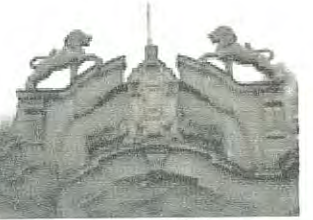


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*Impacts of Deforestation on Rural
Livelihoods:
The Case of Kuyu Woreda, Central Ethiopia*

By
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Addis Ababa
July 2010

ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

COLLEGE OF DEVELOPMENT STUDIES
(CDS)

Title

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By

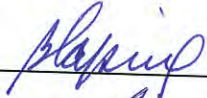
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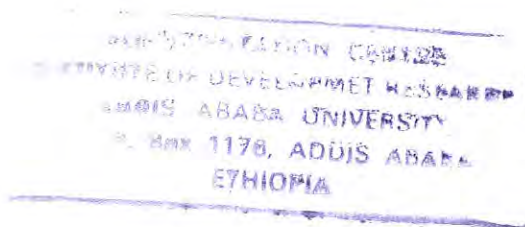


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Acronyms and Abbreviations

- CFSCDD: community forests and soil conservation development department
CSA :Central statics agency
Das : Development Agents
EFAP: Ethiopia forest action plan
EMA : Ethiopia metrological agency
FAO: Food and agricultural organization
GD: Gross domestic product
GFRA: Global forest resource Assessment
KWAO: kuyu woreda agriculture and rural development office
LDC: Least developed countries
MoA: Ministry of Agriculture
NEPAD: New Partnership for Africa's Development
OARD: Oromia Agriculture and rural development
UNDP: Unite nation Development Program
UNEP: Unite Nation Environmental program
WB: World Bank

The
15/14
2010

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DEDICATION

This research paper is dedicated
to the memory of my brother,
Meseret Bayou Erba

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I owe special thanks to my advisor, DR. Fayera Sanbata for his prudent and unreserved guidance and constructive criticisms along all the steps of the paper.

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ABSTRACT

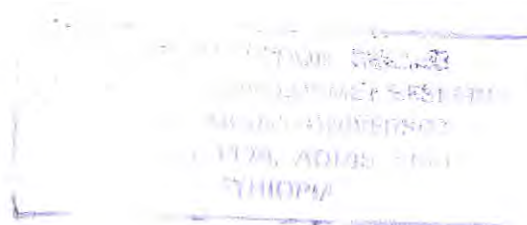
Ethiopia is one of the most severely affected country in sub-Saharan African countries, particularly by deforestation, which resulted in soil erosion, loss of biodiversity and degradation of agricultural land. The full implication of loss of forest resources as well as the root causes should be recognized in order to conserve and manage the remaining vegetation cover of the country. The main objective of this study is to assess the impacts of deforestation on rural livelihoods in Kuyu district. The data for the study were collected using survey questionnaire including informal interviews, observation and focus group discussions. Four kebeles were selected purposely where the vegetation cover is found and forest products are supplied. Ninety households were considered for analysis of the data. Households' size from each kebele was selected through systematic random sampling based on their proportion household number. The results of investigation showed that, vegetation of the study area is highly degraded. The area, once two decades years ago were under vegetation are changed into other land uses such as farming land and range land. The section of the vegetation close to town area has high degree of deforestation. Some scattered vegetation was observed along river valleys, mugger gorge and on other inaccessible area. Rising demand for forest product, population growth, low perception of inhabitants towards environmental roles of forest, lack of alternative economic activities and land holding conditions of the inhabitants are the major causes of forest destruction. Moreover, failure to relate forestry policy to overall development, lack of commitment at individual level and organizational and lack of rural participation in forest conservation are some of prevailing constraints of forest resources. Environmental impacts of deforestation, which influence rural livelihoods, were observed in the study area. Soil erosion, loss of biodiversity (flora and fauna), and rainfall and water variability are among the major one. Therefore, it is suggested that among other things, increasing the real income of the peasants, diversifying the rural economy, subsidizing basic commercial farm inputs, providing affordable fuel wood, incorporation of local knowledge, resolving conflicts between users' right and management responsibility through introducing benefit sharing system and awaking the peasants continuously on issues related to forest resource management and family planning must receive policy attention to reduce forest destruction.

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CHAPTER ONE

1. INTRODUCTION

1.1 Background to the Problem

Through many changes Human have brought changes in land use and land cover, they have modified soils, influenced climate, affected geomorphic processes and changes the quality and quantity of some natural waters. Indeed the nature of whole of landscapes has been transformed by human induced vegetation (Meyer and Turer, 1994).

Forests provide a wide variety of ecological, economic and social services, including the conservation of biological diversity, carbon storage, soil and water conservation, provision of employment and enhanced livelihood, enhancement of agricultural productivity and improvement of urban and per urban living conditions(FAO,1999). Obviously, these services differ widely in nature and therefore tend to be valued in different manners by different society and different social groups. While some services are immediately visible, other are of a long term nature and take their full sense only in the perspective of intergenerational equity. These services are at risk where they are most needed, especially in fragile ecosystem which characterized many poor countries and areas in the developing countries (FAO, 1999). However, these forest functions and services are being continuously affected by forest deforestation and degradation

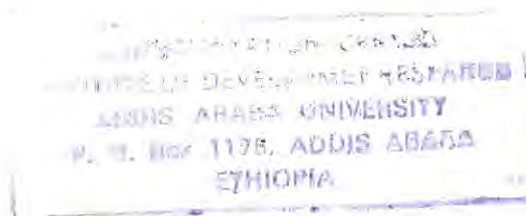
Deforestation of forest resource is one of the major environmental issues not only in directly affected countries and locations, but also from global perspective, the degree of international attention to deforestation is commensurate with the role of forests in the global, national and local ecosystems.

Ethiopia is one of the most severely deforested countries in sub- Saharan African countries, particularly in forest degradation which resulted in soil erosion and degradation of agricultural land. The decline in over all stability and productivity of the country's natural resource is the result of complex and interrelated series of processes that were triggered by the loss of forest cover in critical watershed (Tumcha, 2004

Altitude and topographic location have favored Ethiopia to have numerous or varying agro-climatic zone. This has given rise to the presence of a botanical treasure house containing 6000 different flowering plants in Ethiopia. Out of these flowering plants, 12% are probably endemic (FAO, 2007). These diverse floras are found in the natural forests, which have once covered 35% of the county's total land area. However, today the forest coverage has shrunk to an area of only 2.5% of the total land size.

Measuring the total rate of habitat conservation for the 1990-2005 intervals, Ethiopia lost 3.6 percent of its forest and woodland habitat due to firewood collection, conversion to farm land, overgrazing and use of forest for building materials (FAO, 2005). As a result Ethiopia will face a difficult future, because the agricultural sector which forms the back bone of economy is totally dependent on forest resource.

According to data gathered from district's agricultural and rural development documentation center, in the study area, the deliberate removal of forest by fire and by cutting are one of the most long standing and significant ways in which inhabitants have an impact on the environment. Forests are cleared by the society for various purposes. Among them, the major are to provide fuel for domestic purpose, to provide sawn wood and timber for construction purpose and the need for additional cultivable land. The demand for usage of forest products increased with increasing of population size. With the increasing of population growth, the needs of food and other agricultural products also increased which forced to increase the cultivated land area at the expense forests or wooded area. Deforestation of these natural forests leads to various environmental impacts such as land degradation with associated low productivity and other ecological imbalances with frequent drought and desertification



1.2. Statement of the Problem

The most severe environmental problems in least developed countries are found in rural areas where most of the people live (Holden, 1996). The agricultural sector in Ethiopia accounts for over 50% of the GDP and provides livelihood for over 80% of the population. Agricultural development in Ethiopia is hampered by many factors among which deforestation is the major one. Forests and the benefits they provide in the form of food, income and watershed protection have an important and often critical role in enabling people around the area to secure a stable and adequate food supply.

The full implication of the loss or deterioration of forest for humankind as well as other life is not known. What is known, however, is the loss of forest resource can lead to diminished income, and food-generating capacity for forest dependent communities, higher rates of soil and siltation of water ways, loss of species and genetic diversity and an increase in carbon emission, which, contribute to global warming.

The demand for forest product and services has increased in response to increase in population (FAO, 2003). Of the total increase in volume of consumption, slightly half of forest product was used as fuel wood and the rest was used for a variety of industrial purpose including construction and other furniture. To cover energy needs, most households in Ethiopia resort to freely gathered biomass fuels. More than 85% of Ethiopian population lives in rural areas. The vast majority of these populations are dependent on the traditional fuels of wood, cow dung and crop.

In the study area the annual use of forest product exceeds the sustainability of the forest and woodland area. As a result, forest and wood lands are gradually disappearing. The impact of population growth on forest degradation and forest resource consumption is direct since energy needs and other forest product services are essentially proportional to population size. Urbanization also plays an important role in forest resource deforestation through consumption of the forest product. This pattern damage on smaller area with threshes hold effect that cause the cover to disappear completely around the cities. More over the increment of needs for food and other agricultural products also leads to the clearance of forest resources. In such cases it is necessary to increase the output of lands under cultivation or to increase the cultivated area.

Quite often, however, the option of an increase in yields is difficult to achieve in the study area. Because of adverse natural condition or because it would require costly inputs such as fertilizers, pesticides and irrigation, in those area more land will be cleared at the expenses of forests or wooded area. In these case the most important conditioning factors are the degree of population pressure on both agricultural and forest lands and on the productivity of land under cultivation.

From these all one can infer that increasing demand of wood for fuel and construction purpose, the shortage of farm land ,scarcity of forest product coupled with poverty and rapid population growth in the study are would lead to clearance of vegetation cover . These lead to enormous environmental impacts such as land degradation with associated low productivity and other ecological imbalances, with frequent drought and desertification. This therefore, requires an immediate and sustainable solution. So that the problem can either be better dressed or minimized.

To develop appropriate conservation method that are suitable for agricultural productivity and minimize environmental impact, empirical study should be under taken on environmental impact of deforestation.

1.3. Objectives of the Study

The general objective of the study was to assess impacts of deforestation on rural livelihoods. The specific objectives of the study include the following points:

- ❖ To assess the status of forest product supply and consumption.
- ❖ To examine the effects of deforestation on soil, water and biodiversity.
- ❖ To study the way by which inhabitants degrade forest resources.
- ❖ To examine the effect of deforestation on agricultural activities.
- ❖ To establish the rationale for deforestation and to give the mitigation measures that minimizes the environmental problem

1.4 Research Questions

Most research questions that need profound answer are:

- What is the impact of forest deforestation on the environment?
- What is the rationale for deforestation and forest degradation and how the inhabitants exploit the forest?
- What is the status of forest product supply and consumption.
- What is the relation between income, family size, education and forest product consumption and forest degradation?
- To which extent forest is degraded?
- What is the resultant negative impact of the environment from deforestation?

1.5. Significance of the study

Wisely use of forest resources in any area, especially in rural part of the study area have paramount importance for the improvement of carrying capacity of the environment which helps to raise the living condition of the on-site inhabitants and off-site inhabitants and also contribute the county's economic advancement. Thus, in addition to showing how the society may able to use forest resource wisely and manage the existing forest, the researcher believes that, the result of this study:

- ❖ Enriches the knowledge on forest use pattern and forest deforestation practices prevalent in the study area.
- ❖ Provides the basis for planning and forest management in the district and serves the officials and concerned body as a supplement to their knowledge.
- ❖ May add to the existing literature and may serve as an additional source of reference.
- ❖ Gives bases for others researchers who want to make further investigation in the area and may be used as stepping stones.
- ❖ Lastly, it enables the concerned body and forestry experts to take measure and fight the problem in time. No matter how the problem might be

perceived locally, the result of this may hold true for other similar regions in the country. Above all, this study better the district as there is no previously conducted investigation on the problem at hand.

1.6 The scope and Limitation of the Study

The findings of the research work may be used as a base to solve some of the country's environmental problems, if it is conducted widely including all kebeles of the districts. However, due to time, money, and labor constants, it was too tedious and out of the reach of to include all kebeles. Thus, the study was done on four kebele from the rural area of the district.

The scope of this study was also delimited to the problem related to deforestation practices. Although treating the overall problem of the environment would enable the inhabitants to aware the impact of environmental degradation on the agricultural productivity, the study was bounded on deforestation and forest resource degradation and the resultant negative impact on the environment.

1.7. Organization of the Paper

This research paper has been divided into five chapters. The first chapter deals with the introduction part which states background of the study, statement of the problem, research objectives and questions, and limitation of the paper. In the second chapter the writer tries to review briefly the concepts and current thinking of deforestation and forest degradation, and definitions of important terms in this research. Forest resource distribution, supply and consumption of forest product at different levels and the basic factors behind the prevailing environmental degradation in Ethiopia have also been discussed in Chapter Two. The third chapter deals with the description of the study area and the methods that was employed to do this paper. Physical characteristics of the area are briefly discussed in this chapter. The farming households' socio economic situation, basic factors of forest destruction, and the environmental impacts of forest disappearance are investigated in Chapter Four. The summary of the overall parts of the paper and recommendations that are assumed to alleviate the problems are covered in Chapter five.

CHAPTER TWO

2. REVIEW OF RELATED LITRATURE

2.1. Operational Terms

Assessment: The process by which information about forest management is collected with a view to establishing, within a defined framework of expectations, the current status and probable future direction of interactions between human beings and forests, using certain criteria and indicators.

Biological diversity: The variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystem

Deforestation: A non-temporary change of land use from forest to other land use or depletion of forest crown cover to less than 10 percent. Clear cuts (even with stump removal) if shortly followed by reforestation for forestry purposes are not considered deforestation.

Forest degradation: Impoverishment of standing woody material mainly caused by human activities such as over-grazing, over-exploitation (for firewood in particular), repeated fires, or due to attacks by insects, diseases, plant parasites or other natural causes such as cyclones.

Forest ecosystem: An ecological system composed of interacting biotic and a biotic components of the environment in which trees are a major constituent, such that their canopies cover 20 percent or more of the area.

Forest goods and products: Wood and non-wood forest products obtained from forests.

