

Addis Ababa University
School of Graduate Studies

The contribution of agroforestry based integrated development project in
sustaining the rural livelihoods:-The case of Tombiya Agroforestry project in
Woliso Woreda, West Shewa of Oromiya Regional State, Ethiopia

By

Kebede Woldemedhin

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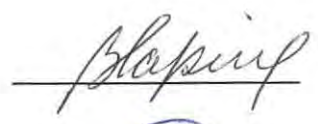
Kebede Woldemedhin

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APPROVED BY THE BOARD OF EXAMINERS:

SIGNATURE

Dr. Belay Simane
CENTER HEAD



Dr. Feyera Senbeta
ADVISOR



Dr. Mulugeta Feseha
INTERNAL EXAMINER



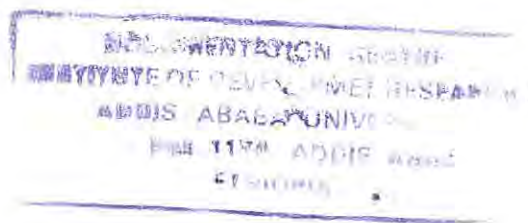


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ABSTRACT

This study was to assess the contribution of agroforestry project on the livelihood of rural farming households in selected rural kebeles of Woliso Woreda. Three rural kebeles namely, Obi Koji, Gute Godeti and Werabo Berio were selected for the study. The specific objectives were examination the attitude of farmers towards agroforestry systems; assessment of the contribution of agroforestry based integrated development project in improving livelihoods and food insecurity in the study area; determination of the existing problems of agroforestry adoption in the study area and the determination of the impact of agroforestry on the livelihood of rural farming households.

In this study AF adopters, non adopters and Agricultural and Rural Development office in the Woreda were contacted. Both structured and unstructured interview questionnaires were used to obtain information from individual farmers in the households and key community leaders. The Multiple Logistic Regression Model was used to examine the inter-relationships between factors that influence adoption. Statistical Software Package for Social Science (SPSS) specifically designed for logistic regression was employed. The results were summarized in a table form so that the analysis and meaningful interpretations of results was made to draw conclusions and implications. The qualitative data collected through key informant interview, focus group discussion and physical observation was narrated and summarized.



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ABBREVIATIONS

AF	Agroforestry
DAs	Development Agents
EFGBC	Ethiopia Full Gospel Believers' Church
FAO	Food and Agricultural Organization
FGDs	Focus Group Discussions
TAFP	Tombiya Agroforestry Project

CHAPTER ONE

1. INTRODUCTION

1.1 Background

Ethiopia's economy is largely dominated by subsistence agriculture of crop and livestock farming. The production system is mainly rainfed, subsistence-based, and smallholder oriented. The land use system is also associated with the decrease in the size of holding both for arable and grazing lands. Thus, there is continued trend toward the conversion of forested and marginal lands to agricultural lands, resulting in massive environmental degradation and a serious threat to sustainable agriculture and forestry. The decreasing in the size of land holding is related to population explosion.

In Ethiopia, the forest area is declining at a very fast rate, resulting in ecological imbalance, environmental degradation and low-agricultural production. Population increase and subsequent increase in human needs and lack of appropriate technologies which integrate agriculture and forestry are some of the major causes.

Agroforestry offers a potential solution to the problem of declining rural agricultural production in the tropics (Jiregna, 1998). Agroforestry (AF) is a relatively new name for a set of old practices. Cultivating trees, agricultural crops and pastures and/or animals in intimate combination with one another spatially or temporally is an ancient practice that farmers have used throughout the world (Nair, 1989; 1993).

Agroforestry is a land use system and practice in which forest trees, livestock, and arable land (for crops) are integrated on the same unit of land and managed to give yield on a sustainable basis either simultaneously or sequentially. It is a practice that is economically sound and culturally compatible. Trees are deliberately left to grow on farmland or pasture. The

total output is greatly enhanced under integrated management over production of each component in isolation. The integration can be linear, mixed or even in blocks in an arrangement based on specific objectives and appropriate technology required for a particular place. There are several types of traditional systems exist in different parts of Ethiopia, and there are new technologies started by several institutions at a national level across different land use systems (Dechasa, 1990). Tombia Agro forestry pilot project is designed to contribute in improving the livelihood of the target group in Woliso, particularly in six peasant associations by combating ecological degradation and increasing agricultural productivity.

1.2 Statement of the problem

The contribution of forests and forest products to household food security and to the national economy is indispensable. However, deforestation has already affected the lives of many in the target area. This has resulted in environmental problems such as forest biomass reduction, decline in the productivity of the land, soil erosion, and loss of biodiversity which subsequently led to frequent socio economic problems. Many of the socio-economic problems in the country in general and in the study area in particular are associated with deforestation and misuse of land. Alteration of forest habitat through grazing and expansion of agriculture could not only lead to decline in local biodiversity but also affects food security of local communities as many people are directly or indirectly dependent on forest and forest related activities.

The population is continuously growing and causing serious environmental problems in Ethiopia. Available land suitable for agriculture or crop production, grazing or forestry is shrinking while human and livestock populations are steadily increasing. As the population continues to grow, the decrease in agricultural productivity, due to land degradation, and the gap between supply and demand for agricultural land, continues to expand. Such a situation is leading to severe land-use conflicts between the crop production,

and other types of land use such as forests, which will cause further clearance of forestland and, consequently, environmental degradation, not only in terms of agriculture aspects, but also other demand like fuelwood collection and processing, construction material needs and others continue to put pressure on the limited forest resources.

Food insecurity, soil erosion, shortages of fuel wood and fodder and environmental degradation are still widespread. Agroforestry –based integrated development program is a strategy that seeks to reconcile the dual goals of forest conservation and improved livelihoods for the local communities. Thus, this study intends to explore these links between forest conservation and local livelihood benefits. In view of this, a case study of Tombia Agro-Forestry project in Woliso Woreda in West Showa Zone of Oromiya Regional State was undertaken.

1.3 Objectives of the study

The general objective of this study is to examine the contribution of agro forestry systems in Tombia Agroforestry-based integrated rural development Project in Wolliso woreda .

The specific objectives of this study are:

- To examine the attitude of farmers towards agroforestry systems;
- To assess the contribution of agroforestry –based integrated development strategy in improving livelihoods and food insecurity in the study area;
- To investigate the major problems encountered during the implementation of the project;
- To recommend solution for improvement of the existing agroforestry –based integrated development project.

1.4 Research Questions

This study is mainly designed to address the following research questions:

- Is an agroforestry program able to deliver environmental benefits to the local population?
- What types of agroforestry interventions can help mitigate or reverse key risk factors associated with land degradation?
- What is the contribution of farmer's agroforestry based integrated development strategy and management in preserving the existing forests?
- What are the appropriate agroforestry management options and their economic and ecological impacts on farming systems and households welfare?

1.5 Significance of the study

The study provides insights into contribution of agroforestry to the livelihoods of large and marginal households. The results of this study will be useful in redirecting, improving and strengthening the agroforestry programs in the area and elsewhere.

1.6 Limitations of the study

This research was carried out under a situation of time limitation and financial constraints. The other encountered drawback was the scarcity of written material.



1.7 Organization of the paper

This study is organized into five chapters. Chapter one gives an overview of the background of the problem, research objectives, research questions, and the importance of the study. Chapter two discusses theoretical and conceptual frameworks in which the study is embedded. The third chapter deals with the methods employed to generate and analysis data and limitations, Physical, socio-economic and administrative aspects of the study. Chapter four comprises the analysis part. It describes how farmer's benefits from agroforestry based integrated development program and estimation of key determinants of Agroforestry technology adoption. Finally, Chapter five gives concluding remarks by outlining the relevant aspects of the study.

CHAPTER TWO

2. LITERATURE REVIEW

2.1 Concepts and definitions of Agroforestry

Agroforestry is a new name for an old set of land-use practices. It is an integrated approach to solving land-use problems by allowing farmers to produce food, fiber, fodder, and fuel simultaneously from the same unit of land. A common characteristic feature of all forms of agroforestry is that a tree component is deliberately grown or retained in an agricultural setting. Various definitions for the term agroforestry have been given through the years since its advent as a scientific approach to land-use problems in the early 1980s. The best and probably official definition is the one that is commonly used by the World Agroforestry Center: "Agroforestry is a collective name for land use systems and technologies where woody perennials (trees, shrubs, palms, bamboos etc.) are deliberately used on the same land management units as agricultural crops and/or animals, in some form of spatial arrangement or temporal sequence. In agroforestry system there are both ecological and economical interactions between the different components" (Lundgren & Raintree, 1982).

The concept of agroforestry is based on the development of the interface between agriculture and forestry. It is a sustainable multiple-production system whose outputs can be adjusted to local needs. The main components of agroforestry systems are trees and shrubs, crops, pasture, and livestock together with the environmental factors of climate, soil, and landform. Other components (e.g., bees, fish) occur in specialized systems (Young, 1989). Under this definition, a variety of combinations of plants may be possible. But there are two important features that identify agroforestry from other land-use systems:

1. There must be a tree component deliberately grown or retained in the land-use system

2. There must be significant interaction, positive and/ or negative, between the woody and non-woody components of the system.

Agroforestry, therefore, involves two or more species of plants and /or animals at least one of which is a woody perennial and with two or more outputs. Owing to the variety of mixtures, therefore, even the simplest agroforestry system is more complex both ecologically and economically than a monocropping system. The aim and rationale of agroforestry lies in optimizing production based on the interactions between the components and their physical environment. This will lead to higher sum total and a more diversified and /or sustainable production than from a monoculture of agriculture or forestry alone.

2.2 Classification of Agroforestry systems

A variety of agroforestry systems are used around the world, and they can be classified in a number of different ways depending on the criteria employed. For example, one classification approach is based on the basis of their primary function. That is the classification approach that has been adopted in many areas. Thus, although all agroforestry systems have the capacity to provide a range of products and services simultaneously, this type of classification distinguishes between systems aimed at producing goods and multifunctional systems, which combine the production of timber and non-timber products with environmental, social and land use services (Nair, 1989, 1993).

Agroforestry systems can also be classified on the type of components involved namely, silvopastoral systems (production of livestock and woody plant species), agrosilvicultural systems (woody plant species and seasonal plants) and agrosilvopastoral systems (production of livestock, woody plant species and seasonal plants)(Nair, 1989, 1993).

2.2.1. Agrosilvicultural systems

This is an agroforestry system where agronomic crops are combined with shrubs/trees on the same unit of land for higher or better-sustained production of annual crops, fodder, and wood. The combinations can also be arranged in space, such as the hedgerow/mixed intercropping practice.

2.2.2 Silvopastoral systems

This is an agroforestry system where range crops and/or animals and trees are combined for better production of grasses and fodder. This combination can be arranged as a pure stand with fodder trees/shrubs planted as a protein bank (with cut-and-carry fodder production) and/or mixed in different configurations such as living fences of fodder trees and hedges. The trees and shrubs and grass components are arranged in such a way that their healthy coexistence is not disrupted. The acacia-dominant system in the arid parts of Ethiopia, Kenya, and Somalia are good examples of this system.

2.2.3 Agrosilvopastoral systems

This is an agroforestry practice by which crop, pasture, and tree/shrub crops are combined on the same unit of land for the production of grass and browse feed, biomass for fuelwood and green manure, and food for human consumption.

