3-4. Operation Plan

3-4-1. Forest Utilisation

(1) Timber production

(i) Standard felling method

Either clear felling or selective felling is employed for main harvest. In principle, selective felling is applied for natural forests while clear felling is for forest plantations. For forest to be added with enrichment planting, shelterwood felling is employed. However, as the sites for enrichment planting cannot be identified at the planning stage, the likely sites subject to shelterwood felling are classified as sites for selective felling. A buffer zone created on the margins of natural forests to prevent encroachment, should be clear cut. The choice of felling method is determined to a certain degree by the regeneration method employed. In general, clear cutting is followed by either copice or planting while selective felling is followed by either natural regeneration or enrichment planting.

(a) Natural Forests

While formulating a selective felling plan for timber production, the felling intensity and trees' growth rate determine the year for felling cycle. Felling cycle is the number of years required for the timber stock (stand volume) of a logged forest to return to its previous (before felling) volume immediately previous to the logging. The following equation is used to calculate felling cycle:

$$\ell = \frac{-\log(1-s)}{\log(1+P/100)} \quad \text{..... (1)}$$

where l: felling cycle, s: selective felling intensity, p/100: growth rate

Data on growth rate are not available for the further target forest compartments, nor the record of the year when the selective felling was carried out. The selective felling intensity and other information were not available. Since, reading tree ring is impossible, growth rate could not be determined from field surveys. Therefore, the growth data in EFAP were adopted.

- Closed high forest: 0.98m^3/ha/year

Commercial species with D.B.H. greater than 60cm (current criterion for selective felling) were adopted for felling.

(b) Forest Plantations

Main harvest

Felling age is basically determined by types of lumber required by the industry, mean growth, and finanacial advantage. *Cupressus lusitanica* and *Pinus patula*, the main plantation species in Intensive Study Area, are meant for the production of general-purpose lumber. Current operations generally target for harvesting at 25~30 years. *Eucalyptus* spp. is for transmission pole as well as general-purpose lumber production. It is harvested at 15~20 years old: Eucalypts construction poles are supplied through thinnings.

To estimate growth rate from the results of standard plot survey in this study proved difficult. This plan therefore includes two production models said to correspond to this region by Orgut-Swedforest Consortium (1990) (see Appendix Tab. 33 (1)). Felling age is as follows:

Tab. 31 Standard rotation age by species

Species	Purpose of production	Rotation age
Eucalyptus spp.	transmission poles; general-purpose lumber	18 years
Cupressus lusitanica; Pinus patula, etc.	general-purpose lumber	26 years
indigenous species	general-purpose lumber	60 years (80 for mother trees)

Since no data are available on the relationship between age and diameter growth for indigenous species such as the *Hagenia abyssinica*, it was difficult to determine their felling age. The felling age of 60 years, used by the forest management project in the surrounding area (Tiro Boter-Becho State Forest Project), is adopted for this plan. Around 20% of mother trees will be left at the time of the regeneration felling, and depending on natural regeneration conditions, the mother trees will normally be felled at 80 years.

The Orgut-Swedforest Consortium (1990) has issued a production model for indigenous species as well. It is shown in Appendix Tab. 33 (3) for reference.

Thinning

According to the schedule set out in the production model, thinning should be carried out by species as follows:

Eucalyptus spp.: At an intensity around 26~34% (of stand volume) in the 4th, 6th, 9th, and 13th year after planting. The material will be used for construction poles.

Cupressus lusitanica, Pinus patula: At an intensity around 25~35% (of stand volume) when stand reaches 8, 12, and 18 years old.

Indigenous species: Few examples of plantations exist now, and no data that can suggest growth stages are available. Therefore, thinning schedule for this plan will be as follows.

- The first thinning will take place along with pruning when the canopy is closed (estimated to take 8~15 years). In the case of *Hagenia abyssinica* , which tends to form a grove of 2~4 trees, this operation will provide an opportunity to single out the good ones and remove the rest (singling).
- For later (second and the ones afterward) thinnings, the method calls for a selection of candidates in good condition to act as main trees until harvest time and a thinning of trees around them.
- Thinning should not exceed 30% of stand volume at all times.

(ii) Timber Harvest Volume

(a) Natural forests

The following demonstrates how the allowable timber harvest volume is calculated from data collected from forest survey (refer to Appendix Tab.34):

For FI forest, the stand volume is 320.4 m^3/ha and the growth volume is 0.98 m^3/ha/yr. Therefore, growth rate (p%) is 0.306%/yr (0.98 m^3/ha/yr ÷ 320.4 m^3/ha). In the case that the selective felling intensity (s) is set as 20%, using equation (1) (page 125), the cutting cycle is calculated to be 73 years

$$l = \frac{-\log 0.8}{\log (1.0 + 0.306/100)} \fallingdotseq \frac{0.09691}{0.001327} \fallingdotseq 73 \text{ years}$$

Divided the total area of FI forest targeted for timber production (26,500 ha) by 73 years, the areas to be harvested annually is 363 ha.

26,500 ha ÷ 73 years ≒ 363 ha/year

The allowable timber harvest volume per year for FI forest, therefore, is:

320.4m^3/ha (stand volume)×0.2 (selective felling intensity)×
363 ha/year (annual harvest area) = 23,261m^3/ year.....(2)

Furthermore, in consideration of bias, decay and hollows, etc. which are unavoidable in implementation of the standard plot survey, 20% was subtracted from the above figure (2).

$$23{,}261 \times 0.8 = 18{,}609\ (m^3) \quad \ldots\ldots (3)$$

(though a standard plot survey of currently active logging site yielded a felling intensity of 3.34%, 20% value was decided for road construction efficiency.)

On the other hand, based on the annual encroachment rate estimated in the targeted logging area of 26,500 ha FI forest, 121 ha will be subject to encroachment per year. If 70% of the encroachment is prevented when the forest management plan becomes operational, the total stand volume might be lost by encroachment would be:

$$320.4 \times 121 \times 0.3 = 11{,}631\ (m^3) \quad \ldots\ldots (4)$$

Consequently, the annual allowable timber harvest volume on the cautious side is (3) - (4) = 18,609 - 11,631 ≒ 7,000 (m^3), and the timber harvest volume over the ten year project period would be about 70,000 m^3.

For 1996/1997 the quota on timber harvest volume assigned by the Regional State of Oromia for Intensive Study Area is 1,340m^3. The goal underlying the establishment of NFPA is a strict conservation of the forest rather than timber production. Therefore, timber harvest volume should be kept as low as practicable. This is the reason to stand on the cautious side also with a view to foreseeable rise of the forest value in the global picture.

Several permanent trial sites of about 1 ha each would be set up in the selective felling area. Periodic (every five years) observations would be carried out in an effort to measure forest stand volume growth.

(b) Forest Plantations

123 ha (11% of the total forest plantation area) conifer plantations (*Cupressus lusitanica* and *Pinus patula*) intended for lumber production will reach felling age (16~20 years old) during the 10 year plan period. Many of them need to be thinned. With the addition of *Eucalyptus spp.* (stand age of 11 - 15 years or more; 315.2 ha) and *Casuarina* (16.2 ha), forests stands of 454.1 ha (42% of the total area of forest plantations) will reach the felling age.

Growth data compiled from the field survey is plotted and compared with the yield table as mentioned before for each species (Appendix Fig. 16~18). *Pinus patula* shows higher tree height growth and lower diameter growth than that of the yield table, indicating that the stand is too dense and needs thinning (Appendix fig. 16). Other species' field data value (tree height growth, diameter growth and density) are similarly lower than the corresponding (Appendix fig. 17-18) yield table's values. Trees in *Eucalyptus* spp. plantations have often

been selectively felled (illegally) by local people for home consumption or regenerated by coppicing. Therefore, large variances in tree height growth, diameter growth and stand density are observed among stands of the same age.

The current situation is that the mean DBH of many forest stands cannot be expected to meet the minimum DBH of 30 cm required for the production of lumber on reaching the felling age. Accordingly, the felling plan for existing forest plantations has been formulated with the decision on the timing of main harvest and thinning for each forest stand taken by comparing tree height, DBH, stand density and total growing stock, etc. with the yield table graph instead of simply following the stand age.

Based on the yield table Appendix Tab. 35 (1)~(9) and Tab. 32 list the allowable timber harvest volume by year for the ten year plan period. Theses tables also include timber volumes which would be harvested from thinnings and main harvest of the new plantations proposed in the Plan. In the planned *Eucalyptus* spp. stands thinning will start from the fifth year after planting. As for *Cupressus lusitanica* and other species, they will be thinned at the ninth year.

Tab. 32 Felling area and timber harvest volume of forest plantations by year/species

Existing forest plantation																								
Year			1		2		3		4		5		6		7		8		9		10		Total	
Tree species	Area (ha)	Timber volume (m^3)	Felling area (ha)	Felling volume (m^3)	Felling area (ha)	Felling volume (m^3)	Felling area (ha)	Felling volume (m^3)	Felling area (ha)	Felling volume (m^3)	Felling area (ha)	Felling volume (m^3)	Felling area (ha)	Felling volume (m^3)	Felling area (ha)	Felling volume (m^3)	Felling area (ha)	Felling volume (m^3)	Felling area (ha)	Felling volume (m^3)	Felling area (ha)	Felling volume (m^3)	Felling area (ha)	Felling volume (m^3)
P. patula	70.0	17,411	16.7	2,166	18.3	876	20.3	3,215			16.8	1,309			12.7	2,564	18.3	1,164	12.8	865			115.9	12,159
									1.9	1,553											6.0	4,011	7.9	5,564
C. lusitanica	608.3	118,629	106.2	5,144	79.6	6,701	33.3	3,287	40.7	6,712	104.9	7,538	85.0	10,603	97.1	9,463	74.4	8,616	53.5	8,903	89.2	14,413	763.9	81,380
																	4.0	5,063	4.0	3,423			8.0	8,486
Eucalyptus spp.	365.7	60,432	36.5	3,884	37.3	3,817	35.1	3,638	64.2	5,331	19.4	3,461	32.2	3,894	53.6	4,834							278.3	29,059
											7.3	2,495											7.3	2,495
C. equisetifolia	16.2	520																					1.0	41
H. abyssinica	12.9	1,340							1.0	41													1.0	191
J. procera	1.3	384															1.0	191					1.0	58
mixed	1.1	114									1.0	58												
Thinning			159.4	11,194	135.2	11,394	88.7	10,140	105.9	12,284	142.1	12,366	117.2	14,497	163.4	16,861	93.7	9,971	66.3	9,768	89.2	14,413	1,161.1	122,888
									1.9	1,553	7.3	2,495					4.0	5,063	4.0	3,423	6.0	4,011	23.2	16,545
M.h.																								
Subtotal			159.4	11,194	135.2	11,394	88.7	10,140	107.8	13,837	149.4	14,861	117.2	14,497	163.4	16,861	97.7	15,034	70.3	13,191	95.2	18,424	1,184.3	139,433
Planned forest plantation																								
C. lusitanica, etc.																			160	7,680	192	9,216	352	16,896
Eucalyptus spp.											54	756	64	896	122	2,734	143	3,218	153	3,434	223	6,837	759	17,875
Thinning											54	756	64	896	122	2,734	143	3,218	313	11,114	415	16,053	1,111	34,771
M.h.																								
Subtotal											54	756	64	896	122	2,734	143	3,218	313	11,114	415	16,053	1,111	34,771
Grand total																								
Thinning			159.4	11,194	135.2	11,394	88.7	10,140	105.9	12,284	196.1	13,122	181.2	15,393	285.4	19,595	236.7	13,189	379.3	20,882	504.2	30,466	2,272.1	157,659
									1.9	1,553	7.3	2,495					4.0	5,063	4.0	3,423	6.0	4,011	23.2	16,545
M.h.																								
			159.4	11,194	135.2	11,394	88.7	10,140	107.8	13,837	203.4	15,617	181.2	15,393	285.4	19,595	240.7	18,252	383.3	24,305	510.2	34,477	2,295.3	174,204

(iii) Felling Sites

(a) Natural forests

Within the 26,500 ha Production Forest of Gera Forest, only forest compartments Nos. 1 through 15, where there is a high distribution of F1 forests, are caluculated for the estimation of logging volume. (F1 forests in other compartments are scattered, therefore, were excluded from prospective logging area mainly for road construction efficiency.)

Production Forests of compartments Nos. 08, 10, and 11 in the east of Gara, where part of the area was logged in 1996/1997, are the target area of logging for the duration of the project period.

In implementing this Plan, the felling area should be clearly identified on the topographical map by aerial photograph interpretation and the felling intensity should be specified.

(b) Forest plantations

When calculating timber harvest volume for forest plantations which were described in the previous section, logging sites were intentionally grouped yearly for work efficiency. The description of subcompartments to be logged is provided in Appendix Tab. 35 (1) ~(9).

(2) Other forest utilization

(i) Collection of fallen branches

The collection of fallen branches by local people for firewood for home consumption is a customary practice in Belete-Gera NFPA. This practice will be left as allowed also in the future. Collection will, however, be strictly limited to fallen branches. Rules on the felling of dead trees for firewood will be enforced. Village administration should be notified when a dead tree is felled for firewood. The felling of healthy standing trees for firewood will be prohibited in areas other than consign forests. Local residents will be educated and guided to observe the rules.

(ii) Felling to produce construction timber for household use

Currently permission from village administration and DADO is required for individuals to fell trees in natural forest to obtain construction timber for household use in Belete-Gera NFPA. In reality, however, felling is taking place without such permission, mainly because local people do not fully understand the permit system. Efforts must be made to make local people aware of the permit system and to thoroughly undergo the process from application for and

acquisition of permits.

The watching regime using forest guards will be strengthened to ensure that local people do not fell standing trees.

(iii) Apiculture

As described in the section dealing with the socio-economic environment, apiculture using the traditional method is popular among farm households in the Intensive Study Area and honey is an importance source of cash income.

(a) Method

The farmers, in order to produce their bee baskets, use cheap local materials like clay, straw, bamboo, leaves of *Musa abyssinica (Enset)*, bark of trees, logs and animal dung. The bark of bee basket's outside mainly comes from trees of *Otostegia integrifolia*, *Olea europaea subsp. cuspidata*, *Olea capensis subsp. welwitchii* and *Ekebergia capensis* (Sombo). Fresh leaves of *Ocimum basilicum* and *Echinops longisetus* are placed inside these bee baskets to feed the bees.

The fully prepared bee baskets are then hung on branches in late April, after the minor rainy season and in September, after the major rainy season. Trees on which the baskets are hung are *Aningeria-addfi federicii* (Kerero), *Cordia africana* (Wanza) and Gatama.

(b) Positive Impact

Trees used to hang the bee baskets are *Aningeria-addfi federicci* (Kerero). These trees will eventually be preserved.

