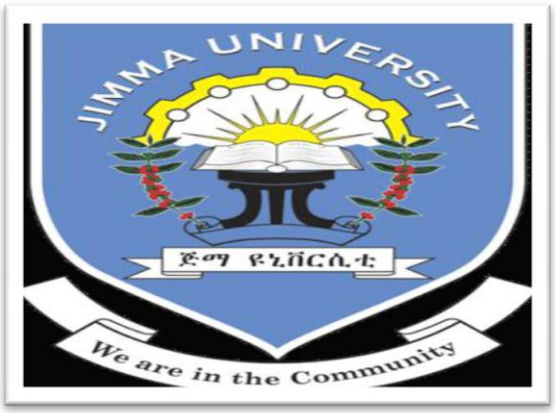

JIMMA UNIVERSITY

COLLEGE OF SOCIAL SCIENCE AND HUMANITIES

DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL STUDIES

Geographic information system and Remote sensing as Decision support tool for Potential Ecotourism Site Selection in Masha District, Southwest Ethiopia

By:

Azene Andemo Alallo

Msc Thesis Submitted to the School of Graduate Studies of Jimma University, Department of Geography and Environmental Studies in Partial Fulfillment for the Award of the Degree of Masters of Science in Geographic Information System and Remote Sensing.

November, 2017

Jimma, Ethiopia

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Under the Guidance of:

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And

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Certificate

This is to certify that the thesis entitled "Geographic information system and Remote sensing as Decision support tool for Potential Ecotourism Site Selection in Masha District, Southwest Ethiopia", Submitted to Graduate School of Jimma University for the award of the Degree of Master of Science in Geographic information system and Remote sensing complies with the rules and regulations of the university and is carried out by Azene Andemo Alallo under our guidance and Supervision. Therefore, we hereby declare that no part of this thesis has been submitted to any other university or institutions for the award of any degree or diploma.

Main Adviser's Name	Signature	Date
Kefelegn Getahun (PhD)	_____	_____
Co Adviser's Name	Signature	Date
Mr. Ashenif Melese	_____	_____

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DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL STUDIES

Board of Thesis Examination

We members of the thesis examination board, hereby approved the originality of this thesis entitled "Geographic information system and Remote sensing as Decision support tool for Potential Ecotourism Site Selection in Masha District, Southwest Ethiopia" thereby critically examining it and evaluating the final open defense by the undersigned researcher. Therefore, we certify that this paper meets the required standards with respect to quality and originality.

External Examiners	*Signature*	*Date*
_____	_____	_____
Internal Examiners	*Signature*	*Date*
_____	_____	_____
Chairperson	*Signature*	*Date*
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DECLARATION

I, Azene Andemo Alallo, proclaim the originality of this Msc Thesis in entitled "Geographic information system and Remote sensing as a decision support tool for potential ecotourism site selection in Masha district, southwest Ethiopia" has been carried out by me under guidance of Kefelegn Getahun (PhD)and Ashenif Melese (Msc). I also confirm that, this research project belongs to me and was my original work which hasn't been submitted for any other institutions or university for the award of any academic qualification or any other events.

Declared by:

Name: Azene Andemo Alallo

Signature: _____

Date: _____

Place : _____

Date of submission: _____

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Acronyms

AHP	Analytical Hierarchy Process
ArcGIS	Aeronautical Reconnaissance Coverage Geographic Information System
CSA	Central Statistical Authority
DEM	Digital Elevation Model
ERDAS	Earth Resource Data Analysis System
GDP	Gross Domestic Product
GIS	Geographic Information System
GPS	Global Positioning System
GLCF	Global Land Cover Facility
ICOM	International Council of Museums
IES	International Ecotourism Society
IISD	International Institute for Sustainable Development
KII	Key Informant Interview
KM	Kilo Meter
LDCs	Least Developed Countries
LULC	Land Use Land Cover
LULCC	Land Use Land Cover Change
MoCT	Ministry of Culture and Tourism
MCE	Multi Criteria Evaluation
MCDM	Multi Criteria Decision Making