This system is practiced when the farmer needs all the benefits that would be obtained from silvipasture and agrisilviculture systems from a unit of land. Usually, such a system is practiced on cultivated land. Alternative rows of hedges, grass strips and/or crops would form such a system, a form of alley cropping. Agrosilvopasture is also practiced when the cropland is constrained by slope and threatened by erosion. These are very common problems of land use in most of the Ethiopian Highlands; therefore, this system has potential for use in various regions of the country.

2.3 Agroforestry Practices

An agroforestry practice denotes a specific land management operation on a farm or other management unit, and consists of arrangements of agro forestry components in space and/ or time (Gholz, 1987). Examples of agroforestry practices are Tree homegardens, Woodlot, Windbreaks/shelterbelts, Boundary planting, Live fences, Hedgerow intercropping, improved fallow, Intercropping under scattered or regularly planted trees ,Trees on rangelands ,Trees on soil conservation and reclamation structures etc.

2.3.1 Homegardens

Homegardens have been defined as a small-scale, supplementary food production system by and for household members by mimicking the natural, multilayered ecosystem. Homegardens are characterized by being near residence, composed of a high diversity of plants, small, and an important source of household subsistence and cash needs. Tropical homegardens consists of an assemblage of plants which may include trees, shrubs, vines, and herbaceous plants, growing in or adjacent to a homestead or home compound and these gardens are planted and maintained by members of the household (Nair, 1993).

Homegardens are of economic importance to small farm families because they provide supplementary and continuous flow of products such as food for household consumption, medicine, poles, and offer a buffering capacity when the main crops fail (Soemarwoto & Conway, 1991; Torquebiau, 1992; Nair, 1993), the gardens also have considerable ornamental value, and they provide shade to people and animals (Nair, 1993).

2.3.2 Windbreaks/Shelterbelts

Windbreaks are narrow plantings of trees and shrubs, mainly tall woody species that form a linear barrier perpendicular to the prevailing winds; they

protect cropland, pastureland, roads, farm buildings and houses from the harmful effects of wind and wind-blown sand and dust.

Windbreaks usually consists of multi-story strips of trees and shrubs planted at least three rows deep and are placed on the windward side of the land to be protected and are most effective when oriented at right angles to the prevailing winds (Nair, 1993). When properly designed and maintained, a windbreak reduces the velocity of the wind, and thus its ability to carry and deposit soil and sand, improve the microclimate in a given protected area by decreasing water evaporation from the soil and plants, protect crops from loss of flowers, reduce crop loss due to sand-shear of seedlings, in addition windbreaks can provide a wide range of useful products from poles and fuelwood to fruits, fodder, fiber, and mulch (Nair, 1993; Torquebiau, 1994).

2.3.3 Woodlot

A woodlot is an agroforestry practice where multi-purpose woody perennials are planted and managed over time to produce fuelwood, poles, and stakes for climbing crops; food and animal components may be integrated into woodlots, especially during the initial establishment phase (Nair, 1993). Depending upon the nature of the land and the purpose for which the woodlot is being established the selected plot of land is marked, lined, and pegged at the recommended or required spacing and on marginal or degraded lands, a spacing of 1m x 1m is recommended to ensure early canopy closure, soil protection and weed suppression (Young, 1997). He reported that where food crops are integrated into woodlots, prunings from the trees should be spread on the ground to serve as mulch and green manure. Harvesting regime and frequency depends on the type of species, the rate of growth and the purpose to which harvested tree is going to be put (Nair, 1993).

2.3.4 Boundary Planting

Boundary planting is an agrosilvicultural technology and the components are spatially zoned (Torquebiau, 1994). It involves planting of trees (including fruit trees), shrubs and grasses in single or multiple lines to define boundaries or spaces dividing separate land-use units and it is mainly used along boundaries of farms, home compounds, pastures or scattered cropland (Torquebiau, 1994; Young, 1997). It is preferred to use tree species that provide useful products which could be sold to generate additional income while at the same time delineating the boundaries (Nair, 1993). Fruit trees like mangoes, avocados, citrus, oil palm, coconut, or timber trees are good species for boundary planting (Nair, 1993). Moreover, Nair (1993) reported that planting trees on boundaries will affect more than one land user and crops on neighbouring farms could be affected through shading at some time of the day. This could lead to conflicts between farmers and in practice, it is important that all land owners and users agree on its establishment.

2.3.5 Live Fencing

This is often practised to keep out domestic or wild animals. The native tree species are planted around a compound, house, cropland, fodder lot and garden. Native tree species to be promoted for this purpose will be: *A. tortilis*, *A. bussei*, *B. aegyptiaca*, *A. seyal*, *A. tortilis*, *A. sieberiana*, *A. etbaica*, *Z. spinachristi*, *A. abyssinica* and *F. albida* (Kindeya, 2004).

These trees have been revealed to provide fuelwood, charcoal, shade for human and livestock, fodder, etc. while serving the primary objective of fencing. Since they can be grown along the boundary in croplands, agreement to its installation is needed among all affected land owners and users.

Protection and management are crucial for success. Protection is needed for young seedlings till they will be large enough to protect themselves. As the trees grow, they will be trimmed, providing either mulch for the soil or fodder for livestock. The planting pattern is often in lines. This practice does not

require substantial labour for planting and maintenance. It can also serve as boundary demarcation, and windbreaks in wind prone areas.

2.3.6 Hedgerow intercropping

This form of agroforestry is practiced in many parts of Ethiopia. The sorghum/maize and chat (*Catha edulis*) hedgerow intercropping in the Hararghe Highlands of eastern Ethiopia is one such example. The shrub chat is a stimulant cash crop that generates cash for the farmer. Although the soil regenerative properties of the system are not obvious, it has undoubtedly helped in the soil conservation of the hilly landscapes of Hararghe (Bishaw & Abdelkadir, 1989).

Another form of hedgerow intercropping that has recently been introduced and has been widely tested in the scientific community is alley cropping. Alley cropping is an agroforestry technology suited to humid and sub-humid tropics and entails the growing of food crops between hedgerows of planted shrubs and trees, preferably leguminous species. The hedges are pruned periodically during the crops' growth to provide biomass and enhance soil nutrient status (Nair, 1989, 1993). There is great potential for use of the system in Ethiopia, particularly to improve soil and water conservation in the hilly and mountain ranges for which Ethiopia is known.

Research on interaction at the tree-crop interface, species screening, and socioeconomic studies are some of the research areas that are needed to verify and underline the adoptability of the system to the humid and sub-humid areas of Ethiopia that can support the system (Bishaw & Abdelkadir, 1989).

2.3.7 Trees on rangelands-Silvipastoral systems

This involves the incorporation of the native tree species having high fodder values in rangelands. They can either be scattered irregularly or arranged

according to some systematic pattern. Species that can be promoted include: In the semi-arid and sub-humid areas: *F. albida*, *A. seyal*, *A. tortilis*, *A. sieberiana*, *A. abyssinica*, *A. etbaica*, *A. bussei*, *B. aegyptiaca* and *Z. spinachristi*(Kindeya, 2004).

In the arid areas there is the Acacia - Commiphora woodland vegetation with *Acacia misera*, *A. socotrana*, and *A. spirocarpa* species; and near wadis *Tamarix nilotica*, *Ziziphus mauritiana*, *Z. mucronata*, *Phoenix reclinata*, *Leptadenia spartium* and *Conocarpus lancifolius* becoming frequent (FRA, 2000). The agroforestry species of these areas need to be studied – as so far there is only a list of the kind of species that occur in these areas and no detail on their usefulness.

These tree species have had great potential in their fodder value for most of the livestock. Most of them produce leaf fodder and edible pods. Most have higher crude protein, mineral content and some higher dry matter density than the associated grasses, particularly during the dry season. Though the species will primarily be incorporated to produce fodder, they can also provide poles, fuelwood, pollen and nectar for bee fodder, or improve the soil. The paramount importance of the trees in this agroforestry practice is to meet wood and fodder demands throughout the year and maintain fodder through dry periods. They can also help to maintain the stability and fertility of grazing lands and reverse trends in land degradation and desertification.

Either planting or natural regeneration or both would be involved. This can be encouraged through rain harvesting with microcatchments, as well as protection from grazing animals. Especially in the arid areas, in the past extended periods of rest, where natural regeneration was encouraged used to be practiced. With the ever increasing pressure, these periods have become progressively shorter, now resulting in very minimum regeneration. A recent study done by the author in the Tekeze valley where *Boswellia papyrifera* grows revealed that continues extensive grazing has resulted in most species having

near to no regeneration. This trend was however, basically reversed by establishing closed areas where no grazing was allowed. Some management schemes will be necessary to promote and enable the establishment of seedlings and saplings to ensure the future of these systems. To minimise the protection requirements, the trees could be planted in clumps. Because it is easier and economical to protect group of trees than the same number of trees planted in lines or dispersed throughout the pasture. In sloppy lands the planting pattern should follow contour lines (Kindeya, 2004).

2.3.8 Trees on soil conservation and reclamation structures

Soil and water conservation has been practiced in many parts of Ethiopia, and it has been promoted by the governments (the past and present) for more than 20 years. It is thus increasingly becoming a culture in many areas. In this light, native tree species have a lot to contribute. Traditionally, they have been incorporated in many of the conservation earthwork structures - especially, soil and stone bunds. Furthermore, they can be grown on terraces, raisers etc. with or without grass strips for the purpose of reclamation of degraded soils, and sand dune stabilisation while providing various tree products. There exists a great potential in improving productivity and land use sustainability in sloppy farmlands. Native tree species to be promoted for this purpose include: *F. albida*, *A. seyal*, *A. tortilis*, *A. sieberiana*, *A. etbaica*, *A. abyssinica* and *Z. spinachristi*. Where adequate moisture can be conserved to plant fruit and cash trees, the following species could be considered: *Musa* spp., *Cofea arabica*, *Persea americana*, *Carica papaya*, *Rsidium guajava*, *Mangifera indica*, and *Citurs* spp. could be planted (Kindeya, 2004).

These tree species have been indicated to have potentials in providing various tree products while stabilising the conservation structures found in farmlands. They make lost cropping space productive by using the surfaces of structures where other crops can't be grown. To maximise water availability to the growing

seedlings in the bunds, microcatchments can be utilised. Cut-off drains could also be incorporated during wet seasons (Kindeya, 2004).

Protection against browsing will be necessary during the early establishment periods. Cut and carry could be used to supply fodder for livestock in a form of stall feeding. Trees should not be allowed to grow too high and cause shedding on the accompanying crops, in cases of croplands. Topping and pollarding need to be done to secure light shade for growing crops and this also maximises biomass production both for soil litter and fodder for livestock.

2.4 Importance of Agroforestry

Oram (1993) reported that agroforestry provides a wider range of products, more secure subsistence or more cash income from wood products to enable the farmer to buy food. Nair (1993) indicated that the combination of several types of products which are both subsistence and income generating, helps farmers to meet their basic needs and minimizes the risk of the production system's total failure. Nair (1993) found that in tree home gardens, the production is for home consumption, but any marketable surplus can provide a safe guard against future crop failures and security for interval between the harvests (e.g. rice in Java and Sri Lanka, coffee and maize in Tanzania, coconut and rice in South Western India). Soemarwoto and Conway (1991) reported that compared with the rice fields of Java, the homegarden has a greater diversity of production and usually produces a higher net income; in West Java, fish production in homegarden ponds is common, with an income of 2 to 2.5 times that of rice fields in the same area.

Torquebiau (1994) found in Sumatra, for example, some people plant trees as a source of food, as well as rubber trees in their fallow fields. In Bornea, some people, plant rattan canes in rice fields during the last rice season and that rattan, a very aggressive vine, will use the trees as supports. He stated that rattan is a very profitable cash crop and can be harvested after 8 – 10 years.

