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LAND DEGRADATION & IT'S IMPLICATION ON SUSTAINABILITY OF WENCHI LAKE, OROMIA REGION AND POSSIBLE ENVIRONMENTAL PLANNING SOLUTIONS



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This is to certify that the thesis prepared by Bethlehem Engidawork, entitled: *Land degradation & its implication on sustainability of Wenchi Lake, Oromia Region and possible environmental planning solutions* is submitted in partial fulfillment of the requirements for the Degree of Master of Science in **Environmental Planning and Landscape Design** complies with the regulations of the university and meets the accepted standards with respect to the originality and quality.

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DEDICATION

I would like to dedicate this paper to my mother **W/o Kidan Addissu** who has nurtured and helped me throughout my life. Acknowledgements for the unconditional love she has given me.

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ACRONYMS

A.A:	Addis Ababa
ADPPRD:	Action Development Plan Program Re - Design Document
BMP:	Best Management Practice
CBET :	Community Based Ecotourism
ENVI:	The Environment for Visualizing Images
ETM+:	Enhanced Thematic Mapper Plus
FAO:	Food Agricultural Organization
FDRE:	Federal Democratic Republic of Ethiopia
GC :	Gregorian Calendar
GIS:	Geographic Information System
GTZ :	Germen Technical Corporation
LADA :	Land Degradation Assessment On Dry Land Areas
LANDSAT:	Land Satellite
LULC:	Land Use Land Cover
M:	Meters
MEA:	Mono Ethanol Amine
MOPED :	Ministry of Planning and Economic Development
MSS:	Multispectral Scanner
NGO :	Non Governmental Organization

PRLD:	Promoting Rural Local Development the case of Wenchi Ecotourism Society
RS:	Remote Sensing
TM:	Thematic Mapper
UNCCD :	United Nations Convention to Combat Desertification
UNEP :	United Nations Environment Program
USGS:	United States Geographical Survey
UTM:	Universal Transverse Mercator
WETA:	Wenchi Ecological Tourism Association
WHO:	World Health Organization
WTO :	World Tourism Organization

ABSTRACT

In Ethiopia Land Degradation has been an issue for years. This is the result of the topographic feature of the country. Many approaches has been done and experimented to battle the effects of land degradation. The efforts made include terracing, planting endemic trees, correcting poor land management and avoiding inappropriate cultivation systems. Prior consideration of the actions were protecting the environment and maintaining its sustainability.

This paper; Therefore, identifies LU/LC changes of the Wenchi crater Lake, examines the challenges that the Lake and its surrounding environment encountered, investigates type of land degradation and their causes, studies how to maintain the sustainability of the lake and assesses the ecotourism potentials. Finally concludes and recommends appropriate solutions to promote the sustainability of the study area.

Sampling size is based on the topographic contour line surrounding the Lake and covers about 27,194,235.6355meter². Both primary and secondary data had been employed. The LU/LC dynamics of the study area are studied by gathering images of years 1973,1984,2000 and 2015 G.c. from Land sat Multispectral Scanner, Land sat Thematic Mapper, Land sat Enhanced Thematic Mapper plus and Land sat 8. The extracted images were analyzed by using ENVI and Arc GIS. Based on the final output, results in percentage and colorful maps are presented and discussed .Qualitative and quantitative data analysis were made from semi - structured interviews and focused group discussions by SPSS software. Major challenges of the study area are discussed by categorizing it as Physical, Environmental, Social, Economical, and institutional aspects .

Based on the findings of the study, it is concluded that the major challenges identified are soil erosion, washing away of top soil, un sustainability of soil and water conservation methods used and lack of availability of main infrastructures.

Finally, the study addresses the major challenges of the study area by providing possible recommendations and environmental planning solutions.

KEY WORD: Conservation, Degradation, Ecotourism, Sustainability

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CHAPTER ONE : INTRODUCTION AND BACKGROUND

1.1. BACKGROUND OF THE STUDY

Environmental degradation is extensive in Ethiopia, but not all areas of the country are equally suffering. Both the extent and severity of the problem manifest spatial variations depending on different relief, ecology, rainfall, land use and land cover and soil types. Environmental degradation in Ethiopia replicated in the form land degradation and degradation of water resources as well as loss of biodiversity (Demel, 2001).

Land use is constrained by environmental factors such as soil characteristics, climate, topography, and vegetation. But it also reflects the importance of land as a key and finite resource for most human activities including agriculture, industry, forestry, energy production, settlement, recreation, and water catchment and storage. Land is a fundamental factor of production, and through much of the course of human history, it has been tightly coupled with economic growth (Habtamu, 2011).

Each year in Ethiopia it is estimated that 1.5 billion tons of top soil are washed away from their original location, which is an average of about 30 tons per hectare in the highlands, and about 40 tons a hectare from cultivated land. Indeed annual losses of up to 300 tons a hectare have been recorded in the case of sloping fields ploughed to a fine tilt for the tiny-seeded traditional cereal, *teff* (Hurni, *et al*, 1987, Muhidine, 2013). Land degradation in Ethiopia is especially sever in the highlands where the average soil loss from farm land is estimated to be 100 tons /hectare/year (FAO.,1986).

Some forms of land degradation are the result of natural physical processes shaping the landscape and high intensity of rainfall.

1.2. PROBLEM STATEMENT

A year ago I had the opportunity to visit Wenchi crater Lake, By the time I had noticed the landscape is highly rugged, highly affected by soil erosion and the lake is not supporting the local community as expected. The rugged topography and the absence of improved roads makes

the area inaccessible to visitors. This made the community not to benefit from the ecotourism potentials of the area. The sloped pathways conventionally used by the community are in appropriate.

The scale of the problem, however, dramatically increased due to an increase in deforestation, overgrazing, over cultivation, inappropriate farming practices and increasing human population. Removing vegetation cover on steep slopes (slope ranging from 15-20%) for agricultural expansion, firewood and requirements as well as for grazing space paved the way to massive soil erosion (Yihenewe,2007).

People who know the area for long time are witnessing that the lake and its surrounding has been covered with vegetation and it gradually decreases through time. This raises the concern that the land degradation and inaccessibility problem has been advanced through time, and if those problems are not tackled on time, the situation would be worse in the future.

The study focuses on the problems listed below:

1. The dynamicity of land use / land cover changes for the past forty two years is identified and verified. In the process vegetation cover changes, accessibility, changes in water level and watershed management are observed.
2. The sloped path ways to the Lake and their inconvenience shows the main problem in the area is Land Degradation. The types of Land Degradation in the area is listed point by point. Much has been tried to maintain the land degradation but all the efforts are being degraded during rainy season. The sloped pathways are not convenient both for pedestrian and vehicle users and needs unconditional solution that will consider the sustainability of both rainy and dry seasons.
3. The dynamicity result of area leads in identification of major challenges existing in Wenchi Lake and its surrounding environment.
4. The Wenchi creator Lake is known for its special clean water. How to maintain the purity is studied for future sustainability.

5. The Ecotourism potentials of Wenchi crater Lake is not utilized as its availability. Possible community based ecotourism(CBET) potentials are studied in detail.

Therefore, the study will identify the major environmental problems that caused the current degradation, to examine the measures taken, to study their gaps and to recommend appropriate solutions.

1.3. OBJECTIVES OF THE STUDY

1.3.1. GENERAL OBJECTIVE

The general objective of the study is to compare the land use land cover (LU/LC) change of Wenchi crater Lake and its surroundings, its effect on the sustainability, productivity and accessibility of the lake and to propose possible landscape design solutions and recommendations addressing the problems.

1.3.2. SPECIFIC OBJECTIVES

The specific objective of the study will focus on maintaining the sustainability of Wenchi crater Lake and the surrounding environment in detail. Understanding the state of the environmental degradation with its root cause, nature and consequences as well as previous management practices is critical to look for options to mitigate the problem and its impact. Thus, the following are the specific objectives of this research paper:

- a) To assess the state of LU/LC changes of the Wenchi crater Lake Landscape of the years 1973, 1984 2000 and 2015 G.C. time intervals.
- b) To identify types and causes of Land Degradation on Wenchi crater Lake and its surrounding environment.
- c) To identify major challenges of Wenchi crater Lake and surrounding environment in terms of physical, environmental, social and economical aspects so as to maintain its sustainability.
- d) To identify the soil and water conservation strategies deployed in the study area.
- e) To asses Ecotourism potentials of the site. Mainly, community based ecotourism.
- f) To recommend possible ways to avert the problems observed in the study area.

1.4. RESEARCH QUESTIONS

- a) What is the LU/LC of Wenchi crater Lake for the years 1973,1984,2000 and 2015 G.C ?
- b) What types and causes of Land Degradation occurred in the study area?
- c) What are the major challenges of Wenchi creator Lake in terms of Physical, Environmental, Social and Economical aspects that hinders its sustainability?
- d) What kind of soil and water conservation methods had been practiced in the study area?
- e) What are the Ecotourism potentials of the area and contributions of the community in this regard?
- f) What are possible recommendations and environmental planning solutions that can attempt the problems faced on the study area?

1.5. SCOPE OF THE STUDY

1.5.1. SPATIAL SCOPE

The spatial scope of the study area lies in the Geographical location of 8⁰47'14.45" N and 37⁰53'46.17" E, in Oromia Regional State West Shoa zone in a local district known as Haro, Wenchi village.

1.5.2. THEMATIC SCOPE

The thematic scope of the study focuses on detail study of LU/LC changes and dynamics for the years 1973, 1984, 2000 and 2015 G.c., understanding the major environmental problems that poses a question on the sustainability and accessibility of the Lake. The main concern is understanding the state of the environment regarding its sustainability, figure out possible landscape design solutions and proposing community based ecotourism (CBE) alternatives.

In the process cause and effect of community actions that promote the degradation of the environment had been studied in detail. The major thematic scope are described in detail as follows:

- a) LU/LC changes of the study area, particularly satellite image maps of 1973, 1984, 2000 and 2015 G.c is used so as to assess the degree of LU/LC changes observed.
- b) The types and causes of Land Degradation existing in the study area are identified and studied in detail: Such practices like inappropriate cultivation, deforestation, over grazing etc....
- c) The major challenges of the study area are identified in terms of physical, environmental, social and economical aspects are examined in detail .
- d) Major soil and water conservation methods are deployed based on the types of land degradation in the area.
- e) Ecotourism potentials of the site are sensitively seen. Community based ecotourism is seen as a major startup.
- f) To recommend solutions that addresses the major problems of the study area and to propose possible environmental planning solutions.

1.5.3. TEMPORAL SCOPE

In order to attain the LU/LC dynamics satellite images for the past 43 years with different intervals were gathered. Satellite images of 1973 ,1984, 2000 and 2015G.c. were available by the time of the study. Details of spatial resolution and acquisition date are illustrated in the table below.

Table 1 :Spatial resolution meter and acquisition date

DATA SOURCE	SPATIAL RESOLUTION	ACQUISITION DATE
Landsat Multispectral Scanner (MSS)	60 meter	1973
Landsat Thematic Mapper(TM)	30 meter	1984
Landsat Enhanced Thematic Mapper plus (ETM+)	30 meter	2000
Landsat 8	15 meter	2015

1.6. METHODOLOGY

1.6.1. DESCRIPTION OF STUDY AREA

Lake Wenchi is 29 Km and 38 Km away from the town of the district (Chitu) and the town of the zone (Wolliso) respectively (PRLD, 2014). The altitude of the area ranges between 2900 and 3384 meters above sea level. The average annual rainfall in the area is 1420 millimeters (PRLD, the case of Wenchi Ecotourism society, 2014).



*Figure 1 : Wenchi Creator Lake
Source: Photograph by the Author,2016*

As it is illustrated in the figure 1 the lake is very attractive and surrounded by green vegetations. The lake has a depth ranging between 6 and 78 meters and an area of 560 ha. The lake with its natural color, hot springs, waterfalls, and cold water around the lake, beautiful and natural landscape, natural forests, and historical church in the area are the key natural tourist attractions around the lake. There are 10 small villages around the lake hosting a total of 400 households. The lake area is surrounded by hilly mountains. The existing land use types are forest, agriculture and residences. The hilly mountains around the lake are covered by forests, small highland trees, and residential houses (PRLD, 2014).

Wenchi Crater Lake is the result of volcanic eruption of thousands of years ago, the lake is offering much to the community by keeping resources, history and heritage. The lake is

surrounded by a beautiful scenery of mountainous features. At the North and North East direction it is aligned to mountain Goro Wenchi in the west direction it is aligned to Kella mini mountain which is found a bit down to Goro mountain, in the South Gulle Tekelehymanot hot spring water which has a healing power for certain diseases.

Though it is quite difficult to specify the exact source point of the spring water that is joining the lake, it is obvious that it is from the mountains surrounding the lake. The amazing springs are so pure and beautiful with a special quality. At the same sea level; the Wenchi Lake has different character of cold and hot spring (H/Meskele, 2003)

There is an island that is fully surrounded by water that is called Saint Kirkos church. Which was founded by Atse Zerayakob in the 15th century. It was Atse Fasil who migrated from Gonder and rehabilitated the island. He also opened the lake water outlet through the south east of the lake, after all the rehabilitations made on the church Atse Fasil kept many valuables and souvenir on the island. The church is richly surrounded by dense long aged Juniperous and Eucalyptus vegetation. And is another source of tourism for Wenchi with many years of historical heritages. At this moment the church is even building a museum for further management and attraction of tourist.



Figure 2: Areal and front view of 'Saint Kirkos Church'

Source: Photograph by the Author, 2016

All the Showa churches, after suffering during the islamic invention of '*Gragh Mohammed*', they all escaped to this island for security of heritages. Later on , After *Haileselasie* came to power , he modernized the entire compound of the church. The main reason for his actions were the

church listened to his request to free Eritrea from the Great Britain, but there is no a single written materials that talks about the event.(H/Meskele,2003)

- **WATER BODY**

The Wenchi creator Lake is the result of many volcanic activities and have a land size of 560 hectares with a depth of 6 to 78 meters. It is located in Oromia Regional state, South west shoa zone, 155 Km west away from Addis Ababa. Other attractions also include hot mineral springs, waterfalls and valleys around the lake gives the place attractive nature and tourists called it 'Switzerland's of Africa'.

The lake is gifted with its natural color, hot springs, waterfalls, and cold water, beautiful and scenic landscape, natural forests, and historical church where the lake is surrounded by hilly mountains and natural forest the so called Kibate forest on the western side. Geographically, the crater is impressive, wide and very steep with its dramatic valley. Wenchi crater Lake is a good potential for such tourist activities as hiking, boating/canoeing, horse riding, forest exploring, bathing, medical tourism, trekking, adventure and other leisure activities. Furthermore, the lake provides a picturesque scenery landscape, culture and nature with its ability of ecosystem in accepting managed level of visitors, historical monastery built in the 15th century (Kirkos Monastery), and cultural landscape being shaped. The lake is suitable to develop ecotourism with the availability of local products to build accommodation and recreational facilities, electricity in the site, gravel road, pathways and parking facilities, and insufficient clean water to meet extra demands of tourists and locals.

As it is very cold, both the water and the climate, the place has been known for its continuous visitors from across the country. Although the water is known for its high content of fluoride ion, many residents use it for drinking water and cleaning purpose.

There is no known type of fish or other aquatic life that serves the community. Moreover, there are no harmful animals like snake and crocodile too. The reason has been under study by NGOs but no further fact has been demonstrated. For trial purpose around 50,000 fishes from Zeway has been introduced on 1998 G.C. by World vision but no fish has survived to live. Many say

that there is no food for the fishes in the water and others say the composition of the water and the coldness doesn't support fish.

There exists an out let through which the water goes out through Gulle Mountain' and joins to Walga river. By the South of Gulle Mountain depression, there is a place called Hora. At the center of this depression, there are ample hot spring water resources. In addition to this there is a fountain that goes from the wall of the mountain called Dawallla fountain.

As it is illustrated in the figure below the Wallga river plays a crucial role in the lively hood of the community, after it offers various purposes of the communities' need. Finally it goes directly to the Gibe River after it serves farmers.



Figure 3 : Wallga River

Source: Photograph by the Author,2016

1.6.2. SOURCE AND TYPE OF DATA

Both primary and secondary data were collected. Primary data were collected by interviews, community discussions and site observations while the secondary data were obtained by different analytical qualitative and quantitative data results, literatures, software outputs, etc....

1.6.2.1. PRIMARY DATA

Primary data is collected from semi - structured interviews such as focused group interviews, key informant interviews and distribution of questionnaires for the community and concerned body.

The participants of focused group discussions were composed of Social administrators; woreda officials and ecotourism association members. The key informant interviews were made with some investors, office employees, community influential people and the community living at the buffer zone of the lake and at Haro woreda.



Figure 4 : Group discussion in Ecotourism office

Source : Photograph by the Author,2016

During discussions everyone was cooperative and flexible for change. Additionally, two hundred questionnaires were prepared to be filled by the community but only one hundred seventy were successfully filled. The rest of the questionnaires were filled by investors and tourists by changing the type of questions.

Main issues raised in all types of data collection includes; identification of major environmental problems, causes and effects of these problems, potentials of the area, how the community can be benefited from the available resources, availability of infrastructure in the area , maintaining the sustainability of the lake and soil and water conservation methods.

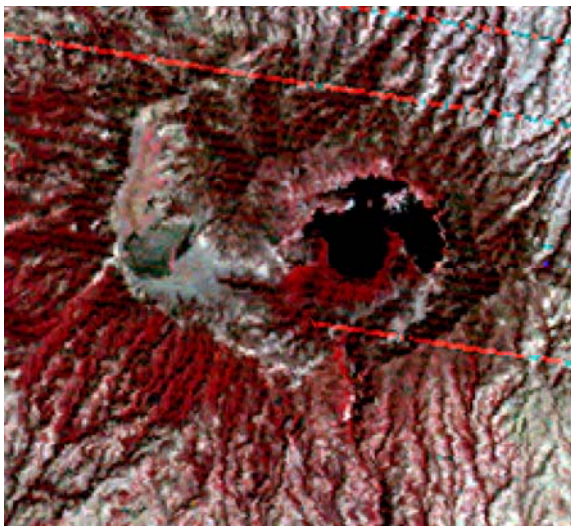
Finally, by gathering information from the above listed methods socio economic data's were successfully compiled based on the objective of the study.

1.6.2.2. SECONDARY DATA

Secondary data were collected from Chittu woreda office , Haro Woreda social farmers office, Ecotourism association office and additional literatures . From Chittu woreda office which is far from the study area, Some hard copies like demographic data and some socio economic data were gathered. From the woreda social farmers administrator office, some land use land cover data were collected . From the Ecotourism association office a report containing many useful information with guiding map of the study area were gathered willingly. The information obtained from such offices are used to analyze the situations supported by primary data. Moreover, grey literatures such as journals and scientific books are used to relate the situation of the area with other countries.