MELCA	Movement for Ecological Learning and Community Action
MDARDO	Masha District Agricultural and Rural Development Office
MDCTCO	Masha District Culture, Tourism and Communication Office
MS	Multi Spectral
NGO	Non Governmental Organization
OLI-TIRS	Operational Land imager and Thermal Infrared Sensor
RS	Remote Sensing
SNNPRS	South Nation, Nationality People Regional State
SRTM	Shuttle Radar Topography Mission
SMCE	Spatial Multi Criteria Evaluation
SZCTCO	Sheka *Zone* Culture, Tourism and Communication Office
TIES	The International Ecotourism Society
UNEP	United Nation Environmental Program
UNESCO	United Nation Economic and Social Council Organization
UNWTO	United Nation World Tourism Organization
USA	United States of America
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
ZoFEDD	Zone Finance Economic Development Department

Abstract

Ecotourism is one of the fastest growing sectors in the tourism industry now adays. It is also a distinctive kind of the tourism that focuses to maintain unique natural and cultural resources, generate income for local communities and serves as an educational research center. Like other developing countries, Ethiopia is not effectively using its rich and endemic wildlife species for ecotourism due to various physical and socioeconomic factors. Masha district has also abundant and valuable natural and cultural resources that can be developed into ecotourism, but the district was not used its attractive resources for ecotourism. The current study was initiated to select potential sites for ecotourism using GIS and RS as a decision support tool in Masha district, southwest Ethiopia. To identify a suitable site for ecotourism, this study employed GIS based Multi-Criteria Evaluation method because it was a commonly used technique in suitable site selection. To achieve the objective of this study, about seven physical and socioeconomic parameters were selected through literature review. Then weights for each factor were assigned based on Analytical Hierarchy Process using pairwise comparison matrices. After assigning weights, all evaluation criteria were integrated in a GIS software to map out potential ecotourism suitable site. Based on the overlay result a thematic map of potential ecotourism sites was produced. The final results reveal that, about 21.2% of the study area was classified as highly suitable potential ecotourism sites (S1) whereas about 59% and 19.5% of the district were under moderately (S2) and marginally suitable (S3) classes. But, only the small portion of the district (0.4%) was considered as not currently suitable site (N) for ecotourism. These largest parts of the highly suitable potential ecotourism sites were lies in the central, northern, northwestern, southern and southwestern part of the district. Therefore, decision makers should give a due attention to advertise the selected suitable site for both local and foreign tourists in order to develop the district as one of ecotourism destination areas in the country.

Keywords: *Ecotourism, Multi criteria evaluation, Remote sensing, Suitability*

CHAPTER ONE

INTRODUCTION

1.1. General Background

Tourism is one of the world's principals and quickest growing industries, which contributes over 10% to global GDP (Ake, 2001). In recent times, it has shown sustained growth in both revenues and number of tourists. It has also a broad economic, social, cultural and environmental development sector that reaches almost every part of the world (Dabour, 2003). As a distinctive subset of tourism, ecotourism involves enjoying with nature, culture and understanding the local environment. It also demands conservation of nature and enhancement of local communities to make the environment and tourism sustainable (Gray, 2003).

The potential of ecotourism as a strategy for sustainable development was recognized during the recent time when sustainable tourism was considered as an environment friendly economic activity (Joshi, 2011). The basic purpose of ecotourism is the protection of the natural and cultural resources, generation of income for local communities, educational research centers and capacity building (Ross and Wall 1999). It was emerged in the late 1980s and is a comparatively new idea that has significantly captured the concentration of many developing countries that enables them to collaborate it in their economic development and protection strategies as it is an efficient tool for sustainable development (Koeman, 1998).

