Farmers' Perception on the Role of Vetiver Grass in Soil and Water Conservation in South Western Ethiopia:-*The Case of Tulube Peasant Association; Metu District*

By

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DECLARATION

I hereby declare that the Dissertation entitled "**Farmers' Perception on the Role of Vetiver Grass in Soil and Water Conservation in South Western Ethiopia:-*The Case of Tulube Peasant Association; Metu District***" submitted by me for the partial fulfillment of the M.A. in Rural Development to Indira Gandhi National Open University, (IGNOU) New Delhi is my own original work and has not been submitted earlier either to IGNOU or to any other institution for the fulfillment of the requirement for any course of study. I also declare that no chapter of this manuscript in whole or in part is lifted and incorporated in this report from any earlier work done by me or others.

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CERTIFICATE

This is to certify that Mr. Tekalign Negash Terefe student of M.A. (RD) from Indira Gandhi National Open University (IGNOU), New Delhi was working under my supervision and guidance for his project work for the course MRDP-001. His project work entitled "**Farmers' Perception on the Role of Vetiver Grass in Soil and Water Conservation in South Western Ethiopia:-*The Case of Tulube Peasant Association; Metu District***", which he is submitting, is his genuine and original work.

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List of Acronyms

CSA:	Central Statistic Authority
DA:	Development Agent
DNA:	Deoxyribo Nucleic Acid.
EHRS:	Ethiopian Highlands Reclamation Study
EWNRA:	Ethio-Wetlands and Natural Resources Association
FFW:	Food for Work
GDP:	Gross Domestic Product
Ha	Hectare
HH:	Household
IIRDP:	Illubabor Integrated Rural Development Project
JARC:	Jimma Agricultural Research Center
m.a.s.l:	Meters above sea
MDADO:	Metu District Agricultural Development Office
MEWNRA:	Metu Ethio-Wetlands and Natural Resources Association
MfM:	Menschen für Menschen
NGO:	Non-Governmental Organization
NRC:	National Research Council
NRGO:	The National Regional Government of Oromia
PA:	Peasant Association
PCO:	Projects Coordination Office
SW:	Social Worker
SWC:	Soil and Water Conservation
SWCE:	Soil and Water Conservation Engineering
TVNI:	The Vetiver Network International
VG:	Vetiver Grass
VGT:	Vetiver Grass Technology
VS:	Vetiver System

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Abstract

Land degradation is one of the major challenges in agricultural production in many parts of the world, especially in developing nations like Ethiopia. Even though a number of soil and water conservation measures were introduced to combat land degradation, mainly because of high construction cost and lack of skilled manpower, adoption of these practices remains below expectations. By the initiation of World Bank, since 1980s vetiver grass as bio-soil and water conservation measure got acceptance and almost 120 counties of the world are adopting and practicing it. Since 1990s, vetiver grass is used in Ethiopia as one of the soil and water conservation measures. Therefore, this study concentrated on the role of vetiver grass for soil and water conservation in Tulube Peasant Association, Metu District of Illubabor Zone, South West Ethiopia.

Data was collected from 112 randomly selected farm households using structured questionnaire, interview with government and NGO officials of the area, workgroup discussion with carefully selected community members. Bothe qualitative and quantitative methods were used to gather and descriptive statistics was employed to analyze and assess farmers' perception on the use of Vetiver grass and to identify the major role it played in soil and water conservation.

This study identified that Vetiver grass is the cheapest and easily handled by farmers of the area. The assessment of farmers' perception on Vetiver grass and its use for soil and water conservation showed that most of the farmers got awareness by the NGOs. But illiteracy, land size and ownership problems hinder the further expansion of vetiver grass to the area.

This study also identified that Vetiver grass is a very simple, practical, inexpensive, low maintenance and very effective means of soil and water conservation, sediment control, land stabilizations and rehabilitation. Farmers who planted vetiver grass on their farm land have been benefited both in land management and as a source of income which improved has their socio economic status in the community.

Keywords: *Soil; Water; Erosion; Land management; Conservation; Vetiver Grass; Perception; Farm.*

1. INTRODUCTION

1.1 Background

The population of the world is dependent on land resource for food and other necessities. More than 97% of the total food is derived from land, the remaining from the aquatic systems. Agriculture is an essential component of societal well-being and occupies 40% of the land surface and consumes 70% of global water resources. At every point of production, agriculture influences and is influenced by ecosystems, biodiversity and the economy (NRC, 1993).

Today, depletion of natural resources is the major problem facing the world. World Resource Institute of the United Nations Environment Program estimated that millions hectare of land are degraded and completely disappeared with their original biotic functions and 1.2 billion hectares (10%) of the earth's vegetative surface are moderately degraded of which about one fourth is found in Africa and Asia and the rest three-fourth in North America. Undoubtedly, environmental degradation (soil erosion and climate change) has direct effects on agricultural productivity and food security (Mulugeta Demelash and Karl Stahr, 2010).

On the other hand, degradation, which can be physical, chemical and/or biological, is claiming six million hectares of the global agricultural land per annum. About 16% of the world's agricultural land is affected by soil degradation. Of all the processes leading to land degradation, erosion by water is the most threatening and accounts for 56% of the total degraded land surface of the world. In Africa alone, it is estimated that five to six million hectares of productive lands are affected by land degradation each year ((Mulugeta Demelash and Karl Stahr, 2010). Poor farming practices in rural areas of the developing countries have resulted in soil loss and nutrient

depletion which finally led into land degradation. Ethiopia lost over 1.5 billion tons of topsoil from the highlands by erosion (Tadesse, 2001). This in turn resulted in low agricultural productivity, food insecurity and poverty (Menale Kassie, et al, 2008).

Ethiopia, with a population of about 81.2 million and with an area of 1.127 million km^2 (Michael E. Porter and Klaus Schwab, 2009), is the tenth largest and second populous country in Africa (Wikipedia, 2001**).** The country's population, predominantly rural (84%), is currently experiencing a sharp increase and growth rate estimated at 2 million people per year (Jonathan Mckee, 2007).

Ethiopia is one of the poorest, ranking 170 out of 177 countries in the Human Development Index. More than half of the country's GDP is dependent on the agricultural sector, which suffers from frequent drought and poor cultivation practices (World Bank, 2004), and, thus, vast areas of arable land are turning into desert each year.

Currently only three percent of a total area of the country is covered by forests. The major causes for desertification are overgrazing or excessive livestock farming, an ever increasing population, cutting trees for firewood and construction, and climate change. Moreover, enormous amounts of fertile land are being degraded and causing arable land to become desolate (Alemu Mekonnen, 2000).

Soil erosion is one of the most severe problems affecting croplands in Ethiopia. According to the Ethiopian Highlands Reclamation Study (EHRS, 1991), over 14 million hectares of the highlands are seriously eroded, and about 15 million hectares were found to be susceptible to erosion. A preliminary soil loss and run-off study at Melko also indicated that 82.3 tons of soil is eroded annually (Tesfu Kebede and Zebene Mikru, 2006).

Farmers in Illubabor Zone of the Oromia Regional State are relying on agriculture for their incomes. Despite the fact that the area get a long and intensive rain, the production per unit area is too small. Thus, farmers have the lowest incomes and highest rates of poverty.

Public resources have been mobilized to develop soil and water conservation (SWC) technologies such as soil and stone bunds, agronomic practices (minimum tillage, grass strips and agro-forestry techniques) and water harvesting options like tied ridges and check dams constructions in the area (Shiferaw, et al, 2007). But the physical SWC schemes were found to be very expensive and required frequent maintenance. The physical structure maintenance cannot be afforded and managed by poor and non-skilled farmers of the area.

Soil erosion causes a chronic environmental and economic burden (Wellington Z. Rosacia and Rhodora M. Rimando, 2001) and results in soil degradation in most parts of the world. This phenomenon is equally important in the study area. Soil degradation processes include the loss of topsoil by water or wind, chemical deterioration such as nutrient depletion and salinization, physical degradation such as compaction, and biological deterioration such as the reduction of soil biodiversity (Lal, 2001). Of all degradation process, the detachment of soil particles from the landmass and the transportation of the loosened material to another place (Elision, 1946; Hudson, 1965), is perhaps the most fearsome threat confronting mankind today (Babalola, 1993) and poses a great danger to agricultural production. Though the magnitude varies with ecological zones, soil erosion persists on agricultural lands in Ethiopia and continues to pose a formidable threat to both national food security and environmental quality. To curb down the problem of land degradation it requires soil conservation measures that are cheap, replicable, sustainable and easily understandable by the Ethiopian farmers.

The loss of 20 billion tons of soil per year is not only degrading the environment but also affecting the economic viability of countries (Richard Webb, 2009). Land degradation is caused by the interacting effects of factors such as population growth, intensive farm, overgrazing, deforestation and climatic change. Degradation due to soil erosion and nutrient depletion are the most challenging environmental problems in Ethiopia. The Ethiopian highlands have been experiencing declining soil fertility and severe soil erosion due to intensive farming on steep and fragile land (Amsalu and De Graaff, 2006).

Recognizing land degradation as a major environmental and socio-economic problem, the government of Ethiopia and NGOs have intervened to alleviate the problem. As a result, large areas have been terraced using soil bunds or other physical means, protected by area closures and planted degraded lands with tree seedlings. Nevertheless, the achievements have been far below expectations. The country still loses a large amount of fertile topsoil and the threat of land degradation is broadening alarmingly (Teklu and Gezahegn, 2003).

Vetiver, a Tamil word for "root that is dug up," is a unique tropical plant native to India (Paul Truong et al, 2008). It belongs to the same grass family of maize, sorghum, sugarcane and lemongrass, and is a perennial grass growing up to two meters high and three meters deep and in some case even up to five meters. It has a strong vertical and netted root system.

There are twelve known varieties of vetiver grasses in India, and the well-known Vetiveria Zizanioides L, now spread in more than 120 countries mainly in South and Southeast Asia, Tropical and South Africa, and Central and South America. It grows splendidly in well drained sandy loam soil and in areas with annual rainfall of 1000 – 2000 mm and with temperatures

ranging from 21 to 44.5 ^{oc}. It is also adaptable to a wide range of acidic, sodic, alkaline and saline soils and tolerates wide ranges of climatic conditions, including drought and fire.

Vetiver grass is a very simple, practical, inexpensive, low maintenance and very effective means of soil and water conservation, sediment control, land stabilization and rehabilitation. It is also environmentally friendly and when planted in single rows it will form a hedge which is very effective in slowing and spreading runoff water, thereby reducing soil erosion, conserving soil moisture and trapping sediment and farm chemicals on site. In addition, the extremely deep and massively thick root system of vetiver grass binds the soil and at the same time makes it very difficult for it to be dislodged under high water velocity. The very deep and fast growing root system also makes vetiver very drought tolerant and highly suitable for steep slope stabilization. Most of the evidence suggests that other SWC structures so far implemented could reduce soil losses but do not reduce runoff significantly, and in some cases, they have a negative impact on soil moisture (Greenfield, 1989; Habtemariam Abate & Belay Simane, 2001).

When planted on the contour, vetiver grass forms a protective barrier across the slope, which slows the runoff and causes sediment deposition. Since the barriers reduce the velocity of runoff water reaches the bottom of the slope at lower velocity without causing any erosion and being concentrated in any particular area (Greenfield, 1989). Vetiver grass was first introduced to Ethiopia in the early 1970s by Jimma Agricultural Research Center for the purpose of protecting coffee plantation from the invasion of couch grass. Since then, the Ethiopian Research Center multiplies the grass for the purpose of protecting coffee plantation from Bermuda and Couch grasses. In the mid-1980s, vetiver grass was distributed for the first time out of the Jimma Research Station to the nearby coffee state farms and NGO, with the intension of utilizing it as mulch and SWC material. In subsequent years, vetiver grass was distributed throughout the

country including different districts of Illubabor, Debrezeit, Wolayta, Gonder and Tigray, mainly for erosion control purpose (Greenfield, 1988; Lavania, 2004; Meffei, 2002; Kemper, W.D.I, 1993 and Habtamu Webshet, 2009).

1.2 Statement of the Problem

The population in the rural areas is increasing and more food is required to feed this population. On the other hand the land size used by farmers is reducing. These situations forced the farmers to use the land intensively throughout the year that has resulted in soil degradation. Soil degradation in turn encompasses mineral depletion, poor physical (low water retaining capacity) and biological conditions of soil (Bekelech Tolla, 2010). Fertility maintenance and the availability of soil moisture in the topsoil are the two most important elements critical to sustainable agricultural production.

Agriculture in Ethiopia is under continuous threat because of various forms of land degradation. Moreover, land degradation is a long-term process in which the effect is hardly noticed until it manifests itself in various forms. In Ethiopia, water erosion is the most important land degradation process that affects the physical and chemical properties of soil resulting in on-site nutrient loss and off-site soil sedimentation. Most studies indicate that sheet and rill erosions and burning of dung and crop residue are the major components of land degradation that affects on-site land productivity.

In Illubabor Administrative Zone, soil erosion is a severe problem due to lack of proper mechanism to control erosion caused by the heavy rain; and as a result, the livelihood of many farmers has been seriously affected. The physical conservation structures are expensive and labour intensive for the farmers. The prevention of soil erosion relies on selecting a practical and

inexpensive, effective and easily manageable soil protecting schemes. One such option is the use of vetiver hedgerow that has shown effective results worldwide (Richard Grimshaw, 2009).

Since soil erosion is a critical problem in all regions of Ethiopia, the proper investigation and assessment of the problem and the best solutions achieved in the area can be replicated in other parts of the country.

1.3 Objectives of the Study

1.3.1. Major Objective

The major objective of this study is to examine the role vetiver grass played in controlling soil erosion and conserving water.

1.3.2 Specific Objectives:

1. To examine the extent and effects of soil erosion problem in the study area;
2. To investigate the role of vetiver grass in increasing soil fertility, crop yield, soil moisture, ground water level and sediment control;
3. To assess the role played to create community awareness in using vetiver system for soil erosion control;
4. To study the attitude of the community in implementing the system towards reducing soil erosion problem; and,
5. To closely investigate the other uses of vetiver grass and benefits gained from this system in land use management, alleviating poverty and improving social and economic status of the community.

1.4 Research Questions

This study will address the following three interrelated research questions:-

1. Is the introduced vetiver grass improving the degree of soil erosion and rehabilitate the degraded land in the peasant association?
2. For what purposes the farmers in the peasant association use vetiver grass other than erosion protection?
3. What tangible and meaningful socio-economic benefits are exactly gained by the community from the introduced vetiver grass?

1.5 Significance of the Study

Since there is no study conducted so far concerning the vetiver grass system for soil erosion in this particular peasant association of Illubabor Zone, Oromia National Regional Government, the research result can provide information on the specific knowledge related to soil conservation practices, indicate the factors that need urgent intervention, and identify directions and information that need further research works. It can be a good opportunity to the administrative zone in general, and the district in particular, to have an organized document that can serve as guideline in the future planning. The results can also be used in refining development efforts of non-governmental organizations whose main concern is soil and water conservation.

Moreover, the information from this research can help the soil and water conservation stakeholders and policy makers in promoting the vetiver grass system to all degraded areas of the country. In addition it can also serve as a reference for future researches on the subject of vetiver grass.

1.6 Scope and Limitation of the Study

Even though the works done in introducing vetiver grass for soil and water conservation in Illubabor Administrative Zone covers many districts and peasant associations, only Tulube Peasant Association (P.A.) of Metu District was taken for this case study purposively.

The main focal point was on the factors that affect vetiver system for soil erosion control and the improvement on the lives of the community in the past few years. In this particular case the study the personal, socio-economic, agro-ecological, communication, behavioral and institutional factors that were assumed to have effect on adoption of the technology by farmers are considered. Furthermore, because of time limitations and resource constraints, the study addressed the randomly selected sample households of the targeted beneficiaries and non-beneficiaries in the peasant association.

2. LITERATURE REVIEW

2.1 Concepts of Soil and Water Conservation

Currently rapid deforestation is taking place in the tropics and damaging the thin layer of soil that is fragile and quickly washed away when exposed to the heavy rain. Globally, agricultural activities that makes the land surface more susceptible to soil erosion account for 28% (2 billion hectares), overgrazing for 34% and deforestation for 29% of soil degradation (Encarta, 2009). Surface run-off on cultivated lands can easily wash away the topsoil (M. P. Islam et al, 2008). Soil erosion is the world's most chronic environmental problem and carries off totals 20 billion tons of soils in a year and this loss is not only degrading the environment but also eroding the economic viability of countries (Richard Webb, 1995).