Forest services: Environmental services (conservation of soil, water, biological diversity; micro and macro climatic effects; nutrient cycling) and socio-cultural services other than those provided by the production of wood and non-wood products (e.g. recreation and tourism, protection of cultural, aesthetic and scientific values) provided by forests.

Offsite inhabitants: people living outside of forest area

Onsite inhabitant: people living in and around forest coverage area

Shrub and brush land: Woody perennial plants, generally of more than 0.5 m and less than 5 m height, and often without a definite stem and crown. "Trees outside the forest" are excluded

Sustainable forest management: It is the stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biological diversity, productivity, regeneration capacity, vitality and their potential to fulfill, now and in the future, relevant ecological economic and social functions, at local, national and global levels, and that does not cause damage on other ecosystems.

2.2. Definition of Deforestation and Global Over View of Forest Resources

2.2.1 Definition of Deforestation

Deforestation defined broadly can include not only conversion to non-forest, but also degradation that reduces forest quality, density and structure of the trees, the ecological services supplied, the biomass of plants and animals, the species diversity and the genetic diversity (FAO, 2005). United Nations Research Institute for Social development (UNRISD) also defines deforestation as the loss or continual degradation of forest habitat primarily due to human related causes. Agricultural, Urban sprawl, unsustainable forestry practices and mining all contribute to human caused deforestation. In this case the term deforestation used to refer to activities that use the forest, such as fuel wood cutting, commercial logging, as well as activities that cause temporary removal of forest cover such as the slash and burn technique, a component of some shifting cultivation agricultural system or clear cutting. It also used to describe forest clearing for annual crops and forest loss from over grazing.

According to Williams (2006), the causes of deforestation are complex and often differ in each forest and country. It may be difficult to determine the cause of deforestation in a particular forest and noted that there are three schools of thought with regards to the causes of

deforestation. One is the *Impoverishment* school, which believes that the major cause of deforestation is “the growing number of poor”. This school of thought sees smallholders as the principal agents of deforestation. The second school of thought is *Neoclassical* which believes that the major causes of deforestation are “open-access property rights”. They see various agents as the principal agents of deforestation. The third school of thought which believes that the major cause of deforestation is that “capitalist investor’s crowd out peasants” is called *political-ecology*. This school sees capitalist entrepreneurs as the major agents of deforestation.

2.2.2 Global Over View of Forest

The unique nature of forest ecosystems has long been acknowledged. Forest ecosystems play multiple roles at global as well as local levels as providers of environmental services and as sources of economically valued products (UNEP 2000). The 1972 Stockholm conference recognized forests as the largest, most complex and self-perpetuating of all ecosystems, and emphasized the need for sound land and forest use policies, and the need for introduction of forest management. It was recommended that countries should:

- ◆ Strengthen basic and applied research for improved forest planning and management, with emphasis on environmental functions of forest; and
- ◆ Modernize forest management concepts by including multiple functions and reflecting the cost and benefits of the amenities that forests provide;

The conference also called for:

- ◆ Cooperation of united nations bodies to meet the needs for new knowledge to incorporate environmental values in national land use and forest management and
- ◆ Continuing surveillance of the worlds forest cover through the establishment (in countries) of appropriate monitoring systems.

Today, the Stockholm conference recommendations relating to forests remain valid and unfulfilled, in many ways, because of conflicting interests in managing forests for environmental conservation and economic development.

Deforestation and forest degradation over the past 30 years has been the continuation of a process with a long history. The historic loss of forests is closely related to demographic expansion and the conversion of forest land to other uses. Major direct causes of forest degradation brought on by humans include over harvesting of industrial wood, fuel wood and other forest products, and overgrazing. Underlying causes include poverty, population growth, markets and trade in forest products and macroeconomic policies. Forests are also susceptible to natural factors such as insects, pests, diseases, fire and extreme climatic events (UNEP, 2006).

A number of assessments of changes in forest cover have been carried out over the past 30 years including FAO and UNEP 1982, FAO 1995, FAO 1997, WRI 1997, FAO 2001, and UNEP 2001. While differing in their definitions of forest cover, methodology and specific results, making detailed comparisons unreliable, these assessments have reinforced each other in their overall depiction of declining forest areas and continued degradation of forest ecosystems.

The 1980 Tropical Forest Resources Assessment by FAO, and UNEP was the first comprehensive assessment of tropical forests. The rate of tropical deforestation was calculated at 11.3 million ha a year (FAO and UNEP 1982).

Since then, while forest area in developed countries has established and is slightly increasing overall, deforestation and forest degradation has continued in developing countries (FAO, 2000, 2001b, 2001a).

A recent study using globally comprehensive and consistent satellite data estimated that the extent of the worlds remaining closed natural forests (where crown cover is more than 40 percent) in 1995 was 2870 million ha, about 21.4 percent of the land area of the world (UNEP 2001).

Table 2.1 Change in forested land 1990-2000 by region

Region	Total land area (million ha)	Total forest 1990 (million ha)	Total forest 2000 (million ha)	% of land forest in 2000	Change 1990-2000 million	% change per year
Africa	2963.3	702.5	649.9	21.9	-52.6	-0.7
Asia & the Pacific	3463.2	734.0	726.3	21	-7.7	-0.1
Europe	2359.4	1042.0	1051.3	44.6	9.3	0.1
Latin America & Caribbean	2017.4	1011.0	964.4	47.8	-46.7	-0.5
North America	1838.0	466.7	470.1	25.6	3.9	0.1
West Africa	372.4	3.6	3.7	1.0	0.0	0.0
World	13014.1	3960.0	3866.1	29.7	-93.9	-0.24

Source: Compiled from FAO 2001b

2.3 Forests and wood lands in Africa

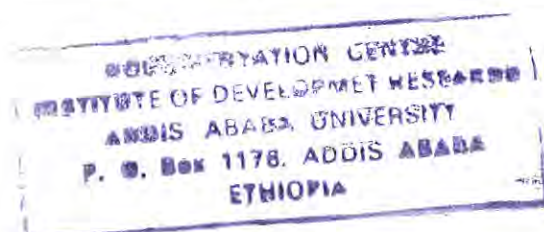
Forests and woodlands occupy an estimated 650 million hectares (ha) or 21.9 percent of the lands in Africa. These account for 16.8 percent of the global forest cover. The distribution of forests and woodlands varies from one sub-region to the other, with Northern Africa having the least forest cover while central Africa has the densest cover (UNEP, 2005).

Africa's forests can be classified into nine general categories including, tropical rain forest, tropical dry forests, tropical shrubs, tropical mountain forests, subtropical humid forest, subtropical humid forests, subtropical dry forests, subtropical mountain forest and plantation.

Only 32.5 million ha of forests and wood lands, or 5 percent of the total forests areas, are formally protected (ibid, 2005).

According to UNEP (2005), the forest sector in Africa plays an important role in the livelihoods of many communities and in the economic development of many countries. This is particularly so in western, central and Eastern Africa where there is considerable forest cover. Africa has a high per capita forest cover at 6.8 ha per person compared to 0.6 ha globally. On average, forests account for 6 percent of gross domestic product (GDP) in Africa, which is the highest in the world. In Uganda, for example, forests and woodlands are now recognized as an important component of the nation's stock of economic assets and they contribute in excess of US \$ 546.6 million to the economy through forestry, tourism, agriculture and energy. Forests and woodlands are also contribute to the long term social and economic development goals of New Partnership for Africa's Development (NEPAD) and can play an important role in addressing the millennium development goals.

Forests provide a wide array of environmental resources, some of which can be successfully commercialized, increasing financial benefits. Forests play an important role in carbon sequestration and by investing in forests development and conservation countries can benefit from carbon trading. Number of corporate institutions in Europe are already benefiting from carbon trading by investing in tree planting in some parts of Africa. The market for environmental services from frosts is growing rapidly around the world, often facilitated by national and regional policies as well as international conventions and agreements. Certain segments of society that are able and willing to pay for these services are creating opportunities for the forest owners. Markets for carbon sequestration have been adopted in Uganda, Tanzania, Malawi and Madagascar. Forests and woodlands are also key components of the environment and provide essential services that are critical to combating land degradation and climate change, as well as to conserving wet lands, coastal areas and fresh water system. In this regard, the NEPAD programs, including those on combating land degradation and climate change, and on conserving wetlands, coastal and freshwater resources (UNEP, 2005).



2.4 Population and deforestation

Concern with population pressures is ubiquitous in literature on forest degradation, soil degradation, loss of biodiversity, threats to future peace and stability, food scarcities, global warming and underdevelopment. Many scholars focus on overpopulation when they analyze resource use (Abernathy, 1993; Avise, 1994; Holdren, 1992; Meffe, Ehrlich and Ehrenfeld, 1993; Wilson, 1992). According to Wilson, "the raging monster upon the land is population growth. In its presence, sustainability is but a fragile theoretical construct". A policy document from the World Bank affirms that "the causes of environmental degradation are as varied as its manifestations. But, the heart of the problem is the rapid rate of population growth in many developing countries" (World Bank in Banuri and Marglin, 1993).

Two themes in the literature about overpopulation merit a critical focus: the concern with population growth in the developing world and concern with the activities of the numerous small producers who use land. Wilson (1988) asserts, "Exploding human populations are degrading the environment at an accelerating rate, especially in tropical countries".

"Many environmental problems," Bilsborrow and DeLargy (1991) remark, "including elimination of tropical forests and reductions in biodiversity, are most clearly evident in the Third World". Li (1991) claims that "the most important thing the Chinese government can do to break the vicious circle of overpopulation and deforestation is to promote the practice of family planning and to strictly control population growth".

Yet, these same analysts also commit themselves to contradictory, incomplete and untenable claims: Bilsborrow and DeLargy concede that "while population pressure is often considered an important factor in environmental degradation, solid empirical evidence on its role is almost non-existent"; and as he blames deforestation on overpopulation, Li reveals that China's forested land area changed from 8 percent in 1949 to 12 percent in 1984 to 8.4 percent in 1988. If forest area increased and decreased while population went up each year, clearly there are other factors that are much more significant in explaining deforestation.

The second focus - the responsibility of numerous small producers and users in environmental degradation - is evident among writers such as Myers (1991) and Wilson (1992). Gathering bite

from the bias against smallholders that is present among Marxist and modernization theorists alike, these writers reserve a special ire for the small-scale agricultural producer and allege that the sheer number of small producers as well as their limited options and resources force them into irrational courses of action which lead inevitably to environmental damage. Raven (1991), for instance, singles out the very poor and judges that they use natural resources very destructively. Something seems wrong with this picture, however. Raven contradicts himself by conceding in the same paragraph that it is the industrial countries that "consume 80-90 percent or more of virtually all commodities..." And, increasingly, theorists are diverting their attention to the knowledge and practices maintained by peasants and indigenous populations to learn about resource management and conservation (Gupta, 1992).

The analysis that follows examines the actions of impoverished, rural resource users in a developing world context of generalized pressure on resources. The Lesser Himalayas in India have one of the highest population densities in India, especially in view of the limited availability of arable land. While the local demander, fuel wood and construction timber (Ashish, personal communication, 1990). The constraints they have forged to restrict resource use, and the specific institutional strategies they employ therefore constitute a significant cause for skepticism towards a cause-effect relationship that analysts often postulate as being inevitable between population density and resource degradation. Micro-level research shows that people and the environment are not necessarily antagonistic and it provides a different perspective on the population environment relationship.

2.5 Forests and Forestry Practice in Ethiopia

High forests, either coniferous or broad leafed, were the climax vegetation of 35-40 percent of Ethiopia before human settlement took place. With the inclusion of savanna woodlands some 66 percent of the country was covered with forest or woodlands at that time. Over the last 5000 years, these have been progressive deforestation which has accelerated tremendously during the last century as the country's population has grown (Wood, 1990).

The rapid population growth (3 percent per year), extensive forest clearing for cultivation and over-grazing, movement of political centers, and exploitation of forests for fuel wood and

construction materials without replanting has reduced the forest area of the country to 16 percent in the 1950's and 3.1 percent in 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 percent of the land surface is under forest and wood land, (Kuru, 1990: MoA, 1991).

The Ethiopian Forestry Action Plan outlines the pattern of deforestation. The current rate of deforestation is estimated at 150,000 ha per year (Ethiopian Forestry Action Plan) or 62,000 ha/yr (World Bank 2001). Forests in general have shrunk from covering 65% of the country and 90% of the highlands to 2.2% and 5.6% respectively (Table 2.2).

Table 2.2: Forest Reduction

	Original Extent of Forest	1950's	1990	2000
Ethiopia	65%	16%	2.7%	2.2%
Highlands	90%	20%	?%	5.6%

Source: World Bank (2001)

The current rate of deforestation is estimated to be 200,000 hectares per year. As a result large areas of the country are now exposed to heavy soil erosion. It is estimated that fertile top soil is lost at a rate of 1 billion cubic meters per year (FAO, 2001), resulting in a massive environmental degradation and serious threat to sustainable agriculture and forestry.

Most of the present forest is located in the south west and central parts of Ethiopia. It is also estimated that open savanna type of woodlands dominated by Acacia species cover more than 20 million hectares. These lands are used for grazing and charcoal production. In addition to the natural forest cover, there are about 162,000 hectares of plantation forest and about 36,000 hectares of per urban fuel wood plantation. These are managed by the state, and Eucalyptus is the main plantation species (MoA, 1991).

As might be expected in a country with such wide variations in climate, topography and soils, Ethiopia is one of the few countries in Africa where virtually all major types of natural vegetation are represented, ranging from thorny bushes native flora species has been estimated at over 10,000 while more than 50 different botanical plant communities exist (Money, 1991).

Little of the natural vegetation of the highlands remains today, except, for south and south western parts of the country. The influence of man and his domestic animals has profoundly altered both the vegetation and the landscape. Ecological degradation, including deforestation and erosion, is widespread, particularly in the northern and central highlands.

2.5.1 Forestry Development in Ethiopia

Ethiopia's forest resource conservation, development and utilization today is not the product of a long evolving processes in which different land use-planning measures have 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 production is the outstanding forestry problem in Ethiopia (MoA, 1990).

