Deforestation and Land Degradation on the Ethiopian Highlands:

A Strategy for Physical Recovery

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ABSTRACT

Deforestation, accelerated soil erosion, and land degradation are serious problems in Ethiopia. To overcome these problems, efforts have been made to launch afforestation and conservation programs; however, success to date has been limited. This paper will discuss agriculture and forestry practices on the Ethiopian Highlands and try to identify the causes of deforestation and land degradation there. Agroforestry and social forestry practices, plantation forestry, and conservation of the remaining forests are proposed as a strategy for physical recovery. Social and policy issues, such as participation of the local people in natural resource management and the existence of clear land and tree tenure policies are critical for the long-term sustainability and expansion of forests in Ethiopia. In general, tree planting through agroforestry and social forestry should be an integral part of rural development programs and should provide the community with food, fuelwood, income, and environmental benefits. Increasing public awareness through education about forestry and natural resource conservation is vital if Ethiopia wants to maintain the remaining natural forests and biodiversity.

Key words: Ethiopia, deforestation, land degradation, agroforestry, social forestry, plantation forestry, forest conservation, land tenure.

1. INTRODUCTION

Forests and the benefits they provide in the form of wood, food, income, and watershed protection have an important and critical role in enabling people to secure a stable and adequate food supply. Deforestation and land degradation, however, are impairing the capacity of forests and the land to contribute to food security, and to provide other benefits, such as fuelwood and fodder in Ethiopia. Ethiopians are facing rapid deforestation and degradation of land resources. The increasing population has resulted in extensive forest clearing for agricultural use, overgrazing, and exploitation of existing forests for fuelwood, fodder, and construction materials. Forest areas of the country have been reduced from 40% a century ago to an estimated less than 3% today. The current rate of deforestation is estimated to be 160,000 to 200,000 ha per year. It is estimated that fertile topsoil is lost at a rate of one billion cubic meters per year (FAO, 1981; UNEP, 1983, Constable, 1985, Kuru, 1990, Yirdaw, 1996), resulting in massive environmental degradation and constituting a serious threat to sustainable agriculture and forestry.

To reduce these problems, rural afforestation and conservation programs on farms and community lands have been practiced in Ethiopia for the past three decades. The Ministry of Agriculture, in collaboration with national and international organizations, has made efforts to

implement agroforestry and community tree planting programs. Rural tree planting on farm and community lands was identified as the most important topic of international development. The United Nation Development Program, in consultation with the Food and Agricultural Organization (FAO), has been helping Ethiopia to promote tree planting and soil conservation programs on the highlands of Ethiopia since the early 1970s (FAO, 1985). The objectives of these activities were as follows: 1) to meet the needs of fuelwood, construction materials and fodder from trees planted outside forests, 2) to reduce degradation of soil resources and improve productivity of agricultural lands and 3) to reduce the pressure from the remaining natural forests and to conserve biodiversity.

Additional research on agroforestry and transfer of technology has been conducted by the International Center for Research in Agroforestry (ICRAF), in collaboration with National Research and Development Institutions on the East African Highlands since the mid 1970s (Nair, 1990, Hoekstra et al., 1990). The primary objectives of this collaborative research were to identify potential agroforestry practices and research needs using "Diagnosis and Design" methodology developed by ICRAF. As part of this effort, a blueprint for "Agroforestry potential and research needs for the Ethiopia Highlands" was prepared by the Technical Committee for Agroforestry in Ethiopia, in collaboration with ICRAF scientists. Based on altitude, topography, and intensity of land-use systems, the following agroforestry practices were identified for the Ethiopian Highlands: alley cropping, trees in home gardens, fodder tree planting, trees as living fences, farm boundary and road side planting, woodlots and agroforests, trees on contour bands, and gully planting (Hoekstra et al., 1990).

Yet despite the large commitments of scarce resources by both governmental and non-governmental agencies, success in tree planting and conservation has been limited. The current tree-planting practices result in less than 20% tree survival on the national average (Uibrig, 1989; Gamach, 1990). These problems are one of several major obstacles hindering the development of forestry programs in Ethiopia.