Ecotourism provides a valuable economic incentive for conserving and enhancing bio-cultural diversity. It also helps to keep the natural and cultural heritage of our stunning planet (IES, 2015). During the 1990s, the yearly growth in demand for ecotourism ranged from 10 to 34%, while in 2004, UNWTO predicts that ecotourism and nature tourism were increasing three times quicker than conventional tourism manufacturing as a whole. In 2005, the International Tourism Network also ranked it as one of the greatest growing sub sectors in the tourism industry, with an annual growth rate of 5% universal, representing 6% of the world GDP and 11.4% of all consumers' expenditure (Honey, 2008).

Africa is blessed with natural resources which includes natural, graceful water, coastline and the safari natural life which makes Africa as a potential ecotourism site in the world. On the continent; Ethiopia, Kenya, Tanzania and Uganda are among the world's top list countries well known for their endemic species (Melaku, 2011). However, the economic significance of tourism in the continent is comparatively modest which accounts 5% and 3% of global international arrivals and global intercontinental receipts respectively. The total international tourism revenue from Africa in 2013 reached US$ 34.2 billion. Absolute statistics are also predicted to more than double during the future decade, reaching 134 million international arrivals in 2030 (UNWTO, 2014).

Ethiopia is one of the motivating visitor attraction countries in Africa which is gifted with eye catching natural resources and distinctive cultural heritages. These attractive natural resources of a country include a high variety of plants and animals, the exciting features of high mountains, rivers and lakes. Some of cultural resources of Ethiopia such as the slanting, churches, castles, archeological sites and caves. Both natural and cultural resources with a pleasing variety of climate makes a country as one of potential ecotourism destinations in Africa (MoCT, 2006). However, the country is not effectively using its rich and endemic wildlife species for ecotourism due to the absence of adequate infrastructure, unsustainable use of resources, the low level community awareness towards ecotourism and the weakness in advertising and promoting its potential attractions for both domestic and foreign tourists (UNWTO, 2016).

Like other parts of Ethiopia, Sheka forest constitutes the small number of remaining wet afromontane forest vegetation in Ethiopia. The forest is wealthy in plant and animal species. Over 300 bigger plants, 50 mammals, 200 birds and 20 amphibian species occurring in the forest. Out of them 55 plants and 10 birds are endemic in our country. In addition, the zone has 38 threatened plant and animal species such as 3 mammals, 5 birds and 30 plant varieties. It also endowed with natural attraction sites of 38 mineral waters, 13 caves and 38 big waterfalls which have a greater potential for ecotourism development (MELCA-Ethiopia, 2015). The famous mountain's Gandochi Lake which surrounded by forest and bamboo thickets is among the attractions of the forest in the zone. Been having these huge amounts of attraction site, the zone is not benefited much from this sector (MELCA-Ethiopia, 2015 and SZCTCO, 2016).

Masha district as one of the three districts in Sheka zone is tremendously rich in cultural, historical, and natural attractions. Its distinctive, pleasant climate, flora, fauna, waterfalls, spring waters, mineral waters and the hospitable people put the area among the most important potential

tourist destination area. Masha people have also their own culture of traditional celebration like birth, wedding ceremony, mourning, dressing, song, dancing, which can catch the attention of numerous international and domestic tourist. Despite this huge amount of natural and cultural based attraction sites, the potential area of the district remains untouched in terms of ecotourism destination which is very important to undertake proper planning and management of resources (MDCTCO, 2016).

Potential ecotourism site selection involves a lot of natural, environmental, social and economic factors influence the site selection for ecotourism activities. The suitability site selection analyzes the interaction between these factors, according to their suitability ranks. These days, geospatial technologies such as Geographic information System (GIS) and Remote Sensing (RS) are important tools in ecotourism development (Jafar and Delavar, 2010). Thus, GIS is used to identify potential areas by using suitable location identification tools and topology. While RS is an efficent tool to classify and analyze satellite images in areas of deep forest or trained mountain region where a general survey method is almost impracticable (Bahaire and White, 1999). The integration of GIS and MCE are aslo currently the two most common decision support tools that employed to select a potential ecotourism site. Because, the GIS capabilities of data acquisition, storage, retrieval, manipulation and analysis together with inherent abilities of MCE to judge different alternatives on various criteria for possible selection of the suitable site (Eldrandaly, 2010). Therefore, the current study investigated and selected the optimal ecotourism site using GIS and RS as a tool in Masha district.