According to Mulugeta Demelash and Karl Stahr (2010), water erosion is the most threatening land degradation processes in the world and accounts for 56% of the total degraded land surface of the world. In Africa alone, it is estimated that five to six million hectares of productive land are affected by water erosion each year. Erosion reduces root depth, removes soil organic matter and nutrients and decreases water holding capacities of the soils.

Population pressure, mismanagement of agricultural lands, deforestation and overgrazing are among the major causes of soil erosion and environmental degradation. The average annual rate of soil loss in Ethiopia is estimated to be 12 tons/hectare/year, and can be even higher on steep slopes (greater than 300 tons/hectare/year or about 250 mm/year) where vegetation cover is scant (Alemu Mekonnen, 2000).

According to David Sanders (2004), soil erosion by wind and water becomes important if the soil has loose consistency with fine particles. Under this condition water cannot infiltrate into the

soil fast enough and, thus, the water that flows down the slope carry all the loosely held soil particles. Many cultivated agricultural soils are easily erodible. However, the erosion problem is more severe on certain types of soils and steep slopes, where the vegetation is removed. Even if the intensity varies it is a naturally occurring on all land (Wikipedia, 2001).

There are several causes for soil erosion ,but the intensity of rainfall and wind, walking paths of human and cattle, establishment of homesteads in overcrowded areas, poor agricultural practices, deforestation, uncontrolled animal activity, improper design and construction of conservation techniques, over population, overgrazing, poor land management and land use and ownership policies are the major ones (Md. Nazrul Islam, 2009).

In most cases soil erosion could be a slow process and unnoticeable. However, there are situations where it could occur at an alarming rate and causes serious loss of topsoil. The loss of soil from farmland is reflected in reduction of crop production potential, lower runoff, and water quality and damaged drainage networks (I.J. Shelton, 2003). According to Tadesse M. and K. Belay (2004), land resource degradation due to poor farming system is the main environmental problem in Ethiopia which needs attention and immediate solution.

The world has been encountering critical declining of water availability and quality. Improvement and recharging of ground water is, therefore, an alternative way of water resource planning to mitigate surface water storage as well as reduction of losses through violent rainfall (Grimshaw, 2000). Groundwater is not only supplying water to wells and springs, but also enhances the dry season flow of river systems (Chomchalow, 2003). Appropriate soil and water conservation is reflected on the reduction of runoff, improvement of infiltration, enhancement of soil moisture storing capacity and improvement of groundwater level.

2.1.1. Soil Conservation in Ethiopia

Soil conservation in Ethiopia is considered today to be top priority, not only to maintain and improve agricultural production but also to achieve food self-sufficiency, which is the long-term objective of the agricultural development program (Martin Grunder, 1988). Soil has to be protected from natural and animal induced erosion hazard using all methods of land use management. It also involves protection of soil from damage by machinery or by detrimental changes to its chemistry (D.F. Acton and D. Richard Coote, 2002).

There are varieties of well-known soil conservation measures such as physical soil conservation measures and biological soil conservation measures (H.P. Liniger et al, 2002) control runoff and prevent loss of soil. Moreover, it keeps proper soil compaction; maintain or improve soil fertility and conserve or drain water.

Physical soil conservation structures are the permanent features made of earth, stones or masonry. They are designed to protect the soil from uncontrolled runoff or erosion, and to retain water where it is needed. In steep land farming, physical structures such as rock barriers and contour bunds; waterways such as diversion ditches, terrace channels and grass waterways; and, stabilization structures or dams, windbreaks, and terraces such as diversion, retention and bench, are often necessary (Morgan, 1981 and Bennett, 1970). The construction of physical structures is often labor intensive since steep slopes make construction difficult. Thus, both construction and maintenance require long-term collaborative effort by farmers, the local community and the government.

Biological soil conservation measures are based on covering of land using vegetation and could be agronomic practice or forest cover. Some possible agronomic measures are strip cropping,

mixed cropping, intercropping, fallowing, mulching, contour ploughing, grazing management and agroforestry. Agronomic conservation measures help in reducing the impact of raindrops through interception and thus increasing infiltration rates and thereby reducing surface runoff (Tideman, 1998). These agronomic conservation measures can be applied together with physical soil conservation measure. In some systems they may be more effective than structural measures (Heathcote and Isobel W., 1998). Furthermore, it is the cheapest way of soil and water conservation (Wimmer R., 2002). However, agronomic measures are often more difficult to implement compared with structural ones as they require a change in familiar practices (Heathcote and Isobel W., 1998).

Forest or grassland vegetation covers that prevent splash erosion, reduce the velocity of surface runoff, facilitate accumulation of soil particles, increase surface roughness which reduces runoff, and increases infiltration and stabilize the roots and organic matter that increase the soil aggregates and water infiltration. The use of vegetation as a bio-engineering tool for land reclamation, erosion control and slope stabilization have been implemented for centuries and its popularity has increased remarkably in the last decades (Truong, 2002). This is partly due to the fact that more knowledge and information on vegetation are now available for application in engineering designs, in addition to the cost-effectiveness and environment-friendliness of the approach (Habtemariam Abate and Belay Simane, 2001). These effects entail a low soil erosion rate compared with uncovered soil which resulted in a high soil erosion rate. Even cultivated crops in agricultural areas are a better protection against soil loss than uncovered soil (Morgan, 1999; Richter, D. D., and D. Markewitz, 2001and Hans Hurni, et al, 2005).

Biological measures are an effective method of soil conservation, and nowadays, especially the vetiver system is getting popular and more accepted by the rural community since it is cost

effective and easily manageable. In addition, it can be used with structural and agronomic measures.

2.1.2 Characteristics and Environmental Requirement of Vetiver Grass

Vetiver (Vetiveria Zizanioides (L. Nash) is a fast growing, deep rooted grass with strong and dense leaves that resist fire, drought, flood and livestock. It is a native of Southeast Asia with a particular cultivar in the Indian subcontinent. It thrives in arid and humid conditions (annual rainfall of 300 to 3000 mm) and grows successfully on variety of soils such as shallow, rocky, acidic and saline, with no particular limitation (Alemu Mekonnen, 2000 and Truong, 2000).

Vetiver is a perennial grass belonging to the Poacea family. The southern part of Indian Peninsula is considered as Vetiver center of origin from where it is said to have spread over the rest of the world for the production of aromatic oil (Lavania, 2004). These multi-fold and unique characteristics make vetiver a "Miracle Grass" that can survive in all areas and climates of the global regions (Tessema Chekun Awoke, 2000). Vetiver grass is able to act as a natural barrier against erosion and pollution (M. P. Islam, et al, 2008)

Vetiver is a high-biomass plant having high C4 photosynthetic efficiency (Mucciarelli M, et al, 1998), with a long, 3 to 4 m, massive, aerenchymatous and complex root system, which can easily penetrate into the deeper layers of soil and stabilize it (Dalton, P. A. et al, 1996 and Truong, 2000). Vetiver is capable of withstanding extremely harsh environmental conditions, varying temperature from -20 to 60c (Truong, 2000 and Lavania UC S, Vimala Y, 2004). In addition, vetiver has an outstanding ability to survive in various types of soils and flooded and waterlogged conditions. The effectiveness of this grass in soil and sediment erosion control is due to its morphological and physiological distinctiveness (Greenfield, 1995).

According to Xu, Liyu (2003), and Lavania UC, Lavania S. and Vimala Y. (2004), the emerging vetiver system is a universal remedy and a proven solution for many other environmental problems such as soil and water conservation, wastewater treatment, embankment stabilization, flood control, pollution mitigation, and agro-forestry management. Vetiver is also the key element with low cost and efficient system used for soil and water conservation, infrastructure stabilization, pollution control, waste water treatment, mitigation and rehabilitation, sediment control, prevention of storm damage and many other environmental protection applications of bio-engineering type.

Regarding water conservation, vetiver hedgerows also play a vital role in watershed hydrology and groundwater recharge. Rainfall runoff is reduced by as much as 70% when vetiver hedgerows are planted across the slope and on the contour. The hedgerow helps to slow down and spread out runoff over a larger area. In particular, the capability of its strong roots in penetrating into hardpans is found significantly helpful in water infiltration and soil moisture improvement, comparing with many other plants (Chomchalow, 2003; Bharad and Bathkal, 1991; Howeler, 1996; Rao et al., 1998).

In terms of groundwater recharge improvement; there is good evidence that vetiver grass technology improves groundwater. The case studies conducted in both high and low rainfall areas of India showed that, within the areas where vetiver hedgerows are located, water levels in wells are higher, springs do not dry up, and small streams run longer into the dry season (Chomchalow, 2003). Furthermore, a research by the University of Akola estimated that water recharge has improved by 30% at the location where vetiver is applied (Vetiver Information Network, 1994).

According to Paul Truong (2000), vetiver grass is a densely tufted, perennial clump grass with stiff leaf bases which overlap and does not have stolons or rhizomes, has massive finely structured root system that can grow very fast up to 3-4m in the first year. This deep root system makes vetiver plant extremely drought tolerant and difficult to dislodge by strong water currents. Its stiffed and erected stems can stand relatively strong water flows and, moreover, has high resistance to pests, diseases and fire. Physiological features such as its tolerance to extreme climatic variation like prolonged drought, flood, submergence and extreme temperature (-14ºC to +55ºC); ability to re-grow very quickly after being affected by drought, frosts, salinity and adverse conditions; tolerance to wide range of soil pH (3 to 10.5) without soil amendment; high level of tolerance to herbicides and pesticides; highly efficient in absorbing dissolved nutrients and heavy metals in polluted water and highly tolerant to grow in acid and salt affected soils, are few of the important characteristics.

The most important ecological features of Vetiver is its intolerant to shading and therefore, grows best in an open and weed free environment; weed control may be needed during establishment phase; grows on erodible or unstable ground Vetiver first reduces erosion, stabilizes the erodible ground, then because of nutrient and moisture conservation, improves its micro-environment so that other plants can establish. Because of these characteristics Vetiver can be considered as a nurse plant on disturbed lands. Most varieties of Vetiver are naturally sterile hybrids and do not set seed and produce stolons. Therefore, Vetiver has no danger of grass spreading and it stays at where it is planted.

One of the vetiver grass benefits is that once it is planted, it stays in place and is, therefore, not pestiferous and seldom spreads into neighboring land. Although Vetiver is a tropical grass, it can survive and thrive under extremely cold conditions and the optimal temperature for Vetiver

root growth is 25 ^{o}C (72 ^{o}F), but recent research showed that vetiver roots continued to grow at 13oC (55 ^{o}F).

2.1.3. Expansion of Vetiver Grass System

Vetiver was among the first recognized grasses used for soil and water conservation purposes in Fiji in the early 1950s. Thereafter, it was promoted by the World Bank for soil and water conservation in India since the 1980s. The use of Vetiver has been a tradition in India for contour protection and essential oil production from roots (Peyron, 1989; Lavania, 2004; Paul Truong, et al, 2008). The World Bank has initiated several projects in India for systematic development of Vetiver Grass Technology (VGT), now popularly known as Vetiver System (VS).

Paul Truong (2008) indicated that Vetiver system is simple, practical, inexpensive, low maintenance work incurring and very effective means of soil and water conservation. It is also a well-known sediment control, land stabilization and rehabilitation mechanism besides being environmentally friendly. When planted in single rows, Vetiver grass forms a hedge which is very effective in slowing and spreading runoff water, thereby reducing soil erosion, conserving soil moisture and trapping sediment and farm chemicals on site. In addition, the extremely deep and massively thick root system of Vetiver binds the soil and at the same time makes it very difficult to be dislodged under high velocity water flows. This very deep and fast growing root system also makes it very drought tolerant and highly suitable for steep slope stabilization.

Tony Cisse (2008) pointed out that Vetiver is unique in its growth in a wide range of soil types; ability to grow under very high saline conditions; ability to withstand flooding and submergence for long periods; non-competitive with and beneficial to other plants; tolerance to most insects,

plant diseases, fire, drought, heavy metals and other pollutants; and, noninvasiveness or unnecessary expansion.

2.1.4. Vetiver System in Ethiopia

The introduction of Vetiver grass to Ethiopia is controversial. According to Tessema (2000), Vetiver grass was introduced to Ethiopia in the 1960's by a British scientist who was working in Jimma Research Centre as coffee intensification programmer. National Research Council (1993),Alemu Mekonnen (2000) and Habtamu Wubshet (2009) reported also that Vetiver introduced to some Ethiopian coffee plantations in the early 1970s in order to protect coffee from other grass weeds such as Corch grass and CynodonDactylon. On the other hand Richard Grimshaw (2009) reported that Vetiver was first introduced from Tanzania to the Jimma Agricultural Research Center (JARC) in Southwest Ethiopia during the early 1970s. Twenty years later, Menschen für Menschen Foundation (MfM), initiated a Vetiver hedgerow program for soil and water conservation in the Metu area.

2.1.5. Use of Vetiver on Farm Lands

According to Tesfaye Kumsa and GadisaGobena (2008), one of the alternatives sought to prevent further loss of soil fertility via erosion had been terracing of field crops with Vetiver grass. Global experience shows several advantages of using Vetiver grass on crop field terraces. It is capable of resisting silts and retarding runoff allowing water to be slowly absorbed into the soil. Its strong fibrous root system that penetrates deep into the soil forms a tightly knitted network that binds underground soil together and retards water flow assisting the water to seep into the soil.

Vetiver hedgerows are known to preserve 25-70 % water to the advantage of the crop field. Since Vetiver grass root system grows more vertically than horizontally, it does not compete for more space with crops planted in the field. Mulching from Vetiver grass leave cuts adds more fertility to the soil through balancing the organic content, plant nutrients and microorganisms.

Alemu Mekonnen (2000) indicated that the grass can be effectively used on the existing soil bunds, contours without any physical structure, waterways and cutoff drains, around ponds reservoirs, irrigation and drainage canals, micro basin and check dams.

2.1.6. Benefits of Vetiver Grass

The Vetiver System has many uses such as r soil and water conservation, soil moisture improvement, groundwater recharge, recycling soil nutrients, pest control, mulch, forage, cleanup of agricultural contaminated waste water, protection of farm infrastructure (as canals, drains, roads, and building sites). The vetiver system reduces soil loss from farm land by 90% and reduces rainfall runoff by 70% (Richard Grimshaw 2009). Such a situation significantly increases the amount of water available to crops; increase crop yield due to reduction of siltation on wetlands and in streams; recharge groundwater which subsequently improve flow of springs, streams; raise the survival rate of tree and coffee seedlings more than 80 percent.

In addition, the leaf of vetiver grass is used for fodder, roof thatching, making ropes, mats, hats, baskets, mattress stuffing, making brooms and others. The roots are used for improving the physical element of the soil by absorbing water, minerals and nutrients and maintaining soil moisture. Moreover, it is absorbing toxic substances in chemical fertilizers and pesticides, used in production of herbs and skin care substances. The volatile oils and aromatic ingredients are used in perfume and sops, respectively. It is used also as insect and rodent repellents.

Apart from its use as erosion preventer, Vetiver grass has been a sustained income generator for the rural community. People purchase the cut virtually year round for thatching hut roofs, green mats for festive, and fill for mattress and pillows. Though not practiced here in Ethiopia, vetiver grass leaves can also be used for handcraft weaving like winnowing baskets, trays, hats, lady's bags, belts, picture frames, lampshades and many other household utensils. Vetiver grass has extensively been used in the perfume industry, bio-fuel, pond filter, compost making and mushroom culture (Tesfaye Kumsa and Gadisa Gobena 2008).

3. RESEARCH METHODOLOGY

3.1 General Description of the Study Area

3.1.1 Location

Tulube Peasant Association is one of the 29 rural peasant associations that constitute Metu district of Illubabor Administrative Zone of Oromia National Regional State, South Western of Ethiopia (Figure 1). The peasant association has 13 villages and is located at 35^{o} 30' 15'' – 35^{o} 30' 45'' latitude and 80 ^{o} 15' 35'' – 80 ^{o} 20' 15'' longitude, at a distance of about 628 km from the capital, Addis Ababa. The neighboring peasant associations of Tulube are Sedo in the north and northeast, Ale-Buyain the south, Adele Sego in the west and Metu town in the east.

