2-7. Land-use/Vegetation Survey

2-7-1. Objectives

The objective of land-use/vegetation survey in the Study Area (2.7 million ha) was to understand the distribution of forests. In order to achieve this objective, the forest location map (1/250,000) was prepared from existing maps and aerial photographs taken in 1996 and 1997 during the Study.

In the Intensive Study Area the following were the objectives:

- to produce a 1/50,000 scale Land-use/vegetation map
- to understand the current land-use situations and to identify its impacts and conflicts

Forests in the Intensive Study Area were classified into six types. The Land-use/vegetation map was prepared to depict the distribution of these types. For each forest type, forest survey was conducted to determine an average stand volume. Based on the demarcation of forest types on the map, each forest type was further delineated into forest compartments, which serve as the smallest management unit area for the Forest Management Plan. Multiplication of the average stand volume and the area of a forest compartment, therefore, produces the stand volume of the forest compartment, which is important for the formulation of Forest Management Plan.

The objectives of investigating the current land-use situation are to gather data for formulating an effective Resource Management Plan and to find solutions when conflicts among land-use practices occur. In the Intensive Study Area, the loss of natural forest by encroachment for farmland and coffee plantations has been causing concerns among the authorities for a long period of time. However, little investigation has been conducted to clarify extent and, mechanism of deforestation. It was essential that this information be obtained in order to prepare an effective Resource Management Plan.

2-7-2. Survey Method

(1) Forest Location Map

A forest location map of the Study Area is produced by interpreting aerial photographs and carrying out field surveys. An expert was assigned for the interpretation and transcription of aerial photographs into maps.

The expert was nominated by FWCDD on his experience in aerial photograph interpretation and mapping and joined the Survey Team. The work for the forest location map was divided into two terms, and accordingly two contracts were signed with the expert in April 1996 and May 1997.

(2) Land-use/Vegetation Map

A preliminary Land-use/vegetation map of the Intensive Study Area was prepared by interpreting aerial photographs. While the contact prints of aerial photographs were mostly used, enlarged prints were adopted for forest plantations and other forests which require refined demarcation. Land-use status and forest type distribution were classified on the aerial photographs. And accuracy of this classification was checked by a field survey. The transcription of the demarcations from aerial photographs to 1/50,000-scale topographical maps was commissioned to the same expert. After some corrections, a Land-use/vegetation maps were produced.

(3) Land-use

The current land-use situation was investigated through analyses of aerial photographs, on-site studies and by interviewing farmers and village/district officials. An encroachment distribution map was produced to determine the current state of encroachment into natural forests. Slope and watershed maps were prepared to analyze encroachement patterns, identify critical areas and assess the risk of future encroachment.

The encroachment map was produced on the basis of interviews with the counterpart of JZADO and an analysis of aerial photographs. Understandably, the information provided by the counterparts was limited to the sites they had frequently visited and was of relatively easy access. The longest service period of the interviewed counterparts in Jimma was four years and sets the time frame for the occurrence of encroachment identified on the map.

As for remote sites and other locations with difficult access, encroachment areas were identified by evaluating the size, shape, position and soil color of bare grounds on aerial photographs. These areas have resulted perhaps from recent encroachment with a time frame of 2 to 3 years. The encroachment map is used to: (a) determine the extent of encroachment, (b) classify encroachment characteristics and patterns, and (c) set priorities on locations requiring rehabilitation.

The impact of coffee plantations on natural forests was investigated through interviews with district officials, JZADO and farmers, through analyses of forest survey results, and through on-site studies of coffee plantations and coffee beans collecting sites.

2-7-3. Forest Location Map

British ODA carried out a forest resource survey in southwestern Ethiopia in 1979 (Dr. Chaffy). In his survey 1/250,000-scale forest distribution maps were produced from aerial photographs taken between 1971 and 1975. By adopting Chaffy's forest classification, the following were employed in the preparation of forest location maps for the Study Area:

- Closed high forest
- Disturbed forest
- Heavily disturbed forest
- Woodland
- Bamboo thicket
- Non-stocked forest lands

2-7-4. Land-use/Vegetation Map

Forest and non-forest lands were classified as follows in the production of the Land-use/vegetation map:

Tab. 4 Classification of Land-use/vegetation types and areas

Classification	Sub-classification	symbol	Crown Density	Area (ha)
Forest land	Closed high forest	F1	75% ≤	64,314.0
	Disturbed forest	F2	51% to 74%	18,258.0
	Heavily disturbed forest	F3	20% to 50%	23,810.0
	Under-stocked forest	F4	< 20%	3,096.0
	Forest plantation	PL		1,103.5
	Bamboo thicket	BT		2,232.0
Non-forest land	Farmland, grazing field and village	OT		35,574.0
	Marsh	M		560.0
Total				148,947.5

(1) Forest Classification

It was not possible to identify and classify plant communities and their dominate species (other than bamboo thickets) from aerial photographs. Furthermore, many plant communities have been disturbed by human activities. For these reasons, it was considered more appropriate to classify forests on the basis of stand volume rather than forest composition.

In attempting to classify forests by stand volume, crown density was employed as the most reliable factor obtainable from the aerial photographs. Crown density is known to be highly correlated with the total D.B.H which in turn is highly correlated with stand volume. Also, crown density reflects the degree of human disturbance.

Based on crown density, forests in the Intensive Study Area were classified into six types: (a) closed high forest (F1 forest), (b) disturbed forest (F2 forest), (c) heavily disturbed forest (F3 forest), (d) under-stocked forest (F4 forest), (e) forest plantation, and (f) bamboo thicket. F4 forests include 1) areas where encroachment is at its initial stage and few trees are still present, and 2) rocky areas where the growth of trees is restricted.

Bamboo thickets and forest plantations were easily identifiable on aerial photographs. The distinguishable factors were crown density, tree height, crown shape, color, pattern and texture. Banboo thickets have small uniform crowns of high density. On aerial photographs, their canopy appears flat, finely textured and light gray, lighter in color than other forest types.

Forest plantations have crowns that are similar in size and shape and are lined up, and their boundaries usually run in straight lines. A forest plantation consists of single species of the same age, so that it was possible to distinguish one forest plantation from another by different color tones on aerial photographs. However, as poorly managed forest plantations are often invaded by broad-leaved species, it was sometimes difficult to draw a boundary between forest plantations and surrounding natural forests on aerial photographs. In such cases, the border of a forest plantation was determined by on-site surveys.

In the Intensive Study Area, forest plantations are concentrated in Belete Forest area. JZADO conducted a forest survey of these Belete Forest plantations in 1994-96. This survey classified the forest plantations by species and age. On the Land-use/vegetation map, such a detailed delineation is not described but as forest plantations.

(2) Classification of Non-forest Lands

Non-forest lands in the Intensive Study Area are comprised of farmlands, grazing fields, villages and marshes. Farmlands, grazing fields and villages are grouped together because: firstly, many farmlands are used for direct-sowing cultivation and are practically indistinguishable from grazing fields on aerial photographs; secondly, the boundaries of villages are hard to define and houses are scattering across the farmlands and grazing fields. A house symbol is used to mark the locations where the area of farmlands, grazing fields, villages is too small to describe on the map.

(3) Legends

Legends for Land-use/vegetation maps are provided in Tab. 4 under the category for sub-classification, which includes the above-mentioned small-sized farmlands. The legends are described in English only.

(4) Zone Area

The smallest mapping unit in the Land-use/vegetation map are 40 ha except the forest plantations, where detailed maps are available from the JZADO survey conducted in 1994-1996. During this survey, these maps were checked by aerial photograph interpretation and field surveys. The corrected boundary lines were then drawn on the Land-use/vegetation map.

Fig. 6 shows the percentage of each land-use/vegetation type in the Belete and Gera Forest.

Tab. 5 Areas (ha) of Land-use/vegetation types in Belete and Gera Forest

Sub-classification (Symbol)	Names of Forest		Total
	Belete	Gera	
Closed High forest (F1)	6,695.0	57,619.0	64,314.0
Disturbed forest (F2)	2,455.0	15,803.0	18,258.0
Heavily Disturbed forest (F3)	6,752.0	17,058.0	23,810.0
Non-stocked forest (F4)	1,351.0	1,745.0	3,096.0
Forest plantation (PL)	918.7	184.8	1,103.5
Bamboo Thicket (BT)	153.0	2,079.0	2,232.0
Marsh (M)	0.0	560.0	560.0
Farmland, grazing field and village (OT)	17,109.0	18,465.0	35,574.0
Total	**35,433.7**	**113,513.8**	**148,947.5**

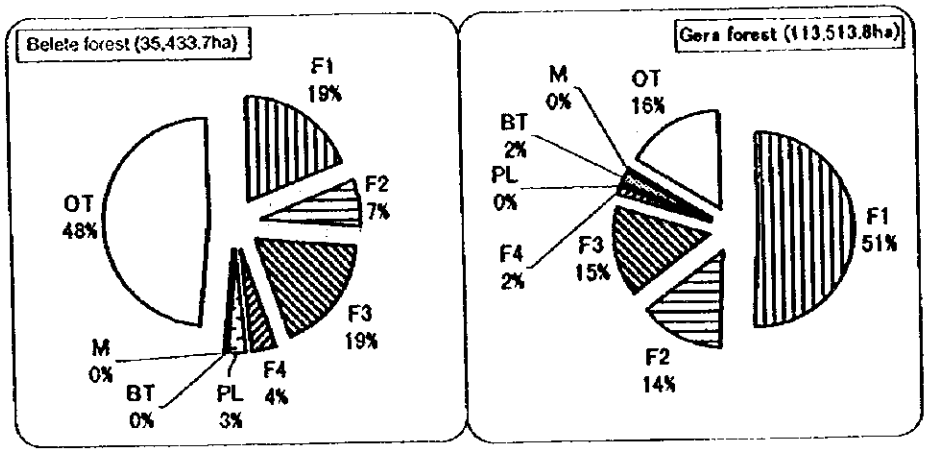


Fig. 6 Areas of Land-use/vegetation types in Belete and Gera Forests

Of the total 148,947.5 ha Intensive Study Area, the Belete Forest accounts for 23.8% and the Gera Forest for 76.2% of the total. The largest portion, 43.2%, or 64,314 ha, of the Intensive Study Area is classified as F1 forests, followed by farmlands (OT), F3 forests, and F2 forests in descending order. Marshes attribute only for 0.4% (560 ha) of the total area. The sum of the F1 and F2 forests, which are the forests least disturbed by human activities, accounts for 55.4% or 82,572 ha of the Intensive Study Area. The sum of farmlands (OT) and F4 forests, which had received the most disturbance, accounts for 26.0% or 38,670 ha of the area.

Comparison of Belete with Gera shows that the F1 and F2 forests combined account for 25.8% of the total Belete Forest area, while that of the Gera Forest is 64.7%. In Belete Forest F4 forest and land classified as others occupy more than half (52.1%) of the area, but in Gera Forest they only account for 17.8% of the area.

It is obvious that Belete Forest is under more deforestation pressure than Gera Forest. It should be understood that the forests in the Intensive Study Area are obviously under pressurs

from other land-use practices. Disturbance is particularly severe in Belete Forest, where only a small portion of the forests are undisturbed. This alarming situation was fully taken into consideration in preparing the Forest Management Plan.

2-7-5. Current Land-use Situation and Related Issues

(1) Current land-use types and vegetative cover

The land-use and vegetative cover in the Intensive Study Area are classified as forest and non-forest land. Forest land is further divided into plantations (PL), closed high forest (F1), disturbed forest (F2), heavily disturbed forest (F3), non-stocked forest (F4), and bamboo thicket (BT). Non-forest land includes; marsh, logging road, and others (farm land, grazing field, and villages).

A household is the basic social unit in land classified as "others". Typically one household owns approximately 1 to 5 ha of farm land, grazing field, and in some cases homestead plantation (Fig. 7 and 8). Homestead plantation can be found in some households and occurs in the form of rows marking the boundary or as a small block in the farm land. Mostly the homestead plantation is of eucalypts. The size and the location of eucalypts plantations are carefully chosen by farmers so that the trees will not compete in water stress with other crops and pasture grasses.

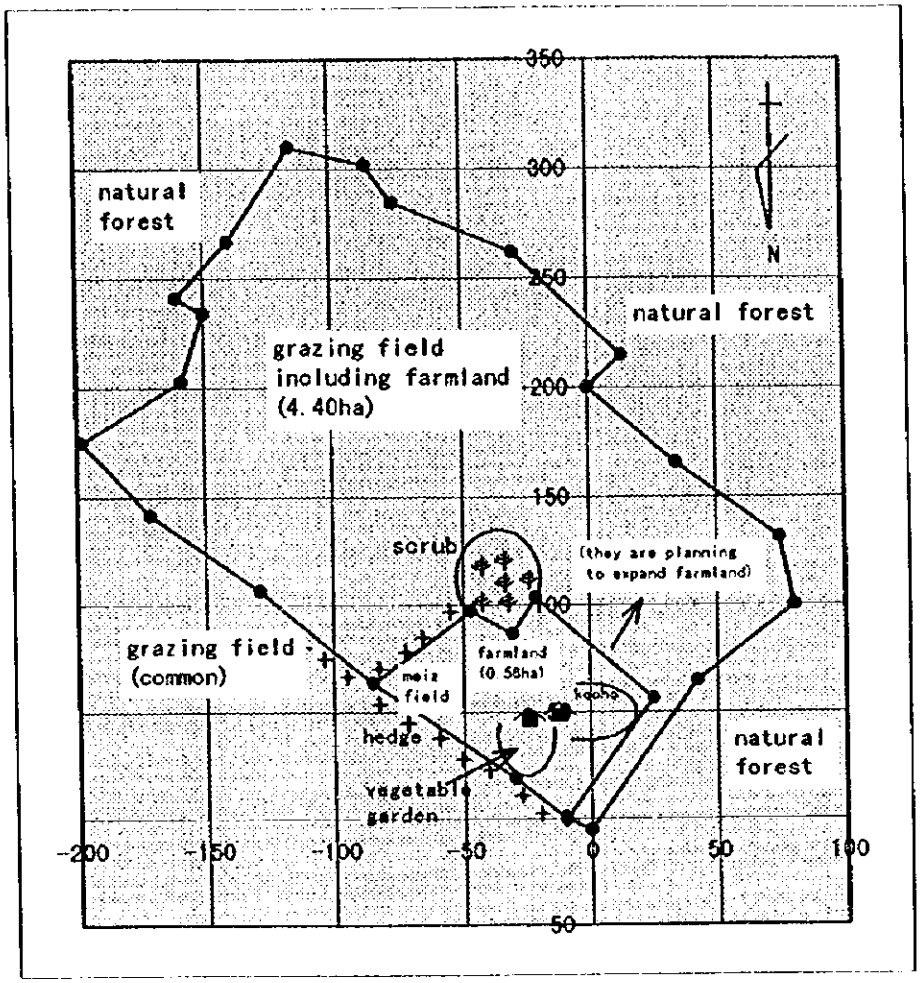
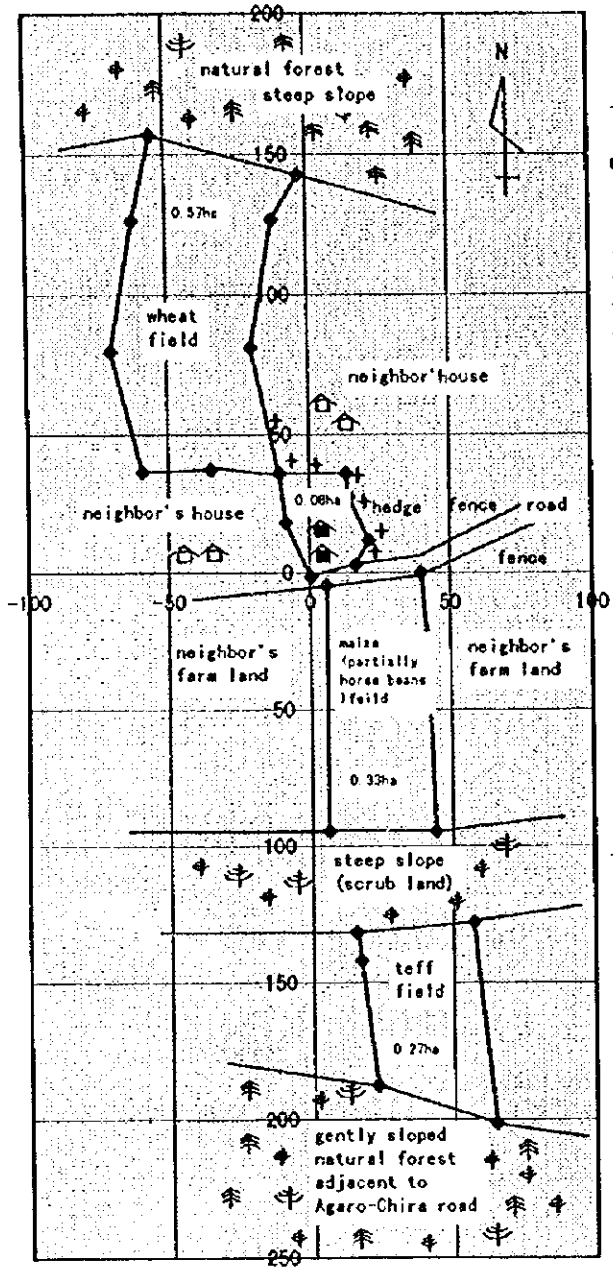


Fig. 7
Layout of Land-use types in a typical big household
(located in the most eastern part of Yukuro Community, Sedi PA)



→He says that he has no intention of cut open this natural forest.

→He says, however, that he planted wheat for the first time and that the area used to be a grazing land. (wheat production season: June ~ December)

→Around the house he has a small vegetable garden of pumpkin, chili, and onion. He says the people from the north do not like Kocho (enset).

→The season for maize growing is from January through July. After that period, he will grow either horse beans or barley depending on how much rainfall he will have.

→He says that ha has done teff growing for the first time. Next year onward he says he will expand teff growing into the natural forest below. He is not intending to grow coffee in the natural forest since he is not familiar with the techniques.

Fig. 8
Layout of Land-use types in a typical small household (a farmer who settled in the most western part of Yukuro community, Sedi PA)

A household has an exclusive usufruct for its farm land paying tax, but the right for the grazing field is not exclusive, though tax is levied. Tax rate is tiered, 10 birr for areas up to 1.0 ha; 17.5 birr for areas more than 1.0 ha, but less than 1.5 ha; 35 birr for areas between 1.5 ha and 2.5 ha; the highest rate 447 birr for areas up to 30 ha.

The grazing field used by households is normally owned by the community and is not monopolized by any group or person. However, to keep the milk cows and calves near the household, small area of grazing field is occupied exclusively.

Several households make a community and several communities constitute a Village (Ganda in [Oromiffa], Kabele in [Amharic]). At the Village level, various communal services, such as road, school, clinic ... etc. are provided. Schools sometimes hold farmlands for education and income generation. Common properties shared by the villagers, for example, could be common grazing field and community forest. From the community forest, villagers can collect dead branches for firewood or construction wood after obtaining a permission from the PA. PA exerts its authorities on matters concerning the common properties through a council of elected villagers.

The size of a Village is fixed at 800 ha in principle, though many exceptions exist. The number of households in each Village varies, ranging from tens to hundreds. Tab. 6, 7 and Fig. 9, 10 illustrate the areas of major land-use/vegetation types and populations of all the Villages in Intensive Study Area.