This paper will review agriculture and forestry practices on the Ethiopian Highlands and discuss the causes and consequences of deforestation and land degradation in the country. The study proposes agroforestry and social forestry practices, plantation forestry, and conservation of the remaining natural forests as a strategy for physical recovery in Ethiopia. In summary, some recommendations on social and policy issues will be given to help promote tree planting and natural resource conservation in Ethiopia.

2. COUNTRY BACKGROUND - ETHIOPIA

2.1. Geography and Agroecology

Ethiopia, situated in the horn of Africa, has an area of 1,100,000 km^2 (472, 000 sq. mi). With a population of over 62.5 million and an annual rate of growth of 2.9% (WRI, 2001), Ethiopia is the third most populous country in Africa, after Nigeria and Egypt; in land area it is the ninth largest.

Although the whole of Ethiopia lies within the tropical altitudes, the climate is cool in the highlands and warm in the lowlands. The annual range of temperature is relatively small because of the proximity of the equator. Rainfall variability generally increases as rainfall total decreases, and thus is generally greatest in the lower rainfall areas of the north and northeast highlands. The rainfall is mostly uni-modal. The climate is mostly determined by the altitude, which dominates

all aspects of land use because of its influence on temperature.
The country has a wide range of agro-ecological zones reflecting the wide variation in rainfall (both quantity and distribution) temperature, altitude, topography and soils. According to the study made by Getahun (1978) and Constable (1985), three broad major agro-ecological zones are identified on the highland zones of Ethiopia (Table 1). These are the High Potential Perennial Zone, High Potential Cereal Zone and the Low Potential Cereal Zone.

Table 1. Major Agro-ecological Zones of the Ethiopian Highlands

Zone	Climate	Growing Period (Number of Days)
High Potential Perennial Zone High Potential Cereal zone Low Potential Cereal zone	Warm and more Humid Intermediate rainfall High variability occasional drought	Mainly > 240 Usually > 180 Mainly 90 -150

The FAO's concept of growing periods was used to classify the land-use systems into distinctly different agricultural potentials. This growing period concept takes into account the influences on plant growth not only precipitation and evapotranspiration, but also temperature and stored soil moisture. However, it is broadly defined here as the number of days in a year in which plants can grow without irrigation.

2.2. Agriculture and Land degradation

Agriculture is the dominant sector of the Ethiopian economy, with 85% of the population living in the rural areas. Agriculture provides about 52% of the country=s GDP, 80% of its employment, and 90% of its export earnings (World Bank, 2000; CIA, 2001). Ethiopia=s economy is largely dominated by subsistence agriculture. Crop and livestock farming are the principal practices. Mixed farming dominates the Highlands, with crop and livestock farming practiced in the same management unit. The production system is mainly rainfed, subsistence-based, and smallholder oriented.

Crops such as barley, teff, wheat, and beans are grown in the higher altitudes, while sorghum and maize are the principal crops in the mid and low altitudes in Ethiopian. In addition, coffee, sweet potato, chat, various vegetables, fruits, and groundnuts are extensively cultivated. Cattle, sheep, and goat constitute the livestock on the highlands. Crop and livestock yields in the highlands are very low and the recent drought has aggravated the situation. Furthermore, population pressures have decreased the size of holdings, including both arable and pasturelands, leading to conversion of forested and marginal areas into agricultural lands (Hoekstra et al., 1990; Bishaw, 1993).

Soil degradation in Ethiopia can be seen as a direct result of past agricultural practices on the highlands. The dissected terrain, the extensive areas with slopes above 16%, and the high intensity of rainfall lead to accelerated soil erosion once deforestation occurs. Additionally, some of the farming practices within the highlands encourage erosion. These include cultivation of cereal crops such as teff (*Ergrotis tef*) and wheat (*Triticum sativum*), which require the preparation of a fine-tilt seedbed, the single cropping of fields, and the down slope final plowing

to facilitate drainage. Furthermore, socio-political influences, especially insecurity of land- and tree tenure has discouraged farmers from investing in soil conservation practices.