(c) Problems

Standing trees are often debarked to make bee baskets. This practice may kill trees in the same way as girdling and result in the depletion of forest resources, are depleted.

(d) Future Prospects

Apiculture contributes to income generation of farm households and would enable them to participate in forest conservation. It is worthy of encouragement in the future under the condition that restrictions on the use of certain materials to make bee baskets are observed. In particular, using the bark of standing trees should be prohibited to conserve natural forests.

(iv) Collection of Naturally Grown Coffee Beans

The collection of naturally grown coffee beans in natural forests in Intensive Study Area is basically accepted as a customary right of local people. However, it is advisable to prohibit planting of coffee seedlings in natural forests, as it may result in an expansion of farmland and the loss of forests. Relevant measures are described in detail in 3.3 - Resource Management Plan.

(v) Collection of Medicinal Herbs

Medicinal herbs are widely used as home remedies by local people. Villagers living nearby natural forests have an excellent knowledge of many locally available medicinal herbs. As the collection of medicinal herbs cause almost no problems to forest management, it will not be regulated at the moment. However, attention should be paid to maintain resource base of the popular herbs and their cultivation in home garden would be encouraged. This is also related to Social Forestry Plan.

3-4-2. Reforestation and Protection

(1) Planting

(i) Selection of Planting Site

Area targeted for reforestation is chosen from areas of F3 forest, F4 forest and OT. Table 33 shows the areas of these land-use/vegetation types within Intensive Study Area.

Tab. 33 The area of F3, F4, and OT in each Forest (ha)

Subdivisions (Key)	Forest Name		Total
	Belete	Gera	
F3	6,752.0	17,058.0	23,810.0
F4	1,351.0	1,745.0	3,096.0
OT	17,109.0	18,465.0	35,574.0
Total	**25,212.0**	**37,268.0**	**62,480.0**

These areas include rocky lands, steep terrains, non-reclaimable encroachment areas and farmlands. The target sites were selected according to the following criteria:

It is within approximately 2 km of an existing road or a road that requires only a small amount of repair to be usable,

It has a slope of less than 50%, and it is located at places where consent is easily obtained from local people.

According to the survey results,

- F4 forests are scattered in areas with poor access, and the soil is not necessarily good.
- Within OT area, the most desirable reforestation site would be the encroached area reclaimed or to be reclaimed. DADO and FWPT officials are working to reclaim the land, negotiating with the occupants, but agreement may take some time to reach. It may not be a realistic option at this point to make a reforestation plan on the lands in the process of negotiation.
- F3 forest is distributed around F2 as well as F1 forests; access and soil condition are comparatively good, and is under pressure of encroachment.
- The planting record for the Gojeb~Gojeb Kishe area (large tracts of F4 forest and grasslands), where planting has been conducted for four years, is bad due to damages from forest fires. In addition, the area is at the lowest elevations in Intensive Study Area, i.e. 1300~1600m, where the planting of indigenous species is not suitable and plantable species area limited. Therefore, further planting in this area is suspended for the time being.

For the above cited reasons, reforestation is to be conducted mainly within F3 forest. Table 34 shows a complete listing of the selected sites. Steep terrain and riparian areas within the selected subcompartment were not included in reforestation plan.

Tab. 34 Summary of planned planting sites

Forest	Forest compartment	Forest subcompartment	Area (ha)	Forest type	Percentage of Area Suitable for Reforestation (%)	Area Suitable for Reforestation (ha)
Belete	02	001	266	F3	80	213
Belete	02	008	34	F3	80	27
Belete	02	010	61	F3	100	61
Belete	03	001	809	F3	70	566
Belete	03	004	97	F3	80	78
Belete	03	006	195	F3	80	156
Belete	06	003	65	F3	80	52
Subtotal			**1,527**			**1,153**
Belete	02	018	1	PL		
Belete	02	020	8	PL		4
Belete	02	021	2	PL		2
Belete	02	023	9	PL		4
Belete	02	027	19	PL		
Belete	06	018	1	PL		1
Belete	06	017	6	PL		6
Subtotal			**47**			**17**
Total			**1,574**			**1,170**

Forest	Forest compartment	Forest subcompartment	Area (ha)	Forest type	Percentage of Area Suitable for Reforestation (%)	Area Suitable for Reforestation (ha)
Gera	08	005	173	F3	80	138
Gera	08	015	286	F3	80	229
Gera	08	016	91	F4	80	73
Gera	08	019	501	F3	80	401
Gera	08	021	49	F3	90	44
Gera	08	023	76	F4	100	76
Gera	08	028	14	F3	100	14
Gera	08	029	59	F3	90	53
Gera	09	008	75	F3	90	68
Gera	09	011	40	F3	100	40
Gera	13	010	53	F4	100	53
Gera	15	012	131	F4	100	131
Gera	16	002	194	F3	70	136
Gera	16	007	70	OT	80	56
Gera	16	008	27	F3	90	24
Gera	16	013	319	OT	60	191
Gera	16	014	303	F3	90	273
Gera	16	020	223	F3	90	201
Gera	16	022	132	F3	90	119
Gera	18	023	190	F4	90	171
Gera	18	025	127	F3	90	114
Gera	19	002	140	F3	80	112
Total			**3,273**			**2,717**

Reforestation after the main harvest of the existing forest plantations will be 17 ha, as shown in Table 34. Annual plans for the selected subcompartments are indicated in Appendix Table 36 (1) and (2). Table 35 shows annual reforestation plans for ten years. Table 36 shows break down of the total reforestation area by forest type. F3 forest occupies 80 % of the total. Table 36 also describes concentrated reforestation in the selected sub-compartments; upto 80% of the sub-compartment area will be reforested.

Tab. 35 Scheduled reforestation area by year

(unit: ha)

Year	1	2	3	4	5	6	7	8	9	10	Total
Belete	112	120	120	120	122	124	110	100	128	114	1,170
Gera	156	200	221	273	303	325	314	320	309	296	2,717
Total	**268**	**320**	**341**	**393**	**425**	**449**	**424**	**420**	**437**	**410**	**3,887**

Tab. 36 Scheduled reforestation area by Forest and Forest type

(unit: ha)

Type	Belete Forest		Gera Forest		Total	
	Sub-compartment area	Reforestation area	Sub-compartment area	Reforestation area	Sub-compartment area	Reforestation area
F3	1,527	1,153	2,343	1,966	3,870	3,119
F4			541	504	541	504
OT			389	247	389	247
PL		17				17
Total	**1,527**	**1,170**	**3,273**	**2,717**	**4,800**	**3,887**

(ii) Selection of species for reforestation

a. Species Selection

Species currently planted are mostly exotic and were chosen from the trial plots. This Plan will continue to apt for these species, because experience was gained and techniques developed to some extent for these species. On the other hand, more positive stance will be taken for the planting of promising indigenous species. These species to be planted are as follows:

For general-purpose lumber:

Exotic species

Cupressa lusitanica, Pinus patula, Casuarina eqaisetifolia, Gravillea robusta, Eucalyptus saligna, Eucalyptus grandis, Eucalyptus globulus

Indigenous species

Hagenia abyssinica, Juniperus procera, Podocarpus gracilior, Cordia africana, Ekebergia capencis, Pygeum africanum, Aningeria adolfi-friedericii

For general-purpose lumber as well as transmission poles:
Eucalyptus saligna, Eucalyptus grandis

For building poles and fuel:
Eucalyptus saligna, Eucalyptus globulus, Eucalyptus camaldulensis

In planting these exotic species, it is advisable to widen their genetic diversity. For those exotic species e.g. *eucalypts* with wide natural distribution, it is important to plan to introduce different varieties from several locations and keep the progeny even if the trees planted show poor growth initially. They may prove resistance should pests and other problems occur in the future. FRC is conducting progeny tests in the trial plots; Exchange of information with FRC is encouraged and its guidance should be asked in this connection.

Among the indigenous species, *Hagenia abyssinica, Ekebergia capencis, Pygeum africanum, Podocarpus gracilior, Cordia africana* and others are used for enrichment planting. *Hagenia abyssinica*, however, is the only species growing well. Although there seem to be problems in seedlings production and planting, improved tending may solve the problem of poor growth to some extent. The currently poor survival rate could be increased if more intensive weeding is implemented. Also, *Aningeria*, not planted so far in Intensive Study Area, is one of the valuable species and successful in the nearby projects, therefore, will be planted

b. Species Composition

Cupressus lusitanica plantations make up 57% and the *Eucalyptus* spp. plantations 34% of the total existing forest plantations. A large scale planting of one species is risky and susceptible when attacked by pest or disease. This plan tries to balance planting species. *Pinus patula* will increase up to 20%, and indigenous species to at least 20% as well.

The planned share of species is as follows.

Species	Current (%)	Planned (%)
Cupressus lusitanica	57	30
Pinus patula	6	20
Eucalyptus spp.	34	20
Other exotic species	2	10
Indigenous species	1	20

(iii) Planting Methods

Different planting methods are applied for different production purposes and they are shown below. A point of caution is put here beforehand; survival of the planted seedlings must be checked early enough while supplementary planting is still possible during the season; if the survival is poor, the reason should be found and carry out supplementary planting as soon as

possible, eliminating the cause of poor results. When the timing is lost, replanting in the next planting season shoud be planned.

a. Production of general-purpose lumber

1600 trees/ha (2.5×2.5m) of exotic species will be planted using contour planting method.
2500 trees/ha (2.0×2.0m) of indigenous species will be planted using contour planting method.

b. Production of construction poles for building

2500 trees/ha (2×2m) of both indigenous and exotic species will be planted using contour planting method.

c. Buffer zone plantation (firewood and construction poles for household use)

4,444 trees/ha (1.5×1.5m) will be the basic planting density for both exotic and indigenous species. The contour planting method will be used.

d. Enrichment

2,500 trees/ha (2×2m) of both exotic and indigenous species will be planted using contour planting method. Planting density should be changed according to the conditions of remaining trees.

(2) Tending and Thinning

Tending and thinning should be carried out according to the standards as shown in Table 37. Again, attention is drawn to the needs to apply flexibility in operation. Appropriate methods should be adopted according to the growth of the target species and to the conditions of the surrounding vegetation.

Tab. 37 Tending and thinning standards

Species	Year	Operation	Harvest (m^3/ha)
Cupressus lusitanica	0	planting, weeding, supplementary planting	
Pinus patula	1	weeding	
Grevillea robusta,etc.	2	climber cutting, clearing	
(Lumber production:	3	access pruning	
1600 trees/ha)	5	first pruning	
	8	high pruning	
	"	thinning1	48 m^3
	12	thinning2	54 m^3
	18	thinning3	88 m^3
	26	main harvest	386 m^3
Eucalyptus spp.	0	Planting, weeding, supplementary planting	
(Lumber production:	1	weeding	
1600 trees/ha)	2-3	climber cutting, clearing	
	4	thinning1	14 m^3
	6	thinning2	33 m^3
	9	thinning3	55 m^3
	13	thinning4	60 m^3
	18	main harvest	212 m^3
Indigenous species	0	planting, weeding, supplementary planting	
(Lumber production:	1	weeding	
2500 trees/ha)	2	weeding	
	3	weeding	
	4	climber cutting	
	7	pruning (climber cutting, clearing)	
	20	thinning1 (construction poles)	15 m^3
	40	thinning2	55 m^3
	60	main harvest with	140 m^3
		mother trees being left	
	80	mother trees logged	40 m^3
Eucalyptus spp.		First Rotation	
(Buffer zone: 4,444	0	planting, weeding, supplementary planting	
trees/ha)	1	weeding	
	2	climber cutting, clearing	
	3	climber cutting, clearing	
	5	main harvest	97 m^3
		Second Rotation	
	6	clearing (singling)	
	7	climber cutting, clearing	
	10	main harvest	112 m^3
		Third Rotation	
	11	clearing (singling)	
	12	climber cutting, clearing	
	15	main harvest	110 m^3

(i) Weeding

Weeding is necessary to save planted seedlings from water stress and competition with the undergrowth. Weeding will be done in the first two years after planting. The standard frequency is twice in the first year and once in the second year but will be flexible depending on the state of competition between the forest floor vegetation and planted trees and other relevant local conditions. The yardstick for the time to stop weeding is when a planted tree reaches height 1.5 times higher than the surrounding forest floor vegetation.

The initial growth of indigenous species is slow, therefore, one extra weeding is planned in the third year after planting.

(ii) Climber Cutting and Improvement Felling (clearing)

In areas where climbers are many, climber cutting is required to protect the trees even after weeding is no more necessary.

Clearing is the cutting of unnecessary native trees that obstruct the growth of planted trees, and damaged or deformed planted trees in order to ensure the growth of the target species.

These tasks should be carried out mostly in accordance with Table 37, but should be flexible as and when the conditions of the reforestation site call for the operation.

(iii) Pruning

Pruning is given to the species aimed at lumber production - *Cupressus lusitanica* and *Pinus patula*, etc. - in order to produce high-quality knot-free logs and to minimize damage in case of fire. Pruning standards are as follows.

Access pruning	In the 4th year prune the lower branches up to 2m from ground
First pruning	In the 6th year prune the lower branches up to 4m from ground
High pruning	In the 9th year prune the lower branches up to 4~8m from ground

Pruning on indigenous species such as *Juniperus procera*, *Podocarpus gracilior*, *Hagenia abyssinica* should be done around the 8th year after planting. *Eucalyptus* spp. do not need to be pruned.

(iv) Thinning

Thinning will be done based on the standard thinning year shown in Table 37. In the case of existing forest plantations, thinning priority will be given to those stands which are older than ten years old and which are overcrowded for lack of thinning. As the purpose of thinning is to produce high quality timber, inferior trees should be felled first while ensuring the uniform density of stands.

(v) Tending and Thinning Plan

The plan has been prepared for the planned planting sites shown in Table 35 in accordance with the tending and thinning criteria described earlier. Table 38 shows the combined schedule of this plan and the tending plan for existing reforestation sites. Detailed tending plan for existing forest plantations is given in Appendix Table 37.

