VII. FOREST MANAGEMENT PLAN FOR INTENSIVE STUDY AREA

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VII.1 Basic Targets

The proper satisfaction of the development needs of the Intensive Study Area, i.e. future demand for industrial timber, needs of local people and the preservation of a good environment and the like are essential in order for the Forest Management Plan to be truly effective as already described in Chapter VI, which are the basic targets of the Forest Management Plan in question.

(1) Preservation and Increase of Timber Resources

One target of the present Forest Management Plan is the future increase of industrial timber resources through the early restoration of forests (forest creation at grassland). Timber production from plantations will be promoted with a new emphasis on the active planting in degraded forests, particularly the area classified as grassland, away from traditional timber production through the felling of natural forests. In this way, the excessive felling of existing natural forests will be alleviated, resulting in the conservation of natural forests performing various functions. During the production process of industrial timber, social forestry techniques will be introduced to assist the lives of local people and to provide incentives for local people to protect the newly planted sites.

(2) Increase of NTFPs and Agricultural Crops to Meet the Needs of Local People

Proper forest management cannot be achieved without the understanding and cooperation of local people. Consequently, the plan will aim at achieving the sustainable collection of such NTFPs as medicinal herbs and bushmeat, etc. provided by forests by conserving existing natural forests. It will also be necessary to aim at increasing the production of agricultural crops on forest land by means of the introduction of agroforestry, such as the taungya system, in the course of plantation development on grassland while establishing a participatory system to benefit local people which reflects the real conditions of the local community, including the introduction of profit-sharing rights regarding trees for final cutting.

Moreover, the production of fuelwood trees as well as multi-purpose trees will be promoted to respond to the real needs of local people.

(3) Prevention and Control of Bushfire

Busufires are assumed to be the most direct and large factor for forest degradation. The forest reserves in question have already been degraded due to them. Then, as a precondition of the implementation of forest restoration measures, it would be necessary to take the prevention / control of bushfires in a sufficient manner.

(4) Protection of Environment

The fact that the subject area of the plan is adjacent to "sites of frequent bushfires" in an "environmentally critical and sensitive area" and that rare species (plants) which are facing possible extinction due to their small population in Ghana are found in the area, makes full consideration of the environmental implications of the plan (establishment of conservation areas etc.) essential.

VII.2 Basic Items for Plan

VII.2.1 Establishment of Plantations and Conservation of Natural Forests

(1) Proper Categorization of Land Use

① Concept of Land Use

In order to implement forest management practically, land use of the forest should be reasonably classified by individual plot (based on land attribute), in accordance with the function of the forest and the needs for national levels and local level i.e. surrounding areas of the forest reserves, while the examination of the plot by the classifications and by individual piece of the categories should be required. Consequently, these countermeasures should be taken on the basis of the land use categories.

As a result of the study this time, the area for natural forest is about 13,000 ha, out of about 30,000 ha of the intensive study areas, about 3,100 for existing plantation, and 13,000 ha, for grassland.

The policies of proper categorization on land use for preparation of the plan, is as follows:

a. In the forest land classified under current land use and vegetation, the project target areas are designated as degraded natural forest, existing teak plantation and treeless land like grassland, etc. The restoration of grassland which is considered the final stage of forest degradation, is given the top priority of the project in the target areas and active development of forestation should be applied to the land.

b. In the target areas, current land use categories should continue to be applied to degraded natural forest and existing teak plantation. Supplementary planting should be applied to the specific portion of the natural forests.

c. The area categorized as sacred place (fetish grove) or admitted farmland in the past should follow the classification.

d. Steep slope lands, habitats of rare species, certain thickly grown natural forests and important areas in respect to environmental concern, etc., should be designated as protection areas.

According to the above mentioned issues, the area of land use in each category in the intensive study area shows on Table VII-2-1.

Table VII-2-1 Land Use in Intensive Study Area

Category	Area (ha)	Remarks
Plantation and Establishment Area	12,844	Industrial plantation (including Taungya), Village Woodlots, Green Firebelt
Natural Forest Conservation Area	12,954	Including supplementary planting
Existing Plantation	3,139	Management by Forest Department
Protection Area	85	Protection of Subject Area
Admitted Farm	1,344	Including Sacred Grove
Others	98	Including Settlement and Rocky land

② Zoning Based on Activity Range of Local People

As already described, the socioeconomic survey concluded that the daily commutable distance for farming by local people is 3 km. Unless this range is taken into consideration, the taungya system designed to promote the participation of local people in afforestation will remain unpractical. Therefore, the subject areas are divided into three zones under the Plan to ensure the smooth participation of local people.

a. Participatory Forest Management Zone

Areas within a 3 km radius of settlements located around FRs, incorporating green firebelts, community woodlots and NTFPs tenure sites in natural forests, all of which are closely related to village and local life

b. Collaborative Forest Activity Zone

Areas subject to industrial plantation within a 3 km radius of settlements for joint management by local people and private companies through the introduction of the taungya system

c. Private Company Reforestation Zone

Areas outside a 3 km radius of settlements for industrial plantation by private companies

③ Division of the Site

a. Subject Sites for Forest Management

a) Industrial Plantations (1)	:	including those created under the taungya system (new planting ⇒ clear cutting)
b) Industrial Plantation (2)	:	excluding those created under the taungya system (new plantation ⇒ clear cutting)
c) Industrial Plantations (3)	:	existing plantations and newly planted sites in existing plantations (clear cutting ⇒ new planting ⇒ clear cutting)
d) Green Firebelts	:	agroforestry zone, including taungya sites (new planting ⇒ cutting method not specified
e) Community Woodlots	:	man-made fuelwood forests of indigenous species (new planting ⇒ cutting method not specified)
f) Conserved Natural Forests (1)	:	supplementary planting if required (not specified cutting method)
g) Conserved Natural Forests (2)	:	conserved as they are (selecting cutting)
h) Protected Area	:	cutting prohibited
i) Forest Roads and Other Facilities	:	conserved as their objectives

b. Sites Excluded from Forest Management

a) Admitted Farms	:	sites indicated by relevant records held by the Forestry Department
b) Settlements	:	settlement areas inside forest reserves

(2) Selection of Species for Planting

A document published by the Forestry Commission classifies species for planting into exotic and indigenous species and predicts the growth of both types of species. The species listed are reproduced below. (see Table VII-2-2)

Table VII-2-2 Growth Characteristics of Tree Species for Planting

(m^3/ha/year)

a. Exotic Species (Fast Growing)		b. Indigenous Species (Non-Fast Growing)		c. Indigenous Species (Fast Growing)	
Tectona grandis (teak)	5-12	*Entandrophragma* (tiama)	4	*Triplochiton scleroxylon* (wawa)	9
Gmelina arborea (gmelina)	15-20	*Khaya* spp. (mahogany)	4	*Terminalia superba* (ofram)	9
Cedrela odorata (cedrela)	14	*Nauclea diderrichii* (___)	5	*Terminalia ivorensis* (emeli)	10-12
Azadirachta indica (neem)	8	*Chlorophora* spp. (odum)	5	*Ceiba pentandra* (ceiba)	20-26
Leucaena (leucena)	15	*Nesogerdonia* spp. (___)	5		
Cassia siamea (cassia)	5-10				
Acacia mangium (___)	6-10				
Casuarina equisetifolia (___)	6-10				

Notes: 1.The figures next to the species name indicate the annual increment per ha.
2.Entabdraphragma, Syn. Madura excelsa

a. Industrial Plantations

Teak, cedro, ofram and gmelina are considered to be the main species for silviculture in Ghana. Of these, teak is the most promising species in view of its wide planting throughout the country and economic high value. Teak and Ofram are selected as the planting species for industrial plantations under the Plan because of the following reasons.

< Teak >

- Availability of an established global market for its use for industrial and commercial purposes and, hence, the possibility of fetching a high price
- Availability of certain relevant data in Ghana
- Expectation of demand for electric poles by electrification programme
- Availability of certain established nursery and tending techniques for use as a species for silviculture
- Availability of seed procurement routes (via import or FORIG)
- Relative immunity to serious pest or disease damage
- Listed as a candidate silviculture species for the transitional zone by the Forestry Development Master Plan

< Ofram >

- Availability of an established market for its use as excellent veneer
- Availability of relevant data as it is a popular silviculture species in Ghana
- Local species in Ghana
- Relatively fast growth (local fast-growing species) as well as serving multi-purposes
- Serious pest and disease damage is unknown; excellent growth on lowland (0 - 500 m in elevation); suitable for most types of soil

b. Green firebelt

As green firebelt aims at preventing the spread of bushfires, the planting of fast-growing evergreen species with an excellent fire control performance is necessary. The selection of species from the list of species providing materials for daily life while also meeting the needs of local people and the site conditions is also important. The planting species for green firebelt under the Plan will be selected from the following species which are found to perform the fire control and other functions in the tree preference survey on local people.

- Mango (Mangifera indica)
- Paopao (Carica papaya)
- Cassia (Cassia siamea)
- Orange (Citrus spp.)
- Mahogany (Khaya spp.)
- Cashew (Anacardium occidentale)

c. Community Woodlot

Species suitable for the specific needs and site conditions, will be selected from the candidate species of the table VII-2-2.

d. Degraded Natural Forest Sites

The following species are selected for supplementary planting at gap sites in natural forests because of their strong resistance to shade despite the fact that these species are slow growing species.

- tiama (*Entandrophragma angolense*)
- mahogany (*Khaya spp.*)
- kusia (*Nauclea diderrichii*)

- odum (*Chlorophora excelsa*)
- danta (*Nesogordonia papaverifera*)
- wawa (*Triplochiton scleroxylon*)

(3) Introduction of Agroforestry

① Types of Agroforestry in the Study Area

The following types of agroforestry are considered feasible for application in the Study Area in view of the climatic conditions, topographical conditions and population pressure found through the socioeconomic conditions study.

a. Improved Tree Fallow

During the fallow period, tree species are planted and left unattended thereafter. Suitable species are fast growing *Leguminosae* species.

b. Taungya System

The taungya system combines trees and agricultural crops at the initial stage of silviculture. This system has been popular on and off forest reserves in the Study Area.

c. Alley Cropping

Agricultural crops are planted between hedges made of tree species. Fast growing Leguminosae species with vigorous sprouting ability are preferred. The positive and negative results of alley cropping can be observed in other areas of Ghana.

d. Home Gardens

Home gardens are the gardens of farming households and combine many different trees and agricultural crops. Although fruit trees are the main tree species, other types of trees and climbers are also planted. Farming households in the Study Area tend to plant trees individually around their homes.

② Plan Components and Agroforestry

The plan has two components for introduction of agroforestry, i.e. (i) industrial plantations and (ii) green firebelts, as described earlier. Table VII-2-3 examines the compatibility between agroforestry and each of these components.

Table VII-2-3 Agroforestry Suitable for Each Component

Component	Improved Tree Fallow	Taungya System	Alley Cropping	Home Garden
Industrial Plantation		○		
Green Firebelt	○	○	○	○

③ Selection of Agricultural Crops

The findings of the socioeconomic survey indicate that most local people are immigrants and that maize, which is consumed at home and sold for cash income, is the main crop cultivated locally. The demand for cocoyams and plantains is also strong among local people for home consumption and, therefore, these crops attract the strong attention of local people.

Meanwhile, the findings of the soil survey indicate that *Dystric cambisols* are the most suited to tree as well as crop growth in the Intensive Study Area. Based on these findings, Table VII-2-4 shows suitable crops for different categories of subject plantation sites classified by soil conditions. Cassava is not introduced in line with the policy adopted by the Forestry Department.

Table VII-2-4 Candidate Crops for Intensive Study Area

Site Category	Soil Type	Crops	Remarks
A (Good)	Distric Cambisols	Plantains and cocoyams	Traditional crops for mixed cultivation by indigenous men and women
B (Poor)	Others	Maize and yams	-

④ Introduction of Fruit Trees as NTFPs Production

Although the findings of the socioeconomic survey indicate that the cultivation of fruit trees is not particularly popular among local people, there is strong interest in the cultivation of fruit trees as NTFPs. However, the Forestry Department has adopted a policy of banning fruit trees on commercial plantations of such tree crops as oil palm and cacao.

As shown in Table VII-2-5, different fruit trees should be selected depending on the soil conditions. Many parts of the Intensive Study Area are Type B, i.e. unsuitable for fruit production, and, therefore, the scope of agroforestry mainly consisting of the cultivation of such fruit trees as orange and avocado is limited despite the strong interest on the part of local people.

Table VII-2-5 Candidate Fruit Trees for Intensive Study Area

Site Category	Soil Type	Species	Remarks
A (good)	Dystric Cambisols	Orange, Avocado	Highly concerned species for woman
B (poor)	non-Dystric Cambisols	Cashew, Sugar apple	

⑤ Introduction of Agroforestry for Each Component

This plan introduce the following agroforestry for each component.

a. Industrial Plantation

The basis is the Taungya system with the combination between the trees, Teak and Ofram and agricultural crops.

b. Green Firebelt

The basis is the fruit production with the combination between maize by improved tree fallow system and tanugya method.

(4) Conservation and Utilisation of Natural Forests

① Cutting Prohibition of Standing Trees in Natural Forests

Natural forests in the Intensive Study Area have been regarded as being in the improvement period for some time because of the selective cutting based on rotation has been suspended. This measure is designed to facilitate forest rehabilitation through natural regeneration in order to create sustainable mature stands.

- The continual cutting of these natural forests under the present system would eventually result in the cutting of immature stands and low grade species with undesirable environmental as well as economic consequences.

- The continual cutting of the said natural forests under the present system would also mean continued disturbance of habitats, possibly resulting in a decline of the populations of rare species and others.

② Establishment of Sustainable NTFPs Tenure

"Sustainable NTFPs tenure" will be established for a certain period of time at certain sites in natural forests located near (within 3 km) settlements as a comprehensive measure to strengthen the control of NTFPs resources (prevention of negative impacts on the

environment) and to simplify the permit system for the collection of NTFPs which are sources of cash income for local people.

The establishment of continuous NTFPs tenure sites will depend on the relevant permit issued by the Forestry Department (district forestry offices) as has been the case so far. However, the management of these sites regarding the use of NTFPs (including their collection for cash income purposes), excluding matters related to compliance with the set rules, will be entrusted to the nearby village forest management committee (to be discussed in detail in Ⅶ-3 Plans of Each Project Component). The reasons for introducing such sites are given below.

- The introduction of measures to deal with forest degradation factors associated with the activities of local people is necessary. These factors include the excessive collection of some wild plants for cash income and the hunting of bushmeat using the burning method.

- The findings of the environmental survey and others indicate that the entrustment of NTFPs management to local people under the quota permit system may not be sufficiently effective to prevent the excessive collection of resources or may lead to neglect of management duties by local people because of the complicated work of controlling the collection volume.

- There is a lack of reliable data on the existing volume and growth of NTFPs which is required to determine the quota and a long period is required to collect such reliable data.

- For those people who are uninterested in the agroforestry to be introduced as an incentive for plantation establishment or those who cannot participate due to one reason or another, there is only limited opportunity to benefit from the forest reserves.

(5) Rotation Age

① Industrial Plantations

The cutting periods for teak (Tectona grandis) and ofram (Terminalia superba) will be 35 years and 25 years respectively as suggested by the Silvicultural Regimes mentioned above.

② Community Woodlots

The cutting periods will be 50 years. This rotation age may be changed depending on the specific needs of local people.

③ Green Firebelts

In case of Firebreak Zone rotation period is not fixed because of natural regeneration.

In Maize Production Zone, rotation period of Leguminosae tree species is set at 5 years.

And in case of Fruit Production Zone, rotation period is set at 15 years.

④ Conserved Natural Forests (1)

As non-fast growing species are planted, the standard cutting period is set at 50 years.

(6) Silviculture Standard

The silviculture standards for teak are shown as Table VII-2-6 in accordance with the Silviculture Regimes.

Table VII-2-6 Silviculture Standards for Teak

Year	Work	Forest Product and Production Volume
1	Planting (1,100 trees/ha)	
2	Pruning	Fuelwood
3	Pruning	Fuelwood
4	Improvement Cutting	Fuelwood
7	Improvement Cutting	Fuelwood
10	Thinning (500 trees/ha-retention)	Fuelwood Poles: 50 Utility Poles: 20
14	Thinning (250 trees/ha-retention)	Fuelwood Poles: 50 Utility Poles: 20
20	Thinning (150 trees/ha-retention)	Poles: 40 Utility Poles: 40 Logs for timber/small round logs: 10
35	Regeneration Cutting (0 trees/ha)	Logs for timber/small round logs: 150

The silviculture standards for ofram are given below.

Table VII-2-7 Silviculture Standards for Ofram

Year	Work	Number of Remaining Trees	Product(s)
0	Planting	1,100	
4	Thinning	600	No wood of commercial value
8	Thinning	300	No wood of commercial value
14	Thinning	150	Small diameter round logs: 50
25	Regeneration Cutting	0	Logs for timber: 150

(7) Concept of Nursery Practices

① Forestry species

To steadily produce high quality and standardised seedlings in large quantities, emphasising the quality of the produced timber, as these seedlings will serve the major parts of the FRs designated for timber production

② Species to encourage participation

To produce inexpensive seedlings using a simple and flexible nursery practices method in terms of the quality and standard of the produced seedlings to meet the various needs of local people as the subject sites will be green firebelt and village woodlots, both of which will mainly be established by local people

VII.2.2 Development of Infrastructure

(1) Forest Road-Firebreak

① Principles of Forest Road Construction

The construction of forest roads is essential to support forest establishment in view of the transportation of seedlings to silviculture sites, improvement cutting and other tending work and the hauling of cut logs, etc. Moreover, once constructed, forest roads greatly contribute to local life for the transportation of harvested crops from silviculture sites under the taungya system, collection of NTFPs and response to bushfires, etc. Forest roads will, therefore, be constructed under the Plan in accordance with the following principles.

- To secure access to silviculture sites for the machinery and vehicles required for planting and harvesting work, i.e. the main forest management work
- To make them function as permanent firebreaks to prevent the spread of bushfires and to improve access for vehicles for bushfire control work, including patrolling and fire-fighting
- To be constructed in each FR with emphasis on their networking with existing roads
- To plan feeder roads as the main forest roads in FRs while constructing spur roads to link these feeder roads with blocks.
- To take work efficiency into consideration in view of the topographical conditions of each FR and also such environmental aspects as soil loss and impacts on flora and fauna

② Forest Road Network Density

A higher forest road network density increases the work efficiency but also increases the initial project cost. In contrast, a lower density reduces negative impacts on the environment, such as those on the soil, land, hydrology and water quality, etc. A forest road network with as high a density as feasible from the viewpoint of economy is planned here to maximise the positive impacts on the environment through the prevention/control of bushfires.

- In consideration of an efficient operation range[1] of crawler-type machinery, a vehicle road network with an average density[2] of some 10 m/ha will be constructed.
- In consideration of the present firebreak construction density, a road density of some 20 m/ha totalling 200 ha (including shoulders) of non-vegetation area, i.e. some 2% of the subject area of new plantations (approximately 12,000 ha), is set as the upper limit while providing a reasonable prospect of preventing the spread of bushfires.

(2) Nurseries

In line with the above targets, the forestry species seedlings will be raised at a large-scale permanent nursery where quality control will mainly be conducted by the Forestry Department[3] (Central Nursery).

The species to encourage participation will be nursed at small nurseries where quality control will mainly be conducted by the village forest management committees. As the raising of seedlings is not strictly timed to the period of plantation establishment, these nurseries will be fixed and semi-permanent [4] (village nurseries).

① Central Nursery

a. Description

a) Large-Scale Production for High Quality Seedlings of Forestry Species

This nursery will supply a large quantity of seedlings required for industrial plantations (high quality seedlings with a good survival rate and of a suitable strain for timber production as required by industries). In addition, it will supply seedlings for supplementary planting by the Forestry Department for the conservation of natural forests.

b) Comprehensive Management for Forest Management Projects

The Central Nursery will also function as a technical centre for the development and extension of large-scale production techniques for high quality seedlings and a seed bank of local species which are expected to be required by village

[1] For harvesting work, the economical operation range is said to be a 500 m radius for yarding.

[2] The forest road density is calculated vis-a-vis plantation areas which are the main subjects of investment.

[3] This is because of the fact that private companies do not have sufficient experience of establishing plantations for timber production. In the case of teak, the main planting species, there are cases where the raising of seedlings will be entrusted to local people provided that the aim is to produce firewood, etc. and, therefore, the tree form, etc. is not important.

[4] Temporary nurseries are unsuitable because of the facts that the agroforestry system in green firebelt will be artificially regenerated every five or 15 years, that these nurseries will be required to act as cultivation sites for garden crops and NTFPs strongly required by local people and that water intake facilities must be constructed.

nurseries. It will also function as a coordinating base for the bushfire control system across the Intensive Study Area.

c) Seedling-Related Technical Extension for whole Ghana (Particularly for Transitional Zone)

The Central Nursery is expected to contribute to the production of seedlings required for future forest rehabilitation projects in forest reserves other than those located in the Intensive Study Area and to the breeding of suitable strains for timber production.

b. Location

A smooth supply of seedlings for planting sites is essential for successful industrial plantation establishment. While the establishment of a nursery producing a large quantity of seedlings in each FR may be an idea, it is considered a better option to use the existing nursery located at the campus of the School of Forestry and run by the Sunyani District Forestry Office as the site for the proposed Central Nursery because of the following reasons.

- The establishment of a new nursery in each FR is both time-consuming and expensive because of the need to acquire suitable land and other reasons.
- There will be a question of the maintenance of such nurseries following the completion of the planting work under the Plan
- The nursery can be utilized for other reforestation projects after the completion of this project.

② Village Nurseries

a. Description

- These nurseries will supply the seedlings required for green firebelt and village woodlots among the different types of participatory plantations.
- They will assist the breeding of plant NTFPs aimed at facilitating the extension and participation efforts and the production of the seedlings required for agroforestry outside FRs.
- They will contribute to an improved standard of living in the settlements around them.

b. Locations

They must be located at the suitable sites but not at each village based on nursery practice.

Village nurseries will be located at those candidate sites selected on the newly prepared land use and vegetation map, taking the points listed below into consideration. As these sites will be managed by the Forest Management Planning Committee, their free provision by the chief (or traditional authority) of the settlement in question is assumed.

- Suitable site conditions for a nursery: fertile land with good drainage (along a river)
- Easily accessible to nursery for workers: the selected sites are those where the secretariat or forest establishment branch of the Forest Management Planning Committee (to be described later) is located (main settlement of participating local people in forest establishment)
- Seedling transportation: within a 3 km radius of a forest establishment branch along a main road or with easy access to a FR via a vehicle road or footpath
- Feasibility of land acquisition and facility construction: on the outskirts of a settlement on grassland outside a FR (particularly a site with dotted high trees or a site in the vicinity of a natural forest because of the requirement for shading during the nursery practices period) as no surplus land is available at the settlement centre
- Coordination with traditional as well as administrative organizations: the site should belong to the same paramount stool governing the secretariat of the village forest management committee and should also belong to the same village stool or constituency of the unit committee if possible

VII.2.3 Extension and Education for Forest Management

(1) Objectives of Extension and Education

The decline of the forest area, depletion of forest resources, frequent occurrence of bushfires and progress of desertification in the FRs have been causing significant impacts on local life as well as economic activities. To prevent these negative impacts, improvement of the awareness of the importance of forest conservation on the part of local people, staff members of the Forestry Department and employees of private companies participating in afforestation projects is essential together with encouragement of their participation in forest rehabilitation projects. To achieve this objective, all people involved in forest rehabilitation projects must acquire new

knowledge and skills regarding technical and operational matters through extension and educational activities. In the future, the Forestry Department, private companies and local people will develop a mutual understanding and cooperation through these activities, making the sustainable use as well as conservation of forest resources possible.

(2) Tasks for Extension and Education and Relevant Measures

The field surveys identified the following tasks for extension and education in the Intensive Study Area and measures to deal with these tasks.

① Local People

a. While local people are mainly immigrants from the north, people living in the southern areas show less interest in forests, making the introduction of uniform forest conservation activities difficult. It will be necessary to identify the needs of local people through a relevant survey and the contents of education and training should incorporate the local characteristics.

b. As forest land is locally considered to be fertile farmland, local people are more interested in the cultivation of agricultural crops rather than growing trees. They should be made to understand that forest conservation activities through agroforestry will greatly benefit participating people.

c. While local people are aware of the soil and water conservation effects of forests, they are unsure of the exact relationship between these conservation effects and FRs. Local farmers should be encouraged to acquire a first-hand understanding of the state of soil loss in FRs and the negative impacts of such soil loss on the lower reaches.

② Staff Members of Forestry Department at the field

a. At present, staff members of the Forestry Department lack a clear idea of how to build a cooperative relationship with local people to protect forests. They should, therefore, be guided to understand that the cooperation of local people is essential for forest management in FRs using examples of bushfire control measures, etc.

b. No firm cooperation system is in place vis-a-vis local fire services regarding bushfire prevention and agricultural offices regarding crop cultivation. The desirable approach by the Forestry Department to dealing with bushfires will be demonstrated, including the establishment of a local initial fire-fighting system and detailed exchanges with other organizations at meetings of the environmental committee. Moreover, a

cooperation system with agricultural extension workers will be established to facilitate technical exchanges on agroforestry and exchanges of market information, etc.

③ Private Companies

a. While having experience of cutting and hauling in regard to the management of natural forests, private companies have little experience of large-scale plantations. Visits to the plantations of other private companies will be organized together with the provision of training on planting and management techniques at the School of Forestry.

b. While private companies have experience of employing local people for cutting and other work, they have not been involved in joint work for large-scale plantations. Some have experienced disputes with local people because of illegal cutting by the latter. In view of past history, it may take some time before joint work with local people is feasible and the introduction of a sound management system and regular contact with local people will be essential.

VII.2.4 Operation and Management

(1) Executing Bodies

① Private Company

a. Development of industrial plantation

The development of the plantation should be established by the private sector basis (timber industry side). The private sector is considered to include such bodies as forestry investment enterprises which operate large scale development (more than 1,000 ha) of plantation for commercial use, timber processors and/or concessionaires which undertake middle scale development of plantation (less than 1,000 ha), individuals and farmer (or groups of them) who are engaged in small scale of plantation development (less than 40 ha), etc.

② Local People

a. Green firebelt

The development of the belt should be implemented mainly by the local people. In this case, the resident would plan to organize groups, such as existing Taungya group or new one organized by the intermediate groups, etc., mentioned above. As

incentives for local people, the ownership of crops and planted trees, the utilization of fruits, fuelwoods and the like related to them, must be assured.

b. Community woodlot

The development of the community woodlot should be implemented by the local people. The community woodlot will be established in the natural forests or plantations in the forest reserves, it should be implemented with the system which affords to take measures to the impacts on the surrounding environment, caused by the development, from technical and managerial viewpoint (i.e. maintenance of boundaries and bushfire control, etc).

③ Forestry Department

a. Natural forest

Conservation should be implemented with supplementary planting by the Forestry Department as main body. It is desirable to employ local people for the planting under the supervision of the foresters so as to create job opportunities for the local people in the area.

b. Existing artificial forest

Harvested trees will be sold by Forestry Department. The production activities (i.e. logging and transportation of the timber, etc) in the forests should be implemented by the enterprises which undertake the development of the industrial plantation based on the consideration for the relationship between the logging site and establishing plantation site (convenience attributed to the location).

(2) Forest Management Centre

The Plan envisages the establishment of the Forest Management Centre (to be described in detail in the work plan) with the following functions at the Brong-Ahafo Regional Forestry Office to ensure the smooth implementation of the planned work/projects.

- In view of the proposed reorganization and manpower cut at the Forestry Department, the Centre will assist the establishment of a system to prevent and to quickly settle disputes between the main actors among the functions required of the Forestry Department to achieve general project/work management.

- The Centre will help to enhance the sustainability of the forest management activities of the main actors in accordance with the collaborative forest management agreement and will

attempt to establish a system to liaise with local governments to facilitate the coordination between interested parties other than the main actors (see (4) below).

(3) Management at Village Level

An effective body which is capable of strengthening the cooperation between participating farmers, conveying necessary information, extending knowledge as well as techniques/skills, controlling activities which violate the set rules and negotiating with external organizations, including the Forestry Department, is required to promote the participation of local people in forest management. In view of this need, the introduction of a Forest Management Planning Committee is planned for the purposes of promoting the participation of local people in taungya plantations, green firebelt, village nurseries and NTFPs management in natural forests and coordinating between existing intra-village groups. This committee will supervise (i) forest establishment branches involved in the taungya system and green firebelt and (ii) village nurseries (see Table VII-2-8).

Table VII-2-8 Establishment of Proposed Forest Management Planning Committee

Participatory-type forest management zone		Forest Reserve		Location of organization (persons)				Stool
Symbol	Name of zone			Committee secretariat[1)]	Forest establishment branch[1)]	Village nursery	Water supply facility	
A	Kyekyewere-Tainso	Tain II	N	Kyekyewere (1,500)	Akokurom (600人) Kogu (?)	Tainso	Control of river water (Small dam for intake the water)	Wenchi
B	Namasua-Oforikrom	Tain II	N	Namasua (1,600)	Oforikrom (140)	Namasua	Use of existing well	Berekum
C	Adantia-Sereso	Tain I	W	Adantia (1,700)	Sereso (?) Dinkyene (?)	GyaeNkonitabuo Adantia	Ground water (Shallow well) Control of river water (Low level reservoir)	Dormaa
D	Buku-Ohene	Tain I Nsemire Yaya	N/E S W	Buku (1,500)	Kyrinkoromp o (?) Ahewene (800) Kotoa (?)	Kyrinkorompo Ahewene	Control of river water (Low level reservoir) Control of river water (Low level reservoir)	Wenchi
E	Asuakwa	Yaya	S/W	Asuakwa (1,700)	Asuakwa	Asuakwa	Use of existing well	Dormaa
F	TanoKwayem-Mfante	Yaya	S/E	TanoKwayem (?)	Mfante (450)	Mfante	Use of river water (Pump)	Offinso
G	Amoakurom-NanaTwumkrom	Nsemire	N	Amoakurom (1,000)	NanaTwumkrom (?)	NanaTwumkrom	Ground water (Shallow well)	Wenchi
H	Nsuata-Mangoase	Yaya Sawsaw	N S	Nsuata (?)	Malaamkurom (200) Konkronpe (?)	Jackkurom	Ground water (Shallow well)	Wenchi
I	Tremeso-Bepotrim	Sawsaw	Central～S	Tromeso (1,500)	Bepotrim (500)	Tromeso	Use of existing well	Wenchi
J	Nyinamponase	Sawsaw	S	Nyinamponase (1,700)	Nyinamponase	Nyinamponase	Control of river water (Low level reservoir)	Wenchi
K	Nkonsia-Ayaaya	Sawsaw	C～N	Nkonsia (?)	Ayaaya (150)	Ayaaya	Ground water (Shallow well)	Wenchi
L	Adukwaakokurom-Nyamebekyere	Sawsaw	N	Asukwaakokurom (?)	Aobbei (?) Nyamebekyere (?)	Asukwaakokurom	Ground water (Shallow well)	Wenchi

Note: 1) Population from the interview of socioeconomic survey

The villages in which a Forest Management Planning Committee will be established, will be selected on the basis of the following criteria.

- The village is relatively near a FR but is not large (like Sunyani).
- The estimated number of households is around 100 (population of approximately 1,600).
- The village is the location of a village stool or unit committee of the district assembly.

- The village is located along an existing main road.

Moreover, under the Forest Management Planning Committee, forest establishment branches will be established at the villages or settlements where there live possible candidates of participation who have the accessibility to plantation sites and close relationship with forest resources. And as a result of it the application is easy.

(4) Collaborative Forest Management Agreement Involving Forestry Department, Private Companies and Village Forest Management Committee

- The agreement aims at clearly establishing the division of management responsibility to prevent open access to forest resources in the Intensive Study Area.

- It also aims at preventing disputes involving the Forestry Department, private companies and the village forest management committee, i.e. the three main actors of forest management, and also establishing a collaborative system which incorporates industrial circles, the government and local people for sound forest management in the Intensive Study Area.

① Basic Issues for Agreement

The basic contents of this agreement will be carefully examined and prepared based on the "social responsibility agreement" (between private companies and local people) and the "collaborative forest management agreement" (between the Forestry Department and local people) employed for policy management by the Forestry Department, and a mechanism to promote forest management will be established to facilitate cooperation for smooth work/project progress on the part of private companies and the participation of local people.

The roles of the main actors and the system of collaboration will be clearly defined and such matters as those listed below which are required to prevent any dispute between actors and any delay of project implementation will be clearly described.

- Obligation to conserve natural forests
- Obligation to detect bushfires at the earliest opportunity and to conduct initial fire-fighting activities
- Division of responsibility for the rehabilitation of damaged plantations

- Guarantee for planned plantation establishment and project management and obligation of private companies to manage and implement such projects.
- Guarantee for participatory forest management projects and obligation of local people to implement such projects

② Signing and Management of Agreement

The agreement will consist of "the text" (to be signed by those persons with the highest authority) describing the basic division of responsibility and collaboration and "the detailed rules" (to be signed by persons with practical responsibility) describing the necessary matters to prevent disputes. The text will be concluded among director of regional forest office, CEO of private company, stool chief and chair-person of Forest Management Center.

(5) External Assistance

① External Consultants

External consultants are necessary because the plan include such integrated measures for forest management as large scale plantation, people's participation, fire control etc..

External consultants will assist the specialist planning and guidance functions among the functions required of the Forestry Department for general project/work management in view of the proposed reorganization and manpower cut of the Forestry Department.

Because of the shortage of experience in the implementation of large scale plantation, external consultants will provide guidance on detailed planning, design and work supervision for each work plan with a view to assisting efficient, economical and effective work/project progress.

② Assistance of NGOs

For the conservation and management of forests including fire control, people's participation is necessary with the assistance by NGO who are familiar with extension work. Then NGOs will efficiently promote cooperation for and participation in forest management by local people.

NGOs will also assist the establishment of the village forest management committee, the key feature of the implementation of participatory forest management, and will promote organized forest management activities with the participation of local people.

③ Planned Strengthening of Administrative Section of Private Companies

In principle, it is assumed that participating private companies will be companies or joint ventures with sufficient capital and business know-how to establish large-scale plantations. Through the establishment of joint ventures with or subcontracting of the work to local companies in Ghana, it is assumed that these large investors will conduct the assigned work/projects using existing equipment and know-how in coordination with local people. As described earlier, private companies have little experience of large-scale plantations and are, therefore, expected to appoint experts to strengthen their administrative section.

(6) Division of Project Area: Working Units and Compartments

a. Working Units

The Project Area is as vast as some 30,000 ha, stretching from east to west and consisting of five forest reserves. Although it is essential that all of the Project Sites in these forest reserves be included in a single project, each existing forest reserve is considered an independent working unit in view of the different legal status and land ownership by different stools, etc. from one forest reserve to another.

So, it is better for each existing forest reserve to become a working unit.

b. Forest Division

a) Blocks

Using 1,000 ha as the yardstick, each working unit is divided into blocks using such topographical features as ridgelines and valleys as the main factors.

b) Compartments

Each block is further divided into compartments of less than 100 ha using the land use, forest type and vegetation as the main classification factors. The current conditions of the following items of each compartment are compiled in the forest inventory book (see separate volume). The number of compartments by each forest reserve in the Intensive Study Area is shown in Table VII-2-9.

Table VII-2-9 Number of Blocks and Compartments by Forest Reserve in Intensive Study Area

Forest Reserve	Blocks	Compartments
Sawsaw	9	353
Nsemere	3	65
Yaya	6	148
Tain I	4	83
Tain II	10	300
Total	32	949

(7) Plantation Establishment Period and Project Implementation Process

① Plantation Establishment Period

The target area of plantation is some 12,000 ha in this Plan. The period of plantation establishment needs 10 years because of 1,200 ha required for large-scale plantation in each year.

② Project Implementation Process

a. Conditions

The following conditions must at least be met for the implementation of the Project.