Soil degradation is thus the most immediate environmental problem facing Ethiopia. The loss of soil, and the deterioration in fertility, moisture storage capacity, and structure of the remaining soils, all reduce the country's agricultural productivity. Soil erosion is greatest on cultivated land, where the average annual loss is 42 tons/ha, compared with 5 tons/ha from pastures. As a result, almost half of the loss of soil comes from land under cultivation, even though these lands cover only 13% of the country. Not surprisingly the highest average rates of soil loss are from formerly cultivated lands, which are currently unproductive because of degradation and have very little vegetative cover to protect them (Hurni, 1990).

The present status and rate of soil erosion in Ethiopia calls for immediate action to retard and reverse this degradation process. However, the present population growth rate of 3%, in comparison with the economic growth rate of 1% (IAR, 1991), will lead to even more intensive use of cultivatable and pasture land to produce more food and feed for the growing human and livestock populations. Hence, it is clear that intensification of land use must be accompanied by technological innovations that will lead to increased productivity, while simultaneously conserving the soil resource.

3. FOREST RESOURCES OF ETHIOPIA

3.1. Natural forests X High forests, either coniferous or broad-leaved, were the climax vegetation of 35-40% of Ethiopia before human settlement took place. With the inclusion of savanna woodlands, some 66% of the country was originally covered with forest or woodlands (Britenbach, 1961, Wood, 1990, Kuru 1990, Yirdaw, 1996). Over the last 3000 years, there has been progressive deforestation, which has accelerated tremendously during the last century. Rapid population growth (3% per year), extensive forest clearing for cultivation, over-grazing, movement of political centers, and exploitation of forests for fuelwood and construction materials without replanting has reduced the forest area of the country to 16% in the 1950s and to 3.1% by 1982 (UNEP, 1983). Further estimates of the distribution of forest and woodland areas made on the basis of information from LANDSAT imagery (1979) revealed that 2.8% of the land surface is under forest and woodland (Kuru, 1990; MOA, 1991; Table 2).

Table 2. Natural Forest Vegetation Coverage of Ethiopia in 1990

Vegetation Type	Area (million ha)	Coverage (%)
High forest	3.44	2.8
Riverain and mangrove forest	1.30	1.1
Bamboo woodlands	0.45	0.4
Mixed deciduous	2.50	2.0
Acacia-Boswellia, *Commiphora* spp., including wooded grasslands	20.00	16.0
Sub total	27.69	22.3
Other lands	92.31	77.7
Total	120.00	100

Source: Ministry of Agriculture, 1991

The forests on the highlands can be broadly divided into dry montane forests and moist montanae forests. The dry montane forests are dominated by hard leaved evergreens, while the moist montane forests are characterized by large broad leaved and soft leaved species (Bekele, 1994). The dry montane forests are dominated by *Juniperus procera*, *Podocarpus gracilor*, and *Olea europaea*. The wet montane forests consists of species like *Aningeria adolfi-friederici, Olea welwitschii, O. hochstetter, and Croton macrostachyus.* Mountain cane (Arundinaria alpina) stands are also found at humid highland elevation areas (2,500 –3,400 m.) as scattered, but large and compact concentration (FAO, 1981). However, because of deforestation, much of the highlands at present are covered with wooded grasslands in which secondary tree species like *Acacia abyssinica, Acacia negrii* and *Acacia pilispina* occur (Friis, 1992).

The remaining natural forest areas are located primarily in the south and southwest of the country. High forests in these areas have been identified and efforts are being made to conserve, protect and manage these resources on a sustain yield bases. However, at present, accessible high forest areas are exposed to the various development project pressures, including coffee-and tea-cash cropping, human resettlement, grazing and logging operations (MOA, 1991).

Due to immediate significance and long-term impact of these problems, efforts have been made to identify the remaining high forest and designate them into 57 National Forest Priority Areas (NFPA), covering 3.5 million hectares, which is 2.8 percent of the country (Table 2). However,

the proper protection and management of these NFPA is questionable because of the lack of clear and efficient forest policy.

Little of the natural vegetation of the highlands remains today. The influence of man and his domestic animals has profoundly altered both the vegetation and the landscape. Ecological degradation, including deforestation and erosion is wide spread, particularly in the northern and central highlands. Though not as severely degraded, the southern parts of the highlands are being increasingly affected (Getahun, 1990; Hurni, 1990).