Tab. 38 Yearly tending and thinning
(excluding thinning of existing forest plantations)

unit: ha

	Species / Year	1	2	3	4	5	6	7	8	9	10	Total
Area Planted (itemized)	*Cupressus*, etc	160	192	205	235	255	269	254	252	263	246	2,331
	Eucalyptus spp.	54	64	68	79	85	90	85	84	87	82	778
	indigenous species	54	64	68	79	85	90	85	84	87	82	778
		268	320	341	393	425	449	424	420	437	410	3,887

Species	Year	Task / Year / Harvest Volume (m^3/ha)		1	2	3	4	5	6	7	8	9	10	Total
Cupressus lusitanica	0	planting, weeding, supp. planting		160	192	205	235	255	269	254	252	263	246	2,331
Pinus patula	1	weeding			160	192	205	235	255	269	254	252	263	2,085
Grevillea robusta, etc.	2	climber cutting, clearing				160	192	205	235	255	269	254	252	1,822
	3	access pruning		49			160	192	205	235	255	269	254	1,619
	5	first pruning		126	14	49			160	192	205	235	255	1,236
	8	high pruning		5	53	18	126	14	14			160	192	582
	8	thinning1	48									160	192	352
	12	thinning2	54											
	18	thinning3	88											
	26	main harvest	386											

	Year	Task / Year / Harvest Volume (m^3)		1	2	3	4	5	6	7	8	9	10	Total
Eucalyptus spp.	0	planting, weeding, supp. planting		54	64	68	79	85	90	85	84	87	82	778
	1	weeding			54	64	68	79	85	90	85	84	87	696
	2	climber cutting, clearing				54	64	68	79	85	90	85	84	609
	3	climber cutting, clearing					54	64	68	79	85	90	85	525
	4	thinning1	14					54	64	68	79	85	90	440
	6	thinning2	33							54	64	68	79	265
	9	thinning3	55										54	54
	13	thinning4	60											
	18	main harvest	212											

	Year	Task / Year / Harvest Volume (m^3)	1	2	3	4	5	6	7	8	9	10	Total
Indigenous species	0	planting, weeding, supp. planting	54	64	68	79	85	90	85	84	87	82	778
	1	weeding		54	64	68	79	85	90	85	84	87	696
	2	weeding			54	64	68	79	85	90	85	84	609
	3	weeding				54	64	68	79	85	90	85	525
	4	climber cutting					54	64	68	79	85	90	440
	7	pruning (climber cutting, clearing)							54	64	68	79	265

(3) Nursery Production

(i) Number of Seedlings

The number of seedlings by species required was calculated based on the planting methods (trees per ha) and yearly plans. Result is shown as follows (Table 39). 20% for supplementary planting and another 20% for safety margin are added.

Tab. 39 Number of seedlings required by year

Belete Forest											
Tree species Year	1	2	3	4	5	6	7	8	9	10	Total
Cupressus, etc. (ha)	68	72	72	72	74	74	66	60	76	68	2,331
Number of seedings (1,600 trees/ha)	108,800	115,200	115,200	115,200	118,400	118,400	105,600	96,000	121,600	108,800	1,123,200
Eucalyptus spp. (ha)	22	24	24	24	24	25	22	20	26	23	778
Number of seedings (1,600 trees/ha)	35,200	38,400	38,400	38,400	38,400	40,000	35,200	32,000	41,600	36,800	374,400
Indigenous species (ha)	22	24	24	24	24	25	22	20	26	23	778
Number of seedings (2,500 trees/ha)	55,000	60,000	60,000	60,000	60,000	62,500	55,000	50,000	65,000	57,500	585,000
Subtotal for number of seedings	199,000	213,600	213,600	213,600	216,800	220,900	195,800	178,000	228,200	203,100	
Auxiliary planting	39,800	42,720	42,720	42,720	43,360	44,180	39,160	35,600	45,640	40,620	
Safety margin	47,760	51,264	51,264	51,264	52,032	53,016	46,992	42,720	54,768	48,744	
Total, planting area(ha)	112	120	120	120	122	124	110	100	128	114	3,887
Total number of seedings	286,560	307,584	307,584	307,584	312,192	318,096	281,952	256,320	328,608	292,464	2,998,944
Gera Forest											
Tree species Year	1	2	3	4	5	6	7	8	9	10	Total
Cupressus, etc. (ha)	91	120	133	163	181	195	188	192	185	178	2,331
Number of seedings (1,600 trees/ha)	150,400	192,000	212,800	260,800	289,600	312,000	300,800	307,200	296,000	284,800	2,606,400
Eucalyptus spp. (ha)	31	40	41	55	61	65	63	64	62	59	778
Number of seedings (1,600 trees/ha)	49,600	64,000	70,400	88,000	97,600	104,000	100,800	102,400	99,200	94,400	870,400
Indigenous species (ha)	31	40	41	55	61	65	63	64	62	59	778
Number of seedings (2,500 trees/ha)	77,500	100,000	110,000	137,500	152,500	162,500	157,500	160,000	155,000	147,500	1,360,000
Subtotal for number of seedings	277,500	356,000	393,200	486,300	539,700	578,500	559,100	569,600	550,200	526,700	
Auxiliary planting	55,500	71,200	78,640	97,260	107,940	115,700	111,820	113,920	110,040	105,340	
Safety margin	66,600	85,440	94,368	116,712	129,528	138,840	134,184	136,704	132,048	126,408	
Total planting area (ha)	156	200	221	273	303	325	311	320	309	296	3,887
Total number of seedings	399,600	512,640	566,208	700,272	777,168	833,040	805,104	820,224	792,288	758,448	6,981,792
Belete Gera Forest Total											
Total planting area (ha)	268	320	311	393	425	419	424	420	437	410	3,887
Total number of seedings	686,160	820,224	873,792	1,007,856	1,089,360	1,151,136	1,087,056	1,076,544	1,120,896	1,050,912	9,963,936

(ii) Nursery Techniques and Production Periods

Seedlings for reforestation should primarily be raised from seeds taken from elite trees in neighboring plantations with similar environmental conditions. Seeds should be properey handled for good germination and growth. Bare root seedlings will be considered if and when poor access makes the transportation of seedlings difficult from the nursery to the planting site, i.e. the situations of existing satellite nurseries. Potted seedlings will be the main and used whenever possible.

a. Seed Collection

Timing of flowering and fruiting, (especially the maturity and dispersion of seeds), will be studied for major species. Forest stands thought to have superior genetic characteristics will be registered as seed sources. Their flowering and fruiting conditions will be studied periodically. Collection will take place at appropriate time.

b. Sowing and Nursing

(a) Timing of Sowing

This will be planned to fit the out-planting time. Care should be taken to avoid delays.

(b) Disinfection

Disinfection of seeds by immersing seeds in proper solutions should always be performed to prevent seeds from getting mold. Potted seedlings tend to become excessively moist at certain time during irrigation and are more prone to infection than bedded seedlings. Seedlings should be checked regularly and appropriate disinfection should be conducted when necessary.

(c) Shading

Shading is normally provided for seedlings before the transplanted seedlings take root. Large grasses and palm leaves are easily available locally and should be used as shading material.

(d) Watering

Watering will be carried out to prevent drying when rainfall is not adequate, every day in early morning and late afternoon for about ten days after transplanting. Care should be taken at this time to prevent overwatering. Watering should be eased off to once a day or every other day (the rate should vary according to plant condition) starting about one month before outplanting.

(c) weeding

Even in case of direct sowing and cultivation of bare-root seedlings, weeding should start from early stage. Potted seedlings in particular require early weeding.

c. Nursing Period

The nursing periods for the main species is as follows:

Eucalyptus spp.: 3~5 months; *Cupressus lusitanica*: 7~9 months; *Pinus patula:* 6~7 months; *Casarina equisetifolia:* 4~5 months; *Hagenia abyssinica:* 3~4 months; *Podocarpus gracilior:* 11~13 months.

The planting stock are temporarily planted in a shady area near the scheduled planting site for about one month. Nursing period should be planned with this point in mind.

(4) Forest Protection

(i) Forest Fires

a. High-Risk Areas

Main cause of forest fires is the burning by farmers to regenerate grazing fields or to expand farm land that escaped and spread into neighboring forests. Since reforestation has primarily been carried out on grasslands and encroached forest lands near the NFPA boundaries, this type of forest fire has inevitably damaged the forest plantations. Grasslands dominated by high grasses called Bila and Dagalia, in particular, are subject to frequent burning and have caused many forest fires. This type of grassland is distributed in Gojeb~Gojeb Kishe and Yannga of Belete Forest, making firebreaks indispensable for the forest plantations in the area. Sedi~Dedo of Gera Forest is also frequently burned, and need much care for the planning of reforestation.

b. Preventitive Measures

(a) Raising Awareness for Forest Fire Prevention

Forest fires resulting from accidental or intentional burning of fields inside NFPA deny all the planting and conservation efforts and the loss of water conservation function and acceleration of erosion will leave serious damages to local communities.

For forest fire prevention the first to be considered is to raise people's awareness on the importance of forests and the risk of forest fire rather than the introduction of physical prevention measures. It is essential to promote forest fire prevention awareness in local

communities through extra teaching at schools and social forestry extension activities.

(b) Patrolling

For the prevention of forest fires, and in order to promote appropriate forest management practices in general, forest guards should regularly patrol assigned areas and report findings on forest growth, outbreak of disease and harmful insects and illegal felling to FWPT officers. Their number will be increased to strengthen control in the management area.

(c) Construction of Lookout Towers

Several lookout towers will be constructed to ensure early detection of forest fires. The existing five lookout towers in Belete Forest lack durability (roofs of some are damaged) and rebuilding is planned in five years. One additional tower (near subcompartment 03-001) will be constructed in line with future planting plans. In Gera Forest, one each in western (subcompound 16-002) and southern (08-019) Chira, and one in the Elke Togobe area (08-015) will also be constructed. Near the towers, fire fighting teams will be organized and trained with the forest guard playing the central role.

Tab. 40 Construction plan for lookout towers

Year	1	2	3	4	5	6	7	8	9	10	Total
Belete	1				3	2					6
Gera		1		1	1						3
Total	1	1		1	4	2					9

(d) Fire-Fighting Tools

Each forest fire-fighting team should be equipped with simple fire prevention and fire-fighting tools, such as hatchets (10), chainsaws (1), axes (10) and portable water tanks (2). Forest Guard, the team leader, will be provided with transceiver for liaison.

(e) Construction of Firebreaks

When planting is carried out in areas with a high forest fire risk, firebreaks must be constructed to divide the sites into small units. Site of the unit should be about 20 ha. The standard firebreak width should be around 10 m wide and should be well maintained. In the current reforestation area, 20 km (year 1) of firebreaks will be built in the Gojeb-Gojeb Kishe area. The existing foot paths should also be kept in good order so as to function as firebreaks and assist fire prevention/fire fighting.

Tab. 41 Firebreak construction plan

unit: km

Year	1	2	3	4	5	6	7	8	9	10	Total
Belete	30	10	10	10	10	10	8	8	10	10	116
Gera	12	16	16	20	20	20	20	20	20	20	184
Total	42	26	26	30	30	30	28	28	30	30	300

(f) Miscellaneous

Ample tending is important for fire prevention in forest plantations. Pruning helps to prevent crown fires. Branches and litter produced by clearing, weeding and pruning must be removed from the roadside and footpaths to prevent the fire to spread.

(ii) Forest Damage by Diseases and Pests

(a) Forest Diseases and Pests

Although no serious damage by either disease or pest has occurred in Intensive Study Area, signs of damage to *Cupressus lusitanica* and *Pinus patula* forest plantations have been reported in other NFPAs (1989 Management Plan for Tiro Boter-Becho State Forest Project) and the exact causes of the damage are not clearly known. Possible diseases and pest for major species being planting are briefly described below.

Eucalyptus spp.:

Young plantations are liable to termites' attack. Other pests are borers such as Gonipterus and Carambycidae. Oidium and other diseases may occur at nurseries, if overly watered.

Pinus patula:

This species has a relatively high resistance to diseases and pest, therefore, is one of the species receiving less damage than other species. However, damping-off and diseases attacking the leaves, roots and cones are observed. The most hazardous diseases are die-back caused by *Diplodiapinea* and root disease caused by *Armillaria mellea* or *Heterobasidion annosum.*

Cupressus lusitanica:

This species is vulnerable to canker caused by *Seiridium cardinale* and *S. unicornis.* Once affected, resin oozes out and the bark is discoloured, paving the way for a secondary attack by pest and other organisms through the areas affected by canker. Damage due to *Seiridium unicornis* has been reported in East Africa. *Eumycetes*

causing the dwarfing of seedlings is apt to propagate at nurseries, making it necessary to fumigate the nursery bed. Pests include *Ambeodontus tristis* and *Oemida gahani*, for which timely and careful pruning is effective as a preventive measure. In Africa, damage caused by *Oemida gahani*, a type of long-horned beetle, is common.

Casuarina equisetifolia:

Germinated buds are vulnerable to damping-off and young seedlings may be eaten by ants and crickets (mainly *Brachytrupes achaetinus*). Attention should be paid on caterpillars and aphides (Aphidiae) at nurseries. No serious damage other than that caused by Apate monchus (a type of borer) has been reported in well established plantation sites.

(b) Preventing Measures to Diseases and Pest

Poorly cared low quality stands are extremely vulnerable to the invasion and spreading of pest and disease through dead branches, poor ventilation and wet forest conditions. In many cases, the outbreak of disease or pest in a forest can be attributed to stand degradation, illustrating the necessity to create healthy stands by appropriate tending. A large-scale reforestation has a high risk of spreading damage once an outbreak of disease or pest occurs. It will, therefore, be necessary to keep the size of the area planted with single species small enough to prevent the spread of damage. Regular patrolling will be able to ensure early detection and quickly remove the trees affected by disease to stop the spread of damage.

At nurseries, efforts should be made to prevent the outbreak or spread of disease or pest by fumigating soil and seeds. Quick preventive or eradication measures should be taken including the use of chemicals, if necessary.

It is useful and necessary to maintain close contact with research institutes, such as FRC, for the identification of diseases and pest, improvement of conditions inviting outbreak or propagation and advice on preventive methods. A system for early detection, identification and quick eradication of damage should be established.

(iii) Damage by Animals

At the early stage of reforestation, the seedlings are often browsed by rodents. Unless the outbreak is on a major scale, preventive measures include (i) careful filling of the holes during tending work, (ii) intensive weeding and (iii) removal of the trimmed branches to create an unfavourable habitat for harmful animals.

Damage from unchecked grazing is seen in the early stages of reforestation. Local people should be well informed to control grating and patrolling should be intensified. Simple barriers of thorny plants such as acacia branches would be set up to ensure the control.

(iv) Weather Damage

The main weather damage in the area is wind-related. To minimise the damage, tending will be properly done to grow healthy stands. Once damage occurs, damaged trees should be quickly removed from the forest, and intensified patrolling to monitor the outbreak of disease or pest should follow. Supplementary planting will be carried out in the following year if the damage is extensive.

3-4-3. Social Forestry Measures

(1) Measures to Meet Needs of Local People

(i) Firewood for Home Consumption

a. Principles

Locations of villages in great need of stable firewood supply are shown in Appendix Fig. 12. These villages are given priority to encourage tree planting for firewood.