Despite this problem, however, massive soil conservation and afforestation programs have been going on in Ethiopia since the early 1970's. These programs are undertaken by various agencies of the government through the assistance of many international and bilateral organizations. According to Gammachu and Humi (1990), there are three most important governmental and international organization involved in soil conservation measures and afforestation programs in Ethiopia. The first organization is community forests and soil conservation development department (CFSCDD) 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 in three main activities; farm forestry, community forestry and soil conservation.

In form forestry programs, peasants are encouraged to establish small private plantations around their homes-usually various species of eucalyptus. The community forest 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 the peasant Associations (Pas) Development Department (SFCDD) of the Ministry of Agriculture is the second agency and is involved in the establishment rehabilitation of degraded forests as a source of industrial wood. It is also involved in the establishment and management of fuel wood in rural areas and around urban areas. The SFCDD has professionals and technical staff and also uses paid laborers for field work.

The remaining natural forest areas of the SFCDD 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 sustained yield basis. 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, 1990).

The third organization is World Food Program of the UN. It has been involved in and has continued to support soil conservation, afforestation and small scale irrigation projects in Ethiopia since the mid 1970s. Its assistance is mainly in the form of food for work programs in which peasants who come to work on the projects are provided with grain and vegetable oil. Various documents of the CFSCDD 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 have been impressive, it has been reported by the CFSCDD 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 recent years.

Moreover, in the use of community forests in particular, there is no clear legal basis for determining ownership. Farmers tend to assume that the forest belong to the state. The fact that

even the small plantation around their dwellings are partially confiscated by the Pas is likely to produce further disincentives to plant or once planted to manage and protect the trees.

Also, the massive national soil conservation and afforestation efforts between 1976 and 1985 (Gammachu, 1990; Humi, 1990) are often seen as government imposed activities, and since they are not accompanied by education, the advantages of these efforts are not associated with individual benefits.

2.5.2 Deforestation in Ethiopia

Deforestation is caused by what human beings do to the forests and can be accentuated by drought. Generally deforestation occurs when people clear forest for their personal need such as, for fuel, hunting, when they need the land to grow and harvest crops, for building houses, and at times because of religion beliefs (Sucoff, 2003).

The main causes of deforestation in Ethiopia are shifting agriculture, livestock production and fuel wood in drier areas (Ibid, 2003).

Ethiopia is a country in Eastern Africa; it has the second largest population in Africa and has been hit by famine many times because there was a shortage of rain, and a depletion of natural resources. (Haileselassie, 2004). Growing populations are increasing forest degradation which is leading the country to famine. As the population continue to grow the need of the people increase. And the country has lost 98% of its forested regions in the last 50 years (parry, 2003).

Forests in Ethiopia play a big role in protecting erosion, because if there are more trees the water wouldn't be able to wash away the soil. Trees also help to keep water in the soil and reduce global warming by uptake of carbon dioxide. Because there are not enough trees, the Blue Nile is carrying all the soil and other nutrients in the water to the neighboring countries of the Sudan and Egypt, where their land is very fertile.

Historically forests have been any important for the people of Ethiopia for their livelihood even more than now. People used trees to cook their food, to build their traditional homes. They also



made traditional medicines from trees and other forests plants. Forests were also important in Ethiopia religious beliefs, believed in holy spirits in the forest that they treat the same as human beings.

At the beginning of the 20th C around 42 million hectares or 35% of Ethiopia's land was covered by trees, but recent research indicates that forest cover is not less than 3 percent because the number of the population growth fast and the need is growing plus people don't have enough knowledge about the benefits of trees (Parry, 2003).

Ethiopia which is a country badly affected by deforestation and forest degradation loses 141,000 hectares of natural forest each year for many reasons. If the number continues to grow the future of the country will be very bad. Currently, the total number of the country land covered by forest is 13,000,000 ha of land (Mongabay, 2006). Between 1990 and 2005 the country actually lost 14 percent of its forest or 2.1 million hectare, and that indicate us deforestation increased by 10.4 percent from 1990-2005, therefore because of deforestation the number of wild animals the country has is becoming less and less overtime. Previously the country has around 6,603 species of plants, 839 birds, 205 mammals 288 reptiles and 76 amphibians as well (Mongabay, 2002).

2.6. Goods and Services of Forest

The global demand for forest product increased in line with world population growth. Surprisingly almost half of the total wood forest product is consumed as fuel wood and the rest half are consumed in industrial and other constructional purposes (FAO, 1997:50).

Developing countries account for 2123 million ha (55%) of the world's forest, of which 1850 million hectare are tropical countries. Global forest resource assessment (GFRA) 2000 (cited in FAO, 2003a:178) revealed that there is a net annual loss of forest area that is about 9.4 million hectare between 1990 and 2000 world wide at the globe at large. Annual forest clearance was estimated 14.6 million ha as compared to the 5.2 million ha of forest increases. The same source indicated that nearly all forest loss is occurring in the tropics owing to increased fuel wood demand and consumption of forest for construction purpose through round wood and timber. This indicates the incompatibility of rates between regenerations and consumptions (Ibid, 179).

African forest is known to produce a variety of goods and services in response to the diverse needs of people locally, nationally, regionally and globally. However, absence of information in this respect is a big problem particularly the case with locally collected and used wood fuel and construction materials such as saw logs and poles (FAO, 2003b:8-9).

Table 2.3: Global forest product consumption by regions (2000 per capita)

No	Product	Unit of Measurement	Africa	Asia	South America	North America	Europe	World
1	Round wood	m ³	0.876	0.281	0.972	1.589	0.783	0.554
2	Fuel wood	m ³	0.769	0.213	0.535	0.325	0.154	0.29
3	Industrial round wood	m ³	0.080	0.072	0.436	1.264	0.609	0.268
4	Sawn wood	m ³	0.013	0.019	0.074	0.386	0.165	0.670
5	Wood bared panels	m ³	0.003	0.014	0.026	0.132	0.088	0.32
6	Printing	Kg	1.8	8.0	10	68	42	16

Source: FAO (2002:9)

Table 2.3 shows a comparison of various forest products consumed in different continents. It clearly indicated that the amount being consumed varies with countries and types of wood products. Accordingly the records of forest products consumed as fuel wood in Africa is by far greater than that of others. Africa's round wood consumption is also high only next to North America and South America respectively.

In most rural parts of the world wood and wood products were and still are fundamental materials in constructing residential, houses, offices and other buildings and to furnish them (NRMCD, 1990:20). This is however, a common aspect of life in developing countries like Ethiopia. Round wood in Ethiopia is obtained directly from the natural forest except in few

cases. The splitting of big round logs into smaller size to rough slabs into boards by using axe and wedge have long been practical for many centuries in Ethiopia (NRMCD, 1990:201). These rough sawn products are further decorated by handcrafting or painting and oiling. This can be seen for instance in Ethiopian churches, palaces and other traditional buildings and their furnishing. What matter is the expansion of this traditional, in efficient and destructive process of producing sawn wood particularly with the introduction of two-man sawn (UNDP, 1992:260). Thus sawing has become a common practice for lumber production even at the village in rural Ethiopia.

According to Addis 1985 (cited in NRMCO, 1990:201), even though modern sawn milling began to expand in 1950, and 1960, the production of sawn woods decreased. This decline in the production of sawn woods is in response to increasing scarcity of big round woods.

In Ethiopia the energy sector remains heavily dependent on wood for fuel. Despite the poor documentation the production and consumption of wood for fuel (EFAP, 1994) estimated that wood provide 62% while dung and crop residues providing 27% of the energy required. However, national figures conceal considerable regional and local variation in both supply and consumption patterns. This could be due to the varying fuel wood prices and cost of supplying alternatives energy sources which also have large influence on the consumption pattern and the level of biomass consumption (UNFCCC, 2001:37).

A great proportion of the total energy supply in developing countries of non-commercial energy derived from the burning of fuel wood and plant and animal residues. Fuel wood and charcoal provide most of the fuel for such essential purposes as cooking and heating in rural and urban areas of Africa as well (UNEP, 1995, 38). The removal of trees in both semi arid and humid land in African countries is a result to a large extent of increasing energy needs from an increasing population both rural and urban (Ibid, 191).

Fuel wood shortage, though worse today than ever before, is not new to the deteriorating forest resource. Today woman have to walk much further than 3kms to obtain their fuel wood and fuel wood for large cities and town often comes from 100km away (Ibid, 26). In Ethiopia also (UNFCCC, 2001:37) traditional biomass fuel such as woody biomass, agricultural residue,

charcoal and dung are the dominant energy sources of Ethiopia at the expense of disappearing forest resource.

2.7. Impact of Deforestation on the environment

2.7.1 Deforestation as a process

Deforestation is the major problem facing Ethiopia. At the current rate of about 150,000 to 200,000 hectares per year, it threatens to eliminate the remaining natural forest within a period of thirty years. Deforestation had caused and continuous to cause environmental degradation, which involves land degradation, water resources degradation and loss of biodiversity. Tropical forests are declining rapidly owing to forest degradation through fuel wood collection, charcoal production and logging and other factors such as conversion to arable land (Demel and Yonas, 2002:).

Between 30 and 40 percent's of the world's population depends on fuel wood for cooking and warmth as cash is not available for purchasing fossils fuels. Consequently, fuel wood and charcoal production alone account for about half of all wood consumption being 96% for Ethiopia in 1980 (Ibid:38).

According to UNDP (1992:259) quite a large amount of forest of Ethiopia is being wasted through agricultural purposes or wasted through un improved logging and charcoal production. As a result, that about 60,000 ha/year of acacia woodland were being cleared for charcoal production. These have a various consequences on various ecosystems in the country.

As to Gete (2003:53), the over increasing population growth with increasing demand for fuel wood, construction materials and charcoal, for more cultivated land and lack of appropriate forest policy are the major driving force for the high rate of deforestation and forest degradation in the country.

Though agricultural expansion partly contributes to deforestation, it is the demand for fuel that will be damaging to forests. Hence, substitute for energy should be brought immediately (UNDP; 1992:66)

2.7.2. Land Degradation

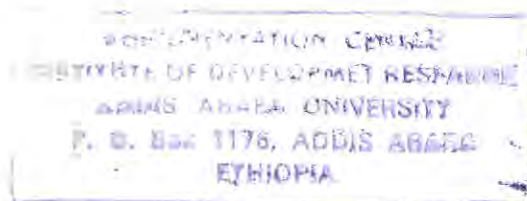
Land degradation – a decline in quality and productivity of land and its components may result from wind and water erosion, chemical and physical deterioration along with forest degradation. According to Desta (1999:19), the over exploitation of forests and the resulting deforestation are responsible for several soil degradation constituting about 56 mill.ha/year world wide. Erosion, the leading agent of land degradation, is 81 percent human induced through forest degradation in Oromia region (ILRI, 2002:18). The situation has pressure on the highlands of the region (Hararghe highlands, East and North Shoa, etc) in response to increased demands for forests for construction and fuel and partly of expanding farmlands to steep and marginal areas (Ibid). Emanating from deforestation and scarcity of fuel, burning cow dung for fuel instead of using it, soil conditions decreased in its fertility, and hence, induced soil degradation with resulting low productivity (Get, 2003). This has implications on depletion of natural resources and subsequently reduced quality of life of the people.

The unprecedented scale and rate of human induced changes to forests are threatening forest based biodiversity. The deterioration of forest ecosystems has led to the extinction of some species and the reduction of genetic variation with in other species through the loss or reduction in size of certain population in an area (FAO, 2000:80).

Ethiopia has unique place in the world as one of the global biodiversity center. It is estimated to possess about 6000 species of higher plant (Demel and Yonas, 2002).

Tropical deforestation and forest degradation account for estimated 23% of the green house effect (FAO, 1997:4). However, forests source and sink of CO₂, can contribute to and mitigate climate change.

The world's forests now days estimated to be net source of CO₂, primarily due to deforestation and forest degradation in the tropics. The increasing consumption of forests foe fuel wood and charcoal substantially contributes to the global warming (Demel and Yonas; 2002). The resulting climatic change has been determined to have enormous impact on food production.