Tab. 6 Areas (ha) of major Land-use/vegetation types in Belete area

Village	Code	Farmland	Grazing field	Forest	Waste land	Total	Population
Elke Togobe	El To	1,040	80	160	200	1,480	7,111
Atro Sufa	At Su	510	20	90	20	640	3,511
Mirgano Baso	Mi Bo	720	200	480	80	1,480	5,546
Kishe	Ki	2,118	50	10	422	2,600	4,831
Yanga Deo	Ya De	780	200	920	320	2,220	4,350
Sabaka Debiye	Sa De	612	40	1,298	50	2,000	2,762
Atro Gafere	At Ge	844	157	32	40	1,073	4,120
Sonbo Daru	Se De	922	240	20	218	1,400	6,496
Komo Hari	Ko Ha	1,000	120	60	20	1,200	6,148
Shebe Mofa	Sh Mo	924	66	200	450	1,640	3,897
Total		**9,470**	**1,173**	**3,270**	**1,820**	**15,733**	**48,772**

Tab. 7 Areas (ha) of major Land-use/vegetation types in the Gera Area

Village	Code	farmland	grazing field	forest	waste land	total	population
Gada Kashimairi	GK	427	171	130	22	800	1,434
Guba Korro	Gko	466	116	182	36	800	1,260
Gutte	Gu	320	160	212	108	800	695
Dusta	Du	425	106	153	116	800	3,537
Kombolcha	Km	392	98	243	67	800	2,383
Gemina	Ge	40	0	760	0	800	592
Oba	Ob	160	40	600	0	800	911
Dacholaki	Da	280	120	400	0	800	226
Wala	Wa	495	105	200	0	800	577
Gura	Gu	440	80	280	0	800	323
Kelaherere	Ke	160	120	520	0	800	1,250
Afalo	Af	80	40	680	0	800	141
Anderacha	An	130	38	672	10	800	178
Chala	Ch	320	80	600	0	1000	777
Selaja	Se	480	80	160	80	800	1,689
Gera	Ge	90	45	840	25	1000	685
Kobokocho	Ko	500	200	100	0	800	2,227
Gure Kesso	Gke	440	60	290	10	800	1,089
Nasawabo	Na	150	10	340	0	500	298
Muje	Mu	800	160	40	0	1000	3,504
Sadi	Sa	480	20	300	0	800	2,241
Kola Sulaja	KS	300	80	420	80	800	1,782
Total		**7,375**	**1,929**	**8,122**	**474**	**17,000**	**27,799**

Villages constitute a District (Ana in [Oromiffa], Woreda in [Amharic]). Within a District the Agriculture Development Office of the Ministry of Agriculture serves the community by providing coffee and tree seedlings as well as technical assistance. In Intensive Study Area there are two Districts, Gera and Seka Chekorsa. The forest in Gera is called Gera Forest and the one in Seka Chekorsa, Belete Forest. More forest lands are found in Gera District than in Seka Chekorsa District (Tab. 6, 7 and Fig. 9, 10).

From the interest of the local communities, coffee production, firewood collection and obtaining construction poles are major land-use patterns on the forest land. The production of coffee is done in the following three manners: (1) coffee beans collection from wild coffee in the natural forest, (2) coffee planting in the natural forest, and (3) coffee planting on household land (homestead coffee plantation, also called coffee garden in Gera District). Most of them involve intensive management activities, which include thinning and planting of shade trees (in case of homestead coffee plantation), weeding, eliminating middle and lower layer trees, preparing forest floor, and pruning (stumping) of the coffee plants. Coffee wildings are also collected by the farmers for plantation or for sale in the market. Coffee production is more

commonly practiced in Gera District their in Seka Chekorsa District. There are 16 villages fully dependent on coffee production in Gera District. Detailed description on firewood collection is presented in the Social Forestry Survey Section.

Other forest land-use practices are timber production, honey production and herb, nuts, and spices collection. The scale of honey production, herb, nuts, and spices collection is very limited. Detailed description for timber production is given in the Forestry Operation Survey Section.

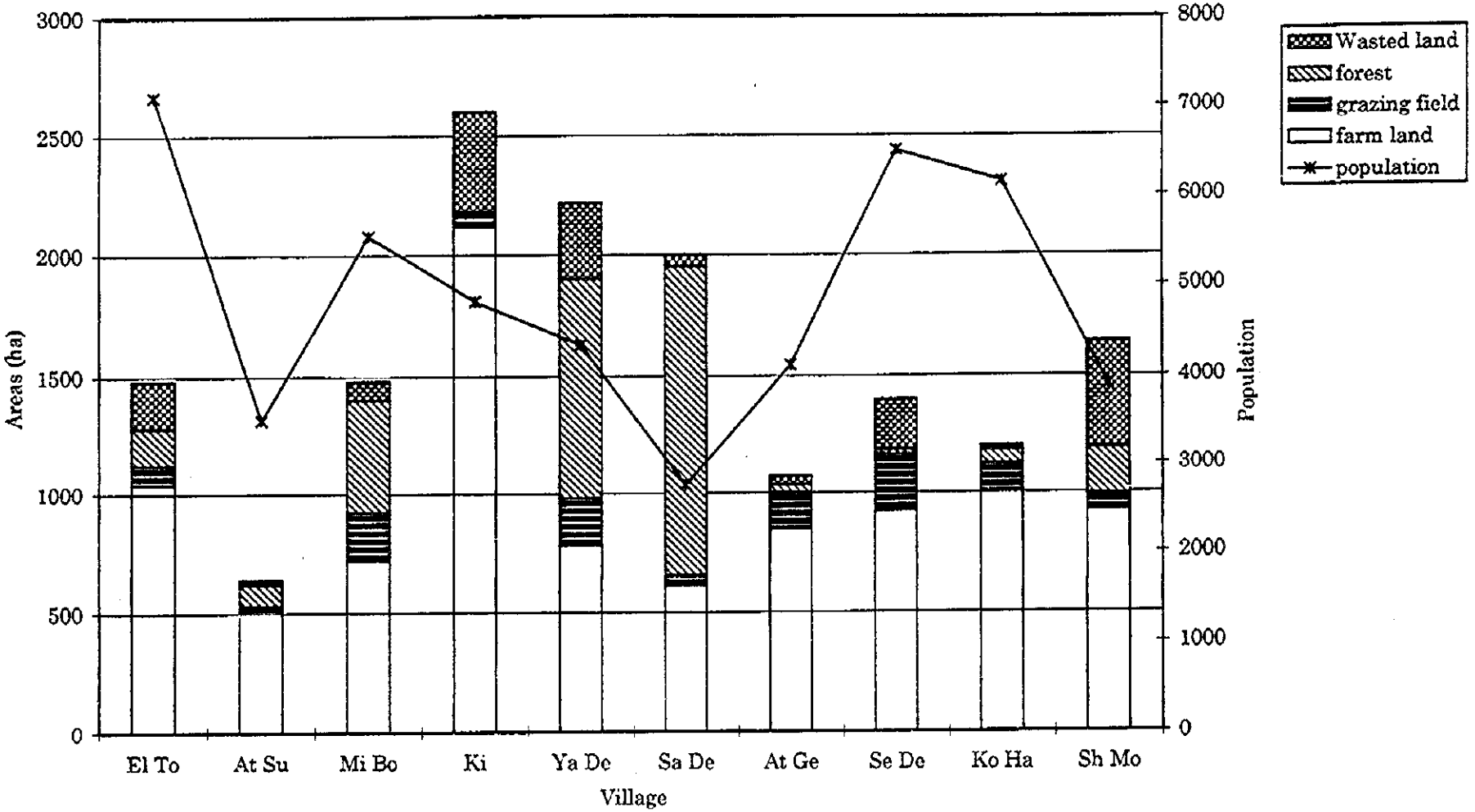


Fig. 9 Areas of major Land-use/vegetation types in the Belete Area

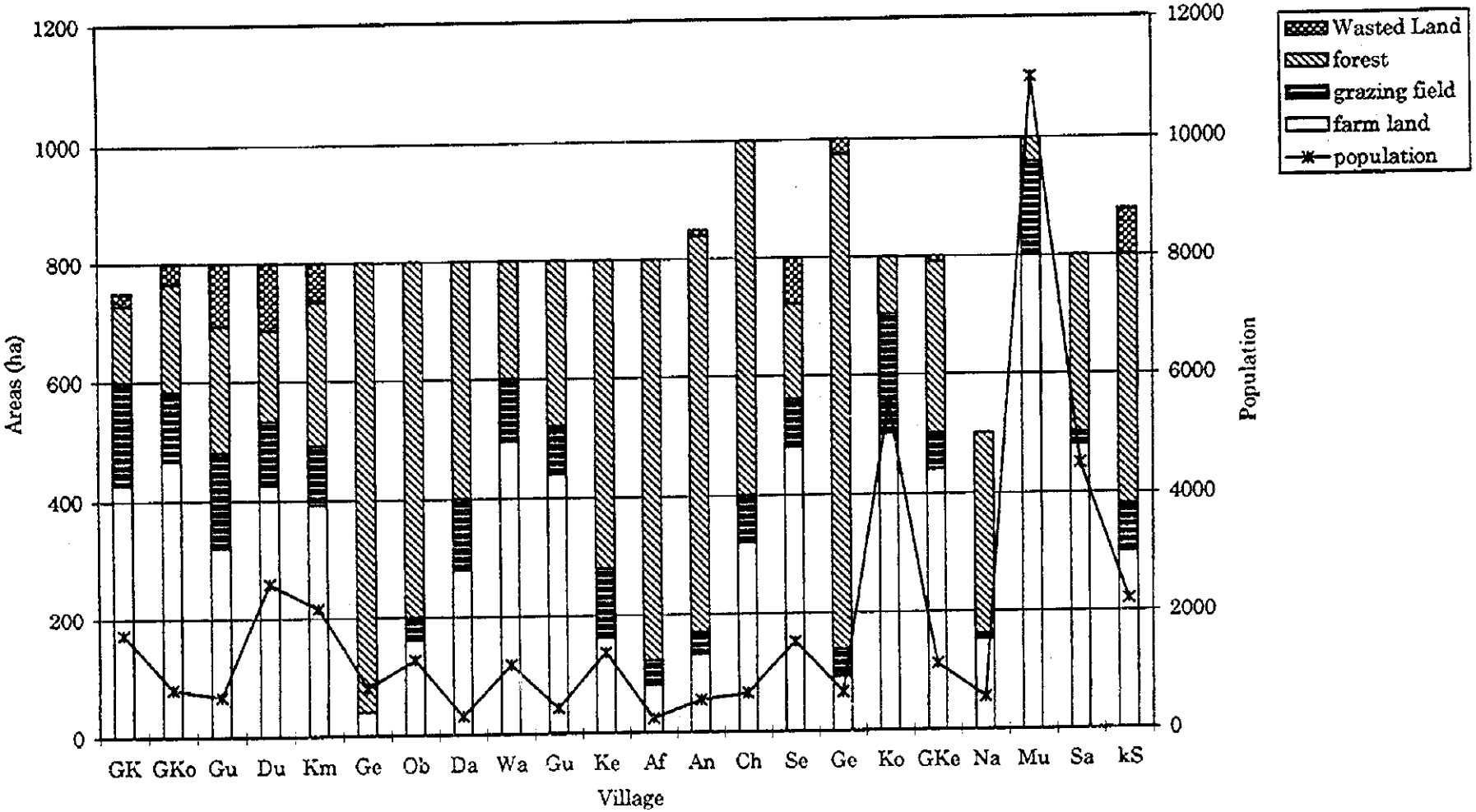


Fig. 10 Aeas of major Land-use/vegetation types in the Gara Area

(2) Land-use constraints and potentials

In general, land classified as "others" is most commonly found in lowlands and highlands, due to the topography of the area. Traditionally, a site at the highlands is favored more than the lowlands as residential area. Natural forests are distributed on steep slopes, with Fl covering the steepest and plantations on the moderate slopes. The following are details of the limiting factors for each land-use type:

(i) Farm land: The major limit for farm land is the steepness of slope. Except for swamp land, land with a slope of not more than 8% is best suitable for agriculture. For land with slope between 8% and 15%, farming is suitable if soil conservation measures are taken. Only limited farming activities (terrace farming) can be practiced on land with slope of more than 15%, but less than 50%. Areas with slope of more than 50% are not suitable for agriculture.

(ii) Grazing field: Grazing is most suitable on land with slopes less than 15%. For land with slopes between 15% and 50% grazing may be practiced. Grazing field is not necessarily open grassland and certain degrees of forest cover could be compatible. In addition, livestock is mobile, therefore, there is room for flexibility. For example, rows or patched of trees for firewood can be accomodated on the grazing field, of course, with proper protection. Grazing field and farm land share the same land bases of non-forest land. Often, conversions between the farm land and grazing field are observed.

(iii) Homestead plantation: Homestead plantation is least constrained by the environmental factors in the case for eucalypts plantations in the Intensive Study Area. All the land with slopes of less than 50% can be plantations. Due to the short harvesting schedule (4-5 years) practiced in the area, converting to grazing field or farm land is possible.

(iv) Coffee plantation: In the ppresent practice coffee needs to be under shade trees. The altitude range for coffee is 1100 to 2000 m, however, the optimum elevation range in southwest Ethiopia is from 1700 to 1900 m. Social and economic constraints for the coffee plantation are coffee price, market, accessibility (road), and technologies. It is noticed that settlers from northern part of the country are not interested in planting coffee, because they are not familiar with the technique. Coffee can be planted on farm land and grazing field as homestead plantation, or within natural forest. It is not compatible with timber production, but to some extent feasible if combined with other forest related practices, such as collecting honey, herb and spices.

(v) Firewood collection: This practice is highly dependent on the forest resource, including natural forest, plantations, and homestead plantations. Location and accessibility of the forest are major constrains. It seems 2.5 hours walking distance one way (10 km) is the maximum that the villagers can afford to spend on firewood collection. Other minor constraint is the tree species. Firewood collection, if properly organized, can co-exist with the timber and coffee plantation, and other practices.

(vi) Timber production: Major constrains for timber production are the forest resource and slope. The resource can be either natural forest or plantations, but needs to be marketable. Areas with slope of more than 50% are not suitable for timber production. Firewood collection can be allowed in forest designated for timber production.

(vii) Collections of other forest products: Herb, spice, and nuts collections can only take place in natural forest where there is little disturbance. The condition of the forest is the major constraint for these land-use practices. However, other activities, such as collecting coffee beans and the bark of Podocarpus trees (for apiculture), may potentially disturb the forest and way lead to deforestation. These activities can be undertaken with firewood collection, and to some extent with timber production and coffee plantation.

(3) Influence of Land-use and Related Issues

Major task of the forest resource management in the region is to arrest the reduction of forest land areas and the degradation of natural forests. The remaining natural forests are under strong and perpetual pressure from the local population, and, if the trend proceeds unchecked, the adverse environmental and economic effects will eventually spread throughout the region and the country.

The area of forest land in the Intensive Study Area and the whole country has been decreasing at an alarming rate and has caused concern among local, national, and international communities. Many local communities are suffering from hardship of collecting firewood (see Social Forestry section) and construction materials. A report of FAO (1990) stated that at the current rate of deforestation, all natural forests in the country will disappear in 30 years.

In the Intensive Study Area, the major reason for the shrinking forest is the encroachment into the natural forest, resulting from the rapid population increase and the low recognition of local residents on the value of the forest.

The population growth is taking place by the Government's resettlement program initiated in the second half of the 1960s and the high birth rate in the region (1960s onward for the Seka Chekorsa District and 1970s onward for the Gera District). During the resettlement process, forests were cleared for building villages and creating new agricultural lands. The population increase further caused expanded needs for farmland and heightened the demand for firewood, construction material and other non-timber forest products.

Many local residents lack the awareness of protecting natural forest, nor the incentive to plant trees. Many villagers interviewed stated that the Land Reform (Proclamation No.31) in 1975 killed their interest in tree planting and many trees were cut down thereafter. The land reform policy does not grant the land and tree tenures. Without land tenure the incentive to provide measures to protect the productivity of land is lost and without tree tenure no one wants to plant trees. This is clearly a sign for a quick amendment of the land-use policy. The bad relationship between the local residents and the forest/foresters may also be from the fact

that settlers from non-forested regions do not perceive the value of forests or that the new-comers do not respect the land as the long time local residents do.

To expand farm land and grazing fields is the major reason for the farmers who encroach the natural forest. Collecting firewood for household use, livestock grazing in the natural forest, obtaining Podocarpus barks for apiculture, coffee plantations and coffee bean collecting are major causes of the degradation of the natural forest (construction poles are mainly of eucalypts spp. and are from plantations).

Currently, collecting of firewood is allowed for dead trees and branches. Grazing in the natural forest is restricted and prohibited only on plantation sites. Debarking Podocarpus trees is basically illegal and could be punished. Coffee production is ambiguous, as it is promoted by the DADO, on the forest under defects authority of PA, but the forest in question is to be protected by the JZADO.

Having identified the encroachment and the coffee production as major impacts, the following are the current situation and the management prescriptions in the Intensive Study Area.

i) Encroachment of natural forest - the expansion of farm land and grazing fields

a. Current state of encroachment

Encroachment occurs in two ways: (1) farmers clear the forest using fire and/or gradually cutting down trees, and (2) farmers reclaim logged over forest site and plant crops. However, in the latter case, it is noticed that encroachment seldom occurred on the logged sites replenished with reforestation.

On the encroachment map, totaling 291 isolated patches of land, 237 in Gera and 54 in Belete Forest, have been identified as encroachment areas (note: areas being encroached). The size of them ranges from 1 ha to 1099 ha. Total encroachment area during the past four years is estimated at 8615 ha (3322 ha in Belete Forest, 5293 ha in Gera Forest), 5.8% of the Intensive Study Area (9.5% of the Belete Forest, 4.7% of the Gera Forest) at a rate of 2154 ha (1.45%) per year. They are mainly distributed along roads and around villages.

While examining the locations of encroachment areas, two patterns became apparent, satellite and marginal. The satellite pattern is that the encroachment area is located as an isolated island completely surrounded by the forest. The marginal pattern is that the location of encroachment area is found along the periphery of settlements and only partially surrounded by the forest. The total area of marginal encroachment is more than that of the satellite encroachment (Tab. 8). And, in general, the size of marginal encroachment areas is larger than that of the satellite encroachment areas (Appendix Tab. 11 and 12).

It is not possible to identify the original vegetation type of the encroachment areas, because

aerial photos taken previously are not available. Many encroachment areas, especially those of large size, are therefore classified as "Others" on the land-use/vegetation maps, although some clues may be obtained by looking at the surrounding vegetation types of the encroachment area. Table 7 lists the results. It is obvious that marginal encroachment occurs mostly on non-forest land (OT) and satellite encroachment occurs on forest land. It is alarming that many satellite encroachment areas are found in F1 and F2 types in Gera Forest.

Tab. 8 Summary of encroachment areas by vegetation type and location

(unit: number of encroachment areas and ha)

Forest	Spatial pattern		Vegetation type:						
			BT	F1	F2	F3	F4	OT	Subtotal*
Gera	Marginal	Number	1	11	15	11	2	83	123
		Area (ha)	7	63	131	79	20	2,775	3,075
	Satellite	Number	4	38	49	39	14	6	150
		Area (ha)	24	200	262	346	922	464	2,218
	Subtotal	Number	5	49	64	50	16	89	273
		Area (ha)	31	263	393	425	942	3,239	5,293
Belete	Marginal	Number		3	2	2	1	39	47
		Area (ha)		19	150	18	75	2,789	3,051
	Satellite	Number				10	1	3	14
		Area (ha)				80	36	155	271
	Subtotal	Number		3	2	12	2	42	61
		Area (ha)		19	150	98	111	2,944	3,322
Total	Marginal	Number	1	14	17	13	3	122	170
		Area (ha)	7	82	281	87	95	5,564	6,126
	Satellite	Number	4	38	49	49	15	9	164
		Area (ha)	24	200	262	426	958	619	2,489
	Grand total	Number	5	52	66	62	18	131	334
		Area (ha)	31	282	543	523	1,053	6,183	8,615

* Number may exceed the total number of encroachment areas, because one encroachment area may take place in several vegetation types.

Slope of the encroachment areas concentrates on class 2 (2-8%), 3 (8-15%), and 4 (15-30%). A few encroachment areas are found on class 5 (30-50%) and class 6 (greater than 50%) slopes. Compared to Gera Forest, more encroachment areas are found on steeper slopes in Belete Forest (Tab. 9).