Initiative and positive participation of local people is essential for the success of planting. People will be invited from the planning stage to provide opinions as well as make decisions on the selection of planting sites and other issues. At the implementation stage, they will participate in the planting and other activities. The system of Debo (temporary communal working groups) will be useful facilitate the planting work as a whole.

b. Methods

- Planting of fast-growing species on private land, such as home gardens and the periphery of farmland
- Planting of fast-growing species along roadsides
- Planting trees on grazing fields which are commonly owned by the village or community, though protection is important in this case.
- Planting trees along the boundaries between natural forests and farmland/grazing fields under pressure by encroachment (Ref. Buffer zone).

c. Expected Effects

- Firewood collection sites will be easier.
- Participation of local people from the planning stage will ensure a realistic plan and good relation between foresters and local people.
- Local people as decision-makers will help create a consensus and a sense of responsibility to implement the plan

- The participation of local people at the plan implementation stage implies the developing of a self-reliant problem solving ability
- It is anticipated that illegal felling will decline when the planted trees mature

(ii) Construction Timber for Household Use

The demand for construction timber for household use is high, but not as great or urgent as that for firewood. Accordingly, planting exclusively for construction timber for household use will not be undertaken. Construction timber will be supplied through part of plantations aimed at firewood.

The principles for people's participation, methods and positive effects of planting would be the same as those of planting for firewood.

(iii) Seedlings Production

a. Principles

When planting is carried out for firewood and construction timber for household use, the most important point is a stable supply of seedlings. Currently, there are one FWPT nursery and four DADO nurseries (excluding nurseries for coffee seedlings only) in Seka Chekorsa District and two FWPT nursery and three DADO nurseries (similarly excluding coffee nurseries) in Gera District, totalling nine nurseries. As the distribution and production capacity of these nurseries was poor, there has been a seedling shortage among local people.

Seedling supply will be increased, including new nurseries. For establishing new nurseries, the opinions of local will be fully considered as in the case of tree planting. Moreover, local farmers will be encouraged to start their own nurseries.

b. Methods

- Increase seedling production at FWPT nurseries including new ones
- Increase seedling production at DADO nurseries also including possibly new ones
- Start school nurseries if and where possible
- Encourage starting of nuseries by farmers' groups

c. Positive Effects

- Tree planting will be supported by increased supply of seedlings.
- Opportunities for employment and income will be generated.

(iv) Family Planting

a. Principles

Family planting has been practiced and proved to be an effective measure in some villages around Intensive Study Area. A plan to encourage family planting will be developed based on the past performance.

b. Method

- Supplying seedlings of fast-growing species for each household to plant in home gardens and on margins of farmland

c. Positive Effects

- Firewood for home consumption and construction timber for household use will be easily available.
- Sale of mature trees will create cash income.
- Planting of trees will improve the environment.

(2) Ideas for Social Forestry Models

(i) School Nurseries

a. Objectives

(a) Distribution of seedlings to households to produce firewood for home consumption

(b) Provision of environmental education for pupils

(c) Practical training on nursery techniques for pupils

b. Methods

(a) Establishing nursery with the assistance of local people and DAs

(b) Having pupils work in nursery activities under the guidance of teachers and DAs

(c) Distributing produced seedlings to establish:
- plantations at the homes of pupils
- school forest plantation, if possible

c. Selection of species

Feasible species would be *Eucalyptus* spp., *Annona muricata*, papaya and other fruit trees. Appendix Table 38 lists potentially feasible species.

d. Plan Schedule

(a) Preparatory Period (including plan formulation period)

One Year
- Formulation of the plan; selection of candidate schools; preparation of seeds, equipments and tools

(b) Plan Implementation Period

Four Years (seedlings are produced four times)
- Establishment of the nursery and distribution of the seedlings to families
- Work period: *Eucyalyptus* spp. - five months, *Cupressus* spp. - eight months

e. Scale of Plan

The field survey findings suggest that a size of 0.25 ha (50 m x 50 m) each would be appropriate.

f. Model Schools

The following two model schools are selected and the reasons are given below.

Seka Chekorsa District: Chekorsa Elementary and Junior School
Gera District: Gera Elementary and Junior School

- Both schools have experience in establishing and running a nursery, and seen motivated.
- Both are located in villages where the firewood is in short supply.
- As they are located along main roads, operation of the nurseries would be possible even during rainy season (June - September).

(ii) Family Planting Extension

a. Objectives

In order to alleviate the firewood shortage and to produce construction timber (poles) for household use seedlings will be supplied to households in those villages which have

an urgent need for firewood. In addition, seedlings of fruit trees and other species will be supplied to farm households to promote agroforestry and generate cash income.

b. Methods

- Increase supply of the seedling through expanded seedling production at the existing district nurseries and farmers' group nurseries
- Expend the seedling recipient areas and raise of the seedling survival rate through improved transportation and proper handling of seedlings
- Provide technical guidance on nursery operation and family planting

c. Selection of species

It is necessary to provide seedlings for agroforestry, firewood and construction poles in the homestead plantations. Major species will be acacia, avocado, papaya and eucalypts. Appendix Table 38 lists the preferred species.

d. Plan Period

(a) Programme Formulation Period

Six Months
- Select new nursery sites and prepare seeds, equipments and tools

(b) Programme Implementation Period

Two years (seedlings are produced twice)
- Establish nurseries and delivery of seedlings

e. Plan Scale

Field survey and other indications suggest that the candidate villages selected for the model nursery are competent to establish new nursery. Assuming 500 seedlings will be provided for each households per year, for 100 households (which is the size of one community), it will be necessary to produce 60,000 seedlings per year with a safety margin of 20%. Referring to existing DADO nurseries, a nursery size of 0.2 ha should suffice to meet this production demand.

f. Distribution

When a nursery is managed by local people, seedlings will be distributed free of charge. However, when a nursery is managed by the DADO, it is preferable to charge a certain fee for the seedlings so that the production cost could be shared by local people. Field survey

findings suggest that the following fees would be feasible.

- Fruit tree seedlings: 0.5 Birr/seedling
- Seedlings of such woody species, such as *Eucalyptus* spp: 0.04 Birr/seedling

As far as the seedling distribution method is concerned, their direct collection from the nursery by local people is desirable.

g. Candidate Villages for Model Nursery and Programme Implementation Order

Seka Chekorsa District: first - Kishe, second - Sombo Daru
Gera District: third - Chira, fourth - Wegecha

The creation of a new nursery will be conducted in each village in the above-mentioned order at two year intervals. At present, it is planned to produce seedlings twice (in two years) at each of these village nurseries.

(iii) Buffer Zone Planting

a. Objectives

The main objective of buffer zone planting is to alleviate the adverse impact of firewood collection in natural forests. Buffer zone plantation will be located along the boundaries between natural forests and settlement areas. It is aimed to supply firewood for home consumption and construction timber for household use.

Moreover, in utilizing adjoining natural forests, PA and autonomous local organizations would be used to ensure that resources in the natural forest are utilized in an appropriate and sustained manner.

The purpose of people's participation in buffer zone planting is to develop a self-reliant and problem-solving ability on the part of local people. Local people groups will be encouraged to deal with problems from the planning to implementation stages.

b. Method of People's Participation

Communities of the size approximate 100 households, which will be the suitable unit for people's participation (see Appendix Tab. 39).

(a) Planning Stage

- Local people provide information on suitable sites, current land-use

situations of those sites and suitable time for planting, etc.

- Community selects the sites for buffer zone planting and species, plans planting schedule and organize planting labour
- Community representatives attend the planning council (attended by the Belete-Gera Forest Management Office, DADO, DA and village chairman, etc.) and present community/village information and to report issues addressed at community meetings
- When necessary the planning council should provide opportunities for community people to directly express their opinions
- Decisions on the use of mature trees and felling method will be determined at community meetings.
- Forming of agreement concerning rules for methods of adjoining natural forest utilization

(b) Plan Implementation Stage

- Work groups, such as Debo, will be used to provide labor for seedling transportation, land preparation at planting sites and planting

(c) Right and Obligation of Local People

- Right: local people will have the right to use the planted sites after five years
- Obligation: no felling or pruning of the planted trees for five years after planting
- An agreement will be signed between the community people (the leader) and OADB or JZADO on the above proposed right and obligation
- In utilizing adjoining natural forests, PA and autonomous local organizations would be employed to carry out natural forest management operations.

c. Selection of species

In principle, the selection of species will be done while formulating the plan with people's participation. Possible species are *Eucalyptus* spp. and *Cupressus lusitanica*, both intended for firewood and construction timber. Those species are listed in Appendix Tab. 38.

d. Plan Period

(a) Plan formulation: one year
(b) Plan implementation: five years (one year for seedling production and planting and four years for trees to grow)

e. Scale of Plan

Width of the buffer zone would be 50 m. Sites selected for buffer zones are listed in Tab. 42. The number of buffer zones is set at nine for sub-compartments with a total area of 137 ha. Planting will be 608,828 seedlings with a density of 4,444 seedlings/ha (planting distance of 1.5 m x 1.5 m). The total number of seedlings required for this planting scale is 876,712 bearing a safety margin of 20% and an extra 20% for supplementary planting. The scale and size of temporary nurseries required for each buffer zone plantation are shown in Tab. 43.

Tab. 42 Buffer zone designation sites

District	Village	Altitude of Area (m)	Compartment		Forest Type	Width (m)	Length (m)	Area (ha)
			Compartment	Subcompartment				
Seka Chekorsa	Elke Togobe	2,400-2,460	02	006	F2 (F4)	50	3,000	15.0
	Komo Hari	2,200-2,300	03	006	F3	50	1,700	8.5
Gera	Dedo Boge	2,300-2,400	18	006	F1	50	2,700	13.5
			18	018	F2	50	9,000	45.0
	Dusta	2,200-2,300	16	002	F3	50	1,500	7.5
			16	004	F4	50	2,500	12.5
	Gore Dako	2,100-2,200	08	015	F3	50	2,400	12.0
			08	016	F4	50	1,500	7.5
			08	019	F3	50	3,100	15.5
Total						**50**	**27,400**	**137.0**

Note: The forest type of Elke Togobe will be changed from F2 to F4.

Tab. 43
Production capacity and area of temporary nurseries required for buffer zone plantation

District	Plan Implementation Order	Village	Planting Area (ha)	Number of Planted Trees	Number of Seedlings Produced	Nursery Size (ha)
Gera	1	Dedo Boge	58.5	259,974	374,362	0.50
	2	Dusta, Gore Dako	55.0	244,420	351,965	0.40
Seka Chekorsa	3	Elke Togobe	15.0	66,660	95,990	0.20
	4	Komo Hari	8.5	37,774	54,395	0.10
Total			137.0	608,828	876,712	1.20

f. Candidates for Model Villages and Programme Implementation Order

Five villages are selected for this plan. Planting will be completed within eight years with a schedule of two years for each selected village(s). The sequence of planting will be: (1) Dedo Boge (Gera Dis.), (2) Dusta and Gore Daka (Gera Dis.), (3) Elke Togobe (Seka Chekorsa Dis.), and (4) Komo Hari (Seka Chekorsa Dis.).

(3) Gender (WID) and Poverty Alleviation

(i) Gender (WID) Issues

a. Women's Participation

As women are responsible for the collection, transportation and use of firewood, they have a precise knowledge of where firewood can be obtained and which species are useful as firewood. Involving women for the planning of tree planting for firewood would be:

- Utilizing women's knowledge on firewood for planning
- Setting up meetings specifically only for women to identify the needs of women, and ensuring that these meetings are chaired by female.
- While involving women in planting, extra burden on women must be avoided.

b. Relationship with Social Forestry Plan

The school nursery development, family planting extension and buffer zone planting should improve the access to firewood, thereby reducing the work load of women in terms of firewood collection. In addition, the mature trees are also expected to produce construction timber for home use which should help to improve housing as well as cooking facilities, including stoves, possibly reducing the meal preparation time. It will be necessary to conduct follow-up studies on the reactions of local people, particularly women. Women's groups could be interviewed to identify the positive or negative aspects of the plan and issues for further improvement.

(ii) Poverty Alleviation

a. Methods

(a) Provide guidance and extension service to improve the efficiency of traditional apiculture techniques
(b) Improve honey harvesting and refining techniques
(c) Cultivation of medicinal herbs

b. Positive Effects

(a) The prompt cash income will immediately improve the local standard of living.
(b) Guidance and assistance on the beehive making techniques will reduce the adverse impact on natural forest.
(c) The improved quality of honey will add extra value to the product.
(d) Added cash income.

c. Target Groups

Groups targeted for receiving guidance and extension service are Debo (temporary communal working group for farming, etc.) and other groups of approximately 20 to 30 farmers.

d. Implementation System

An apiculture or herbs collection group will be formed. Members should include specialist(s) in apiculture or herbs and representatives of the Belete-Gera Forest Management Office, Gera DADO and local farmers. Guidance and extension work will be conducted by agricultural extension officers while coordinating with the above committee and farmers' groups.

e. Period

One Year

(a) Identifying shortcomings of traditional apiculture techniques and honey harvesting / refining methods (six months)
(b) Providing guidance and extension service on beehive making and honey refining techniques (six months)
(c) Identifying useful medicinal harbs (one year)

f. Contents and Scale

(a) Identifying problems:

A survey will be conducted at villages located to the south of Chira in Gera District where apiculture is popular.

(b) Providing guidance and extension service

Guidance on beehive making using materials other than bark and other technical improvements will be provided for farmers' groups in 2 - 3 villages where apiculture is popular. Similar guidance will be provided for villagers located to the north of Chira with a prospect to promote apiculture into these villages. A pamphlet briefly explaining apiculture will be prepared and distributed to assist the guidance and extension activities.

g. Candidate Model Villages

Gara Naso, Gura Afalo, Kela Ariri

(4) Extension and Conservation Education

(i) Objectives

To strengthen extension activities in nursery and silviculture techniques to local people in order to facilitate family planting, and to promote education on the benefits and importance of forests to raise public awareness of the need for forest protection/conservation.

(ii) Methods

Nursery and silviculture techniques would be included in the scope of the present extension work of DAs. Activities relating to forestry will be further encouraged to intensify the extension of such techniques.

The extension on forest protection can be conducted in several ways: (i) add forest protection education to the present scope of work of DAs, (ii) design relevant activities for women and children through home agents, and/or (iii) creat new positions for field staff, such as forest agents, within the organizational structure of the JZADO and DADO.

The first two strategies are selected based on the following: reasons the use of home agents to provide education and guidance on forest protection in primary schools and villages where forests are depleted should prove effective for the immediate future. This decision is supported by the facts that DAs have already been allotted various tasks with the extension of and guidance on farming techniques. The collection of firewood is mainly conducted by women and children and that forest protection should lead to an improved standard of living in the future.

When entrusting home agents to conduct the said extension and guidance, they should be trained to acquire new knowledge of and educational methods for forest protection due to the absence of such tasks in their present scope of work.