Some important service roles of agroforestry are: soil conservation, either erosion control (presence of a permanent soil cover, barrier effect against runoff), soil fertility maintenance (incorporation of organic matter into the soil, nutrient pumping from the deep layers of the soil through the tree's roots, these nutrients then improve the crops through litter and mulch, nitrogen fixation) or soil physical properties maintenance (Young, 1989). He indicated that the creation of a microclimate, which can be beneficial to certain plants or animals, for example modifications of light, temperature, humidity or wind, and can also help fight weed proliferation. Maintenance or increase of organic matter has been proven and widely demonstrated, and is quantitatively known through studies of organic matter cycling under agroforest; a widely – quoted, now – classic, study is that of Nye and Greenland (1960).

2.5 The Concept of Adoption

Adams (1982) conceptualized that adoption of innovation by the individual innovator is of five stages:

- Awareness – the individual first hears about or becomes aware of the innovation, but is not yet motivated to seek further information.
- Interest stage – he feels that the innovation may be relevant to his needs he becomes interested and seeks additional information about it.
- Evaluation stage: Weigh up the advantages and disadvantages of using it.
- Trial Stage: If his evaluation is favourable, he may decide to give the innovation a trial, by applying it on a small scale to determine its utility under his condition.
- Adoption – in the light of his experience during the trial stage, the individual may decide to apply the innovation fully, thus, on a relatively large scale and continuous use of the idea and personal satisfaction of it. It does not necessarily mean the constant use of the idea but that the

idea has been accepted and the individual intends to include it in his practice. According to Ahmed (1991) a farmer is considered to have adopted a technology if he uses it to any extent on his farm.

From the concept put forward by Adams (1982) it may be decided that adoption of new innovations is not immediate and the final decision is usually the result of a series of influences operating through time. It might also be important to distinguish between adoption and diffusion. Agyemang (1991) gave a theoretical distinction between diffusion and adoption as: - Diffusion begins at a point in time when technology is ready for use. How the technology is made available to the potential user is the main focus of diffusion. Adoption considers the behavior of individuals in relation to the use of the technology; more particularly the reasons of adoption at a point in time are of primary interest.

The concept of adoption has often attracted considerable attention as a result of the infrequent success in achieving high adoption rates in developing countries. Some of the underlying factors for low adoption rates can be found in the proposition by Rogers and Shoemaker (1971). According to them the adoption rate usually is a function of: - the relative advantage of the innovation as perceived by the farmer; the compatibility of the innovation in the context of the farming systems; the complexity, that is the degree to which the innovation is perceived as difficult to understand and use; the degree to which it can be subjected to simple and non - consequential trial on the farm; and the observability of the innovation and its effect. These propositions have been the core of much research on adoption. For example, Burch (1992) analyzing evidence from 100 studies found that innovations that permit a trial run have strongest initial local support. The perceived advantage and compatibility, he concluded, does not seem to be a great consideration in adoption.

2.6 Factors that affect adoption of agroforestry

Generally, the factors that affect adoption of agroforestry technologies may not be much different from the adoption of agricultural innovations. Agroforestry systems, however, can often be more complex than existing crop and other farming practices (Arnold, 1987). Thus there is the need to isolate factors that might specifically affect the adoption of agroforestry technologies. This is even more important because sometimes where trees are especially scarce, rural people may be unwilling to grow them. It is unlikely that the reason for this is ignorance of the benefits of trees or of the technologies used in cultivating them; it is far more likely that there is other real constraints (FAO, 1986).

2.6.1 Socio-economic factors that affect adoption of agroforestry

Technologies

Socio-economic considerations are increasingly becoming important in technology diffusion and adoption processes. This is more so for agricultural, forestry, agroforestry and related innovations, which are meant for the diverse environments and circumstances of rural people (Rocheleau & Raintree, 1986).

The need to examine socio-economic factors in the adoption of agroforestry technologies has been highlighted by Raintree (1991) in his evaluation of the storm over Eucalyptus in social forestry programmes in India. Among his findings he stated that: "On closer examination of the issues, it appears that while most of the debate has been couched on ecological terms, many of the underlying issues are social and economic in nature. The debate demonstrated how important the socio-economic context of the intended user can be in determining whether or not he or she will be able to make effective use of a particular tree planting practice. Again, Hoskin (1987) gives a partial list of socio-economic issues that must be taken into consideration if farm families are to adopt agroforestry technologies as: local uses and knowledge of trees, tenure, organization, conservation, landlessness, enterprises and marketing,

labour, nutrition and gender/age. In his analysis on socio-economic context and development strategy for tree growing Raintree (1991) pointed out that factors that are relevant to consider under the broad heading of socio-economic will vary from place to place. Among the most important are: - degree of local socio-economic stratification (by wealth, land holding size, gender, ethnic group etc.); access to resources (land and tenure); overall economic development strategy; general approach to tree planting programmes, opportunity for relocation of resources; access to credit; processing technology and marketing assistance etc. It could be seen from the above discourse that the socio-economic factors that affect the adoption of agroforestry are many and varied and differ from place to place and it is time specific. In spite of these variations the major socio-economic factors that are necessary in the adoption of agroforestry by individuals are land tenure and ownership issues, socio-economic stratification, labour requirements, capital, markets and institutions.

2.6.1.1 Land tenure and Tree ownership Issues

One of the critical factors that have been given consideration in determining the potential acceptability and viability of agroforestry is land tenure systems and tree ownership. Francis (1987) gave the assertion that patterns of technology adoption will be shaped by the structure of opportunities and constraints presented by the rules of tenure. In the study of "Agroforestry adoption and risk perception by farmers in Senegal", Caveness and Kurtz (1993) found out that land ownership was one of the two predominant factors (the other was labour) affecting the adoption of agroforestry practices. Raintree (1991) has also found that if a would be user does not have security over the intended planting location; adoption of the tree planting innovation may be quite out of question. Kolade (1984) also noted that in vast agricultural lands of Tropical Africa, agroforestry has yet to make a break through. The reason is largely due to the flexible system of land tenure as well as its attendant insecurity.

Governments in many African countries are aware of the need for tenure reformation. For example in Ghana the Rent Stabilization Act 109 of 1960 as amended the same year by Rents (Cocoa Farms Amendment) Regulation among others prohibited ejection of tenants without ministerial approval (Arhin, 1985).

Leach and Mearns (1988) asserted that tenure issues in agroforestry do not relate to land tenure only but also to tree tenure. The distinction between land and tree tenure is crucial to the participation of rural communities in projects involving tree growing. Fortmann (1985) has listed four major categories of rights that make the bundle, which comprises tree tenure: - the right to plant, the right to use, the right to dispose and the right to own or inherit. Each of these categories or combinations of any, Fortmann emphasizes, have restrictions on community participation in agroforestry projects in several African countries. He also points out that tree tenure issues in the community intended for the project needs careful examination to avoid problems like the loss of rights, particularly to other uses of land or the trees on it and loss of gathering rights among others. The complexity of tenure issues is believed to have discouraged many tenants from growing trees. Francis (1987) said that in areas where land pressure is more intense and other terms of tenancy are more definite, permanent tenants, many of whom grow food crops under tenancy leases, may be disallowed from planting tree.

2.6.1.2 Socio-economic stratification

Raintree (1991) pointed out that the degree of socio-economic stratification, which exists within a locality, is important in determining the adoption of a new technology particularly if it is highly attached to factors, which govern access to resources. The stratification of a community can be on the basis of wealth, landholding size, gender, age, ethnicity, religion, education etc.

Eckman (1991) deduced from his studies that individuals within a household may have different rights depending on gender or birth. He found also that in

some African countries, for example, women plant and tend firewood or fruit trees but do not have right to harvest fruits or wood; these may be sold or appropriated by male members. Fortmann (1985) has also pointed that group rights which alienate “strangers” and deny them use rights of trees and discourage their participation in agroforestry projects. Socio-economic stratification has been found to be important in extension work. Johnson (1987) has concluded that to be effective in encouraging adoption of innovations, extension workers must work with rather homogenous categories of farmers i.e. Based on their access to land, water, labour inputs, markets, credit and information.

2.6.1.3 Labour requirements

One of the major factors influencing farmers’ adoption of agroforestry is labour requirement (Arnold, 1987). He stated that a farmer’s decision to grow trees can be influenced by two main factors: one is the high cost of labour and capital and the other is the potential of income to be generated from tree as distinct from food production in farmers’ production objectives. Njoku (1991) in his studies on adoption of improved oil palm production found that a major constraint was high cost of labour. He concluded that many new technologies require intense labour use, which contrasts greatly with the limited amount of labour expended in the traditional wild oil palm groves and that smallholder farmers must hire expensive labour to implement the improved technologies. The strong competition for household labour with other activities in the farming system particularly during critical periods in the agricultural season would obviously influence farmers’ decision about adopting agroforestry. This has been found for example to be true of alley farming (Kang & Wilson, 1987).

2.6.1.4 Capital

One of the captivating arguments about capital requirements and adoption of agroforestry products has been put forward by Arnold (1987) as; “It is widely

argued that the lengthy production period and the incidence of most of the costs at the time of establishment, create financial problems for farmers in adopting practices involving tree growing". It is this argument that underlies the widespread provision of planting stock, either free or at subsidized prices in programmes to support tree growing. However, the evidence that tree systems are favoured by farmers when capital is scarce because trees require less investment than alternative crops and/ or provide substitutes for purchased inputs example fertilizer and herbicides suggests that improved access to capital would not necessarily increase adoption of agroforestry practices. In support of Arnold argument, Hyman (1983) in his investigation on pulpwood production in the Philippines concluded that capital could be an impediment to investment in larger rotation timber species grown as cash crops. In this situation however, the constraint seems to be not the capital cost of establishment but lengthy period that elapses before there is any return. Schutjer and Van der Veen (1977) argued that adoptions of scale-neutral innovations are not necessarily inhibited by credit constraints. They stated that the profitability of innovations often induces small-scale farmers to find the cash required for adoption from their relatively meager resources.

Contrary to the above discourse, capital in the form of savings and credit is required in order to form many agricultural and agroforestry innovations. Therefore differential access to capital is frequently cited as a major factor determining adoption rates (Mercer & Hyde, 1992). For example, Owusu Sekyere (1991) concluded that participating farmers in an agroforestry project complained that they needed credit in the form of cash to pay for extra labour required to maintain their agroforestry plots and that without attending to farmers cash needs project implementation can be very slow.

2.6.1.5 Markets

Marketing of products could serve as a great incentive or disincentive to virtually all productive ventures. According to Hedge (1990), the important

criteria for farmers to grow any new tree species, depend among others on assured demand for the produce and really market outlets, minimum support price, at which tree growing is profitable; and generation of cash surplus as the most powerful incentive for most farmers. The important role of markets in tree growing is further highlighted by an observation of a participant in a farm forestry project in Gujarat, India and quoted by FAO (1989):

“Having invested heavily in planting and maintaining the trees we waited patiently for four years. Now it is the end of 1986 and we have not been able to sell the trees. There are no buyers the Lokhariti workers are hiding away from us and the Forest Department Official who used to visit us has been transferred to another place, so we have nobody to turn to. We see this business of farm forestry as a disaster for our people”. The scenario above depict the frustrations farmers go through if they cannot market their tree products and also it underscores the risk aversion tendencies of farmers in adopting tree planting practices. It is only with a co-ordinated effort to market the forest produce at a remunerative price that afforestation programmes can be implemented successfully with the active participation of the rural people (Hedge, 1990).