Tab. 9 Slopes of the encroachment areas

(Unit: number of encroachment areas)

	0-2%	2-8%	8-15%	15-30%	30-50%	>50%	Total*
Belete		1	13	17	18	18	67
Gera		72	177	90	25	1	365

* Total number may exceed the number of encroachment area, because many encroachment areas are on sites with more than one slope category.

A detailed inventory of encroachment areas is provided in Appendix Table 11 and 12, which can be used as a management tool and baseline information.

(b) Management prescriptions

It is clear that areas surrounding villages are more susceptible to large scale encroachment. This does not relieve the danger of satellite encroachment, as once the satellite is established marginal encroachment will follow. Strategically it is better to control satellite encroachment first. It is easier to reclaim a satellite encroachment area than the marginal one, because the area is usually smaller and the risk of re-encroaching is lower. And environmentally, the impact of satellite encroachment is larger than that of the marginal. However, other considerations, such as improvement of socioeconomic status of the encroachers and timber harvesting / planting schedules to help them, should be included in the Management Plan. Priority of forest management should be placed on the prevention of further encroachment. Whenever and wherever possible, relocation of encroachers and restoration of the forest should be carried out.

Policies of the Region as well as the nation should be attuned to provide incentive for tree planting, water and soil conservation, and increase of agricultural productivity. Public education and technical assistance on environmental protection, family planning, and intensive farming should be promoted particularly in the Management area.

Strategies to contain encroachment and to encourage positive participation of local communities in forest management in Belete-Gera NFPAs should include (1) increasing the awareness on forest protection, (2) intensifying patrolling and law enforcement and (3) adopting measures to safeguard cut-over sites. Relocation program should focus on (1) setting up priorities, and (2) providing incentives for encroachers to be re-located. Other defensive strategies could be (1) not constructing new roads, (2) re-demarcate the boundary of forest to avoid conflicts on boundaries and facilitate law enforcement, (3) establishing buffer zone plantation to protect natural forest.

ii) Coffee production in the natural forest

The DADO has the mandate for promoting coffee production in the region by providing seedlings for a minimal fee and technical assistance. There are nine nurseries in the region raising coffee seedlings (see Social Forestry section for details). Assistance to cultivation and management of coffee is provided by Extension Agents.

The right to plant coffee and collect coffee beans from naturally grown coffee in the natural forest can be granted by PA. Application and payment of fees to PA are necessary for individuals intending to plant coffee or to have the exclusive right to collect wild coffee beans at certain site. Various intensities of vegetation clearing are conducted in the forest to facilitate the coffee planting and coffee bean collection.

However, not all the forests with naturally grown coffee have been allotted for exclusive collecting rights. In unallotted areas, where legal rights are non-existant, access is open to public and anyone can enter the forest to collect coffee beans. Usually no planting, tending etc. of coffee are seen in these areas.

(a) Coffee Production Practice:

a. Planting:

In the Intensive Study Area farmers plant one year-old seedlings either collected from natural forests or produced in nurseries in June. Planting pits are dug in the meantime and a satellite (i.e. temporary) nursery is set up nearby the plantation site three months beforehand. Coffee seedlings are, first transplanted in the satellite nursery and hardened off for about two months before planted. The pits are filled with clay soil when the planting starts. Compost or fertilizers are added if the soil is not fertile. Farmers then use a planting stick to open up a small hole at the center of the filled soil and plant the seedling. All the planting is completed before the end of June, when the rainy season starts.

b. Shading:

Shade trees are planted to provide shade for coffee plants in the homestead coffee plantation. *Sesbania sesban*, *Leucaena leucocephala*, and *Tephrosia spp.* are planted for temporary shade. Permanent shade is provided by *Acacia*, *Milletia fereuginea*, *Albizia grandibracteata*, *Croton macrostachyus* and *Milletia ferruginea*. The ratio of shade trees to coffee plants is approximately one tree for 4 coffee plants.

For coffee plantations in the natural forest, some trees in the upper and lower layers are removed to attain proper shading. Density of the trees ranges from 75 to 125 trees per hectare. However, one visited site showed quite wide spacing (approximately 40 meters) between trees and the farmer indicated shade was not important when coffee plants were properly managed. Common tree species are *Cordia africana*, *Syzygium guineense*, *Albizia gummifera* and *Milletia ferruginea*.

For the case of collecting coffee beans from the natural forests, the impact on the forest seems varied. Several sites which received no or minimal management treatment show intact stock of upper, middle and lower layer trees with many wildings coming up.

c. Tending:

After planting of coffee, mulch is applied on the ground to keep soil moisture when rainfall is inadequate. Weeding and hoeing (to loosen the soil) are conducted in September. Usually the producing of coffee berries will commence in two years. Pruning of dead branches is done after harvesting, which is in November and December. To increase productivity fertilizer and compost may be applied.

d. Stumping:

After a certain period of time (up to ten years when the soil condition is good), the coffee plant will lose its productivity and stumping is necessary. The stumping is conducted in the dry season (from December to the end of January) to prevent coffee plants from rotting. The stem of the coffee plant is cut off at the height approximately 40 cm above ground in a 45 degree angle, which is to avoid accumulating water on the cut surface. Sometimes the cut surface is painted white to reflect sunlight and shade is provided to the north or south (depending on the season) of the plant in order to avoid direct sunlight. Re-sprouts will reach their maximum in 2 months, when the second pruning is conducted. Only 2 suckers are selected and left to attain full growth, the rest are trimmed off.

The stumping is applied to both planted and wild coffees plants when necessary.

(b) The extent of coffee production

Tab. 10 and 11 list the areas of coffee production in Gera and Seka Chekorsa Districts, which encompass the Intensive Study Area. These data are collected from the DADO. The accuracy of the figures could not be confirmed. For Gera District the classification standard of coffee production categories is not clear either (Tab. 10).

Tab. 10 Coffee production areas (ha) in Gera District

	area (ha)
Total plantation areas from 1981 to 1995	1,008.05
Natural coffee population	1,688.00
Coffee plantation in natural forest	1,305.23
Homestead coffee plantation	1,710.28
Stumped coffee plantation	36.40

Tab. 11 Coffee production areas (ha) in Seka Chekorsa District

	area (ha)
Total plantation areas from 1980 to 1997	2,269.59
Plantations in natural forest	1,769.59
Homestead coffee plantation	500.00
Natural coffee population	1,412.71
Stumped coffee plantation	232.56

Therefore, at least there are 3,074.82 ha coffee plantation and 3,100.71 ha coffee beans collecting sites in the Belete-Gera area. Calculations show that at least (1) 1.9% of the

90811.04 ha Gera Forest (F1, F2, F3 combined) has coffee beans collecting activity and 1.4% of the forest has coffee plantations, (2) in Belete Forest, 9.0% of the 15733.66 ha forest (F1, F2, F3 combined) has coffee beans collecting activity and 11.3% of the forest has coffee bean plantations. This estimation is unrealistically low because of the relatively vast forest land in the Gera Forest and the inclusion of many steep and inaccessible sites.

If the data from the District is calculated based on F3 (heavily disturbed) forest only, which is more to the real situation and applicable for the management of natural forest in the region, the result shows: (1) in Gera Forest of 17027.1 ha F3 forest 9.9% is under coffee bean collecting and 7.7% has coffee plantation, (2) in Belete Forest's 6643.1 ha F3 forest 21.3% has coffee bean collecting activities and 26.6% has coffee plantations.

The extent of wild coffee populations within the forest can be estimated through the examination of sample plot data from the Forest Survey. Totally, in Gera Forest 25 plots out of 51 plots sampled (49%) have naturally grown coffee plants in the understory, and in Belete Forest 5 out of the 11 plots sampled (45%) have naturally grown coffee presented in the understory (Tab. 12). Therefore it is correct to say that the maximum coffee bean collecting activity can reach between 45 to 49% (42,552.8 - 53,191 ha) of the accessible natural forest.

Tab. 12 List of sample plots with coffee plants in the understory

Gera Forest						Belete Forest		
plot No.	vegetation type	No. of coffee	plot No.	vegetation type	No. of coffee	plot No.	vegetation type	No. of coffee
F1 (13 out of 25 plots surveyed):			F2 (4 out of 14 plots surveyed):			F1 (4 out of 7 plots surveyed):		
5	F1	16	31	F2	1	56	F1	present
9	F1	63	36	F2	present	57	F1	2
11	F1	present	37	F2	present	62	F1	2
12	F1	62	51	F2	present	68	F1	1
13	F1	73						
39	F1	1	F3 (8 out of 12 plots surveyed):			F2 (0 out of 0 plots surveyed):		
47	F1	1	1	F3	dominant			
48	F1	32	6	F3	1	F3 (1 out of 4 plots surveyed):		
49	F1	185	8	F3	1	63	F3	3
50	F1	present	28	F3	present			
52	F1	102	38	F3	16			
53	F1	present	45	F3	6			
54	F1	1	46	F3	6			
			55	F3	3			

* counted in the 10m x 10m subplot.

(c) Impact of coffee production on the natural forest

One of the features of the impact of coffee production activities on the natural forest is reflected on the density of the forest canopy. Considering that F1 forest represents the natural conditions, in Gera Forest, there is a relatively low percentage of coffee grown naturally in F2 forest type and high in F3 forest (Tab. 12). This result could be that the human disturbance (converting F2 to F3 forest) is related to the coffee production activities. Such evidence is not clear in Belete Forest.

Two coffee plantation sites in Belete Forest and five coffee collecting sites in Gera Forest were studied. Among the five coffee collecting sites, two are open without exclusive collecting right claimed, and three have collecting right claimed but have received scarce managerial care. Coffee beans collecting sites with intensive management could not be studied due to poor road conditions.

Tab. 13 lists a summary of the survey results. It is clear that the coffee planting has altered the forest conditions most, by reducing both the species diversity and tree density, especially in the lower and understory layers. There is no noticeable difference among the coffee beans collecting-only sites and sites which received minimal managerial care.

In Belete Forest the first year coffee planting plot showed clear evidence of tree removal. Within a 10m by 10m subplot, total 15 stumps of 7 species were tallied. Diameters of these stumps range from 2cm to 20cm (Appendix Tab. 13).

Tab. 13 Summary of coffee production area plot* survey

Location	Gera collecting only (1)	Gera collecting only (2)	Gera collecting & min. manage-ment (1)	Gera collecting & min. manage-ment (2)	Gera collecting & min. manage-ment (3)	Belete plantation (1) first year	Belete Plantation (2) 4th year
Total number of tree species	11	9	13	14	11	7	6
upper layer	6	5	7	6	2	3	3
middle layer	4	2	5	4	4	4	4
lower layer	5	8	9	9	7	2	1
(understory)*	(7)	(8)	(5)	(5)	(7)	(4)	(0)
Total number of trees	38	45	50	43	51	20	12
upper layer	8	10	17	12	2	4	5
middle layer	7	3	12	7	7	7	6
lower layer	23	32	20	24	42	9	1
Total number* of:							
natural coffee	28	47	241	224	62	26	0
planted coffee	0	0	0	0	0	35	28

* plot size is 40m by 40m, except for understory and coffee plants which are counted within a subplot of size 10m by 10m.

Most number of tree species found in the Belete Forest coffee planting sites are *Syzygium guieense* and *Cordia africana*, while *Albizia gummifera*, *Allophylus abyssinicus*, *Olea hochstetteri* and *Teclea nobilis* are the species most frequently found in the Gera Forest coffee bean collecting sites (Appendix Tab. 13).

In order to determine the impacts and to provide managerial guides, the coffee producing sites survey results are compared with forest survey results of F1 forest type plots which have naturally grown coffee plants in the understory. Details are shown in Appendix Tab. 14 and 15.

For Belete Forest four major species, *Minusops kummel*, *Bersama abyssinica*, *Celtis africana* and *Teclea nobilis*, what appear in F1 forest with coffee plants, are missing in the coffee planting sites. Other species missing in the coffee planting sites are *Albizia grandibracteata*, *Ficus sur*, *Galiniera coffeoides*, *Maytenus senealensis* and *Rothmannia urcelliformis*, though they are not so common. The species diversity is reduced in all three strata, but more significantly in the middle and lower layer of the forest. The total number of trees ranges from 43 to 65 in F1 plots, but only 12 and 20 were found in the coffee planting sites (Tab. 14, Appendix Tab. 14).

In Gera Forest no major discrepancy was found (Appendix Tab. 15) except for the species *Celtis africana*, which is frequently found in F1 forest (7 out of 13 surveyed plots), but not found in the coffee collecting sites. Three species, *Albizia grandifracteata*, *Galiniera coffeoides* and *Clausena anisata* appeared in the coffee bean collecting plots, but not in any of the F1 plots. As for the total number of species and density, the coffee bean collecting sites are all within the range of F1 surveyed plots, but in the lower range (Tab. 14).

Tab. 14 Comparison between coffee production sites and F1 forest with naturally grown coffee in the understory

	Total number				Total number			
	species	u*	m*	l*	trees	u	m	l
Belete Forest:								
1st year plantation	7	3	4	2	20	4	7	9
4th year plantation	6	3	4	1	12	5	6	1
F1 forest (plot number)								
56	20	2	9	17	65	6	16	43
57	12	9	8	5	53	18	23	12
62	12	7	5	6	43	17	11	15
68	11	4	3	10	60	6	10	44
Gera Forest:								
collecting only (1)	11	6	4	5	38	8	7	23
collecting only (2)	9	5	2	8	45	10	3	32
collecting/min. management (1)	13	7	5	9	50	17	12	20
collecting/min. management (2)	14	6	4	9	43	12	7	24
collecting/min. management (3)	11	2	4	7	51	2	7	42
F1 forest (plot number):								
5	10	3	6	6	55	12	13	30
9	18	7	5	12	61	20	11	30
11	11	7	4	7	74	15	12	47
12	13	4	8	8	52	14	17	21
13	8	2	7	6	33	11	13	9
39	8	2	3	7	72	19	7	46
47	13	4	8	10	60	8	25	27
48	12	4	7	10	61	18	17	26
49	11	7	5	7	46	18	13	15
50	15	4	8	11	99	21	23	55
52	11	6	3	7	56	23	23	10
53	12	3	9	7	141	21	47	73
54	11	4	9	7	56	16	26	14

* u - upper layer, m - middle layer, l - lower layer

(d) Implications to Forest Management

Following are strategies should be adopted for forest management in the coffee production areas in the natural forest.

- Establish a registration (permit) system:
  For the management of Belete-Gera Forest it is important to regulate the area, location, and management activities of coffee production in the natural forest. The administration should establish a registration (permit) system to keep the activities of the local people under control.

- Provide coffee growers/collectors guidance
  Farmers should be guided to plant additional trees of proper species and number in the plantation in F2 and F3 forest

- Provide incentives for coffee growers/collectors to follow regulations

- Coordinate with other plans:
  Coffee production is not compatible with timber production activities. Therefore, coffee production activities should be planned and coordinated with the timber production and plantation plans, to reduce unnecessary investment and to maximize the multiple use of forest land.

2-8. Forest Survey

2-8-1. Objectives

The objective of the forest survey is to collect information on each forest type so as to formulate a Forest Management Plan that will closely reflect the actual forest conditions in the Intensive Study Area. Collected data were compiled for each forest classification and will be used to produce a forest inventory book (see 3-2-5, Forest Inventory Book).

Although a survey was conducted on the forest plantations in Belete Forest of the Intensive Study Area in 1994-96, no such survey had been carried out on natural forests, which constitute the majority of forest land in the area. Knowledge of forest stock is essential for the formulation of the Forest Management Plan, which includes a forest utilization plan, an afforestation plan and a forest protection plan.

2-8-2. Survey Method

(1) Inventory of Natural Forests

Use of the Stratified Random Sampling method was initially planned while preparing the progress report; however, the standard plot method was eventually selected for the following reasons:

The distribution of forest types was not known until the interpretation of aerial photographs was completed during the second-term field survey. Results of the interpretation show that: (a) there are extensive F1 forests in the southern part of Gera Forest, and (b) the areas of F3 forests in the southern part of Gera Forest that are larger than those in other areas. The southern part of Gera Forest is inaccessible due to lack of roads and the presence of Naso River and many other riverlets, which maintain ample water flows even during the dry season, making it impossible to cross.

Had the Stratified Random Sampling method been used, the probability of allotting F1 and F3 sample plots in the southern part of Gera Forest was high, but to conduct survey in this area was close to impossible. Therefore, the standard plot method was chosen instead.

(2) Forest Inventory for Plantations

Plantations are homogeneous stands of given species, age, and site class. The most efficient method of carrying out an inventory on such forests is the standard plot method, for which several arbitrarily selected plots were surveyed for each type of plantations.

As was mentioned earlier, plantations in the Belete Forest were surveyed in 1994-1996. Existing data in the inventory book and compartment maps were checked by employing enlarged aerial photographs and field surveys. In the previous survey, 100 m^2 circular plots

were used, and the number of plots was determined by the total area of the forest compartment. The diameter at breast height (D.B.H.) was measured for all the trees within the plot, while the height of only two or three representative trees was measured. Standard plot method was conducted in this survey for areas where existing data are incomplete or incorrect. The adopted inventory method, standard plot method, therefore, involved two steps: first, on-site investigations; and second, plot surveys, for those areas where the existing data was no longer valid.

(3) Sizes and Shapes of Selected Plots

Each plot, in natural forests, had a square shape measuring 1,600m^2 (40m x 40m). In forest plantations, each plot was circular and measured 500m^2. In locations where forest plantation stands were sparse, a larger plot of 1,000m^2 size was chosen.

(4) Measurement of Trees

In forest plantations, all trees in the plot were measured. In natural forests, only those with D.B.H. greater than 10 cm (in the plot) were measured. For invading trees growing in the forest plantation, only those with a D.B.H. greater than 10 cm were measured.

This is the first time that a survey was conducted to estimate the stand volume of natural forests in the Intensive Study Area. The lower limit of D.B.H. for the trees to be measured was decided in cooperation with counterparts for on-site investigations.

(5) Data Collection

The following data were collected for trees with D.B.H. greater than 10 cm in the plot of natural forests: (a) species, (b) D.B.H., (c) total height, (d) merchantable height, (e) tree shape, (f) upper-, middle-or lower-storey classification, and (g) crown diameter of upper- and middle-storey trees. In addition, topographical information including (a) slope, (b) aspect, and (c) topographic position was recorded.

Data collected for trees in selected plots of forest plantations were: (a) species, (b) D.B.H., and (c) total height. For trees other than those planted in forest plantations, whether they are invasive trees or survivors from the previous clear cutting, the above-mentioned data collection standard for natural forests was applied.

For natural forests, a sub-plot of 10 m by 10 m was established within each plot to collect data on trees with D.B.H. of less than 10 cm. For trees with D.B.H. between 4 and 10 cm, the following data were collected: species, D.B.H. and height. Trees with D.B.H. of less than 4 cm and forest bed vegetation were also surveyed.

2-8-3. Volume Table

(1) Objectives

In order to estimate the stand volume per hectare of a plot, it is necessary to calculate the volume of measured trees. For natural forests in the Intensive Study Area, Dr. Chaffey developed volume tables under the auspices of Britain's ODA (1979). As this study covered a much wider area than the Intensive Study Area, the survey team produced a new stand volume table specifically for the Intensive Study Area.

For forest plantations, the form factor method was employed to obtain stand volume. This method involves the multiplying of D.B.H. and tree height with a numeral form factor. As the form factor being used was adopted from a survey conducted outside the Intensive Study Area and might not be appropriate, the survey team formulated a new volume table for each species of forest plantations.

(2) Formulation of Tree Volume Equations

In this study, a merchantable tree volume equation was formulated for natural forests and a stem volume equation was formulated for forest plantations. These equations can be further divided into two types: one containing a single variable (D.B.H.) and the other having two variables (D.B.H. and height). The two-variable tree volume equation was used for natural forests, while both one- and two-variable equations were used for forest plantations.