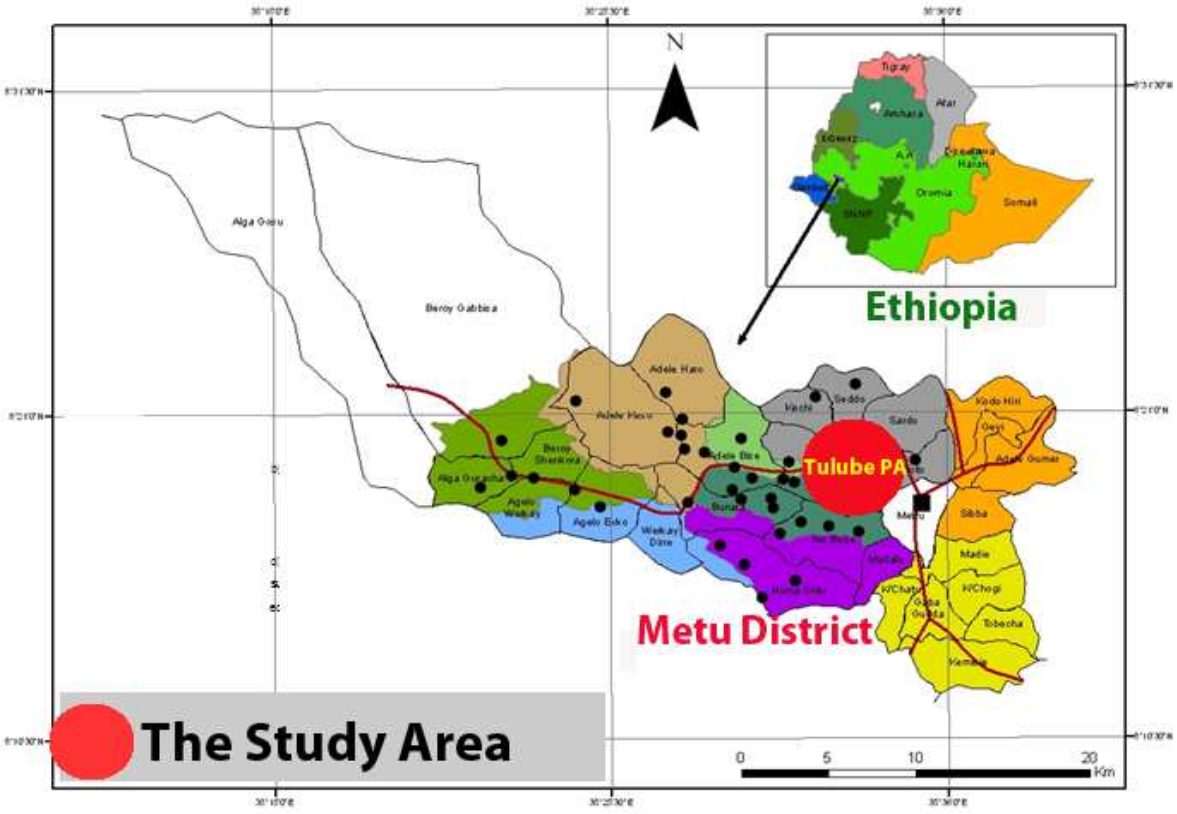

Figure 1: The Study Area

3.1.2 Topography

The total land area of Tulube peasant association is 2,965 hectares, of which 35% (1037.75 ha) is used for cultivation and homesteads, 25% (741.25 ha) covered by coffee plantation, 14% (415 ha) forest and bush land, 10% (296.5 ha) grazing land, 5% (148.25 ha) is wetland and the remaining 11% (326.25 ha) waste land.

3.1.3 Climatic Zone

Tulube peasant association has only one type of agro climatic zone, Wet-Woynadega (mild midland), with the average altitude of 1700m and ranges between 1520 to 1800 m.a.s.l. The peasant association is dominated by gentle slopes which are relatively steep hills with rolling terrains. Cambisols, Nitosols and Leptosols, listed in a descending order of area coverage, are the dominant soil types (Metu District Agriculture and Rural Development Office, 2010).

Tulube is among the areas that enjoy the highest rain in the country and covers from March to October accompanied with short dry season from November to February. The annual average rainfall of Tulube is 1,836.7mm and ranges from 1,660 to 2,200mm. The mean temperature is 19.4°C ranging from 12.3°C to 27°C.

3.1.4 Population

According to the 2007 Ethiopian National Census result, the total population of the peasant association is 4,246. But the data of Metu District Agricultural Development Office reveals that the current total population is 5,212of which 2,552 (about 49 %) are male and 2,660 (about 51 %) are female. The total household of the peasant association are 886 (Central Statistical Agency, 2007), but the data from Metu District Agricultural Development Office (2010),

indicated that the current households reached 1003 and of which 923 of the household heads are male and 80 are female. Tulube has the highest population pressure with average density of 143 persons per km² and this was found to be the highest for the District. The average family size of the households was five persons.

3.1.5 Socio Economic Condition

The main means of livelihood in the Peasant Association is agriculture which is based on mixed farming by the small- landholders. Agriculture in Tulube is predominantly rain-fed and the amount, reliability and distribution of rainfall are important determinants for crop yield. Majority of the farmers are depending on fruit and cereals. Coffee and Chat are the main cash crops. Agricultural productivity in the peasant association is declining due to loss of fertility, which is caused by soil erosion, poor land management, weeds, pests and diseases. Therefore, this heavy accelerated soil erosion caused by the stormy nature of the equatorial rainfall threatens the food security of the area.

Livestock production is an essential part of the farming system. Most farm households in the area keep small stock of sheep, poultry, cattle, equines and beehives. Even though the income generated from sales of animals and their products contribute significantly in farmers' livelihood, the people in Tulube are not able to benefit from livestock production due to prevalence of livestock disease, shortage of animal feed and poor animal management. Deforestation is also one of the problems aggravating poverty in the area (Metu District Agricultural Development Office, 2010).

Coffee is widely grown under the canopy of the natural forest, as part of an agro-forestry system. The shortage of energy sources such as firewood, charcoal, animal dung and crop residue in the peasant association are the main causes for the high deforestation.

Only one elementary school (1 - 4 grades) and one higher primary school (5 - 8 grades) are giving educational service in the area. There are one health center and one health post which give medical care service for the Tulube community. Poor sanitation and shortage of potable water are the major causes of health problems of the community. About 64% of the people use open field and bush as means of sanitation. Potable water coverage is only 11% (Metu District Bureau Registrar, 2010).

According to the Metu District Agricultural Development Office (2010), at present, SWC programmes conducted in the study area have three major parts: without government and NGO subsidy, with government subsidy and with NGOs technical and material support.

3.2 Research Design and Data Collection

3.2.1 Research Design

The study was conducted in Illubabor Zone, Metu District Tulube Peasant Association where NGOs intervene in planting and implementing vetiver grass for soil and water conservation purposes. Thus, all village households (Vetiver grass users and Non Vetiver grass users), village leaders, development agents, social workers, government and non-government officials in the area were the universe of the study from which samples has been drawn. In selecting the population, a number of issues have been taken into account including accessibility, proximity to the district town and availability of Vetiver grass plantation. In other word purposive sampling

method was used. Thus, from the thirteen villages in Tulube Peasant Association, based on the availability of vetiver grass plantation, only seven villages, namely Alelu, Buchillo, Chebaka, Gorba, Kersa-ke'e, Mendido and Mezoria were selected. From each village, fifteen households, ten Vetiver grass users and five Non Vetiver grass users were randomly selected for data collection purposes. To include the local leader's opinion, one village leader from each sample villages was interviewed. One development agent or social worker from each sample village was questioned. In addition, two officials from the District Agriculture and Rural Development Office and two officials from the two NGOs in the area were interviewed. A total of one hundred twelve respondents have been reached for the purpose of this study (Table 1).

Table 1:- Sample Area Respondents by Village and Peasant Association

Peasant Association	Villages	Peasant Association Level Respondents				Government & NGOs Higher Officials & DAs			Total Respondents
		Villagers			PA Total	MDADO Officials	DAs/SWs	NGOs	
		VG UERS	Non VG Users	Village Leader					
Tulube	**Alelu**	10	5	1	16	2	7	2	**27**
	Buchilo	10	5	1	16				**16**
	Chebaka	10	5	1	16				**16**
	Gorba	10	5	1	16				**16**
	Kersa-	10	5	1	16				**16**
	Mendido	10	5	1	16				**16**
	Mezoria	10	5	1	16				**16**
Total		**70**	**35**	**7**	**112**	**2**	**7**	**2**	**123**

3.2.2 Data Collection Tools

Data was collected using both qualitative and quantitative means and also gathered from secondary sources. The major secondary sources include research results, reports and unpublished documents.

In order to obtain the necessary data Questionnaires and Interviews have been used. The questionnaire contained mainly close ended and few open ended questions. In addition to the questionnaire, interview was conducted to obtain information from village leaders, Peasant Association, District and NGOs officials. The questionnaire and interview schedules, both open and close end questions were first pre-tested, standardized and finalized.

About ninety one farmers were questioned and interviewed to obtain information on personal and socio-economic status, awareness of environmental problems, attitude towards erosion control and experiences with Vetiver grass. Most respondents were farmers that actively participate in using Vetiver grass for soil and water conservation purposes. Group discussion and information exchange also conducted with farmers and the district experts.

Observation was also made at the places where the Vetiver grass is planted and used for soil and water conservation.

3.2.3 Data Analysis

Data was analyzed with descriptive statistics and qualitative descriptions. The data that is quantifiable like information from the close-ended questions were coded and fed into computer and analyzed using SPSS V. 19 software. The outputs were presented using tabulation and cross-tabulation of variables with percentage values.

The qualitative data, information obtained by open-ended questions, semi structured interviews, and focus group discussions were presented through qualitative description.

4. RESULTS AND DISCUSSION

4.1 Socio-Economic Profile of the Household

4.1.1 Age, Sex and Religion of the Household

The survey data indicated that, among the 112 sample household heads, males constituted 90% while female heads were only 10%. 86% of the respondents were married and 8% were widowed. The remaining 4% and 2% were singles and divorced, respectively (Table 2).

The largest age group was between 36 and 45 which was 27% of the total sample. The second largest age group was between 46 and 60 (26%). The third largest group was between 26 and 35 which was 21% of the total sample (Table 2). From this result it was possible to indicate that majority of the respondents (about 75%) belonged to the economically active age group.

Majority of respondents were Orthodox Christian (42%), whereas Protestants and Muslims were 33% and 25%of the sample population, respectively. In Ethiopia, one can find multi-ethnic groups with different language living together in a single area. But in Tulube peasant association, there were only two ethnic groups, Oromo and Amhara. Almost all sampled households (86%) belonged to Oromo ethnic group, while the remaining (14%) of the respondents belonged to Amhara ethnic group, which are the two dominant ethnic groups in the country (Table 2).

Table 2: Sample Households by Age, Sex, Marital Status, Religion and Ethnicity. (n=112)

Variables	Number of Respondents	%	Variables	Number of Respondents	%
Age			**Sex**		
18-25	15	13	Male	101	90
26-35	24	21	Female	11	10
36-45	30	27	**Total**	**112**	**100**
46-60	29	26	**Religion**		
>60	14	13	Orthodox	47	42
Total	**112**	**100**	Protestant	37	33
Marital Status			Muslim	28	25
Married	96	86	**Total**	**112**	**100**
Single	5	4	**Ethnicity**		
Divorced	2	2	Oromo	96	86
Widow	9	8	Amhara	16	14
Total	**112**	**100**	**Total**	**112**	**100**

4.1.2 Educational status of the Respondents

Out of the 112 households questioned, about 20% were found to be illiterate, 35% had attended adult education and able to read and write. 16% had attended up to 4^{th} grades and 21% up to 8^{th} grade. The remaining 7 and 2 % attended up to 10^{th} grade and 12^{th} grade, respectively (Table 3). The data showed that less than 50% of the respondents have different levels of formal education. This would have its own impact on the farmers' perception and adaptation of modern soil and water conservation practices.

Table 3: Educational Status of the Respondents. (n=112)

Variable	Number of Respondents	Percentage
Educational Status		
Illiterate	22	19.6
Read & write	39	35
Grade 1-4	18	16.1
Grade 5-8	23	20.5
Grade 9-10	8	7
Grade 11-12	2	1.8
Total	**112**	**100**

4.1.3 Occupation, Land Size and Income Status of the Respondents

The result obtained indicated that8% of the sample respondent households have no farmland since they were engaged in other economic sectors. 92% (103 respondents) have different size of farm, grazing, coffee and forest lands. The Land holding varies between 1 to 13 hectares. 16% of the farmers have less than 2 hectares whereas the remaining63% and 13% were holding up to 5 hectares and more than 5 hectares, respectively (Table 4). From this result it is possible to extrapolate that land was not fairly distributed in the area. A farmer with 15 family members holds 2 hectares of farm land while a farmer with seven family members holds 13 hectares of land.

Regarding the income status, households were categorized based on their farmland size, number of livestock, income generating means and family size. A household was considered high income group if he permanently possessed greater than five hectares of land, more than 4 oxen, more than 20 cows, more than 6 sheep and/ or goats, more than 20 chickens, a mule and a donkey. In addition there were additional income generating mechanisms like grinding meal and other

assets. The middle income groups were those who permanently possessed at least 2 hectares of land, 2 oxen, 5 cows, 3 sheep and or goats, 10 chickens and 1 donkey. The low income groups were those who permanently hold less than two hectares of land and own less than 2 oxen. Based on the above criteria, only one household was in the high income group. 43 households (38%) were categorized under the middle income group while majorities (61%) were categorized under the low income group (Table 4).

Table 4: Landholding, Occupation and Income Status. (n=112)

Variable	Hectare	%
Plot Size		
0	9	8
1	13	12
1.5	5	4
2	19	17
2.5	7	6
3	15	13
3.5	6	5
4	19	17
4.5	2	2
5	3	3
5.5	1	1
6	5	4
6.5	2	2
7	1	1
8	1	1
9	2	2
9.5	1	1
13	1	1
Total	**112**	**100**

Variable	Frequency	%
Occupation		
Farming	70	62.5
Trading	6	2.7
Government Employees	3	5.4
Farming & Trading	10	8.9
Farming & Daily Laborer	23	20.5
Total	**112**	**100**
Income Group		
High	1	1
Middle	43	38
Low	68	61
Total	**112**	**100**

4.1.4 Assessment of Farmers' Perception on the Impacts of Erosion

Accelerated soil erosion is primarily caused by farmers' land use practices. Likewise, the success of any soil and water conservation intervention depends on the extent to which the introduced conservation measures are accepted and adopted by the farming community. In other words, acceptance and farm-level adoption of the newly introduced conservation measures by the farmers is the decisive element for the success of soil conservation activities.

In the study area, the economic impacts of soil erosion as well as soil conservation measures were discussed with the farmers in respect to production trends of the last five to ten years. Farmers generally have developed experience about the effects of erosion on crop yields and have understanding of soil erosion problems. Their replies were unanimously positive to the question concerning knowledge about yield reducing effect of soil erosion and the benefit of soil and water conservation.

The finding suggested that farmers have a good perception on the problem of soil erosion but not sufficient for the farmers to adopt modern conservation measures. The adoption of SWC measures was related to labor supply and economic status. Tenure security has been also identified to be an important factor for adoption of conservation means, besides farmers' awareness and labour availability. All the above factors affect farmers' decision whether to adopt the introduced SWC measures or not. In addition, old respondents considered pests and diseases as great threats to their livelihood than soil erosion, and showed very little interest on technologies that mainly focus on soil conservation alone.

In the evaluation of crop yield trends at plot levels, farmers used four major trends viz. increasing, decreasing, fluctuation and no change. A single farmer could observe different crop yield trends on his plots depending on the micro-climate, location, soil fertility and availability of inputs.

Soil erosion and concomitant factors like deforestation, overgrazing, and intensive use of marginal lands without replenish the lost nutrient, rainfall variability and weeds were reported as the major causes for farm size reduction and declining of yield (Metu District Agricultural Development Office, 2010).

Most of the farmers have awareness that the crop yields reduced rapidly if cultivated land is used for consecutive years without any land management. This has indicated also that farmers understand both the advantages and disadvantages of soil and water conservation techniques to mitigate the effect of soil erosion and moisture stress.

The survey result also showed that 71% of the respondents agreed that soil erosion can reduce crop yields while 29% of the respondents disagreed. The result indicated that rainfall variation was not a severe problem in the area since the area has a long period of rainy season compared with the other parts of the country. Soil plant nutrient reduction and weeds were also other factors that contributed to crop yields reduction (Table 5.).