Unless the conditions are met, the smooth management of forest restoration work will be difficult.

a) The condition for private sector investment must be improved.

b) The conditions for the participation of local people must be met.

c) Bushfire prevention/control measures must be firmly established.

d) A seedling supply system must be developed.

e) The understanding of the project implementation parties must be acquired.

b. Implementation Process

Since according to economic condition in Ghana, Ghana government is hard to improve rapidly investment condition for private sector and it is difficult to establish successfully the fire prevention system without people participation, it would be better to implement the project step by step initially from people's participation to private investment. (see table VII-2-10)

Table VII-2-10 Schedule for Implementation of Project (Plantation Establishment Period)

	1 2 3 4 5 6 7 8 9 10 11 12	Remarks
Reforestation and Management Plan		
Industrial Plantation		
Community Woodlot		
Green Firebelt		
Natural Forest Conservation Plan		
Supplementary Planting Area		1,550ha
Utilisation and Yield Plan (excluding food crops)		
Industrial Plantation (teak)		Including the thinning
(ofram)		
Community Woodlot		
Green Fireblet		Fruit Tree Production (regeneration by every 6~15.15)
Nursing Plan		
Central Nursery		
Village Nursery		
Infrastructure Plan		
Central Nursery Construction		
Village Nursery Construction		
Feeder Forest Road		
Spur Road		
Fire Break		
Fire Tower		
Water Supply		
Extension and Education Plan		Including the organization of the local people.
Extension Activity		
Training and Education		
Management and Operation Plan		
Forest Management Project Center		Transfer the function of this organization to local Governments as Environment Committee in District Assembly
Forest Management Planning Committee		Continue the committee as one village organization
NGO		
External Consultant		
Support to Private Company		

VII.3 Plans of Each Project Component

The present plan aims at restoration of the degraded forests in the Intensive Area by planting. The planning was conducted under integrated manner incorporating local inhabitants' participatory approach and forest fire control.

The outline of the each project component under the present plan is shown as follows.

Project Component		Implementation Body	Planned Action	Planned Volume
Planting and Management Plan	Industrial Plantation (1)	Private Company	• Planting teak aiming at the industrial timber production by private Company	5,918ha
		Local Inhabitants	• Introduction of Taungya system	
	Industrial Plantation (2)	Private Company	• Planting teak aiming at the industrial timber production by private Company	6,191ha
	Industrial Plantation (3)	Forest Department	• Managing the existing teak plantations	3,139ha
	Community Woodlot	Local Inhabitants (Village) Forest Department	• Planting trees conforming to the needs of local inhabitants in the natural forests	426 ha
	Green Firebelt	Local Inhabitants Forest Department	• Introduction of agroforestry for preventing the spread of forest fires	309 ha
Natural Forest Conservation Plan	Natural Forest Conservation (1)	Forest Department	• Supplementary planting on the open land	1,556 ha
	Natural Forest Conservation (2)	Forest Department	• Maintaining the status quo	11,398 ha
Infrastructure Plan	Nursery Facilities Central Nursery	Forest Department	• For industrial plantation and natural forest conservation	One site
	Village Nursery	Local Inhabitants (village)	• For village forest and green firebelt	14 sites
	Forest Road Feeder Road	Private Company	• Main road for planting and maintenance in Forest reserve	96.9 km
	Spur Road	Private Company	• Utilizing boundaries of forest blocks	88.2km
	Firebreak	Private Company	• To be established along the feeder and spur road	56.5 km
	Watch Tower	Forest Department	• Establishing steel fire towers with some 10 m height in villages in which village nurseries will be facilitated	7 sites
	Water supply Facilities	Forest Department Local Inhabitants	• To be installed with village nursery in a set • To operate and maintain	11 sites
Extension & Education Plan	Extension	Forest Department	• Holding various meeting for motivating and supporting related activities	
	Training / Education	Forest Department	• Training staff of Forest Department and local inhabitants	
Management & Operation Plan	Forest Management Center	Forest Department	• Key part of the project implementation • Steering and Arbitration body of the present project	One site
	Forest Management Planning Committee	Local Inhabitants	• Acting as a representative window regarding forest management	12 sites
	Utilization of NGO	Forest Department	• Mainly the contract conclusion between the implementation body and NGOs, and extension activities	
	Utilization of External Consultants	Forest Department	• Supporting the management and operation of the entire project	
	Strengthening of Private Company	Private Company	• Smooth promotion of the Project	

VII.3.1 Plantation Establishment and Management Plan

(1) Industrial Plantations

① Subject Sites

The subject sites for industrial plantations (approximately 12,000 ha)are compartments consisting of grassland in the Intensive Study Area except those where large-scale planting is unsuitable due to the following reasons.

- Difficult sites for planting and tree growth: such sites as rocky areas and thin soil layer as Leptosols
- Sites with low profitability for business: small size of grassland scattered in natural forests

The sites subject to intercropping under the taungya system are compartments located in the participatory-type forest management zone discussed in VII.2.1.

② Planting System

Based on the existing planting system for teak under the taungya system, planting system will be employed with due consideration of the following aspects and taking the site conditions, planting feasibility from a business point of view, needs of local people and environmental consideration into account.

a. Distribution of Ofram (Local Species) Zones

Ofram, a local species, will be planted to establish a 40 m wide zone in teak planting areas for the purposes of mitigating the decline of biological diversity due to the uniform stand structure of teak, the main planting species, preventing damage by pests and diseases and avoiding large scale clear cutting (see Fig. VII-3-1).

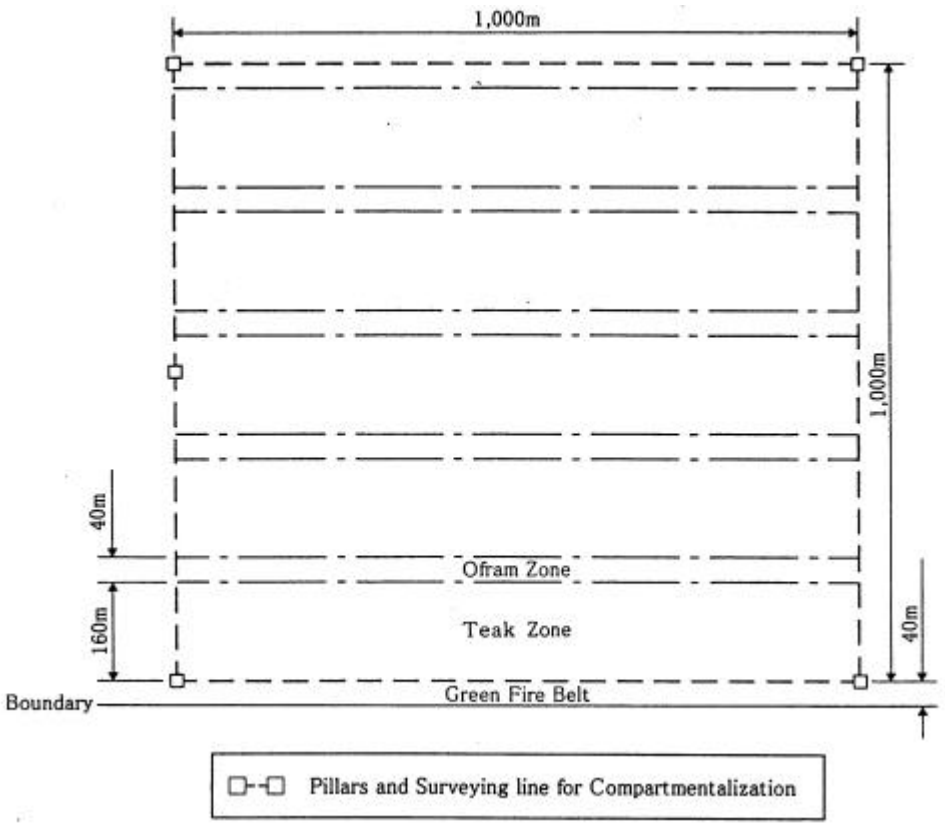

Fig. VII-3-1 Standard Distribution of Indigenous Species Zones

b. Mechanized Land Preparation Work

Mechanized land preparation using a bulldozer equipped with a dozer to remove ground vegetation and a ripper for line ploughing will be conducted in view of the following points.

- Most sites are gently sloping, offering high efficiency for mechanized land preparation work.
- The planned large-scale planting requires the quick and efficient clearance of *Chromolaena odorata* and other weeds.
- The effective work period is short because of overlapping of the suitable planting period and the busy farming period for local people and the soil in the Intensive Area is relatively hard.

c. Distribution of Protected Vegetation Strips

The existing vegetation will be preserved with a standard width and interval of 4 m and 36 m respectively,[5] taking the following points into consideration.

- Mitigation of the negative impacts of large-scale Mechanized Land Preparation on environmental aspects, including soil, land, hydrology and water quality.
- Facilitation of the infiltration of surface water to improve the soil moisture conditions in order to promote the growth of the planted trees.
- Mitigation of the impacts of the rapid establishment of plantations on wild life and flora by means of reserving some grassland.

d. Planting Method

In principle, the planting holes will be dug after line ploughing and teak/ofram seedling (stump seedling for Teak, potted seedling for Ofram) will be planted with a planting distance of 3m x 3m.

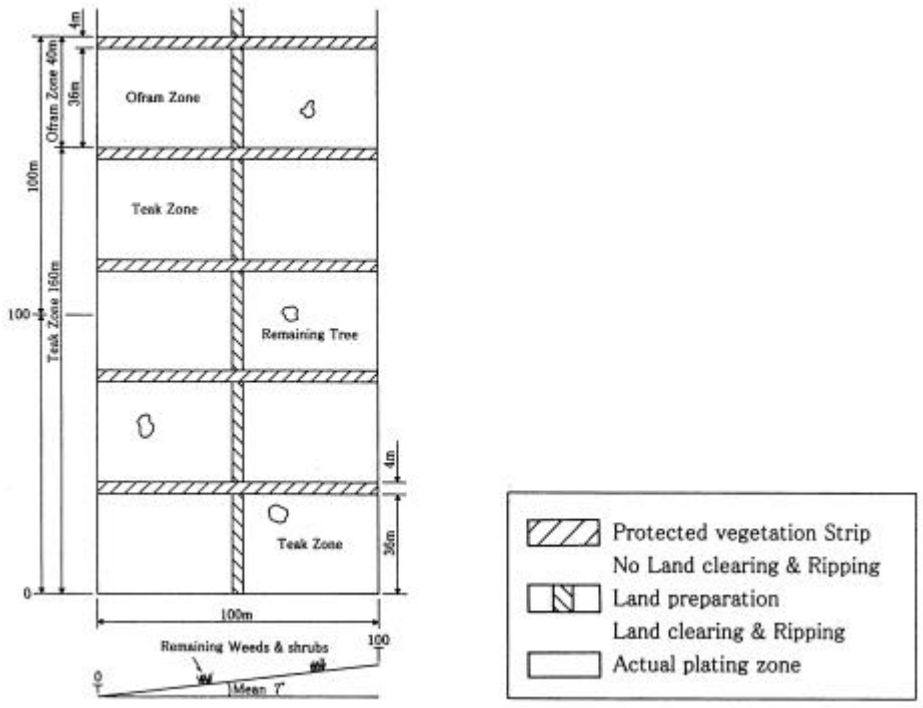

Fig. VII-3-2 Standard Distribution of Protected Vegetation Strips Plan

[5] Based on the standards for contour vegetation strips published by the ICRAF, 1988 - Agroforestry in Dryland Africa (an average gradient of 7° is assumed for the Intensive Study Area).

③ Intercropping Under Taungya System

Intercropping is expected to be feasible for four years[6] after the planting of the seedlings until such time when the light intensity will be decreased when the canopy of planted trees closes.

a. Planting Configuration of Crops

For the survival and growth of the planted trees, crops will be cultivated at a distance of at least 1 m from the trees. The intercropping illustrated in Fig. VII-3-3 is planned by each soil condition, taking both single and multiple cropping examples in the Study Area into consideration.

b. Cultivation and Management of Intercrops

Intercrops will be manually cultivated in accordance with the traditional low input-type cultivation practiced by local people. Accordingly, intensive work, including fertiliser application and watering, is not assumed.

④ Tending Method of Planted Trees

- Weeding will be carried out during initial four years two times a year at the beginning of dry season i.e. July and November according to the material provided by FD, in order to prevent spread of bushfire and to lessen competition with planted trees.

- Pruning will be done taking into consideration the participants' need (fuel-wood and extension of cultivation) and the timber quality (prevention of forking and stem-crooking)

- Sanitary cutting for the trees less than specific size in diameter will be introduced in order to maintain good stands for early removal of suppressed and damaged trees.

- Patrolling for early detection of bushfire and diseased or insect-damaged trees, will be done.

The use of fire will be banned in FR.

[6] The socioeconomic and cultural conditions survey findings suggest that a fallow period of 5 - 7 years is traditionally required. The current fallow period is 0 - 2 years in the Study Area. In order to lengthen the feasible cultivation period under the conventional taungya system by one-year this plan will be double to the current fallow period.

⑤ Yearly Work Plan

The planting area will be increased with the progress of work due to higher efficiency through the active participation of local people, in turn stimulated by support of the village forest management committee, etc. However, the upper limit is set at an annual planting area of some 1,200 ha in view of practical feasibility. The following sites will be given priority for planting (see Table VII-3-1).

- Sites with strong demonstration effects: proximity to a district centre and/or existing local/national road
- Sites for easy promotion of people's participation: sites where the intentions of collaborative forest management are believed to be easily understood by local people because of their relatively close links[7] to forests in terms of land use and other aspects.

[7] The newly prepared land use map indicates a tendency for more tree crops, including oil palms and natural forests to be preserved in the south.

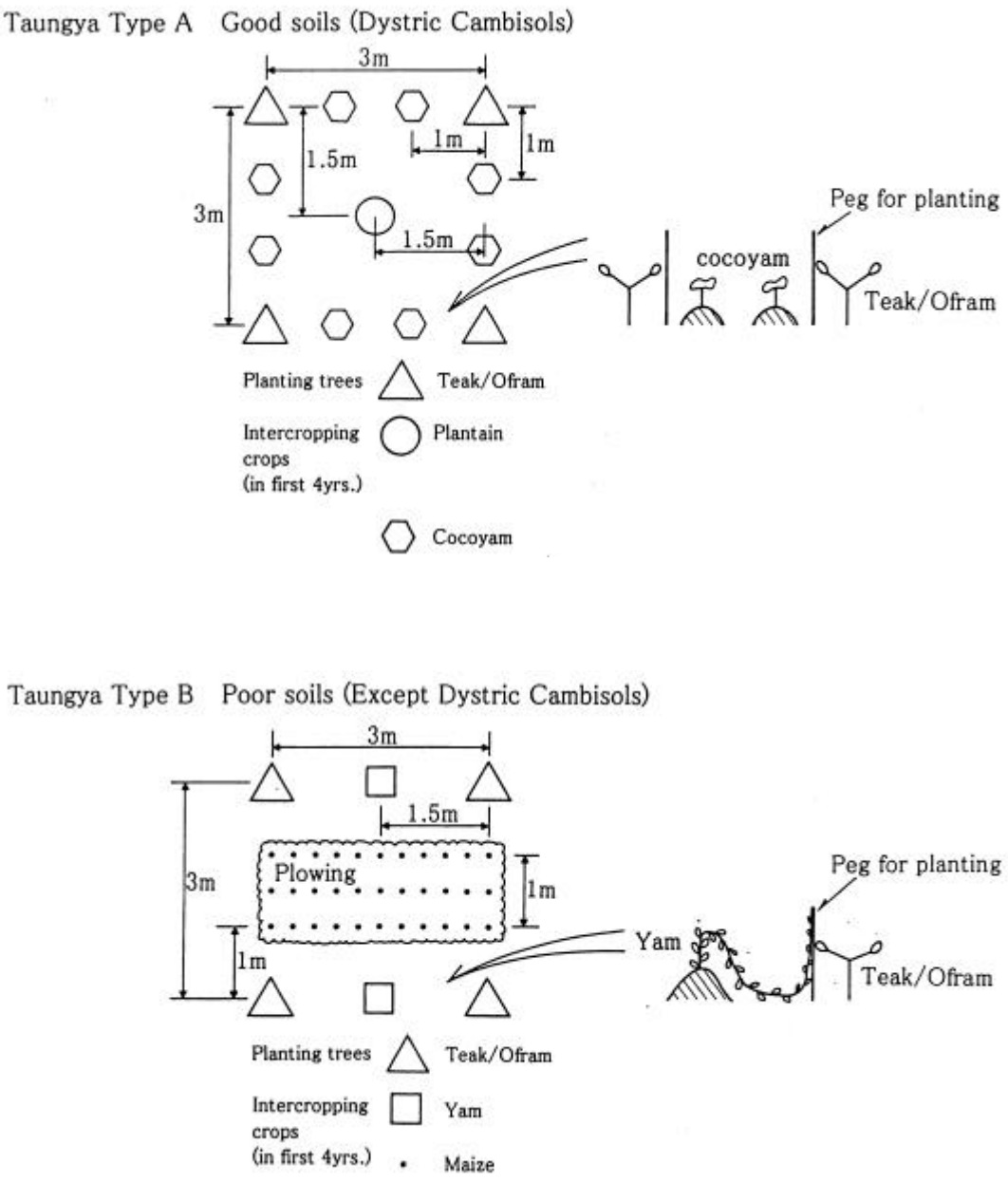

Fig. VII-3-3 Intercropping Under Taungya System

Table VII-3-1 Yearly Work Plan for Reforestation

TOTAL PLANNING AREA (Unit:ha)

Project TREE PLANTATION PRIVATELY PROMOTED/INDUSTRIAL PLANTATION Teak 0.8 Ofram 0.2

Year	Yaya FR				Tain I FR				Nsemire FR				Sawsaw FR				Tain II FR				Total				Accumulation
	Taungya A	Taungya B	Non-Taungya	Total	Taungya A	Taungya B	Non-Taungya	Total	Taungya A	Taungya B	Non-Taungya	Total	Taungya A	Taungya B	Non-Taungya	Total	Taungya A	Taungya B	Non-Taungya	Total	Taungya A	Taungya B	Non-Taungya	Total	
-1																									
1				0				0				0				0				0	0	0	0	0	0
2				0				0				0				0				0	0	0	0	0	0
3	0	221	0	221				0				0				0				0	0	221	0	221	221
4	0	276	0	276	80	0	117	197				0				0				0	80	276	117	473	694
5	124	343	0	467	0	0	327	327	0	192	0	192				0				0	124	535	327	986	1,680
6	16	359	17	392	0	83	118	201	0	181	0	181	0	269	0	269	0	268	0	268	16	1,160	135	1,311	2,991
7	0	259	20	279	122	24	122	268	0	48	159	207	0	331	0	331	0	102	401	503	122	764	702	1,588	4,579
8	0	168	242	410	125	47	0	172				0	0	27	414	441	0	43	524	567	125	285	1,180	1,590	6,169
9	175	45	49	269				0				0	0	367	228	595	97	178	399	674	272	590	676	1,538	7,707
10				0				0				0	64	418	187	669	0	0	775	775	64	418	962	1,444	9,151
11				0				0				0	0	298	314	612	0	0	1,030	1,030	0	298	1,344	1,642	10,793
12				0				0				0	164	73	239	476	127	204	509	840	291	277	748	1,316	12,109
13																					0	0	0	0	12,109
14																					0	0	0	0	12,109
15																					0	0	0	0	12,109
16																					0	0	0	0	12,109
17																					0	0	0	0	12,109
18																					0	0	0	0	12,109
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24																					0	0	0	0	12,109
25																					0	0	0	0	12,109
26																					0	0	0	0	12,109
27																					0	0	0	0	12,109
Ofram 28				44				0				0				0				0	0	0	0	44	12,109
29				55				39				0				0				0	0	0	0	95	12,109
30				93				65				38				0				0	0	0	0	197	12,109
31				78				40				36				54				54	0	0	0	262	12,109
32				56				54				41				66				101	0	0	0	318	12,109
33				82				34				0				88				113	0	0	0	318	12,109
34				54				0				0				119				135	0	0	0	308	12,109
35				0				0				0				134				155	0	0	0	289	12,109
36				0				0				0				122				206	0	0	0	328	12,109
37				0				0				0				95				168	0	0	0	263	12,109
38				0				0				0				0				0	0	0	0	0	12,109
39				0				0				0				0				0	0	0	0	0	12,109
40				0				0				0				0				0	0	0	0	0	12,109
41				0				0				0				0				0	0	0	0	0	12,109
42				0				0				0				0				0	0	0	0	0	12,109
43				0				0				0				0				0	0	0	0	0	12,109
44				0				0				0				0				0	0	0	0	0	12,109
45				0				0				0				0				0	0	0	0	0	12,109
46				0				0				0				0				0	0	0	0	0	12,109
47																									
48																									
49																									
50																									
Total	315	1,671	328	2,777	327	154	684	1,398	0	421	159	696	228	1,783	1,382	4,072	224	795	3,638	5,588	1,094	4,824	6,191	14,531	

(2) Green firebelt

① Size and Distribution of Green firebelt

For the present plan, green firebelt of more than 200 ha, i.e. approximately 2% of the subject area for planting (1,200 ha) will be established. Assuming the participation of local people, the planning of 40 m wide green firebelt along forest reserve boundaries and block boundaries in the participatory-type forest management zone will result in the establishment of some 300 ha in total.

② Planting System

Green firebelt are classified into the firebreaking zone (where the firebreak function is the priority), intercropping zone (where the needs of local people are given priority) and fruit production zone (integral zone) as a comprehensive measure designed to achieve a high crown density which is necessary to reduce the quantity of combustibles, to ensure the permanent production of food crops required by local people and to maintain the firebreak function (Fig. VII-3-4).

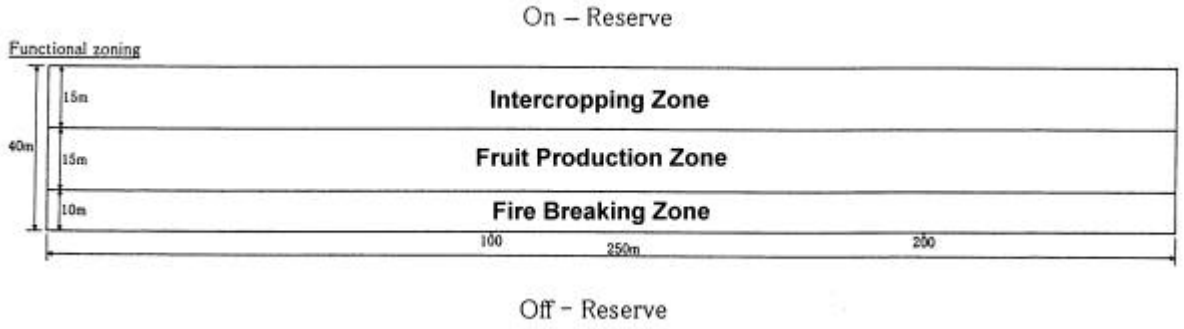

Fig. VII-3-4 Standard Function Classification of Green Firebelt

a) Firebreaking Zone (10 m wide)[8]

Cassia and mango[9] which are evergreen species and which are believed to have a high firebreak performance by local people will be planted as the firebreak species. As the initial growth of cassia is fast, it will be planted with a relatively high density to

[8] Such clssification by function might bring about the possibility that participating people do manage only their own need-priority zone. Because of that, ploanting method must be considered so that firebreaking zone could function without their management.

[9] Mango fruit is also used by local people and its use for medicinal purposes is highly valued. However, the contribution of mango to providing economic benefits for local people is not anticipated for the present purposes as the tree preference survey found little popularity of its use, low fruit quality due to the particular type of locally available species and climatic conditions (small daily temperature range, etc.) and low commercial value in the local market.

act as a shield to prevent the spread of bushfire. In the case of mango, its large and high density crown is expected to reduce the quantity of forest bed vegetation while its thick leaves are expected to shut out heat for preventing the spread of bushfires (see Fig. VII-3-5).

b) Intercropping Production-Zone (maize-shrub rotation-type intercropping zone; 15 m wide)

The soil improving tree area planted with Leguminosae and the maize cultivation area for self consumption will be rotated every five years to ensure the permanent production of maize. For this purpose, the cultivation of 0.25 ha or 0.125 ha (based on five year rotation with a soil improving tree area for the fallow period) per 1 ha of this zone is planned (see Fig. VII-3-6).

c) Fruit Production Zone (15 m wide)

A fruit production zone will be established between the firebreaking zone and food crop production zone to provide cash income, i.e. another need of local people, and to supplement the firebreak function (see Figs. VII-3-7 and VII-3-8).

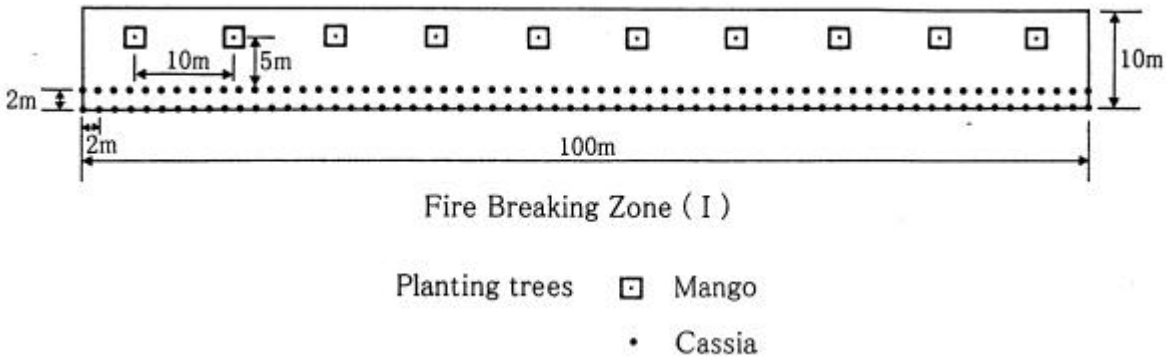

Fig. VII-3-5 Standard Tree Distribution of Firebreaking Zone

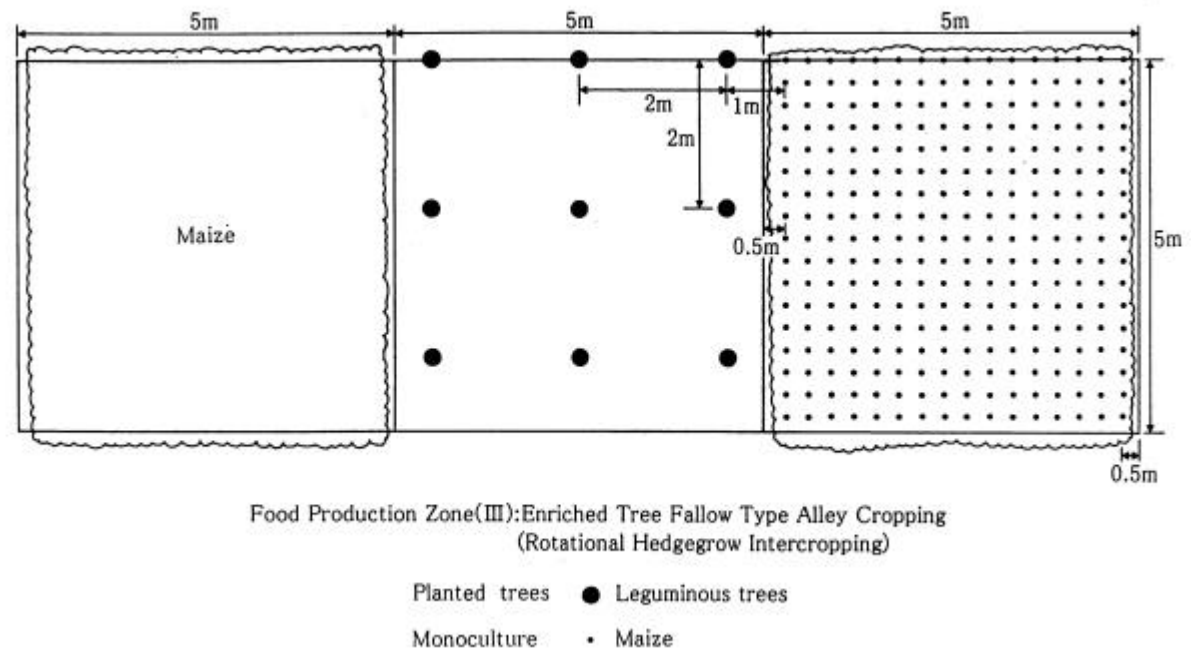

Fig. VII-3-6 Standard Distribution of Soil Improving Trees and Food Crops in Intercropping Zone in Green Firebelt

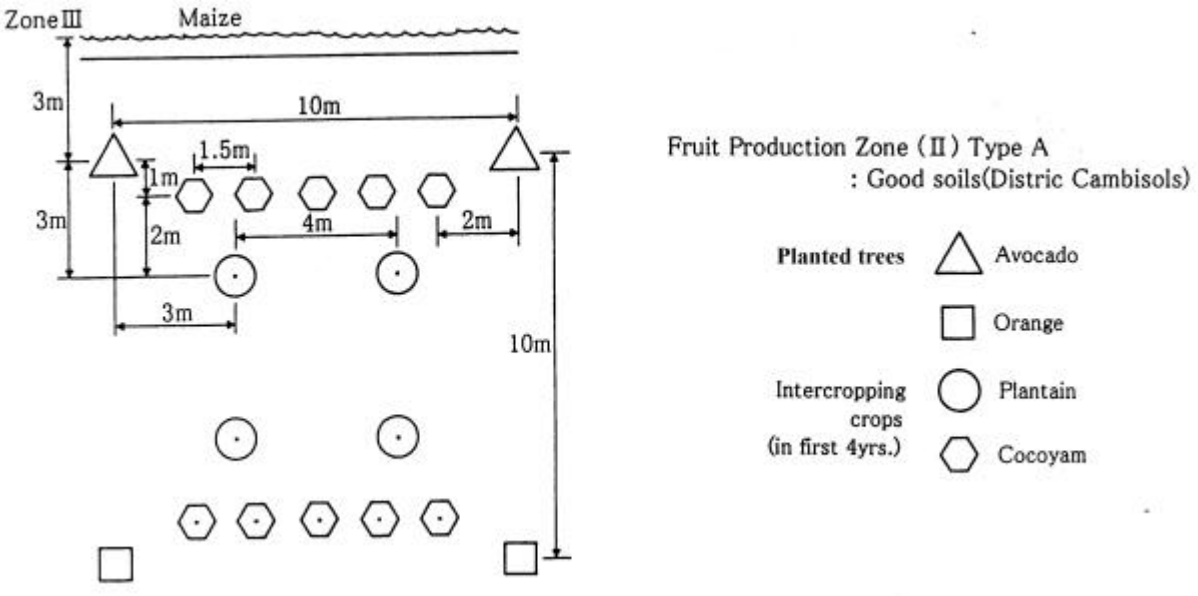

Fig. VII-3-7 Distribution of Intercrops in Fruit Production Zone in Green Firebelt: Type A

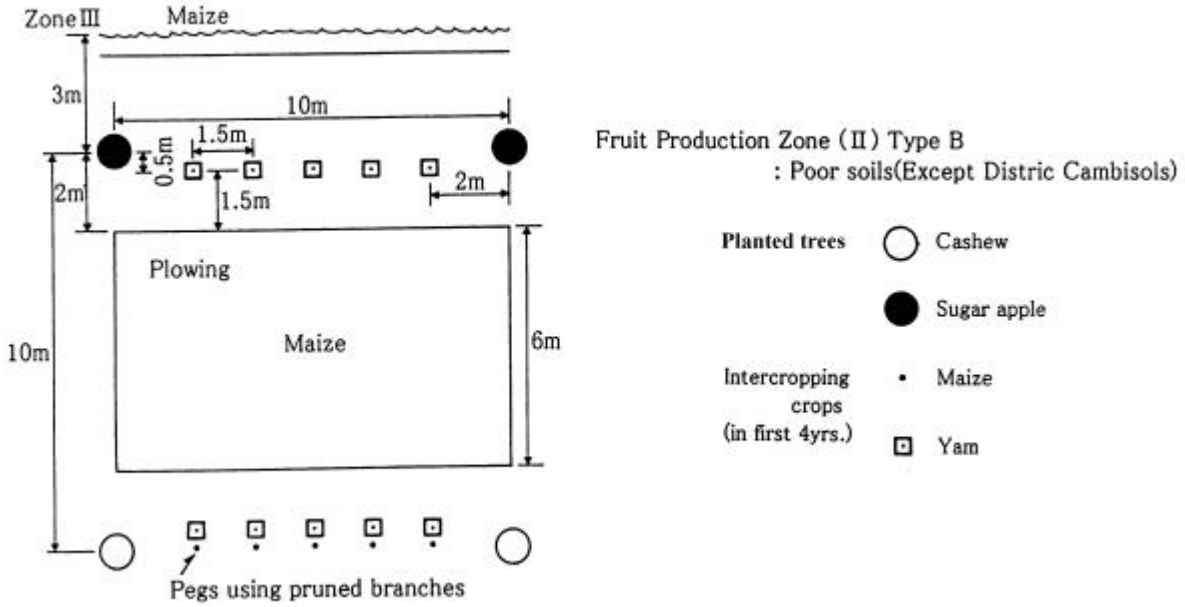

Fig. VII-3-8 Distribution of Intercrops in Fruit Production Zone in Green Firebelt: Type B

③ Establishment Method

a. Land Preparation

As the trees remaining on grassland will not, in principle, be cut, manual weeding will comprise the main land preparation work.

b. Adoption of Potted Seedlings

At the view point of survival and initial growth given the purpose of green firebelt, potted seedlings will, in principle, be used.

④ Tending and Management Methods

The following management standards will be adopted based on the method used to establish existing green firebelt and some information held by the agricultural office. Patrols will be conducted in the major dry season for the early detection of bushfires.

a. Firebreaking Zone

In principle, local people need to get the permission of cutting from the Forest Department. Accordingly, forestry side does not pay attention so much to people's utilization, and planted trees will be relied on natural regeneration from the viewpoint of simplifying its management by local people.

b. Fruit Production Zone

The appropriate regeneration period for fruit trees depends on the period of fruit production for economic benefit. Regeneration cutting will generally be conducted 15 years after planting. The cut trees will be used as wood resources, such as firewood, for local life. In addition, since bee keeping[10] requires patrol and promote the pollination of fruit trees, the patrol for bushfire will be facilitated and the pollination will be assured in dry season by introducing low input type bee keeping with wooden beehives installed.

c. Food Production Zone

Weeding will be conducted approximately at the end of rainy season (twice a year). Soil improving trees of Leguminosae will be cut every five years for conversion of the site for the cultivation of maize. At the same time, former maize cultivation sites will be planted with soil improving trees of Leguminosae. The cut trees can then be used as wood resources, such as firewood, for local life.

⑤ Yearly Work Plan

Green firebelt will basically be established based on the same principles adopted for industrial plantation. As the participation of local people can be easily secured due to the introduction of agroforestry which emphasises the early detection of bushfires, establishment of an early fire-fighting system and the accommodation of local needs, the establishment of green firebelt will be implemented prior to industrial plantation in neighbouring areas (see Table VII-3-2).

Table VII-3-2 Yearly Plan for Establishment of Green Firebelt

Total Planning Area (Unit:ha)

Project Year	**Green Fire Belts**																			Accumulated plantation site
	Yaya FR			Tain I FR			Nsemire FR			Sawsaw FR			Tain II FR			Total			
	A	B	Total	A	B	Total	A	B	Total	A	B	Total	A	B	Total	A	B	Total	
-1																				
1																		0	0	
2	0	2	2													0	2	2	2	
3	0	16	16	6	0	6			0			0			0	6	16	22	24	
4	1	4	5	0	3	3	0	10	10			0			0	1	17	18	42	
5	0	12	12	0	11	11	0	19	19	0	9	9	0	6	6	0	57	57	99	
6	0	16	16	6	0	6	0	2	2	0	9	9	0	0	0	6	27	33	132	
7	0	5	5	14	8	22			0	0	0	0	0	6	6	14	19	33	165	
8	5	2	7							0	15	15	8	17	25	13	34	47	212	
9										9	21	30	0	0	0	9	21	30	242	
10										0	16	16	0	0	0	0	16	16	258	
11										14	10	24	18	9	27	32	19	51	309	
12																		0	309	
13																				
Total	6	57	63	26	22	48	0	31	31	23	80	103	26	38	64	81	228	309		

[10] Honey is considered to be a NTFPs. Wooden beehives are sometimes observed in kitchen gardens in the Study Area. The materials for beehives must be inexpensive so that local people can easily afford them. Technical guidance on beekeeping will be provided.