One-variable tree volume equation: $v = aD^b$
Two-variable tree volume equation: $v = aD^bH^c$

(Both are based on the Schumacher & Hall's formula, where v denotes "tree volume"; D, "D.B.H."; and h, "merchantable height" for natural forests and "total height" for forest plantations.)

To produce a standing tree volume table, tree volume was calculated for each tree, felled or standing, by measuring its diameter at regular heights from the base. Then, regression was conducted using tree volume as a dependent variable, and D.B.H. (for one-valiable equation) or D.B.H. and height (for 2-variable equation) as independent variables. The least squares method was conducted, and constants "a", "b" and "c" in the above Schumacher & Hall's equation were derived.

Natural forest trees were grouped into four types (one type specifically for *Podocarpus gracilior*), and for each type a set of constants was developed. As for trees in forest plantations, constant(s) were derived for each species. Forest plantations were divided into two groups: in the first group the data (average D.B.H.) from the previous survey made by the JZADO were used and in the second group the data (D.B.H. and total height) collected by the Study Team were employed. Accordingly, a one-variable equation was formulated to

calculate the tree volume for the first group, while a two-variable equation was formulated to obtain the tree volume for the second group.

(3) Species and Number of Trees Analyzed

A total of 293 trees of 16 species were employed to calculate the tree volume of natural forests. In total, 419 trees of 9 species were used to derive the tree volume of forest plantations.

(4) Tree Volume Equation

In natural forests, broad-leaved trees were classified into three types by their shape. *Podocarpus gracilior*, which is a conifer, was singled out as the fourth group. These four types have the following characteristics:

Type 0: *Podocarpus gracilior*
Type 1: Stem is straight, with *Aningeria adolfi-friederici* being the most representative species.
Type 2: Stem is also straight, but branches ramify at heights lower than the branches of Type-1 species. Many species are included in the Type-2 group, with *Apodytes dimidiata* and *Syzygium gunieense* being the most representative species.
Type 3: The crown is large, and numerous branches ramify at low heights. *Ficus sur* and *Croton machrosachyus* are representative species.

A list of the above-mentioned four types can be found in Appendix Tab. 11(1)-(3). Tab. 15 below shows the tree volume equations and constants for the four types of trees in natural forests, and the entire species of forest plantations. Volume tables for these types and species are presented in Appendix Tab. 17(1)-(13).

Tab. 15 Standing Tree Volume Equation

(Natural forest)

Tree Volume Equation	type	a=	b=	c=	r=
$v = aD^bH^c$	0	0.000129	1.7861	0.9946	0.994
	1	0.000205	1.3595	1.4270	0.970
	2	0.000132	1.8730	0.8421	0.993
	3	0.000153	1.8160	0.8723	0.977

(v: Merchantable volume (m^3), D: D.B.H.(cm), H: Merchantable height (m), r: correlation coefficient)

(Forest Plantations)

Tree Volume Equation	Species	a=	b=	c=	r=
$v = aD^bH^c$	*Cupressus lusitanica*	0.000054	1.6986	1.1895	0.994
	Pinus patula	0.000053	1.8579	1.0279	0.997
	Eucalyptus saligna	0.000039	1.7977	1.1430	0.985
	E. camaldulensis	0.000100	1.5953	1.0698	0.957
	E. grandis	0.000052	1.7939	1.0738	0.995
	E. globulus	0.000035	1.9070	1.0720	0.969
	E. citriodora	0.000093	1.9585	0.7124	0.996
	Casuarina equisetifolia	0.000134	2.0362	0.3783	0.960
	Hagena abyssinica	0.000117	1.7681	0.7820	0.991
$v = aD^b$	*Cupressus lusitanica*	0.000230	2.3254		0.952
	Pinus patula	0.000052	2.8058		0.980
	Eucalyptus saligna	0.000130	2.4967		0.962
	E. camaldulensis	0.000740	1.9630		0.944
	E. grandis	0.000060	2.8323		0.973
	E. globulus	0.000160	2.4293		0.918
	E. citriodora	0.000360	2.1871		0.965
	Casuarina equisetifolia	0.003000	2.0861		0.951
	Hagena abyssinica	0.000280	2.0628		0.977

(v: Total volume (m^3), D: D.B.H. (cm), H: Total height (m), r: correlation coefficient)

2-8-4. Natural Forests

(1) Number of Plots

The locations of plots selected were spread as widely as possible. They were carefully selected to closely represent the average stand volume of each forest. A total of 62 plots was selected--31 in F1 forests, 15 in F2 forests and 16 in F3 forests.

(2) Results of Plot Survey

(i) Stand volume

(a) Calculation of stand volume

Using data obtained from the plots, the merchantable volume of each tree was calculated by the tree volume equation; then, each plot's stand volume was calculated by adding the entire volumes of trees in the middle- and high-storey. The stand volume per hectare is, thus, obtained by using the total stand volume and the area of the plot. This volume is used to calculate the total stand volume of each forest type, which is:

F1 forest	V=	410.8 m^3/ha	×	64,314.0 ha	=	26,420,191 m^3
F2 forest	V=	282.8 m^3/ha	×	18,258.0 ha	=	5,163,362 m^3
F3 forest	V=	174.8 m^3/ha	×	23,810.0 ha	=	4,161,988 m^3
	Total					**35,745,541 m^3**

(b) Calculation of commercial species stand volume

Since commercial species are harvested, their stand volumes constitute essential data for the logging plan of the Forest Management Plan. These data can be obtained by retrieving commercial species data from the above total stand volume. For the designation of commercial species, EFAP's "Major Commercial Species in Natural High Forests" was adopted (see Appendix Tab. 18). The stand volume of commercial species for each forest type is as follows:

F1 forest	V=	320.4 m^3/ha	×	64,314.0 ha	=	20,606,206 m^3
F2 forest	V=	182.0 m^3/ha	×	18,258.0 ha	=	3,322,956 m^3
F3 forest	V=	90.4 m^3/ha	×	23,810.0 ha	=	2,152,424 m^3
	Total					**26,081,586 m^3**

(ii) Characteristics of Forest Types

In the natural forest, 62 plots were selected and surveyed. A total 3,896 standing trees was measured. Major findings are:

- While the number of trees is well distributed among different storeys in F1 forests, low-storey trees outnumber middle- and high-storey trees in F2 and F3 forests. Thus, inter-storeys balance is poor in F2 and F3 forests.

- Compared to F1 forests, the percentage of commercial species is small, or close to nil, in F2 and F3 forests.

Human disturbance becomes apparent as the forest types gradate from F1 to F2 and F3. This is said not only on stand volume but also on forest structure. Fewer commercial species were found in F2 and F3 forests, and *Podocarpus gracilior* and some valuable species could not be found in the surveyed plots of F2 and F3 forests, while they were found, though in small numbers in F1 forests. It is important that these features of each forest type be considered when formulating the Forest Management Plan.

(a) Number of trees by forest type and storey

Tab. 16 and Fig. 11 show the total number of standing trees in the surveyed plots for each forest type and storey. In F1 forests, number of trees in the low, middle and high stratum are roughly at a ratio of 5 to 3 to 2. On the other hand, the ratio is roughly 7 to 2 to 1 for the F2 and F3 forests, thus indicating a deficiency of high-stratum trees in those forests.

Tab. 16 Total number of surveyed trees by forest type and storey

Forest Type	Stratum			Total
	Low	Middle	High	
F1 forest	901 (46%)	619 (31%)	456 (23%)	**1,976 (100%)**
F2 forest	693 (65%)	231 (22%)	137 (13%)	**1,061 (100%)**
F3 forest	577 (67%)	162 (19%)	122 (14%)	**861 (100%)**
Total	**2,171**	**1,012**	**715**	**3,898**

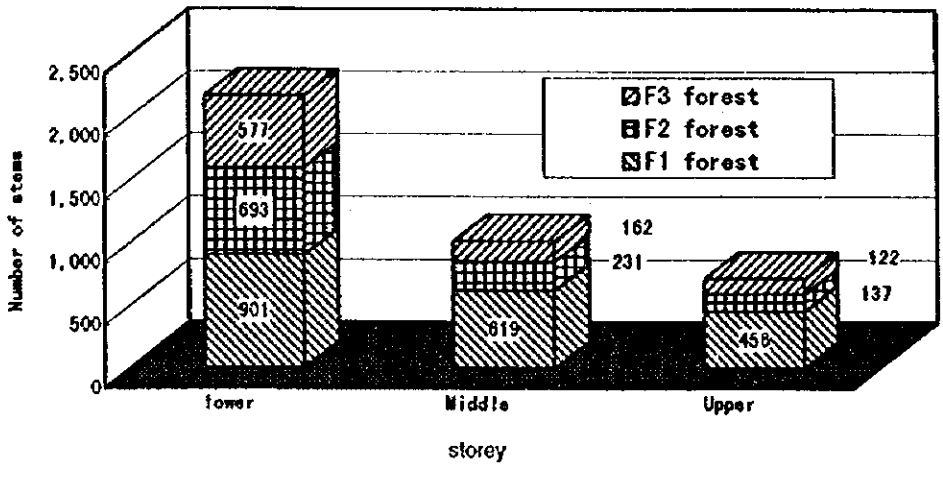


Fig. 11 Distribution of surveyed trees by storey and forest type

(b) Number of trees by forest type and species

Compared to F1, the percentage of commercial species in the total number of trees is clearly smaller in F2 and F3 forests. Commercial species trees numbered 1,097 or 55.6% of the total number of trees surveyed in F1 forests, whereas the corresponding percentage was 35.3% in F2 and 30.2% in F3 forests.

This trend is also apparent when making a comparison of the ten most numerous species in these forest types (see Tab. 17). In F1 forests, six commercial species totaling 864 trees are on the list of the top ten numerous species, accounting for 44% of the total number of trees. In F2 forests, five species totaling 356 trees, or 34%, are in the top ten; in F3 forests, only four species numbering 212 trees, or 25%, are among the top ten list.

Fig. 12 shows the top 25 most numerous species found in F1, F2 and F3 forests. Note that species such as *Olea welwitschii*, *Diospyros abyssinica*, *Celtis africana*, *Aningeria adolfi-friederici*, and *Podocarpus gracilior* were absent in F2 and F3 forests. Of these, extremely few *C. africana*, *A. adolfi-friederici* and *P. gracilior* were found in F1 forests as well.

Tab. 17 Number of trees by forest type and the 10 most numerous species

Forest Type	Species	Total
F1 forest	*Olea welwitschii* *	297
	Elaeodendron buchananii / Diospyros abyssinica *	221
	Teclea nobilis	173
	Cassiporea ruwensorensis	140
	Syzygium guineense *	112
	Bersama abyssinica	107
	Olea hochstetteri *	90
	Celtis africana *	72
	Croton macrostachyus *	72
	Allophylus abyssinicus	58
F2 forest	*Croton macrostachyus* *	130
	Syzygium guineense *	121
	Bersama abyssinica	111
	Milletia ferruginea	74
	Allophylus abyssinicus	49
	Apodytes dimidiata *	45
	Vernonia amygdalina	33
	Olea welwitschii *	31
	Teclea nobilis	30
	Olea hochstetteri *	29
F3 forest	*Teclea nobilis*	92
	Syzygium guineense *	68
	Olea hochstetteri *	64
	Allophylus abyssinicus	63
	Milletia ferruginea	58
	Bersama abyssinica	47
	Vernonia amygdalina	44
	Croton macrostachyus *	42
	Ficus sur	42
	Olea welwitschii *	38

* : shows the commercial species

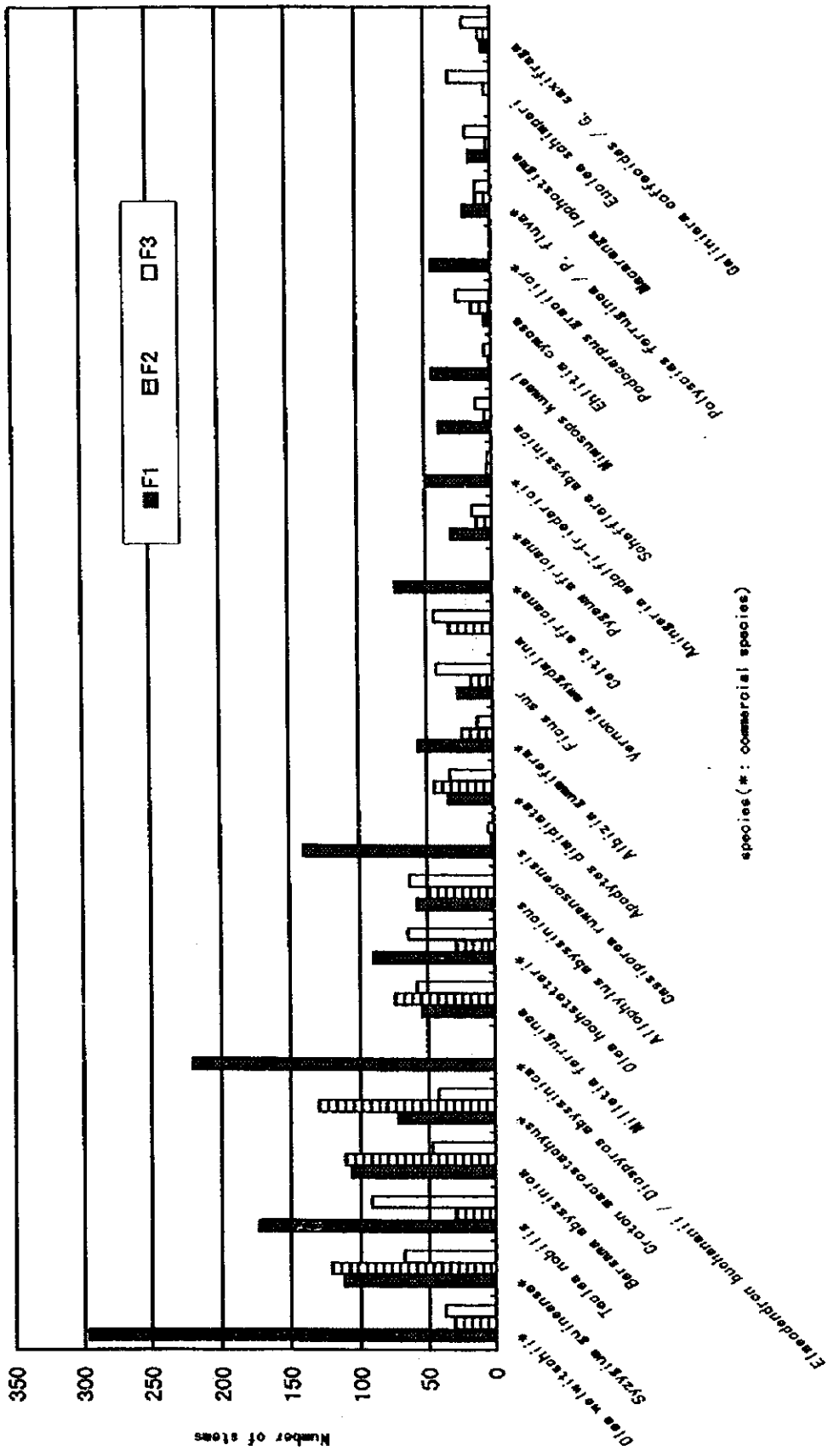


Fig. 12 Species distribution classified by forest type (top 25 species)

2-8-5. Forest Plantations

Having examined aerial photographs, it was found that existing forest compartment maps had some erroneous descriptions concerning zoning and stand volume due to the differences of stand density. Furthermore, some forest plantations were not indicated on the forest compartment map. The survey team, therefore, carried out rezoning through analyses of aerial photographs and a standard plot survey.

FRC has established a 28-hectare trial plot which is divided into many sub-compartments, in Belete Forest. The survey team conducted a standard plot survey in the trial plot in order to examine the growth of major species. This survey treated the whole 28 ha as one sub-compartment.

(1) Survey Results

(i) Growing stock.

Area, age of trees and other information were recorded in the forest inventory book for each forest stand (sub-compartment). Appendix Tab. 19 and Tab. 18 show the results by species and age. There are 90 sub-compartments in Belete Forest and 11 in Gera Forest (see Appendix Tab. 20 (1)-(4)). Forest plantations are concentrated in Belete Forest, constituting 83% (918.7 ha) of the total forest plantation area in Intensive Study Area. The remaining 17% (184.8 ha) is in Gera Forest, with the dominant species being *Cupressus lusitanica*. The total growing stock of forest plantations in Intensive Study Area is estimated at 198,830 m^3, or 185 m^3/ha.

The most prevalent species is *Cupressus lusitanica*, which accounts for 608 ha, or 57% of the total forest plantation in Intensive Study Area. The second species are five eucalypts species, which together account for 366 ha or 34% of the total. Of these eucalypts, *Eucalypts saligna* accounts for 161 ha or about one half. Although *Pinus patula* shows favorable growth, it covers only 70 ha, or 6.5% of the total plantation Area.

Tab. 19 shows the planted areas of various species in accordance with the age of trees. It was observed that many forest stands over 11 years old need a second or third thinning, but not enough thinnings have been performed.

Among these forest stands, those of *Eucalyptus spp.* (315.2 ha) over 11 years old and those of other exotic species (138.9 ha) over 16 years old totalling 454.1 ha or 42% of the total area of forest plantations, will reach felling age within the next 10 years. However, growth of the mean DBH is insufficient in many forest stands and few are likely to reach the minimum DBH of 30 cm which is required for the lumber production. This fact also makes it necessary to stimulate diameter growth through thinning.

Tab. 18 Species and Areas of forest plantations

Species	Forest				Total			
	Belete		Gera		Area		Total growing stock (m^3)	Total growing stock (m^3/ha)
	Area (ha)	Total growing stock (m^3)	Area (ha)	Total growing stock (m^3)	(ha)	%		
Belete trial plot	28.0	-			28.0	-	-	-
Casuarina equisetifolia	16.2	520			16.2	1.5	520	32
Cupressus lusitanica	440.9	98,948	167.4	19,681	608.3	56.6	118,629	195
E. grandis & camldulensis.	30.7	5,066			30.7	2.9	5,066	165
Eucalyptus camaldulensis	16.4	1,789			16.4	1.5	1,789	109
Eucalyptus citriodora	43.0	4,241			43.0	4.0	4,241	99
Eucalyptus globulus	4.4	187	5.6	1,644	10.0	0.9	1,831	183
Eucalyptus grandis	72.7	18,032	1.2	827	73.9	6.9	18,859	255
Eucalyptus saligna	150.7	23,075	10.6	2,761	161.3	15.0	25,836	160
Mixed Eucalyptus[*1]	30.4	2,810			30.4	2.8	2,810	92
Hagenia abyssinica	12.9	1,340			12.9	1.2	1,340	104
Juniperus procera.	1.3	384			1.3	0.1	384	295
Mixed[*2]	1.1	114			1.1	0.1	114	104
Pinus patula	70.0	17,411			70.0	6.5	17,411	249
Total	**890.7 (918.7)**	**173,917**	**184.8**	**24,913**	**1,075.5 (1,103.5)**	**100.0**	**190,830**	**185**

Note : ( ) Area including Belete trial plot
*1 : more than three species of Eucalypts
*2 : mixed with some species except Eucalypts

Tab. 19 Species and Areas of forest plantations by age class

Species	Age class					Total
	1~5	6~10	11~15	16~20	21~25	
Casuarina equisetifolia					16.2	16.2
Cupressus lusitanica	8.8	182.0	317.0	38.6	61.9	608.3
E.grandis & camaldulensis			30.7			30.7
Eucalyptus camaldulensis	7.9			2.1	6.4	16.4
Eucalyptus citriodora			43.0			43.0
Eucalyptus globulus			10.0			10.0
Eucalyptus grandis		20.4	53.5			73.9
Eucalyptus saligna	2.6	19.6	111.5	27.6		161.3
Mixed Eucalyptus			27.5		2.9	30.4
Eucalyptus total	10.5	40.0	276.2	29.7	9.3	365.7
Hagenia abyssinica		0.6	12.3			12.9
Juniperus procera.					1.3	1.3
Mixed			1.1			1.1
Pinus patula		31.9	15.9	20.3	1.9	70.0
Total	**19.3**	**254.5**	**622.5**	**88.6**	**90.6**	**1075.5**

Note : Belete trial plot and unregistered plantation plot are not included

(ii) Growth Rate

Major plantations, such as *Cupressus Lusitanica, Pinus patula and Eucalyptus spp.*, were established at various points of time from 1975 to 1995 (see Appendix Tab. 19). Stand growth was estimated for each species from the results of Standard Plot survey which covered various stands of different age classes. Mean annual increment (MAI) and standing tree density for each forest age group are shown in Fig. 13 for the *Cupressus lusitanica* as well as *Eucalyptus* spp.