2.6.1.6 Institutions

Policy analysis defines institutions as rules, norms and values that shape our behavior. Sometimes known as the „rules of the game; institutions can be:

- Both formal (example, laws that govern land tenure, market transactions or civil rights) and informal (example, social customs and conventions);
- Created (example, as a result of deliberate political or policy decisions) or may evolve overtime;
- Present at local, organizational, national, and international levels.

In many developing countries, policies and institutions discriminate against those with few assets and disadvantage poor people. Such discriminatory policies and institutions undermine development efforts to eradicate poverty. It is now generally accepted that significant and sustainable gains in poverty reduction cannot be achieved unless accompanied by pro-poor reforms to domestic and international policies and institutions (Ashley & Carney, 1999).

2.7 . Conceptual framework

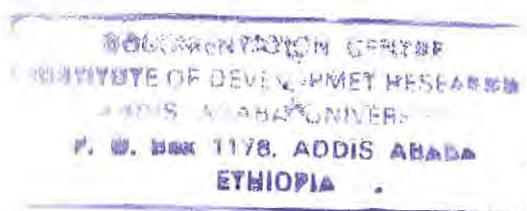
It is a framework for analyzing causes of poverty, peoples' access to resources and their diverse livelihoods activities, and relationship between relevant factors.

2.7.1. Relevant factors to be analyzed

The four factors to be analyzed under the study are:

I. Agroforestry and environmental conservation

Agroforestry has the potential to mitigate land degradation by controlling soil erosion (barrier approach), maintenance of soil organic matter through mulch and biomass transfers. The barrier approach to erosion control by checking runoff and keep valuable top soil in place. The contour hedges created by multipurpose trees provide soil erosion control through barrier approach mechanism. Many trees and shrubs planted through agroforestry can increase plant and ecosystem biodiversity; trees are also helpful in ameliorate global climate change by sequestering vast amount of carbon. The physical presence of trees on farm boundaries serve as living fences and protect home gardens from free grazing livestock.



II. Agroforestry and socioeconomic

Agroforestry can contribute to food security through provision of edible products such as fruits and seeds. Trees can also improve soil fertility by fixing nitrogen from the air and recycling nutrients, thereby helping to increase crop yields. Trees provide valuable supplemental fodder for animals to enhance livestock production. Trees provide household energy for cooking, heating and lighting. Agroforestry provides farmers with products, many of them high in value, which can be sold in rural and urban markets such as selling timber, poles, charcoal and honey. Many trees and shrubs have medicinal value that keeps the farm family healthy and generate additional income. Trees that adapt well to the environment and drought tolerant tree species are insurance mechanism against crop failure.

III. Agroforestry and technology

Fuel Saving Technology using large -scale distribution of improved biomass-fuelled injera stoves that help to reduce pressure on the biomass resources, including forests which increase land productivity by reducing crop residue and dung usage for fuel wood, and improve family health. Additionally, modern beehive techniques that help to improve the income by increasing the honey production. Capacity building through training helps to introduce different technologies that are important in improving the livelihood of the rural people.

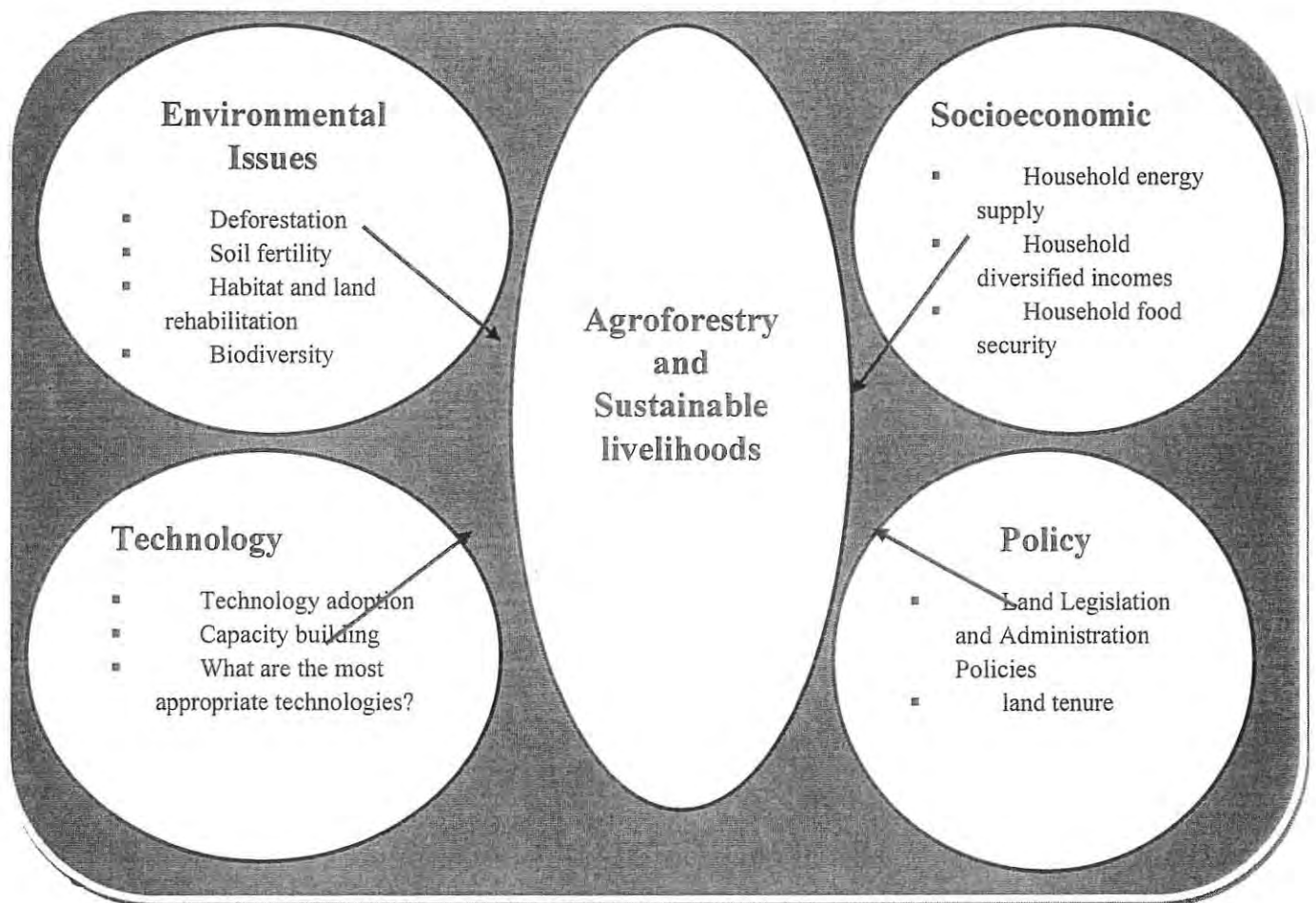
IV. Land tenure system and land tenure policy

One of the critical factors that have been given consideration in determining the potential acceptability and viability of agroforestry is land tenure systems and tree ownership. Francis (1987) gave the assertion that patterns of technology adoption will be shaped by the structure of opportunities and constraints presented by the rules of tenure.

As vast experience throughout the world has demonstrated that private ownership of land is prerequisite to agricultural development and improve

livelihood. Public policy decision can profoundly affect the uptake and impact of agroforestry innovations-tenure security, availability of appropriate credit facilities and inputs, extension services, marketing systems and price fluctuations.

Figure 1: I propose the following conceptual framework for analyzing relationship between relevant factors.



CHAPTER THREE

3. MATERIALS AND METHODS

3.1. Study area description

The study was conducted in Woliso woreda, southwest shewa of Oromia regional state, Ethiopia. Agroforestry pilot project in Woliso started in 2005 through collaborative efforts between Ethiopia Full Gospel Believers' Church Development wing and Sweden International Development Agency.

Tombiya Agro forestry pilot project is operating in 8 kebeles of this six are rural kebeles namely:- Sonbo Yabeta, Worabu Baryu, Adami Gutu, Denbel Keta, Obbi Koji and Gute Godeti and two urban kebeles. The study was carried out in three rural kebeles (Obi Koji, Gute Godeti and Werabo Berio) of the woreda. The three rural kebeles for the study were selected purposefully based on agroclimatic conditions representing Weyna Dega and Dega and their involvement in agroforestry practices.

It is located at about 114 km southwest of Addis Ababa. . It is situated between 8° 31' and 8° 36' N latitude and 37° 58' and 37° 36' E longitude. The district comprises 37 rural kebeles.

3.1.1. Topography and climate

Information collected from Woreda Agricultural and rural development office indicated that the area is characterized by flat lands and moderately steep rolling hills with valley bottoms. The altitude of the Woreda ranges between 1800 to 2300 meters above sea level. The Woreda has two Agro-climatic zones with 55% and 45% of kola and weyina dega types respectively. The rain fall pattern in the area is the bimodal type i.e., middle of March through end of May (the belg rains) and July through September (the kiremt rains). According to the same source, the Mean annual rain fall in the area varies from around

700 mm to 1200mm and average annual temperature is about 24.50c. This temperature is favorable for crop growth because the optimum temperature for most crops grown in the Woreda is 10.4 -270c. During December to March the area is characterized by a prevailing high temperature and strong wind, especially at the end of January until the belg rains come. The soil of the study area is noted as dark reddish brown silt-clay.

3.1.2. Population

According to the 2007 populations and housing census, the Woliso woreda has a population of approximately 242,752 of which 188,504 are found in 37 rural kebeles of the Woreda. According to local sources, the population of the study area is rising continuously and putting huge pressure on the natural resources, especially on the remaining forest fragments.

3.1.3. Means of livelihood and sources of income

There are various sources of livelihood and income for local communities living in the woreda. These include trees, honey, vegetables, crops, livestock production, and other non-timber forest products. These products serve either for house hold consumption or for cash income or for both. For example, honey, tree, and vegetables are exclusively for income and field crops and livestock are mainly for house hold consumption. Certain community members also earn their daily income from petty trading and daily labor. Teff, barley, wheat and bean are the major field crops grown in the district. Cash crops such as banana, chat, tomato and onion are also grow in the area. Livestock like cattle, sheep, goat, donkey and apiculture are common in the area.

3.1.4. Land use/land cover

The major land use categories of the district are forest, agriculture, grazing land, and settlement .According to agricultural and rural development office, agricultural land still accounts for the largest share of the land use types in the district which accounts 72%, 14.7 % is grazing land and 6.3 % of the area is covered by forests. Agricultural expansion, settlement, overgrazing and forest

fire are the major threats to the natural forest. Actually, majority of the population are settled in the lower edge of the forest and they have been imposing a great pressure from internal and external part of the forest.

3.2. Methods of data collection

The choice of research method is the reflection of the interplay of various factors including the aim of research, specific analysis goal and its associated research question, the preferred paradigm, the level of investigator intervention, the available resources and time frame (Crabtree and Miller, 1999). Appreciating this, both qualitative and quantitative methods were adopted as a research instrument for this study.

During data collection, contact was first made with the relief and development office of Ethiopia Full Gospel Believers' Church and the Tombiya Agroforestry project office. In addition to this, contact was also made with Agricultural development office to collect the necessary information about the project and the target area. In this study, the major data collection tools employed were physical observation, key informant interview and focus group discussion to collect mainly qualitative information, and household survey to collect mainly quantitative data from representative households.

Sampling Size and Units

Both agroforestry adopters and non adopters are included in the survey. Only the head of the household are considered for household interview; other members of the family were included in focus group discussions and key informant interviews. This is because, most of the time, the head of the household is the owner of the land and thus the decision-maker on most affairs of the household.