1.2. Statement of the problem

Ecotourism is implemented in a different way around the world, and the impacts on indigenous cultures vary in the same way. Many of the world's natural areas stay under threat due to the loss of biodiversity. The existing resources for conservation remain not enough when world tourism arrivals have grown by 23% and are forecasted to double by 2020. This is the main threat, disturbing the variety of resources due to climate change (TIES, 2006). The magnitude of the global biodiversity situation is unquestionably endangered million times higher than any time in its history. Currently, this situation becomes worse because the world has lost about half of its forest cover from 62 million km² to 33 million km² which serves as a home for biodiversity (Sunderlin *et al,* 2005).

Ethiopia is recognized as one of the 25 most biodiversity rich countries in the world, mainly for its high percentage of endemic flora and fauna (Mittermeier *et al*, 2004). The country possesses abundant tourist attractions, varied in category and pleasing to a broad range of attention. Such a distinctive mixture of attractions within a single country has no competition on the African continent, or wherever else. However, ecotourism is still in its immaturity in Ethiopia (Girma and Malede 2015). The idea of ecotourism is a new event to and it is not easy to clarify its significance achievement since the motive toward ecotourism is not broadly distributed in Ethiopia. The government of Ethiopia also has recognized growth and encouragement of ecotourism by providing consultancy services for a number of potential developers of ecotourism sites, but its implementation is varied within a country (Moreno, 2005).

Ethiopia is not receiving considerable benefits out of tourism in general, let alone from ecotourism because degradation of biodiversity is increasing due to man-made and natural catastrophes. Communities are not also effectively participating in the process of planning, decision making and development of ecotourism (Tewodros, 2014). Many protected areas which are the base for ecotourism are endangered due to ever rising population, habitat loss and degradation. Land use changes through agriculture, rural and urban development activities have led to the decline and alteration of wild areas, resulting in the disappearance to wildlife variety and natural areas, which serve as their habitat. In order to make tourism, sustainable in Ethiopia case there was an attempt to launch ecotourism to rural areas as element of natural resources management through creating diversified livelihoods for local people (Alemneh, 2015).

Masha district comprises an amazing natural and cultural landscape which serves as the base for ecotourism development. However, these large areas of attractive natural and cultural resources of the district are exposed to degradations or threats due to the engagement of the majority population in agricultural activities and planting of tea in and around the forest area. Human disturbance and agricultural activities in the study area have transformed the forest to other land use types. Unfortunately, human encroachment into the forest area causes the diminishing of biodiversity (Tadesse and Masresha, 2006). Their mismanagement coupled with their underutilization has reduced their contribution to the overall development of ecotourism in the district. In order to reverse this situation and to determine the most desirable direction for future development, the most suitable site for ecotourism should be carefully selected with the aim of conserving ongoing biodiversity and generating economic benefits for local people.

Previously, various studies are done in the study area regarding potentials of forest and other landscape for ecotourism. In 2005, MELCA has conducted a baseline study on LULCC and its impact on biodiversity. Similarly, in 2016 MELCA also conducted a survey of biodiversity in Sheka forest including the study area. The survey result indicates that the district has great potential to promote ecotourism. However, any of the studies in the district have not been focused on GIS based delineation of potential ecotourism site sections. Their limitation on how natural and cultural resources of the district being managed in a sustainable way and benefiting the local communities are the main difficulties of the area while huge potentials of underdeveloped ecotourism is available. Therefore, the present study focuses on the scientific way of selecting a potential ecotourism site using Geospatial technologies in Masha district that helps policy maker to mobilize local resources and improve the economy for the wellbeing of local communities through the development of ecotourism. This in turn provides significant input information for effective natural resources rehabilitation, protection and conservation planning.