2.8 Conceptual Frame work

Many human factors are responsible for the gradual decline in the vegetation cover of land. According to Desta (2001), there are three major factors that affect forest destruction in developing countries. These are raising demand for tree products that is fuel wood, transmission poles, construction wood, farm implements, fodder, etc; conversion of forest land to agricultural land and shifting cultivation, urbanization, etc; expanding population pressures resulting in actual human and animal population exceeding the carrying capacity of the land. There are other human as well as natural conditions, which have further intensified the adverse effect of these three factors. These are: shortage of trained foresters and forest rangers, lack of political leadership both at national and regional level, lack of commitment either at individual or organizational level, lack of policies and measures of population control, or inconsistency between population policies and natural policies; failure to relate forestry policy to overall development, failure to empower local governments to make decisions related to forestry and other social and economic factors. These all factors directly or indirectly have a significant impact on the condition of forest resources services which have potential impacts in rural livelihoods. Therefore, human's beings have great potentials to increase deforestation which resulted in loss of biodiversity, soil erosion; water availability and climate change (see Fig 2.1)

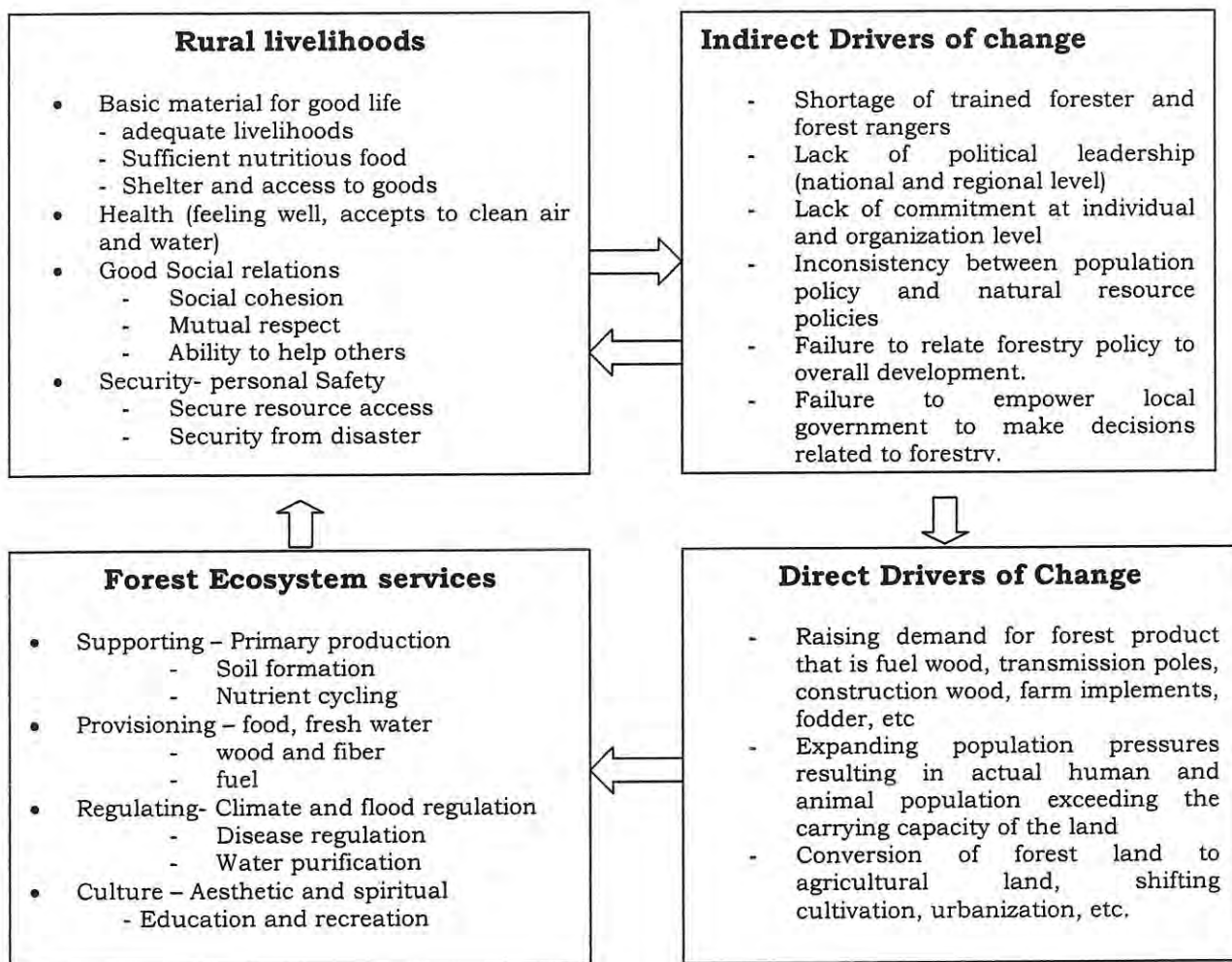


Fig 2.1 Conceptual Frame work

CHAPTER THREE

MATERIALS AND METHODS

3.1 Description of the Study Area

3.1.1. Location

The district is found in North Shewa administrative zone of Oromiya National Regional State. It is located at about 150 km from Addis Ababa in northwestern direction on the way to Bahrdar town. Geographically it is located at about $9^{\circ}36'34''$ N and $38^{\circ}05'00''$ - $38^{\circ}34'13''$ E with altitudinal range of 1200-2800m above sea level.

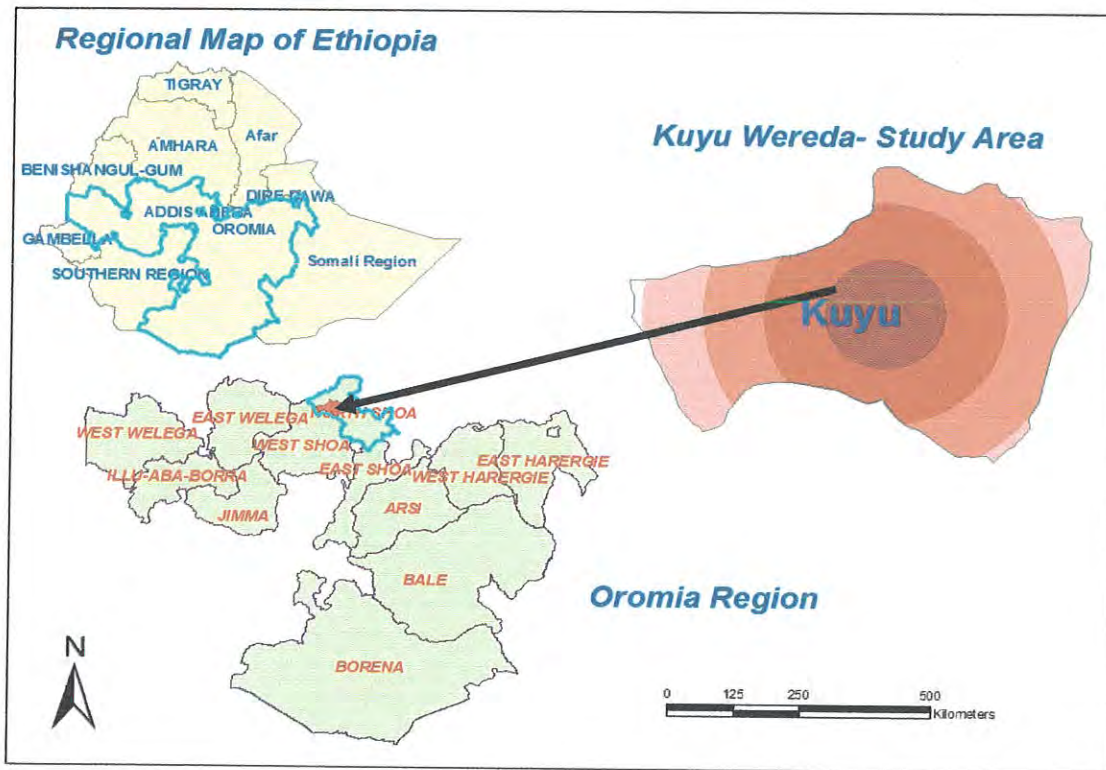


Fig 3.1. Map of regional state of Ethiopia, Oromia region and study area, respectively.

The total area of *kuyyu distirict* is 974 square kilometers. According to the estimated data from *kuyyu distirict's* office of agriculture and rural development, about 45,718 hectares (45.94 percent) of the total land was cultivated. The rest non-arable land of the districts occupied by several land use patterns such as forests (both natural and man made), bush and shrubs, grasslands, bare land and urban areas (see table 3.1).

Table 3.1: Land use Pattern of Kuyyu wereda

Roll. No.	Land use Type	Size (ha)	Percentage
1	Cultivated	45,718	45.94
2	Forest land	2,416	2.48
3	Bush and Shrubs	9,954	10.22
4	Grassland	18,321	18.81
5	Bare land	6,560	6.74
6	Urban area	7,126	7.52
7	Others	7,305	7.50
	Total	97,400	100.00

Source: Kuyyu Wereda Office of Agriculture

In general, the land of Ethiopia is classified into five major traditional agro-climatic zones: *Kur (Wirch)*, *'dega'*, *woinadega*, *qolla* and *bereha*. The two extreme zones, *Kur (Wirch)* and *bereha* are restricted to the areas where altitudes are over 3300, and below 500m above sea level, respectively (EMA, 1981). Hence, no part of the study area belongs to these two extreme climatic zones

Since its altitude varies between 1200m and 2800m above sea level. The vast major part (95 percent) of the *wereda* belongs to *dega* and *woinadega*. *Woinadega* alone accounts for 47 percent of the area followed by *dega* which constitutes 44 percent. The rest 9 percent of the area is constituted by *qolla* agro-climatic zone.

It seems so essential to analyze the data generated from *Garba Guracha* meteorological station which is the only station recording rainfall and temperature in the *district*. In fact, the data recorded at this station may not represent the whole part of the *district* particularly those areas found in *qolla* agro-climatic zones. This is because the station is located in *dega* area at the center of the *wereda*. Moreover, most of the *qolla* agro-climatic zones are found at the southern and western borders of the *wereda* very far from the station.

However, the fact that the station is located in *dega* at the center of the study area makes the data to some extent represent the major part of the *wereda*. The data from this station reveals the general climatic conditions of the study area. One can safely say that the rainfall and temperature data obtained from *Garba Guracha* station reveals the general picture of the study area.

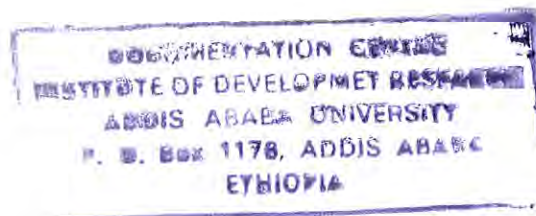


Table 3.2: The Variability of Mean Maximum and Mean Minimum Temperature Measured in Standard Deviation (SD) and Coefficient of Variation (CV) /1995-2008/: Kuyyu Wereda.

	Months												Yearly
	J	F	M	A	M	J	J	A	S	O	N	D	
Mean Max To (°c)	23.7	24.1	24.1	23.9	24.1	22.9	21.1	20.9	22.0	22.7	23.3	23.3	23.0
SD	1.9	1.7	1.7	1.8	1.8	1.9	2.8	2.8	2.7	2.0	2.0	2.0	1.1
CV (%)	8.0	7.1	7.1	7.5	7.5	8.3	13.3	13.4	12.3	8.8	8.6	8.6	4.8
Mean Min To (°c)	6.6	8.4	8.0	8.9	9.0	9.2	9.6	9.3	8.9	7.0	5.8	5.5	8.0
SD	4.2	2.4	2.2	1.5	1.5	0.9	1.1	1.2	1.5	2.5	3.6	3.0	1.4
CV (%)	63.6	28.6	27.5	16.9	16.5	9.9	11.4	12.6	17.2	36.0	61.9	54.4	17.1

Source: National Metrological Services Agency of Ethiopia.

Based on the data generated from *Garba Guracha* meteorological station, the annual average temperature (1995-2009) computed to be 16.5⁰c. As it is indicated in table 3.2, the highest temperature occurs during the months just before the main rainy season, whereas the least temperature occurs in July, August and September. The average annual mean maximum and mean minimum temperature for 14 years are 23.0⁰c and 8.0⁰c, respectively.

3.1.2 Relief and Drainage

Kuyyu district is found within the central highlands of Ethiopia (EMA, 1981). Majority of its area (91 percent) lies above 1500 meters and belongs to the highland parts of the country. Even most of its areas that are found below 1500 meters are river valleys.

Most of the lands in the '*dega*' agro-climatic zone are flat (plateau) and cut by small number and size of streams majority of which are seasonal.

The majority of the study area, are severely cut by running water and are characterized by several gullies, escarpments, cliffs and resistant rocks. It, therefore, undoubtedly belongs to some of the severely eroded parts of the country. The *lowland* parts of the study area are characterized by extensively barren rocky lands and very steep slopes.

Due to several cliffs, river gorges, and steep slopes, movements in lowland parts of the study area is relatively difficult. Hence, the vast majority of the lands in these agro-climatic zones are not suitable for ox-drawn tilling.

As far as the drainage pattern of the study area is concerned, *Muger* is the most important drainage basin which together with its tributaries drains the western, southern and central parts of the area.

3.1.3 Soils

According to the data from kuyyu woreda agricultural and rural development office, the dominant soil type of the district is black soils (Vertis soils) and clay is the dominant soil texture. Soil depth in cultivable land ranges between 125 cm to 25 cm.

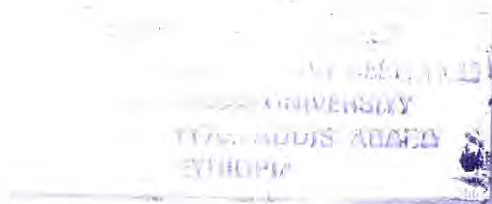
The data from the same office reveals that soil erosion in the area is so severe. About 3000 quintals of soils is lost from farmlands per annum. This is mainly because the vast proportion of the land is uncovered by vegetation and steep slopes are widely available in *woinadega* and *qolla parts* of the *wereda*. About 50 percent of the total area is found within the slope range of 10-30% which is said to be one of the prominent causes of soil loss in the area.

3.1.4 Vegetation

According to the Forestry Development and Protection Department of the district office of agriculture, the study area lacks natural forest in highland parts. In fact, man-made forests (eucalyptus trees) are found scattered in *dega* and *woinadega* regions of the district. Eucalyptus trees are mostly restricted to settlements/villages and churches/.

As it is true for most areas of Ethiopia deforestation has been one of the serious problems in this area. Vegetations have been cleared for the purpose of settlement, firewood, construction materials and farmlands. Experienced peasants told the researcher that some areas which had been once covered by forests some two decades back are currently devoid of natural vegetation. As a result, the fertile soils have been lost and the wild animals have been endangered.

Almost all flat-topped plateaus have small form of natural vegetation; where as the gorges, valleys and sloppy sections are covered by scattered bushes and shrubs. Particularly river valleys are covered by short and denser natural vegetations. Thorny bushes are the typical vegetation of the valleys. *Zigba* (*Podocarpus talacta*), *Wanza* (*Cordia Africana*), *Weira* (*Olea Africana*), *Sombo* (*Ekebergia capensis*) and *Acacia*'s species are also found, but rarely, in the lowland parts of the study area.



3.2 Methods

The fieldwork for this study was carried out from mid January to the first week of March 2010. Four enumerators, who have completed grade twelve, were recruited from each sample villages with the objective that they better approach and handle the peasants whom they personally know very well. Furthermore, the researcher believes that the enumerators can collect more precise data if they are assigned to the community whose socio-economic characteristics they know better.

The first four days of the survey period was devoted to training the enumerators by which they were enlightened how to handle the respondents and fill the questionnaires.