Table 5: Reasons for Yield Reduction in the Study Area. (n=112)

Variable	Agree		Disagree		Total	
	No	%	No	%	No	%
Soil Erosion	80	71	32	29	112	100
Rainfall Variability	15	13	97	87	112	100
Nutrient Reduction	85	76	27	24	112	100
Weeds	45	40	67	60	112	100

4.1.5 Characteristics Related to Soil and Water Conservation Usage

Among the farmers in the different age groups, 94% have participated in different soil conservation measures such as traditional soil conservation (contour plowing and cultural ditches,) and structural conservation like soil bund and waterways, and biological conservation like vetiver hedgerows. Majority of the farm households (89%) involved in the modern SWC measures were below the age group of 60 and those who used traditional conservation system were all in the age group of above 60 years. This showed that the farmers involved in recommended practices were younger than those of non-participants. 46 % of the respondents in the age group above 60 age were not using SWC at all, 23% were using the traditional SWC measures and only 31% of the above 60 years age group uses modern SWC systems (Tables 6 and 7).

Table 6: SWC Types Practiced in the Study Area. (n=103)

Variable	Frequency	Percentage
Tradition SWC measures	13	13
Structural SWC measures	56	54
Vetiver grass for SWC measure	77	75%

It was clearly identified that old aged farmers were reluctant to the modern water and soil conservation measures because of labor shortage that hindered them practicing the labour intensive soil and water conservation measures. On the other hand 89% of the farmers were

Table 7: Distribution of sample household heads by SWC measures & age group (n=103)

Age group	Traditional Conservation only		Structure only		Vetiver Grass only		Both Traditional and Structure		Both Structure & Vetiver		All		Non		Total	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
18-25	-	-	1	12.5	5	14	-	-	7	18	-	-	-	-	13	13
26-35	-	-	2	25	10	27	2	22	6	15	-	-	-	-	20	19
36-45	-	-	4	50	7	22	3	22	15	38	1	100	-	-	30	29
46-60	2	40	1	12.5	13	35	1	34	10	25	-	-	-	-	27	26
>60	3	60	-	-	1	2	1	22	2	5	-	-	6	100	13	13
Total	5	100	8	100%	36	100	7	100	40	100	1	100	6	100	103	100

using different modern SWC measures and among them 85% were below the age of 60 years. Regarding Vetiver grass usage, 75% of the households were using Vetiver grass with and without structural measures (Table 6and 7).

This study also showed that farmers' participation and involvement in the establishment of Vetiver hedgerows was high due to the facts that Vetiver implementation requires less time, less technical inputs, easy to replicate and once established needs little follow-up. The experience of the area indicated that the acceptance of vetiver hedge rows for soil conservation was unquestionable. The respondents agreed that Vetiver utilization was environmentally sound, socially acceptable, economically feasible and technically fit for the study area. As a result 75% of the interviewed sample farmers were applying Vetiver grass for soil and water conservation.

Even though the remaining 25% respondents were not planting Vetiver grass on their plot, they were using it for different in-house uses by buying it from the Vetiver grass user farmers.

4.2 Vetiver Grass for Soil Conservation

Vetiver grass was first introduced to the area by an NGO, Menschen für Menschen Foundation, in the early 1990s (MfM, IIRDP, 2000). According to the study, the MfM Vetiver introduction activity concentration was not in this particular study kebele rather intensive work was done in other PSs of the district.

Later in 2005, an NGO called Ethio-Wetlands and Natural Resource Association (EWLNRA) has launched the program on Vetiver grass hedgerows for soil and water conservation in the study area, Tulube Peasant Association (Metu District Administration Office, 2010). According to the research result, vetiver grass was effective both alone and/or combined with other traditional and modern methods of SWC (figure 2).

Figure 2: Vetiver grass hedgerow, Tulube.

4.2.1 Uniqueness of Vetiver Grass

Based on the result of the study, 75% of the farm households were using Vetiver grass for soil and water conservation purposes (Table 8).

Table 8: Vetiver Grass User and Non-User Respondents, Tulube. (n=103)

Variable	Frequency	Percent
Vetiver Grass User Farmers	77	75%
Non Vetiver Grass User Farmers	26	25%
Total	**103**	100%

According to this study, farmers preferred the bio-conservation measure because it forms a strong permanent hedge. When Vetiver grass was planted close in a row, it developed thick and highly denser hedges that intercept each other and form strong network. Once established, the hedges stayed long and needed only little maintenance. This strongly erected hedge slowed runoff and trapped crop residues and silts transported by runoff and, then, allowed sediments to stay on the site forming natural terraces (figure 3).

Figure 3: Highly denser vetiver hedges, Tulube.

The other characteristic that was appreciated by farmers was its deep tough root. Vetiver's deep, massive and fibrous root system grows vertically deep into soil and forms a tightly knitted net and anchor a hedge firmly and binding the soil (Figure 4). This root system makes vetiver grass a unique and useful plant on earth.

Figure 4 Deep massive and fiber vetiver roots, Tulube.
Source: The Vetiver Network International Blog.

According to the respondent households, there was no other plant that can grow faster in any kind of soil type and weather condition and appropriate for conservation like Vetiver grass. In addition, they indicated that the plant can survived from pests, fire and grazing animals and did not invade surrounding areas or spread into adjacent areas. If they do not want the hedge, farmers controlled and eliminated it easily by digging out. No household identified Vetiver grass as weed in the study areas.

4.2.2 Vetiver Grass Plantation

The focus group discussion pointed out that Vetiver grass is being propagated mainly by root division in the study area. Splitting tillers from a mother clump and each slip included at least two to three tillers and a part of the crown. After separation, the slips were cutback to make it appropriate for plantation. Almost all framers in the study area who used Vetiver grass for soil and water conservation were using this easy method of propagation (Figure 5).

Focus group discussion with sample farmers and Metu Ethio-Wetlands and Natural Resource Association Office indicated that Vetiver grass was planted on plot of voluntary farmers since 2005. Farmers first had prepared 50 to 70 meter long Fanya Juu terraces on their farmland and planted 700 to 1000 Vetiver grass tillers (shoots). It was also noticed that some farmers were planting Vetiver tillers without making Fanya Juu terraces to save labor and time. The study found out that once the farmers were supplied with the initial planting material, within short period they multiplied clumps from their plot for further expansion and sale.

Figure 5: Vetiver grass clumps used for propagation in Tulube

4.2.3. Vetiver Grass Hedgerows for Soil Conservation

According to the information from the MDADO (2010), heavy monsoon showers of the study area removed the surface soil through runoff and the eroded sediments were deposited on the riverbeds. The deposit has reduced water carrying capacity of the rivers and resulted in overflow of the river water, causing inundation of crop lands. The focus group discussion indicated that the land elevations in Tulube PA have reduced over time due to soil erosion.

On the other hand, the poor land management in the area made the land surface more susceptible to soil erosion. Surface run-off washed away the topsoil from cultivated lands. This surface erosion reduced land elevation and the land became susceptible to flooding (figure 6).Both the data from government and non-government organizations (2010) emphasized that the Vetiver system of soil conservation is currently well known as the “flow through” system in the study area. The benefits of Vetiver grass hedges such as its ability to filter runoff and trap sediment, which fills rills, gullies and associated depressions behind the hedges, disperse concentrated flows and reduce the amount of runoff were highly appreciated by the farmers of the study area. As a result loss of soil in cultivated land was reduced by 75% (Metu EWNRA, 2010). The current study has confirmed that Vetiver grass planted in row formed dense hedges that slowdown the flow velocity, spread and divert runoff water and create a very effective filter that controls erosion and maintain soil physical features. In addition Vetiver roots stabilized the soil during intense rainfall and improve soil nutrients status (figure 7).

Figure 6: Effects of soil erosion in the study aria.

Figure 7: The Dense vetiver grass hedgerow on the study area farm land

All the Vetiver grass user households unanimously agreed that the Vetiver grass has a strong, deep and fibrous root that slowed runoff water and trapped sediment (Table 9). And it was acclaimed as the best on-farm erosion control method. The outcome of the focus discussion indicated that Vetiver was best and effective when planted in rows on sloppy farm lands and has been used successfully for flood and erosion control on the flood plains of the study area. All farmers appreciated the Vetiver grass capacity to reduce the velocity and distribute heavy runoff

Table 9: Vetiver grass hedgerows for runoff and sediments control. (n=93)

Suggested Questions	Agree		Disagree	
	Frequency	%	Frequency	%
Do you agree that Vetiver grass, when planted in row:				
a. Form thick hedge with strong, deep, fibrous and networked roots?	93	100	-	-
b. Slow and spread runoff water along the hedgerows?	93	100	-	-
c. Trap sediments and keep soil on farm land?	93	100	-	-
d. Reduce soil erosion?	93	100	-	-

along the hedgerows and terminate its erosive power. As a result, soil erosion was controlled so that sediment and nutrients were trapped on site.

4.2.3.1. Vetiver Grass as Slope Stabilization

75% of the farm plots in the study area have gentle slopes and unstable mainly due to heavy rain that causes sheet erosion. This situation aggravated due to external factors like deforestation (Metu District Agricultural Development Office; 2010). The focus group discussion pointed out that if corrective measures and proper land management were not followed, the soil instability could have led to heavy rill and gully erosions that destabilize the environment. Figure 8showed one of the most important uses of Vetiver grass in highland agriculture and as a means of controlling the erosion on farm land located on sloppy topography.

Figure 8: Vetiver hedgerows on Maize farm, Tulube.

As per the data in Table 10, majority of the respondents agreed that Vetiver grass was easy to implement (80%), easy for maintenance (82%), inexpensive (74%), and environmentally friendly (100%) for soil conservation measures in general and for slope stabilization in particular.

Table 10: Questions Related to Vetiver Grass for Slope Stabilization. (n=112)

Suggested Questions	Agree		Disagree	
	Frequency	%	Frequency	%
1. Do you agree with the idea that vetiver grass binds soil and is used for:				
a. Farm land stabilization?	101	90	11	10
b. Slope stabilization?	98	88	14	12
2. Using Vetiver grass is:				
a. Accessible?	95	85	17	15
b. Cost effective (inexpensive)?	83	74	29	26
c. Easy to manage?	90	80	22	20
d. Easy to maintain?	92	82	20	18
e. Environmentally Friendly?	112	100	-	-

4.3. Vetiver Grass for Water Conservation and Wetland Rehabilitation

The focus group discussion with farmers and development agents justified that the ground water level was reducing. As a result, springs were drying up relatively in short time after the big rainy season. Small streams were not running during the dry season and water volume in big rivers was reducing significantly and the rain season was also shortened.

The data from Metu EWNRA office (2010) showed that when Vetiver hedgerows were planted rainfall runoff has reduced by more than 75% in the study area. The hedgerow helped in slowing down and spreading out runoff over a larger area. In particular, the penetration of soil hardpans by Vetiver roots was found significantly helpful in water infiltration and soil moisture improvement. Response from sample households (Table 11) showed that around the Vetiver hedgerow, soil moisture was improved so that crops nearby grown faster than crops outside the areas of Vetiver hedgerows even during shortage of rainfall.

Table 11: Questions Related to Vetiver Grass for Water Conservation. (n=112)

Suggested Questions	Agree		Disagree	
	Frequency	Percent	Frequency	Percent
Do you agree with the idea that vetiver grass hedgerows:				
a. Increase infiltration?	77	69	35	31
Increase soil moisture?	77	69	35	31
b. Increase underground water?	61	54	51	46
c. Increase flow time of springs and streams?	64	57	48	43
d. Increase well water level?	60	54	52	46

Based on the data from EWNRA (2010), out of 520 naturally existing springs 480 (90%) were dried due to environmental degradation of the study area. After the introduction of Vetiver grass to the area from 2005 up to 2010, 460 (96%) springs have recharged and permanently served throughout the year as source of water for the community. Only 20 (4%) springs are still dry (Table 12). In addition, the water level in hand-dug-wells has increased.

Table 12: Rehabilitated Water Resources, Tulube.

Variables	Exist	Dried	%	Recovered	%	Still dried	%
Wetlands	3	3	100	3	100	0	0
Springs	520	480	92	460	96	20	4

There were three wetlands in the study area. Wichi, Meko and Gorba Wetlands were covering 360,160 and 100 hectares of land. They were the main source of grass for thatching and grazing purposes. All dried due to the environmental change, which was a great disaster. Since the introduction of Vetiver grass to the area water percolation has improved in most parts of the upper catchments. Thus, water started to gather and concentrate in the meadows. As the result of this intervention eventually the three dried wetlands were regenerated and currently cover 620 hectares. Many springs, streams and rivers have also recharged and are flowing throughout the year.

4.4. Vetiver Grass for Soil Fertility Improvement

The Metu EWNR Office data (2010) showed that the main objective of introducing Vetiver grass to the area was to improve soil fertility and moisture. The information from sample farm households and documents from NGOs (2010) justified that maize yield has increased since the introduction of Vetiver grass in 2005. Accordingly, with improved seed, fertilizers and Vetiver hedgerows maize yield increased by 80% where as local seed with the treatments the yield increased by 36% (Table 13 and 14). The table also shows that maize farm with vetiver grass gives more yields. All the thirty five non Vetiver grass user households unanimously agreed that maize yield on their farm was by far less than the maize yield of Vetiver grass hedgerows users both in term of quantity and quality.

Table 13: Maize Yields in the Study Area, Before 2005.

No	Inputs	Yield per hector (Quintal)
1	Improved seed(25 kg) + DAP(100kg) + Urea(100kg)	40
2	Local seed (25kg) + DAP (100kg) + Urea (100kg)	22
3	Local seed (25kg)+ Dap (100kg)	18
4	Local seed(25kg) + Compost or animal dung	16
5	Local seed (25kg)+No other inputs	13

Table 14: Mean Average Maize Yields, 2007-2009.

No	Inputs and Conservation Practices	Yield per hector (Quintals)
1	Improved seed (25kg) + DAP (100kg) + Urea (100kg) + Vetiver without Structure	72
2	Improved seed (25kg) + DAP (100kg) + Urea (100kg) + Vetiver with Structure	70
3	Improved seed(25kg) + DAP (100kg) + Urea (100kg) + Structure only	56
4	Local seed (25kg) + DAP (100kg) + Urea (100kg) + Vetiver without Structure	35
5	Local seed (25kg)+ DAP (100kg) + Urea (100kg)+ Vetiver with Structure	32
6	Local seed (25kg) + DAP (100kg) + Urea (100kg) +Structure only	30

In addition, the study confirmed that the maize with Vetiver grass hedgerows was more green and grown better than the maize without Vetiver grass (Figure 9 and 10).

Figure 9: Maize Farm with VG, Tulube.

Figure 10: Maize Farm without VG, Tulube

4.5 Other Uses of Vetiver Grass

Vetiver grass is nowadays used for roof thatching purpose in the study area. The sample households unanimously agreed that mature Vetiver grass, due to its toughness and resistance to pests found to be an excellent thatch with long life. Vetiver leaves have a better quality and durability than the traditionally used thatching grasses.

The study pointed out that the local grass served only for 4 to 5 years while Vetiver grass served at least longer without replacement compared with the local grasses. For the fact that it is less expensive and durable 80% of farmers in the study area are using Vetiver leaves for construction purposes (home, kitchen, toilet, traditional grain bin, beehives, and livestock shades). Unlike the traditional grass grown on the large areas that consumed huge farm and wetlands, Vetiver grass grows only on strip in the farm (Figure.11).

Figure: 11 Vetiver Grass Hedgerows on Farmland after Harvest, Tulube

Source: Metu EWNRA, 2010.

The result of the study revealed that the sample households are using Vetiver leaves for house (21%), kitchen (66%), toilet (53%), grain bin or store (24%) and for beehives (16%) construction.

Vetiver grass clumps and leaves are used as a source of income in the study area. The clumps are sold for further multiplication and leaves are for thatching, coffee ceremony and other casual ceremonies. The development agents working in Tulube PA confirmed that one Vetiver grass clump (Figure 12) is sold for two Birr and one bundle of VG leaves (Figure 13) is sold for ten Birr. They also sell the grass for the above stated in-house uses and also for those who make hats, bags, baskets and other handicrafts. In addition the urban dwellers and non Vetiver grass user farm households buy Vetiver grass for different uses. As a result, on average farmers generate up to one thousand Birr per year. As Vetiver grass coverage increase the income is also

increasing accordingly. This income generating has increased the acceptance and expansion of Vetiver grass in the area.

Figures 12: Vetiver clumps ready for Sale. Figures 13: Vetiver leaves ready for Sale.

The study also indicated that the young Vetiver grass leaves are used for fodder to feed livestock, but rough mature leaves cannot be used for such purposes. Vetiver grass planted along the field boundaries and on farm land is harvested to be used as fodder or animals are allowed to graze it at a fairly young stage, every two weeks or less.