To determine the sample size of the study I apply the formula provided by (Yamane, 1967).

$$\text{Sample size needed} = \frac{Z^2 \cdot P(1 - P)}{I^2}$$

where 95% degree of confidence is selected in the study.

I converted the confidence level to a Z score which is 1.96 and confidence interval 5%. I expected 50 percent of respondents to respond affirmatively since such kind of research is never conducted previously in the area, 0.5 would be the proportion.

I computed the needed sample size by plugging the values into the above formula, where Z is the Z-score, P is the proportion and I is the confidence interval.

$$\begin{aligned} \text{Sample Size needed} &= (1.96)^2 \cdot 0.5(1-0.5) / (0.05)^2 \\ &= (3.8416 \cdot 0.25) / 0.0025 \\ &= 0.9604 / 0.0025 \\ &= 384 \end{aligned}$$

The sample size was 384 but due to time and resources constraints I have determined the sample size to be 153 (one hundred fifty three) (Table 1:1). The survey was conducted on 120 households for detailed household survey and for gathering agroforestry inventory data. Sixteen (16), Nineteen (19) and Twenty five (25) households of both adopters and non adopters were interviewed from Gute Godeti, Warabu Bariyo and Obi Koji kebeles respectively i.e., One hundred twenty households of adopters and non adopters. For key informant interviews, four carefully selected persons from each sample kebele were involved; (two from elders, one educated, and one from kebele representative). Three focus group discussions were carried out with seven selected persons, representing agroforestry adopters. Moreover, three extension agents working in the sample PAs were involved in a group discussion.

Table 1.1: Summary and descriptions of instruments by type, target and number of target group representations for data collection

No	Type of instruments	Target group	Number of target group representations	Type of sampling	Remark
1	Key informants discussions	Community leaders and Administration	12	Purposive Sampling	
2	Focus group discussions	Adopter and non adopter farmers	21	Purposive Sampling	
3	Survey method	Adopters	60	Stratified-systematic sampling	
4	Survey method	Non Adopters	60	Stratified-systematic sampling	
Total			=153		

3.2.1 Data Collection tools

Reconnaissance

An initial discussion was held with the relief and development office of Ethiopia Full Gospel Believers' Church (EFGBC), Tombiya Agroforestry project office and development agents (DAs) to explain the purpose of the survey and get permission to conduct the study in the area. Based on the information generated from the discussions at various levels, three kebeles (Worabu Bariyu, Obbi Koji and Gute Godeti) where agroforestry adopters are dominant were sampled for the study among the six rural kebeles namely: - (Sonbo Yabeta, Worabu Bariyu, Adami Gutu, Denbel Keta, Obbi Koji and Gute Godeti) where the project is operating. Through these discussions, participant farmers in

focus group discussions were selected from both agroforestry adopters and non adopters.

3.2.1.1 Key informant interview

At kebele level, four key informants per PA and twelve for the three PAs were used to gain an overview of the evolution of vegetation cover changes, agroforestry practices and the interaction between local community and adjacent natural forest in the study area. The information obtained during key informant interview also used in the development and modification of questionnaires that were employed for formal household survey. Key informant with their long residence, better acquaintance with the local farming system, good knowledge in, and ability to articulate the functioning of agroforestry system, and who have lived continuously in the area for 15 and more years have selected.

3.2.1.2 Focus Group Discussion

After the introductory meetings and the identification of participant farmers, three focus group interviews were conducted and seven persons were involved in each group discussion. A separate informal discussion was also held with extension workers so as to make triangulation and validate the information given by different groups.

3.2.1.3 Household survey

Lists of all household heads of the selected kebeles were collected from the kebele administrator and development agents. A random selection procedure using the systematic random method was employed to obtain the representative samples of individual households from the listed household heads in the selected kebeles. One hundred twenty households were systematically selected and interviewed. Questionnaires were developed and modified based on the information gathered during the informal survey and

were translated into Amharic language to simplify for the enumerators. The questionnaires were pre-tested using randomly selected farmers from the sampled households to evaluate whether they were prepared in the way that clarify communication between interviewers and interviewed. The necessary adjustments to the questionnaires were then made before fully duplicating and distributing them to the enumerators. Three enumerators with Diploma qualifications were selected, trained and assigned each to a kebele for data collection. Regular monitoring was conducted by the researcher while enumerators were interviewing the respondents and daily evaluation of the filled questionnaires was undertaken throughout the data collection processes.

3.2.1.4 Review of Secondary Source

Secondary data was secured from the works of others on the impact, contribution and the role of agro forestry practices, experiences of other countries and review of published and unpublished literature and documents.

3.3. Data analysis and interpretation

The Multiple Logistic Regression Model was used to examine the inter-relationships between factors that influence adoption. The logistic regression model is easily extended to more than one independent variable. In fact, several independent variables are usually required with logistic regression to obtain adequate description and useful predictions. Statistical Software Package for Social Science (SPSS) specifically designed for logistic regression was employed.

The data generated through quantitative method was organized and statistical computations were made to explore the inherent relationships among the different variables. Simple quantitative analysis techniques such as percentage and frequency distributions were also employed.

Finally the results were summarized in a table form so that the analysis and meaningful interpretations of results was made to draw conclusions and implications. The qualitative data collected through key informant interview, focus group discussion and physical observation was narrated and summarized.

3.3.1: Definition of variables used for the empirical analysis

1. Age is defined as a variable classified under five groups (20-29 = 1, 30-39 = 2, 40-49 = 3, 50-59 = 4, 60-69 = 5).
2. Sex is classified as 1 for male and 2 for female.
3. Experience in farming is defined as years of experience of respondents classified under five groups (10-19=1, 20-29 = 2, 30-39 = 3 40-49 = 4, 50-59 = 5).
4. Education is defined as level of education of the respondents classified under three groups (illiterate =1, elementary=2 and secondary=3).
5. Family size is defined as the number of family members of respondents classified under three groups (1-4 = 1, 5-10 = 2, and 11+ = 3).
6. Land acquisition is defined as household landholding classified under three groups (Freehold = 1, Tenancy = 2, Communal = 3, State owned = 4, Purchased = 5).
7. Farm size is defined as farm size of respondents classified under five groups (1-4= 1, 5-10= 2, 11+= 3).
8. Source of labour is defined as Source of labour of respondents classified under three groups (Family/household = 1, Hired/wage = 2 and Co-operative = 3).

9. Annual income is defined as an increased level of annual income of the respondents in percentage classified under five groups (decline = 1, No change = 2, 5% = 3, 10% = 4, 15% = 5, 20% = 6).

CHAPTER FOUR

4. RESULTS AND DISCUSSION

4.1 Sampled Household Characteristics

The results of this study show that mixed farming is the major source of livelihood and income for agroforestry adopters in the study area. However, the average land holding size per individual farmers is 1.3 hectare and average family size per individual farmers is seven (7). This small size of land holding and increasing population number forced the farmers to manage their agroforestry practices at plot level, at the same time they are also forced to clear natural forest for the purpose of agricultural expansion. On the other hand, the respondents mentioned as having benefited from this increasing family size for labor availability.

4.1.1: Gender

A total of 60 agroforestry adopters and 60 non adopters were interviewed. (Table: 4.1).

Table 4.1: Gender status of the sampled households in the study area

Study area	No. of AF adopters		No. of Non adopters	
	Male	Female	Male	Female
Obi Koji	24	1	25	-
Warabu Bariyu	19	-	19	-
Gute Goditi	16	-	16	-
Total	59	1	60	

Source: Households survey

The gender type of farmers indicates the poor involvement of women in agroforestry. Many of the agroforestry practices like woodlot, arable intercrop, planting of shelterbelts and windbreaks, as well as fruit trees on cropland in

the study area involved strenuous activities which are done manually. It can be said that women are mostly interested in planting and cultivating vegetables to meet household consumption needs rather than tree crops. In addition to this, wives of agroforestry adopters were actively involved in different trainings and in the preparation of fuel saving stoves organized by TAFP. In addition to this, they were pioneers on horticulture.

4.1.2 Age of Sampled Households

The age range of AF adopters lied between 20 years and 69 years and majority of them (71.67%) were between 20 and 39 years, whereas the majority of non adopters (77.67%) were between 30 and 59 years (Table 4.2).

Table 4.2: Age distribution of Sampled Households

Age Group	AF adopters		Non adopters	
	Number	percentage	Number	percentage
20-29	18	30.00	1	1.67%
30-39	25	41.67	14	23.33%
40-49	10	16.67	20	33.33%
50-59	5	8.33	18	30.00%
60-69	2	3.33	7	11.67
Total	60	100.00	60	100.00

Source: Households survey

It is important to note that the age group from 30 to 39 forms the bulk of AF adopters indicating the potential of this group as the most important clients who could be involved in the dissemination of agroforestry practices and technologies. The age range 20 to 39 years constitute the majority of respondents (71.67 %), which shows that younger farmers are more likely to adopt a new technology because they had more schooling than the older generation and could reap the benefits of tree crops in their life time. Whereas, non adopters are older than AF adopters and 86.66% of them are from 30-59

years of age. The calculated percentage of the chi-square distribution (44.46) is larger than the tabulated statistic (18.47). Hence; there is a real difference in age distribution in study area.

As discussed in the literature review, Tripp (1993) agree that younger farmers are more likely to adopt a new technology, since they have had more schooling than the older generation or perhaps have been exposed to new ideas as migrant laborers.

4.1.3 Farming Experience

As could be seen in Table 4.3, the majority of the farmers (91.77%) interviewed had between 10 to 39 years of experience in farming while a few of them (8.33%) had between 40 and 49 years of experience in farming. Many agroforestry technologies require intensive labour use which contrasts greatly with the limited amount of labour expended in the traditional farming system. Also, it can be said that as the farmer ages increases, his/her physical ability decreases to provide labour. Again, generally males are physically stronger than females and can comparatively provide more labour.

Table 4.3 Years of Experience in Farming

Years of Experience	AF adopters		Non adopters	
	No.	Percentage	No.	Percentage
10-19	20	33.33	13	21.67
20-29	25	41.67	25	41.67
30-39	10	16.67	14	23.33
40-49	5	8.33	7	11.67
50-59	0	0.00	1	1.67
Total	60	100.00	60	100.00

Source: Households survey

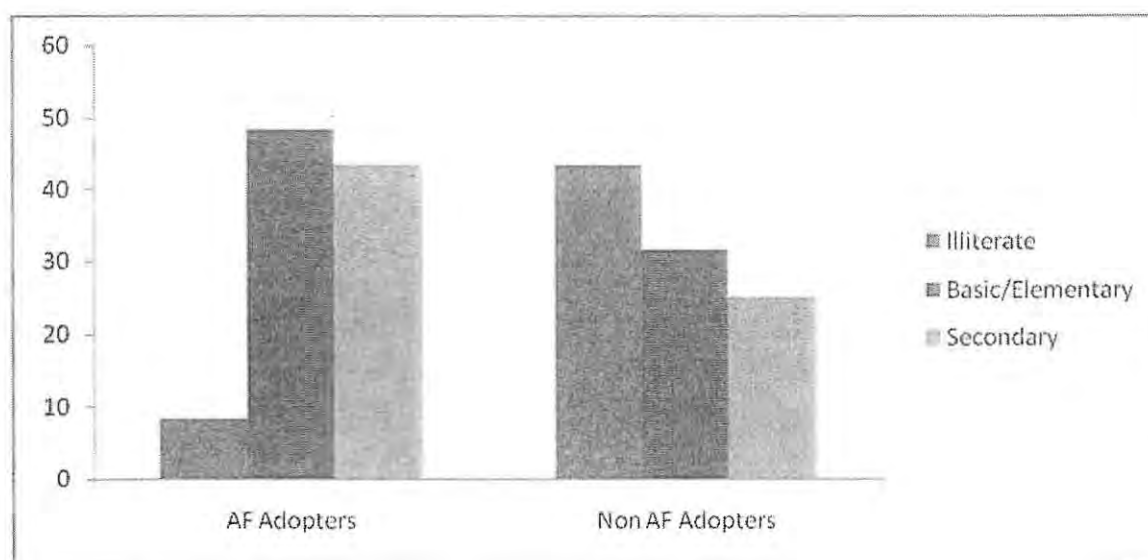
Njoku (1991) indicated that many agroforestry systems require intense labour use to implement the improved agroforestry practices, which contrasts greatly

with the limited amount of labour expended in the traditional farming. Using the probability level, 0.0001, the calculated percentage of the chi-square distribution (40.95) is larger than the tabulated statistic (20.52). Hence; there is significance difference in distribution of years of experience in farming in the study area.