3.2. Forest Plantations

Forests plantations are defined by FAO (1993) as forest stands established artificially by afforestation on land previously did not carry forests, or forest stands established artificially by reforestation on land which carried forests within previous 50 years or within living memory and involving the replacement of previous crop by a new and essentially different crops. Evans (1992), defines plantations simply as a forest crop or stand raised artificially either by sowing or planting (Yirdaw, 1996).

In Ethiopia forest plantation have started by the turn of the 19th century, when Emperor Menelik requested his advisor to get him a fast growing tree species to over come the fuelwood shortage he faced at the time. During the early 19th hundred, it was reported most of Addis Ababa was covered by forests and there were about 13,500 hectares of Eucalyptus plantation in 1964(FAO, 1985). Today, there are about 162, 000 hectares of plantation forest and about 36, 000 hectares of per urban fuelwood plantation. These are managed by the state, and Eucalyptus is the main plantation species (MOA, 1991).

Ethiopia's forest resource conservation, development and utilization today is not the product of a long evolving process in which different land-use planning measures have been devised and used to meet changing needs and various ecological conditions of the country. The absence of sound and comprehensive land-use policies encompassing the identification, selection and appropriation of suitable areas for forestry development based on production and environmental protection is the outstanding forestry problems in Ethiopia (MOA, 1991).

3.3. Community Forestry and Soil Conservation

Community forestry has been defined by FAO (1978) as any situation, which intimately involves local people in a forestry activity. It embraces a spectrum of situations ranging from woodlots in areas with short of wood and other forest products for local needs, through the growing of trees at farm and community level to provide cash crops and the processing of forest products. Despite major problems of deforestation and land degradation, massive soil conservation and afforestation programs have been going on in Ethiopia since the early 1970's (Hurni, 1990; Gamachu, 1990). These programs were undertaken by various agencies of the government through the assistance of international and bilateral organizations. The Community Forestry and Soil Conservation Department of the Ministry of Agriculture is the main government agency involved in the planning and execution of soil conservation measures and afforestation programs. The Department is involved mainly in three main activities: farm forestry, community forestry and soil conservation.

In the farm forestry program, farmers are encouraged to establish small private plantations around their homes – usually various species of Eucalyptus. In the community forestry program farmers are encouraged to plant trees on community lands. The Community Forestry program provides technical and financial support in the establishment of nurseries and the planting of seedlings. The Soil conservation unit is involved with terracing and other soil protection schemes. The Department works directly with farmers who provide labor.

The World Food Program of the United Nations has been involved and continue to support soil conservation, afforestation and small scale irrigation projects in Ethiopia since the mid-1970's. Its assistance is mainly in the form of Food for Work Program where farmers who come to work on the projects are provided with grain and vegetable oil.

Various documents of the Community Forestry Department (CFD), indicate that by September 1986 close to 500,000 hectares of farmland and 175,000 hectares of hillside has been terraced and 181, 000 hectares of land has been afforested by the Community Forestry program throughout the country. Although the achievements were impressive, it has been reported by CFD that soil conservation and afforestation activities have declined over the years and the enthusiasm manifested in the early years of the programs seem to have failed in the recent years (Hurni, 1990; Gamachu, 1990).

The problems seem to be related to disincentives among farmers for soil conservation measures and afforestation programs. These activities although part of a "development package" are not seen to ensure an immediate return to the farmers. The activities take some land out of production and place more pressure on existing farm and grazing land. This is particularly the case in northern Ethiopia where there is a shortage of agricultural land. Farmers are also required to provide their labor and time for activities, which from their point of views do not generate immediate benefits.

Moreover, in the use of community forests there is no clear legal base for determining ownership. Farmers tend to assume that the forests belong to the State and they don't have the right to use and own these forests. Also, the massive national soil conservation and afforestation efforts between 1976 and 1985 were often seen as government-imposed activities, and since they were not accompanied by education, the advantages of these efforts were not associated with individual benefits (Gamachu, 1990; Hurni, 1990).