1.3. Objective of the Study

1.3.1. General Objective

The principal objective of the study was to identify potential ecotourism site using geospatial technologies with the integration of MCDM techniques in Masha district southwest, Ethiopia.

1.3.2. Specific Objectives

In order to achieve the general objective the following specific objectives are aspired:

- To assess the type, status, and distribution of potential ecotourism sites in the Masha district.
- To identify the major determinant factors for ecotourism site selection.
- To map and locate potential eco-tourism sites using GIS and RS.

1.4. Research Questions

The following research questions need to be addressed in achieving the above mentioned objectives

- What are the types, status and distribution of potential ecotourism sites?
- What are the major determinant factors in ecotourism site selection?
- How to produce map of potentially suitable site for ecotourism?

1.5. Significance of the study

The importance of doing GIS-based potential ecotourism site selection will have the following benefits. The findings of this study will be significant for Masha district culture, tourism and communication office in ecotourism development decision making process. It will also help to show potential ecotourism site and aware the significance of ecotourism in terms of the importance it provides for generating revenue by attracting ecotourists, conserving the natural environment and providing a playground for promoting learning. In this regard, it will enable local people to actively participate to conserve their environment and to get benefit for their livelihood. It will also help policy makers to mobilize local resources and improve the economy for the well-being of local communities through the development of ecotourism. The findings of the study will also create awareness to local and national government bodies what policies and strategies should be developed in order to increase the contribution of the ecotourism for economic development. Finally, the study will serve as a good basis for further coming researchers who have a strong desire to carry out a research on this or related topics in Masha district or elsewhere.

1.6. Scope of the study

To effectively address the stated objective, the current study was Gographically conducted in Masha district and temporally analyzed LULC of 2017 based on their suitability for ecotourism. For verification and validation of classified LULC and final suitability map the study was delimited in four selected kebeles of Masha district namely Atle, kewo, Gatimo and Wollo.

1.7. Limitation of the study

The present study focused on selecting potential sites for ecotourism using GIS and RS in Masha district. Its focus was only on the issue of identifying an ecotourism site based on different parameters. The researcher also encountered some challenges such as absence of written data sources related to the topic under study, low resolution of the satellite images and shortage of the time.

1.8. Ethical consideration

Acknowledgement of data generated by others and appropriate citations of scholarly research outputs, books, websites, and any other related documents is also one of conducting ethical research (Zohrabi, 2013). Therefore, by considering the above principles, the researcher was cited and acknowledged all the information taken from literatures and data which is produced by individuals or organization. The researcher was respect the dignity of the respondents through not mentioning their name and printing their photographs. Finally, the researcher also considered himself as one member of a society and respects the norms and the value of the respondents.

It is imperative that the data and the instruments used to collect data to be validated (Zohrabi, 2013). Having this in mind, the study was trying to review different literatures and articles related to the problem under investigation. This makes the researcher to incorporate the main themes in data generating instruments and to select accurate data collection tools and techniques. The researcher also conducted a pilot survey to check how the result reflects the reality on the ground prior implementation of land use cover maps for analysis purpose.

1.9. Structure of the study

This study has divided in to five chapters. The first chapter deals with background of the study, statement of problem, objectives of the study, research questions, significance of the study, scope, limitation of the study and ethical consideration. Chapter two incorporates a review of related literature. Chapter three presents the description of the study area and methods applied in the analysis. Chapter four presents the results and discussions of the study. The last chapter concludes the major findings of the study and recommended some potential measures that should be undertaken by the different concerned bodies in the future.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1. Concepts and Definition of Tourism, Ecotourism and Sustainable development

This section tries to define key concepts about tourism, ecotourism and sustainable development. It also tries to address some characteristics of ecotourism such as types, principles, elements, importance, impacts and strategies to mitigate negative impacts of ecotourism are briefly discussed.