3.2.1 Method of Data Collection

Both primary and secondary data were used for this study in order to achieve the stated objectives. The primary data were collected using structured questionnaires and semi-structured interviewing guides. The questionnaires were filled by sample household heads living in four villages and the interview was held with numerous individuals ranging from the elder group of community to the officials and experts in the field. Some of the interviewees were elderly persons, kebele officials, youngsters, women, development agents (DAs), and experts at the districts office of agriculture and rural development. Focus Group Discussion (FGD) was also conducted with elder farmers who have been there for a long period of time to gather information related to historical records of forest resources.

3.2.2 Sampling Design

A two stage sampling technique was employed in this study to collect the primary data. Firstly, 4 villages (*Tamsasa roge, Dawicha qeransa, Jalisa lutu* and *Dhaye willinco*) were selected purposely out of the 25 kebeles in the district. At this stage the researcher has taken very great care so that the selected kebele will represent the district in terms of socio-economic and

physical characteristics sufficiently. Secondly, the sample household heads were selected from each kebele using systematic sampling method. This was carried after the households in selected villages were listed based on their village which was obtained from districts agricultural and rural development office. About 371, 803, 506 and 512 registered households were identified in *Tamsasa roge*, *Dawicha qeransa*, *Jalisa lutu* and *Dhaye willinco* villages, respectively. At this stage, the DAs and kebeles officials were consulted to identify the location of each household's residence within kebeles. The sample respondents were then taken at certain uniform intervals from the prepared alphabetical list of the whole household heads living in each kebele.

To determine the sample size of households those to participate in the study the sampling formula, which was developed by Cochrm, to determine sample size (n) with desired degree of precision for general population was used. In this case, population variable (p) is house hold units variable and is given as:

$$n = \frac{NZ^2PQ}{d^2(N-1) + Z^2PQ}$$

Where;

n = sample size of house hold

P = housing units variable (rural house hold)

Q = Town house hold = 1-*P*

N = total number of housing units

Z = standardized normal variable and its value that

Corresponds to 95% confidence interval equals 1.96

d = allowable error

According to data obtained from districts agricultural and rural development office (2006), there are about 15,964 house hold units (N); out of this 638 house holds (P) are town inhabitants.

Hence,

$$n = \frac{15964(1.96)^2(0.96)(0.04)}{(0.05)^2(15964 - 1) + (1.96)^2(0.96)(0.04)}$$

$$n = 60$$

Therefore, n =60 is the minimum sample size of housing units for reliable result. How ever, to be safe in the cases of non cooperativeness of household, unforeseen problems during data collection and other cases the sample size is increased to 90 households.

The sample size taken from each village was on the basis of the house hold size proportion of each villages of the district. Accordingly, 21 (23%) of the respondents were taken from *Dhaye willinco*, 34 (38%) were from *Dawicha qerransa*, whereas 20 (22%) were from *Jallisa lutu*. The remaining 15 respondents (19%) were taken from *Tamsasa roge* villages. These add up to 90 total sample households which accounts for 2.53 percent of the total registered farm households in district.

Focus group discussions and field observations were also made to substantiate the data obtained by interviews and questionnaires. Discussions were made with group of different individuals in the community. The researcher has also made field observations and tried to grasp knowledge on some of the environmental and socio-economic conditions of the peasants.

Research results, documents and other related literature were used as secondary data in this research. Several libraries, document centers and offices were visited in order to obtain the secondary data used in this paper. Some of these libraries and offices are AAU libraries, CSA, OARD.EPA, EMA and several offices in *kuyyu wereda* and North Shewa Zone of Oromiya Region.

3.2.3 Data Processing

The methodologies employed to analyze the collected data is descriptive statistics. With regard to data analysis, responses in the questionnaire and interview were entered into SPSS soft ware. Percentage and arithmetic mean was also used in condensing the data for the purpose of analysis and interpretation. Furthermore tables and graphs are used to show and facilitate results of the analysis and interpretation of data.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Socio-economic condition and means of livelihood of the respondents

4.1.1 Population Size and Density

A great deal of variation in population density can be observed within the district based on the variation in agro-climatic zones. There is a general decrease in population density with a decrease in elevation. Based on rough areal estimates from the sketch map, for instance, population densities in *Darro Wilincho* and *Darro Dhaye* kebele, (whose major parts are found in *qolla* zones) were found to be 28.5 and 38.9 persons/Km², respectively. On the other hand, the comparable figure for *Bonde Gidabo* and *Hacho Sombo* kebele (which are entirely in highland) were 262.7 and 256.2 persons/km², respectively. Crude population density, in general varies, from 28.5 persons/km² in *Darro Wilincho* to 262.7 persons/km² in *Bonde Gidabo* kebele.

4.1.2 House hold size

The family size of each house hold is an important factor to determine the nature of supply and consumption of forest product by respective house hold. Thus, family size of each house hold was considered.

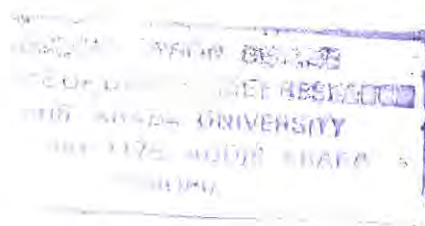


Table 4.1: Household Size and Sex Composition of the Family of the Investigated Households in Kuyu Distirict.

villages	Number of house hold respondent	Population Size in Investigated (hhs)			Household Size (persons/hh)
		M	F	Total	
<i>Dhaye willinco</i>	21	72	42	114	5.4
<i>Dawicha qerransa</i>	34	110	90	200	5.9
<i>Jalisa lutu</i>	20	74	44	118	5.9
<i>Tamsasa roge</i>	15	32	55	87	5.8
Total	90	288	231	519	5.7

Source: Field Survey, Feb - March. 2010.

As shown in Table 4.1, in the investigated households, the average household size was 5.7 persons. This figure is higher than the average rural household size of Ethiopia and Oromiya Regional State. With increasing numbers of house hold size, there has been a related change in the pattern of agriculture, which is still essentially small holder relying on expanding the cultivated area, often into marginal land (vegetation area) rather than adopting intensification techniques. According to the report of MoA (2003), on the findings of a research project “Policies for Sustainable Land Management in the Highlands of Ethiopia”, it was indicated that population pressure has a negative impact on the conditions of vegetation resource in the highlands in order to get additional agricultural land.

4.1.3 Educational status of respondents

Educational level of the society affect house hold decision which determine the welfare of the society such as income, health, and their attitude towards using forest product. It may also enable the house hold to have broad vision of the surrounding environment.

Though almost all the sample household heads reported they attended the literacy campaign launched by the previous government, majority of them (96.8 percent) still cannot read and writes (see table 4.2).

Among those populations who have once attended or currently attending formal education, the females make up only 40.6 percent. The proportion of the number of educated females at high school level is also smaller by more than half than the number of males at this education level. The percentage of female population educated at high school level to the whole population (≥ 10 years old) was only 4.1. The comparable figure for male is 8.7 percent (see Table 4.2).

Table 4.2: The percentage Distribution of the Family Members of the Sample Households Aged Ten Years and Over by Literacy Status

Villages	Illiterate		Grades 1-4		Grades 5-8		Grades 9-12	
	M	F	M	F	M	F	M	F
Dhaye wilinco	57.6	62.1	27.7	25.9	8.2	6.9	6.5	5.2
Dawicha qeransa	56.3	73.1	22.2	18.5	11.9	5.9	9.5	2.5
Jallisa lutu	49.5	76.7	23.8	12.6	16.5	8.7	10.1	1.9
Tamsasa roge	53.8	63.9	25.0	19.0	11.5	11.6	9.6	5.4
Total	54.8	67.8	25.0	19.9	11.5	8.3	8.7	4.1

Source: Field Survey, Feb-March. 2010.

Educational status of the respondents directly or indirectly influences the conditions of forest resource in the study area. According to data gathered from house hold respondents, almost all of them do not know the role of forests towards the environment. Unless human beings have the right perception regarding the role trees play in their lives, phrases like conservation of natural vegetation, reclamation of denuded areas by reforestation, sustainable development and judicious use of the existing natural resources will not hold water(Desta,2001).

According to Belay (1995), environmental degradation is the result of several interactive factors. However, the prevailing rapid population growth rate has been exerting the most serious stress on land in Ethiopia. Along with this rapid increase in human population, the number of farm animals is also increasing. This has created a severe burden on lands in Ethiopia particularly in the highlands where 80 percent of the human population lives. As a result of the scarcity of land in the highlands, the peasants have been forced to cultivate marginal areas (areas of very steep slopes, shallow soils, etc). This situation has aggravated soil erosion and deforestation in these areas (Goyder, 1988).

4.1.4 Economic activities

The occupational characteristics of a given society in one way or other determine the way that society interacts with their immediate environment. Thus it was found important to dig out information about the occupational characteristics of each sampled house hold.

Accordingly, agriculture within the area is the main means of living. Agriculture makes about 62% of the whole economic activities. The major types of crops grown in the area are teff, sorghum, barley and pulses. Self employed and trade occupies about 20% and 17.7% respectively (summarized from table 4.3). No matter how the rural peoples seem to be engaged in different activities they all do cultivate their land and produce crops. That is, almost all are agrarian even if they give attention to different income generating activities. Absences of alternative means of livelihood enforce the respondents to highly dependent on agricultural activities. In the study area, family size in household is increasing from time to time, as a result farm land owned by heads of household fragmented among the family members. Since there is no other alternatives economic activity, the only chance they have is to increase additional agricultural land at the expenses of vegetation. Some respondents says that, lack of other diverse nature of economic activities in their local area enforce us to produce charcoal and other forest product.

Table 4.3: occupational characteristics by the number of respondents (house holds)

Type of occupation	Respondents	
	Number of respondents	Percent (%)
Government employee	-	-
Trade	16	17.7
Agriculture	56	62.3
Self employment*	18	20
Total	90	100

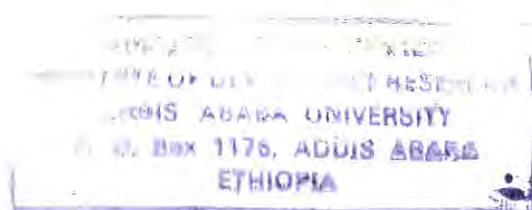
Source: Field Survey, Feb-March, 2010

* *Self employment refers to those peoples engaged in producing and rolling local drinks such as "Areke and Tella" or wood products such as "charcoal, round wood, Sown wood, etc".*

4.1.5 Income level and major source of income of respondents

As indicated in table 4.3, non-farm employment opportunities in Kuyyu district as a whole and in investigated areas in particular are rarely available. Thus, the single most important source of cash for the households is the sale of agricultural products such as grain, livestock and livestock products, and in very few places vegetables and fruits. In fact, extremely poor peasants and some female-headed households secure subsistence cash from firewood and charcoal sales, and petty trades.

As shown in Table 4.4, the most significant source of cash income, livestock and livestock products, accounted for 58 percent of the total cash earned by the respondents in 2010. Though, it is an arrangement to be paid later, rural credit institution as a source of cash, ranked second constituting 18.8 percent of the total income in the community. Grain sale was found the third most important source of the farmers' subsistence cash in the area. Here it should be noted that majority of the



farmers sale their grain produce not because it is surplus, but to meet their cash obligations such as land tax, purchase of inputs, and credit repayment. The remaining minor sources such as transfer or gift, firewood and charcoal sales, poultry and bee production, petty trades and local crafts work are responsible for only 10.2 percent of the total financial income for the sample household.

Table 4.4: Summary of Households' Major Source of Cash Income

No.	Source of cash income	% of hhs	Income (Birr)	% as of total Income	Cash income per h (Birr/hh)
1	Livestock and livestock products sale	81.3	231,488.23	58	712.26
2	Rural credit	22.3	71,174.57	18.8	799.71
3	Grain sale	94.8	44,944.88	11.9	118.72
4	Poultry	94.0	12,347.84	3.3	32.84
5	vegetables sale	40.0	9,513.6	2.5	59.46
6	charcoal sale	10.3	940.13	2.2	22.93
7	Firewood sale	18.0	4,094.64	1.3	56.87
8	local trades	3.0	1,346.40	0.4	112.20
9	Transfer/gift	4.5	1,262.16	0.3	70.12
10	Bee product	3.5	680.96	0.2	48.64
11	Other non-farm activities	1.8	310.10	0.1	44.30
	Total	-	378,153.51	100.0	945.38

Source: Field Survey, Feb-March. 2010

4.1.6 Land holding condition

As summarized in Table 4.4, about a quarter of the households owned land holdings of less than 1.01 hectares. About 43.5 percent owned holdings ranging from 1.01 to 2.00 hectares, while 18 percent of the households owned land ranging between 2.01 and 3.0 hectares. The holding size of the remaining 13.75 percent was found to be over 3.0 hectares. Surprisingly enough, only one farmer reported to have owned over 6 hectares of land. Under current production technology, as justified by different researchers, this holding size is too small to produce adequate grain for a household in the country as a whole. Provided that the present rapid population growth continues unabated, the scarcity of farmlands will be more severe in the future and the corresponding grain production per household will undoubtedly be affected.

Table 4.5: Distribution of Sample Households by Size of Holding per Household During 2010 Crop Year.

Items	Size of Holding (Hectares)							Total
	<0.5	0.50-1.00	1.00-1.50	1.50-2.00	2.00-2.50	2.50-3.00	>3.00	
No of hhs	4	17	25	16	8	9	11	90
% of hhs	4.4	19.75	29.50	14.00	9.25	9.75	13.75	100.00
Average Land Holding per h (ha)	0.38	0.75	1.26	1.76	2.22	2.86	3.56	1.76

Source: Field Survey, Feb-March, 2010

While considering the average land holding size per household in the area, one may say that it is moderately sufficient to produce adequate volume of grain for a household. But when we consider the fact that the sample households, as it has already been pointed out, are only the registered ones and it is assumed that there are thousands of unregistered landless households in the area, this figure is very low to be sufficient for the whole farm community, Moreover, Dessalegn (1984), the well

known researcher in the field, assumes that farmer can handle fruitfully and efficiently a normal quality land of as big as 5 to 6 hectares. Hence, it is safe to say that farmland is a very scarce resource in the area.