Forest stands of well-kept *Cupressus lusitanica* have a mean annual increment (MAI) of about 30 m^3/ha, and some of *Eucalyptus* spp. exceed 50 m^3/ha, but both types show significant variance. With respect to standing tree density, both species show variances due to the effects of thinning and selective felling by the local people (especially common for the *Eucalyptus* spp.). The timing and volume of thinning are not recorded.

In conclusion, it would not be appropriate to prepare a reliable yield table for the Reforestation Plan from the data obtained by the forest plantation survey.

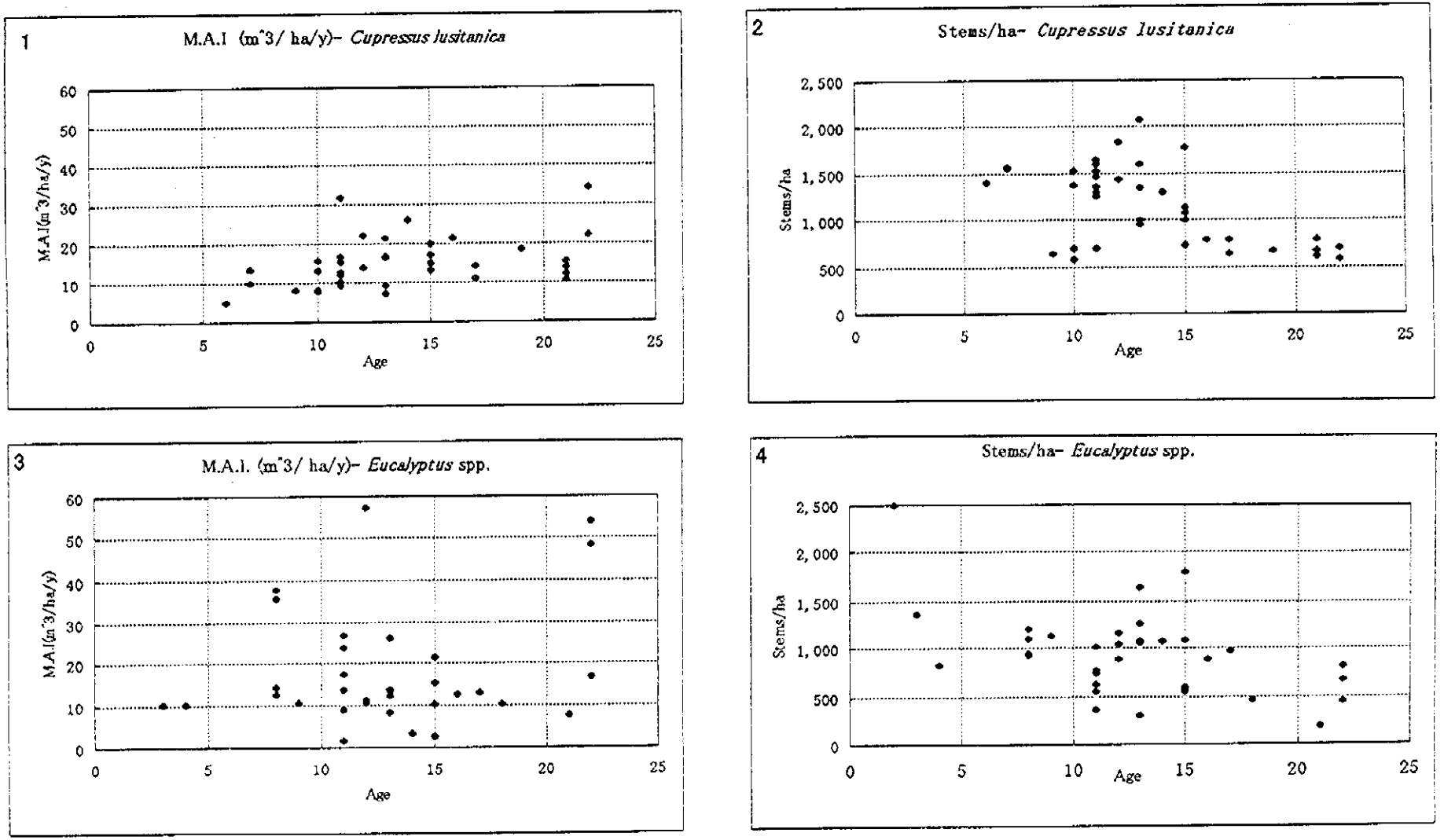


Fig. 13 Mean Annual Increment and Standing Tree Density by age (*Cupressus lusitanica* and *Eucalypyus* spp.)

2-9. Forest Operation Survey

2-9-1. Objectives

The objectives of a forest operation survey is to understand the forestry activities conducted by JZADO's FWPT so as to formulate the logging, reforestation and social forestry plans.

2-9-2. Survey Method

The forestry activities taking place in the Intensive Study Area during the second term survey (May - September, 1997) were logging (including thinning), planting, tending and nursery operations. The major part of forestry operation survey was to interview FWPT officials and site workers. Whenever necessary, measurement of on going operations was carried out on the spot.

2-9-3. Timber Production

(1) Logging in Natural Forests

(i) Logging operations

Logging operations in natural forests in the Intensive Study Area is carried out by Regional State of Oromia.

Areas are determined through negotiations between FWPT officials and purchasers. The boundaries of logging areas are not demarcated, therefore no record is available to confirm the area. Logging is conducted on selective bases, and trees with a D.B.H. greater than 60 cm are selected by FWPT officials in the presence of the purchaser. The tree species felled most is *Aningeria adolfi-friderici*, followed by *Croton Macrostachys*, *Ekebergia capensis*, and *Pygium africanum* in decreasing order (1995/1996).

Logging operations are carried out by purchasers. The logging operation from 1995 until 1996 took place in the northern Sedi, but the one from 1996 until 1997 has been carried out in Afalo and Gara. The felling rate was 3.34 % in Gara, according to the standard site survey data.

Logging crews, consisting of 7 to 11 members, are responsible for the entire range of logging operation, from felling and skidding to cross-cutting and loading. Axes are used for felling, bulldozers for skidding, and chainsaws for cross-cutting. A total of eight logging crews were active in 1995-1996, however, the number is going to be reduced in 1996-1997 due to declining logging volume.

Felled trees are cross-cut to loggs of 2.65m long, up to the top end diameter of 25cm, and the stand volume is calculated from the cross-cut pieces. Logging roads from felling sites

to public roads are constructed at the expense of purchasers.

(ii) Sales volume and price

The stumpage sale is the practice and the purchaser is the Jimma plant of the state-owned Ethiopia Plywood Factory. The Regional State sets yearly sales and provides quota for the company on the basis of their past records and capacity. In the case of Ethiopia Plywood Factory, the purchase in 1995/1996 amounted to 2,670 m^3 but the number plunged by half to 1,340 m^3 in 1996/1997. The sharp decline was for the conservation of natural forests and the total stumpage sale in Oromia Region also dropped nearly by half, from 9,970m^3 in 1995/1996 to 5,000m^3 in 1996/1997. Annual sales are repeated to remain at the similar level for years to come, therefore Ethiopian Plywood Factory plans to fill the shortage of natural logs with substitutions, such as pine and eucalypts.

Sale prices were set by species until 1995/1996. Since 1996/1997, however, a uniform price of Birr 292.1/m^3 was adopted for all indigenous species, said to be reflecting the market values. This price is to be checked every six months.

An auction system is going to be introduced in 1997/1998.

(2) Logging of Forest Plantations

Practically no forest plantations have reached the felling stage in Intensive Study Area. Most felling taking place in forest plantations is the thinning of *Cupressus lusitanica* and *Pinus patula*. Of a total of 1,100 ha of forest plantations in the Intensive Study Area, *Cupressus lusitanica* accounts for 608 ha and *Pinus patula* for 70 ha. Approximately 580 ha of the *Cupressus lusitanica* and *Pinus patula* forests need thinning.

Thinning is carried out by FWPT officials assigned to Belete and Gera Forests, as and when thinning budgets are available. While the standard thinning intensity is to be 30%, there is no thinning plan or standard for Intensive Study Area. FWPT officials select trees to be felled and contractors do the thinning. Felled trees are collected at the forest site or near a forest road and then sold. The volume of thinning in forest plantations varies year to year: Thinning volumes for the past three years are shown in the table below:

Tab. 20 Thinning volumes (1994 - 1997) in Belete-Gera NFPA

Year	Size of land (ha)	Volume of thinning (m^3)	Profit (Birr)
1996/1997	68	1,289	*)
1995/1996	17	300	11,400
1994/1995	70	2,710	42,620
Total	155	4,299	54,020

*) Not yet sold at the time of the survey. See the first paragraph on p.80.

Thinning for 1996/97 was carried out between December 1996 and February 1997, but the sale of thinning logs has not yet been completed when the Forest Operation Survey was conducted (October 1997). Although many forests, including eucalypts forests, require thinning, the operation has been delayed. It is, therefore, urgent to formulate a thinning plan for each stand and to promote thinning operations. Depending on access and topography as well as the age of stand, the thinning cost is in the range from 100 to 400 Birr per hectare (see Appendix Tab. 21, 22).

2-9-4. Planting and Tending

(1) Planting

The reforestation record for the last three years is shown in Tab. 21. In Belete Forest, exotic species consisting mainly of *Eucalyptus* spp. have been planted in the non-forested land in the southwestern Gojeb~Gojeb Kishe area. In Gera Forest, indigenous tree species have been planted in logged over area on the hillsides (Dedo Boge area) of northern Sedi (enrichment planting).

Tab. 21 Area reforested in the last three years (1994/95~1996/97)

Forest	Area Name	Year Planted (ha)			Total (ha)
		1994/95	1995/96	1996/97	
Belete Forest	Gojeb Gojeb-Kishe	50.0	143.3	93.3	193.3
Gera Forest	Dedo Boge	18.4	27.1	34.8	45.5
	Total	68.4	170.4	128.1	238.8

Site preparation is the same for all species. An area of 60~100cm in diameter is cleared of grass for each seedling; planting pit is 30cm in diameter and 15~20cm in depth.

An average cost of planting (from site preparation to planting) is approximately 270 Birr/ha at 2,500 trees/ha (see Appendix Tab. 21, 22, 23).

(2) Enrichment

Indigenous tree species have been panted in the open areas after selective felling in Gera Forest since 1995. The forest type is F2 and the trees have been purposefully planted on pretty denuded sites.

Hagenia abyssinica, at 70%, and *Ekebergia capensis* at 23% make up most of the species. In addition, *Pygeum africanum*, *Podocarpaus gracilior* and *Cordia africana* have been planted on an experimental basis (see Appenidix Tab. 24).

Such denuded sites give rise to rampant growth of grass and climbers, and survival of seedlings is poor unless proper weeding is done. Among those species planted, *Hagenia abyssinica* has proven a rapid growth in early stages, and continues to grow well. A look at the growth conditions indicates a successful survival rate of 89%, and a mean height of 0.4m at 7 months, 2.3m at 19 months.

(3) Planting Density

Past planting was spaced at 2m x 2m (2500 trees/ha) regardless of species. Future plans call for an examination into planting density according to different planting objectives (transmission pole, lumber, construction poles, etc.) and species.

(4) Weeding

Though weeding is the norm for 2~3 years after planting regardless of tree species, this is done only for the first year in practice. Much of the recent poor performance of reforested areas seems to originate from this inadequate weeding. The cost of weeding is about 50 Birr/ha (see Appendix Tab. 21).

(5) Pruning

No pruning is done on *Eucalyptus* spp. Three prunings by age 8~10 would be done for *Cupressus lusitanica* and *Pinus patula*..

Tab. 22
Pruning schedule for *Cupressus lusitanica* and *Pinus patula*

Pruning	Height (m)	Year
Access pruning	2	4
First pruning	4	6
High pruning	8	8

2-9-5. Nursery Operation

(1) Nurseries

Nurseries under FWPT are located, one in Belete Forest (Gojeb) and two in Gera Forest (Sedi, Dedo Boge). The nursery in Sedi is currently closed (see Appendix Fig. 19 for locations of these nurseries).

Tab. 23 Current conditions of the existing nurseries

Placement	Area (ha)	Seedling Production Capacity	Notes
Belete Forest (Gojeb)	1.0	1,000,000	Permanent nursery
Gera Forest (Sedi)	1.0	1,000,000	Permanent nursery, currently closed
Gera Forest (Dedo Boge)	0.4	300,000	Temporary nursery

The Gojeb nursery is a permanent facility used for planting in Belete Forest, and has a production capacity of 1,000,000 seedlings. It currently produces pot seedlings of mainly *Cupressus lusitanica* and *Eucalyptus saligna*. The Dedo Boge nursery is a temporary facility supplying seedlings for enrichment planting of the logged over area, and has a production capacity of 300,000 seedlings of *Hagenia abyssinica, Ekebergia capensis, Pygeum africanum, Podocarpus gacilior,* and *Cordia africana*. The seedling production data of both nurseries for 1996/97 are shown in Tab. 24.

Tab. 24 Seedling production for 1996/97

District Species	Gojeb				Dedo Boge	
	regular seedlings	potted seedlings	total	%	regular seedlings	%
Eucalyptus saligna	15,000	109,000	124,000	42		
Cupressus lusitanica	33,460	104,400	137,860	46		
Casuarina equisetifolia	11,020	15,000	26,020	9		
Hagenia abyssinica		8,000	8,000	3	82,400	94
Ekebersia Capensis					2,537	3
Pygeum africanum					2,398	3
Cordia africana					188	0
Podocarpus gracilior					(1,249)	
Total	59,480	236,400	295,880	100	87,523	100

Note: item inside () is for reference purposes, which is *Podocarpus gracilior* seedlings produced in 1995/96

The nursery workers are mostly female, and daily wage is 3~4 Birr. Sowing, watering, weeding, and other tasks are all manually performed, and the operational cost per seedling is about 0.2 Birr (see Appendix Table 21, 22).

Though the capacity of the existing permanent nurseries is adequate, poor access and transport (FWPT currently has only one vehicle) considerably discount its efficiency. More temporary nurseries will become necessary to meet the needs of enrichment planting for logged over areas and social forestry plans.

(2) Seeds and Seedlings

Most of the necessary seeds are collected from NFPAs in Jimma Zone, and those available from the FRC are used only very occasionally.

The nursery techniques for exotic species, such as *Eucalyptus* spp., *Cupressus lusitanica, Pinus patula* has been well developed and is common knowledge in Ethiopia. Among the indigenous species, operational production of *Hagenia abyssinica* is possible. For other species, the techniques are yet to be developed, and officials in charge are carrying out research from seed collection stage on a trial basis. Seedling procurement rate varies significantly from year to year, and situation is such that planting area is determined by the year's seedling supply. Species, such as *Hagenia abyssinica* show good growth after planting, and is expected to become favorable indigenous species to plant. Further development of nursery techniques for other indigenous species is a topic of immediate importance at present.

2-9-6. Forest Protection

(1) Forest Fires

Belete-Gera NFPA poses only a small risk of fire for the following reasons: (i) Annual precipitation is relatively ample, there is rainfall even during the dry season, and (ii) Sedentary farming is prevailing. However, in the vast non-forested area in the western hills of Belete Forest, where reforestation has been underway since 1994, farmers customarily burn grasslands for grazing and farming. The fire often escapes and spreads into the adjoining forest.

Since the area in Gojeb and Gojeb Kishe has been subject to frequent fire outbreaks, forest guards are posted on three lookout towers. Yet the fire extinguishing capability is limited by insufficient equipment and manpower. Although a 19 km-long firebreak, which costed 19,000 Birr, was constructed, it quickly became obsolete by lush growth of grasses and shrubs. No records are available on past fire damages.

Construction of firebreaks and other fire prevention measures must be incorporated in the reforestation plans in this area and others where the land use pattern is similar.

Two more lookout towers, in addition to those three in this area, exist in Belete Forest. All five lookout towers are simple structures constructed from *Cupressus lusitanica* timber procured during thinning, but they lack durability (up to only 5 years).

(2) Pests and Diseases

(i) Damage by insects and microorganisms

No record of insect damage in forest plantations exists at present, and the risk can be assumed as minimal in terms of forest area. Insect damage can be prevented by thinning overly dense forests. Thinning also helps to prevent soil erosion inside forests. There is no record of insect damage in natural forests either.

(ii) Damage by animals

(a) Damage through grazing

Farmers often lead their cattle into reforestation sites, especially the former grazing fields, and saplings and young trees are damaged by trampling. It occurs more often in eucalypts reforestation sites than in *Cupressus lusitanica* sites, since more forage is available at eucalypts sites. How to control cattle grazing in reforestation sites near farming households is a major challenge to the reforestation efforts and the efforts are to be combined with social forestry plans.

(b) Damage by wildlife

Although there are reports of the buds and barks of young planted trees being browsed by rats, hares, boars and other wild animals, damage does not seem to be serious.

(3) Weather Damages

Frost has been observed during planting season on occasions, but not to the extent to cause significant damages.

Strong winds apparently cause damages to planted trees once every few years. Large-scale storms such as typhoons or cyclones do not attack this region, but heavy rains lasting a few hours and accompanied by gusting winds can be seen during the rainy season. Damaged and broken trunks, though small in area, have been reported in the windpath on these occasions. *Pinus patula* is considered a wind damage-prone species, and the damage more often takes the form of trunk breakage rather than uprooting. This particular damage was seen in the *Cupressus lusitanica* and the *Pinus patula* plantations during the survey period, albeit in limited areas. Rapid removal of damaged trees is necessary after such incidents in order to contain pest damage as well as to restore forest cover.

2-9-7. Timber Utilization

(1) Logs from natural forests in Belete-Gera NFPA

Logs harvested in Belete-Gera NFPA are mainly for plywood and furniture. There are four factories that procure industrial logs from Belete-Gera NFPA: the state-run Ethiopia Plywood Factory (Jimma), the Jimma Sawmill also state owned, and the private Almaz Goshu and Veneer Factories (Addis Ababa).

The Regional State of Oromia granted a sale quota of 3,950m^3 (including Sigmo Gaba) to the Belete-Gera NFPA for fiscal 1995/96. This was half the amount of previous years. Quota to factories in 1996 was 1,800m^3 to the Ethiopia Plywood Factory (Jimma), 750m^3 to Jimma Sawmill, 1,000m^3 to Almaz Goshu Factory, and 400m^3 to Veneer Factory (Addis Ababa).

(2) Logs from Forest Plantations

Logs from forest plantations are purchased mainly by local sawmills and processed into construction lumber. A total of 4,299m^3 of logs from the forest plantations of Belete-Gera NFPA were sold from 1994 to 1996. The purchasers were: Sigmo Jimma (2,710m^3 in 1994/95) and Almaz Goshu (300m^3 in 1995/96).

Similarly, a total of 3,898m^3 of logs from the forest plantations of Babiyaa Follaa NFPA were sold from 1994 to 1996. The purchasers and their log purchase volumes were: Sigmo Jimma (1,500m^3 in 1994/95 and 1,000m^3 in 1995/96) and Almaz Goshu (1,000m^3 in 1995/96).

(3) Timber Utilization at Ethiopia Plywood Factory (Jimma)

This state-run plywood factory relies greatly on Belete-Gera NFPAs for logs and is making large contributions to the local economy by providing jobs. The factory started operation in 1960, and now employs 138 plywood mill and sawmill workers, 9 furniture workers, and 53 clerical workers. In addition, the factory employs 40 to 50 logging workers. Its equipment includes two peeler machines, one 3-stage dryer and one 10-stage hot press.