1.6.3. SOURCE MAPS

All satellite images used for the study are gathered from Land sat Multispectral Scanner (MSS), Land sat Thematic Mapper(TM), Land sat Enhanced Thematic Mapper plus (ETM+) and Land sat 8 and cropped as it is viewed below:



1973; 60 meter Resolution



1984 ; 30 meter Resolution



2000;30 meter Resolution



2015 ; 15 meter Resolution

Figure 5 : Satellite images of 1973,1984,2000 & 2015

Source : Different image processing software as expressed in the temporal scope

1.6.4. SAMPLING METHOD

Transect walking being the main guidance, size of the sample is based on the topographic contour line surrounding the 'Wenchi Crater Lake' Which covers 27,194,235.6355 meter². The contour line Surrounding the 'Wenchi Lake' is demonstrated as follows.

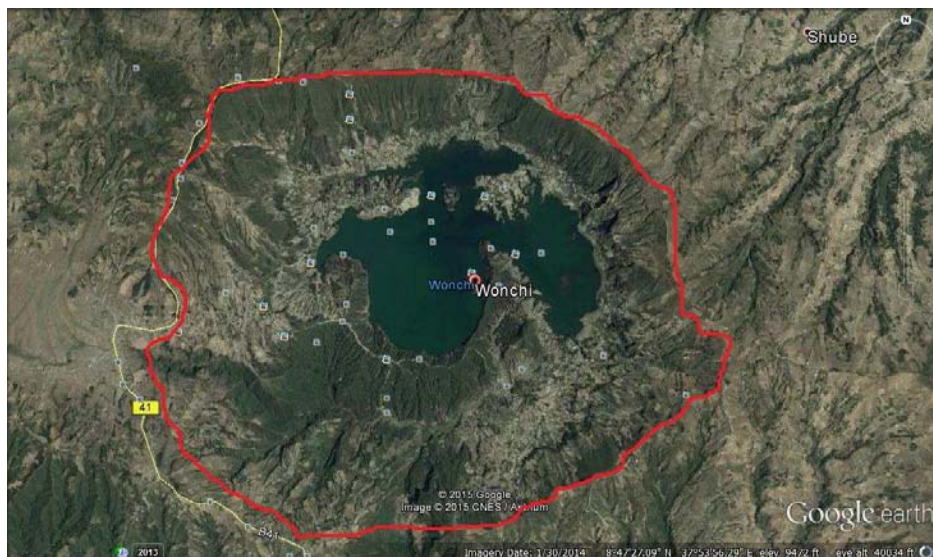


Figure 6 : Boundary of the study area

Source: Google Earth image, 2016

1.6.5. DATA ANALYSIS AND PRESENTATION

a) SPATIAL DATA ANALYSIS

The LU/LC dynamics of the Wenchi crater Lake and its surrounding environment is analyzed using GIS and Remote Sensing tools. First the Land satellite image of the study area are downloaded from Land satellite image files. The images are of years 1973,1984,2000 and 2015 G.c. to understand the change in LU/LC dynamics for the past 42 years and care is taken to get a cloud free image to avoid misinterpretation of the image during analysis.

The extracted images were first inserted in to ENVI software for analyzing the land cover. Firstly supervised classification technique, maximum likelihood is applied to landsat images ; classification of land cover like forest land, grass land, bare land and water body is differentiated followed by post classification (majority/minority). And finally after getting the result it is converted to vector to be analyzed by Arc map GIS. By using the Arc map GIS software all the classified land covers are quantified. The land cover changes are analyzed according to the topographic structure (slope and altitude) by using GIS functions. Based on the final output, results in percentage and colorful maps are gathered.

The aim of change detection process is to recognize LU/LC on digital images that change features of interest between two or more dates. A variety of studies have addressed that post-classification comparison was found to be the most accurate procedure and presented the advantage of indicating the nature of the changes . In this study, change detection comparison of post classification technique was applied to the LU/LC maps derived from satellite images. maximum likelihood classification comparison strategy was employed to clarify the LU/LC changes. Additionally , slope analysis, were made with Arc map GIS from DEM file of Ethiopia.

Spatial description of the area are explained in detail with inventory study of the area. All available resources are identified and studied. especially, available natural resources are identified visually , analytically and historically.

b) STATISTICAL ANALYSIS

Qualitative and quantitative data analysis were made from semi - structured interviews and focused group discussions by SPSS software. Based on the result of the SPSS some major differences were selected for discussion based on the objective of the paper. Descriptive analysis such as frequency, percentage of respondents were gathered according to questions asked. Subjective evaluation of land features were compared from the result of GIS and conclusions are made by using results of Arc map GIS as a base information. Qualitative data were evidenced by visual observations, transect walking, analyzing the perception of the society and last but not list from investors interviews at the area.

Subjective evaluation of the land features of the site is also made through visual observation . Finally the results of the analysis is presented as tables accordingly using Ms Excel, Arc map GIS and AutoCAD, Archi cad, Illustrator and Photoshop graphical software's.

1.7. SIGNIFICANCE OF THE STUDY

The researcher hopes the findings of this research will help the Wenchi community and officials to work towards sustainability, quality and increase the Ecotourism potential of the study area. The output of this paper will help in improving some existing facilities and practices that helps the community to lead better quality life . It will further allow investors to provide better programs and projects that can be facilitated and that could bring positive results to restore degraded lands and protect resource available in the study area.

1.8. LIMITATIONS OF THE STUDY

The study has faced many problems especially by the time of data collection. From the very beginning availability of budget from the institution was very late and also not enough to process the overall activity. Secondly, the sudden unrest in Oromia region on the year 2015/16 G.C has delayed data collection period originally scheduled. Thirdly, not knowing the local language of the study area while collecting data's and distributing questionnaires was another challenge. Fourthly, finding satellite images of appropriate equal time interval was not possible. Because of that available land satellite images are used. Additionally, nonexistence of

AutoCAD files of the study area and also any land use/ land cover analysis were promoting additional work and time. Finally, non-availability of journals, researches and any written documents on the study area.

1.9. ORGANIZATION OF THE STUDY

This paper is organized in to five chapters. Chapter one contains background and introduction part, chapter two includes literature review, chapter three contains description of the study area, chapter four includes results and discussions, finally, chapter five contains the overall paper conclusion and recommendation.

CHAPTER TWO : LITERATURE REVIEW

In this chapter all necessary Literatures relevant to the objective of the paper has been discussed in detail. It starts from definition of terms followed by specific objectives part by part and finally summarizes the overall output of the chapter.

Ethiopia is one of the well - endowed countries in Sub-Saharan Africa in terms of natural resources and valuable diversity in the production environment. However, land degradation is a treat for its natural resources for centuries. High human and livestock population pressures, highly variable and unreliable rainfall, and steep topography have accelerated the process of land degradation. To combat resource degradation and increase food production, different soil and water conservation measures have being implemented since 1970 (Muhidine,2003).

The LU/LC of Ethiopia has been changing for the past few years. Many cause and effects has been noticed through time, based on studies performed on different parts of the country. Major challenges in promoting the dynamicity of LU/LC includes majorly population growth, deforestation, improper utilization of agricultural land and topography of the overall country has contributed a lot. The changes have been increasing from time to time and some government movements have been performed country wise for combating the effects caused by the actions (Lakew *et al.*, 2005).

Sustainability of soil and water resources are in to question. Many of the water resources in Ethiopia are known for their support for the community. Almost many people living around rivers and Lakes use the water resource for their daily use. Therefore, maintaining the quality of the water has been a challenge from time to time (Muhidine, 2013).

2.1. DEFINITION OF TERMS

Land Use: involves the management and modification of natural environment or wilderness into built environment such as settlements and semi-natural habitats such as arable fields, pastures, and managed woods. Land use is characterized by the arrangements, activities and inputs people undertake in a certain land cover type to produce, change or maintain it (di Gregorio, 2005).

Land cover: is defined as the observed (bio)- physical cover on the Earth's terrestrial surface. It includes vegetation and man-made features as well as bare rock, bare soil and inland water surfaces (di Gregorio, 2005). In current practice, many national and regional observation programmers' and research institutes still do not distinguish between land cover and land use. Land use characterizes the arrangements, activities and inputs people have undertaken on a certain land cover type to produce, change or maintain it. Because of the implicit or explicit role of humans in land use characterization and mapping, it should be considered distinct and dealt with separately from land cover type, thus ensuring internal and external consistency and comparability (di Gregorio, 2005).

Land degradation:

Land degradation as “the loss of utility or potential utility or the reduction, loss or change of features or organisms which cannot be replaced. Young; (1998) and Hussien; (2006) gave a more similar definition of land degradation as the process that causes temporary or permanent lowering of current or future productive capacity of land.

- **FAO 1979:** Land degradation is a process which lowers the current or potential capability of soils .
- **UNEP 1992:**Land degradation implies reduction of resource potential by a combination of processes acting on land.
- **MEA 2005:** The reduction in the capacity of the land to perform ecosystem goods, functions and services that support society and development.
- **LADA 2009:** The reduction in the capacity of the land to provide ecosystem goods and services and to assure its functions over a period of time for its beneficiaries..

Sustainability: is the process of suggested to improve the quality of human life within the limitations of the global environment. It involves solutions for improving human welfare that doesn't result in degrading the environment or impinging on the wellbeing of other people (Sue Edwards,2010).

Ecotourism: is tourism that involves travelling to relatively undisturbed natural areas with the specific objective of studying, admiring and enjoying the scenery and its wild plants and animals, as well as any existing cultural aspects (both past and present) found in these areas. Ecotourism implies a scientific, aesthetic or philosophical approach, although the 'eco - tourist' is not required to be a professional scientist, artist or philosopher. The main point is that the person who practices ecotourism has the opportunity of immersing him or herself in nature in a way that most people cannot enjoy in their routine, urban existence. This person will eventually acquire a consciousness and knowledge of the natural environment, together with its cultural aspects, that will convert him into somebody keenly involved in conservation issues. Ecotourism, under whatever definition, is an instigator of change. It is inevitable that the introduction of tourists to areas seldom visited by outsiders will place demands upon the environment associated with new actors, activities, and facilities. Ecotourism will forge new relationships between people and environment, and between peoples with different lifestyles. It will create forces for both change and stability. These forces act at a diversity of scales from global to local. Generally Ecotourism refers to two criteria: environmentally responsible and socially and culturally sound (*Megan Epler Word; 2012*)

Community based Ecotourism: is used to describe ecotourism ventures that are characterized by high environmental consideration, increased control and involvement of the local residents, as well as significant benefits for the host community. Community-based ecotourism refers more specifically to tourism activities or enterprises that involve local communities; it operates in their lands, and is based on their cultural and natural assets and attractions. It is therefore a tourism which focuses on travel to areas with natural attractions (rather than, say, urban areas), and which contributes to environmental conservation and local livelihood enhancement (*Manu, Isaac;2012*)

Landscape and Landscape Ecology: It deals with the ecology of landscapes. Landscape invariably include an area of land containing a mosaic of patches or landscape elements.

- Forman and Godron (1986) defined landscape as a heterogeneous land area composed of a cluster of interacting ecosystems that is repeated in similar form throughout.

Regardless of how landscape is defined, the “concept” of a landscape is unequivocal. All landscapes have a user-defined structure (pattern) that is hypothesized to influence its function (process). This interaction between spatial pattern and process defines the landscape concept.

Ecosystem: is a complex set of relationships among the living resources, habitats and residents of an area. Interaction of communities with their environment. It is a more-or-less self-contained ecological entity, consisting of both organisms and their complete biotic and abiotic environment found in a particular place. It is the smallest functional ecological unit within the biosphere. An ecosystem is a relatively independent, relatively self-contained, and more-or-less self-sufficient unit. A key feature of ecosystems is that members of a particular ecosystem are more likely to interact with other members of the same ecosystem than they are with members of a different ecosystem of the same or different type found in a different place.(www.lerner.org,2008)

Soil erosion: Erosion is the natural process of removal of soil by water or wind. Soil erosion becomes a problem when the natural process is accelerated by inappropriate land management, such as clearance of forest and grasslands followed by cropping which results in inadequate ground cover, inappropriate tillage and overgrazing. It is also caused by activities such as mining, infrastructural and urban development's without well-designed and well-maintained conservation measures (global environment outloo,2007).

Loss of topsoil means loss of soil's organic matter, nutrients, water holding capacity and biodiversity, leading to reduced production on-site. Eroded soil is often deposited where it is not wanted, with the result that the off-site costs, such as damage to infrastructure, sedimentation of reservoirs, streams and estuaries, and loss of hydropower generation, may be much higher than the losses in farm production (global environment outloo,2007).

Watershed: A watershed is defined as any surface area from which runoff resulting from rainfall is collected and drained through a common confluence point. The term is synonymous with a drainage basin or catchment area (Lakew *et al.*, 2005). It is a hydrologic unit that has been described and used both as a bio-physical unit and as a socio-economic unit for planning and implementing resource management activities (Solomon *et al.*, 2013). The bio-physical unit in a watershed includes its water, soil, and vegetation. While, the socioeconomic unit includes

people, their farming system (including livestock) and interactions with land resources, coping strategies, social and economic activities and cultural aspects (Lakew *et al.*, 2005).

Watershed management: Watershed management is the process of guiding and organizing land and other resources use in a watershed to provide desired goods and services without adversely affecting land resources (Brooks *et al.*,1994). Thus, watershed management implies the judicious use of natural resources such as land, water, biodiversity and biomass in a watershed to obtain optimum production with minimum disturbance to the environment (Binyam and Desale, 2014). It is a holistic approach to managing watershed resources that integrates hydrology, ecology, soils, physical climatology and other sciences (Pandit *et al*, 2007).

Deforestation: Deforestation is the conversion of forested areas to non-forest land use . It can be the result of the deliberate removal of forest cover for agriculture or urban development, or it can be a consequence of grazing animals, wild or domesticated. Deforestation has thus many causes. Population pressures, profits, and internal social and political forces can also all push up the rate of forest loss (Prof. Bo Nordell,2007).

Generally the removal or destruction of significant areas of forest cover has resulted in a degraded environment with reduced biodiversity. Deforestation includes not only the conversion to non-forest, but also degradation that reduces forest quality, the density and structure of the trees, the ecological services supplied, the biomass of plants and animals, the species diversity and the genetic diversity. Deforestation results from removal of trees without sufficient reforestation and usually results in a significant loss of biodiversity (Prof. Bo Nordell,2007).

2.2. ETHIOPIAN HIGH LANDS: GENERAL OVER VIEW

The highlands of Ethiopia are areas of over 1500 meter above sea level, which make up about 45% of the total land area, support over 84% of human population and two-thirds of animal population. They are also the sources of many of the country's major resources (Alemneh, 2003). In general, the extent of land resources degradation in Ethiopia, especially the degree of soil erosion, nutrient depletion and deforestation in highland areas of the country is very high. A significant amount of arable land in the highlands of the country is lost due to land degradation, which has different causes behind it (Lakew, *et al* 2005).

Due to high degree of degradation, important renewable natural resources such as soil, water, forest and of biodiversity are highly deteriorating in the Ethiopian highlands. This problem is further aggravated by the expansion of agriculture to marginal areas (Gete, 2002).

Land degradation particularly soil degradation has significant negative impact on productivity of land because soil degradation and soil productivity are inversely related. That is, where degradation is taking place at a higher rate, the productivity is low and vice versa, while other things remain the same. It is manifested by a reduction in the actual or potential productivity of soils. This productivity of soil is significantly affected in Ethiopia due to the serious soil degradation in the country (Ministry of Planning and Economic Development (MOPEd), 1994; Desta, 2009). It is indicated that the soil in cropping land of Ethiopia is not sufficiently fertile to support the required level of food production.

2.3. LAND USE / LAND COVER CHANGES

According to ((Kraaij, T., and P. A. Novellie. 2010)) Land use and land cover classes represent analytical units, which allow to establish a first quantitative link between human activities, environmental impacts and its geographical (spatial) dimension.

Information on land cover and/or land use change are of special value integrating the temporal dimension. Land cover and land use change is commonly divided into two broad categories: conversion and modification.

- **Conversion:** refers to a change from one cover or use category to another (e.g. from forest to grassland)
- **Modification:** represents a change within one land use or land cover category (e.g. from rain fed cultivated area to irrigated cultivated area) due to changes in its physical or functional attributes.

The pure land cover and land use information gains a significant added value through the analysis, identification and description of ongoing processes. Based on land cover and land use change information, certain processes can be retrieved, which might also serve as simple indicators.

2.4. LAND DEGRADATION : CAUSES AND EFFECTS

2.4.1. CAUSES OF LAND DEGRADATION

According to ((Kraaij, T., and P. A. Novellie. 2010)) Although degradation processes do occur without interference by man, these are broadly at a rate which is in balance with the rate of natural rehabilitation. So, for example, water erosion under natural forest corresponds with the subsoil formation rate. Accelerated land degradation is most commonly caused as a result of human intervention in the environment. The effects of this intervention are determined by the natural landscape. The most frequently recognized main causes of land degradation include:

- a) overgrazing of rangeland;
- b) over-cultivation of cropland;
- c) water logging and salinization of irrigated land;
- d) deforestation; and
- e) pollution and industrial causes.

Within these broad categories a wide variety of individual causes are incorporated. These causes may include the conversion of unsuitable, low potential land to agriculture, the failure to undertake soil conserving measures in areas at risk of degradation and the removal of all crop residues resulting in 'soil mining' (i.e. extraction of nutrients at a rate greater than resupply). They are surrounded by social and economic conditions that encourage land users to overgraze, over-cultivate, deforest or pollute. These are considered in the following chapter. It is possible to distinguish between two types of land degrading actions. The first is unsustainable land use. This refers to a system of land use that is wholly inappropriate for a particular environment. It is unsustainable in the sense that, unless corrected, this land use or indeed any other could not be continued into the future.

According to ((Kraaij, T., and P. A. Novellie. 2010)) Un sustainability has the implication of being irreversibly degrading. Many 'badlands' (extremely bare, de vegetated and eroded slopes) are effectively irreversible. However, a large input of technology could start a rehabilitation process, if enough time and resources were to be devoted. Usually, this is uneconomic. Secondly,

inappropriate land management techniques also cause land degradation, but this degradation may be halted (and possibly reversed) if appropriate management techniques are applied.