4.1.4 Level of Education

The level of education in the study area varied significantly. The level of education among AF adopters was generally high. Over 92% of respondents had formal education to the basic/elementary level and above while 8% were illiterate whereas 23 out of 60 (43.34%) of non AF adopters were illiterates (Figure 4.1).

Figure 4.1: Level of Education of Sampled Households in percentage



Source: Households survey

The high level of literacy rate would result in increase of technical efficiency and decreased conservatism among farmers. This would also contribute to the acceptance of AF innovations (Sarfo Mensah, 1994). According to Tripp (1993), education is an important socio-economic variable that may make a farmer more receptive to advice from an extension agency or more able to deal

with technical recommendations that require a certain level of numeracy or literacy. The calculated percentage of the chi-square distribution (26.41) is larger than the tabulated statistic (13.82). Hence; there is significant difference in distribution of education in the study area.

As it is explained above 23 out of 60 (43.34%) of non AF adopters were illiterates. A low education level can be a barrier for agroforestry and agricultural development, since education normally has a significant influence on a household's income strategies, land management and labour use (Nkonya et al. 2004). There is lack of knowledge of effective means for soil improvements, like basic information about the farmyard manure application and compost preparation.

4.1.5 Household Size

The family sizes in the study area varied significantly. About 85% of households had between 5 to 10 members, while 13.3 % had less than 4 members (Table 4.4).

Table 4.4: Patterns of Household size in the study area

Household Size	AF adopters		Non adopters	
	No.	Percentage	No.	Percentage
1-4	8	13.33	12	20.00
5-10	51	85.00	46	76.67
11+	1	1.67	2	3.33
Total	60	100.00	60	100.00

Source: Households survey

Using the probability level, 0.001, the calculated percentage of the chi-square distribution (13.92) is similar to the tabulated statistic (13.82). Hence; there is no real difference in household size in the study area.

4.2: Perception about agroforestry

The respondents (n=21) were aware of the economic and environmental benefits of agroforestry practices and had positive attitude towards those practices. It may be due to the fact that significant portions of AF adopters are literate in the study area (Figure 4.1). Most of the respondents agreed that agroforestry practices increased soil fertility, increased farm income and reduced the chances of complete crop failure (Table 4.5).

Table 4.5: Respondents' individual rating for agroforestry practices

Statement	Responses*				
	1	2	3	4	5
AF practices					
Increased soil fertility					21(100%)
Maintained/improved surrounding condition					21(100%)
Increased farm income				6(28.58%)	15(71.42%)
Saved time on collecting fodder and fuel wood from the forest				18(85.71%)	3(14.29%)
Conserved soil and water				13(61.9%)	8(38.1%)
Took a long time to get income	2(9.52%)	1(4.77%)	16(76.19%)	2(9.52%)	
Reduced chances of complete crop failure			1(4.77%)	10(42.85%)	11(52.38%)

Note: Figure in parentheses is percentage.

*1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree

Source: Focus Group Discussion

Similarly Nair (1993) indicated that the combination of several types of products which are both subsistence and income generating, helps farmers to meet their basic needs and minimizes the risk of the production system's total failure.

Thus, this practice has reduced the chances of complete crop failure. The respondents strongly agreed that agroforestry practices maintained/improved surrounding condition of the forest and saved time for collecting fodder and firewood from the forest. The saved time opened up avenues for other farming activities such as vegetable farming.

Based on the data gathered from three kebeles, 100% of adopter respondents emphasized that they have available land for tree planting and are interested in planting more trees. However, 35% of non adopters reported that they have land available for tree planting but do not intend to plant more trees. Because they felt that agroforestry reduced arable land and it takes too long to realize benefits. The other reasons for not adopting agroforestry system include lack of farmer's knowledge on the value of agroforestry trees and tree planting, laziness, ignorance and unavailability of seedlings.

4.2.1: Farmer's reasons for planting and managing trees

During key informant interview, it was mentioned that tree species to be incorporated into farm land, it must have a role in increasing farm income and soil fertility. Tree species with ever green leave characteristics were kept around the residence, grazing land and farm boundary to provide shade and livestock fodder. Accordingly, *Gravillia robusta* and *Sesbania* tree species were grown deliberately together with other crop components, while trees like *Eucalyptus camaldulensis* were grown around homes and wood lots.

Table 4.6: Tree farmers' most important reason for planting and managing trees on land

Most important reason for planting more trees	Percent of AF adopters	
	Frequency	Percent
Potable leaves by animals	25	41.6
Ability to increase soil fertility	56	93.3
Used for shade	54	90.0
Provide construction materials	50	83.3
Increase farm income	60	100
Used for bee fodder	54	90.0
Having low branch volume	46	76.7

Source: Households Survey

The result from the formal survey indicated that increase farm income and soil fertility are the best criteria followed by tree species that are conducive for bee fodder. Ability to increase shade service for human, livestock and coffee is also the other attributes of trees on which the majority of the respondents (n=60) responded positively. There are also other attributes that are considered for incorporating tree species into agro forestry systems (Table 4.6).

As could be seen in Table 4.6, 100%, 93.3% and 90% of AF adopter respondents reported that their main purpose for planting trees is to increase farm income, to increase soil fertility, to use for shade and bee fodder respectively. Biruk (2006) also reported that farmers in south east langano, Ethiopia maintained trees/shrubs on their farms for different socio-economic

purposes including medicinal products, provision of shade and shelter, fodder, fuel wood and the like.

4.3. Agroforestry practice in the study area

Agroforestry has a great potential for alleviating the land degradation problems associated with poor traditional farming practices in the study area. It also plays a great role in improving agriculture and forest production on a sustainable basis by providing food, fuelwood, and fodder and farm income for agroforestry adopters. The following agroforestry technologies were practiced in the study area. Nair (1993) stated that agroforestry is practiced for a variety of objectives and represents an interface between agriculture and forestry and encompasses mixed land use practices.

1. Alley cropping

Alley cropping is an agroforestry system in which food crops are grown in alleys formed by hedgerows of trees and shrubs. The hedgerows are cut back at planting and kept pruned during cropping to prevent shading and reduce competition with food crops. This AF system can improve soil fertility, produce fodder and fuelwood.

2. Home gardens

Tree planting in home gardens is one of the agroforestry systems practiced in the study area. Fruit trees, coffee, *Sesbania* and *Cordia africana* are planted in the home garden together with *Ensete ventricosum*. The main objectives of this practice are to produce fuelwood and provide farm equipments, food, construction materials for housing and making of household furniture. Moreover, it can serve as windbreaks and shelterbelts for humans, as well as provide feed and shelter for animals. Additional food supply and cash income are obtained by planting fruit trees around homesteads of agroforestry adopters.

3. Trees planting as living fences

Both internal and external farm boundary are used for tree planting to provide farm equipments, food, construction materials for housing, fuelwood and fodder. The main objective of this AF practice in the study area is to provide an alternative source of cash to AF adopters and to supply fuelwood. It also acts as windbreaks and shelterbelts.

4. Trees on soil conservation structures

Planting trees/shrubs on earth structures such as soil bunds, terraces, raisers, etc combines soil conservation with production of various products such as fodder, fruit or fuelwood. This makes productive use of the land because trees would use the area along the structures where other crops cannot be grown.

5. Woodlots

A woodlot is a small patch of land planted with trees to provide fuelwood, pole or timber products to the communities as well as for purposes of environmental regeneration.

4.4 Impact of Agroforestry on livelihood of Households

4.4.1 Household Energy

Almost (100%) of AF adopter respondents emphasized that they are dependent on firewood and crop residues for the fuel. Majority of the AF adopters (95%) reported improvement in firewood supply and are self sufficient from the farm trees whereas 64% of non AF adopter respondents depend on the forest for meeting their firewood need. The study indicated that the dominant energy type in rural households is fuel wood and therefore there is a need to integrate trees in the land use system. Since most or greater proportion of farmers got their fuel wood from their own farm there is the need to integrate trees with food crops in the land use system. AF adopters who integrated trees with food crops sold the tree on regular basis. This increased the income levels of farmers and had positive impact on their living standards. This supports the findings of

Gregerson et al (1989), who concluded that the key to solving the fuelwood problem is encouraging farm families to grow sufficient trees to meet their own requirements and to generate surpluses for sale.

4.4.2 Household Incomes

The farming method used by agroforestry adopters in the study area differed from non adopters. The agroforestry adopters cultivated more cash crops and produced more honey and received a better income than non adopters. About 67% of the non adopters in the study area were dependent only on the income from farming, mainly based on traditional farming methods, while the income of agroforestry adopters came from improved agroforestry systems together with that from livestock and apiculture. Maize, wheat, teff and pea (food crops) were cultivated by non adopters in the study area in traditional ways, while all the cash crops (fruits, coffee, honey, vegetables and spice) were cultivated by agroforestry adopters with improved agroforestry systems. Improved agroforestry secured enough food throughout the year for all agroforestry adopter households, while traditional practices did it only for 74% of the non adopter households, even if they were mainly cultivating food crops. Many of non agro forestry adopters were engaged in off-farm activities such as hiring in flower farming was a means to cover daily expenses of the family.

Therefore, one can conclude that TAFP has had a positive impact on the livelihood of the agroforestry adopters. The study revealed that adopters of agroforestry in the study area have been obtaining increased income levels, improved upon the household food security, a greater proportion are to a larger extent able to afford fees and learning materials for their children, clothes and medical treatment for individuals in the household after adoption of agroforestry. About half of adopters have succeeded in building their own houses from the sales of the tree crops/products and food crops. Others have succeeded in buying building plots in Woliso town.