In 1996, the Ethiopia Plywood Factory (Jimma) purchased a total 2,670m^3 of logs to produce plywood--1,435m^3 of *Aningeria adolfi-friederici* (Kerero), 825m^3 of *Croton macrostachyus* (Besanna), 385m^3 of *Ekebergia rueppeliana* (Sombo), 19m^3 of *Pygeum africanum* (Tekur Enchet), and 6m^3 of other species. The factory produced 72,162 plywood sheets in 1996, averaging 6,013 sheets a month. Three-ply 4 mm sheets accounted for 76%, three-ply 6-20 mm for 20%, and three-ply 3 mm for 4%. The factory sold 50% of its plywood to government organizations and another 50% to private distributors. The most serious problem the factory is facing is the chronic shortage of raw material logs.

2-9-8. Current Conditions of Roads

Due to severe erosion of the road, it is very difficult, sometimes impossible, ever for a four wheel drive vehicle to pass the existing roads in the Intensive Study Area even during the dry season, except the main roads linking Jimma and Bonga (Belete), and Agaro and Chira (Gera) that are passable all the year round. The roads in the Intensive Study Area and their conditions are listed below.

Tab. 25 Conditions of existing roads

	Starting Point	Ending Point	Road Conditions	Remarks
Belete	Sombo	Eleke Togobe	D	
	Sombo	Atoro Sufa	D	
	Shebe	Komo Hari	X	
	Shebe	Yanga Deo	D	*1
Gera	Chira	Gura Afalo	D	*1
	Chira	Wegacha	X	
	Chira	Muje	X	
	Chira	Gera Naso	O	
	Chira	Gera Daka	O	
	Sedi	Sedi Loya	D	*2

Note

O : passable
D : passable with difficulty in fair weather conditions
X : impassable
*1 : road constructed by Rural Road Construction
*2 : logging road

In addition to those listed above, there is a logging road to Guminadajo from the end of Chira-Gura Afalo Road that was constructed in 1997 by the purchaser of stampage sales.

2-10. Social Forestry Survey

2-10-1. Objectives

Objective of the social forestry survey is to prepare for a participatory social forestry plan that will stabilize rural life and improve the welfare of the local people and to bring about rural development.

2-10-2. Survey Method

The survey methods are as follows.

The content and focus of the survey were based on the results of interviews with the local people (Ref. 2-2 Social and Economic Environment) and the survey of the local community by the local subcontractor (Section 2-2. Socio-economic Conditions).

(1) Data Collection and Field Survey

Data on social forestry, agroforestry and gender were collected from agencies, such as FWSLTRD, JZADO and DADO. Also, a field survey was conducted on social forestry activities of NGOs and others.

(2) Interviews with the Local People regarding Forest Utilization

In addition to the local community survey, a more detailed survey of Intensive Study Area was necessary to prepare a social forestry plan. Interviews on forest use, land use practices, and family tree planting were conducted with village chairmen, households, and residents as well as women's groups in the villages located in Intensive Study Area.

(3) A Detailed Analyis of the Local Community Needs

The needs identified by the local community survey were analyzed for each village, and the possibility as well as necessity for social forestry projects were assessed.

2-10-3. Current State of Social Forestry

(1) NGOs' activities

i) Redd Barna (Save the Children)

Redd Barna is a Norwegian NGO which has been active in Gera District since 1987. At the time of its foundation, Redd Barna aimed at providing emergency humanitarian aid for new settlers in Gera District. Its main area of activity in subsequent years has shifted to the promotion of rural development programmes such as the following;

- Improvement of water sources (Komo Hari)
- Construction and improvement of wells (Sedi Loya)
- Improvement of coffee nurseries (Wanja Sulaja)
- Construction of flour mills
- Loans to assist rural women (Chira)

Of these activities, two programmes are further described below to illustrate the activities of Redd Barna.

(a) Community Nursery in Wangya

A nursery was established in Gera District to produce coffee seedlings and such fruit tree seedlings as guava, mango and avocado. Local people were employed to perform sowing and nursery work. The seedlings produced were distributed free of charge. The project ended in 1995. Although the local community was expected to take over and run the nursery, no one at the moment is willing to take the responsibility.

(b) Income Generation of Women's Group

Redd Barna has been offering loan to poor rural women since 1995 at Chala in Chira Village of Gera District. The aim is to increase the income of poor families in general and women in particular by means of loan to start new activities as below.

- Establishing a 3,000 Birr fund at a bank as a loan of 100 Birr per person this is for a rural women's group of 30 members
- Purchasing sheep and other domestic animals for group ownership using interest of the original fund
- Raising these animals for several years
- Selling adult animals to obtain cash income
- Purchasing children's and women's clothes and commodities using the earned cash income

(ii) Ethio-Libyan Joint Venture Development Company

This is an apiculture improvement project run by a joint venture between Ethiopian and Libyan NGOs. The project commenced in 1985 and the project was already terminated. Local people took over the facilities and are continuing its operation. The main activities are listed below.

- Study of apiculture techniques currently practiced in Ethiopia
- Trial introduction of modern apiculture techniques, including fixed bee hives

Atro Gefere (Seka Chekorsa District) and Kecho Andercha (Gera District) where traditional simple apiculture had been practiced were selected to install fixed bee hives. More

than 15 bee hives have been installed at a bee garden in Atro Gefere. Three villagers are engaged daily in managing and monitoring work. Local farmers assess this project as follows.

- The yield of honey is much higher than the traditional method of hanging bee hives on trees.
- A fixed bee hive is much easier to install or to move.

(iii) Finnish NGO

A Finnish NGO is implementing a rural village development programme and its major activities are as follows.

- Health care service
- Farming assistance service
- Assistance for village development by improving water sources and providing loans for low income villagers
- Vocational training to assist rural development

(2) Forest Utilization by Local People

(i) Benefits of Forests

For rural life, one of the most important benefits of forests is the supply of firewood. The results of the questionnaire to local households show that 50% in Seka Chekorsa District and 63% in Gera District indicated that supply firewood is the main benefit of forests. In addition, forests provide most of the construction materials for housing, the next important benefit.

Forests also produce medicinal herbs, nuts, spices, natural coffee beans and honey. The results of the interviews on forest benefits are shown in Appendix Tab. 25. The number of herbs indicated by the interviewees range from 9 to 25 species by community. As for the knowledge on species for nuts, the range is one to seven species, and for spices two to four species respectively.

Naturally produced coffee beans and honey, both important sources of cash income, are gathered in Gura Naso and Gura Afalo in the Gera District. Honey is also gathered in Elke Togobe in the Seka Chekorsa District. No such activities are seen in Yanga Deo.

(ii) Decreasing Supply of Firewood

The depletion of natural forests leads to a decline in the supply of firewood. Tab. 26 classifies the villages located in and around Intensive Study Area into three categories based on the availability of firewood. Villages with serious and with moderate firewood shortage were further surveyed and the patterns of firewood shortage were identified as shown in Appendix

Tab. 26. The salient features of firewood shortage are outlined below.

- Firewood depletion intensified from the mid-1960s to the mid-1970s.
- A shortage of firewood has been continuously felt since the mid-1980s.
- The decline in firewood supply in Sombo Daru (Seka Chekorsa District) and Dusta (Gera District) occurred much earlier than in other areas.

Tab. 26 Firewood availability of villages around Intensive Study Area

District	Villages with poor Firewood supply	Villages with Moderate Firewood supply	Villages with Sufficient Firewood supply
Seka Chekorsa	Atro Gefere Atro Sufa Kishe Komo Hari Mirgano Baso Sombo Daru	Dama Gemech Elke Togobe Helo Godanti Helo Seboka Shebe Mofa Shebeka Debiye	Yanga Deo
Gera	Chira Dedo Boge Dusta Gore Daka Muje Sedi Loya	Geba Gute Kecho Anderacha Kobo Selaja Kombolcha Waja Sulaja	Gara Naso Gemina Gura Afalo Kela Ariri Oba Toli Wala

Note: "Moderate" means that, while firewood is sufficiently available at present, a shortage in the near future is foreseen.

(iii) Firewood Collection by Women

Tab. 27 shows the walking distance to collect firewood by women in the communities with low firewood supply due to forest depletion. Women in Dusta and Dedo Boge Villages in Gera District spend as long as six hours a day for firewood collection while those in Sombo Daru Village in Seka Chekorsa District spend five hours a day.

Tab. 27 Walking distance for firewood collection in villages with a firewood shortage

District	Village	Community	Location of collection	Distance	Walking Time
Seka Chekorsa	Elke Togobe	Busasie	Inside Village	6 km	2 hours
	Kishe	No. 1, No. 3	Inside Village	-	3 hours
	Komo Hari	Hari	Outside Village	-	4 hours
	Sombo Daru	Ramie	Outside Village	10 km	5 hours
Gera	Dedo Boge	Boge	Outside Village	-	6 hours
	Dusta	Dusta Town	Outside Village	10 km	6 hours
	Gore Daka	Chone	Inside Village	3 km	1 hour
	Sadi Loya	Sadi Loya	Outside Village	6 km	3 hours

The required time for firewood collection in these communities are much longer than the average time required for firewood collection reported by the Local Community Survey.

Species used as firewood are listed in Appendix Tab. 27. The following three species are commonly used by the communities surveyed.

- *Myricia salicifolia* (Rejjii)
- *Macaranga lophostigna* (Wangoo)
- *Maesa lanceolata* (Abayi)

In these communities, shrubs, stalks of harvested maize and millet, and Ensete (*Musa abyssinca*) are also used as household fuel.

(3) Customary Land Use

The following are the local customs on land use in villages around Intensive Study Area.

- Land belonging to a local community is distributed to its members (farming households) and each member has exclusive rights to use the distributed land.
- Customary rights of inheritance are guaranteed for the site of residence and farmland.
- Land use rights may be sold.
- Grazing land is often commonly owned by a village or community.
- Natural forests are jointly used by local people.
- Firewood and timber for daily life is collected according to local customs.
- Felling of trees to obtain construction log for private housing requires application to and permission of the relevant authority.

Community forests are only found at Gudo in Gudo Daka and Buyo in Yanga Deo, both located in Seka Chekorsa District. The former is a plantation *Cupressuse* spp. while the latter is a natural forest.

(4) Education and Extensions

(i) Production of eucalypts seedlings at Schools

The survey team visited the Chekorsa Elementary and Junior High School, Kome Hari Elementary School, Sufa Elementary School, Gera Elementary and Junior High School, and Dusta Elementary School. These schools produce in their compound crops like beans, seedlings of vegetables and fruit trees and eucalypts seedlings and also carry out natural drying of coffee beans. Two schools were studied in detail as they have been producing encalypts seedlings regularly. They are Chekorsa School and Gera School, the letter producing mainly vegetable seedlings but experienced in tree seedlings as well. Their activities are summarized below.

a. Chekorsa Elementary and Junior High School

(a) Particulas

Location, etc. : Sombo Daru; 623 pupils (389 boys and 234 girls); 18 teachers
Grades : Eight grades with a total of 11 classes

(b) Nursery Operations

Start:	1995
Objective:	to teach pupils how to raise tree seedlings so that the knowledge can be used at home
Method:	practical training of sowing and raising seedlings of *Eucalyptus* spp., vegetables, fruit trees and coffee at a nursery (about 0.5 ha) set up on school ground
Background:	· The idea came up from discussions among teachers. · One teacher was a graduate of an agricultural college. · The teachers recognized the importance of giving the children skills for nursery operation.
Source of Seeds:	· Seeds of *Eucalyptus* spp. are obtained from a district nursery in Sombo. · Seeds of vegetables and fruit trees are obtained from a Finnish NGO in Shebe.
Technical Guidance:	Provided by the teacher who is an agricultural college graduate.
Problems:	· The present nursery is too small. · The budget is inadequate.

b. Gera Elementary and Junior High School

(a) Particulars

Location, etc:	Chira Town; 752 students (306 girls, 446 boys), 32 teachers
Grades:	Eight grades

Home Communities of students:

Chira town, Challa, Dusta, Kamise, Gure Dako, Anderacha

(b) Nursery Operation

Production:	Twice in two years (1995~1996)
Objective:	To give experience to students in nursery practice
Methods:	A nursery was established in the schoolyard and seedlings of mainly vegetables with some trees (*Cordia africana, Cupressus lusitanica, Eucalyptus* spp.) were raised. The pupils experienced sowing, transplanting, weeding and watering. The seedlings raised were distributed free of charge. The number of seedlings distributed is still small, and in 1995 about 60 for *Cupressus lusitanica* and 70 for *Eucalyptus* spp.
Background:	The importance of training children of rural families in nursery technique was recognized. A desire to experience tree seedlings production was voiced during a meeting of the Enviornmental Protection Club, an extracurricular activity.
Source of Seeds:	Seeds were obtained free of charge from Gera DADO.
Technical Guidance:	A teacher with a degree from an agricultural college provided technical guidance. Govermental orgnizations (National Organization of Food Protection Ethiopia, etc.) assisted in the nursery activities.
Problem:	Shortage of water during the dry season from December to February.

(c) Club Activities

An extracurricular program for students called the Environmental Protection Club is going on. Following activities are carried out by the club:

- A meeting on forest utilization methods of families
- A meeting on tree planting methods

- A meeting to learn from experts of Gera DADO
- A field trip to encroached natural forests

(ii) Current Situation of District Nurseries

Nurseries in both Seka Chekorsa District and Gera District were opened and are being run by the district authority for improving rural life through the distribution of seedlings to the local people.

Tab. 28 shows the nurseries run by Seka Chekorsa DADO and Gera DADO. In addition, the Seka Chekorsa DADO runs five nurseries specialised in coffee. The units responsible for the running of nurseries are the Environmental Protection Team for tree seedlings and the Extension Team for coffee seedlings.

a. Seedling Production

The number of seedlings produced in nurseries run by DADOs in 1996 is as recorded in Appendix Tab. 28. The type of seedlings produced in the seven DADO-run nurseries are: eleven tree species, three fruit tree species, and one coffee, making a total of 15 species. Coffee makes up 48%, the *Eucalyptus* spp. 47%. Kachama and Sombo are the only two nurseries where coffee seedlings are produced; they are not produced in the other five nurseries. Seedlings of *Eucalyptus* spp. make up more than 70% of tree seedlings produced in all the nurseries. Three nurseries in Gera District produce only eucalypts seedlings.

b. Seedling Distribution

Distribution of seedlings by DADO nurseries in 1996 is as follows:

District	Number of Seedlings	Number of Villages	Number of Households	Average No. of Seedlings per Household
Seka Chekorsa	262,000	17	826	317
Gera	223,000	5	214	1,042

As seen from the above, there is a considerable difference in an average number of seedlings reaching the recipient household, i.e. the number in Gera is about three times of Seka Chekorsa. More details of seedlings distribution per family by community and by DADO nusery are shown in Appendix Tab. 29.

At the community level, a maximum and a minimum of the distributed number per household again varies widely between two Districts as seen below.

	Maximum		Minimum	
	Community	Number	Community	Number
Seka Chekorsa	Gibe Baso	808	Liluchaha	100
Gera	Kola Bulcha	3,500	Gure Kaso	480

Apparently, DADO Seka Chekorsa distributes less number of seedlings to more households than in Gera. It would be necessary to look into the background of this trend and to monitor actual planting and survival of trees after planting.

Appendix Tab. 30 shows the percentage of households receiving seedlings. 4.7% in Seka Chekorsa District and 5.3% in Gera District are the receivers. A look at distributed household percentage by village shows that three villages - Sombo, Wushanea Kocha (Seka Chekorsa District), and Kacho Handaracha (Gera District) stand out at more than 10%.

Tab. 28 Nurseries run by DADOs

District	Nursery Name	Village	Year of Establishment	Size of Area	Number of Workers	Major Species
Seka Chekorsa	Kachama	Buyo Kofe	1989	1.25 ha	15 - 21	*Eucalyptus*, coffee
	Gibe	Gibe Boso	1976	0.25 ha	6 - 10	*E. saligna*, fruit and other trees
	Dato	Dato Kersu	1994	0.75 ha	2 - 7	*Eucalyptus*, fruit and other trees
	Sombo	Sombo	1983	2.00 ha	20 - 45	*E. citriodora*, coffee
Gera	Kora Bucha	Kola	1990	1.50 ha	5	coffee, trees
	Wanja Kersa	Wanja Sulaja	1981	2.50 ha	50 - 120	coffee
	Wanja Kersa	Wanja Sulaja	1988	1.25 ha	10	trees
	Gure Genjii	Chila	1995	0.50 ha	4 - 5	trees

(a) Manner of Distribution

The seedlings produced are distributed in the following manner.

- The DADO instructs the district agricultural extension workers (commonly called DAs) to check and report the number of seedlings required by each village.
- Each DA notifies the local residents of the avaliablity of seedlings.
- Each DA compiles a report on the species and number of seedlings requested by local residents for the DADO.
- On receipt of the above information, the DADO allocates the number of seedlings to be distributed to each village, coordinating the number of requests with the available number of seedlings for distribution.
- Local residents receive the seedlings at the nurseries at a designated time.

(b) Price of Seedlings

- Coffee seedlings: charged (0.08 Birr/seedling)
- Fruit tree seedlings: charged (0.5 Birr/avocado seedling)
- Other seedlings: free of charge

(iii) Agricultural Extension Organization

One of the two departments of the JZADO is dedicated to agricultural extension activities and the extension system is firmly established at the Zone and District administrative levels. Extension officers are assigned to rural areas and perform various extension activities, including forest production, which are reaching the grass-root level.

The organizational structure of the Seka Chekorsa DADO and Gera DADO is shown in Appendix Fig. 10 and Appendix Fig. 11 respectively. Extension officers are assigned to both DADOs. Supervisors and DA (described as extension agents in the organization charts) are stationed in villages as on-site workers under the extension officers. DA are engaged in the following extension activities.

(a) Extension of new farming techniques to farmers: production of crops, coffee, vegetable and timber and soil and water conservation, animal husbandry and others (Bee keeping; breeding; nutrition supplement); home science and home economy.

(b) Technical guidance on farming techniques: seed selection; sowing and planting; fertilization; nursery preparation; cultivation and management (crop; coffee; trees; vegetables); pre- and post- harvest control of grains and coffee; advice for community activities (cleaning of water sources; road maintenance during rainy season; bridge maintenance; irrigation)

Qualifications of agricultural extension agents are as follows.

- Education of senior high school or higher
- Specified on-site training provided by administrative organization
- Specified number of agricultural extension training courses at a training centre

The facilities (commonly called DA houses) are provided for agricultural extension agents to be stationed in villages.

There are nine DA houses in Seka Chekorsa District and also nine in Gera district.

iv) Training Facility for Agricultural Extension Agents and Other Personnel

The results of interviews with DADO, DAs and home agents show that training of new field agents take place in the following three locations:

- For long-term yearly training: Bokoji Training Center (located in the Arisi Zone)
  Bale Training Center (located in the Bale Zone)

- For short-term monthly training: Goma Training Center (located in Agaro)

The methods and content of the training at the Goma Training Center are as follows:

Established: 1990

Supervising body: Coffee and Tea Authority (central government)

Objectives:

- Technical improvement and expertise training in coffee production and processing such as cultivation, management processing, and protection of coffee.

- Training of DAs and improving agricultural technology

- Planning and provide short training courses in various expertises at request.

Staff: 26 (includes 4 technical personnel)

Training Duration: One month (15 days of lecture and 15 days field excise)

Full-time training course: Normally, the following five training courses are available. New training course starts in October. A new curriculum will start in 1997.