According to (Assessment of soil degradation in South and Southeast Asia,1997): Land degradation is caused by the following issues:

1) **MAN-MADE CAUSES :**

Various types of human activities may lead to soil degradation. Some degradation processes may also occur naturally, such as erosion, only those degradation types are considered that are the result of the human disturbance of either a natural or anthropogenic state of equilibrium

a) **Agricultural activities:** defined as the improper management of cultivated arable land. It includes a wide variety of practices, such as insufficient or excessive use of fertilizers, shortening of the fallow period in shifting cultivation, use of poor quality irrigation water, absence or bad maintenance of erosion control measures, untimely or too frequent use of heavy machinery, etc. Degradation types commonly linked to this causative factor are erosion (water or wind), compaction, loss of nutrients, stalinization, pollution (by pesticides, fertilizers).

b) **Deforestation and removal of natural vegetation:** defined as the near complete removal of natural vegetation (usually primary or secondary forest) from large stretches of land, for example by converting forest into agricultural land (frequently leading to causative factor, large scale commercial forestry, road construction, urban development, etc. Deforestation often causes erosion and loss of nutrients.

c) **Over-exploitation of vegetation for domestic use:** contrary to deforestation and removal of natural vegetation, this causative factor does not necessarily involve the (near) complete removal of the "natural" vegetation, but rather a degeneration of the remaining vegetation, thus offering insufficient protection against erosion. It includes activities as excessive gathering of fuel wood, fodder, (local) timber, etc.

d) **Overgrazing:** besides actual overgrazing of the vegetation by livestock, other phenomena of excessive livestock amounts are also considered here, such as trampling. The effect of overgrazing usually is soil compaction and/or a decrease of plant cover, both of which may in turn give rise to water or wind erosion.

e) **Industrial activities:** includes all human activities of a (bio)industrial nature: industries, power generation, infrastructure and urbanization, waste handling, traffic, etc. It is most often linked to pollution of different kinds (either point source or diffuse) and loss of productive function.

2) NATURAL CAUSES :

a) **Topography:** The topography of the land determines the velocity at which surface runoff will flow, which in turn determines the erosivity of the runoff. Longer, steeper slopes (especially those without adequate vegetative cover) are more susceptible to very high rates of erosion during heavy rains than shorter, less steep slopes. Steeper terrain is also more prone to mudslides, landslides, and other forms of gravitational erosion processes

b) **Land degradation by water:** the removal of soil particles by the action of water. Usually seen as sheet erosion (a more or less uniform removal of a thin layer of topsoil), rill erosion (small channels in the field) or gully erosion (large channels, similar to incised rivers). One important feature of soil erosion by water is the selective removal of the finer and more fertile fraction of the soil.

c) **Land degradation by wind:** the removal of soil particles by wind action. Usually this is sheet erosion, where soil is removed in thin layers, but sometimes the effect of the wind can carve out hollows and other features. Wind erosion most easily occurs with fine to medium size sand particles.

d) **Soil fertility decline:** the degradation of soil physical, biological and chemical properties. Erosion leads to reduced soil productivity, as do:

- i. Reduction in soil organic matter, with associated decline in soil biological activity;

- ii. Degradation of soil physical properties as a result of reduced organic matter (structure, aeration and water-holding capacity may be affected);
- iii. Changes in soil nutrient content leading to deficiencies, or toxic levels, of nutrients essential for healthy plant growth;
- iv. Build up of toxic substances – e.g. pollution, incorrect application of fertilizers.

e) **Water logging:** caused by a rise in groundwater close to the soil surface or inadequate drainage of surface water, often resulting from poor irrigation management. As a result of water logging, water saturates the root zone leading to oxygen deficiency.

f) **Increase in salts:** this could either be salinization, an increase in salt in the soil water solution, or sodication, an increase of sodium cations (Na^+) on the soil particles. Salinization often occurs in conjunction with poor irrigation management. Mostly, sodication tends to occur naturally. Areas where the water table fluctuates may be prone to sodication.

g) **Sedimentation or 'soil burial':** this may occur through flooding, where fertile soil is buried under less fertile sediments; or wind blows, where sand inundates grazing lands; or catastrophic events such as volcanic eruptions. In addition to these principal types of soil degradation, other common types of land degradation include:

h) **Lowering of the water table:** this usually occurs where extraction of groundwater has exceeded the natural recharge capacity of the water table.

i) **Loss of vegetation cover:** vegetation is important in many ways. It protects the soil from erosion by wind and water and it provides organic material to maintain levels of nutrients essential for healthy plant growth. Plant roots help to maintain soil structure and facilitate water infiltration.

j) **Increased stoniness and rock cover of the land:** this would usually be associated with extreme levels of soil erosion causing exhumation of stones and rock.

Although the foregoing list neatly breaks down the components of soil degradation by cause, very often these agents of degradation act together. For example, strong winds often occur at the front of a storm, thus wind erosion and water erosion may result from the same event.

Additionally, a soil that has suffered some form of degradation may be more likely to be further degraded than another soil similar in all respects except for the level of degradation. One well-accepted indicator of increased erodibility is the level of soil organic matter. Where the organic matter content of a soil falls below 2% the soil is more prone to erosion, because soil aggregates are less strong and individual particles are more likely to be dislodged.

Some environments are naturally more at risk to land degradation than others. Factors such as steep slopes, high intensity rainfall and soil organic matter influence the likelihood of the occurrence of degradation. Identification of these factors allows land users to implement techniques that safeguard against loss of productivity.

Management practices also exert a significant influence on the susceptibility of a landscape to degradation. Extensive and poorly managed land use systems are more likely to degrade than intensive, intricately-managed plots. Milder forms of land degradation can be reversed by changes in land management techniques, but more serious forms of degradation may be extremely expensive to reverse (such as salinity) or may be, for practical purposes, irreversible.

Soil erosion, when serious and prolonged, is effectively irreversible because, in most circumstances, the rate of soil formation is so slow. In moist, warm climates formation of just a few centimeters of soil may take thousands of years and in cold, dry climates it can take even longer. Soil loss through erosion happens far faster: up to 300 times faster where the ground is bare. Soil erosion is the most widely recognized and most common form of land degradation and, therefore, a major cause of falling productivity.

2.4.2. EFFECTS OF LAND DEGRADATION

According to (WTO,2002) The main outcome of land degradation is a substantial reduction in the productivity of the land. The major stresses on vulnerable land include:

- Accelerated soil erosion by wind and water

- Soil acidification or alkalinisation
- Salination
- Destruction of soil structure including loss of organic matter
- Derelict soil

Overcutting of vegetation occurs when people cut forests, woodlands and shrub lands to obtain timber, fuel wood and other products at a pace exceeding the rate of natural re growth. This is frequent in semi-arid environments, where fuel wood shortages are often severe.

Overgrazing is the grazing of natural pastures at stocking intensities above the livestock carrying capacity; the resulting decrease in the vegetation cover is a leading cause of wind and water erosion. Agricultural activities that can cause land degradation include shifting cultivation without adequate fallow periods, absence of soil conservation measures, cultivation of fragile or marginal lands, unbalanced fertilizer use, and a host of possible problems arising from faulty planning or management of irrigation.

The role of population factors in land degradation processes obviously occurs in the context of the underlying causes. In the region, in fact, it is indeed one of the two major basic causes of degradation along with land shortage, and land shortage itself ultimately is a consequence of continued population growth in the face of the finiteness of land resources.

Population pressure also operates through other mechanisms. Improper agricultural practices, for instance, occur only under constraints such as the saturation of good lands under population pressure which leads settlers to cultivate too shallow or too steep soils, plough fallow land before it has recovered its fertility, or attempt to obtain multiple crops by irrigating unsuitable soils. Severe land degradation affects a significant portion of the earth's arable lands, decreasing the wealth and economic development of nations. Land degradation cancels out gains advanced by improved crop yields and reduced population growth. As the land resource base becomes less productive, food security is compromised and competition for dwindling resources increases, the seeds of famine and potential conflict are shown. Unless land rehabilitation measures are effective a downward eco-social spiral is created when marginal lands are nutrient depleted by

unsustainable land management practices resulting in lost soil resilience leading to soil degradation and permanent damage.

Generally, land degradation only affects soil fertility. However, the effects of land degradation often more significantly affect receiving water courses (rivers, wetlands and lakes) since soil, along with nutrients and contaminants associated with soil, are delivered in large quantities to environments that respond detrimentally to their input. Land degradation therefore has potentially disastrous effects on lakes and reservoirs that are designed to alleviate flooding, provide irrigation, and generate hydroelectricity.

2.4.3. EROSION OF SOIL BY WATER :

According to (Edward & Simon, *et al.*,2004) erosion of soil by water occurs throughout the world, but especially in the more humid regions. Erosion results in the loss of topsoil that is not easily replaced. Estimates of erosion are essential to issues of land and water management, including sediment transport and storage in lowlands, reservoirs, estuaries, and irrigation and hydropower systems. Another issue is water pollution by contaminants carried with sediment into water bodies such as; detachment, transport and deposition

2.4.4. EROSION CONTROL:

In addition, stable aggregates at the soil surface are less susceptible to detachment by raindrop impact and to transportation by runoff water. Improving aggregate stability and preventing clay dispersion can be done by applying amendments to the soil. Gypsum and synthetic organic polymers are two types of soil amendments that have potential for controlling seal formation, runoff, and water erosion (Levy, 1996). Organic matter improves the cohesiveness of the soil, increases its water retention capacity, promotes a stable aggregate structure, and reduces soil erosion by water. Organic material may be added as green manures, straw, or as a manure which has already undergone a high degree of fermentation (Morgan, 1995). Risse and Gilley (2001) assembled and summarized information quantifying the effects of manure application on runoff and soil loss resulting from natural precipitation events, and they developed regression equations relating reductions in runoff and soil loss to annual manure application rates. For selected

locations on which manure was added annually, runoff was reduced from 1 to 68 percent, and soil loss decreased from 13 - 77 percent.

2.5. LAND/SOIL AND WATER CONSERVATIONS TAKEN FOR LAND DEGRADATION IN TANZANIA

According to (Landscape design guide,2008) Soil and water conservation methods includes:

2.5.1. RUNOFF CONTROL MEASURES

The control of runoff involves diverting it from exposed soils or other vulnerable areas, slowing its velocity, and controlling the amount of sedimentation that leaves a site. Diversion Channels.

- Runoff should be diverted from exposed slopes and other vulnerable areas by means of a ditch, a dike, or a combination of both. These diversions should run laterally to and be located above the vulnerable area. Additional diversions should be located at intervals across a slope to reduce the slope length and divert runoff away from lower areas.
- Diversions should be sized appropriately to collect and convey runoff that may enter them. Depending on the erodibility of the soils in a diversion itself and the amount and velocity of runoff to be conveyed, the diversion should be planted with vegetation or lined with hard material such as riprap.
- Because of the concentrated volume of runoff in a diversion, there should be a stabilized and appropriately sized outlet to reduce the erosion potential. If adequate area exists, this may be achieved simply by gradually widening and reducing the gradient of a diversion channel to reduce the force of the water.

2.5.2. SLOPE DRAINS

- When runoff cannot be intercepted laterally in a diversion channel, a drain that runs the direction of the slope may be necessary. These drains can be located on the surface as an open channel or can be placed below the surface as an enclosed pipe

- Like diversions, slope drains should also be sized appropriately to collect and convey the runoff that may enter them. Depending on the amount and velocity of runoff to be conveyed, a surface slope drain can have a soft surface, such as grass, or a hard surface, such as concrete or riprap.
- Because of the concentrated volume of runoff in a slope drain, there should be a stabilized and appropriately sized outlet to reduce the erosion potential. Energy dissipaters, such as riprap, may also be required to slow the velocity of runoff at the outlet of a drain to a non-erosive level.

2.5.3. GRADE CONTROL STRUCTURES

- To lessen the velocity of runoff in a drainage way or channel, a grade control structure may be necessary to reduce the gradient of the flow. By reducing gradient, the grade control structure helps dissipate the energy of flowing water and lessens erosion potential.
- Grade control structures include check dams, weirs, and drop spillways. These structures can be temporary or permanent, depending on the long-term need. Permanent structures should consist of a hard material, such as concrete.
- The velocity and volume of the water, and therefore its erosive potential, is concentrated at the grade control structure drop. Additional stabilization of the channel bottom and sides is often required at the grade control structure to prevent undercutting and erosion of the channel sides.

2.5.4. RUNOFF FROM IMPERMEABLE SURFACES:

- Streets, paved parking lots, roofs, and other impermeable surfaces allow no infiltration of runoff and provide little resistance to flow. Runoff draining from these surfaces can be highly concentrated and moving at a velocity greater than runoff flowing over an unpaved surface. This runoff must be removed, but soils must be protected from its erosive force.
- Where a storm sewer system is available, curbs and gutters can be installed on streets and parking lots to capture runoff and convey it directly to sewer system inlets. In this way, paved areas themselves serve as drainage ways.

- Where curbs and gutters are not economically feasible, paved areas should be designed to minimize the distance that runoff will travel before leaving the surface. This will reduce the accumulation and velocity of runoff. Areas at which the runoff leaves the paved surface should be properly stabilized to reduce the potential for erosion.
- At airfields, the accumulation of runoff from runway, apron, and taxiway pavements can be considerable. Measures to control this runoff must be implemented such that they themselves do not interfere with airfield operations activities. The preferred approach from an airfield operations viewpoint is to surface drain pavements to areas outside designated aircraft routes. These areas may be located within paved surfaces, in which case runoff should be directed to storm sewer inlets. Areas at which runoff drains from the pavement surface should be properly stabilized to channelize runoff and reduce erosion and potential damage to the pavement edge. If underground.

2.5.5. DETENTION

- On-site detention of runoff is often required to protect adjacent property from erosion, and to prevent sediment from discharging off site. Detaining runoff allows suspended soil particles to be filtered or settle out before the runoff is released.
- Detention can be achieved with vegetation that can slow the velocity of runoff and act as a filter to intercept sediment suspended in the runoff. Vegetative buffers or strips should be planted between areas of potential erosion and sensitive zones, such as streams, to reduce the discharge of sediment.
- Sediment traps can be constructed across drainage channels to detain runoff for a sufficient time to allow sediment to settle to the bottom. These traps should be cleaned out periodically, removing sediment from the trap basin.
- Detention basins can also be used to detain runoff and allow sediment to settle to the bottom. After sediment has been trapped, runoff can be released from the basin at controlled rates to reduce erosion potential. Detention basins can be constructed by excavating a depression or

building an impoundment. If appropriate, they can be integrated into a site development as a permanent pond.

2.6. ECOTOURISM BENEFITS : WHY COMMUNITY BASED ECOTOURISM

Tourism is among the world's largest and fastest growing industries. It is also one of the byproducts of globalization, which is driving the convergence of humans and wildlife and increasing human impacts on biodiversity. Strategic alliances between major airlines, fewer visa regulations, relative physical and economic ease of reaching remote locations and international marketing strategies have all contributed to the increase in the number of travelers each year.

In theory, ecotourism offers communities an opportunity to improve their well-being and economic livelihood, while preserving biodiversity and encouraging individuals to conserve nature and wildlife (Ross & Wall 1999; Barkin 2002; Stem et al. 2003). While numerous theoretical definitions of ecotourism exist, it is difficult to operationally define the term.

Sustainable community-based ecotourism ventures must actively involve local communities from the earliest stages in order to maximize their chances of success. Protected areas are vital to the preservation of biodiversity and landscapes. They help sustain valuable ecosystem services such as clean water, oxygen, and nutrients. Historically, park management in developing nations has prioritized keeping people out of protected areas (often through forceful eviction), based on the view that human activities are incompatible with ecosystem conservation (Wells and McShane;2004).

This so-called 'fines and fences' approach denied communities living in close proximity to a protected area access to the resources that often formed the basis of their livelihoods.

The key questions that guided includes:

- What are the community's perceptions regarding tourists / ecotourism?
- How can the community manage tourists/ tourism to ensure that it is occurring on their own terms?

In general, Community Based Ecotourism (CBET) is tourism that is managed by the community for the tourist destinations. With general tourism, tourist visits are often marketed and organized

by private travel companies and government protected areas and the bulk of the profits go to the private companies and government enterprises. In contrast, CBET is managed and run by the community itself, management decisions are made by local people and profits directly go to the community.

Sustainable tourism development meets the needs of the present tourists and host regions while protecting and enhancing the opportunity for the future. It is envisaged as leading to management of all resources in such a way that economic, social and aesthetic needs can be fulfilled, while maintaining cultural integrity, essential ecological processes, biological diversity and life support systems (WTO).

Ecotourism goes beyond prevailing notions of “the overlap between nature tourism and sustainable tourism” to encompass the social dimensions of productive organization and environmental conservation. Ecotourism does more than create a series of activities to attract visitors, offering them an opportunity to interact with nature in such a way as to make it possible to preserve or enhance the special qualities of the site and its flora and fauna, while allowing local inhabitants and future visitors to continue to enjoy these qualities. They also establish a durable productive base to allow the local inhabitants and ecotourism service providers to enjoy a sustainable standard of living while offering these services.

2.7. WATERFRONT BUFFER ZONES

According to (Vermont Legislative Research Shop,2008) , Riparian buffers are vegetated zones of land adjacent to water sources. Preservation and reestablishment of these zones can have many environmental benefits. The most important function of these zones is to act as a filter for water flowing into the water source, and studies show that they greatly reduce water pollution. The vegetation and soil absorb runoff water that is often laden with pollutants, sediments and nutrients that are harmful to the water supply, especially if the buffer zone is over 9.1m wide.

The absorption of runoff water has other benefits: it recharges the ground water supply, and can regulate water flow in rivers and therefore reduce and prevent flooding. Having vegetation immediately adjacent to a water source also helps control erosion, as the roots of the plants help hold soil in place. Zones of land adjacent to water sources are often flourishing wildlife habitats,

with many species depending on them for survival. Buffer zones could also theoretically reduce the amount of public spending on storm water management and pollution removal.

2.7.1. BUFFER WIDTH

According to (Introduction to Streamside Buffer Zones: *For the Great Miami River Watershed;2010*): Scientists disagree over the optimal width for riparian buffer zones, but it seems clear that different water sources have different needs. Three factors influence ideal buffer widths: slope, soil type, and vegetation mix.

A buffer with a steep slope needs to be wider because the water will rush over it faster, giving it less time to be absorbed. The type and density of soil also affects the speed of absorption. The type of vegetation in the buffer is perhaps most important buffers with a wide variety of vegetation types (trees, grasses, bushes, etc.) will absorb more nutrients than buffers with just one type of vegetation.

