	386.52	7.71	0.00	0.00	0.00	8.05

Appendix-2 Land Area by Forest Type

Management Unit	Gougounou
Improvement Unit	Kananou

(Unit: ha)

Forest Compartment	Zone	Current Forest Type		Conservation Forest I			Consevation Forest II			Timber Forest		Fuelwood Forest		Silvi-Pastral			Village Forestry			Left-Over Areas
		Symbole	Land Area	Planting	Enrichiment	Original State	Planting	Enrichiment	Original State	Planting	Felling and Regeneration	Planting	Felling and Regeneration	Grassland	Woodland Pasture	Grazing Community Forest	Utilized Land	Fuelwood Community Forest	Forest Reserve	
17	FV	Gf	248.72					23.89	157.97										66.86	
		Fc	45.81						6.40								2.07		37.34	
		Sa	88.77														29.09		59.68	
		Sb	1031.38					109.44									342.47		579.47	
		St	490.27					14.23											476.04	
		Ch	803.96				19.43										651.58	132.95		
		Ja	159.02				2.55										122.30	34.17		
		Cl	11.73																	11.73
		Ag	7.33																7.33	
		Tm	5.69																	5.69
	Total		2892.68	0.00	0.00	0.00	21.98	147.56	164.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1147.51	167.12	1226.72	17.42

Appendix-2 Land Area by Forest Type

Management Unit	Gougounou
Improvement Unit	Mani-Boke

(Unit: ha)

Forest Compartment	Zone	Current Forest Type		Conservation Forest I			Consevation Forest II			Timber Forest		Fuelwood Forest		Silvi-Pastral			Village Forestry			Left-Over Areas
		Symbol	Land Area	Planting	Enrichiment	Original State	Planting	Enrichiment	Original State	Planting	Felling and Regeneration	Planting	Felling and Regeneration	Grassland	Woodland Pasture	Grazing Community Forest	Utilized Land	Fuelwood Community Forest	Forest Reserve	
4	FFC	Gf	37.38		24.21	10.88		2.29												
		Sa	541.70		31.04	69.68		106.83	334.15											
		Sb	245.62		72.24			173.38												
		St	116.34		35.86			80.48												
		Ch	25.24	25.24																
		Cl	22.61																	22.61
		Tm	3.06																	3.06
	Total		991.95	25.24	163.35	80.56	0.00	362.98	334.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.67
5	FFC	Gf	56.54		2.37	16.59		19.18	18.40											
		Sa	183.38		54.51			27.89	100.98											
		Sb	230.02		86.02			139.77	4.23											
		St	96.17		39.54			56.63												
		Ch	80.95	10.56			70.39													
		Ja	4.90				4.90													
	Total		651.96	10.56	182.44	16.59	75.29	243.47	123.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	FFP	Sa	291.34					16.51	29.07		222.41		23.35							
		Sb	246.43					37.13	33.19		122.33		53.78							
		St	171.89					21.82			1.61		148.46							
		Ch	55.12							0.81		54.31								
		Ja	12.79				3.04					9.75								
		Cl	20.40																	20.40
	Total		797.97	0.00	0.00	0.00	3.04	75.46	62.26	0.81	346.35	64.06	225.59	0.00	0.00	0.00	0.00	0.00	0.00	20.40
7	FFP	Gf	11.87					11.87												
		Fc	6.15								6.15									
		Sa	253.71					22.37			204.62		26.72							
		Sb	466.52					29.17	11.84		235.85		189.66							
		St	71.95					24.24			11.01		36.70							
		Ch	40.72									40.72								
		Ja	22.28							18.69		3.59								
		Cl	7.00																	7.00
		Tm	6.32																	6.32
	Total		886.52	0.00	0.00	0.00	0.00	87.65	11.84	18.69	457.63	44.31	253.08	0.00	0.00	0.00	0.00	0.00	0.00	13.32

Appendix-2 Land Area by Forest Type

Management Unit	Gougounou
Improvement Unit	Mani-Boke

(Unit: ha)