Table 4.7A: Change in crop and animal production and income before and after adoption of agroforestry

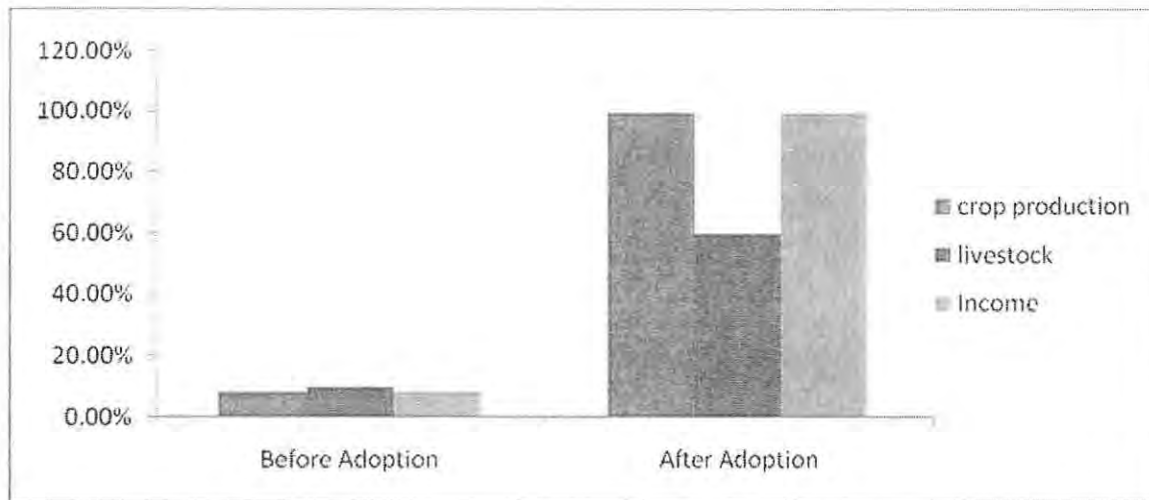
Condition	No. of AF adopters(Before)			No. of AF adopters(After)		
	Production	Livestock	Income	Production	Livestock	Income
Increased	5	6	5	60	36	60
Remain unchanged	23	33	48	0	12	0
Decreased	32	21	7	0	12	0
Total	60	60	100	60	60	60

Source: Households Survey

The change in income before and after adoption of agroforestry is presented in table 4.7A. The incomes involve the money accrued from the sales of both food crops and tree crops/products.

As could be seen in Figure 4:2, 100%, 60% and 100% of AF adopters had increased change in production, livestock and income levels respectively. The increased level of production, livestock and income are positively affecting the lives of the agroforestry adopters. Similarly Nair(1993) noted that in agroforestry system there are three basic sets of elements or components that are managed by the land user, namely, the tree or woody perennial, the herb(agricultural crops) and the animal.

Figure 4.2: The Impact of Agroforestry on the livelihood of AF adopters



Source: Households survey

The research convinced that with improved agroforestry method, the agroforestry adopters are able to raise incomes from their cash crop cultivation and honey production significantly. The annual gross income from cash crops of six(6), thirty two(8), ten(10) and eight(36) agroforestry adopters households increased by 5%,10%,15% and 20% respectively whereas the annual gross income from cash crops of thirty(6) ,eight(8) and six(6) non agroforestry adopter households increased by 5%,10% and 15% (Table 4:7B).

The majority of agroforestry adopters (60%) household's income from cash crops was increased by 20% whereas the majority of non adopter household's (50%) income from cash crops had no change(Table 4:7B). The formal survey indicated that the majority of the agroforestry adopter households obtained twenty times as high as annual gross income of non adopter households. This was possible without great change in cultivation systems and achieved by adding some high value cash crops and cultivating the farms more intensively in combination with multipurpose tree species. Nair (1993) indicated that the combination of several types of products which are both subsistence and

income generating, helps farmers to meet their basic needs and minimizes the risk of the production system's total failure.

Furthermore, in focus group discussions (FGDs) agroforestry adopters mentioned that they have been obtaining diverse types of benefits from their agroforestry practices. Diversification of income, household consumption and soil conservation are some of the major benefits that they have been obtaining. Among these benefits, 100% of the AF adopter respondents indicated that, cash income and soil conservation are the most important benefit that was accrued from agroforestry practices.

All adopters were able to afford school fees and learning materials for their children, clothes and medical treatment for the household from improved food, tree crops, fruits and honey production after adoption of agroforestry. Most adopters obtained income from the sales of surplus food crops, tree crops, fruits and honey. It can be concluded that agroforestry adoption had a significant impact on the livelihood of adopters and their households (Table 4.7B).

Table 4.7B: Annual gross income of AF adopters Vs non adopters from cash crops

Increase income (%)	AF adopters		Non adopters	
	Frequency	Percent	Frequency	Percent
Decline	-	-	10	16.7
No change	-		30	50.0
5%	6	10.0	6	10.0
10%	8	13.3	8	13.3
15%	10	16.7	6	10.0
20%	36	60.0	-	

Source: household survey

One can conclude from above that there is significant economic growth and significant improvement in the lives of the adopters' since the launch of TAFP. The reason behind improvement in production and income were the provision of agricultural inputs on time and availability of quality planting materials of different species that are appropriate for the study site and agroforestry system, past experience of farmers with tree planting and management, accessible market, better farmers' tree propagation and tree nursery management skills. Training and participatory nursery developments were proven methods of building farmers' awareness, leadership and technical skills, production and management capacity.

According to the data in Table 4.7B, 50%, of the non adopters agreed that there was no change in the quality and quantity of crop production. In addition to this, 16.7% of non agroforestry adopters stated that they experienced decreased income from cash crops.

Furthermore, the study indicated that there is significant economic decline and insignificant improvement in the lives of the non agroforestry adopters. The reason behind decline in production and income are lack of agricultural inputs ,scarcity of quality planting materials of different species that are appropriate for the study site and lack of close follow up by development agents(DAs).Potter and Lee (1998) found that the ability of smallholders to plant trees or expand traditional tree-based systems is limited by resource scarcity, absence of technical capacity and experience, as well as market and policy disincentives.

In addition to this, honey products played a significant role in the annual household income of agroforestry adopters and contributed by increasing the annual income of the majority of the households by 50%, whereas eighteen (30%) of non adopters had traditional beehives but most of the time the product used for consumption not for sale (Table: 4.7C).

Table: 4.7C: Annual gross income of AF adopters Vs non adopters from apiculture.

Increase income (%)	AF adopters		Non adopters	
	Frequency	Percent	Frequency	Percent
No change	-	-	18	30
10%	10	16.7	-	-
20%	8	10.0	-	-
30%	7	11.6	-	-
40%	9	15.0	-	-
50%	28	46.7	-	-

Source: Households survey

The research convinced that with modern beehives and honey processing technology, the agroforestry adopters are able to raise incomes from their honey production significantly. As illustrated in Table 4.7C, 16.7%, 10%, 11.6%, 15% and 46.7% of the agroforestry adopters stated that they experienced increased their annual income from honey sale by 10%, 20%, 30%, 40% and 50% respectively after adoption whereas annual gross income of 30% of non AF adopters from apiculture remained unchanged and 70% of them were not engaged in apiculture.

4.5: Estimation of Key Determinants of Agroforestry Technology Adoption

A combination of variables was used in the analysis to bring principal characteristics of agroforestry adopters that could be used to predict adoption of agroforestry in the study area. The Multiple Logistic Regression model was used to estimate the impact that a set of personal and farm level characteristics have on the adoption of agroforestry technologies.

The regression coefficients showed that education, age, years of experience in farming, family size, land acquisition and farm size are positively related to farm income of the households with land size and land acquisition being significantly related (Table 4.8).

Table 4.8: Socio economic factors influencing the household income

predictor	Coefficient	Std. Error	T ratio	P-Value
constant	1.947	0.156	12.47	0.000**
Family size	0.392	0.171	2.30	0.025
Years of experience	0.001	0.137	0.01	0.990
Age	0.409	0.119	0.34	0.733
Sex	-0.518	0.370	-1.40	0.169
Education	0.149	0.104	1.44	0.155
Land acquisition	2.755	0.603	4.57	0.000**
Land Size	1.036	0.102	10.19	0.000**

Note: $R^2 = 93.1\%$ Dependent variable: household total income per year (%).

- indicate negative effect on adoption or negative relationship. *, ** Indicate statistically significant effects at 5%.

The research reveals that productivity of most smallholder agroforestry systems is mainly dependent on the management skills of the AF adopters. The productivity can be improved by enhancing smallholder management skills. Key skills include: species selection, identifying tree farming systems that match farmers' land, and labor; tree management options to produce high quality products; pest and soil management. Therefore, education is significantly related to adoption. Interestingly, the regression coefficients for most of the variables show the intuitively expected sign.

Many agroforestry technologies require intensive labour use which contrasts greatly with the limited amount of labour expended in the traditional farming system. Also, it can be said that as the farmers ages increases his/her physical ability to provide labour decreases which affects the household income. Again, generally males are physically stronger than females and can comparatively provide more labour.

Tombiya Agroforestry project carried out baseline survey to assess the socioeconomic status of adopters before the intervention of the project which helped me to evaluate the contribution of the project in the life of the beneficiaries. Table 4.10 depict that there is extremely high significant difference between the level of income of farmers before adoption and the level of income of farmers after adoption. The study revealed that the level of income of greater proportion of agroforestry adopters increased after adoption compared to before adoption (4.10).

Table 4.10: The Relationship between Level of Income of Farmers before Adoption per year (%) and Level of Income of Farmers after Adoption per year (%)

Annual Income increase (%)	T Value = 0			
	T	Standard Error	Standard Deviation	P
Level of income Before adoption Per year (%)	0.33	0.08	1.49	0.000 **
Level of income After adoption Per year (%)	4.60	0.19	1.04	0.000 **

Note: - ** Indicates statistically significant effect at 1%

CHAPTER FIVE

5. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The study has shown that there are huge potentials for agroforestry development in the study area, such as the existence of indigenous woody perennials (the basic component of agroforestry practices), commodity crops (coffee and fruit), other types of crops, livestock components integrated together and modern knowledge of the AF adopters which enable them managing the modern agroforestry practices.

The study found significant knowledge acquisition taking place, not only for agroforestry methods, but for general soil management and farming practices. Agroforestry adopters valued this information and have often put it into practice. Agroforestry technologies were introduced in the study area in 2005 by the then TAFP. Examples of the introduced technologies are alley cropping, woodlot, shelterbelt and windbreaks, modern beehives, queen excluder, honey processing, fuel saving stove, fruit trees on cropland. The TAFP uses the farmlands of Agroforestry adopters as adaptive trials and demonstration farms in the study area, all in a bid to promote agroforestry adoption. The project has also provided Startup capital for cooperatives training for farmers on modern honey production technology and fuel saving technology. Also nurseries including different type of tree species such as Susbania, Vetiver grass, Gravillea , Acassia ,Mango, Banana, Avocado, Apple, Papaya ,Orange and lemon were established in several areas of the study area.

The age group (20-39) forms the bulk of agro forestry adopters in the study area indicating its potential as the most important target group who could be involved in dissemination of agroforestry. The approach is flexible and dynamic, adjusting to the conditions of target communities. Experience shows

that farmers in the study areas are best positioned to enhance their agroforestry-based incomes by improving the quality and quantity of their products through intensification or expansion of their agroforestry system.

The study revealed high level of literacy rate among agro forestry adopters, which is likely to increase technical efficiency .All agro forestry adopters had their own farmland. This creates an opportunity to transfer and large-scale adoption of agroforestry technologies in the study area as there is no problem of land ownership and acquisition.

I observed that due to the transfer of technology AF adopters were able to produce reliable quantities of high quality products such as fruits,vegetables and processed honey in the last five years whereas non AF adopters harvested small quantities of food crops on their farmland for household consumption.

It was observed that, a greater proportion of the farmers had significant improvement in their annual income after adoption of agroforestry. This had a positive impact on the livelihood of the farmer and his household. Also a greater proportion of the farmers to a large extent are able to afford school fees and learning materials for their children, clothes and medical treatment for individuals in the household. About half of agroforestry adopters have succeeded in building their own houses from the sales of tree and crop products and others have succeeded in buying building plots in woliso town for house construction after adopting agroforestry. It can therefore be concluded that agroforestry adoption has had a significant impact on the livelihood of most farmers" households.