It is impossible to generalize ideal buffer zone widths due to the individual needs of specific streams, but the following are some guidelines from various scientific studies. Most studies find that buffers between 9.144 m and 45.72m are highly effective. Several studies found that narrower buffer zones of around 4.6m still reduce subsurface nitrate flows by up to 80%, but were less effective in reducing surface nitrogen and other pollutants. Another review of the scientific literature found that most studies demonstrate significant nutrient removal in buffers more than 27.4 m wide, but that “these buffers are much wider than what land managers can typically expect farmers to remove from active production”.

According to (Introduction to Streamside Buffer Zones: *For the Great Miami River Watershed;2010*): How big should a buffer be? One size does not fit all. It depends on what you want the buffer to do. There is not one generic buffer that will keep the water clean, stabilize the bank, protect fish and wildlife, and satisfy human demands on the land. The minimum acceptable width is one that provides acceptable levels of all needed benefits at an accept-able cost. The basic bare-bones buffer is 1.3m from the top of the bank.

To Stabilize Eroding Banks : On smaller streams, good erosion control may require only covering the bank with shrubs and trees, and a managed grass buffer. If there is active bank

erosion, or on larger streams, going beyond the bank at least is necessary. Severe bank erosion on larger streams requires engineering to stabilize and protect the bank - but this engineering can be done with plants. For better stabilization, put more of the buffer in shrubs and trees.

To Filter Sediment and Attached Contaminants from Runoff : For slopes gentler than 15%, most sediment settling occurs within a 0.9m wide buffer of grass. Greater width is needed on steeper slopes, for shrubs and trees, or where sediment loads are particularly high.

To Filter Dissolved Nutrients and Pesticides from Runoff A width up to 100 meters or more may be necessary on steeper slopes and less permeable soils to allow runoff to soak in sufficiently, and for vegetation and microbes to work on nutrients and pesticides. Most pollutants are removed within 100 meters , although in clay soils, this may not happen within 500 meters.

To Protect Fisheries: Buffer width depends on the fish community. For cold water fisheries, the stream channel should be shaded completely. Unless there are problems with algae blooms, warm water fisheries do not require as wide a buffer or as much shade, but they still benefit from water cleaned by a buffer's filtering action. Studies show that at least up to 2.5m, the wider the buffer, the healthier the aquatic food web.

To Protect Wildlife Habitat : Buffer width depends upon desired species: 7.6m is a generally accepted minimum. Much larger streamside forest buffer widths are needed for wildlife habitat purposes than for water quality purposes. The larger the buffer zone, the more valuable it is. Larger animals and interior forest species generally require more room. Some use so much habitat that it would be nearly impossible to protect the size buffers they require. A narrow width may be acceptable for a travel corridor to connect larger areas of habitat. Continuity is important - even small patches of trees are better than none at all when it comes to migrating birds.

To Protect Against Flood Damage : Smaller streams may require only a narrow width of trees or shrubs; a larger stream or river may require a buffer that covers a substantial portion of its flood plain. This is why it is not a good idea to build a permanent structure where a river can get at it.

To Grow Valuable Products: Buffer width depends upon the desired crop and its management. Don't forget to consider tax incentives and cost-share programs when looking at the economic return from a riparian buffer.

2.8. CASE STUDY

a) LAND DEGRADATION IN DEVELOPING WORLD : ISSUES AND POLICY OPTION OF 2020

According to (International food policy research institute,2020 brief 44, 1997)

Policy recommendations:

- i. Increase research and technology development for land management and improve the spread of information through widely linked user friendly information system for farmers.
- ii. Promote land improving investments (for example, build up soil organic matter, planting trees and installing small scale irrigation) through technical assistance new financing arrangement suitable for low income farmers.
- iii. Encourage long term land improvements by securing property rights and rights of access to natural resources particularly for low income groups.
- iv. Develop planning systems for sustainable land use that involve key resource user groups.
- v. Improve the economic environment for farmers by developing market , infrastructure, correcting distorted price incentives and encouraging rural income growth and diversification.
- vi. For marginal regions, encourage more public investment in infrastructure, social services and agricultural support services.

b) INTRODUCTION TO LAKE SIDE BUFFER ZONES : FOR THE GREAT MIAMI RIVER WATERSHED

According to (Introduction to Streamside Buffer Zones: *For the Great Miami River Watershed,2010*): The better buffer for every buffer there is a reason. Whether it is pollution

filtration, erosion control, wildlife habitat, or visual screening, the size and vegetation of the buffer should match the land use and topography of the site.

Topography :A buffer is more important for water quality in areas that collect runoff and deliver it to streams, and less critical on land that tips away from the water. Steeper slopes call for a wider riparian buffer below them to allow more opportunity for the buffer to capture pollutants from faster moving runoff. This is also true at both ends of a flood chute, or the path a river takes across a meander at high water.

Hydrology and Soil : The ability of the soil to remove pollutants and nutrients from surface and ground water also depends upon the type of soil, its depth, and relation to the water table. On a wetter soil, a wider buffer is needed to get the same effect.

Vegetation: The purpose(s) of the buffer will influence the kind of vegetation to plant or encourage. In urban and residential areas, trees and shrubs do a better job at capturing pollutants from parking lots and lawn runoff and providing visual screening and wildlife habitat. Between cropland and waterways, a buffer of shrubs and grasses can provide many of the benefits of a forested buffer without shading crops, and trees can be used on the north side of fields. Trees have several advantages over other plants in improving water quality and offering habitat. Trees are not easily smothered by sediment and have greater root mass to resist erosion.

Above ground, they provide better cover for birds and other wildlife using water-ways as migratory routes. Trees can especially benefit aquatic habitat on smaller streams. Native vegetation is preferable to non-native plants.

c) MECHANISM TO PREVENT LAND DEGRADATION AND RESTORE DEGRADED LANDS IN ETHIOPIA, 2015

Land degradation can be prevented through different mechanisms depending up on the nature and form of degradation. Most types of soil degradation can be prevented or reversed by adding nutrients to nutrient depleted soil, rebuilding topsoil through soil amendments, reestablishing vegetation, or buffering soil acidity (Scherr and Yadav 1996).

However, some aspects of land degradation are less easily reversed than others. For example, terrain deformation by gully erosion, or total topsoil loss from erosion, or the wiping out of

native soil fauna is more irreversible than a negative nutrient balance, or surface sealing and crusting (Coxhead and ygard, 2008).

In parallel, Scherr and Yadav (1996) illustrated that some types of land degradation are, for all practical purposes, irreversible. Examples are severe gulling and advanced salinization. Displacement of soil material (erosion) is also irreversible, although its long-term effects on productive capacity depend on the depth and quality of soil remaining. According to Coxhead and ygard (2008), the main environmental principles for reducing land degradation are to maximize vegetation cover to prevent erosion, replace nutrients removed, and to put in place structures (terraces, bunds, vegetation strips) so as to reduce the speed and volumes of water flow over the soil.

From this perspective, tree crops, perennial crops, intercropping and reduced tillage systems are preferred. Similarly, UNCCD (2004) revealed that forests and tree cover combat land degradation and desertification by stabilizing soils, reducing water and wind erosion and maintaining nutrient cycling in soils. Therefore, sustainable use of goods and services from forest ecosystems and the development of agro forestry systems can contribute to poverty reduction, making the rural poor less vulnerable to the impacts of land degradation.

Broadly speaking, land degradation can be controlled, reduced or even reverted if the land is used wisely, if all functions of the land are taken into account, and if long-term interests of all segments of human kinds replace short-term vested interests of privileged group globally, naturally and locally (Getachew 2005). Scherr and Yadav (1996) also pointed out that rehabilitating degraded landscapes depend on the costs relative to the value of output or environmental benefits expected. Throughout history, efforts to combat land degradation in Ethiopia is focused on physical conservation structures (Woldeamlak 2003).

Similarly, Temesgen et al. (2014) reported that farmers in Dera *Woreda*, Ethiopia heavily depend on physical soil conservation structures. However, using of vegetative measures is very much limited.

Table 2: Case study on solutions of LD

NO	COMPONENT	DEGRADATION	IMPROVEMENT
1	Physical soil management	<ul style="list-style-type: none"> • Crusting • Compaction • Sealing • Water Erosion • Wind erosion • De vegetation • Over Tillage 	<ul style="list-style-type: none"> • Soil conservation barriers • Terracing • Re vegetation of denuded lands • Tree protection • Soil decomposition • Breaking up of pans • Cover crops • Wind breaks • Soil deposition • Improved tillage methods
2	Soil water management	<ul style="list-style-type: none"> • Impeded drainage • Water logging • Reduced water holding capacity • Reduced infiltration • Salinazation 	<ul style="list-style-type: none"> • Irrigation • Water harvesting • Field drainage • Draining of water logging areas • Filter strips
3	Vegetation management	<ul style="list-style-type: none"> • Decline in vegetative cover • Decline in biodiversity • Decline in species composition • Decline in availability of valued species 	<ul style="list-style-type: none"> • Increased vegetation cover • Increased species diversity • Improved species composition • Improved availability of valued species

Source : *Journal of Environment and Earth Science*,2014

2.9. SUMMARY OF LITRATURES

Land degradation is a global threat to human population and has been described widely and gained public attention significantly since the Earth Summit in Rio de Janeiro, 1992 and the formulation of the Agenda 21. Land degradation has multiple and complex impacts on the global environment through a range of direct and indirect processes. These affect an array of ecosystem functions and services. Direct, on-site, effects associated with land degradation include the loss of soil organic matter and nutrients, the loss of soil structure, loss of soil biodiversity, loss of water holding capacity and water infiltration, loss of soil, pollution of the land and the sealing of soils.

Over the past few decades, rate of soil erosion by water have been brought more or less under control in any developed nations. But in the same period, many developing nations, particularly in Sub-Saharan Africa, have been severely affected by this form of land degradation. Ethiopia is one of the most severely affected countries in the Sub-Saharan region (Gete and Hurni, 2002).

Environmental changes are result of both manmade and natural factors. Manmade factors mainly include population growth and the effect of it for survival. In many parts of Ethiopia informal settlements and improper cultivation has been a problem for the past few years. Natural factors can only be mitigated by applying certain rehabilitation techniques based on the type of problems observed. Environmental management is another issue to be raised that could contribute to Land degradation. If land is not properly managed the quality and composition of the land deteriorates from time to time. Concerned party has to study these issues and perform appropriate solutions.

The tourism sector is a major contributor to the socioeconomic development. If managed strategically, tourism has the potential for employment and economic benefits for people across the sub-region. Improvement of tourism infrastructure and elimination of impediments in the tourism sector will enhance the development of the industry, which, in turn, would promote Wenchi Lake as a unique tourist destination. It is also essential to establish effective cooperation among the governments, travel and tourism services in private sectors. Development of database and e -marketing system plays a pivotal role for both intra-regional and inter-regional tourism development.

CHAPTER THREE : DESCRIPTION OF STUDY AREA

This chapter gives a brief information of the study area Wenchi, Oromia region, Ethiopia. Additionally, history and natural and social information have also been incorporated to give an overall clue about the study area.

3.1. LOCATION OF STUDY AREA

Wenchi crater Lake is one of the important lakes in Ethiopia. The lake is located in Western Shoa region, which extends between latitude 15° N - 3° S and longitudes 48° E- 33° W. It is situated at the major topographic feature in the country, being 130 km south-west of the capital city, Addis Ababa. This lake, 1,600 square meters in total area, is ecologically, recreationally, and aesthetically important as well as a popular place for tourists (Journal of science and technology;2008).

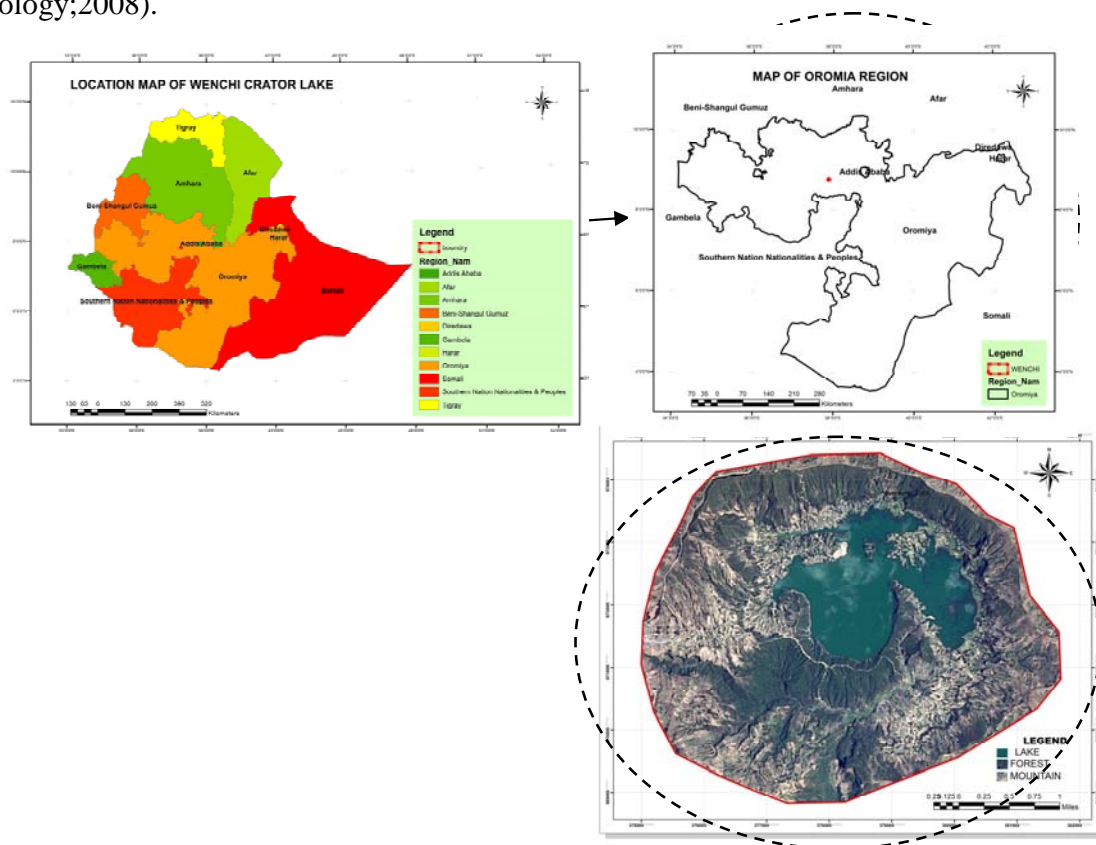


Figure 7 :Location of Wenchi Crater Lake
Source : Dem of Ethiopia and Landsat 8 of 2015

3.2. VEGETATION TYPES IN THE STUDY AREA

The Wenchi woreda is known for its green covered belt all over the village. Many kinds of vegetation are available such as; *Erica arbrea* , *Hygenia abyssinica* , *False banana* , *Olea africana*, *Rhumx*, *Compa*, *Eritrinea*, *Eucalyptus globulus*, *Juniperous procera*.

'*Hagenia abyssinica*' grows well in higher agro- climatic zones of Ethiopia at altitudes of 2,300 to 3,300m. It is dark red hard wood which is good for furniture making but easily attacked by borers. However, it is traditionally used as firewood, timber and medicine for tapeworm infestation.



Figure 8 : '*Hagenia Abyssinica*' (kosso)

Source : Photograph by the Author, 2016

'*Erica arbrea*' is a species of flowering plant (angiosperms) in the heather family, Ericaceae. There are distinct populations in Africa including the Ethiopian Highlands, the mountains of Ruwenzori and the Cameroon Mountains. '*Erica Arborea*' is an upright evergreen shrub or small tree with a typical height in the wild of some 7 m (23 ft), especially in Africa, but more typically 1–4 m (3–13 ft) in gardens, bearing dark green needle-like leaves and numerous small honey-scented bell-shaped white flowers. It is a calcifuge, preferring acid soil in an open sunny situation.

African Pencil cedar grows in many parts of Ethiopia at the altitude between 1,500 to 3,000m, particularly in areas with high rainfall. The wood is termite resistant and is used as timber for house building, poles and as fire wood.



Figure 9 : 'Erica Arbrea'(tree heath) (Asta)

Source : Photograph by the Author,2016

Neché bahr zaf (blue gum) is the most widely planted gum tree in Ethiopia and worldwide. It is frost resistant and grows in wet *dega* and upper *wenadega* agro climatic zones of Ethiopia at altitudes of 2,000 to 3,200m.

Bamboo is an extremely useful plant which has been used for hundreds of years in society. When its shoot is young, it can be eaten as a vegetable. When the stem is strong, it can be used to build houses. That's why there's a Nepali saying that goes "when young, a vegetable; when mature, a house".



Figure 10 :Bamboo (kerkeha)

Source : Photograph by the Author,2016

- **Food plants:**

The area is known for its fertile soil type that is favorable for plants. This is because of the volcanic result of the area that has given the soil ashy character. Farmers in this area plant the below listed types such as; Enset, Denechi, Baroshinkurt, Gomen, Kosta, Gebse, Tosegne, Kariya, Nech shinkuret, Enjori, Pome and Gesho.

False banana (Enset) is widely known in Ethiopia. Enset is a very tall plant. It consists entirely of soft plant material but reaches up to 12m high and the trunk (or “pseudo-stem”) can be nearly a meter thick at the base. It looks a bit like a giant extruded onion, with a big bulbous stem stretching up into a rosette of 3m long crescent shaped leaves, which reach for the sky in competition with neighboring plants. Its main product is the starchy pith of its massive “pseudo-stem”, which is pulped and then fermented in a big bundle, buried underground for 3 to 6 months, to produce *'kocho'* a solid staple a bit like a heavy bread which is eaten with milk, cheese, cabbage, meat and/or coffee.



Figure 11 :False banana (Enset)

Source : Photograph by the Author,2016

3.3. SOCIAL DESCRIPTION

- **The community:**

The people living in this area are divided in to eight types of clan, namely *Eyake, Ferafo, Ametemedhin, AbaAowa, Kese, Abadawie, Mefete and Anda* The language that that is widely spoken is *Oromiffa*, this is because of the larger number of the Oromo tribe. But there also exists the *Amhara* and *Gurage* tribe (H/Meskele, 2003).

The Gurage tribe comes next to the Oromo people in population. Generally, 99% are Oromo and the remaining being Amhara, Gurage and others. All in all the people in the area are very beautiful and slim shaped with an amazing welcoming character.