(iii) Target Groups

a. Extension and Guidance on Nursery and Silviculture Techniques

The subjects of the extension of and guidance on nursing and silviculture techniques will be farming households and individuals in the following groups.

Group size:	individuals; households; local people; community
Sex and Age group:	children (secondary school pupils of fifth grade or above); adult men and women

b. Education and Guidance on Forest Protection

The subject of the education of and guidance on forest protection will be women

and children and individuals in the following groups.

Group size: individuals; households; local people; community; primary school pupils

(iv) Assignment of Field Agents

a. Development Agents

Currently, twenty-nine DAs (21 men and eight women) are assigned to cover 40 villages in Seka Chekorsa District while 14 DAs (nine men and five women) are assigned to cover 14 villages in the Gera District. There is a total of five supervisors stationed at Seka, Sombo and Shebe in Seka Chekorsa District and at Chira and Sadi in Gera District. While DAs cover many villages, nine villages in Seka Chekorsa District and 11 villages in Gera District have no DA. Of these villages, Komo Hari and Gudo Daka in Seka Chekorsa District should have a DA assigned to implement the Social Forestry Plan.

b. Home Agents

The further assignment of home agents will be necessary for the following villages if the extension of and guidance on forest protection is to be provided for villages where forests have been depleted and for primary schools.

Seka Chekorsa District: Kishe
Gera District: Sadi Loya, Dusta

(v) Contents of Extension and Guidance

a. Nursery and Silviculture Techniques

- Techniques on establishing homestead nursery and management methods
- Planting techniques and management method for homestead plantations
- Consultation regarding raising seedlings and silviculture
- Solving problems regarding the implementation of raising seedlings and silviculture

b. Education and Guidance on Forest Protection

- Guidance on optimal firewood collection method in the natural forests
- Education on the importance of forest protection for the local community
- Education on forest protection at primary schools using easily understandable and interesting methods for school children (for example, a visual method such as the presentation of pictures accompanied by a story)

- Education and guidance on methods to effectively utilise forests plantations

(vi) Training of Field Agents

It will be necessary to develop a curriculum for a training course on nursery and silviculture techniques and education methods at the Bokoji Training Centre, Bale Training Centre and Goma Training Centre. The training course should be included as a regular curriculum at a long-term training centre or as a special training course at a short-term training centre.

3-4-4. Infrastructure Improvement

(1) Roads

(i) Road Improvement

Roads, including forest roads, are vital for the proper forest management and efficiency of forest operations like logging and reforestation.

As noted in section 2-9-8, roads inside the Intensive Study Area, with the exception of two main roads, lack any sort of maintenance, and the improvement of these roads is given the top priority. No concrete plans for forest roads can be made until loggin sites are decided, and feeder roads are built by stumpage purchaser at their own expense. Therefore, no new roads are to be constructed within the scope of this forest road plan; improvement of the following roads - the most important ones for forest maintenance and forest operations - are planned.

a) Shebe~Yangga Deo Road (up to the demarcation line of the Belete Forest compartment No.05/16): 5km
b) Sedi~Sedi Loya Road: 11km
c) Chira~Afalo Road (up to the Naso River): 22km
d) Chira~Muje Road: 5km
e) Southwestern Chira Road (up to Gera Forest compartment No.08): 3km

Total improvement and extension involved: 46 km

(ii) Outline of Road Improvements and Repairs

Erosion on the road surface is the major cause for the degradation of roads.

(a) Improvement and Repairs of Roadbeds

- Refilling those sites where the road bed suffers gully erosion
- At locations where the road surface is subject to water accumulation, small logs

will be placed accrossed road surface and boulder will be filled between the logs to drain the water.
- Use of gravel to fill wet sites
- Construction of cross-ditches using logs

(b) Repair and Improvement of Bridges

- Repair and improve bridges using logs

(c) Slope Protection Measures

- Simple soil retention work: construction of masonry soil retention works similar to those seen in some parts of national roads, along the contours
- Revegetation works: plant grasses or slopes

(2) Nurseries

(i) Location and Scale

Reforestation schedule and seedling production goal are cited once again to better demmonstrate the location and scale of necessary nurseries. In the Belete Forest, proposed reforestation areas are concentrated along the main road near the center of the forest. The distance between the Gojeb nursery, currently in use, and the proposed reforestation area is 25~40 km, and the elevation difference is 500~800m. Since there is no reforestation planned in the Gojeb area, a new permanent nursery will be established around the center of the Belete Forest and the Gojeb nursery will be temporarily closed.

For the Gera Forest area, the reforestation plan calls for the establishment of one new nursery and reopening of two nurseries. Scales of these nurseries, based on the number of seedlings needed, is indicated in Table 45.

Tab. 44 Planting schedule and nursery management plan

Year	1	2	3	4	5	6	7	8	9	10	Total
Belete Forest											
Planting Area (ha)	112	120	120	120	122	124	110	100	128	114	1170
Total No. of Seedlings required	286,560	307,584	307,584	307,584	312,192	318,096	281,952	256,320	328,608	292,464	2,998,944
Nursery establishment	———			———	Belete area (new)		———		———		
Gera Forest											
Planting Area (ha)	156	200	221	273	303	325	314	320	309	296	2717
Total No. of Seedlings required	399,600	512,640	566,208	700,272	777,168	833,040	805,104	820,224	792,288	758,448	6,964,992
Nursery establishment	———		Chira (new)	———			———	Sedi (reopen)	———	Dedo-Boge(reopen)	

Tab. 45 The scale of proposed production by nurseries

Location	Area (ha)	No. of Seedlings to be Produced	Notes
Belete (Belete Forest)	0.8	250,000～330,000	permanent
Chira (Gera Forest)	1.0	400,000～850,000	satellite (temporary)
Sedi (Gera Forest)	1.0	800,000～820,000	satellite (temporary)
Dedo-Boge (Gera Forest)	0.8	760,000～	satellite (temporary)

(ii) Facilities in the Area

At present, only simple nursery offices or rest areas called the Guard's House are available in nurseries. The following facilities are to be constructed to provide a comfortable working environment and efficiently produce high-quality seedlings. For nurseries such as the one in Belete which has been in use continuously for 10 years and will continue to function intermittently as a permanent nursery, durable materials will be used to upgrade the facilities. Locally available material will be used for temporary nurseries. Facilities planned are as follows:

a. Nursery Office (around 25m^2 in size)

The structure should facilitate clerical maintenance work and will be equipped with furnitures.

b. Potting House (around 80m^2 in size)

This will be a simple, rain-proof building where soil potting, seeding and

transplant tasks will take place.

c. Guard's house/rest area (25~40 m^2 in size)

The building will serve as a place for workers to rest; overnight stay should be made possible too.

d. Storage shed/garage

The structure will be a wooden shack, capable of accommodating a truck while providing adequate storage for nursery material and equipment.

e. Mechanical equipment

A truck is a minimum necessity to efficiently operate the nursery. The Belete Forest and Gera Forest will each be provided with a truck (4 t).

(3) Buildings

(i) Main Office

A main office will be established in Jimma. The location of the main office cannot be determined until it is clear whether this project, like the Tiro Boter-Becho State Forest Project, will be under the direct auspices of the Oromia Regional State Government or JZADO. In addition, branch office will be built in both the Beleta and the Gera Forest in order to fully dispense forest management measures.

The main office will be constructed in accordance of the standard of the structures of the Munessa-Shashemane State Forest Project. Building dimensions are 30m × 14m ($420m^2$), and will include 7 offices, a conference room, reference room, and one all-purpose room; bathroom will be located in another structure.

The branch office will be $160m^3$ (20m × 8m) in size and will have 3 offices and a storage room.

(ii) Staff (Official) Residence

The staff residence will have 2 units per structure; two structures will be constructed in Belete, and four in Chira area. Each structure is $84m^2$ (6.5m × 13m) in size, and each unit will have two bedrooms, one living room and a kitchen.

An annex of bathroom structure will also be built for each structure.

Additional residence will be gradually built as the project proceeds.

(iii) DA Houses

a. Necessity for DA Houses

As mentioned in the section on the Social Forestry Survey, eighteen villages have a DA house. Their locations are shown in Appendix Fig. 19.

In Seka Chekorsa District, DA houses are located in villages near Seka and in southwestern part of the District. No village neighboring Belete Forest has a DA house.

In Gera District, DA houses are found in villages in northwestern and southwestern part of the District. No DA house is found in the central area of the District. For those villages which do not have DA house, especially those with firewood shortage, the construction of new DA houses is necessary.

Among those villages lacking a DA house, those located near the boundary of the Belete-Gera NFPA and are in shortage of firewood urgently require a new DA house.

At present, the most commonly employed guidance and extension method is visiting individual farming households using the DA house as a base. When necessary, local residents are asked to get together for group guidance.

The social forestry plan emphasises the participation of local residents in planting as a key component and envisages strengthening of the extension of and guidance on nursing and silviculture techniques. DAs play a crucial role in the provision of technical guidance for local residents and act as coordinators between the administration and local residents. It will, therefore, be necessary to construct new DA houses.

b. Locations and Size of New DA Houses

The construction of new DA houses is planned for the following villages.

Seka Chekorsa District : Elke Togobe, Sombo Daru, Komo Hari
Gera District : Gore Daka, Wegecha

The size of the new DA houses will be similar to that of the existing DA houses and the following specifications are likely to be adopted, referring to those of the existing DA houses.

Structure : wooden, single-story building with galvanised sheet iron roofing (annexed by a kitchen-toilet building), mud walls and mud floor

Floor Area	:	40 m^2 for main building; 6 m^2 for kitchen-toilet annex
Layout	:	four rooms (office, living room, dining room and bedroom)
Fixtures	:	bed, desk, chair, table and kitchen equipment, etc. (to be provided by the DA at his own expenses in accordance with the present practice)

(iv) Forest Guard Dormitory

The on-the-site forest guard dormitory shall be constructed in Yanga Deo, Sedi-Loya, Muje and Afalo. The facility measures 60 m2 (4 m by 15 m) and consists of five rooms. Kitchen and bath room shall be separated in the other building.

3-5. Project Cost

3-5-1. Prevention of Encroachment

According to the land use/vegetation map, the boundaries between "F1/F2 forests" and "others" and between "F1/F2 forests" and "peripheral area of the Intensive Study Area" total 300 km (237 km in Gera Forest and 63 km in Belete Forest). These boundaries are intended to be clearly marked to prevent encroachment. The required marking will include permanent monuments, painting of trees, planting belts and signs. Concrete pillars will be erected at proper locations as permanent monuments. Boundaries of forest will be indicated by trees painted with red or white stripes on the trunk. Planting belts will consist of eucalypts planted in a 10 m wide belt.

Based on a project conducted in Sigmo area in 1998, approximately 40,000 Birr is required to mark 100 km of forest boundaries with permanent monuments and painting of trees. Therefore, at least 120,000 Birr should be allocated for marking the 300 km of forest boundaries. The planned work should be completed within four years and the cost will be distributed as 30,000 Birr per year. Additional 10,000 Birr per year should be allocated after the fourth year for the maintenance of forest boundaries and other necessary measures to prevent encroachment.

In summary, cost for the prevention of encroachment will be:

1st- 4th year	:	30,000 Birr per year	(total 120,000 Birr)
5th - 10th year	:	10,000 Birr per year	(total 60,000 Birr)
			totaling 180,000 Birr

3-5-2. Harvesting and Sales

(1) Natural Forests

As trees in natural forests are sold as stumpage, the cost is estimated upto the point when the sale is completed.

(i) Cruising

- The annual yield for the period from the first year to the fifth year will be gradually increased by 1,000 m^3 each year from a starting yield of 3,000 m^3 and the annual yield from the fifth year onwards will remain at 7,000 m^3.

- Assuming an average volume of 1.6 m^3 per tree, the number of trees subject to cruising will be 1,875 for the first year and 4,375 for the fifth year.

- A cruising team will consist of one staff member and two workers. The wage for

workers will be 4 Birr/day/worker.

- Each team will select 20 trees a day.

- Annual cruising cost = total number of trees selected ÷ 20 (trees/day) x 4 (Birr) x 2 (workers) (excluding personnel cost of the staff member)

(ii) Felling Supervisor

- Two staff members will be appointed as felling supervisors (no workers will be employed).

(iii) Volume Measurement of Felled Trees

- A measurement team will consist of one staff member and two workers.

- Each team will measure 10 trees a day.

- Annual measurement cost = total number of trees felled ÷ 10 (trees/day) x 4 (Birr) x 2 (workers) (excluding personnel cost of the staff member)

Tab. 46 Annual Harvesting Cost at Natural Forests

(Unit: Birr)

Year	1	2	3	4	5	6	7	8	9	10	Total
Cruising	750	1,000	1,250	1,500	1,750	1,750	1,750	1,750	1,750	1,750	15,000
Measurement	1,500	2,000	2,500	3,000	3,500	3,500	3,500	3,500	3,500	3,500	30,000
Total	2,250	3,000	3,750	4,500	5,250	5,250	5,250	5,250	5,250	5,250	45,000

(2) Logging of Forest Plantation

The cost associated with the logging of forest plantations can be divided into surveying expenses incurred in designating logging site, selecting of trees to be logged, calculating the timber volume and logging (which is done through contructing and includes main harvest and thinning cost).

(i) Survey and measurement of felled trees costs

The cost includes (1) surveys related to the designation of logging site and selection of trees to be felled, and (2) survey on felling volume. Annual survey cost for the logging of forest plantations is shown in Table 47.

Tab. 47 Annual survey cost for the logging of forest plantations

Year		1	2	3	4	5	6	7	8	9	10	Total
Planned	Thinning	159.4	135.2	88.7	105.9	196.1	181.2	285.4	236.7	379.3	504.2	2,272.1
Felling Area (ha)	Regeneration Felling				1.9	7.3			4.0	4.0	6.0	23.2
Total		159.4	135.2	88.7	107.8	203.4	181.2	285.4	240.7	383.3	510.2	2,295.3
Selection of trees to be felled												
Workers	man-day/ha	0.14										
	unit price (Birr/ha)	4										
	Expenses (Birr)	4,554	3,863	2,534	3,080	5,811	5,177	8,154	6,877	10,951	14,577	65,578
Measurement of Felled Trees												
Workers	man-day/ha	0.1										
	unit price (Birr)	4										
	Expenses (Birr)	6,376	5,408	3,548	4,312	8,136	7,248	11,416	9,628	15,332	20,408	91,812
Total Expenses		10,930	9,271	6,082	7,392	13,947	12,425	19,570	16,505	26,283	34,985	157,390

(ii) Logging of Forest Plantations (Thinning and Regeneration Felling)

As indicated in Tab. 47, thinning is the main type of felling in forest plantations and accounts for approximately 100~200 ha per year. Logging cost was divided into main harvest and thinning. Thinning expense was calculated by determining the area for each stage (first thinning, second and so on) by species, and then consolidating into one unit price for a year (see Appendix Tab. 45). The result is shown in Tab. 48.