The active involvement of agroforestry adopters shows that they are aware of the value of on-farm tree diversity for the sustenance of their livelihood. But their major concern is how they can access the trees they prefer to grow on the farmland when outside support is terminated. This situation calls for

exploration of other alternative means. One of the nearest sources for accessing seedlings is the government run nursery. But these nurseries mainly produce forest-based trees especially the timber species that are not the preference of the farmers. The group discussion revealed that government officials do not consult with them before the production of the seedlings. On the one hand these households perceive that officials' duty is just to manage government owned forestland; on the other hand, government officials focus their job to accomplish just their target oriented forestry development plan. This indicates that Woreda Agricultural and Rural Development office has not given any attention towards on-farm agroforestry development.

Finally, this study could not precisely or separately analyze all the factors underlying the observed differences in crop yields and income between the two farmer groups (i.e. adopters and non adopters).The differences may also partly be explained by the qualitative criteria used when forming the two groups (adopters and non adopters).These may provide a categorization into well resourced and less resourced farmers. As it is known, the farmers in the study area are not normally keeping any records concerning the yields or income, thus all the qualitative information can be considered only as an estimate.

5.2 Recommendations

It is recommended to encourage the farmers to plant cash crops in the study area for several reasons. Cash crops can generate better income on smaller land areas as compared with food crops.

In the study area, a kind of cooperative among agroforestry practitioners was already initiated, and the AF adopters sell their honey product with a fixed price. agroforestry adopters said they could easily intensify their honey production if they had better markets. Lack of their own market place in the town for selling of processed honey was the main challenge of agroforestry adopter's cooperation which had a negative impact on their success since the

availability of market place is the main factor contributing to the success of the households. The effectiveness of a cooperative depends, however, on governance and management. The local government needs to provide market place for the cooperation so that they can sale their product with fare price in serving the community.

The research reveals there was no delivery of appropriate extension services (no technical advices, no provision of seedlings) from office of agricultural and rural development. The issue of appropriate extension work for increasing the scale of agroforestry is of particular importance because agroforestry is a relatively 'knowledge intensive' practice, reducing the likelihood that knowledge will spread easily on its own. Therefore, the woreda office of agricultural and rural development and other concerned bodies should provide suitable extension services.

Farmers will need to be supported with appropriate country-wide policies that reduce some of the above constraints; removing barriers to land access and tree tenure, establishing seed sources and nurseries to meet demand and skilled extension workers with the capacity to provide information for farmers on the benefits and techniques of agroforestry. Improvements in these areas would do much to promote agroforestry in the woreda.

This study was conducted at specific site with limited experience. Therefore, similar study should be conducted in other part of the country to get reliable information on the role of agroforestry in improving the livelihood of rural people.

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ANNEXES

The instrument contains three parts. The first part is questionnaire to be filled by the agroforestry adopters and non adopters' .The second part is interview guide line to the key informants, focus groups, administration and concerned offices. Only the households are required to fill the questionnaires and to respond to interview guidelines. Part one and part two are attached in the following five Annexes.

ANNEX 1: Questionnaire for farmers

I. HOUSEHOLD BACKGROUND

1. Age (Years)

2. Sex:

2.1. Male 2.2.Female

3. Name of Town/Village

4. Years of experience in farming (Years)

5. Highest Education level

5.1 Illiterate 5.2 Basic/Elementary 5.3 Secondary 5.4
Vocational/ Technical

5.5 Tertiary

6. Household size

6.1 Small size (1 – 4)

6.2 Medium size (5 – 10)

6.3 Larger size (11+)

7. Marital status

7.1 single

7.2 Married

7.3 Divorced

7.4 Widow

II. LAND TENURE

1. Does the land belong to you?

1.1 Yes

1.2 No

2. How did you obtain your land?

2.1 Freehold

2.2 Tenancy (Share Cropping)

2.3 communally owned

2.4 state owned

2.5 through purchase

2.6 Others

3. What is the size of your land in hectares or acres? -----

4. Are you likely to face land acquisition problems in the future?

4.1 Yes

4.2 No

If yes, why? -----

5. What would you most likely use your best land to grow?

5.1 Food crop

5.2 Cash crop

5.3 Tree crop

5.4 others (Specify)

Explain -----

III. LAND USE SYSTEMS AND PRACTICES

CROP PRODUCTION SYSTEM

1. What type of crop(s) do you cultivate or what do you use the land for?

1.1 Food crop -----

1.2 Cash crop -----

1.3 Tree crop -----

1.4 Others (specify) -----

Why? -----

2. Distance from Home (km) -----

3. Total land size under cultivation (acres) -----

4. Type of Farm (practice) -----

4.1. Wood lot

4.2. Windbreaks

4.3. Fruit trees on cropland

4.4. Alley cropping

4.5. Strip cropping

4.6 Home gardens

4.7 Live fences

4.8. Others

5. What limits farm size?

5.1 Land 5.2 Labour 5.3 Capital 5.4 Others (specify)

6. How do you prepare your land for cultivation?

6.1 Slash and burn 6.2 Set fire in the bush 6.3) Zero burning

6.4 Minimum tillage 6.5 Tilling 6.6 Others (specify)

7. What has been the trend of crop production over the last 4 years?

7.1 Increasing 7.2decreasing 7.3. About the same

8. What has been the trend of the fertility status of the farm land over the last 4 years?

8.1. Improving 8.2.Declining 8.3. About the same

If there is decline in soil fertility, how are you trying to resolve the problems? ---

9. What is the mode of weed control in your farm?

9.1. Manually 9.2.Use of herbicides 9.3.mechanically 9.4. Others

IV. TREE PRODUCTION SYSTEM

1. What has been the trend of tree production over the last 4 years?

1.1 Increasing 1.2decreasing 1.3. About the same

2. What has been the trend of fruit production over the last 4 years?

2.1 Increasing 2.2decreasing 2.3. About the same

3. What has been the trend of honey production over the last 4 years?

3.1 Increasing 3.2decreasing 3.3. About the same

4. What type of seedling production do you use?

4.1 Fruits 4.2Coffeee 4.3Trees and shrubs 4.4 leguminous plants 4.5 others

5. How significant is the tree production in minimizing deforestation?

5.1 necessary 5.2 very important 5.3 It minimizes, but not necessary 5.4 not so important

IV. ANIMAL PRODUCTION SYSTEM

1. Indicate the type of animals do you rare in the households?

1.1Sheep 1.2 Goats 1.3 Poultry 1.4 Cattle 1.5 Others

2. Indicate the typical herd size of the animals mentioned above in the households? -----

3. Indicate the type of animals feed in the households?

3.1 Tree/shrub fodder 3.2Household waste 3.3. Grassland
3.4 feed from mills 3.5 others

4. What has been the trend of rearing of animals over the last 4 years?

4.1 Increasing 4.2 decreasing 4.3. About the same

5. What is the contribution of the animals in the household?

.....
.....

V. MARKETING AND INSTITUTIONAL SUPPORT

1. What is/are the sources of labour on your farm?

1.1 family/household 1.2 Hired/wage-perday/contract
1.3 Debo/cooperative 1.4 others (specify)

2. Do you obtain sufficient planting materials?

2.1 Yes 2.2 No

3. Have you been getting or already received any assistance from a non-governmental organization in terms of monetary support and/ or other inputs?

3.1 Yes 3.2 No

If Yes what kind? -----

4. Name the NGO(s) -----

5. Where do you sell the Food crops and the tree crops?

5.1 Local Market

5.2 Urban Market

6. If you are not satisfied with the marketing system, of the food crop and tree crops, what do you think can be done to improve it?

.....
.....

7. Do you receive extension support from government agencies or non-governmental organizations in using the Agroforestry technology?

7.1 Yes

7.2 No

If Yes, explain

.....
.....

IV. INCOME OF THE HOUSEHOLD

1. What is the type of household energy?

1.1 Gas

1.2 Fuel wood

1.3 Charcoal

1.4 others (specify)

2. What is the source of household energy?

2.1 Own farm

2.2 Forest

2.3 Purchase

2.4 Others (specify)

3. Do you use fuel saving stove?

3.1 Yes

3.2 No

4. Does the fuel saving technology improve the fuel wood consumption of the household?

4.1 Yes 4.2 No

If yes, Explain -----

5. Can beekeeping increase your annual income?

5.1 Yes 5.2 No

If yes, by what percent,

a) 5% b) 10% c) 15% d) 20% e) Others

6. How significant is the cash crops income to your family?

6.1 necessary 6.2 very important 6.3 good extra income, but
not necessary

6.4 not so important

7. Can the cash crops increase income to your family?

7.1 Yes 7.2 No

If yes, by what percent,

a) 5% b) 10% c) 15% d) 20% e) Others

8. How is the general food security situation in the household after adoption?

8.1 very good

8.2 somewhat good

8.3 not very good

ANNEX 2: Interview guide line to the key informants

Description of the study area

1. Location

- Woreda----- zone----- region-----
- Distance from Addis Ababa-----km
- Distance from zone capital (Robe) -----km
- Number of PA`s in the woreda-----
- The name of the neighboring woredas and the direction they bordered ---
- Latitude-----north and longitude-----east

2. Biophysical data

2.1. Climate

- Annual rainfall (average in mm) -----mm
- Duration /belg / from-----to-----months, meher from-----to-----months, and dry spells from-----to-----months
- Average temperature, maximum-----minimum-----

2.2. Agro ecology

Dega-----%, weyina dega-----%, kola -----%

2.3. Altitude-----m.a.s.l.

2.4. Topography-----

2.5. Soil types-----

2.6 Vegetation

- Dominant tree species in the woreda-----
- Current forest coverage in the woreda-----hectares

- How the current forest coverage as compared to the previous? Increasing or decreasing?

If decreasing explain the causes -----

If increasing, explain the factors contributing to increasing -----

3. Socio- economic environment

3.1. Population

- Total population-----male, -----female -----
- Head household, male-----, female ----- total -----
- Average family size-----

3.2. Land

- Total land coverage of the woreda -----hectare
- Average land size per HH-----hectare
- Population density per km2-----
- Write the Land use of the woreda according to the table provided.

Land use types	Area coverage in hectare	Proportion/%/	Remark
Natural forest			
Plantation forest			
Cultivated land			
Grazing land			
Settlement			

Margin land			
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3.3. Livelihood (income source) of the population in the woreda

Source of income	Share in %

- What are the major types of food crop grown in the woreda-----?
- What are the major types of cash crop in the woreda-----?
- What are the major types of livestock in the woreda -----?

4. Institutional and infrastructural aspects

- Are there any credit facilities for the rural community? 1=yes, 2= no.

If yes, mention the name of credit facilities-----

- Are there any extension services in agroforestry practices? 1= yes, 2= no.

If yes, mention the types of extension services-----if not, why?

- Are there any nursery sites in the woreda? 1= yes, 2= no. if yes,

How many? -----

Mention the names of exotic tree species produced in the nursery -----

Mention the names of indigenous tree species produced in the nursery---

Mention the names of cash crops produced in the nursery-----

**ANNEX 3: Attitude of model farmers towards Agroforestry based –
integrated development project**

1. Agroforestry practices Increased soil fertility

1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree

2. Agroforestry practices Increased farm income

1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree

3. Agroforestry practices Conserved soil and water

1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree

4. Agroforestry practices Reduced chances of complete crop failure

1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree

5. Agroforestry practices Saved time on collecting fodder and fuel wood from the forest

1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree

6. Agroforestry practices Took a long time to get income

1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree

7. Agroforestry practices Maintained/improved surrounding condition

1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree

Declaration

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

Declared by

Komfeng

Candidate

Confirmed by

[Signature]

Advisor