An attempt has been made to show the variation in the size of land holding by agro-climatic zone (Table 4.6) and it seems that more proportion of the farmers in dega have access to larger farmlands than those living in woinadega and qolla regions. For instance, of the total sample households, about 21.8 percent who owned over 2.5 hectares of land lived in dega, whereas only 1.8 percent reported to have owned the same size of land in the other parts of the area. On the contrary, while only 12.3 percent of the samples whose size of holding lies between 0.10-1.50 ha lived in dega, those in woinadega who's holding size lie between these ranges make up 36.5 percent.

Table 4.6: Percentage distribution of the sample households by size of land holding and agro-climatic zone.

Items	Size of Holding (Hectares)							Total
	< 0.500	0.50-1.00	1.01-1.50	1.51-2.00	2.01-2.50	2.51-3.00	>3.00	
% of hhs in Dega Zone	2.50	0.0	9.75	4.75	5.25	8.5	13.25	44.0
% of hhs in Woinadega Zone	1.50	19.0	16.0	9.25	1.25	0.0	0.0	47.0
% of hhs in Qolla Zone	0.0	0.75	3.75	0.0	2.75	1.25	0.5	9.0
% of All Households	4.0	19.75	29.50	14.0	9.25	9.75	13.75	100.0

Source: Field Survey, Feb-March, 2010

Generally, as discussed above in detail farmlands in the study area are small and fragmented. This could contribute a lot to expansion of agricultural land at the expense of vegetation area.

There is a widespread agreement that the issue of tenure security is a crucial aspect of sustainable agricultural development and environmental conservation. Several researchers conclude that insecure land rights have adverse impact on natural resources and agricultural production. Maler, K. (1998:262), for instance, notes "in Southern and Eastern Africa ...the lack of well-defined property rights is the main force driving forest degradation over-grazing soil degradation and over fishing." However, as true for the country as a whole the property right of land and other natural resources have been vested on the state in the study area. This, no doubt, has adversely affected the peasant's long-term concern to the well-being of the soil, vegetation and other natural resources on the land which they occupied but not possessed.

This might be why, as learnt from the respondents, natural vegetation is being severely cut down and farmlands are being quickly degraded in the study area. Presumably, this might have contributed to the previously discussed environmental problem in the study area. According to Berhanu (1998), Bekele and Holden (1998) and Tekie(2001), there are many factors that negatively affect investment decision of farmers on the land and enhance deforestation. Among them insecurity of tenure emerges as a prominent explanatory factor. Land with secured long term provides farmers with more incentive to invest.

With the exception of agricultural lands, the major land resources (pasture and forests) are held and managed collectively under a variety of tenure regimes. Data from field survey indicated that the trends of those resources are declining both in quality and quantity. Change in land cover and land use in particular shows consistent contraction in forests and permanent pastures. Thus, uncertainty over access to common resources and perceived inequality in sharing benefit stream are the major source for deforestation and decline of natural resources in the study area

From the overall discussions in this part, one can easily understand the fact that the study area is encircled by several socio-economic problems such as dense and rapidly growing population, high illiteracy rate, low income and land holding size. This might have contributed a lot to the

prevailing forest degradation, since all these are constraints to forests and its value for the environment as shall be discussed in the proceeding sections.

4.2 Supply and consumption of forest product

4.2.1 Consumption of forest product

Forest product utilization or forest product consumption is the process of harvesting, converting and disposing of forest products and other resources of forest (Mehta, 1981). It deals with felling of trees, their extraction, processing and manufacturing into various usable commodities. Its scope covers major forest products such as timber and fuel: also other minor forest products such as honey, grasses and so on. Wood is a significant source of energy in both developing and developed countries. It is estimated that about 45 percent of the wood consumed in the world is used for home heating and cooking. Ethiopian's per capita consumption is about 1.5 m³ of fuel wood per year (Desta, 2001). Shortage of wood for fuel is threatening the remaining forests in the study area. Due to fuel wood shortage, crop residues and cow dung, which under normal circumstances are used to build up the fertility of the soil, are being used for fuel, thereby impoverishing the soil (Cesen, 1998).

Of the various energy sources, the greater majority is derived from forest in the study area. From this fuel wood and charcoal are dominantly used forms of energy source. There are also other forms of energy sources such as cow dung, crop residue and electricity respectively. According to table 4.7 fuel wood and charcoal are predominantly used energy sources for households in rural villages, constitute 75 and 80 percent of total energy sources, respectively. As rural populations have grown and wood land is converted to cultivation, the use of dung and crop residue for fuel has become much more important for inhabitants. This energy demands therefore, growing at the expense of depleting soil in the area. Thus, forest and soil are being degraded. On top of this, the way of consumption is very much traditional and fuel intensive as there is no tradition of using close stoves.

Table 4.7: Energy consumption of respondents by major source of energy

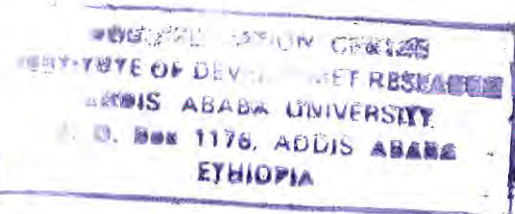
Fuel	House hold energy consumption(percent)	
	Number	Percent
Wood and charcoal	72	80
Dung	9	10
Crop residue	7	8
Kerosene, gas	1	2
Electricity	0	0
Total	90	100

Source: Field Survey, Feb-March. 2010

4.2.2 Supply of forest product

Forest resources play a major role in the social and economic development of many nations in addition to its protective function of the environment. Over 90 percent the wood consumed in developing countries constitutes fuel wood, which accounts for about 90 percent of total energy consumption (EFAP.1998). In the study area, forest is exploited for various purposes by local community. Among them exploitation for the purpose of fuel wood and charcoal production, construction material and furniture making took the leading.

Most of the inhabitants of the sample kebeles collect fuel wood for sale at the nearby local market. These people generate income from nearby forest in several ways. For instance, they sell forest product such as charcoal, fuel wood, timber, raw wood, house hold furniture, etc. since 1995 the commercialization of charcoal and timber has been intensified in area because of road construction. As a result of this, intensive destruction, commercially valuable tree species are now threatened because, the production and sale of charcoal and timber in particular have



become the livelihood of the local people. Even the well to do is trading these forest products all the way to Addis Ababa across 155 kms. Of course, this could be due to the existing high demand, easy transportation of charcoal compared to fuel wood and its high profitability for traders as well.



Fig 4.1: Traditional way of charcoal production in the study area

The local people also debark acacia, gourde for sale which is used as a strong tying material in house construction. The local people cut the forest into pieces and then burn in traditional kiln to produce charcoal. A number of large trees are cut to produce much amount of charcoal. Hence, the process is destructive. When they produce they also pollute the environment. These merchants by secretly buy charcoal in villages and transport during night as it are illegal to sell charcoal at the

market. In some cases the local people provide fuel wood for sale to generate income. In most cases these activities were done by children and women this may be due to tradition that, males work on farm and it is women's share to collect fuel wood for sale. On other hand the existing unemployment drives children to do this activity as one income generating opportunity.



Fig 4.2: charcoal supply to nearby market by local inhabitants

4.3 Cause of forest destruction

In the study area, especially in the highland part of the district, forest resources were completely cleared. Only bush and shrubs types of vegetation are found. But in the low land part of the study area, forest resources are found along river valleys, gorge and on other in accessible areas which is not suitable for agricultural purposes. According to experienced farmer in the villages their local area was covered by forest some two decade ago. During that time forests of the area are an important habitat for a great diversity of wild life. However, deforestation was place the wild life population and biodiversity at great risk. A number of wild animals were found in forest such as tiger, lion, monkey, etc. which are disappeared know from the area. Tree species such as *cordial*

african (wanza), Albizia lebbek, Acacia nilotica, Olea Africana, Faidherbia albadia, Ekebergia capensis (sombo), Croton macrostchys (bissana), podocarpus gracilior (zigba), Millietia ferruginea (birbira), maesea lanceolata (kelewa) and other variety tree species were highly distributed in the district. However, these tree species are highly affected and destructed by deforestation and forest degradation at the present time/. Large areas of land which was once covered forest is changed into other land use and only small areas are covered by bush and shrubs. In fact some tree species are still found around mugger gorge. The cause for forest destruction of the study area is complex and many in numbers. Many human and natural factors are responsible for the gradual destruction in the vegetation cover of the land masses of the study area. Data obtained from districts agricultural and rural development offices reveals that, rising demand for tree products, conversion of forest land to agricultural land, poverty and expanding population pressures are the major factors.

4.3.1 Fuel wood and construction materials production

The inexorably rising demand for fuel wood, particularly in and near urban areas is the most important cause of forest depletion in the study area. The demand for fuel wood is much higher than the capacity of forest to provide it. Much of the fuel wood collected is used for cooking food. In the study areas some fuel wood is used for heating houses during cold period. However, the devices used for the purpose of cooking are so poor that much of the energy generated is wasted. That means that the stoves used are extremely inefficient. As reported by reported by Cesen (1986), the Tigrai type of stove where the fire is partially enclosed by a clay wall, is more than twice as efficient as commonly used open fire injera baking stove. This is one of the reasons contributing to the fast disappearance of the natural forest of the district. As indicated in the previous section, the local community freely cut tree for charcoal and fire wood and supply for the market. They considered this activity as the easiest means of making quickest return.

As the study area is close to town like gebre gurrach, Fitcha and Addis Ababa, the area serves as the major source of fuel wood supply. According to interviews with charcoal merchants in the town of gebre gurracha, charcoal selling is more profitable than other forest products. There are

over ten merchants in the town who transport hundreds sacks of charcoal to Addis Ababa per day by track.



Fig 4.3 charcoal productions in the villages

The inhabitants of the study area also make use of the surrounding vegetation for different purposes such as social, cultural, and environmental values. The local population obtains almost all of their house hold utensil and construction material from forest product. The survey conducted in the area also show that the great majority of the house hold utensil and furniture are derived from forests of the area.

It can be said that forest is everything so as far as house construction, fences and furniture are concerned in the area. The construction of any kind of houses demands forest at least to obtain doors, windows and the like, although Eucalyptus trees are obtain from own plot or commercially. These forests products for construction purposes are obtained from ether by collecting or commercially depending on the accessibility. All the ingredients of most building are of forest origin except in few cases. The introduction of two man's saw has accelerated an ease exploitation of forests especially in timber production. This over exploitation of the

distributed forest ecosystem for local construction purpose and commercialization of it has induced substantial pressure on the forest resource of the area.

4.3.2 Agricultural land and forest area

The farmers in the study area are extending the farm lands to the fragile forest ecosystem in an attempt to meet the increasing demand for food. The one uncontrolled population growth and subsequent increase in demand for food to support the surplus population could contribute to further deforestation. During field survey, many inhabitants reported that they have do not have enough agricultural land to produce enough food for their family. According table 4.5 greater than 85 percent of the total sampled hold in the village owned farm land less than 3 hectares of farm lands. Under current production technology, as justified by different researchers, this holding size is too small to produce adequate grain for a household in the country as a whole. Provided that the present rapid population growth continues unabated, the scarcity of farmlands will be more severe in the future and the corresponding grain production per household will undoubtedly be affected. Therefore the only chance the respondents have to increase food production is increasing agricultural land at the expense of forest areas. In fact most inhabitants obtain additional agricultural land in the form of crop sharing and contract.

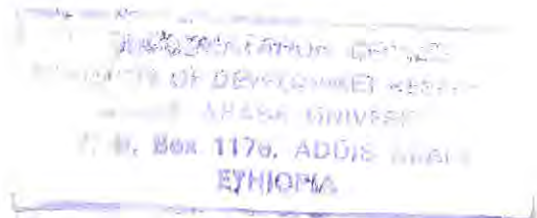


Table 4.8: Mechanisms of obtaining agricultural land by sampled house hold

Mechanism of obtaining agricultural land	Respondents	
	No of HF	%of HF
By clearing vegetation	39	43.33
From government	-	-
By inheritance	9	10
Contract	17	18.88
Crop sharing	25	27.7
Total	90	100

Source: Field Survey, Feb-March. 2010

One can easily infer from table 4.8 that about 43 percent of respondents obtain farm land through clearing vegetation area and change it into agricultural land. The vegetation area of the study area started to change into agricultural land since two decade years ago. This is because of decline of soil fertility, population growth and food insecurity. They also respond that the low productivity of traditional method of farming demands extensive lands. On the other hand, the amount of land required to feed the growing population is steadily increasing. With agricultural productivity lagging far behind population growth rates the gap between the availability and the demand for agricultural land continues to grow from year to year. This led to severe land use conflicts among crop farming animal grazing and forestry. At the present time, one house hold said that he obtain additional agricultural land of 100 m² which is traditionally called “*Gamzi*”. Under such condition clearance of the existing forest resource and soil degradation is inevitable. The following figure shows the land previously under forest and ready to use for farming purpose.



Fig 4.4. Clearance of vegetation for agricultural purposes

4.3.3 The cattle population and the forest land

The district in general is known for crop production predominantly and less attention is given for rearing animal. This is related to the scarcity of grazing land. However, the cattle population is large enough to affect the communal grazing area of the forest. Some farmers with relatively large cattle population from different corners of the woreda drive their cattle's in group to unsettled and forested area especially around Mugger basin. These farmers have the habit of communally grazing on this area without restriction which is called "Daraba". Hence, people with large population commonly spent three months of summer on this communally grazing land. They return with their cattle around September when their own grazing land at home regenerates.