(3) Community Woodlot

① Subject Sites

Among the small areas of grassland scattered in natural forests in the Intensive Study Area, those compartments (totalling some 400 ha) located in the participatory-type forest management zone will be subject to planting to establish community woodlot.

② Planting Method

a. Land Preparation

Land preparation will mainly consist of manual weeding while preserving the remaining trees. The weeds and shrubs should be piled in a belt along the contour lines from the viewpoint of environmental consideration (at approximately 2 m intervals).

b. Planting

For the present plan, wawa (*Triplochiton scleroxylon*) and odum (*Milicia excelsa*) will be planted with a planting distance of 3 m x 3 m (see Fig. VII-3-9).

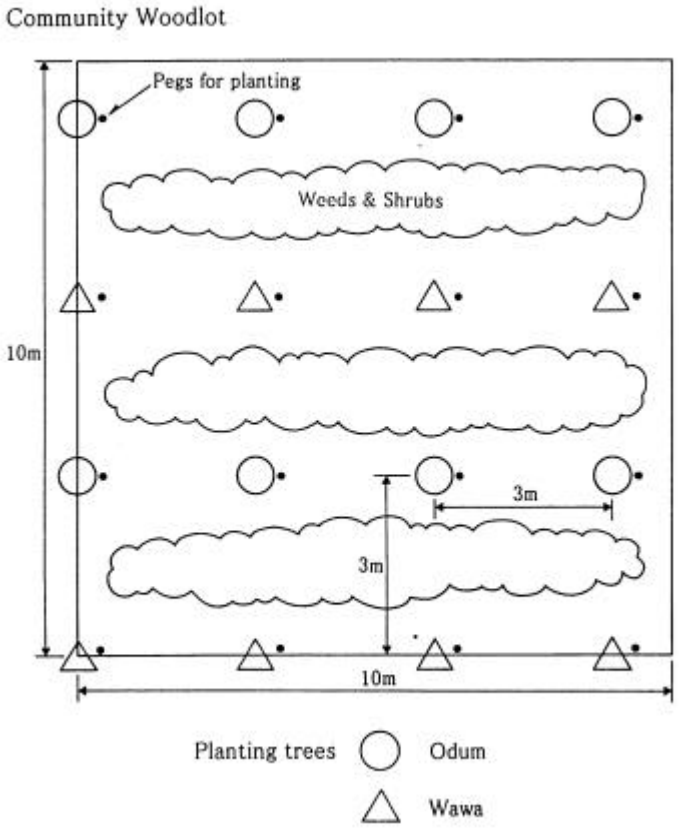

Fig. VII-3-9 Standard Planting Plan for Community Woodlot

③ Tending and Management

Weeding will be conducted twice a year up to the fourth year after initial planting. Because of the absence of accumulated data required for the thinning and harvesting of local species and because of the fact that the target is to meet long-term needs of local people for preparation to forest resource reduction in the future, no harvesting of the planted trees during the plan period is scheduled. Compliance rules in Collaborative Forest Management Agreement will be applied to the collection and breeding/growing of NTFPs in community woodlot. In the case of animal NTFPs, community woodlot will be treated as permitted hunting areas.

Patrols will be conducted during the major dry season for the early detection of bushfires. The use of fire in forest reserves will be prohibited.

④ Yearly Work Plan

Because priority is given to the establishment of areas with sustainable tenure for the use of NTFPs, village woodlot will be established in the second half of the forest development period.

Table VII-3-3 Yearly Plan for Establishment of Community Woodlot

Total Planning Area (Unit:ha)

Project Year	**Community Woodlots**																		Accumulated plantation site
	Yaya FR			Tain I FR			Nsemire FR			Sawsaw FR			Tain II FR			Total			
			Total			Total			Total			Total			Total			Total	
-1																			
1																		0	0
2																		0	0
3																		0	0
4																		0	0
5																		0	0
6																		0	0
7			14			13			18			16			15			76	76
8			14			5			6			55			13			93	169
9			11			7			2			45			14			79	248
10			24			16			6			30			13			89	337
11			29			19						35			6			89	426
12																		0	426
12																			
Total	0	0	92	0	0	60	0	0	32	0	0	181	0	0	61	0	0	426	

VII.3.2 Natural Forest Conservation Plan

(1) Improvement of Natural Forests

① Subject Sites

The subject sites are those compartments with a crown density of less than 20% and with many gaps in the canopy in the natural forest. (around 1,500 ha).

② Improvement Method

The supplementary planting of local species (non-fast growing species) will be conducted in the form of line planting (see Fig. VII-3-10).

a. Land Preparation

Land preparation will be conducted in a belt fashion with a width of 5 m in view of the severe invasion of Chromolaena spp.

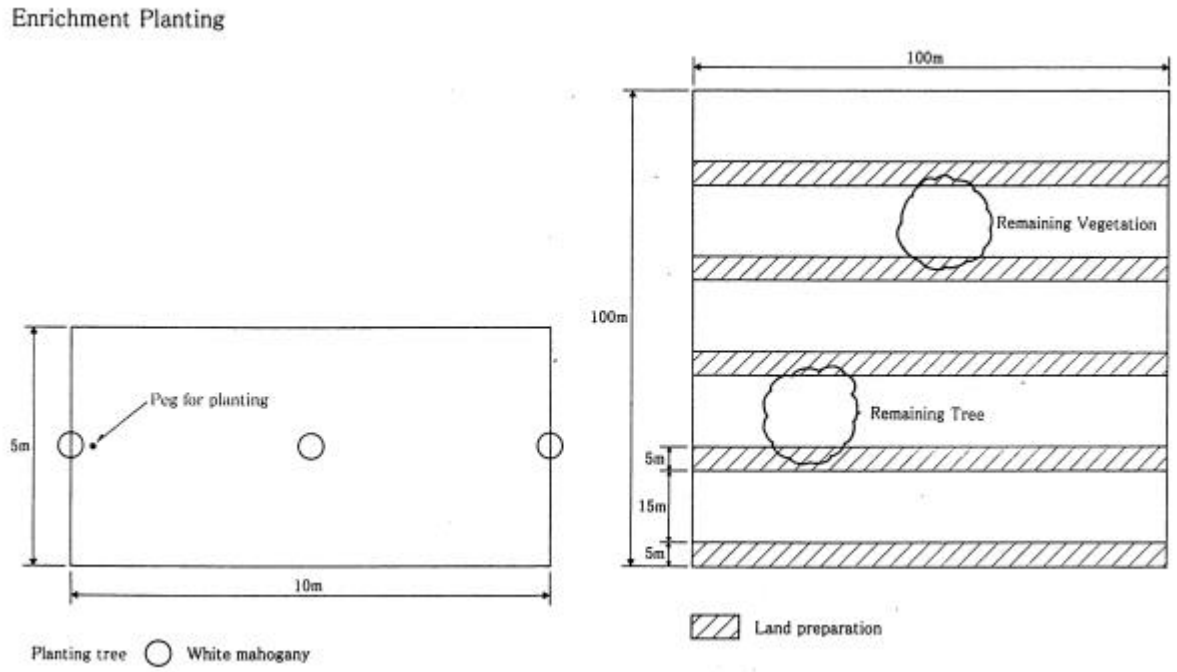

Fig. VII-3-10 Standard Supplementary Planting Plan for Natural Forest Improvement

b. Planting

The use of potted Mahogany (Khaya spp.) seedlings is planned as the planting materials. The actual planting is planned in the second half of the planting period, i.e. May or June, for the establishment of plantations in order to avoid competition vis-a-vis the participation of local people in the establishment of plantations and the planting of crops (particularly such main crops as maize, etc.) by local people.

c. Tending

Given the severe invasion by Chromolaena spp., weeding will be conducted at the end of rainy season (twice a year) up to the fourth year from planting when it is believed that the planted trees will have grown above the height of Chromolaena spp. and others in order to prevent bushfires and to ensure the growth of the planted trees.

③ Yearly Work Plan

As there have been few cases in Ghana of large-scale supplementary planting in natural forests, the establishment of sustainable NTFPs Tenure Areas will be set up in the first half and the work will be conducted in the second half of the forest establishment period (see Table VII-3-4).

Table VII-3-4 Yearly Plan for Planting in Natural Forests

Total Planning Area (Unit:ha)

Project Year	**Natural Forest Rehabilitation/Natural Forest Conservation No.1**												**Enrichment Planting**												Total	Accumulated plantation site
	Yaya FR			Tain I FR			Nsemire FR			Sawsaw FR			Tain II FR			Total									
			Total			Total			Total			Total			Total			Total			Total			Total	
-1																										
1																									0	0
2																									0	0
3																									0	0
4																									0	0
5																									0	0
6																									0	0
7						15			15			40			65			170							305	0
8						15			15			40			65			170							305	305
9						15			15			40			65			170							305	610
10						15			15			40			65			170							305	915
11						14			21			50			79			172							336	1,220
																									0	1,556
Total	0	0		0	0	74	0	0	81	0	0	210	0	0	339	0	0	852	0	0					1,556	

(2) Management of Sustainable NTFPs Tenure Areas

① Establishment of Sustainable NTFPs Tenure

Sustainable NTFPs tenure will be established for a certain period at certain sites in natural forests located near villages as a comprehensive measure designed to strengthen the

management of NTFPs resources, i.e. prevention of negative impacts on the environment, to provide cash income opportunities as required by local people and to simplify the NTFPs collection permit system.

② Designation of Candidate Sites for Sustainable NTFPs Tenure

Candidate sites for sustainable NTFPs tenure will be designated in natural forests distributed in the participatory-type forest management zone in the following manner. However, the collection and culture of small animals (bees and snails, etc.) among animal NTFPs and the collection (excepting the trunks of living trees) and culture of plant NTFPs will be permitted regardless of designation. Approval will not be required for the collection of small animals and plant NTFPs (mushrooms) other than seed plants even if they are collected for cash income purposes (see Table VII-3-5).

Table VII-3-5 Candidate Sites for Sustainable NTFPs Tenure by F/R

(Unit : ha)

Forest Reserve	Permitted Hunting Zones		Hunting Prohibition Zone		Total
	D1	D2	D3	D4	
Sawsaw	206	276	419	55	956
Nsemire	37	227	50	13	327
Yaya	74	710	227	0	1,011
Tain I	45	119	490	0	654
Tain II	184	613	1,050	105	1,952
Total	546	1,945	2,236	173	4,900

a. Permitted Hunting Zones

As stands with a low crown density (forest type: D1 and D2) provide suitable habitat for bushmeat (particularly rodents), the hunting of bushmeat without fire will be allowed.

b. Hunting Prohibition Zone

The hunting of bushmeat will be prohibited at stands with a high crown density (forest type: D3 and D4) as these stands comprise unsuitable habitation for animals for bushmeat.

③ Approval of Sustainable NTFPs Tenure Sites

- The Forestry Department (District Forestry Offices) will evaluate the village NTFPs resources and village needs for NTFPs resources through the use of NGOs.

- The Forestry Department (District Forestry Offices) will establish sustainable NTFPs tenure sites in natural forests of a suitable size and location, will inform the relevant village forest management committees of these sites.

④ Management of Sustainable NTFPs Tenure Sites

- The Forestry Department (District Forestry Offices) will conduct a briefing on approved sustainable NTFPs tenure sites for the relevant village forest management committees.

- Members will report any violation of the rules regarding tenure sites to the relevant village forest management committees. The latter will conduct patrols when deemed necessary (see VII.3.7-(3)).

⑤ Renewal or Extension of Sustainable NTFPs Tenure Sites

The permit period will be extended from the initial one year to three years and subsequently to five years whenever "a sustainable NTFPs tenure permit" is renewed. At the time of renewal, the Forestry Department (District Forestry Offices) will decide on the suitability of extension, taking previous reports on collection, state of compliance with collection rules and past culture performance into consideration. The operation and management of tenure will be implemented under the system shown in Fig. VII-3-11.

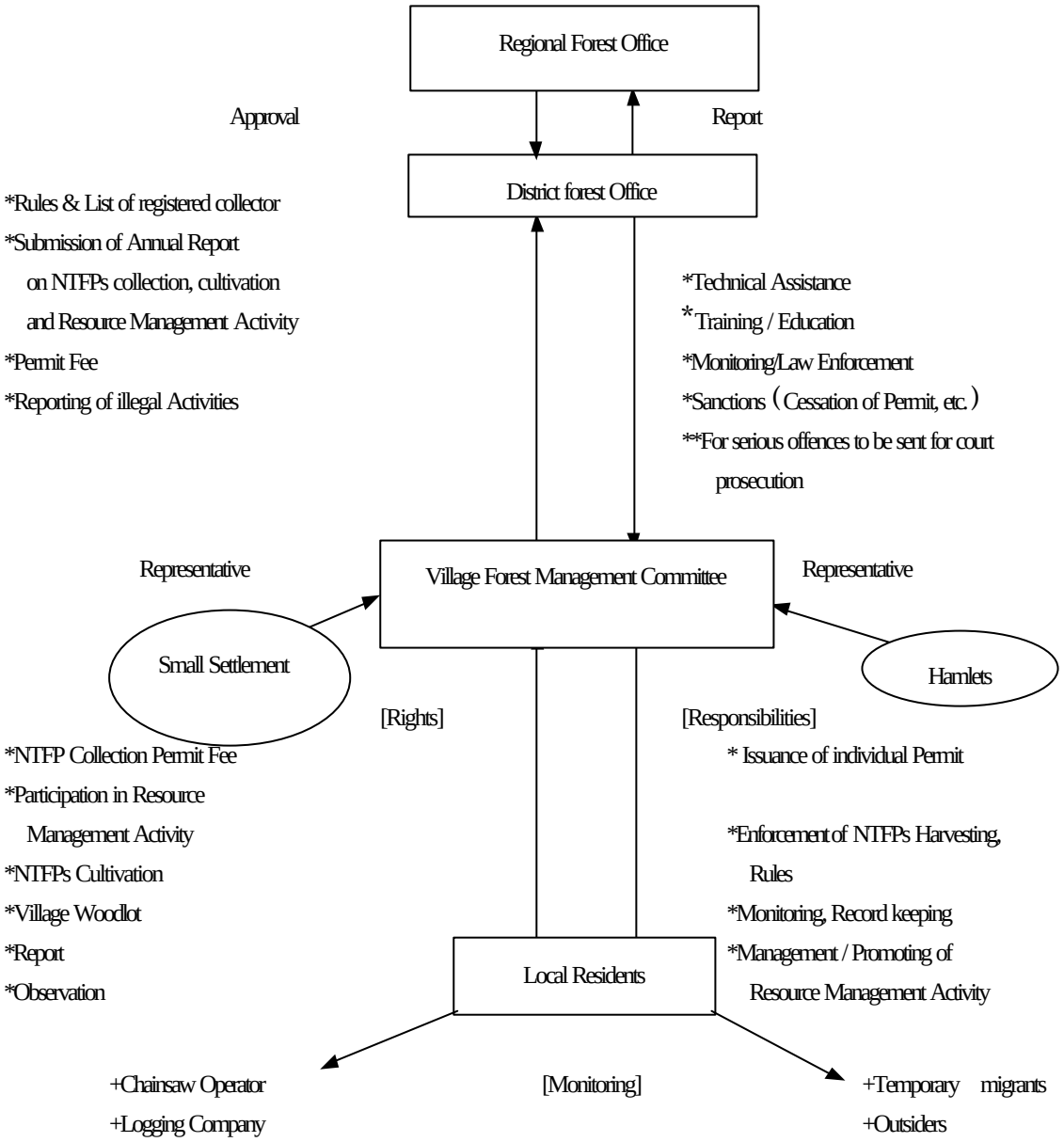

Fig. VII-3-11 Outline of Operation and Management System for Sustainable NTFPs Tenure Sites

VII.3.3 Cutting and Harvesting Plan

Cutting and harvesting are planned for the planted trees as well as fruit trees and crops for plantations and green firebelt under the plantation establishment and management plan. Plantations already planted by the Forestry Department, village woodlots with a cutting period of more than 50 years and NTFPs in natural forests are not included in the scope of this plan. Cutting and harvesting work will be conducted by private company in the case of industrial plantations and the employment of local people for this work will be encouraged. Cutting and harvesting work in village woodlots and green firebelt will be conducted by local people.

(1) Industrial Plantations

① Cutting Method

The planted trees will be cut by a team of one operator and one assistant using a chainsaw. The branches and leaves of the cut trees will be removed on site in view of yarding efficiency and the supply of fuelwood for local people. The cut trees will be transported by a tractor to a yard on the spot which has been established along a spur road.

② Harvesting of Planted Trees and Crops

As already described, the final cutting age will be 35 years for teak and 25 years for Ofram. The yield of teak and ofram undergoing thinning and final cutting is estimated by multiplying the standing tree volume estimated on the basis of the data prepared by the Planning Branch by the number of trees subject to thinning and final cutting in accordance with the standards set by the Planning Branch. Table VII-3-6 shows the annual yield of planted trees as well as crops cultivated under the taungya system up to the year when the harvesting of the planted trees is completed.

In regard to the timing of planting and harvesting, maize and yams will be harvested every year and plantains and cocoyams will be harvested every two years based on the socioeconomic and cultural conditions survey findings.

Table VII-3-6 Harvesting of Planted Trees and Crops at Industrial Plantations

Outline of Plantation Establishment & Management and Production

Industrial Plantation (Unit: per ha unit of gross sites)

Planting cycle	Main process **Forestry work**						**Wood production (m3)**					Food crop cultivation					
	Teak zone Investment (Standard remaining) [trees]	Actual(ha) O & M	Actual remaining trees	Ofram zone Investment (Standard) remaining) [trees]	Actual(ha) O & M	Actual remaining trees	Firewoods/Sticks (Incentive for LP)	Pole & posts	Electric poles	Logs for sawing	Total	Intercropping Teak section	Ofram section	Yields(t) Type A Maize ha/mono-actual	Cocoyam ha/mono-actual	Type B Plamtain ha/mono-actual	Yam ha/mono-actual
			0.92			0.92								0.30	0.23		
1	Planting:1,100 (1,100)	Weeding	1,000	Planting:1,100 (1,100)	Weeding	1,000						○	○	0.40	1.27		
2		-Weeding -Pruning & climber cutting			-Weeding -Pruning & climber cutting		(Pruined branches:Teak & Ofram)					○	○	0.40	1.27	4.79	0.72
3		-Pruning & climber cutting			-Pruning & climber cutting		(Pruined branches:Teak & Ofram)					○	○	0.40	1.27		
4		-Improvement cutting		Thinning:500 (600)		550 Gap space(ha) 0.42	(Cut trees:Teak) -Thinned Ofram 8.23				8.23	○	○	0.40	1.27	4.79	0.72
5													○				
6													○				
7		-Improvement cutting					(Cut trees:Teak)						○				
8				Thinning:300 (300)		280	-Thinned Ofram 12.02				12.02		○				
9	(660)		600														
10	Thinning:160 (500)		450 Gap space(ha) 0.48				-Thinned Teak 7.62	-Thinned Teak 4.23	-Thinned Teak 1.69		13.54						
11												○					
12												○					
13												○					
14	Thinning:250 (250)		220	Thinning:150 (150)		130	-Thinned Teak 27.46 -Thinned Ofram 38.18	-Thinned Teak 7.63	-Thinned Teak 3.05	-Thinned Ofram (Effective:19.09)	38.14 38.18	○					
20	Thinning:100 (150)		130				-Thinned Teak 3.99	-Thinned Teak 15.99	-Thinned Teak 15.99	-Thinned Teak 4.00 (Effective:1.16)	39.97						
25				Final felling:150 (0)		0				- Felled Ofram 204.55 (Effective:59.32)	204.55						
35	Final felling:150 (0)									- Felled Teak 136.52 (Effective:39.59)	136.52						

③ Cutting Area

While the yearly cutting area is decided in correspondence with the yearly planting area, approximately 1,000 ha is used as the yardstick. In consideration of possible environmental impacts, the cutting area per cutting block is set at 20 ha or less. The yearly cutting area for teak and ofram is shown in Table VII-3-7.

Table VII-3-7 Yearly Cutting Area for Teak and Ofram (Final Cutting)

	Total planting Area		Tree Plantation Privately /Industrial Plantation								(unit:ha)	
Project	Yaya		Tain I		Nsemire		Sawsaw		Tain II		Total	
Year	Teak	Ofram	Teak	Ofram	Teak	Ofram	Teak	Ofram	Teak	Ofram	Teak	Ofram
28	0	44	0	0	0	0	0	0	0	0	0	44
29	0	55	0	39	0	0	0	0	0	0	0	94
30	0	93	0	65	0	38	0	0	0	0	0	196
31	0	78	0	40	0	36	0	54	0	54	0	262
32	0	56	0	54	0	41	0	66	0	101	0	318
33	0	82	0	34	0	0	0	88	0	113	0	317
34	0	54	0	0	0	0	0	119	0	135	0	308
35	0	0	0	0	0	0	0	134	0	155	0	289
36	0	0	0	0	0	0	0	122	0	206	0	328
37	177	0	0	0	0	0	0	95	0	168	177	263
38	221	0	158	0	0	0	0	0	0	0	379	0
39	374	0	262	0	154	0	0	0	0	0	790	0
40	314	0	161	0	145	0	215	0	214	0	1,049	0
41	223	0	214	0	166	0	265	0	402	0	1,270	0
42	328	0	138	0	0	0	353	0	454	0	1,273	0
43	215	0	0	0	0	0	476	0	539	0	1,230	0
44	0	0	0	0	0	0	535	0	620	0	1,155	0
45	0	0	0	0	0	0	490	0	824	0	1,314	0
46	0	0	0	0	0	0	381	0	672	0	1,053	0
Total	1,852	462	933	232	465	115	2,715	678	3,725	932	9,690	2,419

④ Yearly Yield Plan

The yearly yield of the planted trees shown in Table VII-3-8 is planned for plantations reaching their final cutting age by multiplying the area of plantations by the yield per unit area.

Table VII-3-8 Yearly Yield Plan

Project Year	<with Taungya> Total felled volume							<without Taungya> Total felled volume						
	Firewood T & O *44* (m3)	Pole & Post T & O *45* (m3)	Electric pole Teak *46* (m3)	Log(Effective) Teak *47* (m3)	Ofram *48* (m3)	Total *47+48=49* (m3)	Total *44+45+46+49 =50*	Firewood T & O *44* (m3)	Pole & Post T & O *45* (m3)	Electric pole Teak *46* (m3)	Log(Effective) Teak *47* (m3)	Ofram *48* (m3)	Total *47+48=49* (m3)	Total *44+45+46+49 =50*
			13,220	13,220	4,080					13,220	13,220	4,080		
-3														
-2														
-1														
1														
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	700	0	0	0	0	0	700	0	0	0	0	0	0	0
7	1,100	0	0	0	0	0	1,100	300	0	0	0	0	0	300
8	2,000	0	0	0	0	0	2,000	1,000	0	0	0	0	0	1,000
9	3,500	0	0	0	0	0	3,500	400	0	0	0	0	0	400
10	4,100	0	0	0	0	0	4,100	2,100	0	0	0	0	0	2,100
11	3,600	0	0	0	0	0	3,600	4,300	0	0	0	0	0	4,300
12	8,200	700	300	0	0	0	9,200	4,200	0	0	0	0	0	4,200
13	11,300	1,200	500	0	0	0	13,000	4,500	400	200	0	0	0	5,100
14	10,700	2,200	900	0	0	0	13,800	10,600	1,100	400	0	0	0	12,100
15	11,500	4,000	1,600	0	0	0	17,100	10,800	500	200	0	0	0	11,500
16	15,900	4,300	1,700	0	800	800	22,700	8,700	2,400	1,000	0	0	0	12,100
17	13,500	3,600	1,400	0	1,400	1,400	19,900	16,100	4,700	1,900	0	400	400	23,100
18	21,700	6,900	2,800	0	2,500	2,500	33,900	20,100	4,300	1,700	0	1,200	1,200	27,300
19	32,500	8,800	3,500	0	4,500	4,500	49,300	13,700	4,100	1,600	0	500	500	19,900
20	21,300	6,400	2,600	0	3,400	3,400	33,700	23,600	8,800	3,500	0	2,700	2,700	38,600
21	12,500	4,400	1,800	0	1,600	1,600	20,300	30,500	9,700	3,900	0	4,500	4,500	48,600
22	19,600	8,100	4,900	700	3,300	4,000	36,600	14,900	4,100	1,600	0	2,600	2,600	23,200
23	11,700	7,500	5,700	1,100	1,800	2,900	27,800	21,500	7,400	3,800	400	3,700	4,100	36,800
24	8,700	10,300	9,200	2,100	1,100	3,200	31,400	30,600	12,400	7,500	1,000	5,100	6,100	56,600
25	20,600	18,500	16,400	3,800	2,200	6,000	61,500	22,600	6,300	3,600	400	2,900	3,300	35,800
26	2,800	11,300	11,300	2,800	0	2,800	28,200	2,200	9,000	9,000	2,200	0	2,200	22,400
27	1,300	5,200	5,200	1,300	9,000	10,300	22,000	3,800	15,100	15,100	3,800	0	3,800	37,800
28	2,800	11,000	11,000	2,800	14,600	17,400	42,200	2,200	8,700	8,600	2,200	4,800	7,000	26,500
29	1,500	6,200	6,200	1,500	27,000	28,500	42,400	3,100	12,300	12,300	3,100	13,400	16,500	44,200
30	1,000	3,800	3,800	1,000	48,100	49,100	57,700	4,300	17,200	17,200	4,300	5,500	9,800	48,500
31	2,500	7,300	7,300	1,800	36,200	38,000	55,100	2,400	9,600	9,600	2,400	28,700	31,100	52,700
32	1,100	0	0	0	16,800	16,800	17,900	300	0	0	0	48,300	48,300	48,600
33	2,000	0	0	0	35,300	35,300	37,300	1,000	0	0	0	27,700	27,700	28,700
34	3,500	0	0	0	19,700	19,700	23,200	400	0	0	0	39,400	39,400	39,800
35	4,100	0	0	0	12,200	12,200	16,300	2,100	0	0	0	55,000	55,000	57,100
36	3,600	0	0	0	23,200	23,200	26,800	4,300	0	0	0	30,600	30,600	34,900
37	6,900	0	0	19,300	0	19,300	26,200	4,200	0	0	0	0	0	4,200
38	9,100	0	0	31,100	0	31,100	40,200	3,700	0	0	10,200	0	10,200	13,900
39	6,700	0	0	57,600	0	57,600	64,300	8,600	0	0	28,600	0	28,600	37,200
40	4,400	0	0	102,800	0	102,800	107,200	10,000	0	0	11,800	0	11,800	21,800
41	7,300	0	0	77,400	800	78,200	85,500	4,400	0	0	61,300	0	61,300	65,700
42	5,900	0	0	35,800	1,400	37,200	43,100	7,200	0	0	103,100	400	103,500	110,700
43	7,000	0	0	75,300	2,500	77,800	84,800	11,300	0	0	59,100	1,200	60,300	71,600
44	12,700	0	0	42,100	4,500	46,600	59,300	5,900	0	0	84,100	500	84,600	90,500
45	6,800	0	0	26,000	3,400	29,400	36,200	5,400	0	0	117,400	2,700	120,100	125,500
46	3,100	0	0	49,600	1,600	51,200	54,300	9,000	0	0	65,400	4,500	69,900	78,900
47														
48														
49														
50														
Total	330,800	131,700	98,100	535,900	278,900	814,800	1,375,400	336,300	138,100	102,700	560,800	286,300	847,100	1,424,200

(2) Green Firebelt

① Fruit Production Zones

For the present plan, fruit trees in fruit production zones will be replanted sooner than usual in consideration of the following points. The yield of fruit trees shown in Table VII-3-9 are estimated based on the available data.

- It is inferred that most of the fruit trees to be planted will reach the peak of profitable fruit bearing approximately 10 years after planting.

- Although there are species with a long period of profitable fruit bearing, such as cashew, harvesting work becomes increasingly difficult with the ageing and height growth of the trees, creating unfavourable conditions for use of the fruit.

② Food Crop Production Zones

The estimated harvest of maize in food crop production zones is shown in TableVII-3-10.

Table VII-3-9 Yields of Fruit Trees and Crops in Fruit Production Zones

(Unit: per ha unit of gross sites)

Planting cycle			Fruit production (t)				Food crop cultivation					
			Type A		Type B		Intercropping	Yields(t)				
			Cashew	Sugar apple (Cashew)	Orange	Avocado		Type B Maize	Yam	Type A Plamtain	Cocoyam	
			0.17	0.17	0.10	0.21		0.15	0.06	0.16	0.03	
			ha/mono-actual	ha/mono-actual	ha/mono-actual	ha/mono-actual		ha/mono-actual	ha/mono-actual	ha/mono-actual	ha/mono-actual	
1	16	31					○	0.20	0.33			
2	17	32					○	0.20	0.33	0.46	0.05	
3	18	33					○	0.20	0.33			
4	19	34					○	0.20	0.33	0.46	0.05	
5	20	35	0.05	0.05	1.02	0.95						
6	21	36	0.10	0.10	1.02	0.95						
7	22	37	0.16	0.16	1.02	0.95						
8	23	38	0.23	0.23	1.02	1.26						
9	24	39	0.31	0.31	1.52	1.26						
10	25	40	0.37	0.37	1.52	1.26						
11	26	41	0.44	0.44	1.52	1.26						
12	27	42	0.51	0.51	1.52	1.26						
13	28	43	0.61	0.61	1.52	1.26						
14	29	44	0.68	0.68	1.52	1.26						
15	30	45	0.77	0.77	1.52	1.26						

Table VII-3-10 Maize Yield in Food Crop Inter-cropping Zones

Planting cycle			~~Zone III~~	Actual(ha)	0.38					
			Forestry work			Timber production	Food crop cultivation			
			Ipil-ipil Investment	Actual(ha)	0.125	Firewoods/Sticks	Monocolture with tree- enriched fallow	Alley-cropping & (Rotaitional Hedgegrow Intercropping system)		Yields(t)
				O & M		(Incentive for LP)	2 sections	1 section		Maize
			[trees]		Actual remaining trees					0.250 0.125 ha/mono-actual
1	16	31	Planting:375		375		○			0.67
2	17	32					○			0.67
3	18	33					○			0.67
4	19	34					○			0.67
5	20	35	Final felling		0	(Felled trees: 375)	○			0.67
6	21	36	Planting:750		750			○		0.67
7	22	37						○		0.67
8	23	38						○		0.67
9	24	39						○		0.67
10	25	40	Final felling		0	(Felled trees: 750)		○		0.67
11	26	41	Planting:375		375		○			0.67
12	27	42					○			0.67
13	28	43					○			0.67
14	29	44					○			0.67
15	30	45	Final felling		0	(Felled trees: 375)	○			0.67

VII.3.4 Nursery Practices Plan

(1) Nursery Practices Method

① Stump Seedlings (Teak: *Tectona grandis*)

Stump seedlings will be used for the planting of teak, the main species for industrial plantations, because of the following reasons.

a. There is sufficient experience in Ghana of the planting of stump seedlings of teak.

b. Stump seedlings are suitable for large-scale plantation because of their easy storage, handling and transportation.

② Potted Seedlings (other than teak)

Potted seedlings will be used for the planting of species other than teak because of the following reasons.

a. While the planting of some species using stump seedlings is possible, the relevant experience is scarce.

b. Bare root seedlings are disadvantageous in terms of survival and initial growth and are unsuitable for both natural forest improvement and participatory-type plantation establishment where tending and other work cannot be strictly controlled.

(2) Basic Specifications for Nursery Beds

The following nursery beds will be used based on the beds currently used.

① Stump Seedlings

Both the seed beds and transplanting beds will be the banked type (banking height of approximately 0.2 m) as in the case of bare root seedling beds. The bed size will be 12 m^2 (1.2 m x 10 m) per bed. As it assumed that the work will mainly be manually conducted, the distance between the beds is set at 0.5 m.

② Potted Seedlings

a. Central Nursery

- As most of the considered species have large seeds, the seeds will be directly sown into pots without using a seed bed.

- As flood-type watering is not planned for the pot beds, wooden boards will be used to create a frame (height of approximately 0.2 m) in which the pots will be placed. The size of the bed will be similar to that for stump seedlings.

b. Village Nurseries

- As most of the considered species have large seeds, the seeds will be directly sown into pots without using a seed bed.
- The pots will simply be placed on the ground. The bed size will be similar to that for stump seedlings.

The nursery beds will be constructed along the contour for preventing soil erosion in the case of steep slope. But in the case of gentle slope, nursery bed will be constructed in parallel with contour to prevent root disease by bad drainage. Simple shading consisting of wooden poles (height of approximately 0.5 m) and the leaves of oil palms, both of which can be obtained locally, will be used.

(3) Basic Process for Seedling Production

The seedling production process shown in Fig. VII-3-12 will basically be adopted based on the work process at existing nurseries and taking the examination results in (1) and (2) above into consideration.

The existing nursery practices method has not resulted in any large-scale damage by pests or diseases due to the local climatic and soil conditions. Accordingly, disinfection of the soil and the spraying of agrochemicals for pest and/or disease control will only be conducted when actual damage by pests or diseases occurs.

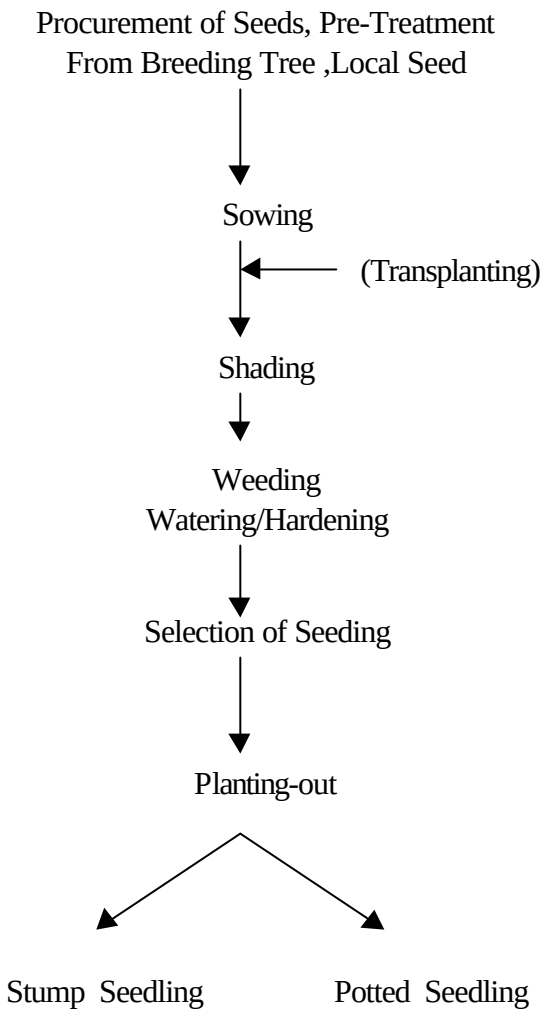

Fig. VII-3-12 Basic Process for Seedling Production

① Nursery Practices Period

a. Stump Seedlings

Following the existing nursery practices period, the seeds will be sown at the beginning of the major rainy season and preparations for planting out will be conducted in the second half of the major dry season. The standard nursery practices period will be approximately 8 months (October - May).

b. Potted Seedlings

• Local Species for Forestry Purposes

Although the nursery practices period varies from one species to another, the nursery practices period for stump seedlings, using those of Khaya spp. as a typical example, will principally be employed.

- Fruit Trees

  Again, the nursery practices period for fruit trees varies depending on the species and people, the standard period will be approximately six months based on the nursery practices period for avocado. The seeds will be sown during the minor rainy season and preparations for transplanting will be conducted in the second half of the major dry season. The standard period will be approximately 6 months.

- Fire Prevention and Soil Improving Trees of Leguminosae

  While the actual nursery practices period slightly varies from one species to another, the standard period is set at approximately six months based on the nursery practices period for Cassia *siamea*. The seeds will be sown during the minor rainy season and preparations for transplanting will be conducted in the second half of the major dry season. The standard period will be approximately 6 months.

② Sowing

Teak seeds will be sown in the germination bed (seed bed) to produce stump seedlings while selected seeds will be directly sown in container to produce potted seedlings taking into consideration the curtailment of raising process and the size of seeds. In the case of teak, the sowing density is an average of 1,200 (1,000 - 1,500) seeds/bed with an expected germination rate of 50%. The expected germination rate for potted seedlings is approximately 60% (40 - 80%) although this will depend on the species and sowing method.