Tab. 48 Consolidated annual logging expenses for forest plantations

Year		1	2	3	4	5	6	7	8	9	10	Total
Planned	Thinning	159.4	135.2	88.7	105.9	196.1	181.2	285.4	236.7	379.3	504.2	2,272.1
Felling Area (ha)	Main harvest				1.9	7.3			4.0	4.0	6.0	23.2
Total (ha)		159.4	135.2	88.7	107.8	203.4	181.2	285.4	240.7	383.3	510.2	2,295.3
Logging	Thinning	25,381	22,869	22,564	18,056	28,329	27,587	45,845	35,566	52,912	79,228	358,336
Expense (Birr)	Main harvest				1,824	5,183			3,840	3,840	5,760	20,447
Total (Birr)		25,381	22,869	22,564	19,880	33,512	27,587	45,845	39,406	56,752	84,988	378,783

3-5-3. Reforestation and Protection

(1) Reforestation

(i) Seedling Production Cost

Based on the number of seedlings required per year, the cost of seedlings for reforestation is shown in Tab. 49.

Tab. 49 Seedling production cost

Year	1	2	3	4	5	6	7	8	9	10	Total
Production quantity	686,160	820,224	873,792	1,007,856	1,089,360	1,151,136	1,087,056	1,076,544	1,120,896	1,050,912	9,963,936
Unit price Birr/seedling	0.2										
Expenses Birr	137,232	164,045	174,758	201,571	217,872	230,227	217,411	215,309	224,179	210,182	1,992,786

(ii) Reforestation Cost

Reforestation cost was grouped into planting and tending cost, tallied according to the planting and tending standards indicated in Tab. 37. A consolidated unit price was obtained. Cost of each year is then calculated by the area planned each year. The annual planting cost is shown in Tab. 50, and the tending cost is listed in Tab. 51.

Tab. 50 Annual reforestation cost

Year		1	2	3	4	5	6	7	8	9	10	Total
Cupressus etc.	(ha)	162	192	205	235	255	269	254	252	261	246	2,331
Unit price	(Birr/ha)	290										
Cost	(Birr)	52,488	62,208	66,420	76,140	82,620	87,156	82,296	81,648	84,564	79,704	755,244
Eucalyptus spp.	(ha)	53	64	68	79	85	90	85	84	88	82	778
Unit price	(Birr/ha)	290										
Cost	(Birr)	17,172	20,736	22,032	25,596	27,540	29,160	27,540	27,216	28,512	26,568	252,072
Indigenous species	(ha)	53	64	68	79	85	90	85	84	88	82	778
Unit price	(Birr/ha)	370										
Cost	(Birr)	23,532	28,416	30,192	35,076	37,740	39,960	37,740	37,296	39,072	36,408	345,432
Total area	(ha)	268	320	341	393	425	449	424	420	437	410	3,887
Total cost	(Birr)	93,192	111,360	118,644	136,812	147,900	156,276	147,576	146,160	152,148	142,680	1,352,748

Tab. 51 Annual tending cost

Year		1	2	3	4	5	6	7	8	9	10	Total
Cupressus, etc.	(ha)	340	419	624	918	901	1,138	1,205	1,235	1,433	1,462	9,675
	(Birr)	42,480	43,532	55,864	87,780	80,360	105,604	110,372	113,720	141,612	145,132	926,456
Eucalyptus spp.	(ha)	54	118	186	265	296	322	339	344	346	338	2,608
	(Birr)	7,344	11,512	15,816	21,360	23,588	25,480	26,080	26,344	26,700	25,816	210,040
Indigenous species	(ha)	54	118	186	265	350	386	461	487	499	507	3,313
	(Birr)	9,936	15,556	20,772	27,556	35,270	38,560	44,400	46,526	47,908	48,218	334,702
Total	(ha)	448	655	996	1,448	1,547	1,846	2,005	2,066	2,278	2,307	15,596
	(Birr)	59,760	70,600	92,452	136,696	139,218	169,644	180,852	186,590	216,220	219,166	1,471,198

(iii) Protection Cost

The cost itemized for forest protection are the construction of firebreaks and fire look-out towers, fire prevention materials/equipment and communication equipment. Relevant cost is accounted on an annual basis.

Tab. 52 Forest protection-related cost

Year	1	2	3	4	5	6	7	8	9	10	Total
<Firebreaks>											
New (km)	42	26	26	30	30	30	28	28	30	30	300
Construction Cost (Birr)	147,000	91,000	91,000	105,000	105,000	105,000	98,000	98,000	105,000	105,000	1,050,000
(@ 3,500*)											
Maintenance		42	68	94	124	154	184	212	240	270	
(total length: km)											
Maintenance Cost (Birr)		5,040	8,160	11,280	14,880	18,480	22,080	25,440	28,800	32,400	166,560
(@ 120)											
<Fire Look-out Towers>	1	1		1	4	2					9
Construction Cost (Birr)	450	450		450	1,800	900					4,050
(@ 450)											
<Materials/Equipment>	6	1		1	1						9
Materials/Equipment Cost (Birr)	42,000	7,000		7,000	7,000						63,000
(@ 7,000)											
<Communication Equipment>	6	1		1	1						9
Communication Equipment Cost (Birr)	24,000	4,000		4,000	4,000						36,000
(@ 4,000)											
Total	213,450	107,490	99,160	127,730	132,680	124,380	120,080	123,440	133,800	137,400	1,319,610

*: unit price (Birr)

3-5-4. Social Forestry

The annual cost of the various social forestry programmes is shown in Tab. 52. The basis for the calculation of these costs is given in Appendix Tab. 40 through 43.

Tab. 53 Annual cost of social forestry by programme

(Unit: Birr)

Year	School Nursery	Family Planting	Buffer Zone Planting	Apiculture Guidance and Extension	Total
1	17,200	10,000	14,000	61,800	103,000
2	25,575	14,400	77,722	-	117,697
3	24,775	22,300	14,000	-	61,075
4	24,775	14,400	73,092	-	112,267
5	24,775	22,300	14,000	-	61,075
6	17,200	14,400	21,598	-	53,198
7	25,575	22,300	14,000	-	61,875
8	24,775	14,400	13,129	-	52,304
9	24,775	12,300	-	-	37,075
10	24,775	-	-	-	24,775
Total	**234,200**	**146,800**	**241,541**	**61,800**	**684,341**

3-5-5. Infrastructure Improvement

(1) Roads

Improvement of existing roads will be planned for the following four routes as stated in 3-4-4 Infrastructure Improvement, and will be carries out over the course of four years in order of urgency.

Year One
- Shebe~Yanga Deo Road: 5 km (including bridge repairs)
- Chira~Afalo Road: 7 km

Year Two
- Sedi~Sedi Loya Road: 6 km
- Chira Afalo Road: 7 km

Year Three
- Sedi~Sedi Loya Road: 5 km (including bridge repairs)
- Chira Afalo Road: 8 km

Year Four
- Chira~Muje Road: 5 km
- Southwestern Chira Road (up to Gera compartment 08): 3 km

Total 46 km

Tab. 54 Road improvement cost

	Year 1	Year 2	Year 3	Year 4	Total (Birr)
Surface Grading	11,520	12,480	12,480	7,680	44,160
Gravelling	100,800	109,200	109,200	67,200	386,400
Labor Costs	9,600	10,400	10,400	6,400	36,800
Simple Bridges	4,920		4,920		9,840
	126,840	132,080	137,000	81,280	477,200

(2) Nurseries

Construction costs are listed in Tab. 55 based on the nursery construction plan. Belete nursery and Chira nursery are to be newly constructed. In addition, each nursery in Belete and Gera Forest has a truck listed for year one, which is included in Section 3-5-6. Vehicle and Forest Guard Cost.

Tab. 55 Nursery construction cost

Per Forest		Yearly Unit Price (Birr)	1	7	10	Total
Belete Forest						
Belete Nursery	Area (ha)		0.8			
(new)	Site construction (Birr)	12,000	12,000			
	Nursery Facility (Birr)	6,300	6,300			
	Subtotal		18,300			18,300
Gera Forest						
Chira Nursery	Area (ha)		1.0			
(new)	Site construction (Birr)	12,000	12,000			
	Nursery Facility (Birr)	2,100	2,100			
	Subtotal		14,100			14,100
Sedi Nursery	Area (ha)			1.0		
(reopened)	Site construction (Birr)	1,500		1,500		
	Nursery Facility (Birr)	2,100		2,100		
	Subtotal			3,600		3,600
Dedo-Boge	Area (ha)				0.8	
Nursery	Site construction (Birr)	1,500			1,200	
(reopened)	Nursery Facility (Birr)	2,100			2,100	
	Subtotal				3,300	3,300
	Total		**32,400**	**3,600**	**3,300**	**39,300**

(3) Buildings

(i) Main Office and Branch Offices

The construction cost of the main office and branch offices is based on the unit price costed for the new DADO building in Chira. The main office building will be constructed in the first year of the project. The unit price per square metre will be 690 Birr.

a. Main Office

690 Birr/m^2 x 420 m^2 = 289,800 Birr

b. Branch Offices

The branch office buildings in Chira and Belete will be constructed in the second and third year of the project respectively.

690 Birr/m^2 x 160 m^2 x 2 = 220,800 Birr

(ii) Staff Residence

The construction cost of staff residence is based on the unit price of a DA house. Two houses each will be constructed in the second, third and fourth years of the project. The unit cost

per square metre will be 350 Birr.

350 Birr/m^2 x 84 m^2 x 2 x 3 = 176,400 Birr

(iii) DA House

The construction cost of an existing DA house is shown in Appendix Tab. 50. Based on this example, the construction cost of a new DA house is shown in Tab. 56. The cost per house of 16,100 Birr means a total cost of 80,500 Birr for five new DA houses.

Tab. 56 Construction cost of new DA house (Standard type)

Building Type	Structure	Floor Area (m^2)	Unit Cost (Birr/m^2)	Cost (Birr)
DA House	wooden, single-story	40	350	14,000
Service quarter	wooden, single-story	6	350	2,100
Total				16,100
(Breakdown)	Material Cost			11,100
	Labour Cost			5,000

(iv) Forest Guard Dormitory

Two forest guard dormitory will be constructed in the second year, followed by one forest guard house each in the third and fourth years. One dormitory consists of five rooms. The unit cost per square metre (m^2) is set at 250 Birr.

250 Birr/m^2 x 60 m^2 x 2 + 250 x 60 m^2 x (1+ 1) = 60,000 Birr

Building construction cost is shown in Tab. 57.

Tab. 57 Buildings construction cost

(unit: Birr)

	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Main Office	289,800					289,800
Branch Office		110,400	110,400			220,800
Staff Accommodation		58,800	58,800	58,800		176,400
DA House	16,100	16,100	16,100	16,100	16,100	80,500
Forest Guard Dormitory		30,000	15,000	15,000		60,000
Total	305,900	215,300	200,300	89,900	16,100	827,500

3-5-6. Vehicle and Forest Guard Cost

(1) Vehicle Cost

Four-wheel drive vehicles : 8 × 470,000 Birr = 3,760,000 Birr
Medium-size trucks : 4 × 170,000 Birr = 680,000 Birr
Motorcycles : 54 × 25,000 Birr = 1,350,000 Birr

Tab. 58 Purchase cost for vehicles by year

(Unit: Birr)

		Year 1	Year 2	Year 3	Year 4	Year 5
Four-Wheel Drives	Quantity	2	1	1		
	Cost	940,000	470,000	470,000		
Trucks	Quantity	1	1			
	Cost	170,000	170,000			
Motorcycles	Quantity	8	2	2	10	4
	Cost	200,000	50,000	50,000	250,000	100,000
Total		1,310,000	690,000	520,000	250,000	100,000

		Year 6	Year 7	Year 8	Year 9	Year 10	Total
Four-Wheel Drives	Quantity	2	1	1			8
	Cost	940,000	470,000	470,000			3,760,000
Trucks	Quantity	1	1				4
	Cost	170,000	170,000				680,000
Motorcycles	Quantity	2	10	4	2	10	54
	Cost	50,000	250,000	100,000	50,000	250,000	1,350,000
Total		1,160,000	890,000	570,000	50,000	250,000	5,790,000

(2) Forest Guard Cost

The forest guard cost is set at 135 Birr per month (4.5 Birr/day).

Tab. 59 Forest guard cost by year

(Units: persons and Birr)

		Year 1	Year 2	Year 3	Year 4	Year 5	(Birr)
Forest Guards	Number	60	70	80	90	100	
	Personnel Cost	97,200	113,400	129,600	145,800	162,000	
		Year 6	Year 7	Year 8	Year 9	Year 10	Total
Forest Guards	Number	100	100	100	100	100	
	Personnel Cost	162,000	162,000	162,000	162,000	162,000	1,458,000

(3) Other

Tab. 60 Preservation for facilities

(unit: Birr)

	Year 1	Year 2	Year 3	Year 4	Year 5	
Maintenance of buildings, etc. and other	22,983	25,185	25,185	25,185	25,185	
	Year 6	Year 7	Year 8	Year 9	Year 10	Total
Maintenance of buildings, etc. and other	25,185	25,185	25,185	25,185	25,185	249,648

3-5-7. Staff Salaries

The monthly salaries of staff were calculated based on the following standards.

a. Project manager : 1,580 Birr
b. Department chief class : 1,350 Birr
c. Section chief class : 1,150 Birr
d. University graduate (A) : 980 Birr
e. University graduate (B), high school graduate (A) : 835 Birr
f. High school graduate (B) : 710 Birr
g. High school graduate (C) : 500 Birr

(1) First Year

$a \times 1 + b \times 3 + c \times 9 + d \times 4 + e \times (1 + 3) + f \times 15 + g \times 10 = 38,305$
$38,305 \times 12 = 459,660$ (Birr).....(1)

(2) Second Year onwards

$38,305 + e \times 2 + g \times 4 = 41,975$
$41,975 \times 12 \times 9 = 4,533,300$ (Birr) ..... (2)

(3) Total

(1) + (2) = 4,992,960 Birr

3-5-8. Total Project Cost

To sum up each project cost, the first year's total expenditure is 3 million Birr, due to initial investments such as for vehicle preparations. Total expenditures for the second and third years are in the 2 million Birr range, and the fourth and fifth are in the 1.5 million Birr range, but the total expenditures of the sixth, seventh and eighth years are in the 2 million Birr range due to vehicle renewals.