Forest Compartment	Zone	Current Forest Type		Conservation Forest I			Consevation Forest II			Timber Forest		Fuelwood Forest		Silvi-Pastral			Village Forestry			Left-Over Areas
		Symbol	Land Area	Planting	Enrichiment	Original State	Planting	Enrichiment	Original State	Planting	Felling and Regeneration	Planting	Felling and Regeneration	Grassland	Woodland Pasture	Grazing Community Forest	Utilized Land	Fuelwood Community Forest	Forest Reserve	
8	FFP	Gf	126.53						126.53											
		Sa	255.44						9.28		219.89		26.27							
		Sb	422.19					97.12	7.84		109.63		207.60							
		St	116.27					49.43					66.84							
		Ch	66.99									66.99								
		Ja	14.70							8.95		5.75								
		Cl	11.41																	11.41
		Tm	22.74																	22.74
	Total		1036.27	0.00	0.00	0.00	0.00	146.55	143.65	8.95	329.52	72.74	300.71	0.00	0.00	0.00	0.00	0.00	0.00	34.15
13	SP	Gf	29.20						29.20											
		Sa	101.36					6.15						35.35	59.86					
		Sb	269.06											4.00	265.06					
		St	72.67												72.67					
		Pf	0.85													0.85				
		Ch	76.26											76.26						
		Ja	56.28											36.04	20.24					
		Ce	12.21																	12.21
		Cl	3.76																	3.76
		Tm	9.73																	9.73
	Total		631.38	0.00	0.00	0.00	0.00	6.15	29.20	0.00	0.00	0.00	0.00	151.65	417.83	0.85	0.00	0.00	0.00	25.70
14	SP	Gf	59.98					6.00	53.98											
		Sa	92.15											35.16	56.99					
		Sb	165.21											2.75	162.46					
		St	123.21											3.67	119.54					
		Ch	107.89											103.72	4.17					
		Ja	46.41											42.08	4.33					
	Total		594.85	0.00	0.00	0.00	0.00	6.00	53.98	0.00	0.00	0.00	0.00	187.38	347.49	0.00	0.00	0.00	0.00	0.00
15	SP	Gf	13.41						13.41											
		Fc	11.73													11.73				
		Sa	168.58						17.36					87.52	63.70					
		Sb	478.75					50.89	44.90						382.96					
		St	123.61					31.22							92.39					
		Ch	1.35												1.35					
		Ja	8.69											8.69						
		Cl	15.44																	15.44
	Total		821.56	0.00	0.00	0.00	0.00	82.11	75.67	0.00	0.00	0.00	0.00	96.21	540.40	11.73	0.00	0.00	0.00	15.44
16	FV	Gf	239.05					17.51	206.82										14.72	
		Fc	24.97						13.58										11.39	
		Sa	67.28														43.88		23.40	
		Sb	826.06					18.74	32.31								222.06		552.95	
		St	323.95																323.95	

Appendix-2 Land Area by Forest Type

Management Unit	Gougounou
Improvement Unit	Mani-Boke

(Unit: ha)

Forest Compartment	Zone	Current Forest Type		Conservation Forest I			Consevation Forest II			Timber Forest		Fuelwood Forest		Silvi-Pastral			Village Forestry			Left-Over Areas
		Symbol	Land Area	Planting	Enrichiment	Original State	Planting	Enrichiment	Original State	Planting	Felling and Regeneration	Planting	Felling and Regeneration	Grassland	Woodland Pasture	Grazing Community Forest	Utilized Land	Fuelwood Community Forest	Forest Reserve	
		Ch	361.22														322.46	38.76		
		Ja	50.88														41.16	9.72		
		Ce	6.48																	6.48
		Cl	3.33																	3.33
		Ag	8.59																8.59	
	Total		1911.81	0.00	0.00	0.00	0.00	36.25	252.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	629.56	48.48	935.00	9.81