③ Transplanting and Pot Nursing

Seedling of teak is assumed for the present plan to achieve a density of approximately 500 seedlings/bed. A loss rate of stump and potted seedling is assumed[11] approximately 20% (10-40%) depending on the species and sowing method.

④ Watering

An annual average daily watering volume of 11 tons/ha (1.1 litres/day/m^2) is planned, taking the following points into consideration.

a. Basic Watering Volume

The basic watering volume will be equivalent to the water volume which makes the

[11] Design procurement volume of seeds = number of required seedlings (number of required seedlings for planting + estimated number of seedlings for supplementary planting) x [1 + (estimated loss rate of sown seeds + estimated loss rate during nursing)/100]

monthly rainfall in the dry season[12] reach the annual mean monthly rainfall.[13] To be more precise, this will be 1.8 mm/day.[14] In order to achieve this target, 18 tons of water per day will be sprayed per ha of nursery bed (1.8 litres/day/m^2) in two watering operations per day. This watering will be manually conducted using a watering can or other suitable means.

b. Hardening

In the case of the nursery practices of tobacco[15] by local tobacco growing farmers entrusted by a tobacco company or the nursery practices of teak, the watering volume is estimated to be 0.2 litres/time/m^2, implying that the nursery practices of tobacco or teak can be conducted with a watering volume of approximately 0.5 litres/day/m^2. In view of this prospect, the watering volume during the nursery practices period is adjusted with the use of the basic watering volume for one-third of the period, half of the basic watering volume for one-third of the period and 0.5 litres/day/m^2 for the remaining one-third of the period.

⑤ Based on the quality standard of stump seedlings, they are to be dug out and trimmed in the majour dry season. The stump seedlings should be kept in pits with ventilation and taken out at the time of planting out in accordance with planting operation.

(4) Yearly Work Plan

① Central Nursery

Based on the yearly planting and intercropping plan examined in VII.3.1, nursery practices will commence one year before the planned planting. The required quantity of seedlings for yearly planting and supplementary planting is shown in Table VII-3-11.

② Village Nurseries

Based on the yearly planting plan examined in VII.3.1, seedling production will commence one year before the planned planting. The required quantity of seedlings for yearly planting and supplementary planting is shown in Table VII-3-12

[12] Mean monthly rainfall of dry months in a dry year (see III.1.1): assumed to be 27 mm
[13] Mean monthly rainfall of a dry year (see III.1.1): assumed to be 80 mm
[14] Equivalent to 53 mm/30 days
[15] Based on the findings of interviews conducted near Tromeso settlement

Table VII-3-11 Yearly Seedlings Production Plan for Central Nursery

Summary of Seedling Production Plan

	Central Nursery							
	Industrial Plantation			Natural Conservation No.1		Total		
Project	*Stumps*	*Potted*		*Potted*		*Total*	*Potted*	*Stumps*
Year	Teak	Ofram	Total	Mahogany	Total			
	1,000	1,000		100				
	0.80	0.20						
	1.1	1.3		1.4				
-1	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0
2	194,480	57,460	251,940	0	0	251,940	57,460	194,480
3	313,280	92,560	405,840	0	0	405,840	92,560	313,280
4	579,920	171,340	751,260	0	0	751,260	171,340	579,920
5	1,034,880	305,760	1,340,640	0	0	1,340,640	305,760	1,034,880
6	779,680	230,360	1,010,040	42,700	42,700	1,052,740	273,060	779,680
7	360,800	106,600	467,400	42,700	42,700	510,100	149,300	360,800
8	758,560	224,120	982,680	42,700	42,700	1,025,380	266,820	758,560
9	424,160	125,320	549,480	42,700	42,700	592,180	168,020	424,160
10	262,240	77,480	339,720	47,040	47,040	386,760	124,520	262,240
11	499,840	147,680	647,520	0	0	647,520	147,680	499,840
12	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0
27		57,460	57,460	0	0	57,460	57,460	0
Ofram28		92,560	92,560	0	0	92,560	92,560	0
29		171,340	171,340	0	0	171,340	171,340	0
30		305,760	305,760	0	0	305,760	305,760	0
31		230,360	230,360	0	0	230,360	230,360	0
32		106,600	106,600	0	0	106,600	106,600	0
33		224,120	224,120	0	0	224,120	224,120	0
34		125,320	125,320	0	0	125,320	125,320	0
35		77,480	77,480	0	0	77,480	77,480	0
36		147,680	147,680	0	0	147,680	147,680	0
37		0	0	0	0	0	0	0
38		0	0	0	0	0	0	0
39		0	0	0	0	0	0	0
40		0	0	0	0	0	0	0
41		0	0	0	0	0	0	0
42		0	0	0	0	0	0	0
43		0	0	0	0	0	0	0
44		0	0	0	0	0	0	0
45		0	0	0	0	0	0	0
46		0	0	0	0	0	0	0
47								
48								
49								
50								
Total	5,207,840	3,077,360	8,285,200	217,840	217,840	8,503,040	3,295,200	5,207,840

Table VII-3-12 Yearly Seedlings Production Plan for Village Nurseries

Project Year	Village Nurseries: Community Woodlots *Potted* Odum	Wawa	Total	Mean Nursery	Green Fire Belts: Zone I *Potted* Cassia	Mango	Total	Zone II *Potted* A Orange	Advocado	B Cashew	Total	Zone III *Potted* Leguminous	Total	Total *Potted*	Mean Nursery *Potted*	Total *Raising* Total	Mean Nursery
	550	550		14	250	25		25	25	50		375			14		14
	1.4	1.4			1.2	1.3		1.3	1.3	1.3		1.2					
-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	600	65	665	0	0	130	130	900	900	1,695	121	1,695	121
2	0	0	0	0	6,600	715	7,315	195	195	1,040	1,430	9,900	9,900	18,645	1,332	18,645	1,332
3	0	0	0	0	5,400	585	5,985	33	33	1,105	1,170	8,100	8,100	15,255	1,090	15,255	1,090
4	0	0	0	0	17,100	1,853	18,953	0	0	3,705	3,705	25,650	25,650	48,308	3,451	48,308	3,451
5	0	0	0	0	9,900	1,073	10,973	195	195	1,755	2,145	14,850	14,850	27,968	1,998	27,968	1,998
6	58,520	58,520	117,040	8,360	9,900	1,073	10,973	455	455	1,235	2,145	14,850	14,850	27,968	1,998	145,008	10,358
7	71,610	71,610	143,220	10,230	14,100	1,528	15,628	423	423	2,210	3,055	40,950	40,950	59,633	4,259	202,853	14,489
8	60,830	60,830	121,660	8,690	9,000	975	9,975	293	293	1,365	1,950	29,700	29,700	41,625	2,973	163,285	11,663
9	68,530	68,530	137,060	9,790	4,800	520	5,320	0	0	1,040	1,040	58,500	58,500	64,860	4,633	201,920	14,423
10	68,530	68,530	137,060	9,790	15,300	1,658	16,958	1,040	1,040	1,235	3,315	52,650	52,650	72,923	5,209	209,983	14,999
11	0	0	0	0	0	0	0	0	0	0	0	29,700	29,700	29,700	2,121	29,700	2,121
12	0	0	0	0	0	0	0	0	0	0	0	52,200	52,200	52,200	3,729	52,200	3,729
13	0	0	0	0	0	0	0	0	0	0	0	35,100	35,100	35,100	2,507	35,100	2,507
14	0	0	0	0	0	0	0	0	0	0	0	40,050	40,050	40,050	2,861	40,050	2,861
15	0	0	0	0	0	0	0	0	0	0	0	60,750	60,750	60,750	4,339	60,750	4,339
16	0	0	0	0	0	0	0	0	0	0	0	14,850	14,850	14,850	1,061	14,850	1,061
17	0	0	0	0	0	0	0	195	195	1,040	1,430	31,050	31,050	32,480	2,320	32,480	2,320
18	0	0	0	0	0	0	0	33	33	1,105	1,170	21,600	21,600	22,770	1,626	22,770	1,626
19	0	0	0	0	0	0	0	0	0	3,705	3,705	32,850	32,850	36,555	2,611	36,555	2,611
20	0	0	0	0	0	0	0	195	195	1,755	2,145	37,800	37,800	39,945	2,853	39,945	2,853
21	0	0	0	0	0	0	0	455	455	1,235	2,145	14,850	14,850	16,995	1,214	16,995	1,214
22	0	0	0	0	0	0	0	423	423	2,210	3,055	40,950	40,950	44,005	3,143	44,005	3,143
23	0	0	0	0	0	0	0	293	293	1,365	1,950	29,700	29,700	31,650	2,261	31,650	2,261
24	0	0	0	0	0	0	0	0	0	1,040	1,040	58,500	58,500	59,540	4,253	59,540	4,253
25	0	0	0	0	0	0	0	1,040	1,040	1,235	3,315	52,650	52,650	55,965	3,998	55,965	3,998
26	0	0	0	0	0	0	0	0	0	0	0	29,700	29,700	29,700	2,121	29,700	2,121
27	0	0	0	0	0	0	0	0	0	0	0	52,200	52,200	52,200	3,729	52,200	3,729
Ofram28	0	0	0	0	0	0	0	0	0	0	0	35,100	35,100	35,100	2,507	35,100	2,507
29	0	0	0	0	0	0	0	0	0	0	0	40,050	40,050	40,050	2,861	40,050	2,861
30	0	0	0	0	0	0	0	0	0	0	0	60,750	60,750	60,750	4,339	60,750	4,339
31	0	0	0	0	0	0	0	0	0	1,430	1,430	14,850	14,850	16,280	1,163	16,280	1,163
32	0	0	0	0	0	0	0	195	195	1,170	1,560	31,050	31,050	32,610	2,329	32,610	2,329
33	0	0	0	0	0	0	0	33	33	3,705	3,770	21,600	21,600	25,370	1,812	25,370	1,812
34	0	0	0	0	0	0	0	0	0	2,145	2,145	32,850	32,850	34,995	2,500	34,995	2,500
35	0	0	0	0	0	0	0	195	195	2,145	2,535	37,800	37,800	40,335	2,881	40,335	2,881
36	0	0	0	0	0	0	0	455	455	3,055	3,965	14,850	14,850	18,815	1,344	18,815	1,344
37	0	0	0	0	0	0	0	423	423	1,950	2,795	40,950	40,950	43,745	3,125	43,745	3,125
38	0	0	0	0	0	0	0	293	293	1,040	1,625	29,700	29,700	31,325	2,238	31,325	2,238
39	0	0	0	0	0	0	0	0	0	3,315	3,315	58,500	58,500	61,815	4,415	61,815	4,415
40	0	0	0	0	0	0	0	1,040	1,040	0	2,080	52,650	52,650	54,730	3,909	54,730	3,909
41	0	0	0	0	0	0	0	0	0	0	0	29,700	29,700	29,700	2,121	29,700	2,121
42	0	0	0	0	0	0	0	0	0	0	0	52,200	52,200	52,200	3,729	52,200	3,729
43	0	0	0	0	0	0	0	0	0	0	0	35,100	35,100	35,100	2,507	35,100	2,507
44	0	0	0	0	0	0	0	0	0	0	0	40,050	40,050	40,050	2,861	40,050	2,861
45	0	0	0	0	0	0	0	0	0	0	0	60,750	60,750	60,750	4,339	60,750	4,339
46	0	0	0	0	0	0	0	0	0	0	0	14,850	14,850	14,850	1,061	14,850	1,061
47																	
48																	
49																	
50																	
Total	328,020	328,020	656,040	46,860	92,700	10,043	102,743	7,898	7,898	49,465	65,260	1,593,900	1,593,900	1,761,903	125,850	2,417,943	172,710

VII.3.5 Infrastructure Plan

(1) Forest Roads-Firebreaks

① Basic Structure and Distribution

Feeder roads stretching 97 km and spur roads stretching 88 km are planned in accordance with the logging manual of the Forestry Department (see Fig. VII-3-13). Given the anticipated strong rainfall intensity,[16] proper attention is paid to roadbed protection and drainage in view of environmental conservation and easier road maintenance work.

a. Feeder Roads (cleared width: 15 m; carriage width: 4.5 m; firebreak width: 10.5 m)

The route of each feeder road will be determined to generally link existing roads via the centre of each plantation site. Crush-run will be laid to constitute the upper basing.

In principle, side ditches with a drainage section equivalent to that of the existing local roads (approximately 0.7 m^2) will be constructed together with cross ditches at an average distance of every 50 m.

b. Spur Roads (cleared width: 10 m; carriage width: 3.5 m; firebreak width: 6.5 m)

Spur roads will be constructed along block boundaries to link feeder roads to footpaths along forest reserve boundaries. In principle, side ditches with a drainage section equivalent to half of that of the existing local roads (approximately 0.4 m^2) will be constructed.

c. For improved vehicle access to planting sites, narrow temporary roads (both cleared width and carriage width: 4 m; land preparation by bulldozer without a firebreak) will be constructed at an approximate density of 15 m/ha (the routes will not be planned in advance).

[16] Daily rainfall of more than 100 mm has been recorded some years. As rain in the area is short and localised, the rainfall intensity is believed to be strong.

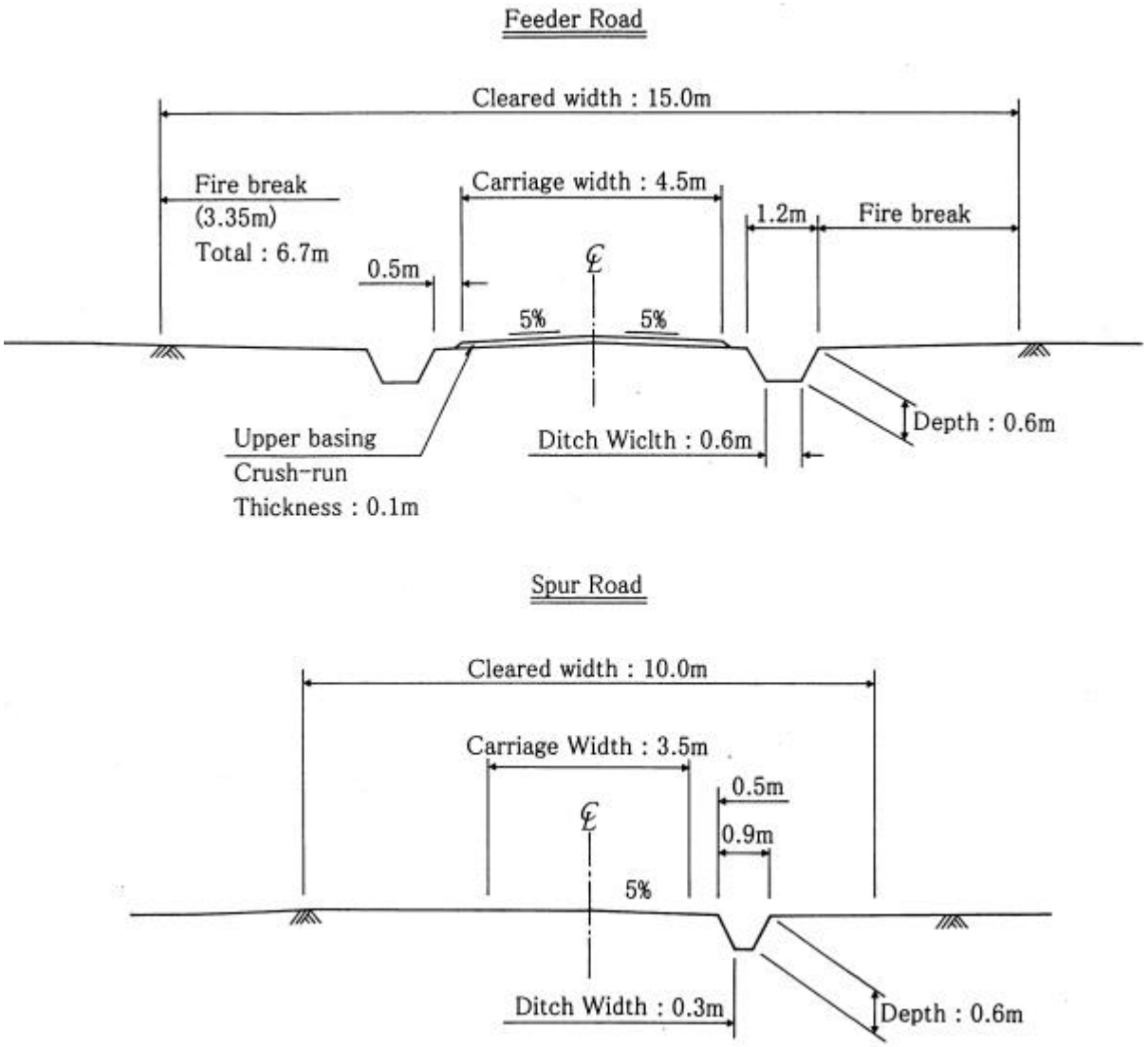

Fig. VII-3-13 Standard Cross-Section of Forest Roads-Firebreaks

② Yearly Work Plan

The construction of forest roads is planned two years before the year of planting because of the following reasons. (See Table VII-3-13, 14)

- As the work will be restricted to the dry seasons pursuant to the EPA guidelines, the feasible period for forest road construction within the year is limited.
- As land preparation is planned during the major dry season, the forest roads must be completed before one year which the planting will be proceeded.

Table VII-3-13 Construction Plan for Feeder Roads-Firebreaks

Road Establishment Plan (Feeder) Unit: m

	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
Saw Saw				2,000	4,000	7,200	5,900	2,500	5,400	2,800			29,800
Nsemire			4,000	4,000	1,200								9,200
Yaya	3,200	1,800	0	0	2,500	1,400							8,900
Tain I		6,000	4,300	3,700	4,200								18,200
Tain II		3,200	6,200	0	2,600	5,900	0	5,300	3,400	4,200			30,800
TOTAL	3,200	11,000	14,500	9,700	14,500	14,500	5,900	7,800	8,800	7,000			96,900

Table VII-3-14 Construction Plan for Spur Roads-Firebreaks

Road Establishment Plan (Spur) Unit: m

	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
Saw Saw				5,200	3,200	0	900	4,700	2,500	4,900			21,400
Nsemire					3,700								3,700
Yaya	900	3,000	3,600	4,100	1,400	2,400							15,400
Tain I			2,200	3,200	1,800	4,400							11,600
Tain II		3,100	2,000	7,800	4,600	400	7,000	2,700	4,200	4,300			36,100
TOTAL	900	6,100	7,800	20,300	14,700	7,200	7,900	7,400	6,700	9,200			88,200

(2) Nurseries

① Central Nursery

a. Location

A single large nursery is planned on government land around the existing nursery of the Sunyani District Forestry Office in view of access to the Intensive Study Area using the existing network of national and local roads, land availability and linkage with the School of Forestry which acts as a base for extension activities.

b. Nursery Scale

The planned nursery will cover an area of some 10 ha in view of the requirements described below (see Figs. VII-3-14 and VII-3-15). A seed orchard to produce high quality teak seeds and an arboretum mainly consisting of local species will be established around the nursery. The site will be fenced for crime prevention purposes.

c. Nursery Facilities

Nursery facilities capable of producing the maximum quantity of seedlings required by the seedling production plan will be established at the nursery site. These facilities will include nursery beds for bare root seedlings corresponding to the production of stump seedlings and nursery beds for potted seedlings for testing and research purposes for forestry species other than teak as well as local species.

The seedlings required for forest rehabilitation work in forest reserves outside the Intensive Study area will be produced for those years when the planting area falls short of the maximum production capacity.

a) Administrative Facilities

The administrative facilities to be established include an office building (equipped with radio equipment, storage for excellent seeds and telephone, etc. with electricity supply and plumbing), generator room (for emergency use given the frequent power cuts), warehouse, work space (with a resting place and a pot soil yard), fuel tank house (for pumps and an emergency generator) and garage (for fire-fighting tank lorry and light trucks to assist the transportation of seedlings from village nurseries).

b) Water Supply Facilities

A huge quantity of water will be required for the production of a large number of seedlings. As the water supply system in Sunyani and existing wells cannot meet the demand for a huge quantity of water at a low cost, a new borehole accompanied by a pumping house will be constructed. Water will be pumped to the water tank for gravity supply to the nursery beds.

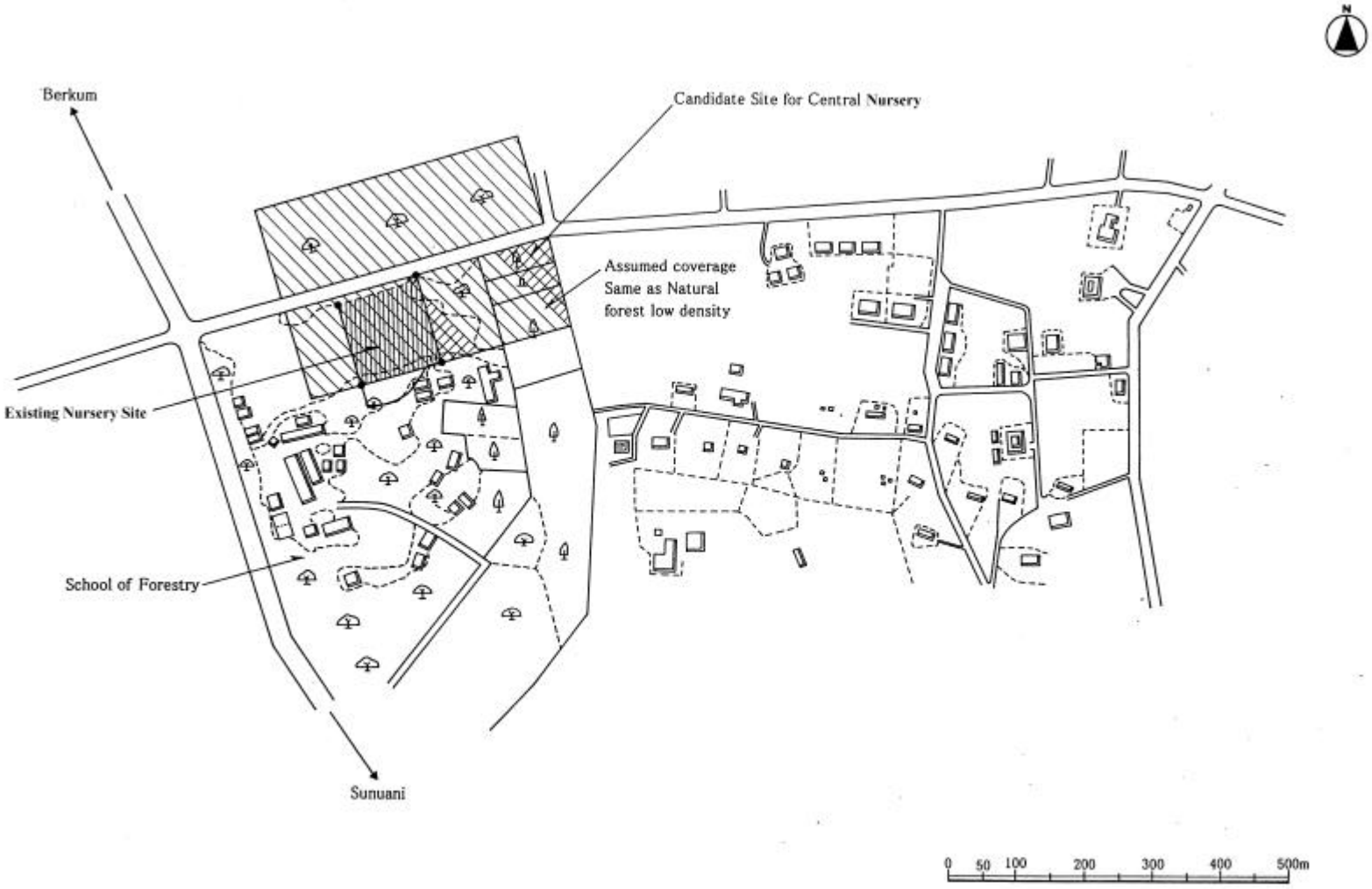

Fig. VII-3-14 Location of Central Nursery

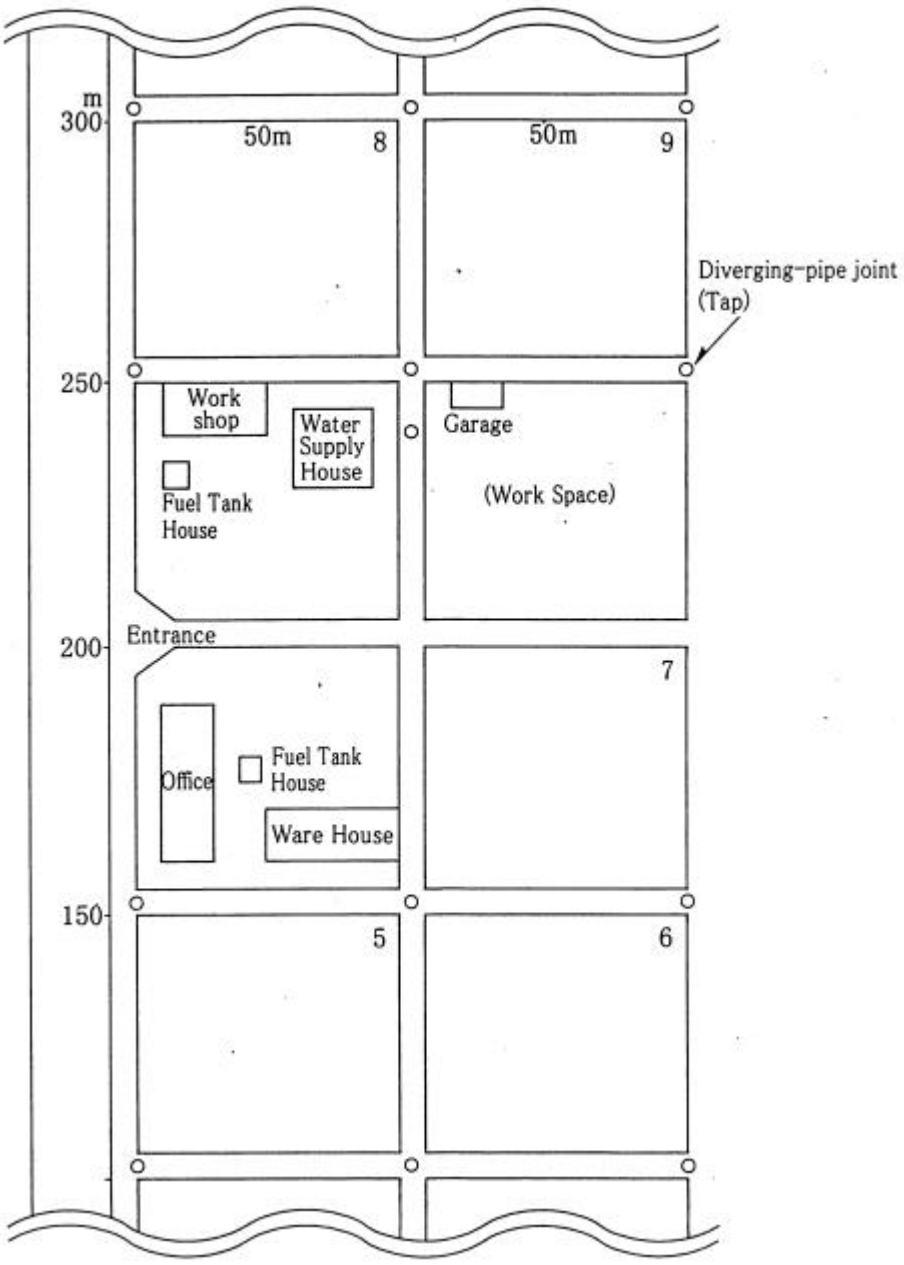

Fig. VII-3-15 Standard Plan of Central Nursery

② Village Nurseries

a. Nursery Sites

The 14 village nurseries shown in Table VII-3-15 are planned, taking the water supply situation and distance from the nearest forest reserve, etc. into consideration.

Table VII-3-15 Planned Village Nurseries

Participantory-type forest management zone		Forest Reserve		Location of organization (persons)				Stool
Symbol	Name of zone			Committee secretariat[1)]	Forest establishment branch[1)]	Village nursery	Water supply facility	
A	Kyekyewere-Tainso	Tain II	N	Kyekyewere (1,500)	Akokurom (600人) Kogu (?)	Tainso	Control of river water (Small dam for intake the water)	Wenchi
B	Namasua-Oforikurom	Tain II	N	Namasua (1,600)	Oforikurom (140)	Namasua	Use of existing well	Berekum
C	Adantia-Sereso	Tain I	W	Adantia (1,700)	Sereso (?) Dinkyene (?)	GyaeNkonitabuo Adantia	Ground water (Shallow well) Control of river water (Low level reservoir)	Dormaa
D	Buku-Ohene	Tain I Nsemire Yaya	N/E S W	Buku (1,500)	Kyrinkortompa (?) Ahewene (800) Kotoa (?)	Kyrinkortompa Ahewene	Control of river water (Low level reservoir) Control of river water (Low level reservoir)	Wenchi
E	Asuakwa	Yaya	S/W	Asuakwa (1,700)	Asuakwa	Asuakwa	Use of existing well	Dormaa
F	TanoKwayem-Mfante	Yaya	S/E	TanoKwayem (?)	Mfante (450)	Mfante	Use of river water (Pump)	Offinso
G	Amoakurom-NonaTwumkrom	Nsemire	N	Amoakurom (1,000)	NonaTwumkrom (?)	NonaTwumkrom	Ground water (Shallow well)	Wenchi
H	Nsuata-Mangoase	Yaya Sawsaw	N S	Nsuata (?)	Malaamkurom (200) Konkronpe (?)	Jackkurem	Ground water (Shallow well)	Wenchi
I	Tremeso-Bepotrim	Sawsaw	Central～S	Tremeso (1,500)	Bepotrim (500)	Tremeso	Use of existing well	Wenchi
J	Nyinamponase	Sawsaw	S	Nyinamponase (1,700)	Nyinamponase	Nyinamponase	Control of river water (Low level reservoir)	Wenchi
K	Nkonsia-Ayaaya	Sawsaw	Central～N	Nkonsia (?)	Ayaaya (150)	Ayaaya	Ground water (Shallow well)	Wenchi
L	Adukwaalwokurom-Nyamebekyere	Sawsaw	N	Asukwaalwokurom (?)	Aobbei (?) Nyamebekyere (?)	Asukwaalwokurom	Ground water (Shallow well)	Wenchi

Note: 1) Population from the interview of socioeconomic survey

b. Nursery Scale

The planned nursery scale is approximately 400 m² per site in view of the following considerations (see Fig. VII-3-15).

a) Nursery Facilities

Nursery facilities capable of producing the maximum quantity of seedlings required by the nursery practices plan will be provided at each village nursery site. The scale of these facilities will be the same at all sites in preparation for changes of the planned production volume at the project implementation stage. The seedlings required for activities related to extension and participation will be produced for those years when the planting volume falls short of the maximum production capacity.

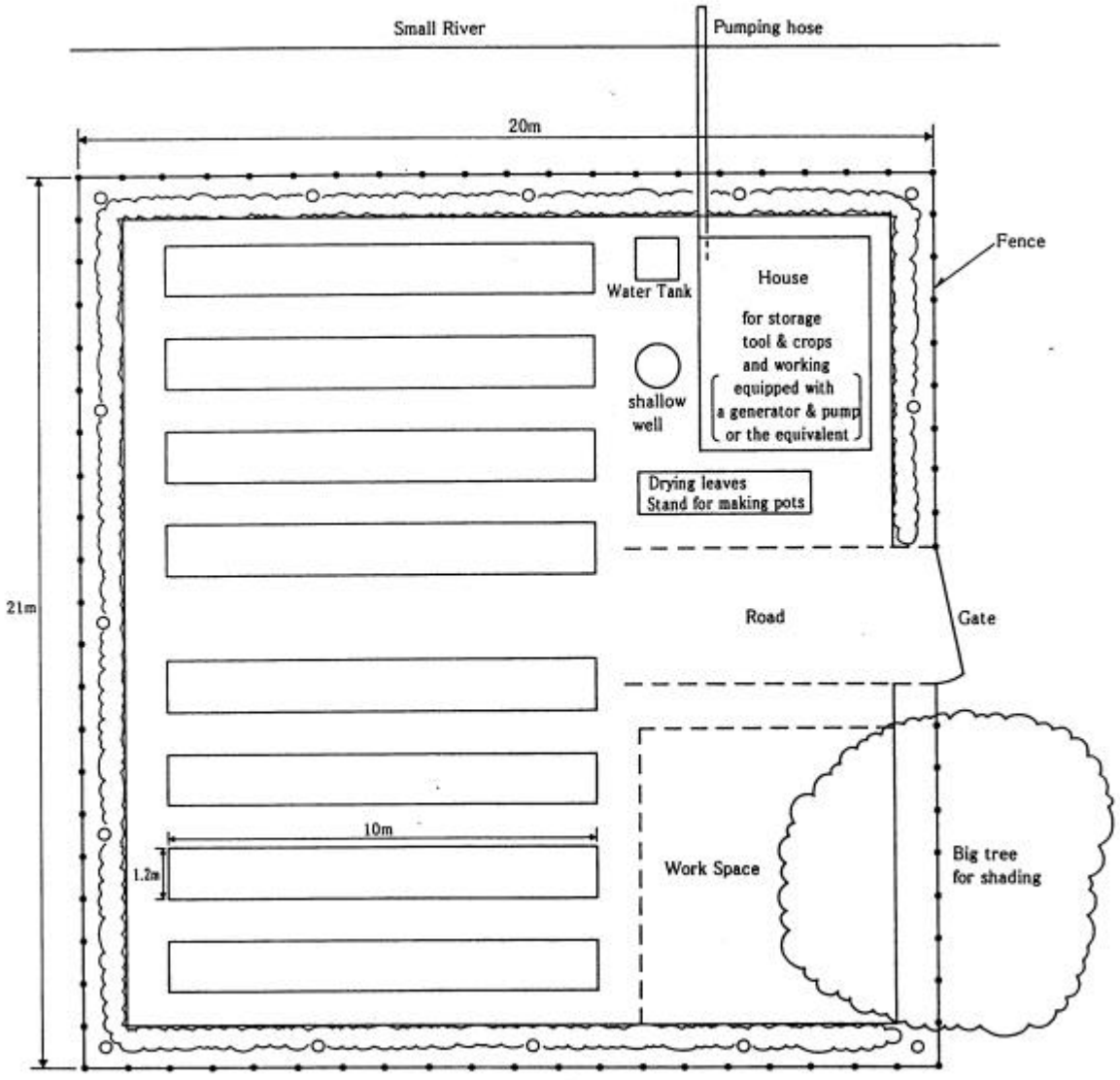

Fig. VII-3-16 Standard Plan for Village Nurseries

b) Vegetation Garden for Local People

In consideration of the needs of the women's group which is assumed to play a central role in nursery practices work, village nurseries are expected to allow the cultivation of vegetables and other garden crops (food crops which prefer fertile land, demand such intensive work as watering and which can earn cash income). Accordingly, the surplus nursery beds will be used for this purpose.

c) Administrative Facilities

A warehouse-cum-office building will be constructed to store equipment and materials, including pumps (and will also act as a resting place and workshop). In addition, drying and storage facilities for maize and other crops will be provided, partly to improve the added value of the crops produced by the villages concerned.

d) Water Supply Facilities

In principle, nearby river water or non-pressurised groundwater from a shallow well will be used for the following reasons (see Table VII-3-16).

- For the present plan, the construction of boreholes is not considered to reduce the construction and maintenance costs, to prevent competition with other projects, to prevent the drying up of pressurised groundwater and to prevent a reduction of the pumped water volume from existing boreholes.
- It is deemed important for the planned work to assist the intake of river water in order to facilitate awareness of the need to conserve forests.
- The structure must be the one that water could always flow down, so that the pool could not be the spreading source of epidemic mediator such as Malaria mosquito. It also must be protected from destruction by flood in rainy season.

c. Yearly Construction Plan of Nursery

Village nurseries will be constructed in each forest reserve in the first half of the year preceding the planned year of planting for green firebelt and village woodlots. Their maintenance and management will commence in the year following construction (see Table VII-3-16).