Tab. 61 Total project cost chart

(Unit: Birr)

Project Component	First Year	Second Year	Third Year	Fourth Year	Fifth Year
Prevention of Encroachment (Boundary Posts, etc.)	30,000	30,000	30,000	30,000	10,000
<Felling and Sales>	38,561	35,140	32,386	31,772	52,709
• Natural Forests (Cruising Cost)	2,250	3,000	3,750	4,500	5,250
• Forest Plantations	36,311	32,140	28,646	27,272	47,459
- Cruising Cost	10,930	9,271	6,082	7,392	13,947
- Cutting Cost	25,381	22,869	22,564	19,880	33,512
<Reforestation and Protection>	503,634	453,495	485,014	602,809	637,670
• Seedling Production	137,232	164,045	174,758	201,571	217,872
• Planting	93,192	111,360	118,644	136,812	147,900
• Tending	59,760	70,600	92,452	136,696	139,218
• Protection	213,450	107,490	99,160	127,730	132,680
<Social Forestry>	103,000	117,697	61,075	112,267	61,075
• Creation of School Nurseries	17,200	25,575	24,775	24,775	24,775
• Extension of Family Planting	10,000	14,400	22,300	14,400	22,300
• Buffer Zone Planting	14,000	77,722	14,000	73,092	14,000
• Extension of Apiculture	61,800	-	-	-	-
<Facility Improvement>	465,140	347,380	337,300	171,180	16,100
• Roads	126,840	132,080	137,000	81,280	-
• Nurseries	32,400	-	-	-	-
• Buildings	305,900	215,300	200,300	89,900	16,100
- Offices	289,800	110,400	110,400	-	-
- Residence and Dormitory	-	88,800	73,800	73,800	-
- DA Houses	16,100	16,100	16,100	16,100	16,100
<Others>	1,430,183	828,585	674,785	420,985	287,185
• Vehicles	1,310,000	690,000	520,000	250,000	100,000
• Forest Guards	97,200	113,400	129,600	145,800	162,000
• Others	22,983	25,185	25,185	25,185	25,185
Subtotal	**2,570,518**	**1,812,297**	**1,620,570**	**1,369,013**	**1,064,739**
Staff Salaries	459,660	503,700	503,700	503,700	503,700
Total	**3,030,178**	**2,315,997**	**2,124,270**	**1,872,713**	**1,568,439**

(to be continued)

Project Component	Sixth Year	Seventh Year	Eighth Year	Ninth Year	Tenth Year	
Prevention of Encroachment (Boundary Posts, etc.)	10,000	10,000	10,000	10,000	10,000	180,000
<Cutting and Sales>	45,262	70,665	61,161	88,285	125,223	581,174
• Natural Forests (Cruising Cost)	5,250	5,250	5,250	5,250	5,250	45,000
• Forest Plantations	40,012	65,415	55,911	83,035	119,973	536,174
- Cruising Cost	12,425	19,570	16,505	26,283	34,985	157,390
- Logging Cost	27,587	45,845	39,406	56,752	84,988	378,784
<Reforestation and Protection>	680,527	665,919	671,499	726,347	709,428	6,136,342
• Seedling Production	230,227	217,411	215,309	224,179	210,182	1,992,786
• Planting	156,276	147,576	146,160	152,148	142,680	1,352,748
• Tending	169,644	180,852	186,590	216,220	219,166	1,471,198
• Protection	124,380	120,080	123,440	133,800	137,400	1,319,610
<Social Forestry>	53,198	61,875	52,304	37,075	24,775	684,341
• Creation of School Nurseries	17,200	25,575	24,775	24,775	24,775	234,200
• Extension of Family Planting	14,400	22,300	14,400	12,300	-	146,800
• Buffer Zone Planting	21,598	14,000	13,129	-	-	241,541
• Extension of Apiculture	-	-	-	-	-	61,800
<Facility Improvement>	-	3,600	-	-	3,300	1,344,000
• Roads	-	-	-	-	-	477,200
• Nurseries	-	3,600	-	-	3,300	39,300
• Buildings	-	-	-	-	-	827,500
- Offices	-	-	-	-	-	510,600
- Residence and Dormitory	-	-	-	-	-	236,400
- DA Houses	-	-	-	-	-	80,500
<Others>	1,347,185	1,077,185	757,185	237,185	437,185	7,497,648
• Vehicles	1,160,000	890,000	570,000	50,000	250,000	5,790,000
• Forest Guards	162,000	162,000	162,000	162,000	162,000	1,458,000
• Others	25,185	25,185	25,185	25,185	25,185	249,648
Subtotal	**2,136,172**	**1,889,244**	**1,552,149**	**1,098,892**	**1,310,211**	**16,423,805**
Staff Salaries	503,700	503,700	503,700	503,700	503,700	4,992,960
Total	**2,639,872**	**2,392,944**	**2,055,849**	**1,602,592**	**1,813,911**	**21,416,795**

3-5-9. Revenue and Expenditure

(1) Revenue

(i) Natural Forest

As seen in the following Table, the harvest volume from natural forests will gradually be increased by avoiding a full operation from the first year. The revenue was calculated by multiplying the harvest volume of each year by the stumpage price (292.1 Brr/m^3).

Tab. 62 Annual harvest volume and revenue from natural forests

	Year 1	Year 2	Year 3	Year 4	Year 5	
Harvest volume (m^3)	3,000	4,000	5,000	6,000	7,000	
Revenue (Birr)	876,300	1,168,400	1,460,500	1,752,600	2,044,700	
	Year 6	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Total**
Harvest volume (m^3)	7,000	7,000	7,000	7,000	7,000	60,000
Revenue (Birr)	2,044,700	2,044,700	2,044,700	2,044,700	2,044,700	17,526,000

(ii) Forest Plantation

Thinning produces fuel, construction poles and general-purpose lumber. Volume produced by each species at each thinning stage is obtained from the aforementioned yield table. The price by species and lumber type is set by the Oromia regional government. An average price for each species at each thinning stage was then calculated (Appendix tab. 46). Sales revenue was obtained through the multiplication of felling volume and the average price (Appendix Tab. 47). The calculated result is as follows (Tab. 63).

Tab. 63 Annual revenue from forest plantations

Year	1	2	3	4	5	6	7	8	9	10	Total
Planned harvest volume (m^3)											
Thinning	11,194	11,394	10,140	12,284	13,122	15,393	19,595	13,189	20,882	30,466	157,659
Main harvest				1,553	2,495			5,063	3,423	4,011	16,545
Total (m^3)	**11,194**	**11,394**	**10,140**	**13,837**	**15,617**	**15,393**	**19,595**	**18,252**	**24,305**	**34,477**	**174,204**
Planned revenue (Birr)											
Thinning	873,427	1,068,065	1,286,248	1,168,793	1,126,929	1,753,891	2,323,909	1,656,840	1,896,154	2,987,156	16,141,412
Main harvest				261,209	238,273			851,597	575,749	674,650	2,601,478
Total (Birr)	**873,427**	**1,068,065**	**1,286,248**	**1,430,002**	**1,365,202**	**1,753,891**	**2,323,909**	**2,508,437**	**2,471,903**	**3,661,806**	**18,742,890**

(2) Revenue and Expenditure

Tab. 64 Revenue and expenditure summary chart

(Unit: thousand Birr)

	First Year	Second Year	Third Year	Forth Year	Fifth Year	Sixth Year	Seventh Year	Eighth Year	Ninth Year	Tenth Year	Total
Revenue (a)	1,750	2,236	2,747	3,183	3,410	3,799	4,369	4,553	4,517	5,707	36,271
Project cost	2,571	1,812	1,621	1,369	1,065	2,136	1,889	1,552	1,099	1,310	16,424
Staff salaries	460	504	504	504	504	504	504	504	504	504	4,996
Total expenditure (b)	3,031	2,316	2,125	1,873	1,569	2,640	2,393	2,056	1,603	1,814	21,420
a - b	-1,281	-80	622	1,310	1,841	1,159	1,976	2,497	2,914	3,893	14,851

Since figures of less than 1,000 Birr have been rounded, values may differ from those given in Table 61.

Although the first and second years will produce a deficit because of the initial investment required for the construction of the project office building and procurement of vehicles, etc., the balance will go into the black from the third year onwards. In the period from the fourth year to the seventh year, the surplus will fluctuate at the one million Birr level but will sharply increase from the eighth year due to additional revenue from main harvest at forest plantations.

These revenue and expenditure values have been estimated based on assumption of various prerequisites and do not guarantee an excess of revenue in later years as shown.

3-6. Initial Environmental Impact Assessment and Erosion Control Measures

3-6-1. Initial Environmental Impact Assessment

(1) Natural Environment

As the Forest Management Plan is about the utilizing existing natural forest resources in an effective and sustainable manner to ensure their conservation, it involves very few elements which are environmentally unsound. In particular, efforts to rehabilitate (regenerate) declining natural forests together with the reforestation of abandoned farmlands and grazing fields imply the expansion and improvement of forest resources. Sound forest management, therefore, contributes to environmental improvement. Logging methods with minimal impacts on the environment are employed in this Forest Management Plan.

(i) Rare species and Ecosystem

Diversification of vegetation and improvement of natural forests through natural regeneration and reforestation are believed to have favorable impacts on protection of wildlife habitat and ecosystem. Although felling temporarily causes changes in plant diversity and degradation of natural forests, its adverse effects would be minimal due to the employment of the selective felling and small felling area methods.

(ii) Soil and Land

Though logging operations on steep slopes can result in the loss of top soil and/or landslides, improved logging methods can reduce the adverse impacts of felling. In order to prevent erosion, landslide and damage to existing roads accompnied with the construction of new feeder roads, an erosion control plan has been formulated to incorporate slope protection works and the construction of drainage channels.

Reforestation of grassland, development of tree planting for firewood near villages and improvement (regeneration) of natural forests will prevent the degradation of land, conserve soil, and maintain soil fertility.

(iii) Hydrology and Water Quality

Although felling can temporarily cause changes to surface water flow, loss of top soil and pollution, improved felling methods and the promotion of natural regeneration are expected to enhance the flood and erosion control functions of forests. The reforestation of grassland and bare land, and the improvement of natural forests will have positive environmental impact, such as the improved microclimate and increased CO_2 fixation function.

(iv) Sustainability of Forest Resources and Functions

While felling reduces part of the forest resources, steady regeneration and planting will ensure the sustainability of forest resources as well as the environmental conservation function of forests.

(2) Social Environment

(i) Local Living Standards

Implementation of the Forest Management Measures would contribute to: (1) the upgrading of living conditions of local people by increased employment opportunities associated with reforestation and forest management practices; (2) improved living conditions due to the repair of roads; and (3) alleviation of women's hardships through the creation of firewood plantation near their villages (reduction of work and time involved in firewood collection).

(2) Social System and Customs

The various social forestry activities will further encourage local people to cooperate with each other and to organize their forest utilization rights, contributing to the revitalisation of communal activities.

Evaluation of Initial Environmental Impact

Impact		Evaluation					
		Forest Management Plan					
		Logging	Nursing	Reforestation	Natural Regeneration	Improvement and Construction of Forest Roads	Social Forestry
1. Rare species and Ecosystems							
1) vegetation change					+		
2) Decrease of biodiversity		△					
3) Degradation of natural forests		△			+		
2. Soil and Land							
Soil:	1)Soil erosion	○				△	
	2)Soil Acidification						
	3)Decrease of soil fertility				+		
Land	1)Land devastation			+	+		+
	2)Land slides	△				△	
3. Hydrology and Water Quality							
Hydrology	1)Changes of surface water flow	△			+		
	2)Sedimentation	△			+		
	3)Riverbeds rechannelling				+		
Warer Quality	1)Pollution	△					
	2)Eutrophication						
Atmosphere	1)Release of CO_2			+	+		
	2)Changes in microclimate			+	+		
4. Sustainability of Forest Resources and Functions							
1) Sustainability of raw material		△	+	+	+		
2) Sustainability of environmental conservation function			+	+	+		
5. Local Living Conditions							
1) Changes in lifestyle				+		+	
2) Reduction of women's workload labor							+
3) Economy				+		+	+
6. Social System and Tradition							
1) Forest utilization rights		△					+
2) Organization							+

◎ Negative ○ Somewhat negative △ Negative in certain cases + Positive

3-6-2. Erosion Control Measures

In the Intensive Study Area, striking erosion is found along roads in mountainous areas, on the forest floor of over-crowded forest plantations located on steep terrain, and in some areas of grazing fields.

(1) Existing Roads

Measures for the prevention of erosion on existing roads are dealt in Section 3-4-4.

(2) Forest Plantations

Results of soil survey conducted in forest plantations indicated that soil erosion mainly occurs in the *Cupressus lusitanica* forests, where the growth of forest floor vegetation is restrained due to extremely low level of light.

Adequate thinning should improve the situation; attention must be paid to the followings.

(i) Avoid planting *Cupressus lusitanica* on steep terrain
(ii) Plantmixed, rather than single species forests
(iii) Apply proper site preparation method based on topographical features:

(a) Leave pruned branches on the ground to: (1) keep soil moisture, (2) alleviate sheet erosion, and (3) furnish humus.

(b) Apply spot weeding to preserve ground cover when planting takes place in grasslands and open areas.

(3) Grazing Fields and Others

Appropriate measures would be taken at planting time for the following types of grasslands.

(i) Sheet erosion sites: introducing seedlings of soil conservation species, such as *Vetiveria zizanoides* (a perennial grass)

(ii) Gully erosion sites:
- masonry retaining walls
- wicker works (posts, which could be obtained from thinning plantations or bamboo thickets with woven small-diameter branches; placed along the contours of gullies to stabilize the slope surface.)

3-7. Management System

3-7-1. Management Organization

It has not been decided yet as to whether the Oromia Regional State Government, which is responsible for the Tiro Boter-Becho State Forest Project and other similar projects, or the JZADO will be responsible for the implementation of this Forest Management Plan. The implementing body of this Plan will be tentatively called the "Belete-Gera Forest Management Office".

In implementing the Forest Management Plan, the Management Office will play a central role in conducting the following activities (plans/programmes).

- Resource management
- Forest utilization
- Reforestation and protection
- Social forestry
- Infrastructure improvement and erosion control

As the Forest Management Plan involves many activities covering different areas, the management organization will consist of three divisions, nine sections (one being Audit Section directly under Project Manager) and one committee.