According to the information from central statistics authority, the house of the community were made here and there in a fragrant manner, but the type of distribution is not good for their social reaction and relation. Now due to the increment of the population houses are built very close to each other almost wall to wall. Now approximately 4,000 people are believed to live at the side of the lake (H/Meskele, 2003)



Figure 12 :Beauty of Wenchi people
Source : Photograph by the Author,2016

- **Local foods in the area:**

The Haro Wenchi woreda is known for its fertile land and the people use organic foods from their own gardens. Food mostly known in the area is *Kocho* which is made from *Enset* and they make many kinds of form. Some of the foods made out of *Inset* (false banana) includes: *Ganjuri/kumusi, Holeta, Enkuro, Amicho, and Kocho* (H/Meskele, 2003).

Enkuro is mostly served during breakfast. *Kocho* Served with *Injera* and *Tibs* is mostly prepared as their daily meal. Mostly this meal is served during lunch and dinner time.

Boiled potato is another food that is highly eaten in the area. The amazing part is that this food is eaten during day time as a lunch and people who are served this mean are supposed to finish it. Removing the cover and eating it one by one is such an enjoyable moment (H/Meskele, 2003).

- **Religion:**

The dominating religion in the area is Orthodox. There are two churches at the lake and one at the Haro Woreda; Saint Kirkos, Tekele hayemanot and Iyesus church respectively. There also exists two Protestant churches away from the location of Iyesus church on the way out of the Haro Woreda. Percentage wise Orthodox constitutes 58.9%, Protestant 39.6% and Muslims constitute 1.3% as per the terminal evaluation findings of 2013 (H/Meskele, 2003)

Mostly they are very strict to their religion and somehow it has influenced their socio economic life by refereeing 12days to be regarded as holydays among the 30days. It is obvious that no one is allowed to perform any duty by this days. Rather during this days they plan what they should do for the next working days ((H/Meskele, 2003)

- **Demographic data:**

Demographically the Woreda has a population of 119,736 with almost equal gender ration of 49.8% male and 50.2% female. The average family size is 6 and the average number of children per household was nearly 4 indicating that it is found to focus to development intervention addressing child wellbeing to bring real development in the community (H/Meskele, 2003)

3.4. ECOTOURISM ACTIVITIES

As discussed with the ecotourism officials, the Wenchi creator Lake has been neglected for the past few years but now it has started generating as a new resource for the past 10 years. Especially an international Non Governmental Organization (NGO) called German Technical Support office (GtZ) has played a vital role with direct collaboration with the woreda cooperation office from nearby town *Chittu* (H/Meskele,2003)

The company GtZ has played a great role in training certain people in the area and creating an association that has helped the community to benefit from the tourism. Before the creation of associations the community was not organized enough to promote the lake for tourists and to benefit from the tourism activities. Lack of knowledge and education being the drawback of the situation, regarding conservation and rehabilitation nothing has been done by the time. All the negative impacts has decreased the benefit of the tourism.

The *Wenchi Ecological Tourism Association (WETA)* started as a project during the mid-2003 G.C. then after certain challenges and obstacles it got legalized by 2005G.C.

The main objective and vision of the establishment of '*WETA*' was to organize and unify all the volunteer people in various tourism services and activities but during the establishment of the association, the total number of members were 194, out of this 21 were women while the remaining 173 were men. All organized members of the community were provided an awareness of tourism and natural resources protection and conservation along with generating sideline income. Right after the establishment of the association the flow of tourists increased. Accordingly, the livelihood of each and every member has completely changed.

The '*WETA*' is community based initiative that promotes sustainable and promising ecological tourism. The mission of '*WETA*' is improving the livelihood of the local people through promoting development via sustainable use of natural and cultural resources, creating socio-economic values through ecological tourism and to foster the conservation of natural resources of the area and Socio- cultural conservation.(H/Meskele,2003)

The association is subdivided in to 5sub-groups:

- **Horse rent Association:** it is composed of 130 members with the exception of 2 horse protocol arrangers. The horse is decorated as much as possible as illustrated in the picture below.



Figure 13 :Tourist riding a horse

Source : Photograph by the Author,2016

- **Tourist Guide association:** it is composed of 26 members whose activities are informing clients about the entire history of the Wenchi Lake and its surrounding.
- **Tourist car Guard/ Security:** members that are responsible in safeguarding the tourist car at the parking area.
- **Boat rent Association:** it is composed of 70 members who are responsible for touring tourists via boats. The boats are of wood made in order to avoid the noise pollution.
- **Apiary / honey producers Association:** It is composed of 40 members and they play a great role in honey market both for domestic market and for international market by exporting to Italy. As far as the quality and its standard is concerned, it ranks the second next to Wokro's honey. As illustrated in the figure bellow the bee hive is constructed in the forest with wooden protection.



Figure 14 : Honey comb cylinders of bamboo

Source : Photograph by the Author,2016

The producers use both traditional and modern bee hives. The main flowers that are rich in nectar in this area are *Hagenia abyssinica* (*kosso*) and *Erica arboreal* (*asta*) and strawberry.

WETA is doing much on the community benefiting and awareness of the society. Along with the provision of main infrastructures it might do a lot . In a condition that nothing has been provided the community has managed this far. Therefore, if conditions were suitable they could have done more admirable things (H/Meskele,2003).

Even though Africa is the world's poorest region, with almost fifty percent of its population living with less than \$ 1 per day, especially in rural areas it is recognized by its huge potentials for tourism development (WTO, 2002). There is no inadequate facilities and services infrastructures in many places which hampers the full use of exploiting this potentials of tourism even though there is an existing potentials for developing tourism in Africa. The major trends influencing the growth of international tourism globally will also apply in Africa. The will particularly benefit from the increasing international travel interest in nature and cultural tourism and other forms of special interest tourism (WTO, 1999). It is evident, that there is an opportunity exists for Africa to have a fairer distribution of tourist flows across the world, with the purpose of contributing to the alleviation of poverty in the continent (WTO 2002).

According to WTO as Africa is benefiting from tourism majorly, it shows how the community is getting involved in many actions related to tourism. Doing artifacts, sculptures and the so like helps the community to get some income. In Wenchi not much has been done regarding promoting their knowledge but much has to be done to make a change. Especially more must be done by the females so as to create participation of women in the communities backbone project.

Promoting Wenchi Lake worldwide promotes the country as a whole. Government and N.G.Os has to study more about Wenchi and actions has to be taken immediately.

CHAPTER FOUR : RESULTS AND DISCUSSION

In this chapter major findings, both quantitative and qualitative are explained in detail. Physical, environmental, social, economical and institutional contexts are seen in detail to attain the objectives of the study. While doing so some major identifications on challenges of the study area are studied. Additional information were collected through observation by transect walking through rugged topography of the study area. Results gathered from satellite images were successfully processed and the results are further explained in detail. Some results has shown unexpected outcome but all have been cross checked with the results of questionnaire and group discussions made during data collection.

Finally, major issues are explained in comparison of the objective of the study. Each sub topic explains the details of the results gathered and discusses that explains the objective of the study.

4.1. LAND USE / LAND COVER CHANGES OF THE STUDY AREA

LU/LC changes of the study area has been analyzed and their root cause have been verified through respective information gathered during data collection.

After analyzing the satellite images on ENVI the results were quantified and illustrated on Arc map GIS . The LU/LC of every specified year is viewed with clear maps and area descriptions. The LU/LC of 1973,1984,2000 and 2015 are illustrated on the subtopics below:

4.1.1. LAND USE/ LAND COVER OF 1973

By the year 1973 the land covers observed were forest land, bare land, grass land and water body, acquiring an area of, 1,567 ha, 37 ha, 683 ha and 442 ha respectively. Evaluating the area for further analysis these areas are converted to percentages in the map and table below:

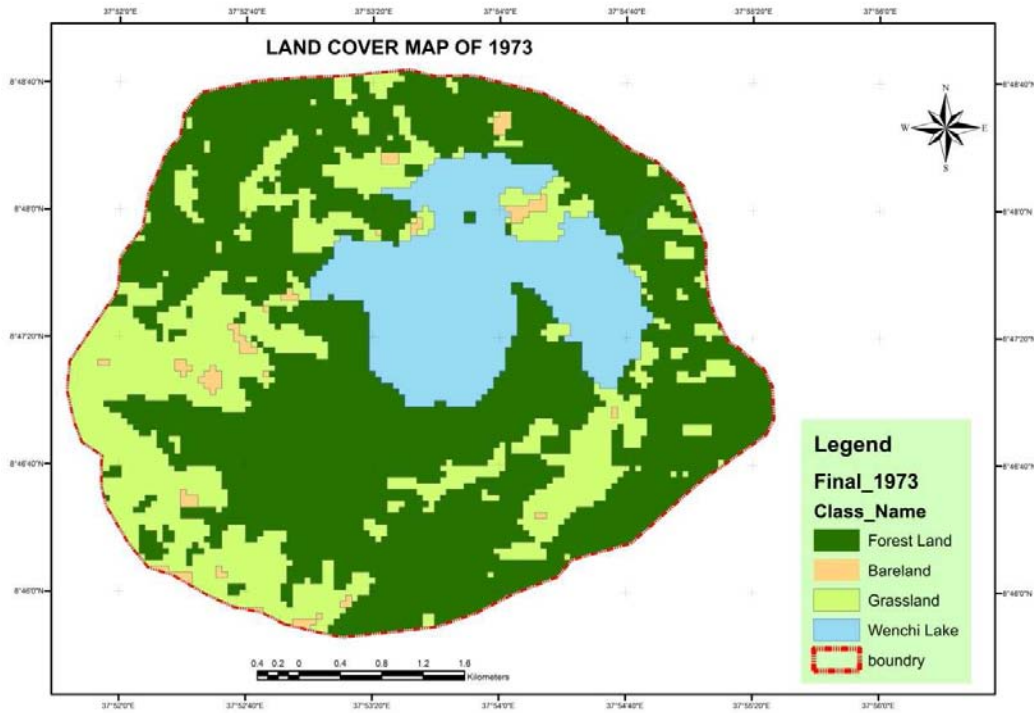


Figure 15 : Land cover map of 1973

Source :Landsat multispectral scanner ,1973

Table 3 : Land cover change of 1973 classification result in percentage

No	Description	Area	Percentage
1	Forest Land	1,567.13 ha	57.5%
2	Bare Land	33.6 ha	1.2%
3	Grass Land	683.11 ha	25.1%
4	Water Body	441.53 ha	16.2%

Source :Landsat multispectral scanner ,1973

The land cover of the study by the year 1973 indicates that the forest cover covered 58 percent of the total land cover. It shows how the study area was rich in forest cover and also major challenges were minimal by this specific year.

However, the grass land taking the second largest percentage about 25 percent , the Bare land 1 percent and the water body covers 16 percent of the total area evidences the domination of the forest cover.

4.1.2. LAND USE / LAND COVER IN 1984

By the year 1984 the land covers observed were forest land, bare land, grass land and water body. Acquiring an area of 1,203 ha, 161 ha, 893 ha and 469 ha respectively. Evaluating the area for further analysis these areas were converted to percentages in the map and table below:

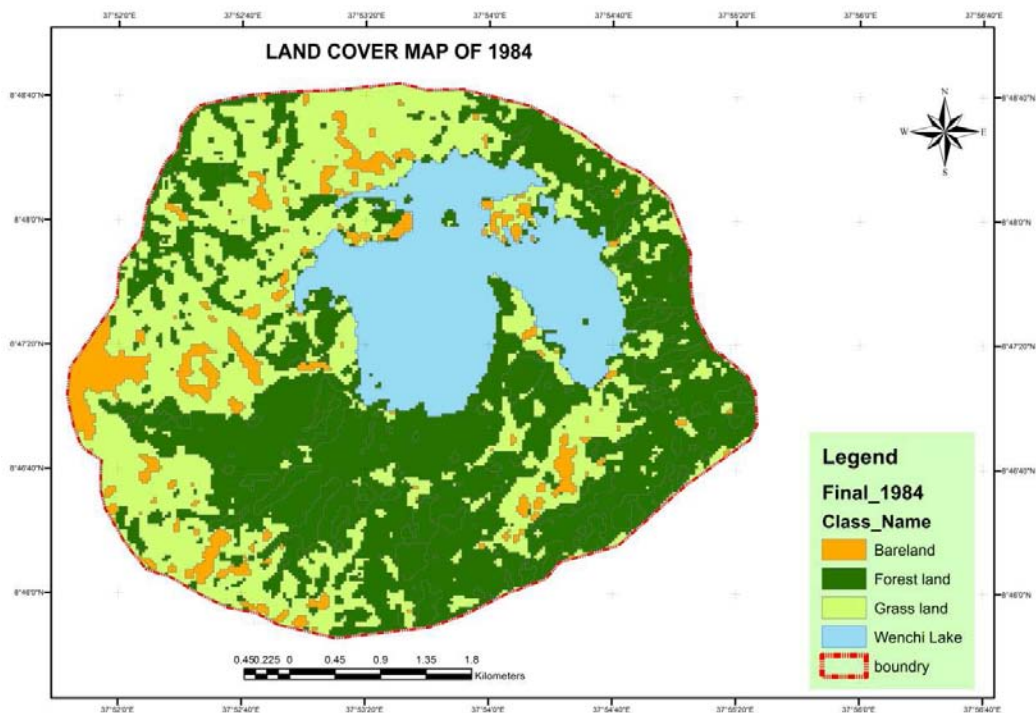


Figure 16 : Land cover map of 1984
Source :Landsat thematic mapper ,1984

Table 4 : Land cover of 1984 classification result in percentage

No	Description	Area	Percentage
1	Forest Land	1,202.9 ha	44.1 %
2	Bare Land	160.5 ha	5.8 %
3	Grass Land	892.8 ha	32.7 %
4	Water Body	468.5ha	17.19%

Source :Landsat thematic mapper ,1984

The land cover by the year 1984 indicates that the forest cover acquired 44 percent of the total land cover.

On the other hand, the grass land taking the second largest percentage about 33 percent , the Bare land 6 percent and the water body covered 17 percent of the total area evidences the domination of the forest cover.

4.1.3. LAND USE / LAND COVER IN 2000

By the year 2000 the land covers observed were the same as the former studied year acquiring an area of 1,446.5 ha, 189.29 ha, 624.2 ha and 472.5 ha respectively. Evaluation of area analysis were converted in to percentages as illustrated in the map and table below:

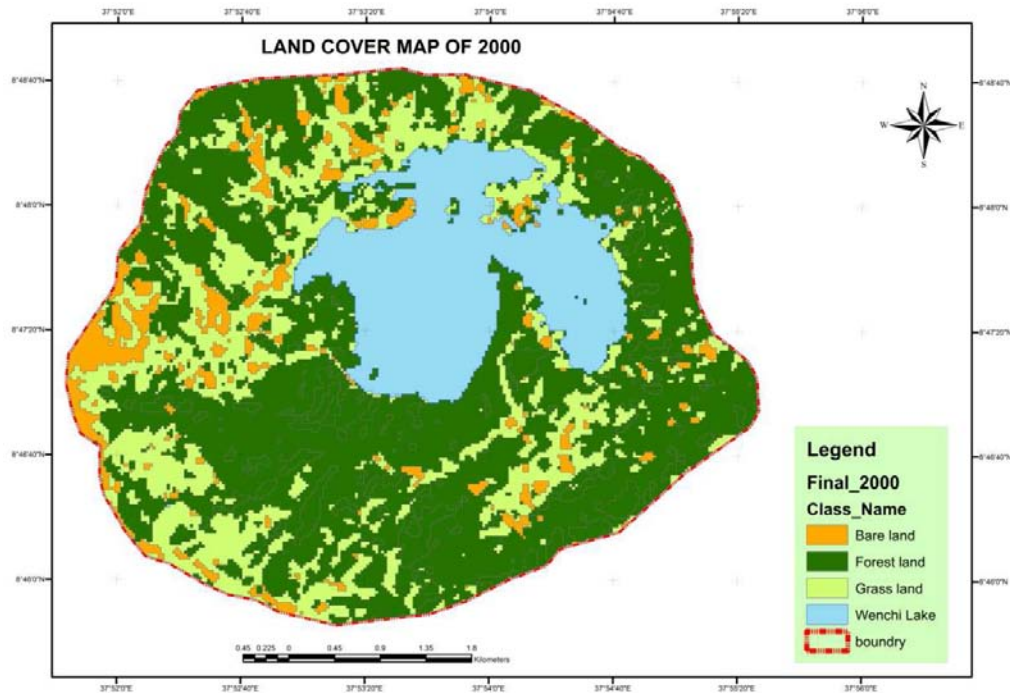


Figure 17 : Land cover map of 2000

Source :Landsat Enhanced thematic mapper plus ,2000

The land cover of the study by the year 2000 indicates that the Forest cover covered 53 percent of the total land cover. The domination of the forest cover is evidenced in this study year accordingly.

Table 5: Land cover of 2000 classification result in percentage

No	Description	Area	Percentage
1	Forest Land	1,446.5 ha	52.9 %
2	Bare Land	189.29 ha	6.9 %
3	Grass Land	624.2 ha	22.8 %
4	Water Body	472.5 ha	17.29 %

Source :Landsat Enhanced thematic mapper plus ,2000

4.1.4. LAND USE / LAND COVER IN 2015

By the year 2015 bare land, forest land, grass land and water body land covers were observed . Taking an area of 1,717.5 ha, 41.3 ha, 540.49 ha and 420.09 ha respectively Details are presented as percentages in the map and table below:

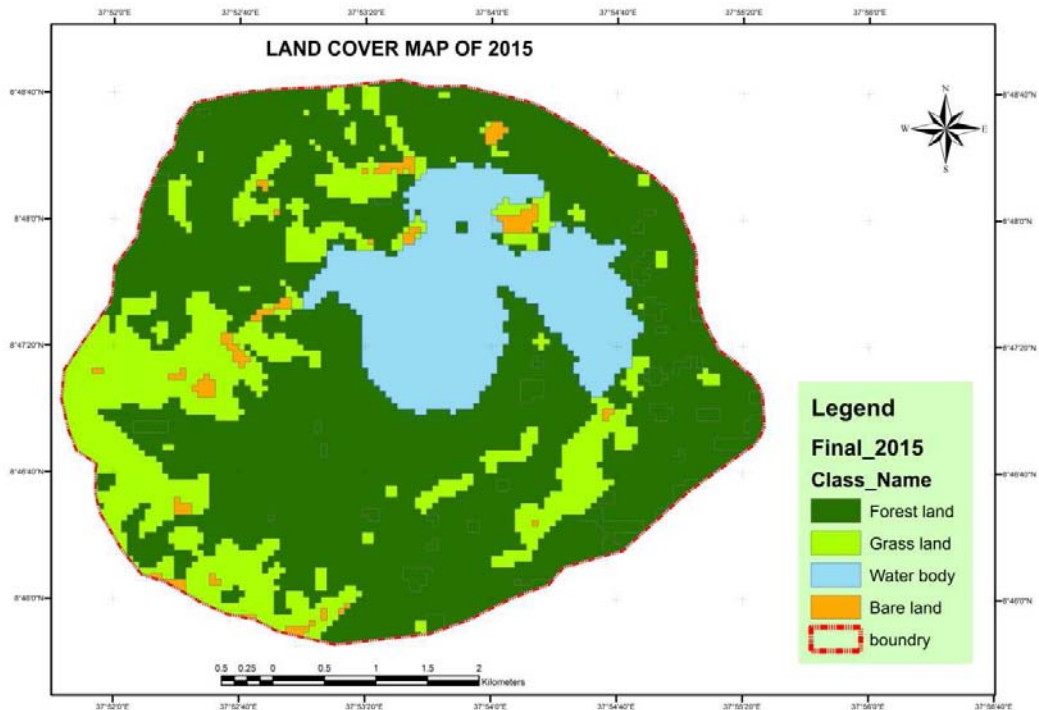


Figure 18 : Land cover map of 2015

Source :Landsat 8 ,2015

The land cover of the study by the year 2000 indicates that the forest cover covered 53 percent of the total land cover. Repeatedly the domination of the forest cover is also observed in this study year.