4.3.4 Socio-economic factors

4.3.4.1 Forest ownership issues

Absence of or improper land use policy had a very adverse effect on forest resources of the country in general and in the study area in particular. Many respondents agree with this idea by raising as good example the situation during the previous government. During the Ethiopian government which ruled the country between 1974 and 1991, land was a public property, which the farmers were allowed to use, but not to sell. Thus, they did not want to make a long term investment on the land because they did not trust the government which forcefully evicted them from their fertile lands and made them re-establish on less fertile grounds. Such type of system still has impact on the local community on their attitude towards forest resource conservation and management. Therefore in the study area land holding system is among the factors that affect forest resources. The forests are belonging to the government. The woreda officials attempt conserve the resource by restricting the inhabitants from using forest resources through punishment on them. Thus, farmers feel that they are not beneficiaries and claim to use the resource. They also believe that it is not their own as possessed by districts agricultural offices. Therefore, the farmers are destructing the resources without any feeling of ownership.

4.3.4.2 Income level and forest utilization

The economic situation of forest product suppliers is one of the factors that determine the frequency and extent to which they are engaged in this activity. From field data survey, it is clearly shown that the physical quantities of forest resources used per capita of households are significantly influenced by households' economic indicators such as income. The extent poverty as well as depth and severity of poverty have been found to be considerably higher in the study area as compared to national average. Not only the extent but also the depth and the severity of poverty are found to be extremely high among the households having lower landholdings, lower level of literacy, higher family sizes and lower social respect. It is also found to be higher among the households headed by illiterate, and having inferior occupation. Analysis of aggregate indicators at the ward level suggests that higher the percentage share of wage income in household income and higher the member engaged in wage labor the higher the incidence of

poverty. On the contrary, higher percentage of member in other occupations (other than farming), and higher the share of other income in total household income lower the incidence of poverty. Similarly, higher the level of literacy, higher the landholding per capita, better land quality, and higher the household saving per capita, the lower would the incidence of poverty. Besides, the inability to attain certain minimum level of income and consumption expenditure, deprivation from sufficient and quality land title, illiteracy, higher family size, and lower educational attainment, and inferior occupation of household head are strong correlates of absolute poverty. One particular finding of this study is that incidence of poverty is found to have highly negatively correlated with forest and pasture land holding.

4.3.4.3 Lack of awareness of environmental role of forest and rural population participation

The importance of trees varies from community to community. The role of forests for environmental protection is not well known by many household respondents. Even though there are development agents (DA) experts who have responsible to teach the inhabitants about the environmental role of forests, the respondents in the study area have low perception towards this role. The farmers in the study did not feel that trees in community forests belonged to them. Additionally, lack of rural population participation in rural development programs such as afforestation highly increases deforestation. Purcell (1997) noted that failures of the various tree planting programs is frequently due to this factors rather than to technical deficiencies of the programs. The destruction of the forest resources of the study area right after the fall of the Dergue Regime in the early 1990s attests the fact that rural development in general and forestry activities in particular could not succeed without the unserved participation of the rural population. More importantly, the farmers would have cared for the trees if they have been told that they would share the benefits accruing from tree planting and management. According to Admassie (1998), none of the trees planted in the World programs catchment areas had been used by farmers and that the farmers did not feel that the trees in community forests belonged to them.

4.4 Environmental impacts of Deforestation

In the study area, where the population grows unabated, forests are being cleared at alarming rates to make way for agricultural crops, and to meet the demand for fuel wood, construction wood, etc; the vegetation cover of the study area is vanishing at a frightening rate. Not long ago, about half of study area's land mass is believed to have been covered with lush vegetation. However within less than fifty years, almost all of it has been cleared leaving patches of forest areas not exceeding two percent of the study area. The major natural forests remaining are found in gorge escarpment, gorge bottom, isolated hills, mountain areas which are not physiographically suited for arable farming. Some of these forests do exist because they are inaccessible. The forest is situated in a gorge surrounded by mountain and covers an area around lowland zones of Mugger River. According to Dejene (1990), the most common indicators of deforestation and forest degradation on the physical environments are: soil erosion, soil fertility, soil depth, loss of biodiversity, rainfall variability and water and fuel wood availability. Studies of these indicators reveal that the fact that much of the land of the country is highly degraded.



Fig 4.5 Degraded lands once under vegetation

This deforestation in turns brings about the loss of biodiversity both flora and fauna. A number of plant species are being threatened owing to the increasing pressure. For instance, tree species such as *Acacia Garrard*, as cordial african (wanza), *Albizia lebbek*, *Acacia nilotica*, *Olea Africana*, *Faidherbia albadia*, *Eckebergia capensis* (sombo), *Croton macrostchys* (bissana), *podocarpus grciliar* (zigba), *Millietia ferruginea* (birbira), *maesea lanceolata* (kelewa) and the like are being threatened. Wild fauna species are also losing their habitat. According experienced respondents in the area, before disappearance of local forests there were a large number of wild animal species. But at the present they could not see such type of wild animals. Decline of vegetation area was associated with subsequent decline of wild life through death and migration. Thus, the situation is treating both forest bared floras and fauna species in the study area. The study areas wild life population has been dwindling concurrently with the decline of its natural vegetation cover

Soil degradation in one way or another is resulted from the cumulative effect of human activity in the study area. This in turn has a great effect on the economies of the local people. This is because of the fact that most of these people in the area depend heavily on their natural resource base.

The farmers in the study area are subsistence oriented expanding their plots on sloping and marginal lands highly eroded. These peasants also constitute the poorest and largest segment of the population in the study area. Their livelihood thus directly depend on the exploitation of the natural resources enhancing the over all degradation.

One benefit that accrues from vegetation cover is its immense significance in controlling soil loss affected by wind and water erosion. Soils, which have ample amounts of vegetation cover, remain intact for years, whereas those whose vegetations covers are depleted, are often removed by either wind or water. According the report of different research, the ratio by which soil loss rates exceed soil formation rates is four to ten times greater on cultivated land than on grass land depending up on agro- climatic zone. It is the top rich and fragile soil, which is susceptible to erosive forces of nature. The removal of the fertile soils generally renders the land unproductive. Much of the lands in the study area are heavily eroded as they are devoid of vegetation cover. The loss is largely due to expanding populations, which in turns increase the demand for crop both for food and fodder, and fuel wood. The removal of vegetation cover for use as fodder or fuel wood exposed the soil to surface run off, which washes away the top soil from the highlands of the region.

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Fig 4.6 Local community at construction of terracing on degraded land

Table 4.9 Rational behind soil degradation

Factors encouraging soil degradation	Respondents	
	Number of respondents	% of house hold
Increase in population	32	35.55
Crop failure	6	6.66
Absence of sound land use policy	4	4.44
Lack of forest substitution	22	24.44
Price of fertilizers	7	7.78
Nature of lands such as slope	19	21.13
Total	90	100

Source: Field Survey, Feb-March. 2010

Table 4.9 illustrates factors that directly or indirectly accelerated soil degradation in the study area. Similarly, the increase in population exerts a relatively high pressure among the others as indicated by 35.5% of the respondents. Whereas lack of forest substitution and nature of land escapes attribute 24.4 and 21.13 percent to soil degradation, respectively.

The data from the same office reveals that soil erosion in the area is so severe. About 3000 quintals of soils is lost from farmlands per annum (kuyu woreda Agricultural and Rural Development Office). This is mainly because the vast proportion of the land is uncovered by vegetation and steep slopes.

Generally, those mentioned factors coupled with expansion of frontier of agricultural activity contribute to forest and marginal land degradation.

Deforestation alters the hydrological cycle, altering the amount of water in the soil and ground water and moisture in the atmosphere. Shrinking forest cover lessens the landscape's capacity to intercept, retain and transport precipitation. Instead of trapping precipitation, which then percolates to ground water system, degraded areas become source of water run off, which moves much faster than subsurface flows. During field survey large numbers of respondents reported that they do not have enough water even for house hold consumption. To fetch water the inhabitants travel more than five kilometers from their home area.

In fact there are some natural springs widely distributed in the study area around large trees are found. But the capacity of the springs is not enough to support all the house hold. Since the spring is not found in all sampled villages, sometimes conflict was there between villages in the study area. According to interviews with some inhabitants in the area, they will sleep around the spring's areas to protect the others from using the water during night. One house hold cannot fetch more than 25 liters (locally called Jerican) per day. Even there is a time when it is allowed after two days especially during winter when there is high capacity of sun. At that time the capacity of the springs also decline.

Deforestation and degradation of forests in the study area also implication beyond the physical removal of forest, water and soils. The climate of the study area has been changed that is relatively becoming very hot and the variability of rainfall is also increasing from time to time. The problem of variable rainfall conditions has been substantiated by the survey respondents. A great proportion of the peasants say that the varying condition of the rains both in time and amount has been severely affecting agricultural activities over the past several years. Thus, the area is also confronting frequent droughts which inform resulted in crop residue and poverty, enhancing further deforestation and there by desertification.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

In countries like Ethiopia where the population grows unabated, forests are being cleared at alarming rates to make way for growing agricultural crops, and to meet the demand for fuel wood, construction, etc. the vegetation cover of such countries is vanishing at a frightening rate. According to FAO (1991), not long ago, about half of Ethiopia's land mass is believed to have been covered with vegetation. However, within a span of fifty years, almost all of has been cleared leaving patches of forest areas not exceeding three percent. A more recent accounting of available forest cover reveals that the 1990-2000 decades in Ethiopia saw an average yearly deforestation rate of 0.8 percent; among the highest in the world.

In Ethiopia, because of forest destruction, there are many adverse effects on environment and socio-economic conditions. Among the major adverse effect are erosion, sedimentation of streams, rivers and dams, shortages of wood products, destruction of wild life habitats, degradation of watersheds and catchments, breakdown of hydrological system, formation of gullies and loss of cultivable land and fragmentation of the whole system.

The causes for deforestation and forest degradation are due to different interrelated socio-economic and political factors. The major factors are: rising demand for forest products like fuel wood, transmission pole, construction wood, fodder, etc. Conversion of forest land to agricultural land, shifting cultivation, urbanization, etc. Additionally expanding population, resulting in actual human and animal population exceeding the carrying capacity of the land also has a great impact on forest resource.

Like many other rural areas in Ethiopia, forest resources of the area highly degraded. According to information collected from local elders, through focus group discussion (FGD), more than half of

their respective village was covered by vegetation some two decade ago. The major part of this forest was located in lowland part of the village. During that time forest was rich in biodiversity and hosts several trees that has valuable.

The assessment of deforestation situation in distirict clearly showed that the vast majority of the inhabitants in the villages supplied forest product to the market as one source of income. Specially, charcoal and fuel wood production is among the major ways in which inhabitants degrade forest. House hold size, low awareness to the role of forest, lack of alternative job in rural, low size of agricultural land holding system are also another factor for the disappearance of forest resources in the study area. During field survey environmental condition in the villages was observed and that the result of deforestation on the environment particularly on biodiversity, soil erosion and water availability is strong. The result of survey also showed that loss of fauna and flora, high soil erosion which affects agricultural productivity was a common phenomenon. Additionally drought and fluctuation of rain fall was experienced in the area.

From the overall discussions in the foregoing chapter, in general, it is evident that the farming households in Kuyu distirict faced a number of interlocked problems. Severe environmental degradation, rainfall variability, extreme poverty, low production resource and income base, rapid population growth and low use of modern farm inputs were among the drawbacks to forest resources and sustainable development in the area.

5.2 Recommendations

It has already been indicated that the scope of this research is limited to four kebeles in Kuyu district. However, the findings of the study could be used to suggest a number of policy measures that can be used to minimize the deforestation problems and brings about sustainable forest resource conservation elsewhere in Ethiopia. As can be seen from the results of this study, the forest resource of the area is endangered. The factors and processes affecting this forest resource are also many and diverse. This requires the alleviation of root causes of the problems so that it would at least be minimized. So, the following solutions are recommended:

1. Generally, poverty is the main cause of environmental degradation in general and forest degradation in particular. Hence, in order to achieve food security in rural Ethiopia in general and in the study area in particular attempts should be made to increase the real income of the farm households which release dependency on forest resources.
2. The study reveals that several households do not have enough agricultural land and could not produce enough food for their family. Thus, the writer recommends that resettle, those households who have no or very small agricultural land to other unoccupied part of the country.
3. As the survey data analyses of the variables indicate, family size highly affects forest resources in the area. Moreover, the area is characterized by very large population density by the Ethiopian standard on national average which could have contributed to the prevailing severe environmental degradation. Contrary to this, most of the peasants have not been well informed about family planning and the problems related to large family size. Thus, concerned bodies should make more attempts in this aspect so that the peasants are able to have reasonable family size.

4. Encouraging committed individuals, organization and the like in educating the local people about the importance of forest and there by forest conservation. In addition, providing fast growing tree species to meet the fuel wood demand and construction material instead of relying on forest.
5. Incorporation of local knowledge and conservation system. Despite pressures that increasingly undermine local knowledge and management system, vegetation area management plans should start with what people already know and do well, so as to secure the livelihoods of the local community and sustain the diversity of natural resource on which they depend on.
6. Any policy and programmers' intended towards conservation and management of forests should not ignore the socio-economic reality, especially the existing apparent socio-economic disparity among the users. It further implies that just changing the legislation to provide local autonomy to the users community may not be sufficient condition for better management in the face of highly forest based existing farming system and acute state of poverty of the masses. It would, therefore be important to support the local management initiatives providing affordable and viable alternatives to fuel wood, and other employment opportunities to reduce the existing forest based economic dependency.
7. Resolving the conflicts between users' right and management responsibility as soon as possible. In the study area like in other rural part of Ethiopia forests are under government control. The vegetation of the area are found most vulnerable in terms forest degradation and misuse of forest resources, which is clear indication of the state failure for management of forests. It seems to be due to the dichotomy between immediate use and management. Therefore the concerned body should solve the conflicts as soon as possible. But this does not mean that privatization of public forest would be a solution. Rather introducing benefit share system in to the management scheme.