Unlike many other grasses, harvesting or grazing does not stop the growth of Vetiver or cause any harm to its development. Vetiver grass is a year round source of animal fodder. This is particularly important during the end of the dry season, where fodder is in short supply and many cattle and sheep suffer from feed shortage. The study showed that 39% (Table 15) of the respondents were using Vetiver grass for animal feeding

Farmers in Tulube kebele also harvest Vetiver straw to make mud bricks resistance to cracking. . The house built using Vetiver straw has low thermal conductivity, which makes the construction

comfortable and energy-efficient. Farmers of the study area used also the mud for wall plastering. The study found out that 73% (Table 15) of the respondents are using Vetiver grass for wall plastering.77% (Table 15) of the sample households are using Vetiver grass leaves for mattress for the reason that it is durable and free from fleas and other bedbugs. The study result indicated that farmers were preferring mattresses made from Vetiver leaves. 88% and 13% of the sample households used also Vetiver leave to make broom and rope, respectively.

Field rodents are the cause for maize and other crops yield reduction in the study area. The most common rodents are rats and they nested in the structures built for soil and water conservation purpose. As per the information from Metu Agricultural Development Office, (2011) rodents were damaging crops in the field and caused 10-12% crop yields reduction. Rats were damaging also the grains in the traditional silos. The information from the respondent farmers clearly indicated that after the introduction of Vetiver grass, the damage caused by rodents has been minimized by 85%.

This study looked into other uses of Vetiver and found out that most of the farmer planted Vetiver grass around their home mostly to protect homes from snakes. Snakes cannot cross the dense and hard leaves of Vetiver grass.

Vetiver grass is also used to protect beehives from ants. Farmers have planted Vetiver grass around beehives to protect it from ants. Accordingly, 40% of the household were using Vetiver hedges to protect their properties from the attack of rodents, snakes and ants (Table 15).

Table 15: Other Uses of Vetiver Grass, Tulube. (n=112)

Variables	Frequency	Sample Respondents	Percentage
a. Vetiver Leave			
1. Thatching for:			
House	23	112	21
Kitchen	74	112	66
Toilet	59	112	53
Grain Bin (Store)	27	112	24
Beehive House	18	112	16
2. Animal Feed	44	112	39
3. Mattress Stuffing	86	112	77
4. Broom Making	98	112	88
5. Rope Making	15	112	13
6. Mud for Wall Plastering	82	112	73
7. In-house use for Different Ceremonies	106	112	95
b. Vetiver Root			
1. Root powder for religious ceremony	61	112	54
2. For medicine	27	112	24
c. Hedgerows			
1. Rodents, Snakes and Ants protection	45	112	40

5. CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Land degradation due to erosion is a global problem and Ethiopia is changing into desert mainly due to intense water erosion. Over the recent decades the country's forest coverage level has reduced to 3% and consequently 97% of the total landmass remained highly exposed to erosion by water and wind.

To overcome erosion problem, however, the government of Ethiopia is taking different soil conservation measures which are expensive, labour intensive and demand technical knowhow to establish, manage and maintain the structures. To minimize these difficulties, biological soil and water conservation method like Vetiver grass system, which is effective and simple to manage and maintain, is preferred now days.

The study result showed that soil erosion is a critical problem in Tulube Peasant Association. Clearing of marginal lands of steep slopes to produce food for the growing population coupled with poor land management made the land surface more susceptible to degradation. Consequently, soil fertility has reduced and production per unit area significantly dropped, paving the way for food insecurity.

Based on the result of this study it is possible to conclude the following points:-

1. The degree of farmers' perception on soil erosion problems and adoption of Vetiver grass for soil and water conservation measures are positively related to their age, education level and wealth status. In addition, the degrees of awareness creation activities and initial investment support by the concerned parties have its own impact on farmer's

adoption of the technology. The survey result generally revealed that the negative impacts for the introduction and implementation of SWC in the area were lack of formal education by almost half of the study area farm households and aged respondents. The aged respondents consider pests and disease as great threats to their livelihood than soil erosion and showed little interest on the new SWC technologies and also reluctant to the technology primarily because of its labour intensiveness. But by the help of the District Agricultural Development Office and NGOs, majority of the farm households are now using traditional and structural SWC measures to protect soil erosion and land degradation.

2. Since 2005 Vetiver grass has been introduced to the area and its acceptance as a means of soil and water conservation has been significantly increased. Majority of the farmers' have preferred and involved in the establishment of the grass hedgerows than other SWC measures because its implementation is simple and cheap (requires less time, less technical inputs, easy to replicate and once established needs little follow-up), and its effectiveness, suitability, cultural and social compatibility. The study also showed that Vetiver utilization was environmentally sound, socially acceptable, economically feasible and technically fit for the study area.
3. Farmers have been significantly benefiting from Vetiver grass as effective means of soil and water conservation (control erosion, reduce and filter runoff, preserve sediment, stabilize and rehabilitate the degraded land), improved agricultural production and productivity. In addition, they use Vetiver grass for household construction and furnishing, ceremonial, handicraft and medicinal purposes. They sale Vetiver leaves and clumps to generate additional income which contribute to improve their socioeconomic

status in the community. In general, the study verified that after planting vetiver grass in the area as soil and water conservation mechanism erosion is reduced, soil moisture and fertility improved and as a result crop yield significantly increased. The dried wetlands, springs and rivers are recharging and ground water level is increasing.

The District Agricultural Development is working on the physical SWC measures and most of the Vetiver system promotion works are done by the NGOs without considerable attention/contribution from the government side. Since land degradation due to erosion is priority concern of the study area, it is an adequate justification to use and promote Vetiver as a means to control erosion. To increase the current number of Vetiver grass users in the study area from 75% to 100% and keep its sustainability, the inputs of all actors (governmental, non-governmental bodies and local community) is highly needed. The multiple uses of vetiver grass and scaling up of its application must be seen as one of the best sustainable land management practices and means of livelihood for the community.

5.2 Recommendation

Based on the results of this study, in order to alleviate soil erosion and land degradation problems and to improve the living standard of the farmers in the study area in particular and in the country in general, in the foreseeable future the following points should be critically considered.

- Soil and water conservation policies that fail to account for inter household and inter plot variation and important biophysical factors that influence the adoption of soil and water conservation measures by farmers must be revised and the policies should consider design and promotion of pertinent technologies.

- Unlike the mechanical SWC methods, Vetiver grass system is much cheaper and low in its labor requirement. Therefore, Vetiver grass deserves scaling up and promoting for country wide replication. To do so, better public awareness creation work on multiple uses of Vetiver grass must be undertaken and farmers need to be motivated, adequately funded and technically assisted. This can also be supported through organizing continuous media coverage.

- Champions of Vetiver grass should be selected based on sound criteria and rewarded with financial, material and technical support. This can help the Vetiver grass promotion work significantly.
- On the other hand Vetiver grass can be used together with other SWC measures in agro-forestry and gulley and steep slopes stabilization and farmers must be motivated to do so.

- The agricultural development office gave more attention to other SWC measures than Vetiver grass. No budget was allocated to promote Vetiver grass to the area. The existing activities are only supported by NGOs. Therefore, the government has to plan and give due attention to promote the grass since it is promising and useful as land reclamation mechanism and source of income for farmers.

- Currently, the prevalent limited sources of seedlings in the area are not sufficient to fulfill the farmers' demand. Therefore, other options and techniques of mass propagation should be explored and made available without much delay.

- Parallel to planting the Vetiver grass for soil and water conservation purpose, supplementary leguminous fodder varieties should be planted along the hedgerow to increase the feed value of the grass and soil fertility maintenance.
- Handcrafts made from Vetiver grass are economically beneficial for farm households. Particularly, if women and young girls are motivated to participate in making different decorative and marketable products, they can get the opportunity to possess assets and empower themselves. Therefore, the prevailing traditional mode of production should be upgraded to more advanced and organized system of design and implementation through trainings and workshops so that farmers can fully utilize the economic advantage of the grass.
- Finally, research on vetiver grass that aimed at refining the already available technologies and other potential use of the grass which may help to enhance its utilization and integration in various farming systems has to be conducted.

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Appendix I

Definition of Terms

Agro-forestry: Land-use systems in which trees or shrubs are grown in association with agricultural crops, pasture, or livestock and in which there is ecological and economic interaction between the trees and the other components.

Biological Soil Conservation: A soil conservation measure for protecting soil from loss or damage through planting trees and vetiver grasses, for instance.

C4 photosynthetic Plants: Plants like corn (maize) and grass (vetiver) that create a four carbon (C4) sugar as their basic sugar unit when performing photosynthesis. They are adaptable to arid conditions, with higher tolerance to drought, and also grow in high temperature and high irradiance.

Cambisol: Is a soil at the beginning stage of soil formation This is evident from the weak horizon differentiation, mostly brownish discoloration and/or structure formation in the soil profile. Cambisols are developed in medium and fine-textured materials derived from a wide range of rocks.

Conservation tillage: Land-use systems in which trees or shrubs are grown in association with agricultural crops, pasture, or livestock and in which there is ecological and economic interaction between the trees and the other components**.**

Kebele: A lower government administrative structure consisting of various villages or peasant associations.

Land degradation: The deterioration of land through such processes as soil erosion, Stalinization, acidification, pollution, or sediment deposition.

m.a.s.l. : Meters above sea Level is a standard metric measurement of the elevation of a location in reference to historic mean sea level.

Mulch: Any material, usually straw or other plant residues, left on the surface to protect soil.

Nitosols: Clay rich subsoil which is characterized by good structure, high fertility level and contain considerable amount of plant nutrients. This soil type is exclusively limited to Africa's rift valley region.

Physical Soil Conservation: A conservation measure to protect soil from loss or damage through physical construction such as contour and terrace (soil or stone bund, or both) and others.

Rainfall erosive: The ability of rain to cause erosion relative to rainfall intensity.

Region: The administrative constituents of the federal state of Ethiopia like States in India.

Runoff: Rainfall that does not soak into the soil but flows into surface waters.

Shifting Cultivation: The production of food crops, usually for subsistence, alternating with fallow where the land is allowed to revert to forest or grass.

Soil Conservation: The combination of appropriate land use and management practices that promote the productive and sustainable use of soils, thereby minimizing erosion and other forms of land degradation.

Soil Erodibility: The susceptibility of soil to be eroded**.**

Soil Erosion: The gradual wearing away of top soil and other soil particles by water, wind or mass movement.

Soil Structure: The combination or arrangement of primary soil particles into secondary particles or units.

Vetiver System (VS): Is a system of soil and water conservation whose main component is the use of the vetiver grass in hedgerows. It is promoted by the Vetiver Network International (TVNI), an international non-government organization.

Water erosion: The erosion or removal of soil primarily through the forces of water.

Wind erosion: The erosion or removal of soil primarily through the forces of wind**.**

Woreda: An administrative area, like blocks in India, with broader sense that constitutes Kebeles and Villages.

Woynadega: Woynadega is an Amharic term equivalent to mild midland or temperate, meaning land that is between highland and lowland with medium altitude and moderate temperature.

Zone: An administrative area within the bounds of regions, like districts in India.

Appendix II

Interview Schedule for Villagers

Objective:

This Interview Schedule is prepared and designed to collect relevant primary data related to the usage of vetiver grass for soil & water conservation from Tulube PA farmers who use the vetiver grass for more than two years and also from non vetiver grass users for comparison purposes. The information obtained from this interview questionnaire will be used only for academic purpose and the personal information will be kept confidential. Please tick check mark (√) in the box you consider relevant and or fill the blank space provided.

I, therefore, kindly request you to feel free in answering the questionnaire.

Thank You

Tekalign Negash

A. General Information

1. Interview No.:_____
2. Date of interview: _____
3. District: Metu
4. PA: Tulube
5. Village: _____
6. Name of the Enumerator: _____ Signature_____

B. Personal Information

7. Sex: (0) Male ☐ (1) Female ☐
8. Ages: (0) 18 – 25 ☐ (1) 26 – 35 ☐ (2) 36 – 45 ☐
   (3) 46 – 60 ☐ (4) > 60 ☐
9. Ethnicity: (0) Oromo ☐ (1) Amhara ☐ (2) Tigre ☐ (3) Others (specify)_____
10. Religion: (0) Muslim ☐ (1) Orthodox Christian ☐ (2) Protestant ☐
    (3) Catholic ☐ (4) Traditional Believers ☐
11. Marital status of the household: (0) Married ☐ (1) Single ☐
    (2) Divorced ☐ (3) Widowed ☐
12. Family size: (0) 1 – 2 ☐ (1) 3 - 4 ☐ (2) 5 - 6 ☐ (3) >6 ☐

C. Education, Occupation and Income Information

13. Family member's age, sex and educational status

Age	Sex		Educational Status						
	Male	Female	0	1 - 4	5 - 8	9 - 10	Certificate	Diploma	University
0 - 5									
6 - 14									
15 - 25									
26 – 35									
36 - 45									
46 - 60									
>60									
Total Household									

14. Educational status the of household

(0) Cannot read & write ☐ (1) Read & write (1 - 4) ☐

(2) Elementary School (5 - 8) ☐ (3) Secondary School (9 - 10) ☐

(4) High School (11 - 12) ☐ (5) Certificate ☐

15. Number of active workers in the family including household head (0) one ☐

(1) two ☐ (2) three ☐ (3) four ☐ (4) more than four ☐

16. What is your major occupation? (0) Farming ☐ (1) Trading ☐

(2) Governments employ ☐ (3) Laborer ☐ (4) Other

(specify)___

17. In which income group do you locate yourself in the community?

(0) High income group ☐ (1) Middle income group ☐ (2) Low income group ☐

D. Socio Economic and Land Usage Related Information

18. Do you have farm land? (0) Yes ☐ (1) No ☐

19. If no, specify your job_____

20. If yes, specify the number and size of the plot _____ & _____hectare

21. How did you get the land? (0) from government ☐ (1) from family ☐

(2) leased ☐ (3) purchased ☐

22. Land ownership? (0) Privet ☐ (1) Public/Government ☐

23. Is the land ownership status has any impact on the land management level?

(0) Yes ☐ (1) No ☐

24. What do you think about the right to private ownership of land? _____

_____

25. Number of years owne**d**/cultivate**d**/managed _____

26. Type of the land (0) Cultivated land ☐ (1) Fallow land ☐

(2) Grazing land ☐ (3) Homestead area ☐

27. Number of cropping season (0) Once ☐ (1) Twice ☐ (2) Triple ☐

28. Plot distance from home_____

29. Plot fertility level (0) Very fertile ☐ (1) Fertile ☐

(2) Medium ☐ (3) poor ☐

30. What are the major crops types you have been using to your farmland?_____

31. Do you have farm animals /livestock? (0) Yes ☐ (1) No ☐

32. If yes, state the type and quantity. (0) Ox/en_____ (1) cow/s_____

(2) sheep/ or goat/s _____ (3) Chicken _____ (4) Mule _____

(5) Donkey _____ (6) Others _____

33. Do you have coffee farm? (0) Yes ☐ (1) No ☐

34. If yes, how much hectare? _____

E. Physical Soil Conservation Related Information

35. What were the problems caused by erosion? (0) Removal of top soil ☐

(1) Decrease soil fertility ☐ (2) Decrease yields ☐ (3) Land degradation ☐

(4) Removal of seedlings by runoff ☐ (5) Other Problems_____

_____

36. Degree of erosion problem (0) No problem ☐ (1) low ☐

(2) Medium ☐ (3) High ☐

37. Estimated size of degraded land on your plot in square meter _____

38. Was there traditional soil conservation structure or traditional engineered systems built on your farm land? (0) Yes ☐ (1) No ☐