Table 6 : Land cover of 2015 classification result in percentage

No	Description	Area	Percentage
1	Forest Land	1,717.5 ha	63.1 %
2	Bare Land	41.3 ha	1.5 %
3	Grass Land	540.49 ha	19.8 %
4	Water Body	420.09 ha	15.4 %

Source :Landsat 8 ,2015

To conclude with, the LU/LC changes through the years 1973,1984,2000 and 2015 has shown a remarkable un expected changes. Especially regarding the forest cover by the year 1973 it indicated about 58 % and it decreased by 13% in 1984. This is the result of population growth, deforestation and poor cultivation practices on steep slopes. In 2000 forest cover increased dramatically and resulted in 53% and again in 2015 it resulted in 63 %. The final results are rare to find especially in a land that has been degrading majorly because of its topographic features. But this evidences that the community has been acting towards rehabilitating degraded lands by implementing various soil and water conservation techniques.

Table 7 : LU/LC change summary of years 1973,1984,2000 and 2015

No	LULC	1973	1984	Changes b/n 1984 & 1973	2000	2015	Changes b/n 2015 & 2000	Over all changes
1	Forest Land	57.5%	44.1 %	-13.4 %	52.9 %	63.1 %	10.2 %	5.6%
2	Bare Land	1.2%	5.8 %	4.6 %	6.9 %	1.5 %	-5.4 %	0.3%
3	Grass Land	25.1%	32.7 %	7.6 %	22.8 %	19.8 %	-3.0 %	- 5.3%
4	Water Body	16.2%	17.19%	1.0 %	17.29 %	15.4 %	-1.29 %	- 0.8%
SUM TOTAL		100%	99.79%	-	99.89%	99.8%	-	-

During discussions made with ecotourism association members major conservations made includes protection of forests through constructing boundary marker for the past ten to fifteen years. It was implemented based on the land degradation observed by deforestation and poor cultivation methods performed on steep slopes. Major forced measures had been taking place like resettling people living in the forest, punishing people deforesting for fire wood etc... The 'WETA' has been controlling the community by incorporating the youth for control of cultivation on steep slopes, deforestation, and utilization of fire wood. Additionally, they have been forcing the community to plant '*Eucalyptus globulus*' for the past ten to fifteen years. Though the type of vegetation used aggravates soil erosion, their intentions were providing wood for the community

to construct their house and also for fire wood. As a result it has shown an increase in Vegetation cover by 5.6% through the studied years but it has increased the rate of soil erosion in the study area.

The bare land cover shows an increase and finally decrease of percentage through the studied years. As a result of occupation of land through settlements amount of bare land had decreased from time to time.

The grass land cover increases by 7.6% and decreases by 3 % through the studied years as a result of an increase in forest land cover, population growth and improper utilization of land.

The community as a whole agrees in degradation of the land and in the decrease of water level of the lake from time to time. As a result the LU/LC change analysis also resulted in showing the decrease in water level of the lake through the studied years. But during rainy seasons it has been witnessed that the water level increases more than 50cms. Some measures had been practiced by the people living within the buffer of the lake but the protection built (stone terraces) are always covered by water during rainy seasons.



Figure 19 : Stone terracing at the lake surrounding

Source : Photograph by the Author,2016

4.2. TYPES AND CAUSES OF LAND DEGRADATION

The Wenchi woreda is known for its sloped topography that is unsuitable for agriculture, construction and accessibility. Due to this sloped feature top soil is being eroded for many years. Solutions has been tried traditionally but has been failing especially during rainy season.

The woreda has got rugged topography, which is devoid of vegetation. The combined effect of depletion of vegetation cover, occurrence of heavy and sometimes intensive rainfall, nature of terrain and over cultivation of farmlands without proper conservation measures have resulted in serious soil erosion and degradation of the natural environment. And it is the main focal problem that has resulted in water resource and biological resource degradation.(ADPPRDD,2011-2013)

4.2.1. TYPES OF LAND DEGRADATION OBSERVED IN THE STUDY AREA

Major types of land degradation observed on the study area includes loss of top soil and soil erosion. Both are the result of the sloped topography. The fact that the study area is the result of volcanic eruption made the type of soil very fragile and very loose. Especially during rainy seasons the top soil is easily washed away and creates its own path by eroding the land. Even on vegetation rich areas, the soil has been eroded and all the roots of vegetations are exposed to be visualized.



Figure 20: Land degradation on the study area

Source : Photograph by the Author,2016

4.2.2. CAUSES OF LAND DEGRADATION

Based on the primary and secondary data collected and results analyzed, causes of land degradation. According to interviews and visual observations of the study area main problems observed by the locals includes; Lack of land, type of soil, lack of health facilities, lack of educational institutes , flood, no grazing area for livestock, and inaccessibility of water resources. Evaluating the change in availability of cultivated land 91% believes that it has decreased from time to time and the rest believes in no change noticed and few think it has increased. For the cultivated land to decrease from time to time the reason behind is believed to be increase in population and loss of land by land degradation by 84% of the respondents.

The society believed that introducing investors in the study area decreased the rate of degradation because the area had been secured and protected. Additionally, allowing investors to participate in protection of land degradation helps the community to exercise new techniques and procedures.

Based on the findings of the study the causes of Land Degradation in the study area are categorized as man - made , natural and combination of both. How these causes are occurring in the study area are described below:

a) MAN MADE CAUSSES

Man - Made factors observed on the study area includes informal settlements, improper cultivation on steep slopes, deforestation and population growth.

These man - made causes occurred because of the fact that the community is dependent on the natural resources available in the area . The income of the community is highly dependent on the resources they find nearby. Specifically they sell these items for survival. Some items like; charcoal, potato, false banana products, garlic etc...Therefore. in order to do that they need a land to cultivate and as the study area is known for its steep sloped topography they are forced to use the available land feature for the extraction of the aforementioned resources .

At places where terracing had been done people and animals pass by degrading it. This is a result of lack of knowledge on the uses of terraces. And also stone terraces are not used in the area because of the non availability of stone at the study area or nearby village.

Additionally population growth had forced deforestation of the study area and also utilization of forest resources are 100% evidenced by the community.

b) NATURAL CAUSES

Natural causes at the study area starts from the rugged topography. The steep slopes of the study area has forced many activities to be left unaccomplished. The topography surrounding the Lake is very steep sloped and inaccessible.

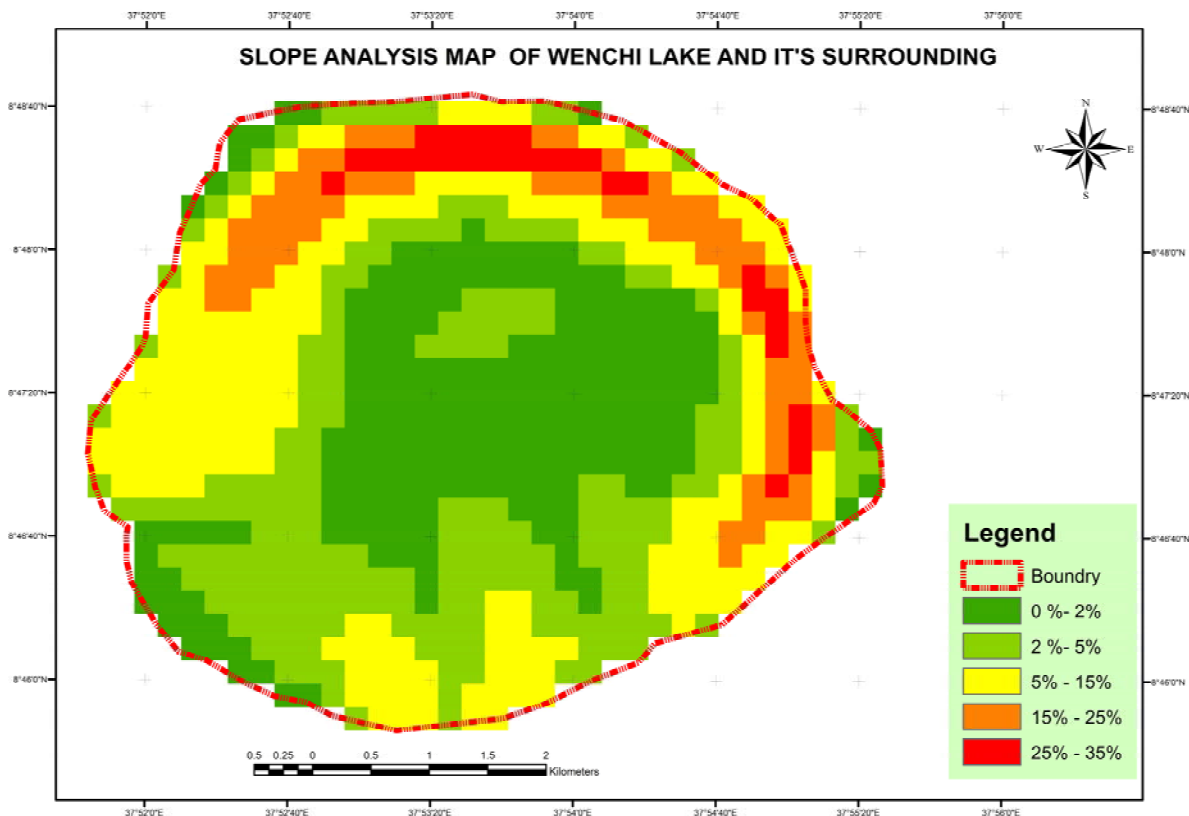


Figure 21 : Slope analysis of Wenchi Lake and its surrounding

Source : Dem file of Ethiopia

Major contribution to the degradation of the study area is the result of the elevation difference as indicated on the map above.

The topographical features of the area show both natural and man interfiled results. Steep slopes and rugged topography being the major observable result some informal settlement and poor land management had been observed on the study area.

As the study area is characterized by steep slope: during rainy seasons it is already known that the path ways and all retaining walls constructed to protect soil erosion had been eroded every year and the community had been doing the same techniques for many years.

The type of soil is another issue to be raised as a natural cause. The study area is the result of a volcanic eruption therefore, the soil type is very fragile and very loose. Constructed terraces are easily degraded because of it.

Some detailed causes are listed below:

- Intense rainfall raises the ground water table; decrease the soil strength and increases weight of associated material.
- Fluctuation of water levels due to rain.
- Erosion caused by continuous runoff over a slope. The removal of toe and lateral support of a soil mass by flow of water brings instability of the soil mass.
- Deposition of loose sediments .
- Volcanic activity – In areas where there is an existing volcano had undertaken, volcanic ash deposits (sometimes called as lahars deposits) are prone to erosion and subjected to mud flows due to intense rainfall .

c) CONCLUSION ON MAN MADE AND NATURAL CAUSES

Combination of both manmade and natural causes aggravates the land degradation in double. Both causes interchangeably promote the degradation level step by step. These causes are inputs for each other.

One hazard triggers another. The fact that the study area is a result of volcanic eruption triggers a land degradation, which in turn may dam a valley causing upstream flooding and subsequent dam burst. This will lead to flooding in lower catchments areas.

4.2.3. EFFECTS OF LAND DEGRADATION ON WENCHI LAKE & IT'S SURROUNDING ENVIRONMENT

i Direct effects of land degradation:

According to discussions made with the community ; Physical damage is observed and affecting the fertility of the land of the study area. Debris blocks roads, supply lines (telecommunication, electricity, water, etc.) and waterways. These in turn leads to injuries to people and animals and promotes in accessibility of the study area.

ii Indirect effects of land degradation:

According to interviews of ten investors at the buffer of the lake; Flood surges caused by movements of large masses of soil into the downstream reduces the quality of Wenchi Lake . Increased sedimentation in the lake is affecting the history and purity of the lake from time to time.

Degradation in the area had been increasing for the past nine years. Luckily the Ecotourism association has been doing a lot in cooperating the community to protect the land. Some of the noticed degradations include: deforestation, soil erosion, informal settlement, informal cultivation on steep slopes etc...

As the community is not dependent on any cultivation practice the only resource they have is the lake and income from tourists. Therefore, they deforest the forest for constructing wooden boat for tour, for charcoal making, for constructing their home.

4.3. CHALLENGES OF WENCHI CRATER LAKE

4.3.1. PHYSICAL ASPECT

a) EXISTING RESOURCE MAP OF WENCHI :

The WENCHI area is administrated by the Haro city and they have tried to make the land use of the area by hand but it is not scaled and the land use composition of the area is not numerically known. It is quite appreciable that the maps below were made by hand by the Haro woreda farmers association administrator. Any referable materials are found at Chittu city which is 28Km away from the Haro Woreda. The woreda is aligned to *Dandi* city by North, *Wolliso* by East, *Gorro* by South and *Amamaya* by West.

The physical challenge of the study area is the type of soil and the rugged topography that had been hard to maintain. Especially during rainy season instability of loose structures had been a problem for many years. Both pedestrian and vehicle users complain about the physical landscape of the study area.

Referring to the research questions, Haro woreda administrators believed that the land use land cover of the area has been changed through the past 20 to 30 years. They all agree that there is a serious degradation in Haro WENCHI woreda and that not much has been done to prevent the cause and effect of it. The reason behind is deforestation, farming on sloped areas, Topography of the area and Flooding. The people of the woreda are limited to natural resources therefore, they use whatever means available for survival. Even though the topography is not comfortable for cultivation they make some terracing and do so. The methods used are very weak and not sustainable.

Considering the land use of the area; some informal settlements are observed in the outskirts of the woreda. Control measures have been taken but still couldn't avoid informal settlements. As a design they have put some statistics of residential, administrative, forest land etc... But still the city is on the process of qualifying the standard. The back lifting reason is the main office being away from Haro Woreda (Chittu), and main infrastructures not being provided. This is to recall the road from Ambo to Wolliso being much degraded, Availability of Water and Electricity

being compromised, non-Availability of Hospitals & schools has all contributed for lifting the woreda backwards.

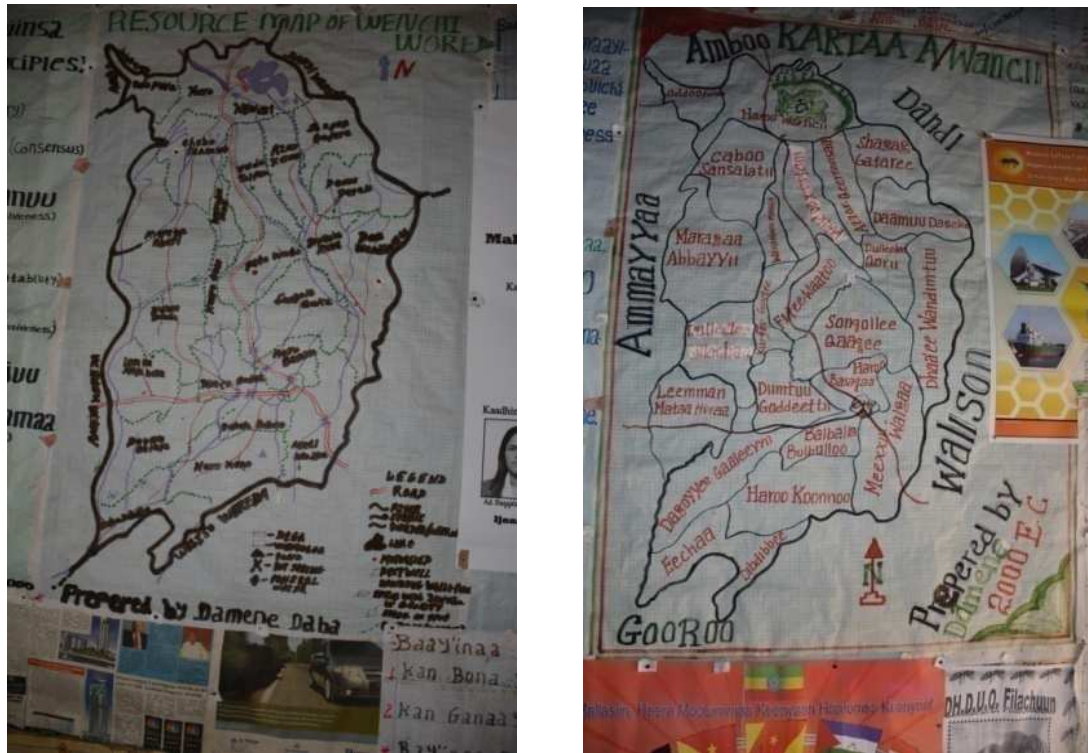


Figure 22 : Handmade maps of Haro Wenchi woreda

Source : Haro woreda Farmers Association Administrator, Photograph by the Author, 2016

b) HUMAN INTERFERENCE AT THE LAKE

The water body *Wenchi Lake* is very pure and it has functioned for years as tourist attraction. No further study had been done so far but the quality of the water is vigorously speechless. Therefore, much has to be done to sustain the quality. But the society using the lake for their daily use might result in deterioration of its quality.

Most physical properties of *Wenchi Lake* conformed to the standards set out by WHO for drinking water, except for the level of magnesium, chloride, and sulphate ions, which just overstepped the borderlines. As for heavy metals, it was observed that only Cu, Mn, and Zn were well within the allowable concentrations while Cd, Ni, Cr, and Pb were significantly higher than

the set limits allowable for potable water. Moreover, the lake sediment was found to be enriched with these heavy metals compared to the lake water.(Journal of science and thechnology,2008)

However, heavy metal enrichment through bio - concentration by plants in the lake was even more conspicuous. The presence of increased amounts of heavy metals may have a direct impact on the health of humans as well as aquatic animals. Visibly the water looks very clean with no contamination. The volume of water in the lake is very high and can potentially be used for various purposes by employing artificial recharging technologies and special purification methods. However, there is a dense population of macrophytes in the lake. (Journal of science and thechnology,2008).