4. STRATEGY FOR PHYSICAL RECOVERY

Various international organizations and consultants, including the World Bank, in the *Ethiopian Highland Reclamation Study* (Constable, 1985); FAO, in *Preparatory Assistance to Research for Afforestation and Soil Conservation* (Davidson, 1988); ICRAF, in *Agroforestry: Potential and Research Needs for the Ethiopian Highlands* (Hoekstra et al., 1990), all have emphasized in their recommendations the need for conservation-based integrated development as a strategy to overcome the degradation of land resources and improve agriculture and forestry development in Ethiopia. Moreover, priorities indicate that the initial effort be directed to areas where the environmental degradation is high and food production returns are low.

To overcome deforestation and land degradation on the Ethiopian highlands and provide the people with food, fuelwood and fodder on sustainable bases the following natural resource management strategies are proposed:

- ∃ Implementation of agroforestry and social forestry in the rural areas where subsistence farming is practiced
- ∃ Expansion of plantation forestry both industrial and non-industrial on currently uncultivated and sloping lands
- ∃ Conservation of the remaining natural forests to conserve species and biodiversity.

If properly practiced and managed, these activities will help achieve sustainable production and environmental protection on the Ethiopian Highlands.

In the subsequent sections I will discuss the contributions of agroforestry and social forestry toward alleviating food insecurity, fuelwood and fodder shortages, while providing environmental benefits on the Ethiopian highlands. Also the potential of plantation forestry to provide wood and other benefits will be discussed. Strategy for conservation and enrichment the remaining natural forests will be addressed.

4.1. Agroforestry and Social Forestry

Agroforestry is not totally a new concept in Ethiopia. It is an age-old practice whereby farmers maintain trees in croplands. Such woody perennials are retained for their multiple uses and benefits, such as their nitrogen-fixing properties and soil improvement capacity, and the provision of fodders, fuelwood, and fruits (Hoekstra et al., 1990).

The role of agroforestry in satisfying the basic needs of the rural peoples of Ethiopia is large, but little research has been initiated to identify suitable agroforestry technologies and appropriate tree species for specific areas of Ethiopia. However, based on the work done by the Technical Committee for Agroforestry in Ethiopia (Hoekstra et al 1990), I propose the following agroforestry technologies appropriate for the land-use systems in the Ethiopian highlands. Even where the proposed technologies were not implemented, they can at least serve as baseline information for further development of agroforestry in Ethiopia.

1) Alley Cropping. This is an agroforestry system in which food crops are grown in alleys formed by hedgerows of trees or shrubs. The hedgerows are cut back at planting and kept pruned during cropping to prevent shading and reduce competition with food crops. When there are no crops the hedgerows are allowed to grow freely. The primary reasons for introducing alley cropping into the farming system are to improve soil fertility and produce fodder and fuelwood, and because of its potential for soil conservation.

2) Fodder tree planting on unproductive pasture and degraded hillsides. Fodder trees and shrub can be planted as pure stands on degraded lands and/or mixed in different configuration with grass and herbaceous legumes on unproductive pasturelands. This practice will involve a cut-and-carry system from stands planted on hillsides. The main objective of this practice is to supplement the low-quantity and -quality feed sources available for livestock during the dry season with high-quality tree leaves and pods. This will substantially increase the productive capacity of poor and scarce pasturelands common in the Ethiopian Highlands.

3) Tree planting in home gardens and woodlots. Tree planting in home gardens and woodlots on poor quality sites and steep slopes is a common practice in the Ethiopian Highlands. Moreover, planting of single species and mixtures of species on micro-sites, such as steep slopes and rocky and marshy sites within farmlands, can be increased. The main objectives of this practice are to produce fuelwood and construction poles for the community. Moreover, trees are planted around homesteads can serve as windbreaks and shelter belts for humans, as well as provide feed and shelter for animals. Additional food supply and cash income could be obtained by planting fruit trees around homesteads.

***4) Tree planting as living fences on farm boundaries and roadsides*.** Both internal and external farm boundaries may be used for tree planting to produce poles, timber, fuelwood, and fodder. The design of this planting scheme will include planting trees in lines or rows in border areas and along roadsides. The main objective of this practice is to provide an alternative source of cash to farmers and to supply fuelwood, which is otherwise scarce. Such tree plantings can also indirectly influence the crop-livestock production system by acting as windbreaks and shelterbelts.