8. An important policy implication of the present analysis indicate that the scope of reducing the existing level of use of forest resources is neither possible nor desirable for the prevailing subsistence farming based rural economy without viable affordable alternatives, in the face of growing population pressure and limited supply of resources. The, emphasis, therefore, should be given to better management existing resources and more equitable sharing of the benefit from the forests.
9. Expanding modernized agricultural practices and appropriate land use to increase yield per unit area.
10. The government should introduce and subsidize close stove types, so that the low income groups can be afford it.
11. Forest degradation in the study area caused not only from on site. From the off-site such as increasing demand for charcoal and wood are the major factors for forest degradation. Therefore, urban inhabitants are also play a major in forest degradation through depending on charcoal and wood as source of energy. Thus, urban people had better if they adopt the culture of using electricity and participating in different forestation and environmental program through the environmental protection clubs and the like. In addition, joining other segments of the economy other than leading their livelihoods by producing local drinks which use fuel wood intensively.



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APPENDIXS

Appendix 1: Survey Questionnaire to be filled by head of household in rural household.

A. Socio-economic background of the respondent

1. Household head Male Female , Kebele _____
2. Age _____
3. Family size _____, Female _____ Male _____
4. Level of Education (house hold heads) _____
5. Educational and marital status of other family members

Grade	Sex and age			
	Male	Age	Female	Age
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
12+				

6. Occupation _____
 7. Monthly Income _____
 8. Source of Income _____
9. How much money did the household earn from the following sources during 2010 crop-year? (Estimate)

Sources	Estimate Income in Birr
1. Livestock and livestock products sale	
2. Grain sale	
3. Firewood and Charcoal sale	
4. Credit:	
i. rural credit	
ii. individual credit	
5. Transfer	
6. Others (specify) _____	

10. Land holding size _____

B. General Forestry related Questions

1. Do you produce forest products? Yes No
2. If your answer for question number (1) is yes, could you list them in order of quantity of product you produce

Rank	Forest product
1.	
2.	
3.	
4.	

3. For what purpose you produce those forest product?
- A. For market B. For Household consumption
- C. If other specify _____

4. Which type of forest product you supply for market please list them interms of quantity of these product per month?

Rank	Type of forest product	Quantity
1.		
2.		
3.		
4.		

5. Do you use forest product as one of the sources of income? How much income you generate from these forest product? Please list them in order of priority.

Rank	Types of forest product	Income per month (Birr)
1.		
2.		
3.		
4.		
5.		

6. Which one is greater in number in your area?

- A. Seller of forest product
- B. Those do not sale

7. Which tree species you use for the production of energy sources you mostly sell? _____

8. Do you use this forest product for household consumption?

- A. Yes B. No

9. Which type of forest product you use for household consumption? Please list them in terms of priority.

Rank	Types of forest product
1.	
2.	
3.	
4.	

10. What types of energy you use for domestic consumption?
- A. Charcoal B. Crop residue E. Kerosene
C. Fuel wood D. Dry dung
11. Which of the above do you use for cooking _____
12. Do you think the agricultural land size you owned is sufficient for the production food for your family?
- A. Yes B. No
13. If your answer for question number 12 is no, by what means you increase food production for your family?
- A. By increasing agricultural land
B. By selling forest product
14. If your answer for question number 13 is A; how do you obtain additional agricultural land?
- A. By inheritance D. Contract
B. By clearing forest E. Crop sharing
C. From government F. Please, if other specify _____
15. If your answer for question number 13 is yes, why do sell forest product?
16. Have you use cattle as a source of income?
- A. Yes B. No
17. If your answer for question number 16 is yes, how do you obtain grazing land for cattle?
- A. Separated grazing land
B. Forest area
18. What type of grazing land you use for cattle?
- A. Privately owned
B. Commonly owned
C. Forest resources degradation and its impact on the environment related questions
19. Do you know the role of forest resources towards environmental protection. Eg. Soil conservation, climate adaptation, rainfall, etc
- A. Yes B. No
20. If your answer for question number 19 is yes, how do you prioritize the benefit obtained from forest? For each option please tick the box that you feel most fits your views?

Issues	High	Medium	Low	Don't know
1. Rainfall patterns				
2. Improvement of water resources				
3. Reducing temperature				
4. Air Quality				
5. Erosion control				
6. Promotion of biodiversity				

21. Are there other benefits missing from question 20

A. Yes B. No

22. If your answer for question number 21 is yes, could you list them.

No	Benefits of forest reason
1.	
2.	
3.	

23. In your local area, do you get those benefit from forest resources sufficiently?

A. Yes B. No C. Specify if others _____

24. If your answer for question no 23 is no, what do you think its reason?

25. When you compose the areal coverage of forest in your local area before 10 years and at the present time, did you observe its change?

A. Yes B. No

26. If there is change, what is this change?

27. With forest change, what do you observe its impact on the environment interms of

		High	Medium	Low	N
A) Climate change (i.e., rainfall variability)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
B) Loss of biodiversity (i.e., fauna and flora)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
C) Decline of soil fertility		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D) Increase of temperature		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

28. Are there other environment impact missing from question 27

A. Yes B. No

29. If your answer for question number 21 is yes, could you list them .

30. What did you observe the impact of forest reduction on the socio-economic of the people in terms of

	High	Medium	Low	N
A) Decline of forest product (quality and quantity) <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
B) Agricultural production <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
C) Distance to be traveled to collect forest product <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

31. Are there other socio-economic impacts of forest reduction on the society surrounding? If, these please list them.

32. What do you think the reasons for forest degradation in your locality?

- A. Natural B. Human impact

33. If your answer for question number 32 is b, could you list the means by which human have impact on forest degradation in your area?

34. Do you participate in community based forest management in your local area?

- A. Yes B. No C. Specify if others _____

35. Did you get raining (education) about forest resource management by woreada Agricultural experts or other NGO's?

- A. Yes B. No

36. Who control (owned) forest resources in your area?

- A. Government B. Community

37. What is you attitude/opinion/ towards forest resource conservation?

38. What do you suggest to minimize forest resource degradation in your local area? For example what should be the following bodies do?

Government _____

NGOs _____

Rural Societies _____

Thank yo

Appendix 2: An Interview Guide

This interview guide is prepared to direct the interviews to be conducted with employee (environmental experts) of woreda Agricultural Office or any equivalent offices in the selected woreda. The purpose of this guide is to secure additional data that may not be clearly secured the questionnaires to be filled by respondents. It is also designed in such a way that it helps the interviews and the interviewees focus the discussion on issues related to the research questions. Thus, this interview is meant to secure only relevant data that could not be obtained through other means of data collecting tools.

1. What is considered as a major problem leading to forest destruction and degradation in Kuyu woreda?
2. Do you have any policy statement regarding environmental education? If yes, what does it say? Does it specify any specific areas of training?
3. Do you believe that there are suitable and enough forest resources management plan? If yes, what are these guidelines?
4. Do you believe that environmental policy and forest resources management plan incorporate the rural livelihood? If so, to what extent?
5. Do you involve the rural poor (forest dependent) in the designing and development of forest resources management plan?
6. What are the government improvement of forest resource degradation and destruction to manage up with the environmental impacts (soil erosion, climate change, loss of biodiversity)
7. What recent actions have been taken to reduce forest resource degradation?
8. What actions do you think need to be taken to reduce the risk of forest resource degradation and to minimize its environmental impact?
9. If you have any opinion about forest degradation and the loss of biodiversity, decline of soil fertility, climate change issues which is not mentioned, I would appreciate if you could mention it.

Appendix 3: Amount of Rainfall in Kuyyu wereda (mm) (1995-2007)

Month	Year												
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
January	14.9	0.0	24.7	29.1	1.0	1.5	0.0	39.4	0.0	0.0	0.0	13.2	
February	0.0	29.4	11.3	36.9	33.2	28.4	12.1	34.7	0.0	0.0	0.0	0.0	
March	36.8	33.5	67.7	3.3	147.1	48.4	114.5	13.1	29.2	51.6*	22.1	0.0	
April	102.2	107.1	120.9	64.3	70.7	53.9	8.3	39.2	112.1	72.5*	108.5	9.8	
May	103.0	112.5	188.0	2.5	26.1	45.0	60.9	53.1	132.3	85.2*	128.6	0.0	
June	110.3	187.2	162.6	80.3	90.6	120.6	113.2	124.4	156.1	145.3*	145.3*	307.6	
July	356.0	378.1	271.5	438.7	270.3	328.8	247.3	432.7	337.9	363.4	300.1	407.5	
August	444.5	341.5	332.1	324.4	394.2	371.1	338.5	293.3	278.1	464.9	360.2	399.9	
September	129.3	260.7	51.9	270.0	124.7	186.7	100.3	152.7	278.1	188.7	200.9	40.0	
October	55.5	17.5	20.7	30.8	20.6	0.2	21.4*	5.9	84.6	0.0	0.0	0.0	
November	6.8	0.0	0.0	0.0	0.0	0.5	0.0	8.6	0.0	5.3	0.0	0.0	
December	19.4	13.3	0.0	0.0	63.0	28.8*	12.2	0.0	0.0	0.0	31.9	25.8*	
Total	1378.7	1480.0	1266.5	1280.3	1241.5	1210.9	1028.7	1197.1	1408.7	1376.9	1297.6	1203.8	

Source: National Meteorological services Agency of Ethiopia

Note: No data available for 2007

Appendix 4: Monthly Mean minimum temperature in 0_c. (Garba Guracha meteorological Station) (1995-2008)

Year	Months									
	J	F	M	A	M	J	J	A	S	O
1995	16.6	11.9	4.9	7.4	9.4	9.2	8.9	9.1	7.4	2.3
1996	3.7	4.4	5.2	8.4	8.1	8.1	8.9	9.0	7.5	5.5
1997	1.7	5.1	5.8	7.7	7.8	9.0	9.0	8.5	8.4	5.6
1998	1.2	6.0	8.8	8.1	9.0	9.2	9.0	9.0	8.2	4.9
1999	5.5	8.4	7.1	9.7	9.4	10.1	10.8	10.4	9.5	6.6
2000	2.6	5.8	7.9	9.4	8.2	8.6	9.9	10.1	9.7	6.9
2001	4.0	9.5	8.1	8.3	9.1	10.1	9.7	10.0	10.3	6.1
2002	8.0	9.3	10.0	10.5	11.1	10.2	10.7	9.6	9.3	5.9
2003	6.3	10.0	9.9	10.8	10.4	9.3	9.6	10.5	9.1	8.9
2004	9.9	10.5	10.2	10.1	9.8	10.7	10.3	9.1	9.1	8.2
2005	8.9	10.4	9.5*	8.9*	8.8*	9.9*	10.6*	10.2	10.2	10.6
2006	9.0	8.3	8.7	7.6	7.7	9.0*	10.9	10.6	12.2	12.5
2007	11.8	11.8	11.8	11.8	11.7	8.2*	8.8*	8.3*	8.8*	8.6
2008	3.6	6.2	4.4	6.4	5.6	7.3	6.7*	6.0*	5.4*	4.7
Average	6.6	8.4	8.0	8.9	9.0	9.2	9.6	9.3	8.9	7.0

Source: National Meteorological Service Agency

Note 1. No data available for 2007

2. * interpolated data

Appendix 5: Monthly Mean Maximum Temperature in 0_c. (Garba Guracha meteorological Station).

(1995-2008)

Year	Months									
	J	F	M	A	M	J	J	A	S	O
1995	22.4	23.6	24.1	25.3	22.4	20.1	18.9	19.6	19.8	21.4
1996	23.0	23.5	24.4	22.2	22.0	22.5	18.5	18.3	19.1	20.5
1997	22.6	22.9	22.8	22.3	23.6	20.5	18.8	18.9	19.5	20.7
1998	22.4	23.7	22.8	22.7	21.6	21.5	20.9	19.6	21.5	22.3
1999	23.6	23.4	22.5	24.6	25.9	23.4	17.7	18.1	19.3	20.4
2000	22.3	22.0	22.6	21.4	23.2	23.0	19.4	18.9	25.9	21.9
2001	23.4	23.4	23.6	24.1	25.1	24.0	19.9	20.7	21.2	22.0
2002	23.8	24.4	24.1	23.8	24.8	23.2	20.8	19.5	22.5	23.0
2003	21.8	22.6	23.8	23.8	24.6	22.6	20.9	20.4	21.2	22.0
2004	23.8	24.2	23.5	23.0	22.9	22.4	21.2	20.5	19.7	22.8
2005	24.7	24.8	24.1*	23.9*	24.1*	24.0*	21.9*	22.7	23.0	23.3
2006	23.9	24.4	24.3	24.0	23.4	25.6*	22.5	21.8	21.9	23.4
2007	23.5	24.3	24.7	25.0	24.6	27.2*	25.6*	25.2*	25.2*	25.8
2008	29.9	29.6	29.6	29.4	29.2	28.8	28.7*	28.5*	28.4*	28.2
Average	23.6	24.0	24.0	23.9	24.1	22.9	21.1	20.9	22.0	22.7

Source: National Meteorological Service Agency of Ethiopia

Note 1. No data available for 2005

2. * interpolated data

Appendix 6: Household Number by Respective kebele of Kuyu Distirict

No.	Name of kebele	Number of HH
1.	Tamsasa rogee *	371
2.	Koyye chabare*	532
3.	Koyye akale *	1055
4.	Koyye gose	952
5.	Dubbana agalo	875
6.	Jilla qerensa *	803
7.	Dawicha qerensa *	831
8.	Halelo carii	1011
9.	Sombo cheka	448
10.	Dirre	723
11.	Liban kura	1169
12.	Bonde gidabo	1114
13.	Halelo derso	394
14.	Rogge qolati*	790
15.	Jallisa lutu*	506
16.	biritii	899
17.	Amuma wacaale	480
18.	Amuma bubisa	440
19.	Darro cangi	710
20.	Dhaye willinco*	512
21.	Darro birbirsa *	624
22.	Darro xaxxessa *	346
23.	Darro willico	373
24.	Gerbe gurracha 01	326
25.	Gerbe gurracha 02	312
.	Total no of house hold in kuyu woreda	15,964

Source: Kuyu Woreda Agricultural and rural office.

Declaration

I, the undersigned, declare that the thesis is my original work, has not been presented for a degree in any other university and that all sources of material used for the thesis have been duly acknowledged.

Declared by:

Tilahun Bayou



Candidate

Confirmed by:



Advisor