(a) If yes, what type? _____

39. Are you using modern soil conservation measures? (0) Yes ☐ (1) No

(a) If yes, what type of physical soil conservation measure are you usi ☐

(0) Stone bunds terracing ☐ (1) Soil bund terracing ☐

(2) Cutoff drain ☐ (3) Waterway ☐ (4) Others (specify) _____

40. Who make the design or the layout?

(0) Government DAs & Agricultural Experts ☐ (1) NGO DAs ☐

41. Who constructed the structures?

(0) Community Participation ☐ (1) Family Labor ☐

(2) NGOs ☐ (3) Labour Exchange (Traditional) ☐

(4) Food-for–Work ☐ (5) Casual Labour ☐

42. Advantage of the physical soil conservation technology

(0) Decrease erosion ☐ (1) Increase yield ☐

(2) Protect land from erosion ☐ (3) Others (specify) _____

43. Problem related to physical soil conservation technology

(0) Home for rodents ☐ (1) Decrease the size of the plots ☐

(2) Difficult to plough with the oxen ☐ (3) Demand intensive labour ☐

(4) Difficult to construct and prevent ☐ (5) Problem related to drainage ☐

(6) Other _____

F. Biological Soil Conservation and Vetiver Grass Usage Related Information

44. What is the Biological Soil Conservation method used in the area? _____

_____

45. Do you know what a vetiver grass is? (0) Yes ☐ (1) No ☐

46. If yes, who introduced vetiver grass to you?

(0) NGOs Development Agents ☐ (1) Community leaders ☐

(2) Government Development Agents ☐ (3) From Print/electronic Media ☐

47. Specify the NGOs_____

48. What methods were used in introducing vetiver grass for soil & water conservation purpose?

(0) Training programs ☐ (1) Workshops ☐

(2) Demonstration sites visit ☐ (3) Field visit ☐

(4) Others (specify)_____

49. Who introduced vetiver grass for soil conservation purpose in your locality?

(0) NGOs ☐ (1) Community leaders ☐

(2) Government Development Agents ☐ (3) From Print/electronic Media ☐

50. Specify the NGOs_____

51. Specify the Year_____.

52. Have you planted vetiver grass on your plot? (i) Yes ☐ (ii) No ☐

53. If yes,

- When? In _____.
- On how many hectares of land have you planted vetiver grass?_____
- How meters long is the vetiver grass hedgerow you have planted?_____

54. Is using vetiver system costly? (0) Yes ☐ (1) No ☐

55. Is vetiver grass easily accessible? (0) Yes ☐ (1) No ☐

56. If yes, who supply you the vetiver seedlings?

(0) Free from NGOs ☐ (1) Purchase from NGOs ☐

(2) Free from Government ☐ (3) Purchase from Government ☐

(4) Purchase from private ☐ (5) Free from others /Specify_____

(6) Purchase from others /Specify_____

57. Specify the NGOs_____

58. Are you still using VG on your plot? (0) Yes ☐ (1) No ☐

59. If no, why? _____

60. Do you agree that vetiver grass :

- Has strong, deep and fibrous root? (0) Yes ☐ (1) No ☐
- Slow and spread runoff water along the hedgerows? (0) Yes ☐ (1) No ☐
- Trap sediments and keep soil on farm land? (0) Yes ☐ (1) No ☐

61. For what purpose do you use vetiver grass on your plot?

0) Erosion/Runoff control ☐ (1) Soil & Water Conservation ☐

(2) Slop stabilization ☐ (3) Land slide stabilization ☐

(4) Terrace Formation ☐ (5) Fodder / Grazing ☐

(6) Border Demarcation ☐ (7) Others (specify) _____

62. Is using vetiver grass manageable by unskilled farmers? (0) Yes ☐ (1) No ☐

63. Is vetiver grass requiring frequent maintenance like other SWC Structures?

(0) Yes ☐ (1) No ☐

64. How often the NGOs and or Government DAs/SWs visit your site for follow up and consult with you?

(0) Very often ☐ (1) Often ☐ (2) Sometimes ☐ (3) Rarely ☐

65. In your opinion, how do you explain the difference between other SWC structures and vetiver grass system in managing soil erosion? (0) No difference. ☐

(1) VG is much better in controlling erosion than other SWC structures. ☐

(2) Other WSC structures better control erosion than Vetiver Grass System. ☐

(3) VG makes the soil nearby more fertile ☐

(4) Both increase yields ☐

66. How do you compare the portion of farm land used for SWC structure construction and vetiver grass plantation?

(0) Other SWC structures construction consume more farm land space than vetiver grass hedgerow plantation. ☐

(1) Vetiver grass hedgerow plantation consumes more farm land space than other SWC structure construction measures. ☐

(2) Both measures consume more farm land space. ☐

(3) Vetiver Grass consumes insignificant farm land space. ☐

(4) Other SWC structure construction measures consume less farm land space ☐

(5) Both measures consume insignificant farm land space. ☐

67. Is using vetiver grass:

- Reducing Runoff water? (0) Yes ☐ (1) No ☐
- Protecting soil erosion? (0) Yes ☐ (1) No ☐
- Stabilizing slopes (0) Yes ☐ (1) No ☐
- Increase Moisture? (0) Yes ☐ (1) No ☐
- Increase Soil Fertility? (0) Yes ☐ (1) No ☐
- Increase Yield? (0) Yes ☐ (1) No ☐
- Increase Underground Water (0) Yes ☐ (1) No ☐
- Generate Income? (0) Yes ☐ (1) No ☐

68. How do you express the role of vetiver grass planted on your farm land in soil erosion protection and improve your leaving condition?

(0) Decisive ☐ (1) Important ☐ (2) Insignificant ☐ (3) Irrelevant ☐

69. Are you using biological soil conservation system other than Vetiver Grass?

(0) Yes ☐ (1) No ☐

70. Which method do you prefer?

(0) VG ☐ (1) Other methods ☐ (2) Both ☐

G. Crop Yields Related Information

71. What is the yield harvested in quintals per hectare when improved seeds, fertilizers, structure and vetiver grass are used?

(0) Maize_____ (1) Sorghum____ (2) Teff____ (3) Others _____

72. What is the yield harvested in quintals per hectare when improved seeds, fertilizers and structure without vetiver grass are used?

(0) Maize_____ (1) Sorghum____ (2) Teff____ (3) Others _____

73. What is the yield harvested in quintals per hectare when local seeds, fertilizers, structure and vetiver grass are used?

(0) Maize_____ (1) Sorghum____ (2) Teff____ (3) Others ____

74. What is the yield harvested in quintals per hectare when local seeds, fertilizers and structure without vetiver grass are used?

(0) Maize_____ (1) Sorghum ____ (2) Teff ____ (3) Others ____

75. What is the yield harvested in quintals per hectare when local seeds, fertilizers and vetiver grass are used?

(0) Maize_____ (1) Sorghum____ (2) Teff____ (3) Others ____

76. What was the yield harvested in quintals per hectare when local seeds and traditional soil Conservation structures were used?

(0) Maize_____ (1) Sorghum_____ (2) Teff_____ (3) Others _____

77. What was the yield harvested in quintals per hectare when local seed used without any soil conservation measures and other inputs?

(0) Maize_____ (1) Sorghum_____ (2) Teff_____ (3) Others _____

H. Other Uses of Vetiver Grass Related Information

78. For what other purposes do you use vetiver grass? (0) As source of income ☐

(1) Thatching house ☐ (2) Thatching grain Storage ☐

(3) Shelter for seedlings ☐ (4) Public holyday ceremony ☐

(5) Mattresses stuffing ☐ (6) Perfume ☐

(7) Medicine ☐ (8) Protect Rodents ☐

(9) Protect Ants from beehives ☐ (10) Wall plastering ☐

(11) Shade for beehive ☐ (12) Making brooms ☐

(13) Making ornament ☐ (14) For Handcraft ☐

(15) Others (specify)_____

_____

79. How do you generate income from vetiver grass?

(0) By making crafts from vetiver grass ☐

(1) By multiplying seedling for sale ☐

(2) By selling the grass for different users and for different purposes ☐

80. How much money you generate from vetiver grass annually? Birr_____

81. Is the income you generated improved your living condition? (0) Yes ☐ (1) No ☐

82. For what purposes you spend the income you generate from the planted vetiver grass?

(0) For different family expenses ☐ (1) For students school expenses ☐

(2) For savings ☐ (3) For farm extension ☐ (4) for others_____

83. In your opinion, what will happen you think if you stop using vetiver grass?

(0) Soil loss increase ☐ (1) Yield decrease ☐ (2) Land degradation increase ☐

(3) Runoff water increase ☐ (4) Moisture decrease ☐ (5) Loss of income from VG ☐

(6) No change ☐

84. Do you agree with the idea that vetiver hedgerow reduce soil erosion and runoff water, increase soil fertility and moisture than any other engineering methods?

(0) I strongly agree ☐ (1) I agree ☐

(2) I disagree ☐ (3) I strongly disagree ☐

85. Will you continue using vetiver grass in the future? (0) Yes ☐ (1) No ☐

Appendix III

Interview Schedule for Non vetiver user Villagers

Objective:

This Interview Schedule is prepared and designed to collect relevant primary data related to the usage of vetiver grass for soil & water conservation from Tulube PA non vetiver grass user farmers for comparison purposes. The information obtained from this interview questionnaire will be used only for academic purpose and the personal information will be kept confidential. Please tick check mark (√) in the box you consider relevant and or fill the blank space provided.

I, therefore, kindly request you to feel free in answering the questionnaire.

Thank You

Tekalign Negash

I. General Information

1. Interview No.:_____

2. Date of interview: _____

3. District: Metu

4. PA: Tulube

5. Village: _____

6. Name of the Enumerator: _____

   Signature_____

II. Personal Information

7. Sex: (0) Male ☐ (1) Female ☐

8. Ages: (0) 18 – 25 ☐ (1) 26 – 35 ☐ (2) 36 – 45 ☐

   (3) 46 – 60 ☐ (4) > 60 ☐

9. Ethnicity: (0) Oromo ☐ (1) Amhara ☐ (2) Tigre ☐ (3) Others (specify)____

10. Religion: (0) Muslim ☐ (1) Orthodox Christian ☐ (2)Protestant ☐

    (3) Catholic ☐ (4) Traditional Believers ☐

11. Marital status of the household: (0) Married ☐ (1) Single ☐

    (2) Divorced ☐ (3) Widowed ☐

12. Family size: (0) 1 – ☐ (1) 3 - 4 ☐ (2) 5 - 6 ☐ (3) >6 ☐

III. Education, Occupation and Income Information

13. Family member's age, sex and educational status

Age	Sex		Educational Status						
	Male	Female	0	1 - 4	5 - 8	9 - 10	Certificate	Diploma	University
0 - 5									
6 - 14									
15 - 25									
26 – 35									
36 - 45									
46 - 60									
>60									
Total Household									

14. Educational status the of household

(0) Cannot read & write ☐ (1) Read & write (1 - 4) ☐

(2) Elementary School (5 - 8) ☐ (3) Secondary School (9 - 10) ☐

(4) High School (11 - 12) ☐ (5) Certificate ☐

15. Number of active workers in the family including household head (0) one ☐

(1) two ☐ (2) three ☐ (3) four ☐ (4) more than four ☐

16. What is your major occupation? (0) Farming ☐ (1) Trading ☐

(2) Governments employ ☐ (3) Laborer ☐ (4) Other (specify)

17. In which income group do you locate yourself in the community?

(0) High income group ☐ (1) Middle income group ☐ (2) Low income group ☐

IV. Socio Economic and Land Usage Related Information

18. Do you have farm land? (0) Yes ☐ (1) No ☐

19. If no, specify your job_____

20. If yes, specify the number and size of the plot _____ & _____hectare

21. How did you get the land? (0) from government ☐ (1) from family ☐

(2) leased ☐ (3) purchased ☐

22. Land ownership? (0) Privet ☐ (1) Public/Government ☐

23. Is the land ownership status has any impact on the land management level?

(0) Yes ☐ (1) No ☐

24. What do you think about the right to private ownership of land? _____

_____

25. Number of years owne**d**/cultivate**d**/managed _____

26. Type of the land (0) Cultivated land ☐ (1) Fallow land ☐

(2) Grazing land ☐ (3) Homestead area ☐

27. Number of cropping season (0) Once ☐ (1) Twice ☐ (2) Triple ☐

28. Plot distance from home_____

29. Plot fertility level (0) Very fertile ☐ (1) Fertile ☐

(2) Medium ☐ (3) poor ☐

30. Do you have farm animals /livestock? (0) Yes ☐ (1) No ☐

31. If yes state the type and quantity. (0) Ox/en_____ (1) cow/s_____

(2) sheep/ or goat/s _____ (3) Chicken _____ (4) Mule _____

(5) Donkey _____ (6) Others _____

32. Do you have coffee farm? (0) Yes ☐ (1) No ☐

33. If yes, how much hectare? _____

V. Physical Soil Conservation Related Information

34. What were the problems caused by erosion? (0) Removal of top soil ☐

(1) Decrease soil fertility ☐ (2) Decrease yields ☐ (3) Land degradation ☐

(4) Removal of seedlings by runoff ☐ (5) Other Problems_____

35. Degree of erosion problem (0) No problem ☐ (1) low ☐

(2) Medium ☐ (3) High ☐

36. Estimated size of degraded land on your plot in square meter _____

37. Was there traditional soil conservation structure or traditional engineered systems built on your farm land? (0) Yes ☐ (1) No ☐

(a) If yes, what type? _____

38. Are you using modern soil conservation measures? (0) Yes ☐ (1) ☐ No

(a) If yes, what type of physical soil conservation measure are you using?

(0) Stone bunds terracing ☐ (1) Soil bund terracing ☐

(2) Cutoff drain ☐ (3) Waterway ☐ (4) Others (specify) ___

39. Who make the design or the layout?

(0) Government DAs & Agricultural Experts ☐ (1) NGO DAs ☐

40. Who constructed the structures?

(0) Community Participation ☐ (1) Family Labor ☐

(2) NGOs ☐ (3) Labour Exchange (Traditional) ☐

(4) Food-for–Work ☐ (5) Casual Labour ☐

41. Advantage of the physical soil conservation technology

(0) Decrease erosion ☐ (1) Increase yield ☐

(2) Protect land from erosion ☐ (3) Others (specify) _____

42. Problem related to physical soil conservation technology

(0) Home for rodents ☐ (1) Decrease the size of the plot ☐

(2) Difficult to plough with the oxen ☐ (3) Demand intensive labour ☐

(4) Difficult to construct and prevent ☐ (5) Problem related to drainag ☐

(6) Other _____

VI. Biological Soil Conservation and Vetiver Grass Usage Related Information

43. What is the Biological Soil Conservation method used in the area? _____

_____

_____

44. Do you know what a vetiver grass is? (0) Yes ☐ (1) No ☐

45. If yes, who introduced vetiver grass to you?

(0) NGOs Development Agents ☐ (1) Community leaders ☐

(2) Government Development Agents ☐ (3) From Print/electronic Media ☐

46. Specify the NGOs_____

47. What methods were used in introducing vetiver grass for soil & water conservation purpose?

(0) Training programs ☐ (1) Workshops ☐

(2) Demonstration sites visit ☐ (3) Field visit ☐

(4) Others (specify)_____

48. Who introduced vetiver grass for soil conservation purpose in your locality?

(0) NGOs ☐ (1) Community leaders ☐

(2) Government Development Agents ☐ (3) From Print/electronic Media ☐

49. Specify the NGOs_____

50. Specify the Year_____.

51. Have you planted vetiver grass on your plot? (i) Yes ☐ (ii) No ☐

52. If no, why? (0) I do not know the advantage of vetiver grass ☐

(1) Vetiver grass is not easily accessible ☐

(2) I do not have soil erosion problem ☐

(3) Vetiver grass cannot protect soil erosion ☐

(4) I have better option than vetiver grass ☐

53. Is there any disadvantage of not planting vetiver grass? (0) Yes ☐ (1) No ☐

54. If yes, what? _____

_____

55. If no, how?

_____

_____

_____

56. Currently, what type of soil conservation method are you using? _____

_____

_____

_____

VII. Crop Yields Related Information

57. What is the yield harvested in quintals per hectare when Improved seed, Fertilizers and structure without vetiver grass are used?

(0) Maize_____ (1) Sorghum____ (2) Teff____ (3) Others ____

58. What is the yield harvested in quintals per hectare when Local seed, Fertilizers and structure without vetiver are used?

(0) Maize_____ (1) Sorghum ____ (2) Teff ____ (3) Others _____

59. What was the yield harvested in quintals per hectare when Local seed and traditional soil conservation structure were used?

(0) Maize_____ (1) Sorghum_____ (2) Teff_____ (3) Others _____

60. What was the yield harvested in quintals per hectare when Local seed used without any soil conservation measures and other inputs?

(0) Maize_____ (1) Sorghum_____ (2) Teff_____ (3) Others _____

Appendix IV

Questionnaire Schedule for Development Agents and/or Social Workers

Questionnaire No.: _____

Date: _____

To: _____
Tulube

Subject: **Cooperation to fill up a Questionnaire**

I am conducting a study on "Farmers' Perception on the Role of Vetiver Grass in Soil and Water Conservation in South Western Ethiopia: - The Case of Tulube Peasant Association; Metu District". In this context, I kindly request you to fill up this questionnaire and return it to me at the earliest possible. I assure you that, the information you give me will be kept confidential and be used only for the dissertation I am working for the partial fulfillment of Master of Arts in Rural Development. Please make a check mark in the box and fill the blanks accordingly.