5) *Tree planting on contour structures, inside and along gullies*. This planting scheme has a wide range of applications because it does not compete with crop production for land. Land scarcity is acute in the densely populated Highlands, where farmers tend to use every available piece of land, without regard to soil conservation. Thus, tree planting on contour structures, inside and along gullies will greatly help in soil and water conservation practices. The main objective of this scheme is to aid bench terraces, gully stabilization, and the prevention of run-off and soil erosion, all of which are very common in Highlands. The additional use of wastelands for tree planting will contribute to the economic and natural resource base of communities. However, these trees, especially when stands are young, will not adequately protect soil unless ground vegetation is also managed properly.

Agroforestry and social forestry as land-use systems have great potential for alleviating the land degradation problems associated with poor traditional farming practices on the Ethiopian Highlands. They can also improve agriculture and forestry production on a sustained basis by providing food, fuelwood and fodder for the farm family.

4.2. Forest Plantations

Establishment of forest plantations to provide timber and construction materials, pulp and paper for industry and public use, and fuelwood for urban dwellers is essential in the future economic development of Ethiopia. Plantations can be established as pure and/or mixed stands with appropriate silvicultural techniques. This can be achieved through private sector involvement by establishing industrial plantations and non-industrial private forests. Encouraging the private sector to be involved in developing industrial forests plantations can potentially help increase self sufficiency in wood production and contribute to the national economy. Furthermore, encouraging farmers and small landowners to be involved in tree growing scheme will help them generate income for the households.

In order for plantations to be successful in checking deforestation and to satisfy the growing timber need, they must be managed based on principles of ecosystems. Improvement in forest

legislation concerning plantations and participation of the local people in forest plantation work is essential. Plantations should not be just Atree crops≅, but also should help in alleviating environmental problems in the area and promote the well being of the local community.

4.3. Natural Forest protection and conservation

Forest protection can be defined as predominantly natural areas safeguarded by law or custom where species and ecosystems are conserved for current and future generations. Since the best way to maintain species is to maintain their habitats, protected areas are an essential means for sustaining diversity. Protected areas also help in stabilizing the local climate, protecting watersheds, and preventing erosion. Protected areas constitute the most widespread mechanism used to conserve the remaining natural forests of Ethiopia. However, the present coverage of natural forest is generally inadequate. Conservation must be a part of a broader process of managing the whole landscape. Thus, protected areas will contribute to the conservation of the remaining natural forests in Ethiopia, if they are able to meet the legitimate developmental aspirations of the people that live in and around them (Sayer et al. 1992). Protection and conservation of the remaining natural forests is critical to protect species and biodiversity in Ethiopia. The identification, demarcation, and gazetting of the remaining natural forests and wildlife and leaving them as a heritage to the next generation will be beneficial to present as well as the future generations.

5. SOCIAL, ECONOMIC AND POLICY ISSUES

Deforestation and land degradation should be seen as the most important issues threatening the survival of Ethiopia. Floods, drought, desertification, drying of streams, and soil erosion are connected one way or another with the process of forest exploitation and destruction. Although various potential strategies for tree planting and natural resource conservation on the Ethiopian highlands are proposed, their successful implementation will be limited unless the following social, economic and policy issues are addressed properly.

5.1. Participation of the rural and urban people

Participation of the rural and urban people in tree planting and conservation of the natural forests is very important to achieve the proposed strategy. Involving farmers and local people who live around the forests in tree planting and natural resource management is critical for conservation and development of forestry. This can be done through a participatory process where farmers and local people are involved in planning, design and implementation of the management plan. This exchange of information and partnership will help build confidence and to reassure all that the programs are relevant to their needs and ensures they have a sense of responsibility towards the project.

Attention should be given to the creation of effective local management organizations to mobilize farmers in the conservation, development and appropriate use of forests and agroforestry products. Institutional arrangements at the community level are often key elements in natural resource conservation in planning agroforestry and tree planting for field implementation. The FAO=s experience in small farmer development work suggests organizing farmers into small homogenous groups of about 10-15 farmers or heads of families so the people can more easily obtain government service. These informal groups work best when farmers have similar incomes, problems and aspirations (Rao, 1986).