- Coffee agronomy
- Coffee processing
- Coffee protection
- Agricultural extension
- Horticulture

Special training course: A special training course can be arranged out in this facility at the request of governmental organizations, NGOs and others. A 3-month planning and preparation period is necessary after the request has been received course. Program and curriculum as well as staff and lecturer selection are made during this period. Past

special training courses are as follows:

- Soil and water conservation course
- Forest management course
- Home agent training

Main facilities:

Training facility:	lecture room (40 people capacity, 2 rooms), library, laboratory, lecture hall, practice farm
Accomodations:	trainee housing (maximum capacity: 40 people), lecturer housing (maximum capacity: 12 people)
Vehicles:	station wagon (1), pickup truck (1)

(v) Gender Related Customs and Activities

As noted before, women perform all the daily domestic chore. As for forest-related issues, firewood was collected more than four times a week, an average of 1.9 hours at a time. In particular, the women of those communities where firewood collection has become difficult due to depletion of forests nearby spend upto six hours a day to collect firewood. Including preparation of meals and fetching water, women spend long hours every day for household work. Under these circumstances, it is practically impossible for women to participate in social activities.

Meanwhile, men are engaged in such physical work as ploughing, tree felling and the making and placing of bee hives. In general, there is a tendency for men to work to produce cash income and women in other types of work. For example, the felling, transportation and sale of eucalypts in the homestead plantation are all conducted by men who are also responsible for coffee collection.

Planting work has the following characteristics.

- Both men and women are eligible for employment.
- The planting of eucalypts at home is mainly done by men.

Village meetings are held frequently. The participants are mainly men and women rarely attend such meetings. Accordingly, women's opinions are seldom reflected on decisions and women have no decision-making power in social events.

As a part of administrative efforts to address the needs of women, there are women, two in Seka town and one in Sombo town, working as home improvement guidance agents (commonly referred to as home agents) with the Seka Chekorsa DADO. They are working on subjects such as stove improvement, proper nutrition, birth control and so on.

According to an interview with Women's Affairs Department, a guideline on gender-related issues is in preparation with the assistance of UNDP. This guideline will be ready around March 1998.

(vi) Traditional Communal Organizations and Inclination of Local People

Two types of traditional communal organizations exist in the local community. They are:

- Shene (Traditional Mutual-Aid Organization)

  A shene is formed by local people to jointly solve or act on events, including funerals, marriages and incidental matters.

- Debo (Temporary Communal Working Group for Farming)

  A debo is formed by local people to jointly conduct ploughing, weeding and harvesting, house building and other work. The group members mutually provide labour to meet individual needs.

At Daka in Gore Daka in the Study Area, debo members are working to construct hedges using *Euphorbia candelabrum* (Adami) in order to prevent the intrusion of cattle and other domestic animals into farmland. There are no records of debo-based tree planting activities.

The inclination of local people could be described as follows:

- Unwilling to be grouped or controlled by any organization
- Argumentative at meetings and on other occasions

(5) Current Situation of Homestead Tree Planting

There are several villages where private tree planting is popular. Of these villages 16 households in four villages (four households per village) were selected for interview on their homestead plantation activities. The survey results are outlined below. A more details of the practice can be found in Appendix Tab. 31.

(i) Species

Major species planted are *Eucalyptus camaidulensis*, *E. saligna* and *E. citriodra*.

(ii) Planting Sites and Patterns

Planting sites are mainly gardens or land surrounding farmland. One family in Chira has planted *Eucalyptus* spp. on its entire farmland (approximately one ha in size), practically

converting the farmland to a tree plantation. There are two planting patterns, rows and small patches.

(iii) Acquisition of Seeds and Seedlings

Seeds are collected either from their own or neighbors' trees. Seedlings are obtained from either a district nursery or are bought from traders or other farmers. The price of the seedlings sold by traders varies depending on the seedling size. The highest price found was one Birr for 50 seedlings while the lowest price was one Birr for 100 seedlings.

(iv) Sowing and Nursing Work

If branches with capsules(the fruit of eucalypts trees) are collected before the rainy season, the capsules are separated from the branches and are dried to get seeds for sowing. In case of capsule-bearing branches obtained during the rainy season when the planting season had already started, the branches are directly lain on a bed for germination. The construction of nursery beds, sowing, tending and planting of seedlings are usually conducted by men although women and children may help with auxiliary work.

(v) Planting Objectives

There are three main objectives for planting.

- Production of building material for household use
- Production of firewood for domestic consumption
- Production of construction timber and/or firewood for sale

(vi) Felling Time and Log Price

The felling usually takes place two years after planting in the case of producing roof truss for traditional houses and four to five years in the case of producing pillars and poles. The log price is 2.5 Birr per log for two year old logs and four Birr per log for four year old logs. Trees may be sold as standing trees. Trimmed branches is used for firewood after drying.

(vii) Demand for Seeds and Seedlings

In reply to the question "Which do you prefer if DADO offers either seeds or seedlings of *Eucalyptus* spp. for you to plant?", 87.5% of household heads opted for seedlings with the remaining 12.5% opting for seeds. Seeds and seedlings have the following advantages and disadvantages.

Seedlings

Advantage: save the time to wait for the growth of seeds and the work of

nursery bed preparation and tending, including watering

Disadvantage: unsuitable for long distance transportation from nurseries due to the cost and risks involved in such transportation

Seeds

Advantage: easily transported to distant locations, including remote villages

Disadvantage: nursing skills and nursing work are required

2-10-4. Expectations of Forest and Needs of Local People

(1) Expectations of Forests in Each Village

The pressing need of villages located within and around the Intensive Study Area is to secure firewood for household consumption. There is a strong need to be able to collect firewood within short walking distance in the case for those villages with a firewood shortage as listed in Tab. 26 in 2.10.3-(2)-ii).

Tab. 29 shows the priority order of the five benefits expected from forests. In many villages, firewood for household consumption and construction timber for household use are ranked high. In addition, the expected benefits range from raw material for handicraft to medicinal herbs, building material for sale, furniture wood and others, indicating a diversity of expectations regarding forests. Six villages in Gera District gave erosion control and positive environmental effects high ranks.

Tab. 29 Expected benefits from forests by village (Top five priorities)

District	Village	First	Second	Third	Fourth	Fifth
Seka Chekorsa	Atro Gefere	T/H	T/S	F/H	Crafts	Fodder
	Atro Sufa	T/H	T/S	F/H	E/C	T/S
	Elke Togobe	F/H	T/H	F/H	E/C	Crafts
	Kishe	T/H	Crafts	E/C	F/S	Food
	Komo Hari	F/H	T/H	Crafts	E/C	T/S
	Mirgano Bosso	F/H	T/H	T/S	E/C	Env.
	Sebeka Debye	T/H	F/H	T/S	Food	M/H
	Shebe Moffa	F/H	T/H	Crafts	E/C	F/W
	Sembo Daru	F/H	T/H	Crafts	Food	M/H
	Yanga Deo	T/H	F/H	T/S	-	-
Gera	Afalo	F/H	F/H	F/W	T/S	E/C
	Anderacha	F/H	T/H	T/S	F/S	E/C
	Chira	F/H	T/H	F/W	T/S	F/S
	Dacholaki	T/H	F/W	F/H	F/S	T/S
	Dusta	M/H	E/C	Env.	R	T/H
	G. Kashimari	M/H	E/C	Env.	F/H	T/H
	Gabakorro	M/H	E/C	Env.	T/H	F/W
	Gamina	F/H	T/H	F/W	T/S	F/S
	Gera	F/H	T/H	T/S	Sap	F/W
	Gura	F/H	T/H	F/W	T/S	Crafts
	Gurekesso	F/H	T/H	T/S	Crafts	E/C
	Gutte	E/C	Env.	M/H	T/H	F/H
	Kalaharere	F/H	F/W	Env.	T/H	E/C
	Kobokocho	F/H	T/H	T/S	Fodder	Sap
	Kollasulaja	E/C	F/H	T/H	-	-
	Kombolcha	T/H	T/S	F/H	E/C	Env.
	Muje	F/H	T/H	T/S	Crafts	Fodder
	Nasoabo	F/H	T/H	T/S	F/W	Crafts
	Oba	F/H	T/H	F/W	T/S	F/S
	Sadi	F/H	E/C	T/H	-	-
	Selaja	F/H	T/H	T/S	Crafts	-
	Wala	T/H	F/W	F/H	T/S	F/S

Abbreviations: T/H = building material for domestic use; F/H = firewood for domestic use; T/S = building timber for sale; M/H = medicinal herbs; E/C = erosion control; F/W = furniture wood for domestic use; F/S = furniture for sale; R = recreation; Env. = positive environmental effects

Note: sample households = 200. Each household was asked to list the three top benefits in order of priority. The first, second and third were awarded three, two and one scoring points respectively and the scores of the benefits was added to decide the top five priorities for each village.

(2) Needs of Planting Trees for Firewood

In those villages where the situation of firewood collection by women was surveyed through interviews, women were asked to list the three top species they would prefer to plant for firewood (see Appendix Tab. 32). The top priority was given to *Eucalyptus* spp., followed by *Cupressus lusitanica* and *Hagenia abyssincia*, all of which are fast growing species. The following reasons were given for the selection of *Eucalyptus* spp.

- Feasible for use as firewood when dried
- Fast growth
- Feasible for use as building material for houses

The preferred planting sites are as follows.

- Garden
- Wetland
- On the boundary of or within the farmland.

Chapter 3: Forest Management Plan

3-1. Basic Principles of Forest Management Plan

This Forest Management Plan would be developed within the framework of national (MoA) and regional (Oromia Regional Government) planning. EFAP and Proclamation No.94/1994 set the national direction for forest and forestry. Five Year Development Plan of Oromia Region (1996-2000) provides policies on forestry and land-use.

In EFAP (MNRDEP 1994) inadequate forest policy and policy measures in the past have been identified as that the forestry development has been pursued largely in isolation from agriculture and rural development and forestry objectives have been established separately from the goals in agriculture. The compatibility of development strategies and programs has not been examined. As a result, the relationship between forestry and agriculture development has tended to be of more confrontation than cooperation. Therefore, one of the EFAP policies emphasizes an integrated approach to forestry development with other sectors, in particular, agriculture.

Forests have multiple functions, ranging from the supply of forest products, water conservation, erosion control to the maintenance of soil fertility. All these functions are closely related to rural life. On the other hand forests are under pressure from the competition with other land uses. The conflicts between the development and conservation must not be ignored.

In order to enhance the functions of forest, appropriate forest management measures should be applied corresponding to the required functions. In some cases, agricultural production would have to be regulated to conserve forests, while considering the specific demands of local people for forest land use.

This Forest Management Plan has been formulated to strike a balance between the conservaiton and enhancement of forest functions and the well being of local people. Particular attention has been paid to the following aspects while formulating the plan.

- Since forestry activities, such as re-afforestation, maintenance and management take long period of time, goals of forest management must be set in a long-term perspective.
- The Forest Management Plan must be implemented. Its contents should, therefore, be highly practicable. This practicability is particularly emphasized in the case of Social Forestry Measures and others to involve local communities and people.
- To meet both the long-term objectives and practicability, the plan should be reviewed from time to time in accordance with changes in socio-economic conditions and state of forests.

· Contents of the Plan would be user-friendly, particularly for the implementing field staff and the local people.

The following principles were adopted in preparing the Plan.

(1) Acknowledgement of Present Situation

The current local situation was acknowledged as much as acceptable.

(2) Cooperation with Local People

As forests are closely related to all aspects of rural life, the socio-economic needs of local people for forests and forestry were accommodated in the plan as much as possible.

(3) Functional Classification of Forests

Forests were classified according to their functions. The adopted forestry practices were designed to maximize the performance of their respective functions.

(4) Conservation of forest resources and attainment of sustainable yield

Efforts were made to conserve forest resources and to ensure a sustainable yield while balancing with the harvesting of trees and conversion of forests for other land uses. While the planting of *eucalypts*, pines and other fast growing species with already well developed nursery, planting and tending techniques, was not rejected, efforts were made to encourage the planting of indigenous species, such as *Hagenia abyssinica*.

(5) Environmental Impact

Particular attention was paid to the implementation of the Plan not to cause any adverse impacts on the environment.

(6) Extension Activities for Local People

The understanding and cooperation of local people are indispensable for the implementation of the Plan. Accordingly, emphasis was placed on extension activities for local people.

(7) Consideration to Local Development

Attention was paid to ensure that the implementation of the Plan would create tangible and/or intangible positive effects on the local development.

The Forest Management Plan consists of the following plans with the plan period of ten years:

- Forest Classification
- Resource Management Plan
- Operation Plan
  - Forest Utilization
  - Reforestation and Protection
  - Social Forestry Measures
  - Infrastructure Improvement
- Project Cost
- Initial Environmental Impact Assessment and Erosion Control Measures
- Management System
- Monitoring

"Forest classification" determines the basic unit for forest management on the basis of forest (stand) location, type of utilization, watershed, function and forest type. Forest classification is essential in the preparation of forest inventory book which is the basis for Resource Management Plan, Forest Utilization Plan, and Reforestation and Protection Plan.

"Resource Management Plan" is one of the most important component of Forest Management Plan. As it contains measures to conserve forests and to deal with growing population pressure, it is closely related to Social Forestry Measures.

"Operation plan" consists of Forest Utilization, Reforestation and Protection, Social Forestry Measures and Infrastructure Improvement.

"Forest Utilization Plan" specifies the appropriate utilization of timber and non-timber products. As this plan will ensure a sustainable timber production and revenue from the sale, it plays a very important role in the Forest Management Plan.

"Reforestation and Protection" aims at putting forward measures to enhance forest resources through the development of forest plantations, and the regular implementation of tending and forest protection measures. It is closely combined with Forest Utilization.

"Social Forestry Measures" aims at improving the welfare of local people and alleviating poverty through their improvement while properly managing forest resources. It is, therefore, closely related to Resources Management Plan.

"Infrastructure Improvement" deals various facilities which are necessary for implementing the Plan. It is related to Forest Utilization Plan , Reforestation Plan and Social Forestry Measures.

"Initial Environmental Impact Assessment" assesses the possible impacts on the natural and social environment when the Plan is implemented. "Erosion Control Measures" intend to rehabilitate the already eroded sites and to prevent more serious soil erosion.

"Management System" puts forward a conceptual management organization for the implementation of the Plan. A new organization is planned.

"Monitoring" describes the monitoring system; The state of implementation and progress are monitored against the initial targets set in the Plans; "Resource Management," "Forest Utilization," "Reforestation and Protection" and "Social Forestry Measures" respectively.

3-2. Forest Classification

3-2-1. Criteria for Forest Classification

(1) Objective

The objective of forest classification is to identify the location, area, ground conditions and conditions of the subject stands in order to ensure efficient and systematic forest management. The Intensive Study Area was divided into named forests, compartments and sub-compartments.

(2) Forest Classification Map

The forest classification map was prepared to display the divided forests. This is basically the land-use/vegetation map on which the individual forest compartments and sub-compartments have been entered.

Using this map, the area of each sub-compartment was measured and the forest survey register that is described later was prepared. The map also acts as an attachment to the forest inventory book.

(3) Types of Forest Classification

The order in forest classification has four tiers from broad to detailed, i.e. named forest, forest or non-forest, compartment and sub-compartment.

(i) Named Forests

Intensive Study Area is covering both Belete Forest and Gera Forest. As these two forests are separate and have no common boundary, they are upheld as the named forest which is based on the NFPA map provided by FWCDD when the Study commenced.

(ii) Forest or Non-Forest Land

In accordance with the classification used for the Land-use/Vegetation Map, both Belete Forest and Gera Forest are further divided into forest and non-forest land.

(iii) Compartments

A compartment is a fixed demarcation. Accordingly, the boundaries of a compartment are determined by such natural topographical features as ridgelines and rivers. Prior to the determination of compartments, a watershed map was prepared to assist the delineation of compartments. While an area of 3,000 ha was used as a yardstick for an appropriate area of a single compartment, the complicated topography of Intensive Study Area made some outlying

compartments smaller than the standard size. The establishment of compartments based only on watershed boundaries, sometimes resulted in a much larger size than the desired size for some compartments. In this case, the watershed was further divided into upper, middle and lower watersheds and/or flanks to produce compartments of appropriate size.

(iv) Sub-Compartments

The compartments were further divided using the Land-use/Vegetation Map to identify stands with similar vegetation. A sub-compartment is the basic unit for forest management activities.

(4) Compartment and Sub-Compartment Codes and Measurement of Area

The compartments in Belete Forest and Gera Forest were number-coded clockwise, starting from 01. The sub-compartments in each compartment were also number-coded clockwise, starting from 001. When forest plantations co-exist with other vegetation types in the same compartment, they are numbered last. The area of each sub-compartment was measured by using a planimeter on the forest division map.

3-2-2. Forests Classification by Functions

Forests have such diverse functions as soil and water conservation, recreation, timber production and ameinety as well as welfare of the people. Furthermore, forest plays an important role in preserving bio-diversity and promoting research. Some of these functions are deemed more important than others depending on the location, topography and stand conditions. Forests are classified by functions based on its characteristics and requirements so that proper forest operations can be conducted to ensure a full performance of the respective functions.

The forests in the Intensive Study Area were classified into the following six major functional categories and each sub-compartment was assigned into one of these categories.

(1) Preservation Forest

Preservation Forest aims at preserving and enhancing the conservation of soil and water as well as bio-diversity. Timber harvest is prohibited to ensure the preservation and/or improvement of the forest conditions. Preservation Forests are found in the following areas:

a. Headwater area of rivers: for water conservation
b. Areas with slope of 50 % or more where land dissection is much advanced: for soil conservation
c. Forests where specific species, such as *Cordia africana, Podocarpus gracillior, Juniperus procera, Hagenia abyssinica* are concentrated: for preserving bio-diversity and genetic resources

(2) Production Forest

a. F1 and F2 forests with relatively moderate slopes under 50 %
b. Existing or proposed forest plantation sites.

(3) Area Closure

A hydroelectric power plant is planned along Gojeb River which flows towards east along the southern boundary of Belete Forest compartment number 04 and 05. Since a land use plan to include the catchment of the proposed power plant has not been decided yet, forestry operations in the above two compartments are kept pending.

(4) Restoration forest

Areas in F3 and F4 forest types with poor access, where active forest practices are not feasible.

(5) Reserved forest

Areas in subcompartments with: (a) Steep slope of 50 % or more; (b) Riparian forest; (c) Forests along roads on steep slopes, are designated as Reserved Forest. Demarcation of these areas is mostly difficult, therefore, is not attempted.

(6) Consigned Forest

In areas with a high risk of being encroached, buffer zones are introduced as forest plantations to prevent the extension of encroachment. Local people are allowed to collect firewood from buffer zone plantations when they reach the felling age. These forests are classified as consigned forests. Buffer zones per se have not been established yet, and will be demarcated after the establishment.

3-2-3. Standards of Forest Managements Practice

The standards are determined by the function assigned. There are four types of harvesting: felling prohibition, selective felling, clear felling and reservation (operation pending). Regeneration method for selective felling sites is natural regeneration or enrichment planting being conducted already at some sites. A planting is applied on clear felling sites.

(1) Preservation Forest

Felling in preservation forest is prohibited.

(2) Production Forest

a. For F1 and F2 forests, selective felling is applied and followed by natural regeneration. Enrichment planting using indigenous species is adopted for the regeneration of sites with gentle slopes and a high felling intensity.

b. In case of forest plantation or proposed forest plantation sites, clear cutting is done, followed by a planting. The Reforestation Plan will specify the standards for the planting species, reforestation method and tending.

(3) Area closure

Any forest operation in Area Closure is kept pending until the land ulilization plan has been decided.

(4) Restoration forest

In a restoration forest active forest operations are avoided leaving forests to restore themselves.

(5) Reserved forest

Forests are reserved as much as possible to conserve water and soil and to protect river banks and roads.

(6) Consigned Forest

a. Clear felling is applied when a natural forest is converted to a consigned forest, as forest plantation.

b. When grassland or understocked forest (F4) is to be converted to a consigned forest, no felling is applicable and reforestation is carried out. Details of practices in buffer zones are stated in Reforestation Plan and Social Forestry Plan.

3-2-4 Area by Function and Working Method

The area by function and working method is shown in Tab. 30.