Table VII-3-16 Construction Plan for Village Nurseries

Project Year	VILLAGE NURSERIES						
	Yaya	Tain I	Nsemire	Sawsaw	Tain II	Total	Accumulation
-1						0	0
1	0	0	1	0	0	1	1
2	1	1	0	0	0	2	3
3	1	1	1	0	0	3	6
4	1	0	0	1	1	3	9
5	1	0	0	0	0	1	10
6	0	0	0	1	0	1	11
7	0	0	0	0	1	1	12
8	0	0	0	1	0	1	13
9	0	0	0	0	0	0	13
10	0	0	0	1	0	1	14

(3) Watchtowers

① Basic Structure and Location

a. Locations of Watchtowers

Seven watchtower locations have been selected on the (newly prepared) land use and vegetation map, taking the following points into consideration. (See Fig. VII-3-17)

- Site from which a relatively large section of the Intensive Study Area can be clearly observed: site with an elevation above the average elevation of the Study Area (approximately 330 m) and which is located either in a forest reserve or within a distance of some 3 km of a forest reserve boundary
- Estimation of combustion/spreading site: it is possible to estimate combustion/spreading sites by means of the intersection and resection method which involves intersection of the scope of view by two or more of these watchtowers.
- Access by look-outs (local villagers): each watchtower should be located near the office of the village forest management committee, branch office VFMC and village nursery (within a 3 km radius)
- Continuity from construction to maintenance: the site should be along a main road or accessible by car from such a road

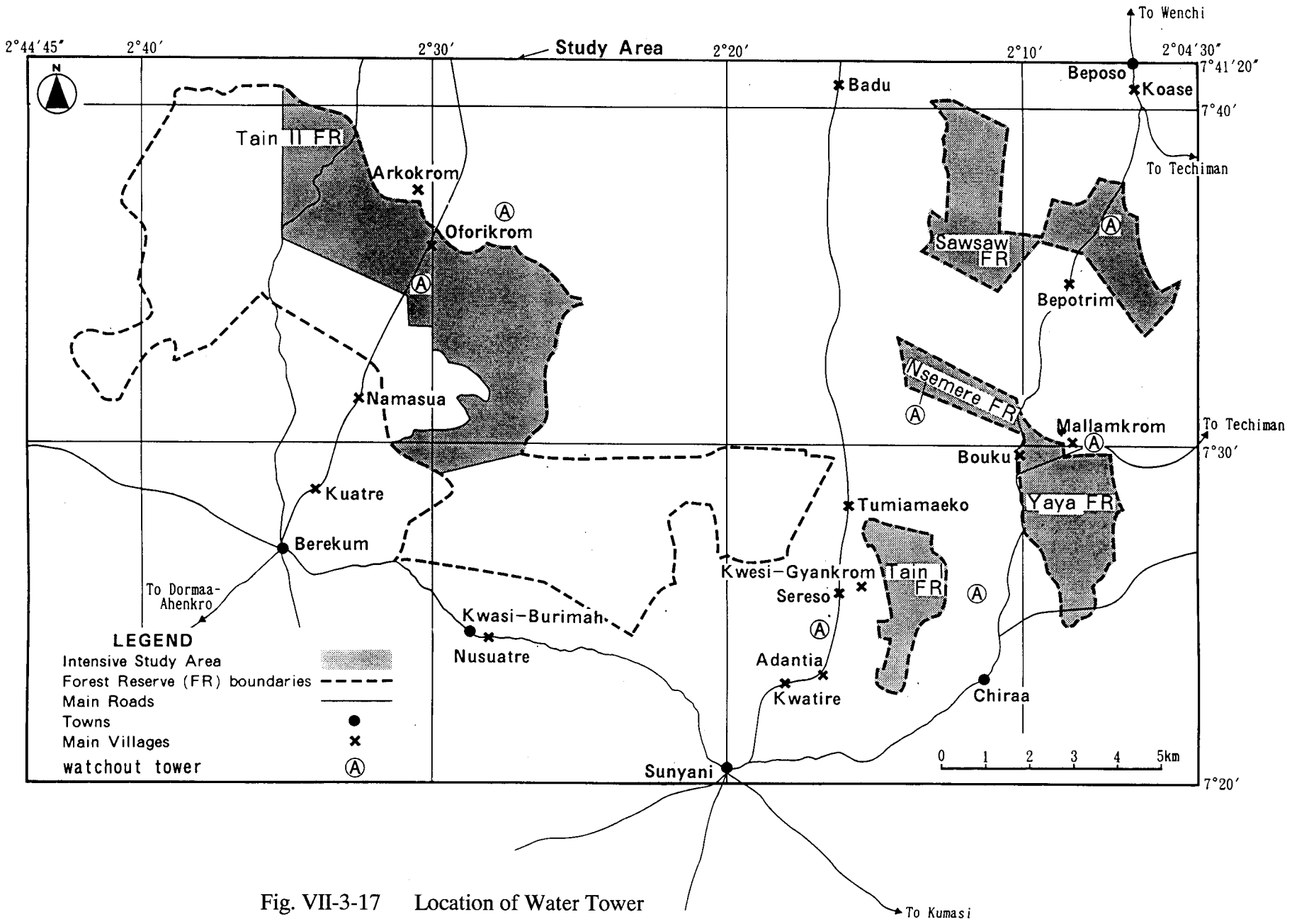

Fig. VII-3-17 Location of Water Tower

b. Structure

In view of durability and easy maintenance, strong foundations (such as concrete) which will also act as an emergency water tank for fire-fighting purposes, will be constructed to support a tower of some 10 m in height[17] (made of steel or a material of similar durability).

c. Yearly Work Plan for Construction

Watchtowers will be constructed in each forest reserve in the first half of the year preceding the year of planting in green firebelt and village woodlots as in the case of village nurseries, etc. Operation and maintenance are to be implemented from the year after construction (See Table VII-3-17)

Table VII-3-17 Construction Plan for Watchtowers

Project Year	Yaya	Tain I	Nsemire	Sawsaw	Tain II	Total	Accumulation
-1						0	0
1	1	0	0	0	0	1	1
2	1	1	0	0	0	2	3
3	0	0	1	0	0	1	4
4	0	0	0	0	1	1	5
5	0	0	0	0	0	0	5
6	0	0	0	1	0	1	6
7	0	0	0	0	1	1	7
8	0	0	0	0	0	0	7
9	0	0	0	0	0	0	7
10	0	0	0	0	0	0	7

VII.3.6 Extension and Education Plan

(1) Extension and Education System of Forest Restoration Project

In view of the tasks regarding extension and education described so far, the following extension and education principles are adopted for the plan.

- As the Forestry Department currently does not have its own extension system, extension activities will be assisted by the Collaborative Forest Management Unit and the Plantation Establishment Unit of the Planning Branch until such system is established. Given the staff

[17] The findings of the survey on the view from the water storage tank (approximately 5 m in height) at Nyinamponase settlement located within a 3 km radius of the Nsemere FR indicate that the height of a watchtower should be more than 5 m.

shortage of the Forestry Department, however, the assistance of NGOs with experience of extension work and/or external consultants will be sought.

- As the scope of the planned project covers various subjects, including farming and bushfire prevention, the linkage with other government organizations (agricultural offices, fire service and water management offices) must be further strengthened.
- The School of Forestry in Sunyani will be actively used for extension and education.
- Extension activities vis-a-vis local people will basically be conducted by each village forest management committee.

The extension and education system for the forest rehabilitation project based on the above principles is shown in Fig. VII-3-18.

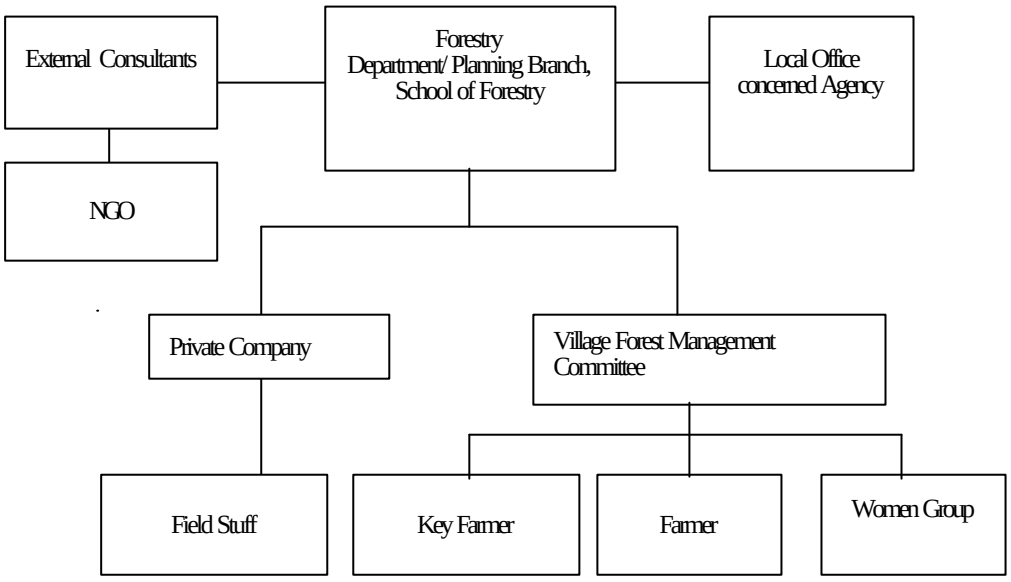

Fig. VII-3-18 Proposed Extension and Education System

(2) Field Extension Activities Aimed at Local People

① Contents of Activities

Technical officers will mainly be responsible for direct contact with local people, the hosting of workshops and practical field training. As stated earlier, however, these extension activities cannot be conducted solely by staff members of the Forestry Department at present and the assistance of NGOs and external consultants will be

required. The guidelines established by the Collaborative Forest Management Unit will be used to determine the procedure and method of extension vis-a-vis local people.

The subjects and contents of extension activities aimed at local people are shown in Table VII-3-18.

Table VII-3-18 Subjects and Contents of Extension Activities Aimed at Local People

Category	Subjects	Contents	Remarks
Home Visit	Key farmer (chief, Queen mother, Unit committee members, Assembly man)	Explanation of the Project contents, Recommendation of hard-working farmer for commendation	Assistance from NGO
Workshop	Key farmer	Explanation of the Project contents, Marketing Service	Assistance from NGO
	Farmer	Explanation of the Project contents, Taunya method and Fire Prevention Work	Assistance from NGO
	Women's Group	Explanation of the Project contents, NTFPs Management and Seedling Production Work	Assistance from NGO
Practical Field Training	Key farmer	Agroforestry technology and Fire Prevention Work	Assistance from NGO and External Consultants
	Farmer	Agroforestry technology and Agricultural Production	Assistance from NGO and Agriculture Extension Worker
	Women's Group	Seedling Production Work, Agricultural Production and Fruit Tree Production	Assistance from NGO and Agriculture Extension Worker

② Required Number of Days for Extension

While the positive effects for extension by home visits and workshops can be expected to increase in line with their frequency, the farming work of local people could be confused by frequent home visits and workshops. Accordingly, the number of workshop days and the frequency of extension sessions per village will be kept to a minimum under the plan as shown in Table VII-3-19.

Table VII-3-19 Required Number of Days and Sessions by Extension Subject

Category	Subjects	Contents	Remarks
Home Visit	Key farmer	3 persons x 2days x 4times	
Workshop	Key farmer	10 persons x 1 day x 2 times	
	Farmer	20 persons x 1 day x 2 times	Priority to farmers who participate in planting activity
	Women's Group	20 persons x 1 day x 2 times	Farmer who engage in seedling production
Practical Field Training	Key farmer	10 persons x 1 day x 2 times	Visit to Model farmland and Fire Prevention Work
	Farmer	20 persons x 1 day x 2 times	Planting activity
	Women's Group	20 persons x 1 day x 2 times	Seedling production and Fruit tree planting

③ Yearly Plan

The period of extension activities aimed at local people is set at five years in order to ensure a proper understanding of forest functions and awareness of the importance of forest conservation on the part of local people. In principle, extension activities will be conducted via the Forest Management Planning Committees. The yearly plan is shown in Table VII-3-20.

Table VII-3-20 Extension Plan Aimed at Local People

(times)

Category	Subjects	1	2	3	4	5	6	7	8	9	10	Total
Home Visit	Key farmer	4	4	4	4	4	0	0	0	0	0	20
Workshop	Key farmer	2	2	2	2	2	0	0	0	0	0	10
	Farmer	2	2	2	2	2	0	0	0	0	0	10
	Women's Group	2	2	2	2	2	0	0	0	0	0	10
Practical Field Training	Key farmer	2	2	2	2	2	0	0	0	0	0	10
	Farmer	2	2	2	2	2	0	0	0	0	0	10
	Women's Group	2	2	2	2	2	0	0	0	0	0	10

(3) Field Assistance for Private Companies

① Contents of Guidance

As in the case of extension activities aimed at local people, technical officers will play a central role in this type of assistance, providing guidance mainly consisting of technical advice in the field. Here again, such extension activities cannot be conducted solely by staff members of the Forestry Department and the assistance of external consultants will be required. The contents of extension activities aimed at private companies are shown in Table VII-3-21.

Table VII-3-21 Contents of Extension Activities Aimed at Private Companies

Category	Subjects	Contents	Remarks
Field Visit	Operation Staff	Reforestation Technique and Fire Prevention Work	Assistance from External Consultants

② Required Number of Days for Guidance

Although the positive effects of field guidance are expected to increase in accordance with a higher frequency of its provision, it is essential that such guidance does not disrupt field work. The required number of days for guidance is shown in Table VII-3-22.

Table VII-3-22 Required Number of Days and Frequency for Guidance for Private Companies

Category	Subjects	Contents	Remarks
Field Visit	Operation Staff	5 persons x 1 days x 2 times	

Note: days per year

③ Yearly Plan

Given the planned contents of the guidance for private companies, the period of guidance is set at approximately five years. If necessary, supplementary technical guidance will be provided through the provision of education and training at the School of Forestry in Sunyani. The yearly plan shown in Table VII-3-23 is prepared in line with the planting schedule.

Table VII-3-23 Guidance Plan for Private Companies

(times)

Category	Subjects	1	2	3	4	5	6	7	8	9	10	Total
Field Visit	Operation Staff	2	2	2	2	2	0	0	0	0	0	20

(4) Education and Training at School of Forestry

① Contents of Education and Training

The subject persons of education and training at the School of Forestry are staff members of the Forestry Department, private companies, NGOs and local people. In principle, lectures and practical guidance will be given by lecturers of the School and external experts will be invited to provide education and training on farming, etc.

While the curriculum will vary depending on the types of trainees, it will basically consist of the introduction of new technologies/techniques and practical methods to solve problems in the field.

The emphasis of education and training will be placed on practical learning using the School's own forest and nursery. If found necessary, the curriculum will include visits to pilot projects in other areas. Lecture fees and other costs will be payable by the trainees. The subject persons and contents of education and training at the School of Forestry are shown in Table VII-3-24.

Table VII-3-24 Subject Persons and Contents of Education and Training at School of Forestry

Category	Subjects	Contents	Remarks
Forestry Department	Officer	Forest Policy and Forest management Planning	
	Technical Officer	Extension Method, Fire Prevention Work, Agroforestry	
Private Company	Management	Reforestation, Forest management, Marketing, Personnel Management	
	Operation	Cutting and Harvesting, Fire Prevention Work	
Local People	Key Farmer	Reforestation NTFPs Management, Agroforestry, Organization Method, Marketing and Fire Prevention Work	
	Farmers	NTFPs Management, Agroforestry and Fire Prevention Work	
	Women Group	Seedling Production, NTFPs Management	
NGO	Staff	Extension and Organization Method	

② Required Number of days for Education and Training

The education and training at the School of Forestry will mainly consist of lectures on such technical subjects as nursery practices and silviculture (planting) as well as administrative subjects, including contracts, and practical learning at the School's own forest and nursery.

The planned trainees are one officer and three technical officers from each of the three District Forestry Offices involved in the forest reserves in question, one manager and all engineers/technicians involved in tree planting and contracts from private company and each of key farmers, ordinary farmers and women's group members, all of which belong to Forest Management Planning Committees. In the case of NGOs, some five field

workers will be invited from each NGO. The required number of days for the education and training for each category of trainees is shown in Table VII-3-25.

Table VII-3-25 Required Number of Days for Education and Training

Category	Subjects	Contents	Remarks
Forestry Department	Officer	2 days x 3 District Forest Office	Training in each District Forest Office
	Technical Officer	2 days x 3 staff x 3 District Forest Office	
Private Company	Management	2 days x 2 staff	
	Operation	2 days x 5 staff	
Local People	Key Farmer	4 days x 14 persons	Training to each Forest Management Planning Committee
	Farmers	4 days x 14 persons	
	Women Group	4 days x 14 persons	
NGO	Staff	2 days x 5 persons	

③ Yearly Plan

As it is believed that the quality of staff members of the Forestry Department, private companies, NGOs and local people engaged in forest rehabilitation will improve with the progress of their work experience, the yearly plan for education and training is prepared for a limited period of five years (see Table VII-3-26).

Table VII-3-26 Education and Training Plan by Category of Trainees

(times)

Category	Subjects	1	2	3	4	5	6	7	8	9	10	Total
Forestry Department	Officer	2	2	2	2	2	0	0	0	0	0	10
	Technical Officer	2	2	2	2	2	0	0	0	0	0	10
Private Company	Management	2	2	2	2	2	0	0	0	0	0	10
	Operation	2	2	2	2	2	0	0	0	0	0	10
Local People	Key Farmer	1	1	1	1	1	0	0	0	0	0	5
	Farmers	1	1	1	1	1	0	0	0	0	0	5
	Women Group	1	1	1	1	1	0	0	0	0	0	5
NGO	Stuff	2	2	2	2	2	0	0	0	0	0	10

VII.3.7 Operation and Management Plan

(1) Main Roles of Each Actor and Implementing System

① Forestry Department

The Forestry Department will play a central role in the operation and management of the following matters.

- General project management: coordination with government organizations concerned; assistance for project management by the appointment of an external consultant(s); preparations for the establishment and operation of the Forest Management Centre (promotion of the signing of a collaborative forest management agreement); promotion of NGO assistance for local people
- Participatory-type plantation establishment and management: surveying to demarcate green firebelt and village woodlots
- Natural forest conservation: approval of natural forest improvement and issue of permits for continuous NTFPs tenure sites (including surveying to demarcate the subject sites for permission)
- Utilisation of and harvesting in existing plantations: application of the existing operation and management system.
- Central nursery: construction and maintenance; nursery practices general management of early bushfire detection and initial fire-fighting system (including management of watchtowers); development of nursery practices techniques
- Village nurseries: promotion of the construction

- Extension and education: instruction on and management of intensified patrols by forest guards (District Forestry Offices); sponsoring of village workshops and field training (NGOs); sponsoring of training courses (School of Forestry)

② Private Companies

Participating private companies will play a central role in the following operation and management matters.

- Plantation establishment and management: management of surveying for land demarcation; land preparation; planting and tending, harvesting, etc.
- Forest roads: construction and maintenance
- Procurement of seedlings required for plantation establishment: contract with central nursery; transportation of seedlings
- Participation in early bushfire detection and initial fire-fighting system: patrols and initial fire-fighting in plantations; look-outs at watchtowers

③ Local People

Local people will be engaged in the following operation and management activities via the Forest Management Planning Committees.

- Collaborative forest management in industrial plantations: planting, management of planted sites (weeding, etc.) and crop cultivation under taungya system by participating groups; monitoring by participating groups based on contracts; management of profit-sharing rights by committee.
- Management of continuous NTFPs tenure sites: application for and renewal of tenure; registration of tenure holders; establishment of utilisation rules (utilisation period, etc.); regular reporting (registered tenure holders, rules and performance, etc.); erection of notice boards for management of tenure sites; patrolling; culture of NTFPs
- Participatory-type plantation establishment and management: transportation, planting and management of seedlings in green firebelt (by participating groups) as well as in village woodlots (by committee)
- Communal nursery (nursery practices): maintenance and nursery practices (including culture of NTFPs and crops)

- Participation in early detection of bushfires and initial fire-fighting: village fire team; patrolling of participatory-type plantations

④ Operating System

The proposed operating system in the Plan is as follows taking into consideration the roles of the actors above mentioned.

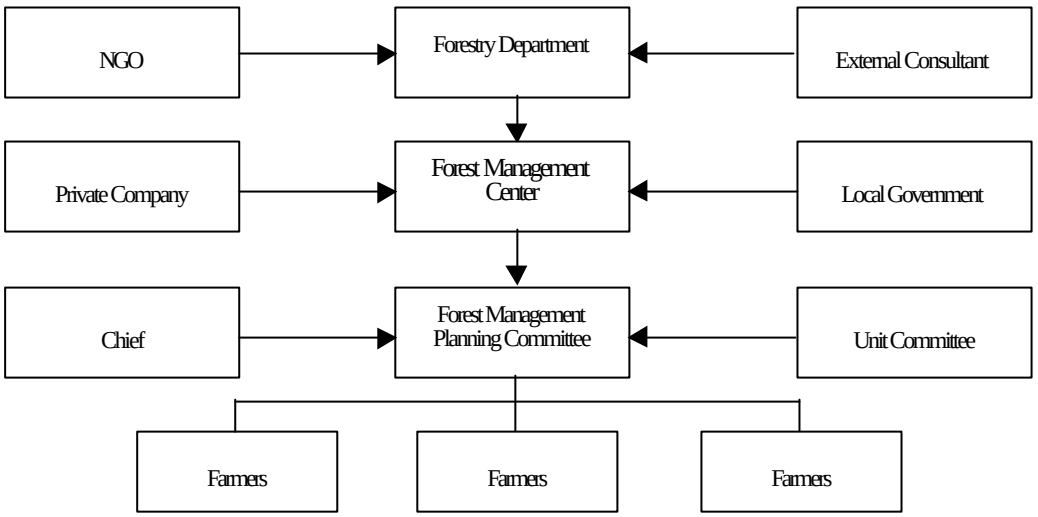

Fig. VII-3-19 Project Operating System

(2) Establishment and Management of Forest Management Centre (Coordinating Body)

① Establishment of Forest Management Centre

a. Core Body and Transfer of Functions

The proposed forest planning system[18] intends that strategic district forest development plans will be implemented under the leadership of the environmental committee of the district assembly. A Forest Management Center will, therefore, be established, assumed that its functions will be transferred to the environmental committee in the future in view of the necessary coordination with the forest planning system.

② Management of Various Committees

Based on the expected issues for coordination in the general work management required by the collaborative forest management agreement, a standing committee which will act as

[18] Based on business materials of the Planning Branch, Forestry Department (October, 1997)

the core of the Forest Management Centre and the special committees described below will be established (see Fig. VII-3-20).

a) Special Committee for Mediation

This committee will mainly be responsible for the operational coordination of the detailed rules of the collaborative forest management agreement. If the committee is convened at the request of an actor involved in a dispute, it will have the right to make the final decision equivalent to that of the standing committee.

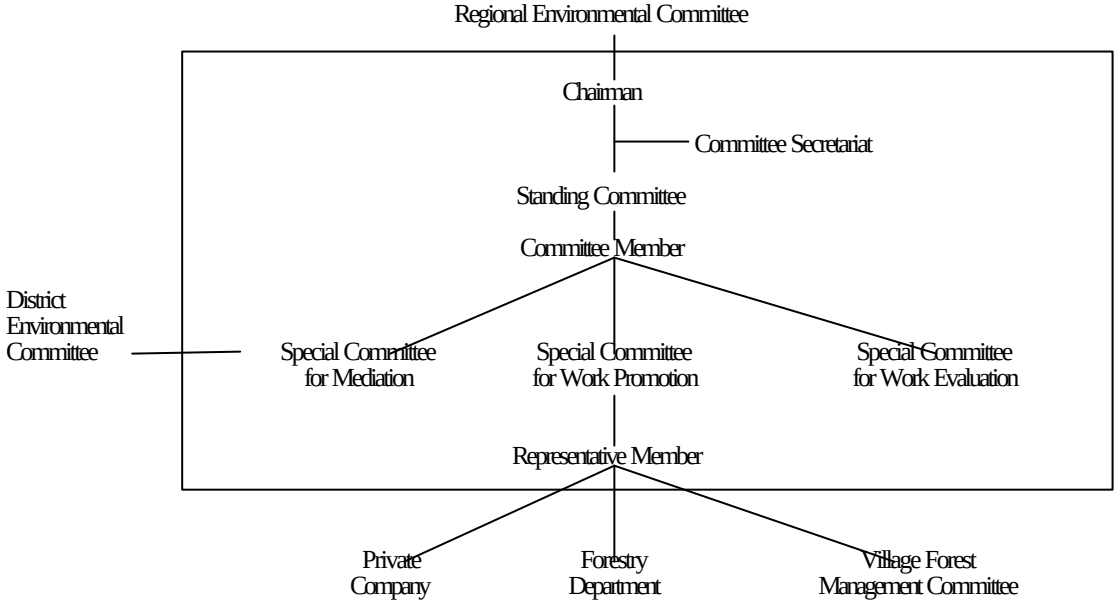

Fig. VII-3-20 Organizational Structure of Forest Management Centre

b) Special Committee for Work Promotion

This committee will be responsible for promotion of the participation of private companies and for the coordination of communication/dialogue between the main stakeholders (landowners) and private companies as well as village forest management committees.

c) Special Committee for Work Evaluation

This committee will receive annual reports from private companies, the Forestry Department and village forest management committees and will report its findings to local governments and others.

② Operation of Coordinating Function

a. Establishment of Committee Secretariat

- A secretariat led by the committee chairman will be established as an auxiliary body to coordinate the operation of the standing committee (and special committees).
- This secretariat will be established at a Forestry Department-related organization or a regional government-related organization in Sunyani and will appoint administrative staff members.

b. Outline of Coordinating Function

In principle, private companies, the Forestry Department and village forest management committees will try to solve problems regarding work implementation through consultations at standing committee meetings held at the Forest Management Centre. Any dispute may be referred to the special committee for mediation by means of lodging a request with the secretariat.

③ Yearly Work Plan

Based on the principles governing the establishment of the standing committee and the transfer of the coordinating function, the operation cost of the standing committee, etc. will be budgeted under the operating cost for the environmental committee. Under the present plan, the cost of recruiting staff members of the secretariat which will play a central role in terms of coordination will be assisted during the forest establishment period in which disputes are likely to occur in order to set the operation of the Forest Management Centre on the right track (see Table VII-3-27).

Table VII-3-27 Forest Management Centre Operation Assistance Plan

M/M

Item	1	2	3	4	5	6	7	8	9	10	11	12	Total
Head	12	12	12	12	12	12	12	12	12	12	12	12	144
Secretary	12	12	12	12	12	12	12	12	12	12	12	12	144
Total	24	24	24	24	24	24	24	24	24	24	24	24	288

(3) Operation of Forest Management Planning Committee

① Establishment of Main Body of Committee

a. Establishment of Committee

- The forest management planning committee will be established with such intra-village institutional personnel as the chief (and traditional council members), queen mother, unit committee members and assembly-men acting as promoters[19] and centering on the village development committee which will have the important role of linking traditional organizations and administrative organizations with the necessary approaches being made to the chief (and traditional council) who has traditionally played a leading role in village affairs and such administrative organizations as the village development committee[20] and unit committee[21] (see Fig. VII-3-21).
- The forest management planning committee will consist of "regular members" responsible for administration of the committee and "ordinary members" who will join the committee through their participation in forest management. Ordinary members will be entitled to collect NTFPs for their own use and their cash income within the scope set by the compliance items and to participate the plantation establishment (payment of an admission fee as well as an annual membership fee to share the cost of common services).

b. Administration of Committee

- Village meeting for committee establishment: the chief or the village development committee will call a village meeting to officiate the village forest management committee and will explain the purpose of establishment to the villagers.
- Hosting of regular committee meetings: regular committee meetings will be institutionalised.
- Establishment of rules: the rules required for the administration and operation of the committee will be prepared and approved by the committee itself. These draft rules will be prepared by committee members with NGO assistance.
- Management and Collection of operation charge: the charges necessary for the management of the committee will be collected from member's fee.

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[19] This is based on the suggestion in FGM in Socioeconomic Survey. In the Forest Management Seminar, held in March 1999, many leading groups in the village agreed to the idea of establishing Village Forest Management Committee. The case of the establishment in Ashante will become a good reference.

[20] Members of the committee, through recommendation by chief, will be decided at residents' meeting.

[21] According to the result of field verification, petitions on the installation of borehole well to the regional government have been made through assemblymen of unit committees. A well is to be installed after the establishment of water management committee and securing of operation and maintenance cost. So the committee seems to have coordination function inside and outside of a committee.

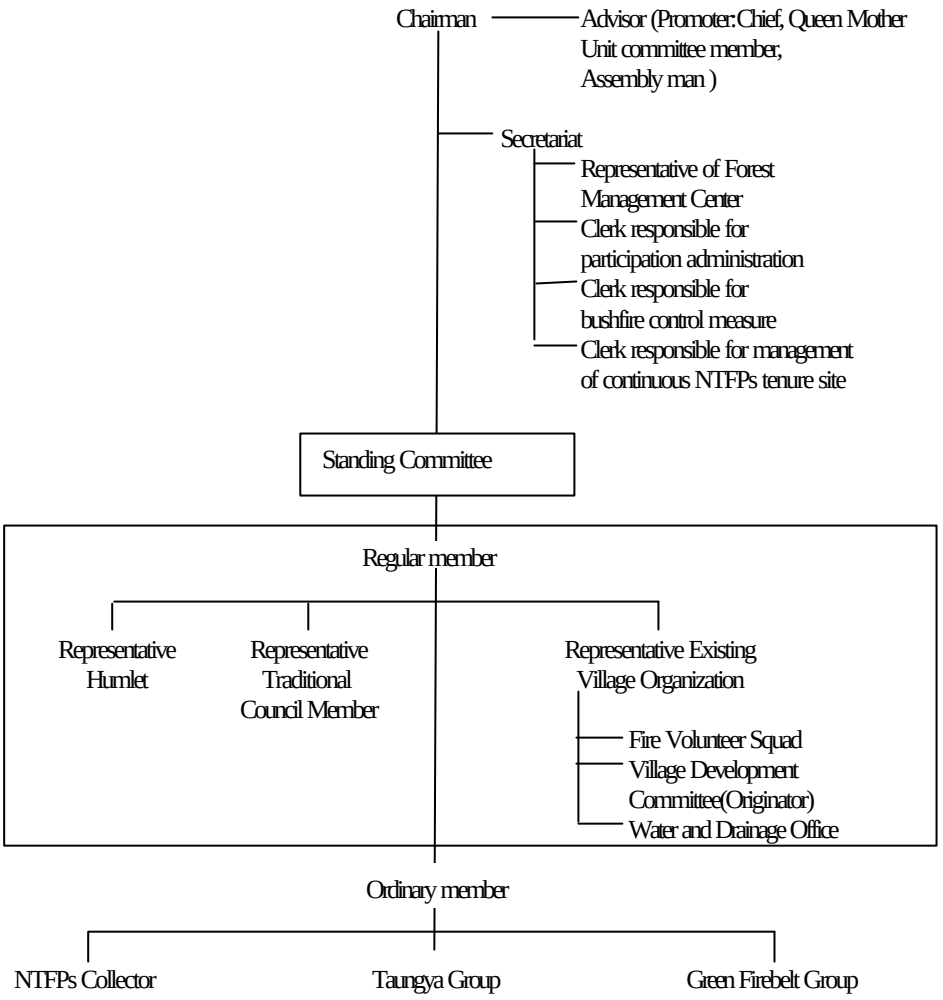

Fig. VII-3-21 Organizational Structure of Forest Management Planning Committee

② Management of People's Participation

a. Establishment of Committee Secretariat

- Led by the committee chairman, the secretariat will be established as an auxiliary body of the committee to promote and administer the participation of local people and also to act as a coordinating body at the village level.
- The committee chairman will act as the secretary and the following members of the secretariat will be selected to ensure the compliance of obligations under the collaborative forest management agreement.
  - Representative of Forest Management Centre
  - Clerk responsible for participation administration

- Clerk responsible for bushfire control measures
- Clerk responsible for management of continuous NTFP tenure sites

b. Outline of Secretariat Functions

The following administrative work is believed necessary to ensure the operation of the forest management Planning committee in which villagers will perform their expected roles so far discussed with the assistance of NGOs.

- Administration of collaborative forest management agreement
- Administration of plantation establishment
- Administration of early detection and initial fire-fighting system
- Administration of continuous NTFPs tenure sites

c. Administrative Method of Participation

a) Coordination of Participants in Plantation Establishment

In principle, the coordination of individual participants and participating groups in the establishment and management of plantations will be conducted through the processes of recruitment, selection and contract signing.

b) Coordination of Village Activities and Ordinary Members

Coordination of the management/administration of the collaborative forest management agreement and continuous NTFP tenure sites will be conducted through the administrative procedure regarding committee members and/or unit/settlement representatives of the forest management Planning committee.

c) Strengthening of Existing Village Organizations

The bushfire early detection and initial fire-fighting system will be reinforced by means of strengthening the village fire-fighting volunteer (the establishment of such a team will be encouraged at those villages which currently do not have such a volunteer).

③ Yearly Work Plan

Forest Management Planning Committee will be set up in coordination with the plans for the establishment of plantation, green firebelt, village nursery etc..

It is assumed that the operating expenses of the committee will be met within the income of the committee. Those people assigned to the administration of the secretariat, which will

play a central role in administering participation, are expected to face a decline of their income from production activities. It is, therefore, planned to subsidise the remuneration for secretariat members (see Table VII-3-28).

Table VII-3-28 Guidance Plan for Forest Management Planning Committee

(Team)

Forest Reserve	Location of Village Forest Management Committee	1	2	3	4	5	6	7	8	9	10	11	12
Yaya	H Nsuata	1	1	1	1	1	1	1	1	1	1		
	F Tanokwayein			1	1	1	1	1	1	1	1	1	1
	E Asuakwa				1	1	1	1	1	1	1	1	1
Tain I	C Adantia	1	1	1	1	1	1	1	1	1	1		
Nsemire	D Buku	1	1	1	1	1	1	1	1	1	1		
	G Amoakrom		1	1	1	1	1	1	1	1	1	1	
Tain II	A Kyekyewere			1	1	1	1	1	1	1	1	1	1
	B Namasua						1	1	1	1	1	1	1
Sawsaw	K Nkonsia			1	1	1	1	1	1	1	1	1	1
	I Tromso					1	1	1	1	1	1	1	1
	J Nyinaponase							1	1	1	1	1	1
	L Askwaal									1	1	1	1
Total		3	4	7	8	9	10	11	11	12	12	9	8

Member of Secretariat
1) Representative of Forest Management Centre: 1
2) Clerk responsible for participation administration: 1
3) Clerk responsible for bushfire control measure: 1
4) Clerk responsible for management of continuos NTFPs tenure sites: 1

(4) Assistance by External Consultants for General Project Management

① Description of Assistance

- Assistance for briefing private companies hoping for participation; assistance for coordination among government organizations concerned, preparation of implementation plan for each type of work and control of procurement and field activities by NGOs
- General design and work supervision for infrastructure development work
- Guidance on detailed implementation planning and management of plantation establishment work; guidance on production and technical development work of high quality seedlings of forestry species
- Guidance on general management of early detection and initial fire-fighting system (at Central Nursery/Forest Management Centre)
- Guidance on environmental monitoring/management/environmental supervision during work implementation period regarding work of private companies

② Appointment of Consultant Team

A consultant team comprising foreign consultants and local consultants will be appointed to deal with the work items including less experience by Forestry Department.

a. Foreign Consultants

Foreign consultants will be in charge of those fields for which local consultants in Ghana are judged to have less experience (general project/work management; fund management; general techniques covering both industrial plantations and social forestry and related techniques; bushfire control and administration of environmental consideration, etc.)

b. Ghanaian Consultants

Ghanaian consultants will be in charge of those fields where the work must be conducted based on the experience in Ghana and the Brong-Ahafo Region and fields related to social development and agricultural development (project/work management; nursery management; construction; civil engineering; agroforestry and participation of local people, etc.)

③ Yearly Work Plan

The appointment of foreign consultants is planned, taking the following points into consideration.