2.1.1. Tourism and Ecotourism

There is no universally agreed definition of tourism and defining it is not an easy task, as it is a complex industry made up of many different businesses, the common theme being that they provide products and services to tourists. The most usually accepted definition of tourism is the comprises events of persons travelling to and staying in places outside their permanent place of residence for not more than one successive year for relaxation, commerce and other functions not associated to implement of an action compensated from within the location visited (Dabour, 2003).

Like tourism, ecotourism also lacked universal agreed definition because different people defined it according to their own particular fulfillment and priorities. However, commonly used definitions are: ecotourism is a type of tourism that provides educational experiences and admiration of the natural situation within its linked cultural environment (Weaver, 1999). According IES (1990) it is an accountable journey to natural sites that protects the surroundings and improves the interests of indigenous people. Ecotourism is also a journey to delicate, untouched, and typically restricted areas that attempt to be little impact and typically small level. It helps teach the tourist, provides resources for protection and management, honestly benefits the economic improvement and political empowerment of native communities, and provides value for different cultures and for human rights (Honey 1999).

2.1.2. Ecotourism and sustainable development

Recently, in the world a sustainable growth through ecotourism is a relating idea. Many countries have planned their local growth based on this perception. In this common sense, sustainable development may be occurred by the ecotourism and local growth on the occasion in a region.

Scope of ecotourism growth refers to the environmental, economic, and social aspects of tourism development, and a suitable balance between these scopes must be recognized to preserve its long-standing sustainability (Bhuiyan *et al*, 2012).

As mentioned above ecotourism as a concept is a sub component of fields of sustainable tourism that strives to reduce environmental or other damage to areas visited for their natural or cultural significance. Whereas Sustainable development is development that performs the desires of the current without compromising the capability of future generations to fulfill their own requirement (IISD, 2012). Ecotourism was given extra concerns in recent times because it is anticipated as a device for ensuring the sustainable management of target areas, fulfilling the satisfaction of tourists, benefiting the target community and contributes to poverty reduction (Scheyvens, 1999).

Blamey (2001), states that there was a great displeasure with mass tourism due to overdevelopment, ecological pollution, and the invasion of culturally insensitive and economically disruptive foreigners that contributed to the approaching out of ecotourism. This grouping of a raise in environmental awareness and the rising displeasure with mass tourism led to an improved demand for ecotourism. Therefore, ecotourisms as a means for sustainable development must plan and managed on the basis of sustainability since it has a negative impact on economic, cultural and environmental resources depending on circumstances how it is managed (Häusler and Strasdas, 2003).

Ecotourism is frequently perceived as a device for promoting sustainable development in developing countries. It helps in society development by contributing the vary source of livelihood to local society which is more sustainable. A lot of analysis considered ecotourism as a feasible technique to manage the natural environment and generate social and economic benefits for society. Ecotourism includes a variety of nature-based actions that encourage tourist admiration and accepting of natural and cultural heritage and are protected to be ecologically, economically and socially sustainable. Therefore, ecotourism is accepted as an optional kind of sustainable development. It has attracted rising concentration in recent years, not only as an optional to mass tourism, but also as a way to encourage a country's economic development and environmental management. Its aim is also to protect resources, especially biological diversity, and maintain sustainable use of resources (Kiper, 2013).

Generally, the basic purposes of ecotourism are to preserve and utilize natural and cultural resources in a sustainable way and to enable economic development of local people. However, achieving the aims in ecotourism depends on whether they are environmentally and ecologically sustainable and economically applicable.