Thank you very much for your cooperation in this regard.

Sincerely yours,

Tekalign Negash

A. General Information

1. Questionnaire No.:_____
2. Date filled: _____
3. District: Metu
4. Kebele: Tulube
5. Village: _____
6. Name _____
7. Signature_____

B. Personal Information

8. Sex: (0) Male ☐ (1) Female ☐
9. Ages: (0) 18 – 25 ☐ (1) 26 – 35 ☐ (2) 36 – 45 ☐
   (3) 46 - 60 ☐ (4) > 60 ☐
10. Ethnicity: (0) Oromo ☐ (1) Amhara ☐ (2) Tigre ☐ (3) Others (specify)____
11. Marital status :
    (0) Married ☐ (1) Single ☐ (2) Divorced ☐ (3) Widowed ☐
12. Family size: (0) 1 – 2 ☐ (1) 3 - 4 ☐ (2) 5 - 6 ☐ (3) > 6 ☐
13. Educational status
    (0). Certificate in_____
    (1) Diploma in _____
    (2) First degree in _____
    (3) Second degree in _____

14. Religion: (0) Muslim ☐ (1) Orthodox Christian ☐ (2) Protestant ☐

(3) Catholic ☐ (4) Traditional Believers ☐

C. Job related Information

15. In which kebele and Village (Gere) are you working? _____

16. What is your job title?_____

17. What is your position/ responsibility? _____

18. What is your qualification?_____

19. For how many years or months are you working in the kebele? _____

D. Soil erosion related information

20. Are you dealing with soil and water conservation work? (0) Yes ☐ (1) No ☐

21. If yes, what types of soil are found in the area? _____

22. Is it easily affected by erosion? (0) Yes ☐ (1) No ☐

23. What are the agents of soil erosion in the area? (0) Rain water ☐

(1) wind ☐ (2) Deforestation ☐ (3) Overgrazing ☐

(4) Intensive cultivation ☐ (5) Mismanagement of cultivated soils ☐

(6) Others /specify _____

24. What are the effects of soil erosion in the area? _____

_____

_____

_____

_____

25. What are the effects of soil erosion on farmer's life and socio economic condition?

_____

_____

_____

_____

26. What types of conventional soil & water conservation structures are you using to protect soil loss in the area? _____

_____

_____

_____

27. Who perform the engineering or design works of SWC structures? _____

_____

28. Is the structure work cost is cheap? (0) Yes ☐ (1) No ☐

29. Is the structure required frequent maintenance? (0) Yes ☐ (1) No ☐

30. Is it easily accepted by farmers? (0) Yes ☐ (1) No ☐

31. Is it manageable by the farmers? (0) Yes ☐ (1) No ☐

32. What results are achieved from the stated conventional soil & water conservation structure constructed in the area? _____

_____

_____

_____

_____

E. Vetiver Grass related Information

33. Are you dealing with the introduction and promotion of vetiver grass plantation work?

(0) Yes ☐ (1) No ☐

34. What methods are you using for the introduction and implementation of vetiver grass?

(0) Onsite Training ☐ (1) Off Site Training ☐ (2) Workshop ☐

(3) Demonstration ☐ (4) home visit ☐

(5) Other Methods (specify) _____

35. Is vetiver grass easily adopted by farmers of the area? (0) Yes ☐ (1) No ☐

36. How many household farmers are living in the Village (Gere)? _____

37. How many household farmers are using vetiver grass on their plots for soil and water conservation purpose? _____

38. Are there vetiver grass nursery sites in the village? (0) Yes ☐ (1) No ☐

39. If yes, how many? _____

40. Is vetiver grass adoptable to the area? (0) Yes ☐ (1) No ☐

41. Is it easy to establish VG? (0) Yes ☐ (1) No ☐

42. How VG is planted in the area? (0) using seedlings ☐ (1) using culms ☐

43. When to plant VG? (0) any time ☐ (1) at the beginning of rain season ☐

44. Is it difficult to get-rid-off? (0) Yes ☐ (1) No ☐

45. Does VG cause erosion? 0) Yes ☐ (1) No ☐

46. Is VG becomes weed? 0) Yes ☐ (1) No ☐

47. Does VG affect nearby plants? (0) Yes ☐ (1) No ☐

48. Is VG fosters diseases or pests that might attack crops? (0) Yes ☐ (1) No ☐

49. Is VG prone to pests and diseases? (0) Yes ☐ (1) No ☐

50. Is VG stops loss of soil? (0) Yes ☐ (1) No ☐

51. Does VG reduce runoff water? (0) Yes ☐ (1) No ☐

52. Is VG increase soil moisture? (0) Yes ☐ (1) No ☐

53. Is it useful for wetland reclamation? (0) Yes ☐ (1) No ☐

54. Is vetiver grass help in the rehabilitation of dried spring water of the area?

55. Do VG hedges require frequent maintenance? (0) Yes ☐ (1) No ☐

56. For how long a VG hedge last? _____ Years.

57. If yes, what type of maintenance? (0) Only trimming every one year ☐

(1) Only trimming every two year ☐ (2) Only trimming every three year ☐

(3) not at all ☐ (4) others / specify_____

58. Is there any species that can do the same purpose as VG? (0) Yes ☐ (1) No ☐

59. If yes, specify _____

60. Is using vetiver grass:

a. Reducing Runoff water? (0) Yes ☐ (1) No ☐

b. Reducing soil erosion? (0) Yes ☐ (1) No ☐

c. Increase Moisture? (0) Yes ☐ (1) No ☐

d. Increase Soil Fertility? (0) Yes ☐ (1) No ☐

e. Increase Yield? (0) Yes ☐ (1) No ☐

f. Generate Income? (0) Yes ☐ (1) No ☐

61. For what purpose do the farmers use vetiver grass?

(0) Erosion control	☐	(1) Soil & Water Conservation	☐
(2) Slop stabilization	☐	(3) Land slide stabilization	☐
(4) Terrace Formation	☐	(5) Fodder / Grazing	☐
(6) Border Demarcation	☐	(7) Thatching house	☐
(8) Thatching grain Storage	☐	(9) Shelter for seedlings	☐
(10) Public holyday ceremony	☐	(11) Stuffing mattresses	☐
(12) Perfume	☐	(13) Medicine	☐
(14) Protect Rodents	☐	(15) Protect Ants from beehives	☐
(16) For wall plastering	☐	(17) Shade for beehive	☐

(18) Others (Specify)_____

62. How do you found the farmers participation in planting VG on their farm land?

(0) very good ☐ (1) moderate ☐ (2) not this much ☐

63. Are farmers of the area benefited from the VG planted on their farm land?

(0) Yes ☐ (1) No ☐

64. What are the major economic benefits they gain from vetiver grass?

_____

_____

_____

_____

65. According to your opinion, what is the reason for other households not to adopt VG?

_____

_____

Appendix V

Interview Schedule for Villager Leaders

Objective:

This Interview Schedule is prepared and designed to collect relevant primary data related to the usage of vetiver grass for soil & water conservation from Tulube PA of each sample village leaders. The information obtained from this interview questionnaire will be used only for academic purpose and the personal information will be kept confidential. I, therefore, kindly request you to feel free in answering the questionnaire.

Thank you for your kind cooperation,

Tekalign Negash

A. General Information

1. Interview No.:_____

2. Date of interview: _____

3. District: **Metu**

4. PA: **Tulube**

5. Village: _____

6. Name of the Enumerator: _____ Signature_____

B. Village Leader Information

7. Sex: (0) Male ☐ (1) Female ☐

8. Ages: (0) 18 – 25 ☐ (1) 26 – 35 ☐ (2) 36 – 45 ☐

(3) 46 – 60 ☐ (4) > 60 ☐

9. Ethnicity: (0) Oromo ☐ (1) Amhara ☐ (2) Tigre ☐

(3)Others (specify)_____

10. Marital status of the household:

(0) Married ☐ (1) Single ☐ (2) Divorced ☐ (3) Widowed ☐

11. Family size: (0) 1 – 2 ☐ (1) 3 - 4 ☐ (2) 5 - 6 ☐ (3) > 6 ☐

12. Educational status (0) cannot read & write ☐ (1) Read & write (1 - 4) ☐

(2) Elementary School (5 - 8) ☐ (3) Secondary School (9- 10) ☐

(4) High School (11 - 12) ☐ (5) Certificate ☐

(6) Diploma ☐ (7) First degree ☐

13. Religion: (0) Muslim ☐ (1) Orthodox Christian ☐ (2)Protestant ☐

(3) Catholic ☐ (4) Traditional Believers ☐

14. For how long are you the Village leader? _____

15. Are you appointed by Government or elected by the village dwellers?

(0) Appointed ☐ (1) Elected ☐

C. Vetiver Grass

16. Who introduced vetiver grass for soil conservation purpose in your locality?

(0) NGOs ☐ (1) DAs/SWs ☐ (2) Kebele Leaders ☐

(3) From Print/electronic Media ☐

17. Are you a vetiver grass user? (0) Yes ☐ (1) No ☐

18. If no, why? _____

_____

19. If yes, for how long? _____years

20. What is the attitude of the community leaders towards the use of vetiver grass for erosion control and conservation? (0) Significant ☐ (1) Moderate ☐

(2) Insignificant ☐

21. What is the attitude of the community towards the use of vetiver grass for erosion control and conservation? (0) Significant ☐ (1) Moderate ☐

(2) Insignificant ☐

22. What is the attitude of the Government towards the use of vetiver grass for erosion control and conservation? (0) Significant ☐ (1) Moderate ☐

(2) Insignificant ☐

23. How do you feel your contribution helps the dissemination of vetiver grass in you locality? (0) Significant ☐ (1) Moderate ☐ (2) Insignificant ☐

24. In your locality, are there non vetiver grass user households? (0) Yes ☐ (1) No ☐

25. If yes, can you specify their number? _____

26. In your opinion, what do you think that they are not interested to use vetiver grass on their plot of land?

(0) Lack of awareness on the importance of vetiver grass ☐

(1) Their plot is very small to use vetiver grass ☐

(2) They think vetiver grass occupies their farm land unnecessarily ☐

(3) Others_____

_____

27. If no, how many households are using vetiver on their plot? _____

28. What are the initiatives given by the government or the NGOs to increase awareness of the community on the vetiver grass usage?

(0) Training ☐

(1) workshops ☐

(2) Visit of fields and demonstration sites ☐

(3) supply of planting materials ☐

(4) All the above ☐

29. What improvement you observe after the introduction of vetiver grass to your locality?

(0) Decrease in damage of the runoff water ☐

(1) Decrease of soil erosion ☐

(2) Increase in soil fertility ☐

(3) Increase in yield per hectare ☐

(4) increase the availability of fodder ☐

(5) increase households income ☐

(6) All the above ☐

Appendix VI

Focus Group Discussion Guideline

Objective:

This Interview Schedule is prepared and designed to collect relevant primary data related to the usage of vetiver grass for soil & water conservation from Tulube PA of each sample village comprising selected from teachers, students, religion leaders, elders and agricultural workers. The information obtained from this group discussion will be used only for academic purpose and the personal information will be kept confidential. I, therefore, kindly request you to feel free in participating in the discussion.

A. General questions

1. What is the economic level status of the community?
2. Is there sufficient health service in the area?
3. What is the educational service level in the area?
4. Is there sufficient educational infrastructure in the area?
5. What energy sources are available in the area?
6. What types of farm are you practicing?
7. What types of grains do you produce?
8. Are you happy with the yield level you harvest?
9. Are you self-sufficient in food production?
10. If not from where do you get supplementary food?
11. What do you think about women empowerment?

B. General questions

1. Do you get sufficient rainfall in the area?

2. Is there erosion problem in your locality?
3. If yes how sever it is?
4. What is the impact of erosion in the area?
5. What is the degree of soil fertility in the area
6. What measures do you suggest to prevent the problem?
7. What types of soil conservation methods are practiced in the area?

C. Vetiver grass related questions

1. Do you know vetiver grass?
2. How do you explain the use of vetiver in your area?
3. For what purposes do you use vetiver grass?
4. What kinds of challenge you faced while planting the grass?
5. What is your opinion on the advantage of vetiver grass?
6. Is vetiver grass sustainable in the area?
7. What are the factors for sustainability of vg in the locality?
8. Do you think this system will sustain for long time? Whay?
9. How do you evaluate the benefit of vetiver grass?
10. Dose low level income and low level of education affect the degree of the usage of vetiver grass?
11. Does land holding size has impact on vetiver grass cultivation?
12. Does land ownership status have impact on the use of vetiver grass?
13. From your own opinion, to ensure success and sustainability of vetiver grass system, what are the major important elements you think should be considered?

Appendix VII

Questionnaire Guideline for the Kebele, Woreda and NGO Officials

Questionnaire No.: _____

Date: _____

To: _____

Subject: **Cooperation to fill up a Questionnaire**

I am conducting a study on "Farmers' Perception on the Role of Vetiver Grass in Soil and Water Conservation in South Western Ethiopia: - The Case of Tulube Peasant Association; Metu District". In this context, I kindly request you to fill up this questionnaire and return it to me at the earliest possible. I assure you that, the information you give me will be kept confidential and be used only for the dissertation I am working for the partial fulfillment of Master of Arts in Rural Development. Please make a check mark in the box and fill the blanks accordingly.

Thank you very much for your cooperation in this regard.

Sincerely yours,

Tekalign Negash

I. Your Organistation_____

Position _____

Year of service _____

II. Dried because of degradation and recharged after the introduction and plantation of vetiver grass in the study area, Tulube Kebele.

Water Conservation	**Total**	**Dried**	**Recharged**	**Still Dried**	**Remark**
Wetlands					
Springs					
Streams					
Rivers					
Other (if any)					

III. Crop type's distribution and yields improvement, other factors remain constant.

Crop Types	**Percentage**	**Average Yields**		**Remark**
		Before VG	**After VG**	
Maize				
Sorghum				
Barley				
Wheat				
Teff				
Others (if any)				

VI What major agricultural activities are practiced in Tulube kebele?

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

V Main uses of vetiver grass in Tulube kebele

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

VI Other uses of vetiver grass in Tulube kebele

1. For mulch
2. Thatching
3. _____
4. _____
5. _____
6. _____
7. _____

8. _____

9. _____

VII General Information of Tulube kebele

1. Temperature of Tulube kebele Average_____Max_____Min_____
2. Altitude Average_____Max_____Min_____
3. Type of Temperate Zone_____
4. Latitude and Longitudinal location of Tulube kebele_____
5. Rainfall_____
6. Current population _____ Male _____Female_____
7. Households _____Male_____Female_____
8. Vetiver user households_____ Male _____Female_____
9. Non vetiver user households_____ Male _____Female_____
10. Vetiver area coverage in hectare_____
11. Vetiver hedgerows length in meters_____
12. Soil erosion improvement in %_____
13. Soil fertility improvement in %_____
14. Soil moisture increase in % _____
15. Sediment protected in %_____
16. Runoff reduction in%_____
17. Number of Cattles _____ (oxen _____Cows_____)
18. Number of Chickens_____
19. Number of equine _____ (Mules _____donkeys _____)
20. Number of Sheep or and goats _____

21. Number of beehives _____

22. Coffee plantation Coverage _____

23. Other income generating activities_____

_____

_____

_____

_____

VIII Other information related to vetiver grass usage in the area_____

_____

_____

_____

_____

XI Metu Branch EWNRA Support regarding VG for soil and water conservation_____

_____

_____

_____

Thank you very much,

Tekalign Negash

Appendix VIII

Approved Project Proposal

Farmers' Perception on the Role of Vetiver Grass in Soil and Water Conservation in South Western Ethiopia: - *The Case of Tulube Peasant Association; Metu District*

Project Proposal

By

Tekalign Negash Terefe

Enrolment No: 089133364

INDRA GANDHI NATIONAL OPEN UNIVERSITY

DEPARTMENT OF RURAL DEVELOPMENT

NEW DELHI, INDIA

September, 2011
Addis Ababa
Ethiopia

PROFORMA FOR SUBMISSION OF M.A. (RD) PROPOSAL FOR APPROVAL

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Date of Submission:	_____
Name of Study Centre:	St's University College
Title of the Project:	Farmers' Perception on the Role of Vetiver Grass in Soil and Water Conservation in South Western Ethiopia:-The Case of Tulube Peasant Association; Metu District
Signature of the Student:	_____
Approved Date:	_____

Table of Contents

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List of Acronyms

CSA:	Central Statistic Authority
DA:	Development Agent
DNA:	Deoxyribo Nucleic Acid.
EHRS:	Ethiopian Highlands Reclamation Study
GDP:	Gross Domestic Product
IIRDP:	Illubabor Integrated Rural Development Project
JARC:	Jimma Agricultural Research Center
MDADO:	Metu District Agricultural Development Office
MfM:	Menschen für Menschen
NRGO:	The National Regional Government of Oromia
NGO:	Non-Governmental Organization
PA:	Peasant Association
PCO:	Projects Coordination Office
SW:	Social Worker
SWC:	Soil and Water Conservation
SWCE:	Soil and Water Conservation Engineering
TVNI:	The Vetiver Network International
VG:	Vetiver Grass
VGT:	Vetiver Grass Technology
VS:	Vetiver System

1. Introduction

1.1 Background

Traditional and poor farming practices in rural areas of the developing countries have resulted in loss of soil and nutrient depletion, which finally lead into land degradation. This in turn results in low agricultural productivity, food insecurity and poverty (MenaleKassie, et al, 2008).