- The appointment of foreign consultants will be limited to the forest establishment period based on the assumption that the Forestry Department and/or Forest Management Centre will become capable of conducting general project/work management in accordance with the project/work progress.
- The emphasis will gradually shift from the use of foreign consultants to the use of Ghanaian consultants in accordance with the project/work progress (Table VII-3-29).

Table VII-3-29 External Consultants Appointment Plan

M/M

Section	Responsibility	1	2	3	4	5	6	7	8	9	10	11	12	Total
Foreign consultants	General project/work management	2	2	2	2	2	1	1	1	1	1			15
	Fund management	2	2	2	2	2	1	1	1	1	1			15
	General techniques	2	2	2	2	2	1	1	1	1	1			15
	Bushfire control	2	2	2	2	2	1	1	1	1	1			15
	Environmental consideration	2	2	2	2	2	2	1	1	1	1	1	1	18
Ghanian consultants	Project/work management	6	6	6	6	6	3	3	3	3	3			45
	Nursery management	6	6	6	6	6	3	3	3	3	3			45
	Construction	6	6	6	3	3	3							27
	Civil engineering	6	6	6	6	6	3	3	3	3	3			45
	Agroforestry	3	3	3	3	3	3	3	3	3	3			30
	people participation	3	3	3	3	3	3	2	2	2	2	2	2	30
Total		40	40	40	37	37	24	19	19	19	19	3	3	300

(5) Plan to Assist Local People by NGO (as People Participation Facilitators)

① Activities

The use of NGOs as an external actor to promote participation is planned because of the lack of extension system in Forestry Department. In order to prevent sudden changes of the communal society due to the impacts of such an external factor, NGOs members should preferably commute to the subject villages instead of living in the villages. NGO members are expected to conduct the following work.

a. Participation and extension promotion survey
b. Preparation of PR and extension tools for participatory-type forest management project
c. Hosting of explanatory meetings on participatory-type forest management project (hosting of forest management seminars at a village level)
d. Administration of preparation of detailed implementation plan for participatory-type forest management in each village
e. Assistance for administration of participation
f. Administration of intra-village extension work
g. Assistance for work supervision and monitoring of participatory-type forest management work/projects
h. To act as the counterpart of the forest guard

② NGO Recruitment

Although NGO activities in Ghana have only become active in recent years, few local NGOs are considered to possess sufficient know-how in regard to the implementation of

wide-area projects. A team (of mixed sexes), consisting of supervisory personnel (including members of foreign NGOs) specialising in such vital fields at a village level as general coordination/consolidation of organization, forestry techniques/bushfire prevention, village development, social analysis/gender care, farming household management/farming practices and the natural environment, etc. and local villagers, should be established for each participatory-type forest management zone to conduct collaborative work.

③ Yearly Work Plan

The NGO recruitment plan should take the following points into consideration (Table VII-3-30).

- NGO recruitment will be restricted to the forest establishment period based on the assumption that forest guards of the Forestry Department and members of the Forest Management Centre will become capable of assisting participation in accordance with the work/project progress.
- In principle, the staff assignment system will be adjusted in line with the progress of the plantation establishment work.

Table VII-3-30 NGO Recruitment Plan

(Team)

Forest Reserve	Location of Village Forest Management Committee	1	2	3	4	5	6	7	8	9	10	11	12
Yaya	H Nsuta	1	1	1	1	1							
	F Tanokwayein			1	1	1	1	1					
	E Asuakwa				1	1	1	1	1				
Tain I	C Adantia	1	1	1	1	1							
Nsemire	D Buku	1	1	1	1	1							
	G Amoakrom		1	1	1	1	1						
Tain II	A Kyekyewere			1	1	1	1	1					
	B Namasua						1	1	1	1	1		
Sawsaw	K Nkonsia			1	1	1	1	1					
	I Tiomso					1	1	1	1	1			
	J Nyinaponase							1	1	1	1	1	
	L Asukwaal									1	1	1	1
Total		3	4	7	8	9	7	7	4	4	3	2	1

(6) Plan to Strengthen Administrative Sections of Private Companies

① Sections Subject to Strengthening

• Field office : - general administration (coordination with Forestry Department and Forest Management Centre, etc)
- land administration (promotion and administration of land lease agreements and profit-sharing agreements, etc.
- accounting (administration of work expenses, etc.)

• Site management : - planting (including procurement of seedlings
- forest roads
- machinery
- bushfire control measures (including administration of early detection and fire-fighting system)
- cutting (only at the time of cutting)

② Yearly Work Plan

An increase of manpower is planned as shown in Table VII-3-31.

Table VII-3-31 Plan to Strengthen Administrative Sections of Private Companies

Section	Responsibility	Number of months	Period (years)	Remarks
Field office	General administration	12M/M	46	
	Land administration	12M/M	46	
	Accounting	12M/M	46	
Site management	Planting	12M/M	46	Liaison of Village Forest Management Committee
	Machinery	3M/M	20	from 3rd year to 12th year, from 28th year to 37th year
	Forest roads	6M/M	12	
	Felling	4M/M	35	from 12th year to 46th year
	Bushfire control	4M/M	46	3 months of dry season (bushfire), 1 month of rainy season (maintenance for tree growing)

VII.4 Calculation of Base Cost

The cost based on the financial value in 2000, the year of commencement of the work, has been estimated to provide the basis for calculation of the work cost.

VII.4.1 Base Cost by Type of Work

(1) Yearly Standard Work Processes

① Direct Costs

The standard work processes for each type of work are assumed based on the examination results described in the previous sections. In addition, the unit cost for each type of work for the standard processes under conditions similar to those in the Intensive Study Area are estimated using examples of similar work in Ghana,[22] information of which was gathered at the Forestry Department and agricultural offices, etc., and also examples of similar work/projects abroad.[23] The following cost categories are adopted regarding investment, operation and management.

- Planting work (including natural forest improvement and agroforestry)
  - Investment: planting preparation cost (surveying and land preparation, etc.), planting cost (forestry species, fruit trees etc.)
  - Operation and maintenance: tending cost (including prunning and intercropping), travelling and patrolling cost; crop cultivation cost

- Nursery Practices Work
  - Investment: material cost (seeds and pots, etc.), personnel cost for nursery practices
  - Operation and maintenance: machine operation cost etc.

- Infrastructure Work

[22] The main examples referred to are as follows.
- Planning Branch, Forestry Department (1988), Unit Cost of Operations (Mv. Ref. No. G32.S.1/116) (GO1)
- Plantation Unit, Planning Branch, Forestry Department, Labour Cost of Development and Maintenance of 1 ha of Gmelia (GO2)
- Kassrjan Co., Ltd., Information on Forest Road Construction (GO3-04)

[23] The main examples referred to are as follows.
- Forestry Agency, Ministry of Agriculture, Forestry and Fisheries of Japan (1998), Guidelines for Forestry-Related Projects (eg. Soil Conservation and Improvement of Protection Forests, Forest Roads (J01)
- Kazuo Miura, Consideration and Present Conditions of Mechanised Silvicultural Operation in Semi-Arid Area of Nigeria, Institute of Forests and Forest Products of Japan (JO2)
- JICA, Annex Report, Feasibility Study on Industrial Plantation Forest Development Plan in South Sumatera Area in Republic of Indonesia (J93)
- JICA, Final Report, Study on Plantation Establishment and Development in Hoskins District, Papua New Guinea (JO4)

- Investment: construction cost; equipment procurement and installation cost
- Operation and maintenance: maintenance/repair cost

• Administrative and Operational Work
- Investment: personnel cost etc.

② Indirect Costs

In the case of the following indirect cost items for which an accurate estimate is difficult to make at the present stage of planning, it has been decided to plan their details at the next stage, i.e. implementation plan, and an estimate is made as a percentage of the domestic portion of the total direct cost.

• Low cost, low volume consumables
• Procurement for building fixtures cost and transportation costs required to provide services
• Transportation cost of machinery required to prepare work sites, cost of temporary work required for implementation of the main work and cost of on-site management/supervision in the case of subcontracted work, etc.

The indirect costs are estimated using the following percentages vis-a-vis the estimated total of direct costs (domestic portion).

- Plantation work by private company : 20%
- Infrastructure construction : 30%
- Work related to services : 10%

③ Infrastructure Maintenance Cost

In regard to buildings and other structures constructed under the infrastructure plan and associated service facilities, the maintenance cost is assumed to fluctuate between 1% and 5% of the original cost depending on the year of completion/installation. As the construction work under the present plan takes durability and the maintenance needs into proper consideration, a constant annual repair cost of a relatively modest 2% of the total construction/installation cost is assumed.

④ Environmental Cost

Based on the examination results of the environmental consideration (see IX.4), the environmental cost to be borne by participating private companies is accounted for.

- Administration cost of EIA: the administrative cost of the EIA (including the cost of preparing an EIS) based on the estimate given by the subcontracted environmental consultant is assumed.
- Environmental supervision/monitoring/management cost: approximately 1% of the direct cost incurred by private companies is assumed.

(2) Calculation of Yearly Work Cost

The yearly work cost is calculated by multiplying the cost of the standard work processes in each year by the yearly volume of work. Labor expense by residents is calculated as unskilled labor cost and the cost paid by private sector and FD is included in gross income for residents. (See Ⅷ)

Ⅶ.4.2 Totalisation of Base Cost

The estimated total work/project cost based on financial prices, excluding price inflation, as shown in Table VII-4-1 (see the Appendix for the base cost by year and type of work/project), is estimated to be 76,470 million cedis (33,393,000 US$) which will be borne by private companies (46,719 million cedis 20,401,000 US$), local people (20,832 million cedis 9,097,000 US$) and the Forestry Department (8,918 million cedis 3,894,000 US$).

Table VII-4-1 Outline of Base Cost

Summary of Total Financial Costs (Without Escalation) (Unit: 1,000c)

Actor	Private Company Cost			Local People Cost			Forestry Department Cost			Total Cost		
	Investment	O &M	Total	Investmen	O &M	Total	Investmen	O &M	Total	Investment	O &M	Total
Forest Management Activities												
Plantation Establishment & Management												
Industrial Plantation with Taungya												
Plantation & Wood Production	1,771,849	8,321,972	10,093,821	472,967	2,866,642	3,339,609	0	0	0	2,244,816	11,188,614	13,433,430
NTFP & Crop Production				0	11,835,450	11,835,450			0	0	11,835,450	11,835,450
Sub-total	1,771,849	8,321,972	10,093,821	472,967	14,702,092	15,175,059	0	0	0	2,244,816	23,024,064	25,268,880
without Taungya												
Plantation & Wood Production	2,348,370	5,082,009	7,430,379	0	0	0	0	0	0	2,348,370	5,082,009	7,430,379
Sub-total	2,348,370	5,082,009	7,430,379	0	0	0	0	0	0	2,348,370	5,082,009	7,430,379
Total	4,120,219	13,403,981	17,524,200	472,967	14,702,092	15,175,059	0	0	0	4,593,186	28,106,073	32,699,259
Community Woodlots												
	0	0	0	92,016	1,591,358	1,683,374	4,303	0	4,303	96,319	1,591,358	1,687,677
Sub-total	0	0	0	92,016	1,591,358	1,683,374	4,303	0	4,303	96,319	1,591,358	1,687,677
Green Fire Belts												
Plantation & Wood Production	0	0	0	311,620	1,065,050	1,376,670	23,731	0	23,731	335,351	1,065,050	1,400,401
NTFP & Crop Production				0	2,101,383	2,101,383			0	0	2,101,383	2,101,383
Sub-total	0	0	0	311,620	3,166,433	3,478,053	23,731	0	23,731	335,351	3,166,433	3,501,784
Total	4,120,219	13,403,981	17,524,200	876,603	19,459,883	20,336,486	28,034	0	28,034	5,024,856	32,863,864	37,888,720
Natural Forest Conservation / Improvement												
No.1 Enrichment Planting	0	0	0	0	0	0	73,443	127,592	201,035	73,443	127,592	201,035
Total	0	0	0	0	0	0	73,443	127,592	201,035	73,443	127,592	201,035
Seedling Production												
Central Nersery	576,530	62,585	639,115	0	0	0	596,881	63,182	660,063	1,173,411	125,767	1,299,178
Village Nersery			0	128,066	4,711	132,777	0	0	0	128,066	4,711	132,777
Total	576,530	62,585	639,115	128,066	4,711	132,777	596,881	63,182	660,063	1,301,477	130,478	1,431,955
Total	4,696,749	13,466,566	18,163,315	1,004,669	19,464,594	20,469,263	698,358	190,774	889,132	6,399,776	33,121,934	39,521,710
Support & Operation Activities										0	0	0
Infrastracture Development										0	0	0
Forest Road - Fire Break												
	4,401,590	3,162,007	7,563,597	0	0	0	0	0	0	4,401,590	3,162,007	7,563,597
Sub-total	4,401,590	3,162,007	7,563,597	0	0	0	0	0	0	4,401,590	3,162,007	7,563,597
Nurseries & Other Facilities												
Central Nursery	0	0	0	0	0	0	1,295,104	2,343,240	3,638,344	1,295,104	2,343,240	3,638,344
Village Nurseries	0	0	0	0	321,429	321,429	386,595	0	386,595	386,595	321,429	708,024
Watchout Towers	0	0	0	0	0	0	110,256	93,555	203,811	110,256	93,555	203,811
Water Source Facilities	0	0	0	0	41,685	41,685	44,611	0	44,611	44,611	41,685	86,296
Sub-total	0	0	0	0	363,114	363,114	1,836,566	2,436,795	4,273,361	1,836,566	2,799,909	4,636,475
Total	4,401,590	3,162,007	7,563,597	0	363,114	363,114	1,836,566	2,436,795	4,273,361	6,238,156	5,961,916	12,200,072
Extension & Education												
Direct Contact to Key Farmers	0	0	0	0	0	0	54,280	0	54,280	54,280	0	54,280
Workshops	0	0	0	0	0	0	992,510	0	992,510	992,510	0	992,510
On Site Training	0	0	0	0	0	0	164,197	0	164,197	164,197	0	164,197
Training Courses	0	0	0	0	0	0	954,325	0	954,325	954,325	0	954,325
Total	0	0	0	0	0	0	2,165,312	0	2,165,312	2,165,312	0	2,165,312
Support for People Participation												
NGO	0	0	0	0	0	0	129,800	0	129,800	129,800	0	129,800
Total	0	0	0	0	0	0	129,800	0	129,800	129,800	0	129,800
Management Consultants												
	0	0	0	0	0	0	1,267,800	0	1,267,800	1,267,800	0	1,267,800
Total	0	0	0	0	0	0	1,267,800	0	1,267,800	1,267,800	0	1,267,800
Forest Management Planning Committee												
	0	0	0	0	0	0	149,760	0	149,760	149,760	0	149,760
Total	0	0	0	0	0	0	149,760	0	149,760	149,760	0	149,760
Strengthening PC Management & Operation												
	753,600	0	753,600	0	0	0	0	0	0	753,600	0	753,600
Total	753,600	0	753,600	0	0	0	0	0	0	753,600	0	753,600
Forest Management Center												
Secreariat for Coordination & Mediation	0	0	0	0	0	0	0	43,200	43,200	0	43,200	43,200
Total	0	0	0	0	0	0	0	43,200	43,200	0	43,200	43,200
Total	5,155,190	3,162,007	8,317,197	0	363,114	363,114	5,549,238	2,479,995	8,029,236	10,704,428	6,005,116	16,709,544
Taxtation & Environmetal Consideration												
Taxtation												
Rent												
Industrial Plantation with Taungya	0	239,472	239,472			0				0	239,472	239,472
Industrial Plantation without Taungya	0	240,437	240,437			0				0	240,437	240,437
Subtotal	0	479,909	479,909	0	0	0	0	0	0	0	479,909	479,909
Loyalty												
Industrial Plantation with Taungya	0	9,519,392	9,519,392			0				0	9,519,392	9,519,392
Industrial Plantation without Taungya	0	9,939,574	9,939,574			0				0	9,939,574	9,939,574
Subtotal	0	19,458,966	19,458,966	0	0	0	0	0	0	0	19,458,966	19,458,966
total	0	19,938,875	19,938,875	0	0	0	0	0	0	0	19,938,875	19,938,875
Environmetal Consideration												
Industrial Plantation with Taungya	0	150,190	150,190							0	150,190	150,190
Industrial Plantation without Taungya	0	74,304	74,304							0	74,304	74,304
Forest Road-Fire Break	0	75,636	75,636							0	75,636	75,636
Total	0	300,130	300,130	0	0	0	0	0	0	0	300,130	300,130
Total	0	20,239,005	20,239,005	0	0	0	0	0	0	0	20,239,005	20,239,005
Total	9,851,939	36,867,578	46,719,517	1,004,669	19,827,708	20,832,377	6,247,596	2,670,769	8,918,365	17,104,204	59,366,055	76,470,259

VIII. PROJECT ANALYSIS AND EVALUATION

VIII. PROJECT ANALYSIS AND EVALUATION

VIII.1 Quantitative Project Evaluation

VIII.1.1 Premise for the Project Analysis

(1) Varieties and Crops to be Introduced

Teak and ofram are planned to be introduced with a ratio of 80% for teak and 20% for ofram. Crops to be planted in the form of agroforestry are in, ① Taungya method in the industrial forest, and ② green fire belt. In the former, maize, yam, cocoyam and plantain will be planted only for four (4) years. In the latter, maize, yam, plantain, cocoyam will be cropped as well as tree crops of cashew, citrus and avocado. These crops are proposed because they are among the prevailing food crops consumed by the people, and tree crops are selected because of their strong resistance against bush fire and preference of people.

(2) Plantation Period and Felling

Plantation period of 10 years for the industrial forest and 7 years for green fire belt are projected, respectively. Felling for teak will be 35 years and 25 years for ofram.

(3) Project Life

Though it depends on the purpose of reforestation, generally, 30 to 50 years are considered reasonable for the project life of reforestation project. In this project analysis 46 years composed of 10 years for plantation establishment and 35 year of felling period of teak and 2 year's preparation.

(4) Profit Sharing

Though actual profit sharing must be decided through a series of discussions by agencies concerned such as forestry department when the project will be implemented, 80% for private company and 20% for local people are used for the convenience of project evaluation.

(5) Cost Sharing

Table VIII-1-1 shows the proposed cost sharing to be borne by the agencies concerned of forestry department local people and private company, which should be borne by the agencies as proposed.

(6) Positioning of Agroforestry

Agroforestry in industrial forestry and green fire belt is necessary activities to manage initial growing of trees in the industrial plantation and sustainable management of green fire belts. So, cost of production for growing crops is categorized as an annual operation and maintenance cost in the project evaluation.

(7) Economic and Financial Analysis

Economic internal rate of return (EIRR) is used as index for economic evaluation which is analyzed from the national economic point of view and financial internal rate of return (FIRR) for financial analysis of the project. Cost and benefit from forestry and agroforestry are taken into account in both analysis. Benefit of fuelwood is also taken into account in the project evaluation. Based on the proposed cost sharing and benefit sharing, financial analysis is done for overall project and for private company which is expected to invest in the project.

(8) Subsidy and Exemption of Taxes

Currently Ghana has no subsidy system for forestry project and also no system to exempt taxes and customs. However, possibility to establish those measures to promote forestry project has been confirmed in the series of discussion with the forestry department.

(9) Transfer Payments

In the economic evaluation, transfer payments such as taxes, subsidy, land rent, royalty and price contingency and so on, are deducted from financial cost.

(10) Crop Yields

Increase in crop yield is not proposed because of the absence of the irrigation plan in the project. Crop yields used in the evaluation have been inspected by the official of PPMED of agricultural department of Sunyani, and then modified taking into consideration the mixed farming with tree nurseries.

(11) Prices

① Commodity Prices

All the prices applied have been estimated on the basis of the latest data and information as far obtained in October 1998. When converting financial prices of crops to economic prices, conversion factors collected from the World Bank office in Accra were used. Stumpage prices of teak and ofram were calculated based on the data collected from

TEDB and field survey. Although price outlook for timber is provided in the World Bank's publication, species of trees are not specified.

Prices of commodities and services marketed in Ghana are converted into economic prices by applying conversion factors calculated from the latest trade statistics and so on.

Standard conversion factor (SCF)	0.958
Farm labor	0.750
Skilled labor	1.000

Table VIII-1-2 shows both economic and financial farmgate prices of agricultural input and output.

② Taxes, Freight and Insurance

Tax revenue of the government is composed of ① taxes on income and property, ② taxes on domestic goods and services, ③ taxes on international trade. Among these, taxes on international trade account for 30% of the tax revenue. Freight and insurance on timber exporting were surveyed at Ghana Shippers Council. There are two types of containers with capacity of 32.7 cu.m and 65.4 cu.m. Freight and insurance per cu.m for both types are calculated at 22.1 US$ between Accra and Amsterdam and 27.2 US$ between Accra and London, respectively.

③ Physical Contingency

The physical contingency is provided in the cost estimation in considering possible increase in construction cost causing from difference in the conditions at design and implementation stages, which could not be predicted at designing stage, and difference in field conditions etc. in the project 15 % are provided for the physical contingency.

④ Exchange Rate of the Foreign Currency

Exchange rate for US$ has considerably been fluctuated over these years as shown below and 2,290 Cedis of the current exchange rate in September 1998 will be used in this analysis.

Table VIII-1-1 Cost to be Borne by the Agencies Concerned

	Forestry Department		Private Company		Local People	
	Cost		Cost		Cost	
	Initial Cost	OM Cost	Initial Cost	OM Cost	Initial Cost	OM Cost
Industrial Forest (1) a) with b) with	X X	X X	O O	O O	X X	OAgro X
Industrial Forest(2)	X	X	X	X	X	X
Community Wood Lot	O	X	X	X	O As labor	O As labor
Green Fire Belt	O	X	X	X	X	O Agro
Natural Forest (1)	O	O	X	X	X	X
Natural Forest (2)	X	X	X	X	X	X
Central Nursery	O	O	X	X	X	X
Village Nursery & Wells	O	X	X	X	X	O
Seedling Production a) Central Nursery b) Village Nursery	 X X	 X X	 O X	 O X	 X O	 X O
Main and Spur Roads	X	X	O	O	X	X
Fire Break & Watchout Towers a) Fire Break b) Watch Towers	 X O	 X X	 O X	 O O	 X X	 X X
Extension & Eduactional Training	X	O	X	X	X	X
Forest Management Center	X	O	X	X	X	X
Village Forest Management Committiee	X	O	X	X	X	X
Supporting People Participation (NGO)	X	O	X	X	X	X
Management Consultant	X	O	X	X	X	X
Strengthening Private Sector	X	O	X	X	X	X

Nore. O: Bearing on the costs
X: No bearing on the costs

Table VIII-1-2 Economic and Financial Farmgate Prices of Commodities

		unit	Financial	Economic	Remarks
1. Logs	Teak log (stumpage)	Cedis/cu.m	135,000	187,205	
	Ofram(stumpage)	Cedis/cu.m	65,000	90,136	
	Teak log thinned	Cedis/log	18,000	18,000	for telegraph pole
2. Products	Maize	Cedis/kg	340	386	CF= 1.137
	Yam	Cedis/kg	560	582	CF= 1.040
	Plantain	Cedis/kg	1,200	1,248	CF= 1.040
	Citrus	Cedis/kg	750	820	CF= 1.093
	Mangoes	Cedis/kg	1,800	1,967	CF= 1.093
	Cashew Nuts	Cedis/kg	3,000	3,279	CF= 1.093 (sugar apple)
	Cocoyam	Cedis/kg	700	728	CF= 1.040
	Avocado	Cedis/kg	2,000	2,186	CF= 1.093
	Firewood	Cedis/kg	366	366	2,614 C/cu.m
3. Labour	Skilled Labour	Cedis/MD	15,000	14,370	
	Farm Labour	Cedis/MD	3,500	2,625	
4. Seeds & Seedlings	Teak	Cedis/piece	100	100	
	Mangoes	Cedis/piece	200	200	
	Cashew Nuts	Cedis/piece	200	200	
	Plantain	Cedis/piece	250	250	
	Citrus	Cedis/piece	200	200	
5. Fuel	Gasoline	Cedis/lit.	711	820	CF= 1.153

Soure. Field & Farm Economic Survey by JICA Study Team
Agricultural Department, Sunyani & Wenchi
Timber Export Development Board, Kumasi
Market survey in Sunyani, Berekum, Chiraa
Economic conversion factor for crops are based on World Bank's report.

(12) Inflation Rate

As shown below, prices of commodities in Ghana have changed at higher ratio over several years. The averaged price escalation during the latest seven years is estimated at 29.6% and the rate was remarkably risen in the latest years and the rate for foods is apt to be higher than that for non-food commodities. There are some difference in price escalation between urban and rural areas, that is, 53.8% from 1992 to 1996 for the former and 38.7% for the latter for the same period. Prices of communication, transportation and cloth have been risen in both rural and urban areas.

Table VIII-1-3 Consumer Price Index

(1977=100)

1990	14,341.5
1992	16,927.4
1993	23,279.7
1994	29,069.4
1995	46,355.0
1996	67,938.0

Source: The State of the Ghanaian Economy in 1996

In this project, price contingency of 30% per year for local currency portion and 2.5% for foreign currency portion which was estimated on forecasted inflation rate by the World Bank, are taken into account in the cost.

(13) Thought of with Project and without Project

Project benefits can be calculated based on the difference between with project and without project. This project is planned to protect , restore and utilize sustainablly five (5) forest reserves in rhe transitional zone in Brong Ahafo region through plantation establishment in such devastated lands as grasslands, enrichment planting in the existing natural forest, establishment of green fire belts and construction forest roads and other supporting activities. This can be said as “with project” case.

VIII.1.2 Calculation of Project Benefits

(1) Project Cost

The project cost is divided into financial project cost estimated based on financial prices and economic project cost based on economic prices. The financial project cost is converted to the economic project cost by applying conversion factors such as SCF. On the occasion, tax, subsidy, cost for land acquisition and compensation, contingency of price escalation etc. are not included in economic project cost. As the result, financial project cost is estimated at 19,669 million Cedis and economic project cost at 18,357,098 million Cedis, respectively.

(2) Project Benefits

Tangible benefits in monetary terms in this Project are those arising from both forestry and agro-forestry. Benefit of NTFPs is not taken into account because of the difficulty in estimating its value. Agroforestry is conducted in industrial forest and green fire belts. In considering current food crop production and soil conditions, maize, yam, cocoyam and plantain are proposed to plant as well as some tree crops such as avocado, cashew in green fire belts. Yield of these crops are targeted lower than usual because of intercropping. Consequently, project benefit including agroforestry is estimated at 257,283,769 thousand Cedis in financial price and 334,408,773 thousand Cedis in economic price.

VIII.1.3 Economic Analysis

(1) Economic Internal Rate of Return(EIRR) • Net Present Value

EIRR is characterized as an index to present economic viability of the project from national economic point of view. In other word, EIRR is the discount rate by which net present values of benefits and costs become zero. In the case calculated EIRR is equal or higher than the opportunity cost of capital, project is justified its economic viability to be implemented. Since the World Bank applies 12% of opportunity cost of capital for various type of projects in Ghana, viability of this project will be judged based on this rate.

As mentioned before, project life for the estimation of EIRR 46 years were set up taking into consideration 2 years preparation period, plantation period of teak and growing period of teak. Net present value of cost and benefit are estimated by discounting them for 46 years by using one discount rate, which is found by a trial-and error method.

As shown in the TableVIII-1-4, EIRR of this project is estimated at 24.7%. As compared with the opportunity cost of capital which is used by the World Bank, the estimated rate of 28.1% is higher than 12%, implying that the project is judged economically feasible.

(2) Sensitivity Analysis

Sensitivity analysis is made to verify the effect on EIRR under some parameters assumed. The following four (4) parameters are assumed: ① 10 percent increase in project cost, ② 10 percent decrease of benefit, ③ combination of ① and ②, ④ 3 year delay of plantation. Results of the sensitivity analysis are shown below:

	EIRR(%)
① 10 percent increase in project cost	22.5
② 10 percent decrease of benefit	21.9
③ combination of ① and ②	19.6
④ 3 year delay of plantation	24.7

VIII.1.4 Financial Analysis

(1) Financial Analysis of the Project

The purpose of the financial analysis is to verify the financial viability of this project. Financial analysis of the project is composed of following; ① overall financial analysis covering industrial forest, green fire belt and forest roads etc., ② analysis for private company which will invest in the project, ③ analysis for the standard farm household in industrial forest and green fire belts. In the analysis for the standard farm household in the industrial forest, 20% profit sharing of forestry benefit will be taken into account in addition to the benefit of crops. Prices used in the financial analysis are current market prices which are not processed distortion caused by subsidy and taxes etc. As mentioned before, inflation in the latest years is averaged at 29.6% per year. Interest rate currently applied in the Agricultural Development Bank is 34% for loaning for forestry and agricultural sectors. If considering inflation, real interest of loan will be estimated at 15% and this rate will be a standard to verify financial viability of the project.

Table VIII-1-4 Calculation of EIRR

(unit:thousand Cedis)

Project Year	Capital Cost	O & M Cost	Total	Benefit	Return	Present Value by Discount Rate					
						Interest= 0.20		Interest= 0.25		Interest= 0.30	
						Cost	Benefit	Cost	Benefit	Cost	Benefit
1	1,826,031	36,785	1,862,816	0	-1,862,816	1,862,816	0	1,862,816	0	1,862,816	0
2	1,125,680	64,172	1,189,852	1,895	-1,187,957	826,286	1,316	761,505	1,213	704,054	1,121
3	1,539,512	86,827	1,626,339	217,872	-1,408,467	941,168	126,083	832,686	111,550	740,254	99,168
4	1,722,402	136,893	1,859,295	498,975	-1,360,320	896,651	240,632	761,567	204,380	650,991	174,705
5	2,010,803	220,847	2,231,650	1,692,087	-539,563	896,850	680,012	731,267	554,463	601,048	455,728
6	1,771,535	307,165	2,078,700	2,562,442	483,742	696,152	858,157	544,919	671,729	430,657	530,877
7	1,411,167	420,320	1,831,487	4,467,593	2,636,106	511,134	1,246,823	384,091	936,922	291,877	711,984
8	1,387,516	558,233	1,945,749	4,358,080	2,412,331	452,519	1,013,550	326,443	731,164	238,528	534,255
9	1,311,158	642,727	1,953,885	6,911,464	4,957,579	378,676	1,339,488	262,246	927,641	184,251	651,748
10	1,292,782	743,179	2,035,961	4,628,338	2,592,377	328,819	747,502	218,610	496,964	147,685	335,731
11	726,909	832,737	1,559,646	7,103,028	5,543,382	209,910	955,982	133,973	610,145	87,026	396,339
12	211,466	829,206	1,040,672	5,552,398	4,511,726	116,718	622,738	71,514	381,558	44,668	238,320
13	25,048	774,695	799,743	7,415,110	6,615,367	74,747	693,045	43,966	407,650	26,405	244,824
14	25,462	644,862	670,324	3,692,514	3,022,190	52,209	287,597	29,481	162,398	17,025	93,781
15	26,476	546,876	573,352	5,067,973	4,494,621	37,214	328,939	20,173	178,313	11,201	99,011
16	24,826	492,659	517,485	1,223,980	706,495	27,990	66,202	14,566	34,452	7,777	18,394
17	24,250	512,945	537,195	1,306,917	769,722	24,213	58,907	12,097	29,429	6,210	15,108
18	24,095	515,487	539,582	1,358,990	819,408	20,267	51,045	9,720	24,481	4,798	12,085
19	26,167	457,070	483,237	1,332,494	849,257	15,126	41,708	6,964	19,203	3,305	9,115
20	27,342	444,627	471,969	1,065,155	593,186	12,311	27,784	5,441	12,280	2,483	5,605
21	24,084	456,255	480,339	743,340	263,001	10,441	16,158	4,430	6,856	1,944	3,009
22	25,035	445,560	470,595	472,012	1,417	8,524	8,550	3,472	3,483	1,465	1,470
23	25,282	441,465	466,747	695,997	229,250	7,046	10,506	2,755	4,108	1,118	1,667
24	25,456	441,439	466,895	1,175,698	708,803	5,873	14,789	2,205	5,552	860	2,166
25	29,585	417,436	447,021	1,928,823	1,481,802	4,686	20,219	1,689	7,287	633	2,733
26	24,280	417,393	441,673	1,771,840	1,330,167	3,858	15,478	1,335	5,355	481	1,932
27	48,528	417,846	466,374	2,941,424	2,475,050	3,395	21,412	1,128	7,112	391	2,467
28	73,704	418,130	491,834	3,944,272	3,452,438	2,984	23,927	951	7,629	317	2,544
29	121,862	424,886	546,748	5,826,002	5,279,254	2,764	29,452	846	9,015	271	2,891
30	175,673	434,782	610,455	7,265,058	6,654,603	2,572	30,606	756	8,994	233	2,773
31	178,047	450,072	628,119	8,068,536	7,440,417	2,205	28,325	622	7,991	184	2,369
32	155,740	464,135	619,875	6,985,353	6,365,478	1,813	20,436	491	5,534	140	1,578
33	177,312	485,493	662,805	6,837,738	6,174,933	1,616	16,670	420	4,334	115	1,188
34	152,845	488,529	641,374	6,477,464	5,836,090	1,303	13,160	325	3,284	86	866
35	153,576	502,340	655,916	6,938,505	6,282,589	1,110	11,747	266	2,815	67	713
36	150,088	505,658	655,746	5,411,681	4,755,935	925	7,635	213	1,756	52	428
37	44311	506,237	550,548	3,877,520	3,326,972	647	4,559	143	1,007	33	236
38	25,269	485,408	510,677	7,892,647	7,381,970	500	7,733	106	1,639	24	369
39	25,559	451,859	477,418	16,288,019	15,810,601	390	13,298	79	2,706	17	586
40	29,530	409,627	439,157	21,658,467	21,219,310	299	14,736	58	2,879	12	600
41	24,280	365,814	390,094	26,505,510	26,115,416	221	15,028	41	2,819	8	564
42	24,613	334,836	359,449	27,005,225	26,645,776	170	12,760	31	2,297	6	442
43	25,048	322,340	347,388	26,474,623	26,127,235	137	10,424	24	1,802	4	334
44	25,462	289,502	314,964	25,099,688	24,784,724	103	8,236	17	1,367	3	243
45	26,476	267,093	293,569	28,494,622	28,201,053	80	7,791	13	1,241	2	212
46	24,826	251,065	275,891	23,171,404	22,895,513	63	5,280	10	807	2	133
Total	18,357,098	20,163,512	38,520,610	334,408,773	295,888,163	8,445,503	9,776,426	7,056,471	6,605,608	6,071,533	4,662,411
								EIRR=	24.7 %		
						B/C Ratio=	20 %	1.16			
						B/C Ratio=	25 %	0.94			
						B/C Ratio=	30 %	0.77			

① Financial Analysis of the Overall Forestry Project

As the results of the financial analysis of the forestry project composed of plantation and construction of green fire belts etc. are shown in Tables VIII-1-5 and FIRR is 19.3%. Inflation rate in Ghana over last several years is averaged at about 30%, however, as the State of Ghanaian Economy (1996), the government targeted annual inflation rate of 20% during 1997 and 10% during 1998. Therefore, financial analysis was analyzed in considering both inflation rate of 30% and 20%. As compared with real interest of 15% which is calculated taken into account inflation, this project is judged financially feasible.

② Financial Analysis of Private Companies

Private companies are expected to invest in this forestry project and considerable number of the private firms which have an attention to this project was confirmed during the field survey. FIRR of private company was calculated based on some assumption such as initial cost and O& M cost to be borne by private firm, profit sharing of 80% (not including benefit of agroforestry). As the result, FIRRs were calculated at 6.8% (Table VIII-1-6) and this rate will be improved at 9.9% if 50% of the cost will be subsidized by the government. It is considered that such lower FIRRs are caused because of ① no benefit compared to considerable investment during initial 10 years, ② no agricultural benefit, which generates benefit earlier than forestry, is considered.

(2) Financial Analysis of Standard Farm Household

Financial analysis for the standard farm household is done to compare farm economy in without project and with project cases. Household expense and off-farm income are included in the analysis taking into account price escalation. All the data used are based on the result of the field survey carried out by the JICA study team. The typical farm households in and around the intensive study area are categorized as the one who is an immigrants, tenants. Financial analysis of farm household is done to compare farm income on the assumption that ① agroforestry with Taungya in the industrial forest, ② agroforestry in green fire belt.