5.2. Economic Incentives

Wood should not be considered as a free good, rather, it should be considered as one of the commodities that requires, land, labor and capital to produce. Thus, it should be priced based on capital and resource invested, and demand and supply in the market place. This will be a great incentive for establishing forest plantations and small private forests in the country. The government must create economic incentives for tree growing and for otherwise adopting suitable agroforestry and tree planting practices by rural people. Direct credit to farmers is another financial matter to be addressed.

New mechanisms must be devised, as there is little experience in organizing credit for tree crop cultivation in developing countries. Incentives may involve supplying seeds and seedlings either free of change or at a nominal price. Ensuring an adequate supply of hand tools for planting and temporary food aid can encourage farmers to participate in the tree planting and adoption agroforestry technology. Another way to provide incentives is for the community to provide the land and the labor while the forest service or NGO provides the seedlings, fertilizers, and technical assistance. When the crop is harvested, the net profit is shared on a proportional basis depending on inputs as agreed upon.

5.3. Land and Tree Tenure

Successful long-term agroforestry and tree planting strategies require land tenure systems that guarantee continued ownership of land. As Nair (1990) indicated, the incentive for investing in soil-fertility improvement for the future is low unless the benefits accrue to the tree planter. This holds true in Ethiopia today, where land is still under the communal control of the government. Unless land is redistributed to individual farmers and they are guaranteed continuous ownership, success in the adoption of agroforestry and tree planting on the Ethiopian highlands is unlikely.

Therefore, the land and tree tenure policy of the country should be changed to reward the farmers who invest in agroforestry and forest plantations, which require long gestation periods.
The government should introduce land and tree tenure policy changes to promote agroforestry and tree plating in the country. Land and tree tenure should give landowners and farmers the guarantee to plant and own the forests. Without clear land and tree tenure policy, it is difficult to give incentives to farmers and landowners to grow trees. Active laws are needed to save the land and the environment. This requires suitable legislation and institutions to implement the laws. Also, commitment from the government is needed to implement forest policy that will fully consider the crisis of environmental degradation and stagnation of agriculture.

5.4. Education and Research

Adequate forestry and natural resource education, research, and extension service is needed to meet the demand for and challenges of managing our natural resources on a sustainable basis. Strengthening the education and research institutions in the country to train qualified forestry and natural resource professionals with appropriate knowledge of forestry and agriculture in Ethiopia is required.

Research in agroforestry in Ethiopia in general should emphasize in the development of appropriate technologies suitable for increasing agricultural productivity and reclamation of degraded highlands. Also, research in plantation forestry should focus on production of fiber and other benefits while maintaining the ecosystems. Conservation of the natural forests should be given adequate attention and research in these forests should focus in improving natural regeneration of the various species and conservation of biodiversity.

A multidisciplinary approach is needed for success in agroforestry and natural resource education, research and extension. All professionals concerned with agriculture, forestry and natural resources should come together and work to develop strategies for sustainable agroforestry and natural resource management that will ensure food security for the rural poor and long-term sustainability of the resource base upon which other development sectors depend.

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Literature Cited

Abdulkadir, A. 1992. Report of periodic productivity of Acacia saligna and Leucaena leucocephala hedgerows grown in alleys with maize. Faculty of Forestry, Alemaya University of Agriculture, Ethiopia. 8p.

Bekele, T.1994. Vegetation ecology of remnant Afromontane forests on the central plateau of Shewa, Ethiopia. Acta Phytographica suecica 79. Uppsala.

Bishaw, B.1993. Determining options for agroforestry systems for the rehabilitation of degraded watersheds in Alemaya Basin, Hararghe Highlands, Ethiopia. Ph.D. Dissertation. Oregon State University, Corvallis, Oregon.

Bishaw, B. and Abdulkadir, A. 1989. Strategies for on-farm research in agroforestry in the Hararghe Highlands, Eastern Ethiopia. P. 164-173. In IAR Proceeding, First Natural Resources Conservation Conference. Addis Ababa, Ethiopia.

Bishaw, B. et al. (1988) Evaluation of Multi-purpose tree and shrub species for Agroforestry land use and the assessment of Agroforestry systems in Hararghe highlands. Paper presented on National Agroforestry Seminar. Awassa, Ethiopia.

Britenbach, F. Von., 1961. Forest and woodlands of Ethiopia. Ethiopian Forestry Review 1.