Generally, the challenges faced in this regard are human interference by utilization of the lake and promoting the un sustainability of the lake.

c) ACCESSIBILITY

The first date of the emergence of the path way from Ambo to Welliso was 1987 G.C. The inaccessibility of Wenchi Lake both from Ambo and Welliso has decreased the number of tourists visiting the area. Luckily by 2015/16 G.C the road from 'Ambo' to Welliso has been started by a Spain company and has added the value of Wenchi Lake for future attraction of tourism. Additionally after arriving to the Haro city the way to Wenchi Lake is quite difficult, but at this moment the community is providing Horse for tourists to minimize the stress of the sloped topography.

Accessibility is major issue that has been a problem for years. Now the Road to Ambo - Wolliso is being constructed and it has a good hope. The access from Haro to the Lake is another issue but many of the community believes that they should be benefited from Horse riding and the road should not be constructed. But the preferable way is as the Horse renters are teenagers it is better for them to go to school.

All in all the major issue for the survival of Wenchi Lake is lack of infrastructure. Giving it more attention can and will increase the potential of the area. Even it will attract many for investing and sharing their experience for the good of the community.

4.3.2. ENVIRONMENTAL CHALLENGES

Agro-ecology of the woreda is characterized by weina dega (midland) and dega (high land). The Weina dega part consists of 56% of the total land area while the dega is 44% (ADPPRD, 2011-2013)

As for vegetation life of the district, about 6,064 ha of the district is covered with natural vegetation including shrubs, bushes and woodland. According to the data received from the district office of agriculture and rural development for the year 2006G.c., out of the total area of the district ,72.5% is cultivated land ,13.7% grazing land, 9.74% covered by natural forest land under crops (both annual and perennial), 0.03% communal forest, 1.03% is water body while others (bare land and settlement) comprise 3%.(ADPPRD, 2011-2013)

As discussed with the community officials environmental challenges of the study area are heavy rainy seasons though out the year. Which in turn facilitates the land degradation level from time to time. Every year soil and water conservations are constructed to combat the degradation but it is always destroyed by flood. Which in turn is the result of the steep slopes of the study area. All the participants believes that better conservation methods has to be employed.

4.3.3. SOCIAL CHALLENGES

- **SOCIO ECONOMIC DATA SURVEY**

Majority of the respondent's source of income is agricultural cultivation which counts 86%, the rest includes petty trade, livestock and poultry farm, and other activities. Many are engaged in two or more activities for survival. Main problems observed regarding utilization of the land includes; lack of land, type of soil, lack of health facilities, lack of educational institutes , flood, no grazing area for livestock, and inaccessibility of water resources.

Evaluating the change in availability of cultivated land 91% believes that it has decreased from time to time and the rest believes in no change noticed. For the cultivated land to decrease from time to time the reason behind is believed to be an increase in population and loss of land by land degradation as stated by 84% of the respondents.

From the result of SPSS the part one questionnaire raised many issues regarding gender. Only very rare females were willing to participate both on questionnaire filling and group discussions. This shows much has to be done regarding gender issues. Females should be given the opportunity to learn, to work and to participate in the community communication centers.

Education being compromised in the area has indicated that much has to be done. Education is very necessary for the growth of the overall country . Therefore, provision of schools ,libraries etc.... can increase the level of the community. Sending their children to '*Ambo*' or *Wolliso* is not fair for the community because people that can't afford are suffering.

Main source of income of the community is farming. It was a surprising point but many of the people have gardens at the back of their home and they cultivate potato, green leaf, false banana etc.. Economically they are benefited from their gardens and additionally they sell it as their source of income.

Main problems observed on the area includes; soil erosion, non availability of infrastructure and lack of proper utilization of water resources. The topography of the area being the main reason for soil erosion and loss of top soil conservation methods can be employed even of it is very hard.

Size of useable land has decreased through the years and the reason behind is population increase and loss of land by degradation. As the degradation level is very high it is an acceptable cause. If the degradation level has resulted in decrease of useable land many much has to be done regarding conservation measures. This is to say increasing the potential of the area is a mandatory case.

For many, the Lake is not accessible for daily utilization but people living surrounding the lake use the water as their daily resource. Availability of aquatic life has been a question for many years the reason behind is thought to be the non availability of food that support the fish and also the coldness of the water.

Accessibility has been unsolved topic for the past many years both for pedestrian and vehicle users. The rugged topography has resulted in degradation of constructed pathways and terraces. Especially the area is known for having many rainy seasons and heavy rain is always expected,

along with this reason all constructed pathways are always degraded as a result. The type of the soil in the area has helped the degradation because as the area is the result of a volcanic eruption it is not strong enough to hold any pressure applied on it.

Ecotourism in Wenchi is performing greatly by incorporating the community. Many wonderful associations are created and the community is actively and positively participating for the past ten years. It is a result of investing knowledge on the community about the environment. Benefits expected from the ecotourism is high by this time and much has to be done additional to what is being done now. In this regard, the community is willing for any activities that might help the community. Positive feed backs have been observed regarding tourism. All are interested in welcoming new investors rather than working by themselves.

4.3.4. ECONOMIC CHALLENGES

Economically the community had been suffering for years because of unproductive nature of the study area and the altitude. Only fixed types of cultivation products are available for production.

The topography of the study area being the major problem for the society , the natural factors such as heavy rainy seasons, type of soil etc... aggravate the problem day by day.

Generally the community benefits from the products of *False Banana (Kocho)* it is processed at their gardens and is always sold to other parts of the country.

Regarding the *WETA* ; the Association has changed many lives by creating income generating practices. For many it has been their only source of income for years. Because of that few disagree in the construction of road to the Lake because they believe that it minimizes their income from horse renting.

Conflict of Interest: Inadequate participation of the locals in ecotourism development process results in inequitable benefit sharing. Simple provision of incentives as a means to exploit resources and marginalize a certain part of a community may intensifies over exploitation of resources, loss of confidence on ownership, and increase the annoyance of marginalized community towards further development of ecotourism. The local community responded that there is a conflict of interest on the owner ship of the lake and tension among the local

communities. For instance, the boat group, guide group, horse riding group and honey group are the most beneficiary group while others not. (Elsevier,2015)

4.3.5. INSTITUTIONAL CHALLENGES

For a city to develop and support its community infrastructure plays a vital role. Here in Wenchi woreda there is lack of availability of institutions like hospitals, schools, police stations, electric and water facilities and administrative unit that is responsible to control and support the need of the community.

Some NGOs like World vision has tried to provide drinkable water for the society but the study was not feasible and because of that it has failed to support the community. Other foreign investors has promised to process the water in return for the availability of farm land .But many has failed to keep the promise.

At this moment the ecotourism managing director is communicating with Italy NGOs for the provision of water for Wenchi woreda. They have managed almost 50% of the agreement and is hoping to get it done as soon as possible.

The availability of school in the area is very scarce. The starting date of school in the area was by 1974 G.C. At this moment there only exists one elementary and one secondary school with poor quality of resources and it has stopped working by 2015/16 G.C. because of the unrest in the Oromia region.

By 1989 G.C. construction of many residents started by local materials like bamboo, mud and also metal sheet for the roofing.

As discussed on the above subtopics major hindering issue for the Wenchi people is lack of availability of infrastructure. For a community to develop and bring out the potential of the area and the people necessary institutions has to be provided. This is to recall availability of schools, hospitals, police stations etc... Children growing in Wenchi deserves to be educated and to be exposed to the world as their wish. Parents suffering to send their children to school is not an easy thing to handle. Hospitals are mandatory for the health of the society . People don't have to travel with challenging road access to city for medication. Additionally, Availability of police

stations is very necessary as the area is tourism center security of the people visiting the area has to be guaranteed.

For a community to have water and electricity is a mandatory issue. This cannot be an issue for a society that has been living in the area for many years. Therefore, as the area is wet, it is very easy to provide water from the ground.

4.4. SOIL AND WATER CONSERVATION PRACTICES IN THE STUDY AREA

Soil and Water conservation activities have been carried out in the woreda for the past many decades. However, still the area demand that further integrated soil and water conservation measures. compromised sense of ownership in the community less sense of ownership, poor management of communal conserved areas; low benefits from area closure and delay of land certification are some of the major contributing factors for un sustainability of soil and water conservation activities done.(ADPPRDD, 2011-2013)

Because of the soil chemical degradation , fertility of the soil has declined. The problem is becoming acute in the highland areas where there is high rate of soil nutrient loss through the washing away of the top soils. Declining of soil fertility has resulted in poor productivity and area loss.(ADPPRDD, 2011-2013)

4.4.1. SOIL CONSERVATION PRACTICES

As it is observed the study area is degraded and loss of soil and water is expected. The community has tried terracing system but it is not strong enough to uphold when animals and people are passing by. This is because the terracing is not supported with stone or any masonry. The figure below clearly depicts poorly supported terracing practices in the study area.



Figure 23 :Terracing practices observed around Wenchi Lake

Source : Photograph by the Author,2016

4.4.2. WATER CONSERVATION PRACTICES

Regarding water conservation not much has been done in the study area. Especially at the lake buffer area, all activities are practiced at the tip of the lake. These activities are the forced result of the steep slope surrounding the lake. As the slope is noticed till the tip of the river people owning the river side are forced to use the available space.

On the other hand people of *Wenchi* uses the lake for their daily use. The fact that many are using it will discourage the sustainability of the lake. The quality of water will be in question if not considered urgently.

4.5. ECOTOURISM ACTIVITITES IN WENCHI

The *WETA* is an association in the area that has been contributing a lot for the community and for promotion of the Wenchi lake. It has contributed in creating community based associations and generating income for the community and also giving certain trainings regarding soil and water conservation methods.

So far the Wenchi Ecological Tourism Association is the main promoting association of the area. It has done a lot in training the community and creating income facilities.

Every year around 1,000-1,500 tourists used to come to Wenchi Lake. But by the year 2015/2016 G.C because of the sudden unrest in the area and the degradation of the Ambo to Wolliso road it has decreased . Another issue to be raised is the non-availability of hotels and guesthouse in the area which has contributed for the decrease of tourists in the area.

On the other hand the existence of St. Kirkose Church has contributed a lot in attracting tourists in the area. Especially during holidays of the church around 25 buses arrive for visiting and worshipping. Now the church is even building a museum to increase the number of tourists visiting the area.

The association benefits from different kinds of works; tour guiding, horse rent, boat rent, tourist car guard/security and apiary/honey selling and export. These all departments are under the association and it is composed of many community members. The members of the honey producers collect all their products and export to Italy once every year. They attend the exhibition in Italy by their representatives and sell their products and promote Wenchi crater Lake in the process.

Members of the association believe that there are many challenging issues that hinders the sustainability of the area. Lack of knowledge and the topography of the area has contributed for the failure of soil and water conservation measures. Many formal and informal trainings have been given for the community but practically not that much effective. All in all not much have been done considering degradation of the area. But for the past ten to fifteen years the association has been doing a lot on protection of forest, avoiding cultivation on steep slopes, avoiding utilization of fire wood and plantation of endemic trees. As a result, it has made significant change in providing knowledge and also protecting the natural resource.

All members of *WET'* support the idea of community based Ecotourism and are willing to do much to increase the number of tourists visiting the area. Additionally, all members believe that giving a chance for investors is another benefit for increasing the number of tourists. This is to

say building of hotels and resorts will promote the area. Employment for the community will be benefited.

In this association many appreciable tasks has been done so far. If not for the association the Wenchi Lake could not have survived as the place is suffering from land degradation from time to time.

The main back lifting situation on the ecotourism is the non availability of infrastructures both for the community and for tourists visiting the Lake. Many of nearby problems are being solved locally but problems like main road leading to Wenchi Lake and availability of drinkable water for the community are out of the control of the community. Additionally, considering these problems investors are tied to build useful means for Wenchi community. Such things like hotels, guest rooms, lodges etc... were supposed to be available for tourists but not even one available hotel is there to provide the need. Camping sites are available at some places with the willingness of some investors and the association itself.

Most of the time the association uses any opportunity that might help the Wenchi people. Any one visiting the area is always socialized with the society because of their welcoming characters. The association always discussed the problems of the area and any one visiting the place will think of the place again . Many have helped with their knowledge, money, and any available resource that might help the community. At this moment an action to be recalled is an action done with Italian cooperate NGOs for provision of drinkable water.

The ecotourism is benefiting the community very well. Many people are members of the Wenchi Ecotourism Association. Providing ownership for the community have increased the protection of the area.

The willingness of the society was an appreciable condition that has helped the study. Degradation has been issue for many years and they have tried to solve it locally. However, the Ecotourism office is doing such an acknowledgeable work that should be appreciated and supported by any means available.

4.6. SWOT ANALYSIS

SWOT analysis refers to Strength, Weakness, Opportunity and Threat related to the study site. It is the in-depth analysis of the strength and weakness of a particular site and they describe the internal issues of the site while the opportunities and threats are issues which have positive or adverse effect on the site imposed by external issues.

➤ **STRENGTH:**

- The existence of Wenchi Lake which is referred as *Switzerland of Africa* increases the potential of the study area. The special pure water of the lake has been admired by many and will keep on shining if protected and reserved effectively.
- The Wenchi people are very sociable and cooperative for change and for anything that might help the community.
- The presence of vegetation surrounding the lake supports the land and protects it from erosion if protected properly.
- The existence of investors at the area protects the environment from degradation. Every efforts done by the investors helps the environment and the community.
- The non accessibility of the lake helps the community to rent their horse and benefit from the income.
- Survival of the community without major infrastructures on the study area. Including the non availability of security.
- The community helping themselves by incorporating themselves at the ecotourism association.

➤ **WEAKNESS:**

- The rugged topography of the study area hinders activities to be taken place on the area. It also promotes soil erosion and loss of top soil. This in turn affects the soil fertility of the study area and also the potential of the area for cultivation.

- Inaccessibility of the Lake affects both pedestrians and vehicle users. This decreases the welcoming character of the area.
- Non availability of main infrastructures such as access road, hospitals , schools, drinkable water and electricity etc...
- No appropriate measures has been taking place to minimize the rate of soil erosion taking place at the study area.

➤ **OPPORTUNITY**

- The place having external exposures like exporting their products like honey on worldwide level triggers promotion for tourism.
- Number of people visiting the area in case of no availability of main infrastructures.
- Tourist knowing the area by the name *Switzerland of Africa* increases the rate of visitors every year.
- The construction of the road from Ambo to Wolliso increases the number of tourists visiting the area.

➤ **THREAT**

- The government , NGOS and any institutions not giving proper attention for this antic area up to the study year. As the area's potential it could have been a major tourist center and also it could have helped the community as a whole.

CHAPTER FIVE : CONCLUSION AND RECOMMENDATIONS

In this chapter all studied issues on the former chapters are concluded in detail. What the study has been touching so far has finally come in to conclusion after many ups and downs. All the former chapters has been experimenting issues point by point especially after results has been gathered many discussions were made. At this chapter the analysis has been finalized and after referring to some literatures, it has recommended appropriate solutions for the identified problems.

Finally the study has come this far to solve the major problems of Wenchi Lake and its surrounding environment based on the objective of the study.

5.1. CONCLUSION

The LU/LC changes studied through the indicated years has justified the increase in population and utilization of bare land . The forest cover resulting after a decrease through the studied years indicates the efforts made for conservation methods. As this result is a rare case the community has to be acknowledged and supported for future community protection techniques. The Grass land cover after increasing it has decreased on the last studied years. It indicates the level of the soil fertility decreasing through the years. The water level after increasing for the three studied years it has decreased. From the interviews and questionnaires concluded it has been decreasing for the past five to ten years. Therefore, details of how the water level is decreasing has to be studied further.

The major challenging issues in the area includes soil erosion, washing away of top soil, un sustainability of soil and water conservation methods used and lack of availability of main infrastructures.

The topography of the study area being the major facilitating factor for the degradation, the experimented soil and water conservation methods are not effective because of the materials used and the non availability of stone in the area.

Lack of main infrastructures like schools, hospitals , road access etc.. has resulted in back lifting the society. It is a main concern as the place is with potentials of tourism attraction. Productivity

and accessibility of the lake is very important for the growth of the community. Availability of drinkable water being a challenge for this community is unbelievable issue. On a land that is wet, ground water can be easily provided if given better attention. For a place that is always exposed to international visitors much could have been done to increase the potential of '*Wenchi Lake*'. The non availability of hotels, guest rooms and lodges has forced tourist to camp on identified camping sites but for safety and comfort of visitors it has to be given better attention.

Sustainability of the study area has to be taken in to considerations and actions has to be employed before it is too late. Luckily, the conservation methods provided by the '*WETA*' has resulted in a good change from the results gathered with GIS. Especially, Protection of Forests has resulted in radical change through the studied years.

Only the level of water is in to question because it always changes on rainy and sunny seasons. But additionally, the washing away of top soil and derbis surrounding the Lake might inter in to the lake and create sediments that might decrease the level of the water.

Ecotourism in '*Wenchi*' has been working for more than fifteen years . The association has been working on the community for the better of the society and the lake. Appreciable actions has been taking place only some push factors and supporting institutions has to be introduced. They are already ready for change and has been implementing and contributing unconditionally for the past years. Therefore, formulating new strategies and implementing them is an easy task as the society is well aware of such procedures.

5.2. RECOMMENDATIONS

5.2.1. LU/LC CHANGE PROTECTION:

As discussed on previous chapters protection of forest land is a mandatory process. As the society has no other alternative for survival it is more likely to be utilized by the community. Forest resources development, protection and use strategies need to be advised to protect the deteriorating soil quality in the study area.

It is known that the community has been planting '*Eucaliptus Globulus*' for rehabilitation purpose but the character of plant degrades the land (high consumption of water from soil).

Therefore, re - plantation of appropriate vegetation types which are adapted to the local climate has to be employed. Additionally, defining the land cover of the study area and creating awareness for the society is necessary.

5.2.2. VEGETATIONS OTHER THAN THE COMMON USE :

• False banana:

Vegetations on the study area are endemic and many benefits can be acquired from them. False banana (*Enset*) other than being a food resource studies should be done to take it to the next level. As the area is abundantly rich in growing False banana the community can be benefited if options are studied. Additionally, A good quality fiber, suitable for ropes, twine, baskets, and general weaving, is obtained from the leaves. Dried leaf-sheaths are used as packing material, serving the same function as Western foam plastic and polystyrene. The entire plant is used to feed livestock

• Erica arborea:

Erica arborea is an upright evergreen shrub or small tree that is very abundant on the study area. It is extremely hard and heat-resistant, and is used for making smoking pipes, jewels and knife holdings. It has been used in Turkey for medicine as a diuretic, urinary antiseptic and laxative. However, its other pharmacological effects have not been yet elucidated clearly. Therefore, studies has to be done on this area and it can be used as a resource.