According to the farm economic survey, current farm household income is averaged at 1,113, 000 Cedis per year. The income generated from agroforestry with Taungya method and one in green fire belt is additional income of a farm household. Though Taungya method in the industrial forest is limited for four (4) years, farm income in both cases will be improved and the implementation of the project is confirmed to contribute to lift up living standard of households. Tables VIII-1-7 and VIII-1-8 show the additional income of farm household who manages agroforestry in the industrial forest (farm size=2.5 ha) and green fire belt (farm size=2.0 ha). When discounting 15%, averaged farm household income will be increased by

150,958 Cedis for Taungya method and 489,757 Cedis for household in green fire belt, respectively.

(3) Sensitivity Analysis

Under the same conditions as those used in the economic analysis, affects on FIRR or net present values with the change in costs and benefits are studied. Differences between the economic evaluation is to use market prices of commodities and to take into account taxes, price escalation and land purchasing cost etc., which are deducted in the economic analysis. Following is the parameters assumed; ① 10% increase in cost, ② 10% decrease in benefit, ③ combination with ① and ②, ④ 3 year delay of plantation.

	FIRR(%)
① 10 percent increase in project cost	17.0
② 10 percent decrease of benefit	16.7
③ combination of ① and ②	14.6
④ 3 year delay of plantation	19.2
⑤ price contingency 20%	16.1
⑥ price contingency 30%	14.8

Table VIII-1-5 Calculation of FIRR

(unit:thousand Cedis)

Project Year	Capital Cost	O & M Cost	Total	Benefit	Return	Present Value by Discount Rate					
						Interest= 0.10		Interest= 0.15		Interest= 0.20	
						Cost	Benefit	Cost	Benefit	Cost	Benefit
1	2,085,510	39,179	2,124,689	0	-2,124,689	2,124,689	0	2,124,689	0	2,124,689	0
2	1,175,062	68,845	1,243,907	1,608	-1,242,299	1,028,022	1,329	940,572	1,216	863,824	1,117
3	1,604,954	96,282	1,701,236	190,732	-1,510,504	1,278,164	143,300	1,118,590	125,409	984,512	110,377
4	1,802,887	159,327	1,962,214	437,210	-1,525,004	1,340,219	298,620	1,121,902	249,976	946,284	210,846
5	2,113,684	266,108	2,379,792	1,520,036	-859,756	1,477,664	943,823	1,183,177	755,727	956,385	610,868
6	1,871,624	381,967	2,253,591	2,297,569	43,978	1,272,093	1,296,918	974,290	993,302	754,723	769,451
7	1,501,184	535,838	2,037,022	4,057,225	2,020,203	1,045,314	2,081,998	765,792	1,525,261	568,495	1,132,297
8	1,482,907	716,614	2,199,521	3,920,853	1,721,332	1,026,093	1,829,107	719,027	1,281,734	511,538	911,865
9	1,393,354	831,711	2,225,065	6,303,743	4,078,678	943,645	2,673,402	632,502	1,791,917	431,233	1,221,708
10	1,370,065	966,892	2,336,957	4,122,348	1,785,391	900,998	1,589,344	577,660	1,018,981	377,432	665,782
11	791,787	1,085,558	1,877,345	6,424,327	4,546,982	657,998	2,251,687	403,523	1,380,866	252,668	864,637
12	243,968	1,089,486	1,333,454	4,974,742	3,641,288	424,880	1,585,106	249,232	929,815	149,556	557,950
13	28,135	1,022,471	1,050,606	6,806,261	5,755,655	304,323	1,971,531	170,753	1,106,208	98,194	636,140
14	28,740	857,694	886,434	3,357,566	2,471,132	233,426	884,152	125,279	474,520	69,041	261,509
15	30,077	733,982	764,059	4,716,848	3,952,789	182,910	1,129,176	93,899	579,675	49,592	306,149
16	27,814	677,067	704,881	1,149,676	444,795	153,403	250,203	75,327	122,860	38,126	62,184
17	27,186	716,047	743,233	1,222,012	478,779	147,045	241,769	69,066	113,557	33,500	55,080
18	26,925	743,073	769,998	1,294,976	524,978	138,491	232,913	62,220	104,641	28,922	48,641
19	29,717	678,618	708,335	1,299,573	591,238	115,818	212,491	49,771	91,315	22,171	40,678
20	31,242	679,767	711,009	1,031,829	320,820	105,687	153,375	43,443	63,045	18,546	26,914
21	26,887	689,963	716,850	719,180	2,330	96,868	97,183	38,087	38,211	15,582	15,633
22	28,225	694,732	722,957	469,530	-253,427	88,812	57,680	33,401	21,693	13,096	8,505
23	28,473	737,892	766,365	632,509	-133,856	85,586	70,637	30,788	25,411	11,568	9,548
24	28,742	857,022	885,764	1,017,421	131,657	89,928	103,294	30,944	35,543	11,142	12,798
25	34,163	878,768	912,931	1,634,514	721,583	84,260	150,859	27,733	49,653	9,570	17,134
26	27,101	872,459	899,560	1,471,671	572,111	75,478	123,481	23,762	38,875	7,858	12,856
27	53,448	910,959	964,407	2,371,709	1,407,302	73,563	180,908	22,152	54,478	7,020	17,265
28	80,813	943,105	1,023,918	3,115,454	2,091,536	71,002	216,036	20,452	62,227	6,211	18,899
29	132,854	1,017,723	1,150,577	4,475,785	3,325,208	72,532	282,151	19,984	77,738	5,816	22,626
30	193,404	1,126,736	1,320,140	5,539,807	4,219,667	75,655	317,478	19,938	83,668	5,561	23,338
31	194,182	1,124,567	1,318,749	6,110,535	4,791,786	68,705	318,351	17,319	80,250	4,630	21,452
32	168,968	865,339	1,034,307	5,236,993	4,202,686	48,987	248,037	11,812	59,807	3,026	15,321
33	194,191	884,953	1,079,144	5,141,023	4,061,879	46,464	221,356	10,716	51,053	2,631	12,533
34	167,004	873,276	1,040,280	4,882,212	3,841,932	40,719	191,102	8,983	42,159	2,113	9,919
35	166,301	924,743	1,091,044	5,166,549	4,075,505	38,824	183,847	8,193	38,795	1,847	8,747
36	164,622	874,387	1,039,009	4,007,881	2,968,872	33,611	129,652	6,784	26,169	1,466	5,654
37	52,720	911,099	963,819	2,863,429	1,899,610	28,344	84,209	5,472	16,258	1,133	3,367
38	28,455	1,174,185	1,202,640	5,743,427	4,540,787	32,152	153,550	5,938	28,357	1,178	5,627
39	28,878	1,722,916	1,751,794	11,793,273	10,041,479	42,576	286,629	7,521	50,631	1,430	9,629
40	34,089	2,041,834	2,075,923	15,667,530	13,591,607	45,867	346,173	7,750	58,491	1,412	10,660
41	27,101	2,305,625	2,332,726	19,209,026	16,876,300	46,856	385,838	7,573	62,358	1,323	10,891
42	27,624	2,271,450	2,299,074	19,631,559	17,332,485	41,982	358,478	6,490	55,417	1,086	9,276
43	28,135	2,202,788	2,230,923	19,278,732	17,047,809	37,034	320,032	5,476	47,323	878	7,591
44	28,740	2,056,256	2,084,996	18,310,795	16,225,799	31,465	276,331	4,450	39,084	684	6,008
45	30,077	2,258,425	2,288,502	20,754,416	18,465,914	31,396	284,734	4,248	38,522	626	5,675
46	27,814	1,861,497	1,889,311	16,909,675	15,020,364	23,564	210,898	3,049	27,292	430	3,853
Total	19,669,833	45,429,225	65,099,058	257,283,769	192,184,711	16,353,112	25,369,166	11,889,728	13,919,486	9,398,750	8,798,996
								FIRR=	19.3 %		

B/C Ratio=	10 %	1.55
B/C Ratio=	15 %	1.17
B/C Ratio=	20 %	0.94

Table VIII-1-6 Calculation of FIRR for Private Company

(Single interest=0%)

(unit:thousand Cedis)

Project Year	Capital Cost	O & M Cost	Total	Benefit	Return	Present Value by Discount Rate					
						Interest= 0.010		Interest= 0.050		Interest= 0.10	
						Cost	Benefit	Cost	Benefit	Cost	Benefit
1	159,866	35,576	195,442	0	-195,442	195442	0	195442	0	195442	0
2	613,456	9,788	623,244	0	-623,244	610964	0	565301	0	515078	0
3	858,708	29,614	888,322	0	-888,322	862197	0	767366	0	667409	0
4	975,333	78,813	1,054,146	0	-1,054,146	1013014	0	867249	0	719996	0
5	1,272,061	163,144	1,435,205	0	-1,435,205	1365548	0	1124521	0	891149	0
6	1,242,333	259,233	1,501,566	0	-1,501,566	1414543	0	1120492	0	847595	0
7	909,453	376,560	1,286,013	906	-1,285,107	1199488	845	913945	644	659928	465
8	1,038,294	522,707	1,561,001	2,531	-1,558,470	1441558	2337	1056547	1713	728218	1181
9	979,010	611,233	1,590,243	1,045	-1,589,198	1454023	955	1025085	674	674418	443
10	991,555	714,400	1,705,955	5,433	-1,700,522	1544379	4918	1047308	3335	657720	2095
11	570,893	814,339	1,385,232	11,125	-1,374,107	1241616	9972	809916	6505	485515	3899
12	112,358	827,217	939,575	18,100	-921,475	833825	16063	523191	10079	299378	5767
13	18,400	777,851	796,251	27,225	-769,026	699636	23922	422269	14438	230646	7886
14	18,400	639,028	657,428	60,108	-597,320	571938	52292	332046	30359	173121	15828
15	18,400	522,445	540,845	71,327	-469,518	465857	61437	260156	34310	129474	17075
16	18,400	469,764	488,164	88,247	-399,917	416317	75259	223634	40427	106239	19205
17	18,400	507,202	525,602	122,434	-403,168	443806	103381	229318	53418	103988	24223
18	18,400	525,021	543,421	161,763	-381,658	454309	135237	225803	67216	97739	29094
19	18,400	463,805	482,205	161,421	-320,784	399140	133615	190825	63880	78844	26394
20	18,400	469,126	487,526	210,157	-277,369	399549	172233	183743	79206	72468	31238
21	18,400	475,206	493,606	217,367	-276,239	400527	176378	177176	78022	66701	29373
22	18,400	483,577	501,977	264,488	-237,489	403286	212489	171601	90415	61666	32491
23	18,400	528,948	547,348	439,487	-107,861	435383	349586	178201	143084	61127	49081
24	18,400	652,606	671,006	804,805	133,799	528462	633837	208057	249544	68124	81708
25	18,400	681,118	699,518	1,243,986	544,468	545462	970021	206570	367353	64563	114815
26	18,400	674,852	693,252	1,031,743	338,491	535224	796555	194971	290168	58168	86569
27	37,345	713,157	750,502	1,548,375	797,873	573687	1183584	201021	414730	57247	118106
28	56,612	745,234	801,846	2,067,339	1,265,493	606866	1564636	204546	527365	55603	143356
29	96,549	818,217	914,766	3,240,296	2,325,530	685473	2428090	222239	787218	57666	204266
30	135,030	925,650	1,060,680	3,986,101	2,925,421	786943	2957380	245417	922294	60786	228438
31	139,091	920,011	1,059,102	4,622,311	3,563,209	777992	3395444	233383	1018570	55178	240816
32	133,841	659,018	792,859	4,010,919	3,218,060	576650	2917158	166394	841756	37552	189967
33	152,399	677,667	830,066	3,633,880	2,803,814	597733	2616768	165907	726313	35740	156463
34	127,573	668,088	795,661	3,584,529	2,788,868	567285	2555674	151458	682332	31144	140307
35	136,777	717,769	854,546	4,213,288	3,358,742	603236	2974220	154921	763828	30408	149926
36	133,782	669,635	803,417	3,208,499	2,405,082	561528	2242500	138716	553971	25990	103792
37	34,210	705,791	740,001	2,096,212	1,356,211	512084	1450589	121683	344692	21762	61646
38	18,400	971,577	989,977	4,749,106	3,759,129	678286	3253866	155036	743735	26467	126967
39	18,400	1,525,049	1,543,449	10,097,920	8,554,471	1047029	6850123	230202	1506084	37513	245424
40	18,400	1,851,929	1,870,329	12,715,287	10,844,958	1256212	8540262	265672	1806152	41325	280943
41	18,400	2,126,925	2,145,325	16,696,232	14,550,907	1426648	11103046	290223	2258693	43092	335365
42	18,400	2,101,573	2,119,973	17,905,770	15,785,797	1395830	11789498	273137	2306973	38711	326964
43	18,400	2,035,611	2,054,011	16,349,064	14,295,053	1339010	10657954	252036	2006102	34097	271398
44	18,400	1,898,677	1,917,077	16,177,788	14,260,711	1237369	10441880	224032	1890558	28931	244141
45	18,400	2,108,459	2,126,859	19,029,001	16,902,142	1359180	12160577	236712	2117861	29179	261063
46	18,400	1,714,370	1,732,770	14,580,393	12,847,623	1096371	9225418	183668	1545473	21611	181847
Total	11,329,729	36,867,580	48,197,309	169,456,008	121,258,699	37,560,904	114,239,996	17,337,134	25,389,489	9,484,714	4,590,030
								FIRR=	6.8 %		
							B/C Ratio=	1 %	3.04		
							B/C Ratio=	5 %	1.46		
							B/C Ratio=	10 %	0.48		

Table VIII-1-7 Financial Analysis for Typical Farm (with Taungya)

Farm Size=2.5 ha/household

	Agriculture(type B) Net Income(Cedis/ha)			Annual	NPV by Discount Rate(Cedis)			
	0.3	0.23	Forestry	Income				
Year	Maize	Yam	Incentive	(Cedis/household)	15%	20%	25%	30%
1	383,625	2,031,188	0	2,414,813	2,099,837	2,012,344	1,931,850	1,857,548
2	383,625	2,031,188	0	2,414,813	1,825,945	1,676,953	1,545,480	1,428,883
3	383,625	2,031,188	0	2,414,813	1,587,778	1,397,461	1,236,384	1,099,141
4	383,625	2,031,188	0	2,414,813	1,380,677	1,164,551	989,107	845,493
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0
22	0	0	9,547	9,547	441	173	70	30
23	0	0	15,379	15,379	618	232	91	37
24	0	0	28,469	28,469	995	358	134	52
25	0	0	64,900	64,900	1,972	680	245	92
26	0	0	38,275	38,275	1,011	334	116	42
27	0	0	76,479	76,479	1,757	557	185	64
28	0	0	131,904	131,904	2,635	800	255	85
29	0	0	196,061	196,061	3,405	991	303	97
30	0	0	325,591	325,591	4,917	1,372	403	124
31	0	0	260,139	260,139	3,416	913	258	76
32	0	0	109,026	109,026	1,245	319	86	25
33	0	0	229,220	229,220	2,276	559	145	40
34	0	0	128,172	128,172	1,107	260	65	17
35	0	0	79,243	79,243	595	134	32	8
36	0	0	151,040	151,040	986	213	49	12
37	0	0	260,677	260,677	1,480	306	68	16
38	0	0	419,914	419,914	2,073	411	87	20
39	0	0	777,312	777,312	3,337	635	129	28
40	0	0	1,387,131	1,387,131	5,178	944	184	38
41	0	0	1,050,551	1,050,551	3,410	596	112	22
42	0	0	492,444	492,444	1,390	233	42	8
43	0	0	1,033,112	1,033,112	2,536	407	70	13
44	0	0	597,721	597,721	1,276	196	33	6
45	0	0	373,490	373,490	693	102	16	3
46	0	0	680,150	680,150	1,098	155	24	4
Total			8,915,945		6,944,086	6,263,189	5,706,025	5,232,024
			Average per year(Cedis/household)		150,958	136,156	124,044	113,740

Note. Numer of beneficiaries=2,000 farm households

Table VIII-1-8 Financial Analysis for Typical Farm Green Fire Belt

Farm Size=2.0 ha/household

	Agriculture(type B)								
	Net Income(Cedis/ha)				Annual				
	0.15	0.06	0.34	0.25/0.125	Income	NPV by Discount Rate(Cedis)			
Year	Maize	Yam	Cashew	Maize	(Cedis/household)	15%	20%	25%	30%
1	153,450	423,900	0	255,750	833,100	724,435	694,250	666,480	640,846
2	153,450	423,900	0	255,750	833,100	629,943	578,542	533,184	492,959
3	153,450	423,900	0	255,750	833,100	547,777	482,118	426,547	379,199
4	153,450	423,900	0	255,750	833,100	476,328	401,765	341,238	291,691
5	0	0	936,641	255,750	1,192,391	592,829	479,195	390,723	321,146
6	0	0	1,873,282	127,875	2,001,157	865,155	670,183	524,591	414,592
7	0	0	3,244,792	127,875	3,372,667	1,267,910	941,249	707,300	537,490
8	0	0	4,348,690	127,875	4,476,565	1,463,397	1,041,106	751,043	548,780
9	0	0	6,021,264	127,875	6,149,139	1,747,969	1,191,744	825,323	579,861
10	0	0	7,359,322	127,875	7,487,197	1,850,721	1,209,224	803,932	543,107
11	0	0	8,630,478	255,750	8,886,228	1,910,034	1,195,980	763,321	495,839
12	0	0	10,035,439	255,750	10,291,189	1,923,497	1,154,225	707,205	441,718
13	0	0	11,975,624	255,750	12,231,374	1,987,940	1,143,192	672,427	403,842
14	0	0	13,380,586	255,750	13,636,336	1,927,205	1,062,087	599,732	346,331
15	0	0	15,053,159	255,750	15,308,909	1,881,380	993,632	538,634	299,085
16	153,450	423,900	0	255,750	833,100	89,029	45,061	23,450	12,520
17	153,450	423,900	0	255,750	833,100	77,417	37,551	18,760	9,631
18	153,450	423,900	0	255,750	833,100	67,319	31,292	15,008	7,408
19	153,450	423,900	0	255,750	833,100	58,538	26,077	12,006	5,699
20	0	0	936,641	255,750	1,192,391	72,855	31,102	13,747	6,274
21	0	0	1,873,282	127,875	2,001,157	106,323	43,499	18,457	8,100
22	0	0	3,244,792	127,875	3,372,667	155,819	61,092	24,886	10,501
23	0	0	4,348,690	127,875	4,476,565	179,843	67,573	26,425	10,721
24	0	0	6,021,264	127,875	6,149,139	214,816	77,351	29,038	11,329
25	0	0	7,359,322	127,875	7,487,197	227,443	78,485	28,286	10,610
26	0	0	8,630,478	255,750	8,886,228	234,733	77,626	26,857	9,687
27	0	0	10,035,439	255,750	10,291,189	236,387	74,916	24,883	8,630
28	0	0	11,975,624	255,750	12,231,374	244,307	74,199	23,659	7,890
29	0	0	13,380,586	255,750	13,636,336	236,843	68,935	21,101	6,766
30	0	0	15,053,159	255,750	15,308,909	231,211	64,492	18,952	5,843
31	153,450	423,900	0	255,750	833,100	10,941	2,925	825	245
32	153,450	423,900	0	255,750	833,100	9,514	2,437	660	188
33	153,450	423,900	0	255,750	833,100	8,273	2,031	528	145
34	153,450	423,900	0	255,750	833,100	7,194	1,693	422	111
35	0	0	936,641	255,750	1,192,391	8,954	2,019	484	123
36	0	0	1,873,282	127,875	2,001,157	13,066	2,823	649	158
37	0	0	3,244,792	127,875	3,372,667	19,149	3,965	876	205
38	0	0	4,348,690	127,875	4,476,565	22,102	4,386	930	209
39	0	0	6,021,264	127,875	6,149,139	26,400	5,020	1,022	221
40	0	0	7,359,322	127,875	7,487,197	27,952	5,094	995	207
41	0	0	8,630,478	255,750	8,886,228	28,847	5,038	945	189
42	0	0	10,035,439	255,750	10,291,189	29,051	4,862	875	169
43	0	0	11,975,624	255,750	12,231,374	30,024	4,816	832	154
44	0	0	13,380,586	255,750	13,636,336	29,107	4,474	742	132
45	0	0	15,053,159	255,750	15,308,909	28,415	4,186	667	114
46	0	0	0	255,750	255,750	413	58	9	1
Total						22,528,805	14,153,572	9,588,657	6,870,666
			Average per/household(Cedis)			489,757	307,686	208,449	149,362

Note. Number of Beneficiaries=150 farm households

VIII.2 Qualitative Analysis of the Project

VIII.2.1 Technical Adequacy

(1) Selection of Trees Candidates

Teak as the major tree is planned to plant in the industrial forest. Teak is considered the species which has higher demand for timber production and telegraph poles in connection with the National Electrification Program (NEP). However, it will be appropriate to plant native species such as ofram in addition to teak with some percentage (20%) taking into consideration risks from mono-culture and farmer's intention to teak plantation.

(2) Land Preparation

It is considered appropriate for afforestation to use tractors for efficient and better land preparation for about 12,000 ha than land preparation by man labor which needs 26 man.days per hectare.

(3) Predicted Yields

It is appropriate to use standard timber yield of forestry department. Since this project does not involve irrigation plan, it is reasonable to set up crop yield as current level and to take into consideration the intercropping under agroforestry system.

(4) Establishment of Nursery and Method of Nursing Seedlings

It is efficient to make village nurseries based on the accessibility to the forest reserves and the settlements in considering encourage and enlighten farmer's recognition to afforestation. And for the community woodlots, it is appropriate that seeds will be collected and managed by farmers themselves and nurseries will be also managed under the proper leadership of FD. While, nursery for the industrial forest will be managed by FD or private companies to supply seedlings for the afforestation.

(5) Construction of Green Firebelts

Bush fire might be broken out at considerable probability if any countermeasures will not be provided and its damage is predicted to affect broad areas if it once occurs. Therefore, measures to prevent bush fire is indispensable for the forestry project. It is adequate to construct green firebelt having 40m width according to the FD's standard to check the spread of the bushfire. The green firebelts will be planned to make by manual labor of the local people. Some fruit trees such as avocado, mangoes, cashew, plantain and citrus will be introduced in the green firebelt in addition to cassia which has a tolerance to fire. Thus, since green firebelts is

adequately planned taking into consideration forest preservation, peoples intention, land condition, the plan is appropriate from technical and social point of views.

(6) Construction of Forest Roads and Fire Belts

Since forest roads is indispensable infrastructure for the forestry project not only for felling trees and its hauling but also for preventing bush fires, it is proper to construct forest roads in the areas.

VIII.2.2 Social Adequacy

It must be taken into consideration that some thousands of people are existing in and periphery of the forest reserves, who are living on the traditional method of life and land use in the forests. Forest reserves are the place for producing food crops for the local people. Also some of them are living on collecting and selling NTFPs. Natural resources such as NTFPs from forests have a irreplaceable worth for their daily life. Fuelwoods are collecting mainly by female, and currently distance to collect fuelwood is apt to become a long way from their villages. Social adequacy of the project implementation can be explained if taking into consideration these current status of the people.

If considering the project from national economic point of view, the project can be verified by examining current socio-economy of Ghana and effects which might be caused when the existing forests will be lost. If existing forest resources which is predicted being exhausted within 15 years would be disappeared, following issues might be caused:

① Effects on the government's revenue from exporting forest resources which has earned foreign currency as the third biggest commodity in exporting.

② Soil erosion and degradation.

③ Decline of agricultural production with the issue ②.

④ Rapid progress of savannah in the transitional zones.

⑤ Increase in disaster incidence with heavy rain.

⑥ Causing unemployment in the forestry sector.

⑦ Effects on rural people's life with the decline of NTFPs production.

⑧ Effects on prevention of the greenhouse effect at the global scale.

⑨ Effects on wildlife and vegetation (as a source of genetic factors)

Since forest resources have played an important roles in the production of logs and timbers as well as the contribution to national and regional economy, employment, agricultural production and environment preservation etc., its disappearance will cause serious effect on various matters as mentioned above. It can be said that the implementation of the Project, therefore, will be justified its social adequacy to prevent or restrain these effects to a minimum.

Other than those mentioned above, the Project effects indirectly, though it is difficult to present in terms of money, and some these indirect benefits often have important meaning.

- The implementation of the Project is expected to become a model case of afforestation project in other transition areas not only in three districts in the study area.
- It become a good example for supporting activities such as educational training for farmers, strengthening farmers groups taken into consideration the farmers educational status and their traditional customs.
- Harmony in the rural community will be strengthened through the educational training on forest management and agricultural practices.
- The project will show the appropriate direction for the promotion of afforestation in the transition areas in hard and soft aspects being provided and supported by many agencies concerned.

VIII.2.3 Adequacy of Operation and Management

The targets of this plan consist of the forest restoration, people's participation , bush fire control and environmental conservation.

In order for the forest management plan to be conducted with the organization reform from Forestry Department to Forest Service, it is necessary to introduce private company and to secure understand and cooperation of local people.

The establishment of Forest Management Center and Forest Management Planning Committee is proposed to implement the project at the central level and village level in this plan.

Since supporting service by external consultants and NGO are incorporated into the plan for the implementation of integrated forest management, proposed operation and management system in the plan are concluded to be adequate.

For the promotion of implementation of this plan, Forest Department take into consideration the following points.

1) To clarify the right window for the project in the Forest Service

2) To ask for the understanding of the local governments on the project through the establishment of Forest Management Center.

3) To promote establishment of the Village Forest Management Committee to secure the understanding and cooperation of local people.

4) To be necessary for local people, private company and Forest Service staff to be trained for implementation of the project including bush fire control.

5) To be essential for the reforestation fund of Would Bank to be introduced, which becomes key factor for the introduction of private companies.

6) To be necessary for the land use and profit sharing right to local people in the forest reserve through the local government to be examined.

7) To prioritize the target area in accordance with the contents of the plan and local condition

IX. ENVIRONMENTAL CONSIDERATION

IX. ENVIRONMENTAL CONSIDERATION

IX.1 Approach to Environmental Consideration

IX.1.1 Background of Environmental Consideration

(1) Environmental Policies Related to Forestry and Wildlife

Accordint to the environmental policies[1] in Ghana, the development of forests and forestry must take into consideration such natural environmental factors as the micro-climate, water and soil resources and the genetic resources of flora and fauna and such social environmental aspects as food production, socio-economic conditions of local communities and the national economy.

Particularly it is important to prevent development activities which cause irreversible as well as grave damage to the ecological balance and also to prevent the degradation and/or extinction of such environmental factors as flora, fauna and landscape, etc. because of its concern in regard to both a qualitative and quantitative deterioration of forest and wildlife resources.

(2) Required Environmental Consideration in Intensive Study Area

① Environmental Improvement

Forests in the transitional zone play important functions for public interests, including the protection of farmland from the harmattan. Accordingly, the Forest Management Plan for the Intensive Study Area is expected to develop an approach of improving the environment, including the restoration of deteriorated forest functions.

The Intensive Study Area in particular is adjacent to the frequent bushfire area. Given its objectives, the Forest Management Plan incorporates bushfire control measures and the plan is expected to have positive effects in terms of bushfire control.[2] In this background, the Forestry Department and the JICA Study Team have already agreed that the environment of the subject area should be given proper consideration at the plan formulation stage (see Table IX-1-1).

[1] Environmental Protection Council (1994). Ghana Environmental Action Plan (Volume 2)

[2] The Ministry of Food and Agriculture and the University of Cape Coast have been playing a central role in the introduction of bushfire control measures, including the hosting of a symposium, from the viewpoint of regarding bushfires as an environmental issue.

Table IX-1-1 Settled Matters on Environmental Consideration in Forest Management Plan for Intensive Study Area

Date of Settlement	Occasion	Outline of Settlement	Reference Document	Item
16 Oct., 1997	Explanation of and discussions on IC/R	1. FD suggested that the study team should consider information provided by the Environmental Protection Agency (EPA) in conducting the Initial Environmental Examination (IEE). 2. The FD and JICA Study Team agree on the importance of environmental consideration in the formulation of the Forest Management Plan.	M/M (16 Oct., 1997)	2
5 Feb., 1998	Explanation of and discussions on FL/R (1)	3. The EPA advised the Study Team not to conduct Environmental Impact Assessment (EIA) but rather conduct the environmental survey in the formulation process of the Forest Management Plan.	M (5 Feb., 1998)	5
19 June, 1998	Explanation of and discussions on P/R	4. Based on the results of IEE and the advice provided by the EPA, the Study Team will conduct an environmental survey instead of an EIA	P/R M/M (19 June, 1998)	Chapter VI

Note: IC/R : Inception Report
FL/R (1) : Field Report No. 1
P/R : Progress Report
M/M : Minutes of Meeting
M : Memorandum

② Nature Conservation

The transitional zone has a unique ecosystem showing the characteristics of savanna and tropical rain forest, both of which are important for the conservation of wildlife. The vegetation is next to sub-Saharan savanna vegetation[3] which is said to have many species which have adapted to the particular micro-living environment. As the environmental factors to maintain the sustainable population level by individual wildlife species in such a dry environment as savanna vegetation are severe, the number of individuals per unit area of specific animal species is rather low, making the population more susceptible to minor environmental changes. Consequently, the formulation of any project plan must take the living environment of wildlife into proper consideration.

[3] Worldwatch Institute (1998). State of the World 1998. W.W. Norton & Company

IX.1.2 Environmental Consideration in the First Phase

(1) Initial Environmental Examination

① In order to examine a suitable approach to environmental consideration for the subject area, an initial environmental examination (IEE)[4] was conducted prior to the environmental consideration at the plan formulation stage. As a detailed field survey and the proposal of basic items of the project plan were expected to be conducted during the Phase II period, this IEE mainly examined various legal conditions and brief characteristics of the natural and social environments of the subject area of the work plan (i.e. Intensive Study Area) and its vicinity.

And then important environmental issues which may arise in the Intensive Study Area based on the basic concept for forest management[5] established in the Phase I period were generally predicted using the brief characteristics of the subject area.

② Results of the Examination

The existing information obtained did not provide sufficient data on the flora and fauna in the Intensive Study Area and a general prediction of the type and degree of impacts was not possible in regard to such factors as "impacts on rare species and indigenous flora and fauna". In regard to those factors for which prediction was possible, negative impacts were predicted for the construction of infrastructure and some forest management activities such as felling. However, the predicted impacts of a minor or medium degree will only occur in a sporadic or linear manner and such negative impacts are believed to be preventable to a certain extent by means of appropriate consideration at the plan formulation stage. This led to the judgement that it will be important to formulate sufficient environmental measures prior to the application of the EIA system which will be required to obtain an environmental permit (EP), i.e. a type of work permit.

(2) Interviews at Environmental Protection Agency (EPA)

An interview was conducted at the Natural Resources Division and Environmental Assessment and Monitoring Division of the EPA in February, 1998 as regards to the application of the EIA system to the Forest Management Plan for the Intensive Study Area. The EPA side made the comment that it will be preferable for the Forestry Department and the JICA Study Team to conduct an environmental survey.

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[4] Initial Environmental Examination: a baseline survey to be completed in a short period of time using existing information, etc. to examine the environmental issues to be considered by the project plan for a development project.

[5] See Chapter V of the Progress Report

According to the Draft Sector Specific Environmental Impact Assessment Guidelines for Forest and Wood Industries (see Table IX-1-2), it is necessary to enlist local experts and NGO staff to confirm the existing wildlife species with particular attention paid to the possible impacts of the harvesting plan. If endangered species are found, planning should pay particular attention to their habitat (including areas of migration).

Table IX-1-2 Summary of Interview Survey at EPA[1)]

Summary of Comments by EPA
1. The FD-JICA Study Team is not at the stage of conducting an EIA. ⇒ As the study and plan formulation stage does not involve actual project implementation activities, the FD-JICA Study Team cannot conduct an EIA at this stage.
2. It is preferable for the FD-JICA Study Team to conduct an environmental survey. ⇒ At the study and plan formulation stage, it is preferable for an environmental survey or strategic environmental assessment [2)] to be conducted. ⇒ At present, the EPA has no statutory regulations, on environmental studies or strategic environmental assessment. ⇒ An environmental survey is preferable to strategic environmental assessment.
3. The EPA is currently preparing EIA Guidelines for the forestry sector. ⇒ The preparation of EIA Guidelines for Forest and Wood Industries (Draft) [3)] is currently in progress. These guidelines are scheduled to become official.

Notes:
1) Results of the interview with the Assistant Director of the Natural Resources Division and acting head of the Environmental Assessment and Monitoring Division of the EPA (3rd February 1998)
2) Strategic environmental assessment: this is assessment from the environmental point of view when making macroscopic decisions, such as basic policies. The assessment subject include government policies, legal framework, institutional arrangements and capacity building of related people, etc. to ensure sustainability of the environment.
3) Environmental Protection Agency (1997). Draft Sector Specific Environmental Impact Guidelines for Forest and Wood Industries

IX.1.3 Environmental Consideration Procedure at Plan Formulation Stage

Based on the IEE results, it was decided to conduct environmental consideration at the plan formulation stage in accordance with the procedure shown in Fig. IX-1-1.

a) To reveal the current status of the environment of the subject area, mainly focusing on flora and fauna

b) To identify current environmental problems which can be incorporated in the Forest Management Plan and their causes in view of preparing remedial measures

c) To identify adverse environmental impacts expected by proposed activities in the Forest Management Plan and to prepare measures to minimize and mitigate such adverse impacts.

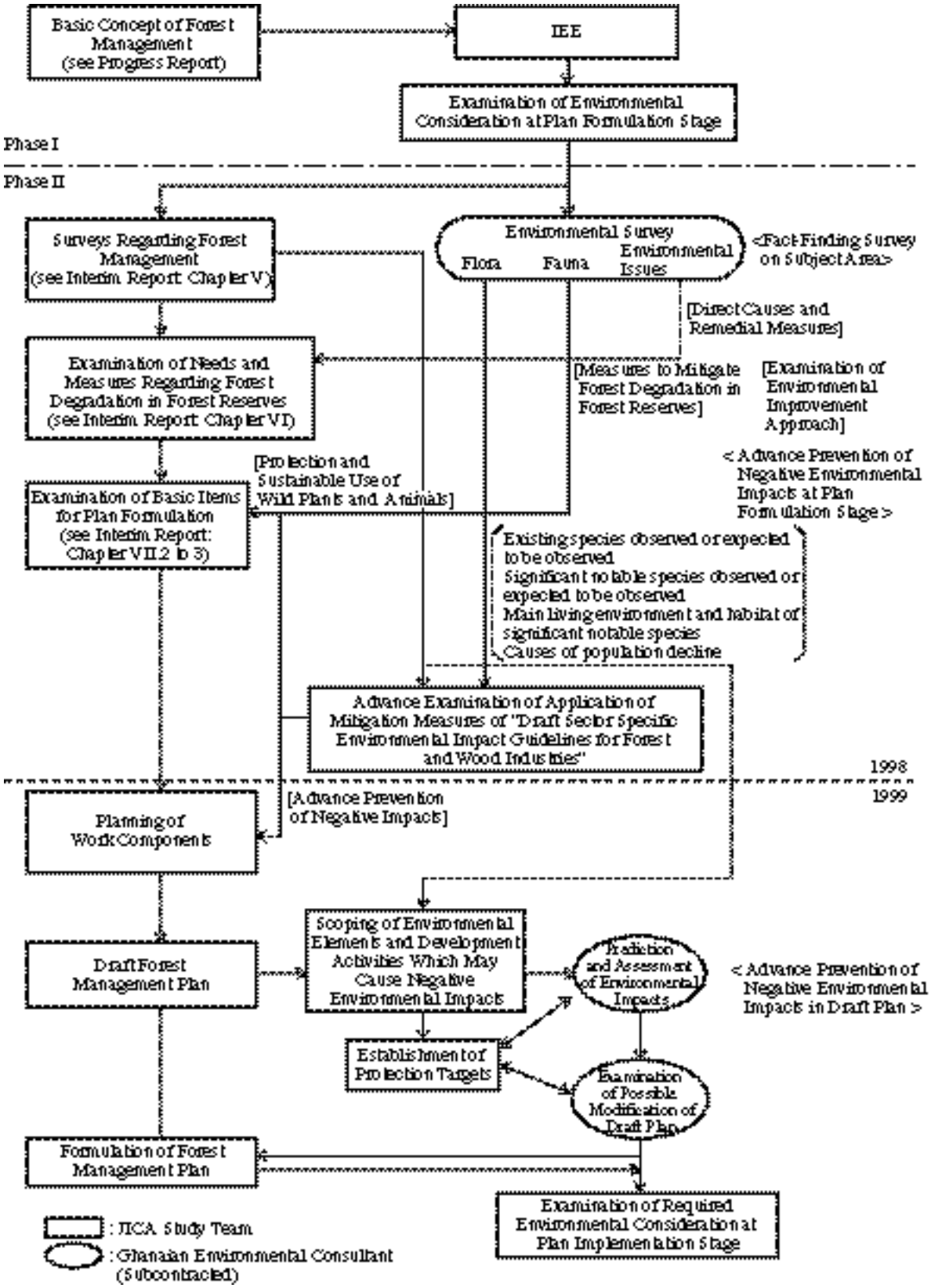

Fig. IX-1-1 Procedure of Environmental Consideration in Forest Management Plan for Intensive Study Area

IX.2 Environmental Survey

The survey was conducted by the subcontracted NGO[6] recommended by the Environmental Protection Agency. The cooperation of Ghanaian experts on flora and fauna was obtained in the course of the survey.