CIA, 2001. CIA --The World Factbook --Ethiopia. http://www.cia.gov/cia/publications /factbook/geos/et.html.

Constable, M. 1985. Ethiopian Highland Reclamation Study. Working Paper 24. Addis Ababa, Ethiopia.

Davidson, J. 1988. Preparatory Assistance to Research for Afforestation and Conservation, FAO/UNDP. Addis Ababa, Ethiopia.

Ethiopian Mapping Authority (EMA) 1988. National Atlas of Ethiopia. Addis Ababa, Ethiopia.

FAO, 1993. Forest Resource Assessment 1990. Tropical countries. FAO Forestry paper series 112. FAO, Rome 59 p.

FAO, 1985. Tree Growing by Rural People. FAO, Forestry Paper 64. FAO, Rome

FAO, 1981. Tropical forest resources assessment project (GEME). Forest resources of Tropical Africa, Part 2, Country Briefs. FAO, Rome.

FAO, 1978. Forestry for Local community Development. FAO, forestry Paper 7. FAO, Rome

Friis, I. 1992. forests and forest trees of northeast tropical Africa. London. 396 p.

Gamachu, D. 1990. Environment and development in Ethiopia. Department of Geography, Addis Ababa University, Ethiopia. P. 54-96.

Getahun, A. 1978. Zonation of highlands of tropical Africa: the Ethiopian Highlands. Working document, Addis Ababa, Ethiopia.

Getahun, A. 1988. An Overview of the Ethiopian highlands: the need for Agroforestry Research and Development for the national survival. In IAR/ICRAF National Agroforestry Workshop Proceedings. Awasa, Ethiopia. P 5-16.

Hoekstra, D., E. Torquebiau and B. Bishaw, eds. 1990. Agroforestry: potentials and research needs for the Ethiopian highlands. No. 21. ICRAF, Nairobi, Kenya. 115 p.

Hurni, H. 1990. Degradation and Conservation of Soil Resources in the Ethiopian Highlands. In Messerli, B. and Hurni, H. (ed.). African Mountains and Highlands Problems and Prospective. Missouri, U.S.A. p. 51-63.

Institute of Agricultural Research (IAR), 1991. Newsletter of Agricultural Research . Vol. 6. No.

1. ISSN 1015-9762 Addis Ababa, Ethiopia. pp.11
Kuru, A. 1990. Roots of Deforestation Problems in Ethiopia. In: Matti, P. et. al. (ed.) Deforestation or Development in the third World? Vol. III. Helsinki.
Ministry of Agriculture (MOA), 1991. Forestry Report Ethiopia. Prepared for the Tenth World Forestry Congress. (Unpublished) Addis Ababa, Ethiopia.
Nair, P.K.R. 1990. The prospects for agroforestry in the tropics. World Bank Technical Paper ISSN:0253-7494. No. 131. The World Bank Washington D.C.
Rao, Y.S. 1986. Some socio-economic and institutional aspects of forest land use. P. 3-10. In Land use, watersheds, and planning in the Asia-Pacific Region. RAPA Report 1986/3. FAO/UN, Bangkok.
Sayer, A.J., Harcourt, S.C. and Collins, M.N., (eds) 1992. The conservation Atlas of tropical forests Africa. IUCN. Cambridge, UK. 282 p.
Uibrig, H. 1989. Report on land use survey in the Alemaya Catchment, Hararghe Highlands, Eastern Ethiopia. Faculty of Forestry, Alemaya University of Agriculture, Ethiopia. 54 p
Wood, A. 1990. Natural Resource Management and Rural Development in Ethiopia. In: Pausewang, S. et. al. (ed.) Ethiopia Rural Development Options. P. 187-198. Zed Books Ltd.
World Bank, 2000. The World Bank Group Countries: Ethiopia. Washington, D.C. http:// www.worldbank.org/afr/et2.htm
World Resource Institute. 2000/2001. Population and human development. P. 75-92. A guide to the global environment. Oxford University Press, New York.
Yirdaw, E. 1996. Deforestation and Forest Plantations in Ethiopia. M. Palo and G. Mery (eds), Sustainable Forestry Challenges for Developing Countries, 327-342. @1996 Kluwer Academic Publishers. Printed in the Netherlands.