Tab. 30 Forest Area by Function and Working Circle

Belete Forest

Function	Production				Reservation	Consign	Restoration	Preservation	A. Closure	Others	Total
Working Method	S.F.	C.F.	B	Subtotal	N.S.f.F.A.	C.F.	Reservation	F. Prohibit.	Reservation		
F 1	4,981			4,981	(2,045)				1,714		6,695
F 2	1,563			1,563	(393)				892		2,455
Sub-total	6,544			6,544	(2,438)				2,606		9,150
F 3		1,527		1,527			1,285		3,940		6,752
F 4							495		856		1,351
Sub-total		1,527		1,527			1,780		4,796		8,103
Pl		881.8		881.8					36.9		918.7
B T			94	94					59		153
Ot										17,109	17,109
Total	6,544	2,408.8	94	9,046.8	(2,438)		1,780		7,497.9	17,109	35,433.7

Gera Forest

F 1	43,519			43,519	(12,823)			14,100			57,619
F 2	13,413			13,413	(1,654)			2,390			15,803
Sub-total	56,932			56,932	(14,477)			16,490			73,422
F 3		2,343		2,343			14,715				17,058
F 4		541		541			1,204				1,745
Sub-total		2,884		2,884			15,919				18,803
Pl		184.8		184.8							184.8
B T			1,912	1,912				167			2,079
Ot/M		389		389						18,636	19,025
Total	56,932	3,457.8	1,912	62,301.8	(14,477)		15,919	16,657		18,636	113,513.8

Belete-Gera Forest

Function	Production				Reservation	Consign	Restoration	Preservation	A. Closure	Others	Total
Working Method	S.F.	C.F.	B	Subtotal	N.S.f.F.A.	C.F.	Reservation	F. Prohibit.	Reservation		
F 1	48,500			48,500	(14,868)			14,100	1,714		64,314
F 2	14,976			14,976	(2,047)			2,390	892		18,258
Sub-total	63,476			63,476	(16,915)			16,490	2,606		82,572
F 3		3,870(42)		3,870			16,000		3,940		23,810
F 4		541		541			1,699		856		3,096
Sub-total		4,411(42)		4,411			17,699		4,796		26,906
Pl		1,066.6		1,066.6					36.9		1,103.5
B T			2,006	2,006				167	59		2,232
Ot/M		389		389						35,745	36,134
Total	63,476	5,866.6	2,006	71,348.6	(16,915)	(137)	17,699	16,657	7,497.9	35,745	148,947.5

Note
( ) : Numbers in blacket included for calculation
S.F. : Selective Felling
C.F. : Clear Felling
N.S.f.F.A : Not Suitable for Forestry Activity
B : Bamboo thicket operation
F. Prohibit. : Felling Prohibition
A. Closure : Area Closure

3-2-5. Forest Inventory Book

A sample sheet of the Forest Inventory Book is shown as Fig. 14, its category are described below.

(1) Classification

As the minimum unit of forest classification is a sub-compartment, the site conditions and forest conditions are described for each sub-compartment.

- Forest cover: "F" for forest and "N" for non-forest land
- Compartment number: indicated by two digits
- Sub-compartment number: indicated by three digits
- Area: indicated in hectare up to one decimal place

(2) Site Conditions

- Elevation: the highest elevation and lowest elevation in each sub-compartment are listed using the topographical map (scale: 1/50,000)
- Slope: the slope is obtained by: (1) taking the ratio of each slope class's area, and then (2) calculating the average value of slope class using the slope map
- Soil type: prevalent soil types (Mapping Unit Symbols: see 2.6 - Soil Survey) observed in each sub-compartment are listed using the soil map (scale: 1/25,000)

(3) Forest Conditions

- Forest type: the keys of the Land-use/Vegetation Map are used, including the non-forest categories
- Species: the planted species are listed for forest plantations and are left blank for natural forests
- Function: the four functions described in 3-2-3 (except the Reserved forest and Consigned Forest) are coded as Prs (Preservation forest), Prd (Production forest), A.C. (Area closure), Rst (Restoration forest)
- Working method: the four working methods described in 3-2-3 are coded as F.P. for prohibited felling, S.F. for selective felling, C.F. for clear felling and Rsv for reservation.
- Mean DBH, Mean total height, Mean merchantable height and Number of standing trees per unit area (stems/ha): the mean values for each forest type and each sub-compartment of forest plantations are calculated using the results of the forest survey. The mean values for a natural forest are calculated using data of the trees in the middle- and high-stratum from the plot survey

- Total stand volume (all species): this is calculated by multiplying the stand volume, calculated using the forest survey findings, by the area of the sub-compartment
- Total stand volume (commercial species): this is calculated by multiplying the commercial stand volume, obtained from the forest survey findings, by the area of the sub-compartment. This column remains blank except for F1, F2 and F3 forests, which have the commercial species.
- Annual increment: EFAP data are used to determine the annual increment level for natural forests. In the case of forest plantations, the value is calculated for each sub-compartment.

Forest name	Belete

Forest Inventory Book

Division				Site condition				Forest condition														NSTP		Remarks
																Total volume								
Forest / None-forest	Compartment No.	Subcompartment No.	Area (ha)	Elevation (max.) (m)	Elevation (min.) (m)	Slope (%)	Soil type	Type	Species	Planted year	Function	Working method	Mean d.b.h (cm)	Mean total height (m)	Mean commercial height (m)	Stems / ha	Stand volume / ha (all species) (m^3 / ha)	Total stand volume (all species) (m^3)	Stand volume / ha (commercial species) (m^3 / ha)	Total stand volume (commercial species) (m^3)	Annual increment (m^3 / ha / year)	(%)	(ha)	
F	03	001	809.0	2,160	1,580	30.0	CMd , NTh , CMe	F3			Prd	C.F.	39.0	21.7	13.1	29	174.8	141,421	90.4	73,134	3.50			
N	03	002	74.0	2,040	1,940	19.0	CMd	OT																
F	03	003	2,244.0	2,740	1,740	35.0	NTh , LPd-CMd , NTh-LPd , NTh-CMd , CMe , CMd	F1			Prd	S.F.	39.3	24.2	14.8	90	410.8	921,835	320.4	719,045	0.98	50	1,112	
F	03	004	97.0	2,376	2,040	29.3	NTh-CMd , NTh	F3			Prd	C.F.	39.0	21.7	13.1	29	174.8	16,957	90.4	8,769	3.50			
N	03	005	693.0	2,560	2,040	20.1	NTh-CMd , NTh	OT																
F	03	006	195.0	2,300	2,080	27.2	NTh	F3			Prd	C.F.	39.0	21.7	13.1	29	174.8	34,088	90.4	17,628	3.50			
F	03	007	205.0	2,360	2,040	22.7	NTh , LPd-CMd	F2			Prd	S.F.	38.2	22.2	13.2	37	282.8	57,976	182.0	37,316	6.00			
F	03	008	102.0	2,160	1,900	20.6	NTh	F3			Rst	Rav	39.0	21.7	13.1	29	174.8	17,831	90.4	9,221	3.50			
N	03	009	157.0	2,040	1,820	22.1	NTh	OT																
F	03	011	214.0	2,320	1,780	42.5	NTh , LPd-CMd	F3			Rst	Rav	39.0	21.7	13.1	29	174.8	37,409	90.4	19,346	3.50			
F	03	012	72.0	2,780	2,440	41.2	NTh	F3			Rst	Rav	39.0	21.7	13.1	29	174.8	12,586	90.4	6,509	3.50			
N	03	013	94.0	2,800	2,440	45.2	NTh , LPq-LPd , LPd-CMd	BT			Prd	B												
F	03	014	3.4	1,720	1,680	11.5	NTh	PL	*Cupressus lusitanica*	1986	Prd	C.F.	14.0	11.0		1,460	142.0	483						

Fig. 14 A sample sheet of Forest Inventory Book

3-3. Resource Management Plan

"Conserve and develop forest resources" and "undertake conservation-based agriculture development in order to attain sustainability" were among the objectives of Five Year Development Plan of the region. One of the major targets of the plan is to increase the growth of coffee production in the region. An annual rate of the growth was targeted at 1.9% in the plan. For 1996 the target for coffee plantation is 9.2 thousand ha and for year 2000, 10.9 thousand ha, in addition to 11.6 thousand ha of existing coffee plantations. To deal with the problem of deforestation, reforestation efforts including 112.8 thousand ha plantation and 3.7 thousand ha agroforestry are targeted in five years. The average annual reforestation will be 23.3 thousand ha, which is intended to cover 29.1% of the total annual deforested land. It is mentioned again, whether or not these targets are realistic and feasible would have to be investigated carefully.

Anyway, in ISA, major conflicts among the land-use types are identified as encroachment (competition between forestry and agriculture) and the coffee production in the natural forest (competition between coffee production and forestry). Causes of those conflicts would be: (1) the increasing population, (2) insufficient public awareness, and (3) weak resource management. Specific management strategies, including environment protection campaigns, are presented in this management plan. However, the effectiveness of these measures will heavily rely on the tune of national and regional policies, specially in terms of controlling population growth, providing incentives for tree planting and balancing forestry, agriculture and coffee production.

In addition, an adaptive management approach should be taken in implementing this plan. Adaptive management approach stresses that management strategies/measures are not rigidly fixed and should be revised as and when the goals/objectives are not achieved or deemed inappropriate. Therefore, monitoring the progress and effects of the management plan is very important.

3-3-1. Land-use standards/guidelines for forest lands

(1) Preservation Forest

Standards/Guidelines:

(i) Discourage common access to these areas by not providing access or blocking access roads at strategic points with gates, and posting signs.

(ii) Increase the number of forest guards and extend their responsibilities to protect the area.

(iii) Set up database recording basic ecological and physiological information, such as

climate, species list, growth, seed production, ... for area preserved for conservation of biodiversity and genetic resources.

(iv) Adopt natural regeneration after natural disturbance (such as landslide).

Permitted: research and observation without disturbing the nature.

Prohibited: timber harvesting; collection of firewood, wild coffee beans, herb, spices, etc.; and any other activities modifying the natural condition of the forest, including coffee plantation, grazing and farming

(2) Production Forest

Standards/Guidelines:

(i) Inform and involve local communities in the planning process.

(ii) Reforest immediately after timber harvest to control encroachment.

(iii) Incorporate soil and water conservation measures when management activities are planned.

(iv) Timber harvesting and regeneration methods should follow the Forest Practice Standards (Section 3-2-3), Forest Utilization Plan (Section 3-4-1 (1)) and Reforestation Plan (Section 3-4-2 (1)~(3)).

(v) Local community's use of the forest should follow the Other Forest Utilization Plan (Section 3-4-1(2)) and Social Forestry Measures (Section 3-4-3).

(vi) Coordinate timber harvest plan with coffee production and apiculture activities.

(vii) Protect forest resources from fire, disease and pest according to Forest Protection Plan (Section 3-4-2 (4)).

(viii)Protect plantation from livestock grazing. Local communities should be advised not to graze in plantation and signs should be posted until planted seedlings reach vigorous enough stage.

(ix) When damages from grazing are found in plantation planting, make temporary fencing (using local material) or cattle guard (a ditch which impedes cattle crossing) at strategic points, increase patrolling, or erect protection cages around young trees.

Permitted: timber production, collecting firewood, wild coffee beans and other non-timber forest products, grazing (well established forest only)

Prohibited: farming

(3) Area Closure

Standards/Guidelines:

(i) Management should focus on the rehabilitation for soil and water conservation.

(ii) Encourage natural regeneration.

(iii) In areas of bare land and shallow soils, native grass seeds should be sown for soil conservation.

(iv) Other physical soil conservation structure should be constructed in eroded areas.

(v) Prevent encroachment through patrolling and extension education.

Permitted: Honey production, collecting herb and spices

Prohibited: all land-use activities except the above mentioned as permitted.

(4) Restoration Forest

Standards/Guidelines:

(i) Protect forest from fire, disease and pest following Forest Protection Plan (Section 3-4-2 (4)).

(ii) May be closed to all uses until it is rehabilitated to targeted conditions.

Permitted: collecting firewood, wild coffee beans and other non-timber forest products, coffee planting

Prohibited: timber harvesting, farming, grazing

(5) Reserved Forest

Standards/Guidelines:

(i) Provide non-timber forest products for local communities.

(ii) Enhance water and soil conservation and restore damaged sites.

(iii) Use artificial regeneration (using native species or exotic species, depending on the site) after natural disturbance (such as landslide).

Permitted: collecting non-timber forest products, including coffee beans, herb, spices, nuts and any activities not modifying forest and not disturbing forest floor

Prohibited: timber harvesting, coffee planting, grazing and farming

(6) Consigned Forest

Standards/Guidelines:

(i) Where there is risk of encroachment in natural forest near the area with firewood shortage, buffer zone should be set up as the consigned forest along the boundary of natural forest.

(ii) While preventing the encroachment of natural forest, collecting of firewood and construction material for domestic use is allowed.

(iii) Community participation is encouraged in the planning and planting of consigned forest.

Permitted: timber harvesting when trees reache usable or merchantable size

Prohibited: grazing and farming

3-3-2. Standards/Guidelines to deal with land-use conflicts

(1) Encroachment

(i) Preventing further expansion of encroachment

General measures/recommendations:

(a) Remark the boundary of Belete-Gera Forest: The boundary of forest land should be redemarcated to exclude farm land and use easily identifiable topographical features, such as rivers, roads, and ridge lines to avoid further conflicts with farmers.

(b) Not constructing new road.

(c) Buffer zone plantation: Coordinate with the Social Forestry Plan to plant trees

along the border of natural forest.

Specific measures:

(a) Raise people's awareness on forest protection:

Local communities should be provided with information on the importance of forest, soil and water conservation methods, and local natural history (especially for new-comers).

A close relationship with PA should be established to both raise the awareness and gather information on encroachment. A liaison position will be created when this management plan is implemented. One of the duties of incumbent is to attend PA meetings to understand the current issues in PAs, to provide information on upcoming forest management activities and schedules, and to present information on methods of soil and water conservation and improve agricultural productivity.

(b) Intensify patrolling and law enforcement:

The areas adjacent to roads and populated villages are susceptible to encroachment. Patrolling should be scheduled at least once a month. For other areas in the forest with gentle slopes or natural coffee populations have potential to become targets for encroachment, patrolling can be scheduled once every other month during rainy season or non-collecting (coffee) season, but should be intensified during the period before planting season and during coffee collecting season.

Law enforcement needs to be backed up by clearly defined boundaries and regulations. The boundary of forest land not intended to be occupied by farmers should be made clear. Rows of plantation, permanent monuments or bench marks, signs, ... etc. all possible means should be used to remind the public of the State ownership of the forest, especially those areas near populated villages. Procedures should be developed and made clear to the public once an encroacher is apprehended. Warnings or fines can be employed before forcing evacuation.

(c) Safeguard the cut-over site:

It has been clear that the greatest threat is posted on newly opened forest after timber harvesting. A weekly patrolling should be scheduled or a forest guard should be temporarity stationed on such sites. Logged sites should be reforested in a timely manner.

(ii) Reclaiming encroached area

According to the relocation guideline in Five Year Development Plan of Oromia Regional Government (1996), encroachers who moved in after May 1991 could be relocated. This sets the legal base of the reclamation program and guarantees the support from ORSG, who agrees to take appropriate actions in implementing this plan. Practically, relocation has many social and economic obstacles and needs cooperation from all levels of government. This program requires investments with time and effort, therefore, a strategic plan which emphasizes setting up priorities is important. To prevent re-encroachment, incentives should be provided to the encroachers subjected to re-location.

The following should be considered while developing and implementing the strategic plan:

(a) Duty officer should set up a task force to estimate the cost of relocation program and search for funds from relevant international donor organizations. He/She should also keep close contact with both governmental and private sectors in order to be better informed on the regional and local economic development, possibility of compensation for relocation, if absolutely necessary, and employment opportunities for encroachers.

(b) When available, portions of the revenues generated from this Plan should be used for relocation program.

(c) Relocate encroachers from environmentally fragile to environmentally robust areas. F1, F2 forest and areas with slope more than 50% should be considered fragile areas and should have higher priority to relocate encroachers from the area. The inventory of encroachment area shows there are approximately 51 encroachment area totaling 282 ha in F1 forest, 62 encroachment area totaling 543 ha in F2 forest, and other 19 areas are with slopes more than 50%. The locations of the last can be identified on the inventory and encroachment map and should be the first group targeted for relocation program considering environmental factors.

(d) Coordinate with Forest Utilization Plan, Social Forestry Measures and Reforestation Plan. Encroachment within the area scheduled to be reforested should have higher priorities for relocation. Relocation can also be synchronized with timber harvest and takes the advantage of extra public awareness, extension and guidance provided through Social Forestry Measures.

(e) Risk analysis should include, but not be limited to, the following evaluations: the potential of expanding encroachment, the potential of re-encroachment, the impact (of the encroachers' activities) on the environment and the size of the area.

(f) Feasibility assessment should include: number of households, the social and

economical status of encroacher, the availability of relocate site and the availability of funding and other job/cash-earning opportunities.

(g) PA should be consulted and involved in the planning and implementation of relocation program.

(2) Coffee production

It should be made clear to the public and the conserved agencies that administrative authority for the activities occurring in the natural forest is held by "Belete-Gera Forest Management Office" (the management organization to implement this Resource Management Plan). One important duty for the incumbent in charge of coffee production in this office is to liaise with PA, DADO, JZADO and Regional State Government.

(i) Permit System

A permit system should be introduced to regulate coffee production activities. The permit system will empower the agency to safeguard the sustainability of coffee production and provide farmers with technical assistance. All activities related to coffee production require permits.

Prior to the establishment of a permit system, identification and registration of the current coffee production areas are necessary. Pertinent permit should be granted after field checking of the site conditions and making sure the practice is environmentally acceptable.

Permit to collect coffee beans without disturbing the forest in F1 and F2 forests should be granted to local residents only. A follow-up report on the amount of coffee beans collected per permit holder should be gathered in order to better understand the productivity of natural coffee population and for the development of future management guidelines.

Permit to collect coffee beans with some disturbance to forest should be granted in F3 and F4 forest, and with some reservations in F2 forest, where an evaluation should be conducted before the permit is granted. While granting permit the size of the land and the source of applicant's labor should be inquired in order to prevent intensive management and severe alteration of the forest. Permits should be revoked or not granted if any indication of intensive management is taking place, especially in F2 forest type.

Coffee plantations should be permitted in F3, F4 forest and forest plantation only. When practicable, an agroforestry approach should be taken for afforestation sites, i.e. seedlings of indigenous tree species intermingled with coffee seedlings, to generate income before tree species reach maturity.

The term of the permit should be approximately ten years and the total area of forest

being modified for coffee production should be maintained under 50% of the total F3 and F4 forest land.

(ii) Agroforestry management guidelines

Officials should ensure that the species composition and age structure of the forest under coffee production is maintained at a healthy and sustainable level. Adequate number of proper species (see Appendix Tab. 14 for optimal species list and density, which is the natural condition of F1 forest with coffee in the understory) in the lower and middle strata should be maintained. Farmers should be guided to plant additional trees of proper species in good number when necessary.

Duty officer(s) should pay attention to the concentration of coffee production sites within one watershed and evaluate their impacts on other forest resources and ecosystems of the region, for example, a risk to the loss of biodiversity.

(iii) Incentives for farmers to follow regulations

To encourage farmers to apply for permits, all permit holders have the advantage of being notified of forest management schedules, such as timber harvesting or planting, getting assistance on coffee management and forest management, coffee market information, cooperative labor and exchanging information.

Farmers should be provided with incentives to plant or preserve more trees of different species on coffee production sites; for example, to a certain degree granting them tree tenure or encouraging apiculture on the same site to compensate the loss of coffee production.

(iv) Coordination with other plans

Coffee production is not compatible at present with timber production activities. Therefore, coffee production activities should be planned and coordinated with timber production and plantation plans, to reduce unnecessary investment and to maximize the multiple use of forest land.