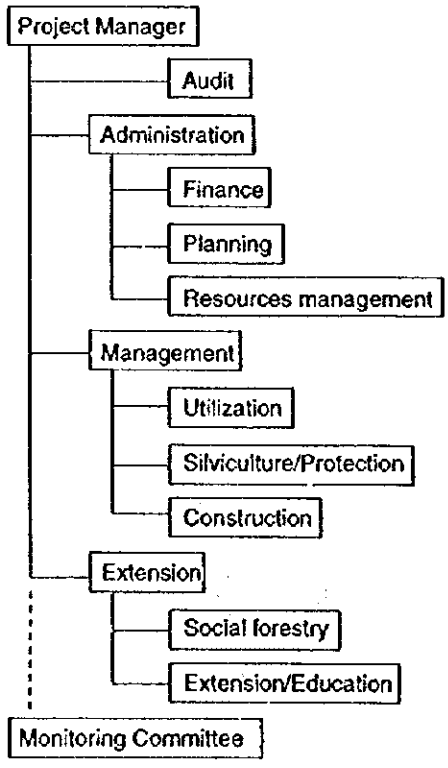

Fig. 15 Organizational Structure of Belete-Gera Forest Management Office

The Management Office will be staffed by the following members.

				Total
• Project Manager	:	1 (graduate)		1
Audit Section (Staff)	:	1 (graduate)		1
• Administration Division (Head)	:	1 (graduate)		1
Finance Section (Staff)	:	1 (graduate),	1 assistant	2
Planning Section (Staff)	:	1 (graduate),	1 assistant	2
Resources Management Section (Staff)	:	3 (graduates),	6 assistants	9
• Management Division (Head)	:	1		1
Utilisation Section (Staff)	:	2 (graduates),	4 assistants	6
Silviculture and Protection Section (Staff)	:	2 (graduates),	4 assistants	6
Construction Section (Staff)	:	2 (graduates),	4 assistants	6
• Extension Division (Head)	:	1		1
Social Forestry Section (Staff)	:	3 (graduates),	6 assistants	9
Extension and Conservation Education Section (Staff)	:	2 (graduates),	4 assistants	6
Total	:	21 (graduates),	30 assistants	51
• Monitoring Committee				
Some people				

Note: All assistants are senior high school graduates, others are university/college graduates.

Staff working at the branch offices are included in the above total. 40 and 60 forest guards will be assigned to Belete and Gera Forest respectively in addition. These forest guards will not be included as the regular staff members and their cost will be counted as variable cost.

Total personnel of the Management Office, including the Project Manager, will be 51 staff members (21 university graduates and 30 senior high school graduates) or 151 including the forest guards. Compared to the personnel of other projects, i.e. ca. 160 for the Tiro Boter-Becho State Forest Project and ca. 470 for the Munessa Shashemane State Forest Project, the planned number of personnel is lower. Given that the plan calls for various projects with different scales and the current manpower level of FWPT (nine), a rapid manpower increase should be avoided and the planned manpower should be reviewed when necessary.

3-7-2. Work Assignment

(1) Project Manager

The Project Manager supervises all the work of the Office and liaises as well as coordinates with upper and other organizations.

(2) Audit

The Audit Section is directly controlled by the Project Manager and is responsible for the appropriate execution of the budget and control of project implementation.

(3) Divisional Heads

Each Divisional Head controls the Sections in his/her division and coordinates the activities among them.

(4) Finance Section

The Finance Section controls the revenue and expenditure.

(5) Planning Section

The Planning Section examines the project implementation results of the previous year and prepares the project implementation plan for the next year in line with the Forest Management Plan.

(6) Resource Management Section

The Resources Management Section is responsible for the formulation and implementation of measures to prevent forest encroachment, which is an important objective of the Forest Management Plan, to control the coffee plantations inside natural forests and relocate encroachers. An effective measure to prevent forest encroachment is to strengthen the duty of forest guards on an enforcement together with their appropriate deployment. At present, forest guards are deployed in the Belete-Gera NFPA but do not function effectively because of the following reasons.

- Patrols are not conducted due to the lack of appropriate vehicles.
- Some forest guards are outside the jurisdiction of the FWPT because they belong to the DADO.
- The salary level is low.

Given the above mentioned reasons, it is proposed to assign forest guards to the Management Office to strengthen their duty and to ensure their appropriate deployment.

(7) Utilisation Section

The Utilisation Section is responsible for the general utilisation of forest products. Its major activity are felling, including thinning, and sales.

(8) Reforestation and Protection

The Reforestation and Protection Section is responsible for planting, tending and protection of the forest and seedling production.

(9) Construction Section

The Construction Section is responsible for the improvement of facilities, including road repair, nursery improvement, construction of protection facilities and construction of buildings.

(10) Social Forestry Section

Social forestry targets local people and its implementation requires the cooperation and mutual complementation of the Management Office, schools and local communities. The Social Forestry Section is responsible for the implementation of Social Forestry Measures, except for extension and conservation education described below. See 3.4.3 for the detailed social forestry implementation system and work assignment.

(11) Extension and Conservation Education Section

The Extension and Conservation Education Section is responsible for the extension of social forestry and agroforestry and for education on forest conservation for local people. It is also responsible for measures relating to gender and development and also for poverty alleviation.

3-8. Monitoring

There are three types of monitoring, i.e. implementation monitoring, effectiveness monitoring and validation monitoring.

Implementation monitoring examines all aspects of project implementation to check if the project is being implemented as planned.

Effectiveness monitoring examines whether or not project implementation has proved effective in achieving the project objectives. It is only conducted when the implementation monitoring is judged to be properly smoothly implemented.

Validation monitoring examines whether or not the originally adopted plan strategy is appropriate or is the best conceivable method.

In addition, evaluation of the project could be organized by the Regional State of Oromia including outside and independent expertise as members of the evaluation team.

3-8-1. Resource Management

(1) Control of Encroachment of Natural Forests

Targets:

Under the forest management plan, an annual planning target for the prevention of encroachment expansion is introduced while aiming at eliminating encroached land at the end of the plan period.

Implementation Monitoring:

The Belete-Gera Forest Management Office will conduct implementation monitoring to check the implementation of various work in compliance with the original plan. This monitoring will be conducted from the viewpoint of checking the actual results of various work and of general forest management. Monitoring will be conducted every year with a view to preventing new encroachment and also every three to four years in the case of reclaiming already encroached land. The following subjects must at least be included in this monitoring work.

(i) Relationship with PAs

How many PAs are contacted; how many meetings are held to explain the purposes of encroachment prevention; how many consultation meetings are held

(ii) Boundary Demarcation

How many kilometres of boundary are demarcated and in what manner

(iii) How many patrol rounds are conducted and what discoveries are made

Effectiveness Monitoring:

Effectiveness monitoring is only conducted when implementation monitoring has judged that the project has generally been smoothly implemented as planned. The Belete-Gera Forest Management Office and the Oromia Regional State Government will conduct this monitoring, the schedule of which will be the same as that of the implementation schedule. Special attention should be paid to the following points:

(i) Whether or not new encroachment has taken place in the Intensive Study Area

(ii) How many hectares of encroached land have been reclaimed

Validation Monitoring:

Validation monitoring will also be conducted by the Belete-Gera Forest Management Office and the Oromia Regional State Government. It will be conducted at the halfway and end of the plan period, i.e. at the end of the fifth year and tenth year respectively. This monitoring is designed to examine the reasons for the success or failure of the project in detail. In addition, cost-benefit analysis will be conducted with a view to considering other strategic alternatives. At least the following points should be incorporated in the validation monitoring.

(i) Has patrolling proved to be effective in the prevention of encroachment

(ii) Have buffer zone plantations solved the local shortage of firewood and, at the same time, proved to be effective in the prevention of encroachment in natural forests

(iii) Has the provision of education for local people proved to be effective in the prevention of encroachment

(iv) Has clear boundary indication proved to be effective in control encroachers as well as in the prevention of encroachment

(v) Has encroachment prevention or the resettlement programme proved to be a cost effective measure to prevent the depletion of forests.

(2) Coffee Production

Targets:

In order to control coffee production in natural forests, (i) a license system will be introduced so that all coffee plantation sites are registered by the end of the forest management plan period with a view to establishing a complete picture of local coffee production activities and (ii) the introduction of agroforestry will be promoted at coffee production sites.

Implementation Monitoring:

The Belete-Gera Forest Management Office will be responsible for implementation monitoring which will be conducted at the end of each year. The main monitoring items are as follows.

(i) How many coffee plantations and coffee bean collecting sites, and of what size are registered and licensed.

(ii) How many coffee production areas have their forest condition improved.

Effectiveness Monitoring:

The Belete-Gera Forest Management Office will be responsible for this monitoring which will be conducted if the implementation monitoring has found to be favorable. Special attention should be paid to the following points.

(i) Does the license system function effectively

(ii) Is the issue of licenses and administrative control conducted without delay

(iii) Do the licensees abide by the rules

(iv) How large is the unregistered area

Validation Monitoring:

The Belete-Gera Forest Management Office and the Oromia Regional State Government will be responsible for validation monitoring which will be conducted at the end of the fifth and tenth years if the effectiveness monitoring has found unsatisfactory. The causes of failure will be examined with a view to formulating new measures.

3-8-2. Felling, Reforestation and Protection

Through monitoring implementation of the felling, reforestation and protection plan, whether or not resources are being utilized and conserved properly can be grasped. Based on the monitoring results, adjustments shall be made to each project component when necessary. Each of the above-mentioned plans shall be verified, against at the time of budget formation, the execution results (implementation monitoring), and validation monitoring shall basically be carried out at the interim point (fifth year) and completion point (tenth year) of the project period. Following are the items to be given priority when carrying out the monitoring.

(1) Natural Forest Felling

Target:

In carrying out the selective felling operation, ensure that a sound stand is preserved through setting appropriate felling sites and areas, selecting trees for felling (species and timber volume, etc.), executing the felling and constructing logging roads.

Implementation monitoring:

The Belete-Gera Forest Management Office shall conduct this monitoring at the end of each year. The main contents are as follows.

(i) Check and record of the state and length, etc. of existing and new logging roads.
(ii) Check and record of felling sites and felling areas.
(iii) Check and record of the logging volume and number of felled trees by species.

Effectiveness monitoring:

This shall be implemented only when necessary. Contents are the same as those for implementation monitoring.

Validation monitoring:

The Belete-Gera Forest Management Office and JZADO's Land Use and Environmental Protection Teams especially maintenance of logging road, shall implement monitoring, once every five years. The main contents are as follows.

(i) Check that appropriate logging road have been constructed and are not adversely affecting the surrounding areas
(ii) Check that felling methods are appropriate and are not causing damages to surrounding areas
(iii) Check that selected trees are appropriate and that mother trees and successor trees are growing

(2) Reforestation

It is important to monitor the planting of indigenous species, for which the target has been set to 20% of the total plantation areas. This monitoring is outlined below.

Target:

Improving indigenous species nursery and planting techniques.

Implementation monitoring:

The Belete-Gera Forest Management Office shall conduct this monitoring at the end of each year. The main contents are as follows.

(i) The achievements on locating trees for seeds collecting determing the right season for seed collection, improving seedling survival rate, and raising targeted number of seedlings for planting, etc.
(ii) Planting sites, area and the implementation of site preparation, etc.
(iii) Survival rate, the implementation of weeding, supplementary planting rate, etc.

Effectiveness monitoring:

This shall be implemented only when necessary. Contents are the same as those for implementation monitoring.

Validation monitoring:

The Belete-Gera Forest Management Office and FRC shall conduct this monitoring once every five years. The main contents are as follows.

(i) Appropriateness of seedling raising methods
(ii) Appropriateness of weeding frequency
(iii) Appropriateness of planting intervals (distance between trees)
(iv) Appropriateness of the selection of species for planting

3-8-3. Social Forestry

(1) School Nurseries

(i) Monitoring Implementing Parties

Third parties including people in charge of monitoring committee, etc.

(ii) Implementation Monitoring

Targets: Coordinate and improve project operation.
Encourage the participation of pupils in seedling raising activities.

Method: In understanding the state of progress in nursery management, provide objective indicators through, for example, preparing check lists. At appropriate times, listen to the thoughts of children regarding their participation in silviculture activities.

Contents: Project operation, budget and expenditure, project achievement rate, project effect, impact on local society, state of pupils participation, etc.

(2) Family Planting Extension

(i) Monitoring Implementing Parties

Third parties including people in charge of monitoring committee, etc.

(ii) Implementation Monitoring

Targets: Coordinate and improve project operation.
Promote the supply of seedlings required by residents.

Method: In understanding the state of progress in nursery management, provide objective indicators through, for example, preparing check lists. Have an understanding of the number of seedlings produced in nurseries. Carry out questionnaire surveys of local people.

Contents: Project operation, budget and expenditure, project achievement rate, project effect, level of citizen satisfaction, etc.

(3) Buffer Zone Planting

In this programme, since resident participation is planned in the programme preparation stage, it is necessary to carry out monitoring from this stage.

(i) Monitoring Implementing Parties

Third parties including people in charge of monitoring committee, etc.

(ii) Implementation Monitoring

a. Monitoring at the programme preparation stage

Targets: Encourage sufficient people's participation during the programme preparation stage.
Prepare a programme that reflects the wishes of local people.

Method: Checking at all times during programme compilation
Examination of the prepared draft programme

Contents: Specific indication of the execution, setup and division of roles, programme appropriateness, people's participation conditions

b. Monitoring at the plantation execution stage

Targets: Coordinate and improve programme operation.
Encourage people's participation in plantation activities.
Conditions of managing plantation areas
Gauge the degree of satisfaction of local people.

Method: In understanding the state of progress in programme implementation, provide objective indicators through, for example, preparing check lists. Get report on the state of people's participation from DA. Carry out questionnaire surveys of local people. Get report on the conditions of plantation management from forest guards.

Contents: Project operation, budget and expenditure, project achievement rate, project effect, people's participation conditions, level of local people satisfaction, etc.

(iii) Effectiveness Monitoring

Contents: People's participation and management operation at the programme preparation stage and the plantation execution stage

(iv) Validation Monitoring

Contents: Appropriateness of *Eucalyptus* spp. planting
Degree of resolution of the fuel shortage problem in community
Effectiveness of natural forest encroachment prevention

(4) Apiculture Guidance and Extension

(i) Monitoring Implementing Parties

Third parties including people in charge of monitoring committee, etc.

(ii) Implementation Monitoring

Target: Coordinate and improve project operation.
Method: Carry out surveys of committee members and local people.
Contents: Project operation, budget and expenditure, project achievement rate, project effect, etc.

(iii) Effectiveness Monitoring

Contents: Level of improvement in cash income
Situation regarding reduction in bark peeling damage
Situation regarding improvement in the quality of honey

(iv) Validation Monitoring

Target: Grasp the level of appropriateness of the implementation plan.
Method: Conduct validation monitoring
Carry out hearing surveys of committee members and local people.
Contents: Appropriateness of the method for understanding improvement points
Appropriateness of the guidance and extension method
Level of utilization of extension pamphlets

Apart from this, evaluation of the project could be organized by the Oromia Regional State Government including outside and independent expertise as members of the evaluation team.

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