• Bamboo:

Bamboo has been used for as a building material for many years. Now as it is available at the study area the community can be benefited other than the usual usage: medical purposes, decorations, building materials, fabrics & clothing, cooking, agriculture, weapons , diapers, instruments etc...

• Hagenia abyssinica:

Purgative and anthelmintic; solutions for tapeworm, and *Koussou* is used to expel the worms. One dose is said to be effective in destroying both kinds of tapeworms, the *taenia solium* and *bothriocephalus latus*; but as it possesses little cathartic power the subsequent administration of a purgative is generally necessary to bring away the destroyed ectozoon.

The dose of the flowers when powdered is from 4 to 5 1/2 drachms, macerated in 3 gills of lukewarm water for 15 minutes; the unstrained infusion is taken in two or three doses following each other, freely drinking lemon-juice or tamarind water before and after the doses. It is advisable to fast twenty-four or forty-eight hours before taking the drug.

The operation is usually safe, effective, and quick, merely causing sometimes a slight nausea, but it has never failed to expel the worm. Occasionally emesis takes place or diuresis, and collapse follows, but cases of this sort are extremely rare. It is said in Abyssinia that honey gathered from beehives immediately the *Kosso* plants have flowered is very effective in teaspoonful doses as a taenicide, its effect being to poison the worms.

5.2.3. SOIL AND WATER CONSERVATION METHODS:

Based on the research finding the socio-economic constraints affecting farmers to apply soil and water conservation in the study area is the topography. These factors affect farmers both positively and negatively to apply conservation practices. Therefore, using techniques like :

- **STRIP CROPPING:**

This practice consists of growing erosion-permitting crops (maize) in alternate strips with erosion checking close-growing crops (grasses, pulses). The erosion checking strips check and hold the flowing water and soil.

- **CROP ROTATION:**

This refers to growing of two or more different crops in sequence in a field for maintaining the soil fertility. Continuous growing of clean cultivated crops causes more erosion. A good rotation should include densely planted small grains, spreading legume which may check soil erosion.

- **STUBBLE MULCHING:**

This means leaving crop residue or vegetative litter on the land as a surface protection against erosion and for conserving moisture by favoring infiltration and reducing evaporation.

- **USING ORGANIC MANURES:**

Organic manures like cow dung, green manure, farmyard manure etc., improve the soil structure. Granular and crumbly structures increase infiltration and permeability in the soil and conserve soil moisture.

- **MECHANICAL MEASURES:**

The mechanical measures that can be used to control erosion are as follows.

- **Contour Tillage:**

On sloping lands, all tillage operations should be done at right angles to the slope of the land. This way, each channel intercepts the flowing water and allows it to soak into the soil.

- **Contour Bonding:**

The idea is to break the slope of the land into smaller, more level compartments by constructing mechanical structures of suitable size along contours. Each bond, thus, holds the rainwater within each compartment.

- **Terracing:**

On steeper slopes, terraces or flat platforms are constructed in steps in a series along the slope. This way water is retained on each terrace which can be used to raise crops.

- **CONSTRUCTING PROPER DRAINAGE CHANNELS AND PLUGGING THE GULLIES:**

- **Basin Listing:**

This refers to scooping out small basins at regular intervals on slopes which help in checking the run-off and in conservation of water. Additionally, the water can be utilized for irrigation purpose.

- **Water Harvesting:**

This refers to trapping or channeling of water into low-lying areas. This helps in checking the run-off and also acts as a flood control measure.

○ **Scientific Slope Management:**

The cropping activity on slopes should be taken up as per the nature of slope. If the slope is between 1:4 and 1:7, proper farming can be done; if more, pastures should be developed; if still more, forestry operations can be undertaken; if it is still greater, then terracing is required before any cropping activity can be done.

5.2.4. AGRICULTURAL TRENDS

Methods can be employed to sustain the water and soil as well as to perform the needed cultivation. Additional strategies shall be planned for increasing the sustainability as listed below:

- Efficient use of resources and materials in agricultural activity.
- Reduction of both degradable and non-degradable waste.
- Reduction of agriculture related hazards and damage to the environment.
- Preservation of agricultural land and open space, and maintaining the culture and landscape values of agriculture.
- Preservation of the nature/agriculture balance.
- Efficient use of land and resources for rural development.
- Preservation of the unique rural character of agricultural communities.
- Maintaining rural open space as "green lungs" for the benefit of urban communities.
- Promotion of sustainable development in accordance with national concepts and international agreements.
- Incorporating sustainable development principles into purchasing contracts among farmers and by the Ministry.
- Sustainable development for agriculture refers to the wise use of irreversible resources (land, water, energy) and minimizing the adverse environmental impact of manmade resources used in agricultural production (fertilizers, pesticides, non-degradable materials). It includes reducing the use, replacing, and improving these resources as well as treatment for additional agricultural byproducts such as organic waste, spillage and gaseous emissions.

5.2.5. INFRASTRUCTURE:

Infrastructure is an important topic for any society . Based on the results of the study, the Road access has to be constructed . The construction has to consider both pedestrian and vehicle users. This is because many depend on the income they get from touring and guiding by hoarse Therefore, considering their needs would result in good way.

Supply of drinkable water for the community has to be given a priority . It might help visitors to consider the area more than one step visit. Promotions has to be done unconditionally to attract investors to invest on hotels, guest houses, lodges etc...

5.2.6. ECOTOURISM:

Community based ecotourism has been an effective procedure to benefit and to train any community in world context. Additional to what has been done by 'WETA' utilization of available resources should be added . Works that incorporate Women has to be introduced and handmade art crafts shall be done. Instead of depending on fixed incomes the people can be creative enough to sell their knowledge for tourists.

Some ideas to be done includes:

- The management should develop a town plan or map to further strengthen its ecotourism offerings which include home and village tours and pick-up tours should be expanded.
- An eco-museum should be established in the community to help preserve some old artistic works that people have done. This can give mythological insight into the values and ancient traditions of the community and further enhance the ability of future generations to learn the former ways of life of their ancestors.
- Central destination should establish linkages with other villages like 'Ambo' to 'Welliso' center place so that their ideas can also be incorporated in the ecotourism development process.
- Making handicrafts from the available resources like bamboo can increase the number of people that participates in the tourism industry.
- Degradation of natural resources around tourists' destinations sites like hot springs, the seasonality in tourism and leakages in and around are indicators of the negative impacts of tourism. Therefore, the concerned stakeholders are responsible to create alternative options for

local communities, create attractive tourist facilities and services, and protect sensitive areas and integrating the surrounding tourism activities with local economic development or agricultural activities.

- Developing and creating diversified livelihood, promoting the development of ecotourism, encouraging benefit sharing and conservation of natural resources and giving the ownership sense of the local people over the natural resources is very necessary for sustainable use of ecotourism resources of the study area.

Increasing the awareness of local communities in and around '*Wenchi Lake*' surrounding towards ecotourism or nature tourism is very important. Therefore, such awareness might be affected through formal and informal meetings of local communities.

5.2.7. LAKE BUFFER AND ZONNING

River buffer is very important in maintaining the sustainability of rivers . The quality and value of water body increases if buffers are exercised significantly. It protects human intervention and also maintains the habitat in the water body. Therefore , considerable allowance of buffers at water body surroundings is a vital issue to maintain their sustainability. Based on that The '*Wenchi Lake*' Surrounding is designed as follows:

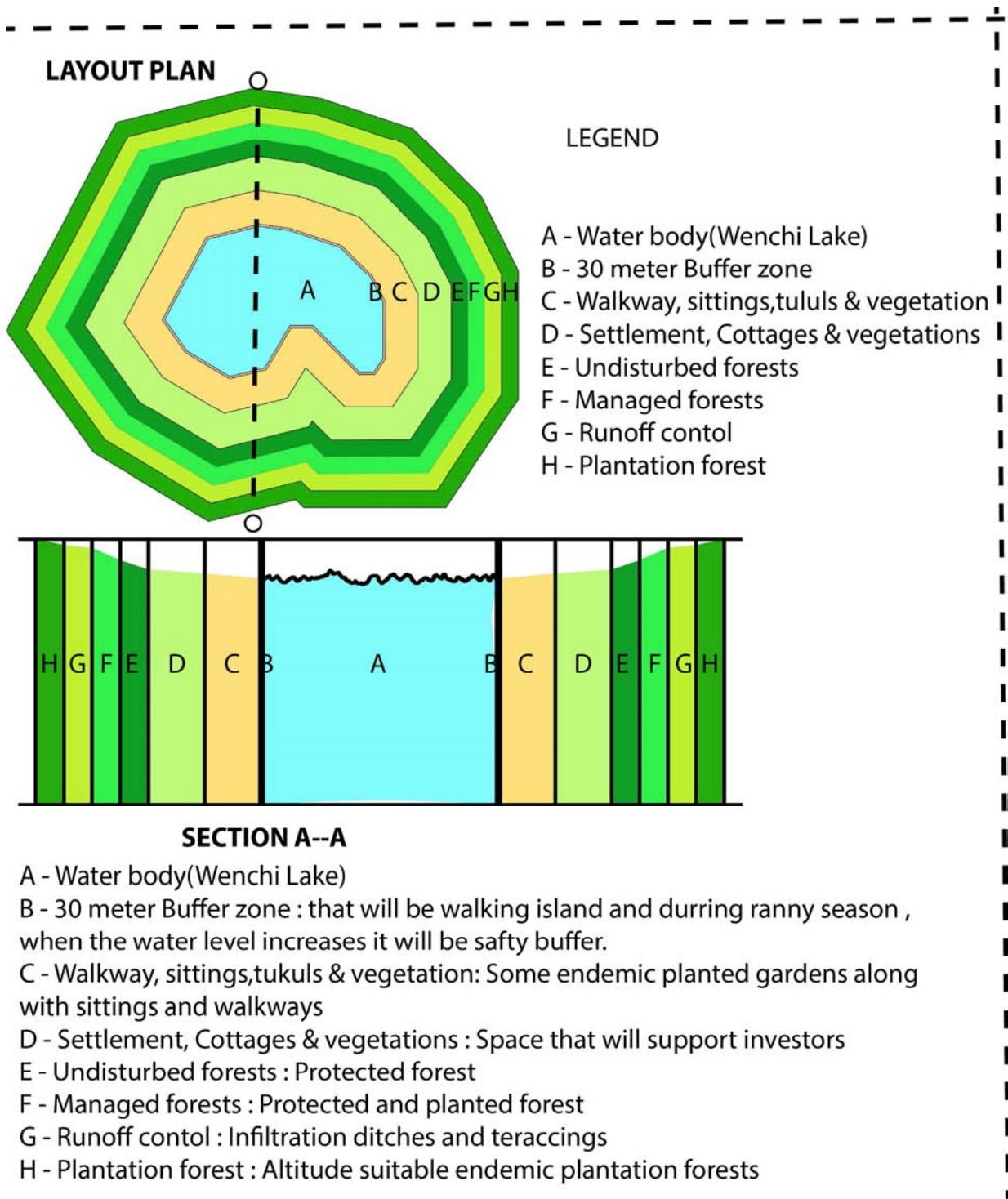


Figure 24 : 'Wenchi Lake' surrounding zoning design

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ANNEX 1

QUESTIONNAIRE

I. PERSONAL DATA

1. Questionnaire Number: _____ Date of interview:

2. Woreda: _____ Kebele/PA: _____
3. Name _____ Gender: a) Male b)Female
4. Age _____ Family size: _____ (M) _____ (F) _____
5. Number of the family in age group of:
a) 0-14: _____ b) 15-35: _____ c) 35-60: _____ d) >60: _____
6. Educational status of the household head:
Cannot read and write=1 Reading and writing=2
Primary School complete =3 Secondary school complete =4
7. How long have you lived in this area:
Less than 10 years =1 10-20 years =2 More than 20 years =3
8. What are your main sources of income? (possible to answer more than 1 answer)
Farming =1 Livestock and poultry farm =2 Petty trade =3
Fuel wood collection and sell =4 Handicraft (wood work, pottery etc) =5 other = 6
9. What do you think are the main problems in your area (give number 1-7 in order, 1 for the most serious problem and 7 for the least problem)?
Lack of land _____
Bad soil/poor soil quality/fertility _____
Lack of health facilities _____
Floods _____
Lack of schools _____
No grazing area for livestock _____
Inaccessibility of the water resources _____
10. How do you evaluate the size of the land are cultivated through time?
No change/as I get it =1 Becoming scarce =2 Increasing over time =3
11. If the agricultural land is becoming scarce over time, what is the reason behind that?

Increasing population =1 Loss of land by land degradation =2 Other = 3

12. What are the major crops you grow in your farm?

a. _____ b. _____ c. _____ d. _____

II. REGARDING WENCHI LAKE

1. Do you know WenchiLake? A. Yes B. No

2. For what purpose do you use the lake?

Fishing=1 Recreation=2 Religious ceremony=3

For drinking water= 4 I never used the lake=5

3. If you use the lake for fishing, do you get enough fish for a living?

Yes=1 No=2 No answer=3

4. If you do not use the lake for a fishing, what is the reason behind that?

There is no fish in the lake=1

The fish is not enough for all fishing community (scarce) =2 No answer=3

5. How do you evaluate the fish potential of the lake for the last 10-30 years?

Increasing=1 Decreasing=2 No Change=3

6. If you say the fish potential is decreasing, what is the reason behind that?

Pollution=1 The size of the lake is decreasing=2

The number of fishery community is not balanced with the fish =3 No idea=4

7. What potential do you think WenchiLake have in your opinion?

Drinking water=1 Fishing potential=2 Recreation potential=3 Other: _____

8. How do you evaluate the vegetation cover of the area surrounding the lake for the last 20-30 years?

The vegetation cover has reduced=1 The vegetation cover has increased =2

No change=3

9. How do you evaluate the local climate for the last 20-30 years?

Became very cold=1 Became very hot=2 Became moderate=3

10. Do you think the change in local climate is the result of deforestation?

Yes=1 No=2 No idea=3

11. How do you explain the fertility status of your land for the past few years?

Improved=1 Decreased=2 No change=3 Other: _____

12. How do explain the accessibility of WenchiLake for local people?

No problem for the local people=1 The area is inaccessible even for local=2

13. How do you rate this inaccessibility for visitors coming from outside?

Inaccessible throughout the year=1 In accessible only in rainy season=2

Accessible = 3

14. Can you state the reasons for the inaccessibility of the area for both the local and visitors?

15. Do you think the local people has been benefited from the lake through eco-tourism?

Yes=1 No=2 No answer=3

16. Are the local people willing, if there is good road access for tourists to visit the lake?

Yes=1 No=2 No answer=3

17. What kinds of benefits do you expect?

18. What do you think the contribution of the society for the growth of wench village?

19. How does the community contribute to maintain the sustainability of WenchiLake?

QUESTIONNAIRE#2(FOR GROUP DISCUSSION)

- ii. Questionnaire Number: _____ Date of interview: _____
- iii. Woreda: _____ Kebele/PA: _____
- iiii. # of people _____ Gender: a) Male _____ b)Female _____
- ivi. Number of the people in age group of:
a) 0-14: _____ b) 15-35: _____ c) 35-60: _____ d) >60: _____

1. What is the land use / land cover of Wenchi Crater Lake for the past thirty years?

2. What are the major challenges of Wenchi Crater Lake that hinders its sustainability?

3. What kinds of land degradation occurs in the area? And what are the possible path ways to access the lake?

4. What kind of soil and water conservation methods had been taking place in the area?

5. What are the ecotourism potentials of the area and what are the contributions of the community in this regard?

QUESTIONNAIRE#3(FOR TOURISTS)

- i Questionnaire Number: _____ Date of interview: _____
- ii #of time visiting Wenchi: _____
- iii Name _____ Gender: a) Male _____ b)Female _____
- iv Age group of:
a) 0-14: _____ b) 15-35: _____ c) 35-60: _____ d) >60: _____

1. Why do you want to visit Wenchi Lake? What makes Wenchi Lake different from other places?

2. What can you say about the land use / land cover of Wenchi woreda?

3. What do you suggest should be done in this area to maintain its sustainability?

4. What kind of soil and water conservation methods can be proposed in this area?

5. What are the ecotourism potentials of the area and what could be the contributions of the community in this regard?

ANNEX 2

PART ONE QUESTIONNAIRE ON GENERAL OVER VIEW SUMMARY

Question number	Question	Answer	Answer in percentage
9	Main problems in the area	Lack of land , Bad soil/poor soil quality/fertility ,Lack of health facilities, Flood, Lack of schools, No grazing area for livestock& Inaccessibility of the water resources	100%
10	Evaluation of size of land through time	No change/as I get it	7%
		Becoming scarce	91%
11	If scarce question #10, what is the reason behind	Increasing population	11%
		Increasing population & Loss of land by land degradation	84%

PART TWO QUESTIONNAIRE REGARDING 'WENCHI LAKE' SUMMARY

Question number	Question	Answer	Answer in percentage
2	For what purpose do you use the lake	Recreation	11%
		Recreation, Religious ceremony, For drinking water	72%
7	Potential of Wenchilake	Drinking water	8%
		Recreation	8%
		Drinking water & Recreation	66%
8	Status of vegetation cover for the past 20-30years of time interval	Reduced	96%
		Increased	3%
9	Status of local climate for the past 20-30years of time interval	Became very cold	97%
10	Status of soil fertility for the past 20-30years of time interval	Improved	8%
		Decreased	88%
11	Accessibility of <i>Wenchilake</i> for local people	No problem for the local people	11%
		Inaccessible	89%
12	Accessibility of <i>Wenchilake</i> for tourists	Inaccessible	55%
		In accessible only in rainy season	43%
13	Reasons for the inaccessibility	Erosion, Flooding, low land potential& sloped topography	74%
14	Are local people has been benefited from the lake through eco-tourism	Yes	99%
15	Are local people willing for construction of roads	Yes	98%
16	Benefits expected from the lake by the local people	Income, drinking, fishing	32%
		Income, drinking, fishing , irrigation	41%
17	Contribution of the society for the growth of <i>Wenchilake</i> village	Protection of forest land & terracing	72%
		Nothing	7%
18	The community contribute to maintain the sustainability of <i>Wenchilake</i>	Terracing & planting endemic trees	85%
		Protection of deforestation &terracing	2%