Ethiopia is one of the poorest, ranking 170 out of 177, countries in the Human Development Index. More than half of the country's GDP is dependent on the agricultural sector, which suffers from frequent drought and poor cultivation practices (World Bank, 2004), and its' vast areas of arable land turn into desert each year. Only three percent of a total area of the country is covered by forests. The major causes for desertification are excessive livestock farming, an ever increasing population, cutting down of trees for firewood and construction and climate change. All the above problems cause arable land to become desolate. Consequently, enormous amounts of fertile land are being degraded (AlemuMekonnen, 2000). Ethiopia with close to 81.2 million population and an estimated area of 1.12 million km^2 (Michael E. Porter & Klaus Schwab, 2009) is the largest and second populous country in Africa (Wikipedia, the free encyclopedia**).**The country's population, predominantly rural (84 % rural, 16% urban), is currently experiencing a sharp population increment estimated at 2 million people per year (Jonathan Mckee, 2007).

Soil erosion is one of the most severe problems affecting the croplands in Ethiopia. According to the Ethiopian Highlands Reclamation Study (EHRS, 1991), over 14 million hectares (27 % of the area) of the highlands was estimated to be seriously eroded, and about

15 million hectares were found to be susceptible to erosion. A preliminary soil loss and run-off study at Melko indicated that 82.3 tons of soil is eroded annually (TesfuKebede and ZebeneMikru, 2006).

Farmers in Illubabor Zone of the Oromia Regional State typically rely, almost wholly, on agriculture for their incomes. Despite the fact that they get a long and intensive rainy season, because of the high erosion in this area, they live with lowest incomes and highest rates of poverty.

Considerable public resources have been mobilized to develop soil and water conservation (SWC) technologies such as soil and stone bunds, agronomic practices such as minimum tillage, grass strips and agro-forestry techniques and water harvesting options such as tied ridges and check dams constructions in the area (Shiferaw, et al, 2007). But the physical engineering of SWC constructions are very expensive and required frequent maintenance which cannot be afforded and managed by unprofessional and poor farmers of the area.

Vetiver grass is a unique tropical plant which is native to India (Paul Truong et al, 2008). Vetiver is a Tamil word, meaning “root that is dug up”. Vetiver belongs to the same part of the grass family as maize, sorghum, sugarcane and lemongrass and is a perennial grass growing up to two meters high, and three meters deep. It has a strong and vertical root system. It is adaptable to a wide range of acid, sodic, alkaline and saline soils and tolerates wide ranges of climatic conditions including drought and fire.

Vetiver grass is mainly used for soil erosion control, slope stabilization, agriculture improvement, disaster mitigation, prevention and treatment of contaminated water, wetland soil reclamation, reducing sedimentation and improving water storages. In addition it also

used for handicrafts, fodder, animal bedding, perfumes, pesticide, medicine, and for various in-house uses (Richard Webb, 2009 and Bruce Carey, 2006).

There are twelve known varieties of vetiver grasses in India and VetiveriaZizanioides L, the vetiver grass now spread in more than 100 countries mainly for perfume and conservation purposes, was first introduced to Ethiopia in the early 1970s by the Indian scientists for the purpose of protecting coffee plantation from the invasion of couch grass in Jimma and Kaffa province, Southwestern Ethiopia. Since then, the Ethiopian research center, multiplies the grass for the purpose of protecting coffee plantation from Bermuda and Couch grasses. (Kemper, W.D.I, 1993 and HabtamuWebshet, 2008).

By taking Metu District-Tulube Peasant Association as a Study Area, this thesis is aimed at emphasizing the results achieved in land rehabilitation, increasing yields, alleviating poverty and bringing sustainable development by using vetiver grass hedge in conserving soil and water, through participatory approach.

1.2 Statement of the Problem

Soil erosion is the world's most chronic environmental and economic burden (Wellington Z. Rosacia and Rhodora M. Rimando, 2001). The soil eroded off now totals 20 billion tons a year and this loss is not only harshly degrading the environment but also eroding the economic viability of countries (Richard Webb, 2009).

Population in the rural areas is increasing from time to time and as a result more food is required to feed this population. On the other hand the land size used by the families is reducing from time to time while the food need is ever increasing. These situations force the family to use the land intensively throughout the year which resulted in soil degradation. Soil

degradation in turn encompasses mineral depletion from the soil, poor water retaining capacity, poor physical and biological conditions of soil (BekelechTolla, 2010).

In Illubabor Administrative Zone, soil erosion is a severe problem because of the heavy rain in the area; and as a result, the livelihood of many farmers has been seriously affected. The physical engineering conservation methods are expensive and labour intensive that the farmers cannot afford to implement and manage. On the other hand, vetiver system is less expensive, easy to manage by farmers and a better way for protecting soil erosion.

Since Soil erosion is a critical problem in all regions of Ethiopia, the proper investigation and assessment of the fight against the problem and the best solutions achieved in this particular area can result in replicating the valuable experiences to other parts of the country.

1.3 Objectives of the Study

The key objective of this study is to examine the role vetiver grass played in controlling soil erosion and the results achieved through the mechanism of conducting a comparative study of the users and non-users of the system in the research area under consideration.

1.3.1 Major Objectives:

- To analyze the role of vetiver grass for soil and water conservation;
- To identify other uses of vetiver grass; and,
- To provide strategies that could help the intervention of stake holders to promote vetiver grass in the area.

1.3.2 Specific Objectives are:

The specific objectives are:

- To study the extent and effects of soil erosion problem in the particular study area;
- To study the role of vetiver grass in increasing soil fertility, crop yield, soil moisture, ground water level and sediment control;
- To assess the role played to create community awareness in using vetiver system for soil erosion control;
- To study the attitude of the community in implementing the system towards reducing soil erosion problem; and,
- To closely investigate the other uses of vetiver grass and benefits gained from this system in land use management, alleviating poverty and improving social and economic status of the community.

1.4 Research Questions

This study will address the following two research questions:

- Is the introduced vetiver grass improving the degree of soil erosion and rehabilitate the degraded land in the kebele? ,
- For what purposes the farmers in the kebele use vetiver grass other than for erosion protection?, and
- What tangible and meaningful socio-economic benefits are exactly gained by the community from the introduced vetiver grass?

1.5 Significance of the Study

Since there is no study conducted concerning the vetiver grass system for soil erosion in this particular PA of Illubabor Zone, Oromia National Regional Government, the research result can provide information on the existing location specific knowledge related to soil conservation practices, indicate the factors that need urgent intervention, and identify directions and information that need further research works. It can be a good opportunity to the administrative zone in general, and the District in particular, to have an organized document that can serve as guideline in the future planning. In addition, it can indicate directions and supply information for further research and development efforts for non-governmental organizations whose main concern is programs in soil and water conservation.

Therefore, the information from this research can help the soil and water conservation stakeholders and policy makers, in promoting the vetiver grass system to all needy areas for better achievement. In addition it can also serve as a reference for future researches on the subject of vetiver grass.

1.6 Scope and Limitation of the Study

Even though the works done in introducing and planting vetiver grass for soil and water conservation in Illubabor Administrative Zone covers many districts and Peasant Associations, because of various reasons, the study will be restricted only to Metu District-Tulube Peasant Association.

The main focal point will be on the factors that affect vetiver system program for soil erosion control purpose and the results achieved in improving the lives of the community in the past few years. The study in this particular case considers the personal, socio-economic, agro-

ecological, communication, behavioral and institutional factors that are assumed to have effect on adoption of the farmers. Furthermore, because of time limitations and resource constraints, the study addresses relatively few members of the targeted beneficiaries and non-beneficiaries in the Kebele.

2. METHODOLOGY

2.1 Description of the Study Area

2.1.1 Location

Tulube Peasant Association, where the study shall be undertaken, is found in western part of the Oromia National Regional State, Illubabor Administrative Zone Metu District. Tulube is one of the 29 Peasant Associations under Metu District and located west of Metu town at about 10 km far and 628 km far from the national capital Addis Ababa.

2.1.2 Topography

The total land area of Tulube PA is 2,965 hectares of which 35 % (1037.75 ha) is used for cultivation & homesteads, 25 % (741.25 ha) is covered by Coffee plantation, 14 % (415 ha) is forest and bush land, 10 % (296.5 ha) is grazing land, 5 % (148.25 ha) is wetland and the rest which is 11 % (326.25 ha) is waste land.

2.1.3 Agro Climatic Zone

According to the data from Metu District Agricultural Development Office, Tulube PA has only one type of agro climatic zone, Wet-Woynadega, with the altitudinal ranges between 1680 to 1700 m.a.s.l.

2.1.4 Climate

Tulube PA is among the southwest areas that enjoy the highest rainy season in the country that covers from March to October and short dry season from November to February. The annual average rainfall of the Kebele is 1,836.4 mm which ranges from 1,660 to 2,200 mm and the mean temperature is 19.4 °C ranging from 12.4 °C to 27 °C.

2.1.5 Population

According to the 2007 Ethiopian National Census result, the total population of the Tulube PA is 4,246 with average density of 107 persons per km². Gender wise, 50.45 % of the population are male and 49.55 % are female. The total households of the Tulube are 886, gender wise 810 of the households are male and 76 are female.

2.1.6 Socio Economic Condition

Mixed agriculture is a common farming system used in the area and majority of the farmers are highly dependent on farm and livestock cultivation. Maize and sorghum are the dominant cereal crops produced in the kebele. Fruit, Coffee and Chaat are also the main financial sources for farmers of the kebele. However, crop productivity is declining due to soil erosion, poor land management, weeds, pests and diseases.

2.2 Data Collection:

2.2.1 Research Design

2.2.1.1 Coverage (Universe)

The study shall be conducted in Illubabor Zone, Metu District, Tulube PA where government and NGOs intervene in planting and implementing vetiver grass for soil and water conservation purposes. Thus, all village households (vetiver grass users and non vetiver grass users), village leaders, development agents, social workers, government and non-government officials in the area will form the universe of the study from which study samples will be drawn. In selecting the population, a number of issues have been taken into account including accessibility, nearness to the District town and availability of vetiver grass plantation.

2.2.1.2 Sampling

From the thirteen villages under Tulube Peasant Association, based on the availability of vetiver grass plantation, only seven suitable villages, namely **Alelu, Buchillo, Chebaka, Gorba, Kersa-ke'e, Mendido and Mezoria** shall be selected. From each village, fifteen households, ten vetiver grass users and five non vetiver grass users, also will be randomly selected for data collection purposes. To include the local leader's opinion, one village leader from each sample villages shall be interviewed. One development agent or social worker from each sample village shall be questioned. In addition, two officials from the District Agricultural Development Office and two officials from the two NGOs in the study area will be interviewed. As a result, one hundred twelve farm households and eleven professional respondents shall be reached for this study.

Table 1: Sample Area Respondents by Village and Peasant Association

P.A.	Villages	Peasant Association Level Respondents				Government & NGOs DAs & Higher Officials		Total Respondents
		Villagers			PA Total	District Agricultural Development	NGO	
		VG UERS	Non VG Users	Village Leader				
Tulube	**Alelu**	10	5	1	16	9	2	**27**
	Buchilo	10	5	1	16			**16**
	Chebaka	10	5	1	16			**16**
	Gorba	10	5	1	16			**16**
	Kersa-ke'e	10	5	1	16			**16**
	Mendido	10	5	1	16			**16**
	Mezoria	10	5	1	16			**16**
Total		**70**	**35**	**7**	**112**	**9**	**2**	**123**

2.2.2 Tools and Procedures

In order to obtain necessary data for this study, the following basic instruments will be used.

- Questionnaires
- Interviews
- Personal observation
- Sampling
- Review of different books, project documents and pamphlets

The questionnaire contains mainly close ended and few open ended structures.

In addition to the questionnaire, interview is used to obtain factual information from village leaders, PA, District and NGOs officials.

The questionnaire and interview schedules, both open and close end questions, shall first be pre tested, standardized and finalized.

About 112 farmers shall be questioned and interviewed to obtain information on personal and socio-economic status, awareness of environmental problems, attitude towards erosion control and experiences with vetiver grass. Most respondents will be farmers actively participate in using vetiver grass for soil and water conservation purposes. Group discussion and information exchange will be conducted with farmers and the District experts. Last but not least, personal observation of the researcher will be properly collected, systematically organized and carefully analyzed.

Observation is also made by the researcher to check personally and observe the condition and situation at the actual place where the vetiver grass is planted and used for soil and water conservation and different purposes.

2.2.3 Sources of Data

The required qualitative and quantitative information will be collected directly from the carefully and randomly selected sample respondents through questionnaires interviews and focus discussions with different community groups. This primary data should be accompanied by the impartial and critical observation of the researcher. The secondary data from District Agricultural Development Office, the PA Administrative Office and NGOs in the Woreda will also be of a paramount importance. In addition different books, Webpages, Project documents and Pamphlets concerning vetiver grass for soil & water conservation shall be reviewed.

2.2.4 Data Analysis

The completed interview schedules shall be scrutinized, verified, edited and arranged serially and coded in such a way that it will be decodable and compatible to computer software. For coding, three code sheets shall be prepared,

- one for the data collected from the villagers,
- second for the data collected from the village leaders, and
- third for the data collected from the officials of the District and NGOs

The data shall be processed on computer using the application software called Statistical Package for Social Sciences (SPSS). Statistical calculations such as percentage cross tabulation, Chi square test and correlation will be used in data analysis and the output will be displayed on tables and graphs. Some of the qualitative information gathered using interview schedules and information filled in open ended questionnaires will be constructed coherently in themes and analyzed for their cause and effect relationships in investigating the vetiver grass plantation towards soil and water conservation.

3. Work Plan and Finance Budget Tables

3.1 Work Plan

Table 2: Work Plan

No.	Activities	Duration
1	Review of literature	01 July 2011 – 31 July 2011
2	Selection of sample	01 August 2011 – 10 August 2011
3	Proposal writing	11 August 2011 – 20 August 2011
4	Proposal submission and comment incorporation	21 August 2011 – 01September 2011
5	Secondary data Collection	02 September 2011– 10 September 2011
6	Primary Data Collection	16 September 2011– 20 September 2011
7	Data Organization and Analysis	21 September 2011 – 25 September 2011
8	First Draft Report Writing	26 September 2011 – 30 September 2011
9	First report submission and comment incorporation	01 October 2011 – 31 October 2011
10	Final report compilation and submission	01 November 2011 – 20 November 2011

3.2 Budget Breakdown and Summary

Table 3: Budget Breakdown

S/N	Item Description	Unit	Quantity	Unit price Birr	Total Cost in Birr
1	Re-writable CD Disk	No	4	25.00	100.00
2	Printing paper	pkt	3	85.00	255.00
3	Photocopy paper	Pkt	4	85.00	340.00
4	Note Book small	No	2	10.00	20.00
5	Note Book big	No	2	20.00	40.00
6	Marker	Pkt	2	60.00	120.00
7	Pen	Pkt	10	2.00	20.00
8	Staples	Pkt	1	8.00	8.00
9	Stapler	No	1	75.00	75.00
10	Photocopying	Ls	-		200.00
11	Printing	Ls			600.00
12	Binding	Ls			150.00
13	Data Encoding	Ls			600.00
	Sub Total				**2,528.00**
14	Public transport 2 round	Trips	2	500.00	1,000.00
15	Researcher				3,000.00
16	Data collectors				700.00
Sub Total					**3,700.00**
Grand Total					**6,228.00**

Table 4: Budget Summary

S/N	Item Category	ETB
1	Stationery supplies and services cost	2,528.00
2	Transport Cost	1,000.00
3	Perdiem	3,700.00
Total Project cost		**6,228.00**

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