IX.2.1 Wild Flora

(1) Flora

The survey identified 231 taxa (hereinafter simply referred to as "kind") (or some 244 kinds including those of which the generic or species name is unclear) which exist or are expected to exist in the Intensive Study Area (hereinafter referred to as "the plants of the Intensive Study Area"). As shown in Table IX-2-1, 43 families were clearly identified among the plants of the Intensive Study Area and many species belong to *Leguminosae*, *Sterculiaceae*, *Meliaceae* and *Euphorbiaceae*. As 20 kinds are considered to be cultivated plants, wild plants in the Intensive Study Area is assumed to consist of 211 kinds with 38 clearly established families.

Table IX-2-1 Summary Table of Flora Lists in and around the Intensive Study Area

Spermatophyta			All		Cultivated species		Wild species	
			Families	Species (Taxa)	Families	Species (Taxa)	Families	Species (Taxa)
Gymnospermae			0	0	0	0	0	0
Angiospermae	Dicotyledoneae	Archichlamydeae	25	129	8	9	23	120
		Metacglkantdeae	10	40	3	4	9	36
		Sub-total	35	169	11	13	32	156
	Monocoty-ledoneae		8	17	5	7	6	10
		Total	43	186	16	20	38	166
Unknown			-	45	-	0	-	45
Ground total			43	231	16	20	38	211

Indicator plants of the moist semi-deciduous forest zone, dry semi-deciduous forest zone and savanna zone are observed, indicating the local existence of diverse flora. 9 kinds of indicators of the moist semi-deciduous forest zone are observed. In most forest reserves, more than one kind of indicators of the moist semi-deciduous forest zone is observed. 11 kinds of indicator plants of the dry semi-deciduous forest zone are also confirmed.

[6] Friends of the Earth-Ghana (P.O. Box 3797, Accra, Ghana; Tel 021-225963, Fax. 021-227993)

5 kinds of indicator plants of the savanna zone are observed while such 11 kinds of characteristic species of the seral stage to the savanna zone are observed. In general, more than one indicator or characteristic species of the savanna zone or seral stage to the savanna zone are observed in all of the forest reserves. This tendency implies the existence of site conditions which are characteristics of the savanna zone in these forest reserves.

(2) Significant Notable Plants

Of the plants in the Intensive Study Area, 68 kinds are considered to be significant notable plants (hereinafter simply referred to as "significant notable plants"). There are two rare species facing possible extinction because of the small population in Ghana. One of these, i.e. *Balanhites wilsoniana* of *Simaroubaceae,* is observed at the boundary of the Intensive Study Area in the Tain II FR as shown in Fig. IX-2-1 while another such species, i.e. *Telfairea occidentalis* of *Cucurbitaceae,* is observed in the village of Chiraa. Protective measures will be required vis-a-vis these species when planning forest management activities, including facility layout and felling.

Of the species of which protection is deemed necessary according to the interview survey results at the Forestry Research Institute (January, 1998) due to a population decline, *Pericopsis elata* of *Leguminosae* and *Khaya grandifolia* of *Meliaceae* are not observed while *Entandrophragma spp.* of *Meliaceae* is observed (Sawsaw FR and Nsemere FR). Of the plants belonging to *Meliaceae* and *Leguminosae,* both of which are considered important by the Forestry Department,[7] *Khaya anthotheca* (Sawsaw FR and Tain I FR) and *Pericopsis elata* (Tain II FR) are observed.

From the viewpoint of plant usage by local people, most kinds found in the Intensive Study Area can be used for small-scale purposes due to their medicinal effects and others. *Mansonia altissima* of *Sterculiaceae* and *Anogeissus leiocarus* of *Combretaceae* are considered to be particularly important.

Meanwhile, from the viewpoint of use and the conservation of plant resources, many significant notable plants have marketing potential. *Lippia multiflora,*[8] of *Verbenaceae* and *Rauvolfia vomitoria* as well as *Voacanga africana*[9] of *Apocynaceae* have strong marketing potential, making their conservation and sustainable use under suitable forest management and market development desirable.

[7] W.D. Hawthorne & M. Abu-Juam. (1995). Forest Protection Ghana. IUCN/ODA/Forestry Department, Republic of Ghana
[8] For beverages: effective for hypertension
[9] Useful as tranquillizers and hypertensive drugs because these species contain alkaloids.

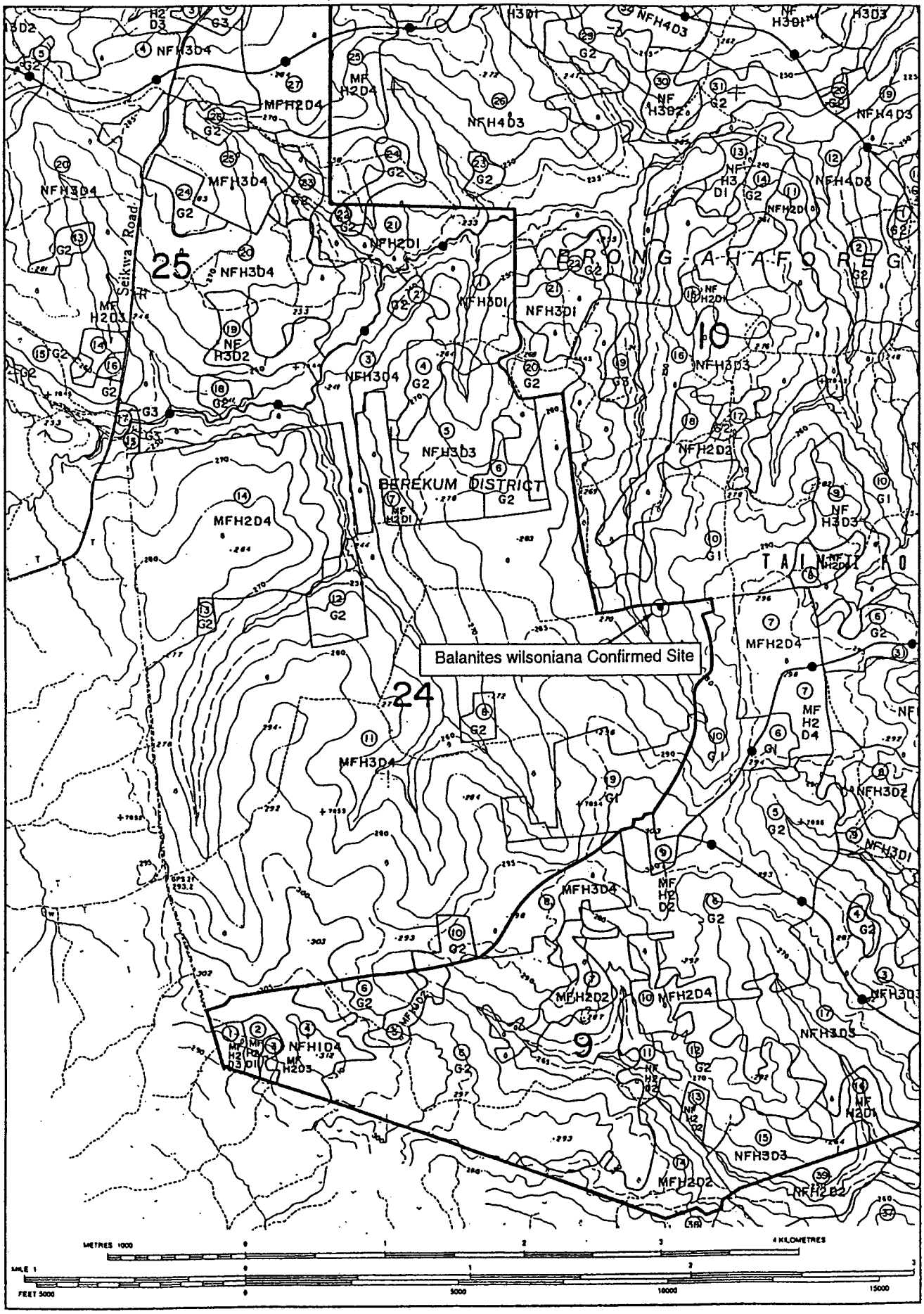

Fig. IX-2-1 Observed Location of Rare Plants in Intensive Study Area

The population of plants requiring protection mentioned earlier is assumed to have declined due to a number of factors, including collection and felling due to their high use value, removal for the felling and logging in natural forests and removal of the remaining vegetation to clear the ground for teak plantations. In the case of these plants, adequate forest product management for sustainable use, conservation of the remaining vegetation at the time of man-made forest establishment and review of the collection/felling method at the time of felling in natural forests or the collection of NTFPs will be necessary.

(3) Environmental Characteristics Regarding Flora

As the Intensive Study Area is situated in the transitional zone from the high forest zone to the savanna zone, indicators of these three zones in terms of vegetation and forest zones apparently exist in this area, reflecting various environmental gradients, including the micro-climate. The significant notable plants tend to appear in natural and man-made forests on the basis of the survey result. The moist semi-deciduous forest zone in particular is believed to be the main distribution area of important species of *Meliaceae* and *Leguminosae*.[2] Natural forests where indicators and important species of this particular forest zone are likely to appear are important as they represent the northern limit of the environmental conditions of the moist semi-deciduous forest zone.

The number of species observed in natural forests ranges 26 - 35 kinds. Compared to the maximum of 141 - 153 species per survey site of another vegetation survey[2] on forest reserves in the Study Area, the number of species observed by the latest survey is extremely low. As far as the results of the latest survey are concerned, many large gaps in the vegetation cover appear to exist in these forest reserves, especially in the Nsemere FR, and the diversity of species has begun to decline. The phenomena shows the habitats in the natural forests of Intensive Study Area have probably been deteriorating. Accordingly, the urgent introduction of protective measures for those stands with a high crown density and minor degree of degradation in the remaining natural forests is believed to be necessary.

IX.2.2 Wild Fauna

(1) Fauna

The survey identified 201 kinds of Tetrapoda which exist or which are expected to exist in the Intensive Study Area (hereinafter referred to as "the animals of the Intensive Study Area"). As

shown in Table IX-2-2, all belong to *Mammalia*, *Aves* or *Reptila* and no *Amphia* is found.[10] The numbers of kinds are relatively large.

Many animals of Mammalia in the Intensive Study Area mainly belong to Bovidae, Ceropithecida and Muridae and some species which are mainly found in savanna vegetation. In the case of Aves, many species belong to Nectariniidae, Ploceidae and Muscicapidae. Prominent reptilian families are Colubridae and Viperidae.

Table IX-2-2 Summary Table of Fauna Lists in and around the Intensive Study Area

	All			Protective species (Taxa)		
Tetrapoda	Order	Families	Species (Taxa)	IUCN	CITES	Ghanaian
Mammalia	11	27	89	8	16	54
Aves	12	21	65	0	2	24
Reptila	1	12	48	0	3	2
Amphibia	0	0	0	0	0	0
Total	24	60	202	8	21	80

Species subject to international protection are eight species of *Mammalia* (IUCN) or 16 species of *Mammalia* (CITES), two species of *Aves* (CITES) and three species of *Reptila* (CITES).

(2) Significant Notable Animals

Of the animals found in the Intensive Study Area, 59 kinds (32 taxa of *Mammalia*, 18 taxa of *Aves* and nine taxa of *Reptila*) are considered to be significant notable animals which are likely to appear (hereinafter simply referred to as "Significant Notable Animals"). Many of these are not usually found in areas of savanna vegetation.

In regard to *Mammalia*, many species of *Muridae* are observed, while *Herpestes sanguinea* of *Herpestidae* which is protected by domestic law in Ghana is also observed. The observed kinds of *Aves* belong to *Muscicapidae*, *Nectariniidae* and *Bucerotidae*. *Turtur afer* of *Columbidae* which is protected by domestic law in Ghana is also found. No species subject to international protection is observed in the case of either *Mammalia* or *Aves*.

The most observed species are those which are not usually found in areas of savanna vegetation. However, *Herpestes sanguinea* of *Herpestidae* and *Turtur afer* of *Columbidae*, both of

[10] A frog was observed in the survey or forest management

which are protected by domestic law in Ghana, are species usually found in areas of savanna vegetation.

From the viewpoint of the relationship between local people and the animals of the Intensive Study Area, most kinds of *Mammalia* in the animals of the Intensive Study Area can be used as food or medicine on a minor scale, illustrating the close link between them. Some kinds of Aves are also marketable because of some kind of relationship between Aves and local people exists. In the case of *Reptila*, live specific kinds are hunted and caught for marketing purposes. As far as the significant notable animals, some kinds of Mammalia are hunted and caught for food while some taxa of Reptila are hunted and caught for marketing purposes.

In addition to the economic values mentioned above, some kinds of the significant notable animals have some cultural values. There are totem animals used as clan symbols, ceremonial species used in specific cultural rites or animals having traditional medical values depend on stool. On the contrary, some species are considered tabooed because of some misfortune in the past. In kinds having little probability to exist or being caught for food out of the animals of the Intensive Study Area, some cultural values tend to be recognized by the local inhabitants.

The marketability of *Herpestes sanguinea* of *Herpestidae* and *Turtur afer* of *Columbidae*, the two observed species subject to protection by domestic law in Ghana, is not particularly high and neither of them constitute bushmeat (food), the main hunting objective of local people. The main habitat of these two species is the savanna zone and the Intensive Study Area is believed to be situated at the edge of their habitat. Hunting cannot, therefore, be considered a cause of population decline and the restoration and stabilisation of the living environment in forest reserves, except the Yaya FR of which the site conditions show the seral stage to savanna or the savanna zone, are essential to restore and stabilise their populations.

(3) Environmental Characteristics Regarding Fauna

As in the case of flora, the most significant notable animals live in natural forests which is their primary habitat and also in man-made forests. These forests are mainly located in forest reserves. Except large natural forests in the Tain II FR, most natural forests are divided into small stands. Because of the gaps in vegetation cover described, the living environment for *Mammalia* is inferred to have deteriorated. The conservation of forests and forestation should lead to enlargement of the habitat as well as stabilisation of the living environment of *Mammalia*.

Such naturality or diversity of species of the vegetation in the Intensive Study Area have declined with the deterioration of the inherent characteristics of natural forests due to bushfires and such human activities as felling. Consequently, the diversity of the environment to meet

different forage of various animals is inferred to have equally deteriorated. While the conservation of large natural forests with dense vegetation cover is necessary, monotonous operation with a single species should be avoided as much as possible in regard to the establishment and management of man-made forests. In addition, as proposed mitigation measures in the EPA Guideline [see the footnote 3) in Table IX-1-2], continuous protected tree belts (natural vegetation belts) consisting of indigenous species should be left over or newly established in man-made forests in order to secure habitat linked to natural forests with dense vegetation cover.

(4) Environmental Characteristics Regarding Locally Hunted Animals for Food

The local inhabitants eat various animals[11] locally called bushmeat. These animals play an important role as the source of protein. Such nocturnal kinds as Bovidae, Hystricidae and Muridae are especially believed to be constantly hunted by local people. While kinds of Muridae may damage agricultural crops, kinds protected by domestic law in Ghana may also be hunted as bushmeat. There appear to be wide-ranging modes of hunting, from individual hunting using a gun to group hunting when grassland and shrubland is burned to corner the target animals.

The target species for bushmeat are herbivorous with mainly live outside forest reserves where much grassland, shrubland and farmland are found. The field signs observed by such field surveys on Forest management as the forest survey and soil survey and also by the observation of field signs which was conducted under the environmental survey suggest that many kinds of *Muridae* live on grassland and farmland and in natural forests with a low crown density in forest reserves (field signs of *Bovidae* were found in man-made forests). Grassland, admitted farms and sparse natural forests in the Intensive Study Area accordingly provide important living conditions or hunting grounds for those mammals which are hunted as a NTFPs for bushmeat. Hunting accompanied by burning destroys such living conditions, including the forage and nesting sites of these mammals. Hunting accompanied by burning should, therefore, at least be prohibited in the Intensive Study Area.

[11] Species most preferred and usually hunted : Grasscutter, Giant Rat, Maxwell Duiker, Royal Antelope, Snails
Species most preferred but not usually hunted : Bushtailed Porcupine, Black Duiker, Bay Duiker
Species usually hunted but not most preferred : Mona Monkey, Pels Flying Squirrel

IX.2.3 Examination of Factors and Remedial Measures for Environmental Problems

(1) Causative Factors of Deterioration of Forest Reserves

The direct factors responsible for the deterioration of forest reserves in the Intensive Study Area are follows.

① Inappropriate Farming

Slash and burn cultivation based on Bush-fallow system, short fallow periods, tree cutting for stakes in Yam cultivation and so on.

② Excessive Felling

Inappropriate felling programme, insufficient supervision on felling, illegal felling, collection of fuelwoods and so on.

③ Uncontrolled Bushfires

Increase of combustible materials, insufficient extension and educational activities and so on.

④ Encroachment on Forest Reserves

Illegal farming, failure of Taungya system, spread of new cash crops and so on.

(2) Draft Measures to Combat Causative Factors of Degradation

The measures to mitigate the adverse effects of direct causes of forest reserve degradation based on the examination results in (1) above are summarised below.

① Promotion of Conservation and Sustainable Utilisation of NTFPs with People Participation

② Improvement of Taungya System

③ Rare Species Propagation Work

④ Bushfire Control Measures

⑤ Promotion of Education and Extension

⑥ Support for the Livelihood of the Local People to Facilitate People Participation

IX.3 Environmental Consideration at Plan Formulation Stage

IX.3.1 Application of Environmental Improvement Approach

From the viewpoint of enhancing the positive impacts on the environment, remedial measures against such important factors causing forest reserve degradation as incorporate farming, uncontrolled bushfires and encroachment of forest reserves were introduced when examining the basic issue for the Intensive Study area, based on the environmental survey results (see Chapter VI and VII-2).

IX.3.2 Measures for Protection and Sustainable Use of Wild Plants and Animals

The environmental survey results suggest a need for the establishment of protection or conservation areas in regard to observed sites of the rare plant and natural forests for the conservation and sustainable use of wild plants and animals through forest management. The establishment of such areas is significant in that they correspond to the establishment of fine/medium/large-grained protection areas, protection working circles and fire protection blocks in the forest reserves having more than 4 of the degradation index needed under the wild plant conservation measures proposed by the Forestry Department.[12] The subjects should include the use activities in forest reserves by local people in the Intensive Study Area in addition to the commercial development activities in the forest reserves for the following reasons.

① Traditional social norms which could control the excessive use of forest resources are unclear (see V).

② Most local people are farmers and their knowledge of the flora they collect and use is believed not to be as good as was once the case. It is assumed that the present social situation makes it difficult to hand down traditional knowledge of flora, particularly knowledge of trees, held by local people.

③ The forest survey results (see Ⅳ.1) indicate that the fruit and medicinal trees preferred by local people have declined in natural forests, making their restoration a priority rather than their use or maintenance of the current collecting practice.

[12] W.D. Hawthorne & M. Abu-Juam. (1995). Forest Protection in Ghana. IUCN/ODA/Forestry Department, Republic of Ghana

④ The main habitat and hunting grounds of mammals which are caught for bushmeat, which are the main hunting targets of local people for food, are grassland, shrubland and farmland outside forest reserves. Accordingly, natural forests with a high crown density which are important habitat for wildlife are not particularly important for hunting purposes in the Intensive Study Area.

⑤ Traditional hunting for food is accompanied by burning, leading to the destruction of forest reserves.

(1) Establishment of Population Protection Sites for Significant Notable Plants

The population of *Balanites wilsoniana* of *Simaroubaceae*, which is observed to exist in the subject area, is declining in Ghana and may face extinction without the implementation of appropriate measures. Although the observed site is located on the boundary of the Intensive Study Area, conservation measures must be conducted because this population faces a high risk of being collected or destroyed because of the location along the access roads to the Intensive Study. Tall, old trees are seen near the edges of forests and juveniles are also observed around these trees. Protective facilities will, therefore, be introduced around them. These costs are planned to be covered by the environmental consideration cost for the forest road development component.

(2) Conservation and Sustainable Use of Stands with High Crown Density in Natural Forests

① Establishment and Protection of Conservation Areas

The natural forests focusing on stands with a high crown density, which covers a certain area without fragmentation, are necessary to prohibit felling for commercial and local-use purposes and collection/hunting of NTFPs until further notice. Such prohibition aims at restoring and stabilising the populations of significant notable plants and animals (especially mammals) which are observed or which may be observed in the Intensive Study Area by means of stabilising the forest environment where the degree of degradation (which has important implications on the habitat and living environments) is still low. Restoration of the populations is assumed to require a long period of time. The minimum period will be such time when plantation establishment and forest rehabilitation on grassland and conspicuous degraded stands in the Intensive Study Area will begin to make forests perform their functions after work completion.

In this plan, the natural forests including stands with a low crown density located out of the daily activity range of the local people will be subject of the conservation area because these areas are not at high needs of the local use. While the natural forests located within

the daily activity range of the local people will be the subject of the area described below in order to coordinate sustainable use with conservation of natural forests (see VII.2.2).

② Establishment of Sustainable Use Areas and Management by Local People Participation

In regard to natural forests which are located near settlements, the felling of trees for commercial and local-use purposes will be prohibited in view of the relative ease of implementing mutual monitoring and management by local people. In the case of NTFPs, only hunting accompanied by burning will be prohibited. This measure aims at minimizing the hunting pressure on and securing the living environment, including forage and nesting places, for significant notable wild animals, and ensuring use activities under the sustainable use of forest products other than tree stems. The collection of NTFPs other than tree stems will be controlled by local people. It includes the collection of the unendangered forest resources for local people. The rehabilitation of forest ground vegetation which provides the living environment for wild fauna and which comprises traditionally important plant resources will be attempted using soil seed bank[13] method by transplanting soils from the forest edge in the area referred to in ① above.

The easy-culture NTFPs will be cultivated actively by such methods as transplanting individuals of medicinal and edible plants from the areas described in ① with soils. In this way the alternative NTFPs of the endangered species will be propagated so that local people can use and manage NTFPs in a sustainable manner. It is necessary to establish hunting/collecting rules specifying the season of huting/collection, prohibited areas of hunting/collection and prohibited activities, etc. for local people in the area including outside of forest reserves. And there should be a registration system for hunters/collecter and hunting/collecter groups to control their activities to hunt/collect NTFPs.

In this plan, the designated NTFPs sustainable use right areas by FD will be managed by the local people in the natural forest conservation component.

[13] Soil seed bank: buried seed mass which exist and do not germinate in soils or deposited organic matters on the ground

IX.3.3 Measures to Prevent Negative Environmental Impacts

In conducting environmental consideration for the formulation of the Forest Management Plan for the Intensive Study Area, the key items for environmental consideration were identified based on the results of the rough scoping conducted as part of the initial environmental examination (IEE). Prevention measures were then examined within the framework of the said Forest Management Plan, mainly for those negative environmental impacts of which mitigation is possible based on the results of the environmental survey. Moreover, the items listed in "Chapter 4 - Mitigation Measures" of "Draft Sector Specific Environmental Impact Assessment Guidelines for Forest and Wood Industries (Draft) (see Note 3) of Table IX-1-2)" prepared by the EPA were selected. The scope of their application was examined in the selected items.

IX.3.4 Revision of Draft Plan to Mitigate Negative Environmental Impacts

(1) Scoping of Environmental Impact Factors and Evaluation of Impacts

Based on the current conditions of the environment and the draft forest management plan described in the Interim Report, the types and degrees of environmental impacts which could occur with the implementation of the draft plan were predicted in order to identify the negative impacts for their scoping and evaluation. The check list method was used to identify the negative impacts, referring to the Draft Sector Specific Environmental Impact Guidelines for Forest and Wood Industries currently being prepared by the EPA and various relevant standards overseas[14] (see Table IX-3-1).

(2) Revision of Draft Plan

Following the findings of (1) above, the draft plan was revised to mitigate the negative environmental impacts at the plan finalisation stage based on revisions proposed by the subcontracted consultant (see Table IX-3-2).

[14] Environmental Consideration Guidelines for Development Studies (Forestry) of the JICA and environmental assessment guidelines of the World Bank and the African Development Bank, etc.

Table IX-3-1 Summary on Scoping of Environmental Impact Factors and Evaluation of Impacts

Development Activities	Environmental Factor	Predicted Negative Impact	Evaluation	Remarks
Site Preparation	Soil / Water Quality	• Soil erosion from clearing sites	+++	
		• Soil compaction and puddling by machinery	++	
		• Loss of organic matters and nutrients by removal of vegetation	++	
		• Loss of nutrients by thinning and clear cutting and by whole-tree harvest	+	Whole-tree harvest is not planned.
		• Contamination in and around the subject site by use of fertilizers, pesticides and herbicides	++	Use of fertilizers and pesticides is not planned.
	Atmosphere	• Air pollution from smoke where burning is involved	+	Site preparation by burning is not planned.
Tree Plantation Establishment	Wildlife / Ecosystem	• Increased potential for massive loss by pests or pathogens through uniformed afforestation or introduction of exotic tree species	++	According to a guideline prepared by FD, introduction of exotic tree species is possible up to 90%.
		• Competing with native species and becoming weeds in agriculture fields by spread of plantation species outside of plantation	+	
		• Chemical and biological changes in the soil and alteration of decomposition dynamics by tree plantation of one or a few species	+++	
		• Direct damage of vegetation in harvesting operations by dragging and skidding logs	++	
		• Build-up of organic matters under plantations posing a fire hazard	+++	To reduce the fire hazard weeding, pruning and thinning are planned.
	Soil / Water Quality	• Localized soil erosion and unequal distribution of debris and organic matters over the site by dragging and skidding logs in harvesting	++	
		• In semi-arid zones depletion of soil moisture and lowering of water table in plantation area	++	
		• Increased sedimentation of streams	++	
		• Eutrophication and navigational hazards by increased organic matters entering surface water streams in form of leaf litter and logging debris or logs	+	There are no rivers where boats can navigate.
		• Soil erosion from logging roads	++	
Natural Forest Conservation	Wildlife / Ecosystem	• Loss of habitat and decreased biological diversity by replacement of natural forests by plantations	+++	Natural forests are not planned to convert into tree plantations

Notes) +: Generally possible negative impact, ++: Likely negative impact, +++: Most likely negative impact

Table IX-3-2 Outline of Necessary Planning Consideration to Mitigate Major Negative Environmental Impacts

Negative Impact Items, Environmental Factor	Item	Development Activities	Actor	Reason	Revised Proposal	Measures: Revised Item	Measures: Mitigation Measures	Reference
Wildlife/ Ecosystem	Diversity of Species	Industrial Plantation Planting	Private Company	Proportion of teak, an exotic species, is as high as 80%	- Lowering of teak proportion to approximately 30%	Revised distribution of local species without changing the rate of composition	Establishment of 40 m wide local species belt every 200 m at teak plantation sites	Plantation establishment and management plan
	Damage due to Pests and Diseases	As above	As above	As above	- Relocation of indigenous species to teak plantation sites - Training for early detection of pest and disease damage - Introduction of pest/disease control measures	Revised as proposed Revised as proposed	- As above Training of managerial and field staff members of company - Survival monitoring more than 1 time a year - Transportation of damaged trees outside stand for incineration (no use of chemical agents in view of maintaining water quality) - Improvement cutting and thinning to lower density of infected trees	Extension and education plan Plantation establishment and management plan
	NTFPs	Natural Forest Management-Simplification of NTFPs Permit	Local People	Control of NTFPs quota is difficult - Little data on existing and regeneration quantities - Difficulty of estimating the sustainable yield - Expected non-commitment of village forest management committee without a subsidy - Unsuitability of controlling NTFPs yields regarding medicinal herbs and other essential items for local life from the viewpoint of facilitating participation	-	Change of control regime from that based on the quota to that based on allocated sites	- Designation of natural forests located in activity range of local people as sustainable NTFP use areas; entrustment of management of permitted sites to the committee; registration of NTFPs for cash income with the committee - Subsidy for key personnel of the committee; support for involvement of NGOs assigned to facilitate people's participation to ensure appropriate management	Natural forest conservation and utilisation Operation and management plan
	Bushfire Control	Patrols with Participation	Local People	Non-contribution of bushfire detection and initial fire-fighting to industrial plantation if the participation of local people is limited to the taungya system	- Employment as patrolmen	Revised as proposed together with the introduction of a vigilance system using watchtowers	- Payment of wages to taungya system participants as patrolmen responsible for vigilance at participation sites - Trial vigilance system using watchtowers to establish economical warning system to complement patrols by local people	Bushfire control measures Plantation establishment and management plan
Soil/Water Quality	Soil Degradation	Industrial Plantation-Site Preparation	Private Company	Large-scale removal of ground vegetation by machinery (soil erosion, soil hardening and decline of soil organisms, etc.)	- Restriction of site preparation work to dry seasons - Planting immediately after site preparation	No revision (already responded)	- Establishment of 4 m wide protected belt of existing vegetation at 36 m intervals - Site preparation to be conducted in second half of major dry season, followed by planting in early rainy season - Planting plan to ensure maximum cutting area of 20 ha per site; exclusion of steep slopes from plantation sites	Plantation establishment and management plan [VIII.3.1-(1)]
		Industrial Plantation-Felling	As above	Large-scale removal of vegetation by cutting	- Restriction of felling to dry seasons - Avoidance of felling on steep land	As above		
		Forest Roads	As above	As above (soil erosion, etc.)	- Introduction of drainage facilities - Avoidance of passage through steep land - Regular maintenance work	As above	- Introduction of drainage facilities meeting standards set by Department of Feeder Road and Forestry Department - Avoidance of steep slopes in route selection - Annual maintenance/repair of road surfaces and drainage facilities	Infrastructure plan
General	Monitoring/Assessment	General	Private Company / FD / Local People	Absence of a system to guarantee achievement of the intentions of environmental consideration at the planning stage at the field implementation stage	-	As above	- Guidance on and management of those involved mainly by external consultant - Thorough supervision of environmental conservation through appropriation of environmental consideration cost vis-a-vis private companies of which activities are expected to produce many environmental impacts	Operation and management plan [VIII.3.7-(4)] Environmental management system [VIII.4.1-(1)~X.4.2-(2)]

IX.4 Examination of Environmental Consideration at Implementation Stage

The management of environmental consideration at the implementation stage was planned mainly at the time of tree plantation establishment and under infrastructure construction.

IX.4.1 EIA Procedure for Participating Companies

It is judged that companies participating in industrial plantation need to undergo the EIA procedure in view of the facts that the planned forest establishment project covers a large area with a high proportion of teak, an exotic species, and others and possibly falls in the category of a critical development/project implementing activities vis-a-vis the environment referred to in the EPA's EIA procedure.[15] Consequently, the environmental impact survey cost is accounted for in the present plan in order to prepare the environmental assessment registration forms required by the EIA procedure and the preliminary environmental report or environmental impact statement which may subsequently become necessary depending on the judgement of the EPA.

IX.4.2 Environmental Management System

(1) Planning of Environmental Conservation Measures

The necessary environmental conservation measures will be examined as part of the general implementation plan to be prepared by an external consultant at the preparation period for implementation based on the scoping results of environmental impact factors, the results of the environmental assessment study to be conducted in the near future under the EIA procedure. The main issues for which environmental conservation measures are believed to be necessary according to the results of environmental consideration at the plan formulation stage are listed below.

- Sediment discharge and turbid water control measures at the time of large-scale mechanical work, mainly consisting of site preparation and forest road construction
- Protection of small customary conservation sites and sacred sites which are not registered with the Forestry Department
- Protection of the planned population protection sites for the significant notable plant
- Conservation of wildlife at such mechanical work sites as plantation sites and forest road construction sites

[15] Environmental Protection Agency. (1995). Ghana Environment Impact Procedure

(2) Supervision of Environmental Conservation

At the time of the implementation of development activities which are expected to cause negative impacts (see Table IX-3-1), supervision will be required to strictly enforce the intentions of environmental consideration at the work sites. These development activities are work processes which are mainly related to industrial plantation and forest road construction involving mechanical work and there is a strong likelihood that the work will be conducted by subcontractors rather than directly by private companies which are responsible for the implementation of the said work. Consequently, private companies will be required to set aside the environmental consideration cost regarding processes involving mechanical work so that they can supervise the implementation of the above-mentioned environmental conservation measures. As it is assumed that the Forestry Department will be unable to deal with all of the subject issues examined above by itself, external consultants will be employed to manage/guide the supervision of environmental conservation by private companies.

RECOMMENDATIONS

RECOMMENDATIONS

1. The swift implementation of the Plan is desirable as it is judged effective for forest conservation and bushfire prevention, etc. in the transitional zone and also for enhancement of the standard of living and welfare of local people.

2. The Government of Ghana should adopt the following measures to facilitate the participation of private companies in the Plan.

   (1) Financial assistance for the development of infrastructure to benefit the public, including the construction of feeder forest roads, preferential treatment for participating companies in terms of income tax and import duties on goods and creation of a low interest rate loan system for plantation establishment

   (2) Allocation of plantation sites under the Plan to beneficiaries of TUCs

   (3) Implementation of a pilot industrial plantation project involving some 1,000 ha led by the Forest Service as a demonstration for private companies

3. From the viewpoints of reducing the cost of bushfire prevention for participating companies and also of providing incentives for local people to participate in silviculture, an appropriate profit-sharing ratio vis-a-vis the harvested trees should be established for those industrial plantations in which local people participate. The agricultural products produced under the taungya system at such plantations should be entirely given to the producing farmers, negating their sharing with landowners.

4. Efforts should be made to develop a system to supply high quality seedlings of teak and other species to meet the demand for prompt delivery in an adequate quantity at an appropriate price through the establishment of the Central Nursery and others while also contributing to the development of nursery techniques and the introduction as well as extension of nursery standards.

5. The following measures should be adopted to strengthen bushfire prevention/control measures.

   (1) Education on bushfire prevention and guidance on appropriate burning techniques

   (2) Establishment of a communication and cooperation system between administrative organizations and self-governing organizations for a quick response to the

occurrence of bushfires and improvement of the composition of fire-fighting teams and fire-fighting skills

6. Financial assistance (subsidy) should be provided to assist the establishment of village forest management planning committees and advice should also be provided to ensure their democratic management through the fair selection of committee members and other means together with technical guidance on the management of village nurseries and other relevant matters.

7. Technical assistance should be provided for the nursing of excellent seedlings of the planting species and for the artificial culture of NTFPs.

8. Extension bodies in both the agricultural and forestry sectors should cooperate with each other for the implementation of educational as well as extension activities on the sustainable production of agricultural crops, methods to maintain the soil fertility, importance of forests and bushfire prevention.

9. The following measures should be introduced to support the timber industry which will handle the timber from plantations.

   (1) Financial and technical assistance for those companies which switch from the present sawing line specialising in natural large diameter wood to a down-scaled line to handle the small to medium diameter wood from plantations

   (2) Development of the timber market to ensure an appropriate timber price and a stable supply of raw wood

10. A national land use plan should be formulated in cooperation with the Ministry of Agriculture and other ministries and agencies concerned to determine the areas to be managed strictly as forests. For this purpose, environmental conservation measures should be taken into consideration in the determination of such areas in addition to the industrial viewpoint.