2.1.3. Principles and Components of Ecotourism

Various companies and government promoted ecotourism without considering of its most essential principles. Establishing internationally and nationally acknowledged principles, approaches proceeded throughout the 1990s, but a modest rate, because the procedure involves stakeholders from many regions, disciplines, and backgrounds. As discussed above ecotourism and sustainable development are complementary to each other. However, it is not hard to see the considerable overlap between the core principles of ecotourism and sustainable development. The correlation between the two has become so intertwined; that they should no longer be thought of as disconnect philosophies (Bhuiyan *et al*, 2012).

Sustainability can be found in almost every single piece of literature on ecotourism whether it is economic, social, environmental, or all three united. The idea of sustainable tourism, which has existed for decades, encompasses mass tourism as well as ecotourism. In many ways, sustainable tourism exemplifies the correlation between ecotourism and sustainable development. Numerous groups have proposed sets of rule or principles of sustainable tourism and ecotourism (Blamey, 2001). Therefore, each region affected by ecotourism should develop its own principles based on the resources already available internationally to promote ecotourism in their economic development in a reasonable way.

Natural and cultural landscape principles form a basis for ecotourism. These values are the existence of water, natural beauties, microclimatic conditions, the existence of wildlife, the existence of natural vegetation, local food, festivals, traditional agricultural structure, local handicrafts, regional dress culture, historical events and people, artistic activities, heritage appeals, traditional music, architectural variety, folk dance, and so on (Gerry, 2001). Any ecotourism promoter should consider natural and cultural features in the formation of the principles of ecotourism.

According to UNEP (2002) countries should understand the following principles before they promote ecotourism. The first thing is to inform the explorer on the significance of protection and

this activity can decrease the negative impacts on nature and culture that can injure a destination, then direct revenues to the protection and administration of natural and protected areas will gain and stress the significance accountable companies which works cooperatively with local authorities and people to meet local wants and bring protection benefits. So companies primarily give emphasis to the want for local tourism zoning and for visitor management strategy intended for other regions or natural areas that are slated to become eco- destinations. Stress use of ecological and societal base line studies as well as long tern monitoring programs to evaluate and reduce impacts then it give an opportunity to capitalize economic profit for the host countries, local business and communities, particularly people living in neighboring to natural and confined areas. Finally, it seeks to ensure that tourism growth does not go beyond the public and ecological restrictions to suitably change as determined by researchers in collaboration with local inhabitants and rely on infrastructure that has been developed in harmony with the environment, reducing the use of fossil fuels, protecting local vegetation and wild life, and unifying with natural and cultural environment.

As UNEP (2002) stated that a sound planned and managed ecotourism must contain the following components or elements of ecotourism: primarily, it can contribute to protect biodiversity to sustain the life form of local people including understanding or learning skill. Then it involves answerable events on the parts of tourists and the tourism industry, which is delivered principally to small groups by small level business. It also requires lowest possible expenditure of non renewable property. Finally, it needs the effort of local contribution, ownership, and business opportunities, principally for local people.

2.1.4. Types of Ecotourism

Buchsbaum (2004) states that there are different types of ecotourism: such as "hard" versus "soft", "deep" versus "shallow", or "active" versus "passive" ecotourism. However, the most commonly used types of ecotourism, which is argued by Kiper (2013), are as follows:

- Marine Ecotourism: - including sailing, yacht and power cruising, sea kayaking tours
- Land based Ecotourism:- including bicycle Touring/Mountain Biking, horseback Trail Riding, hiking/Backpacking/Trekking, Freshwater River Rafting, Canoeing and Kayaking, winter Tourism (Back Country /Tour Skiing, Dog Sledding, Snow Shoeing)

- Walking, camping, boating, hunting, sight-seeing, swimming, cultural activities, observing wildlife and nature, skiing, visiting historical places, and horse riding is among the types of ecotourism.

2.1.5. Importance and Impacts of Ecotourism

Ecotourism is the strategy for supporting preservation and providing income for communities in and around protected areas. It can supply to the economic growth and preservation of protected areas through generating revenues that can be used to sustainably manage protected areas, supplies local service and inculcating a sense of society's own. However, without attentive scheduling and managing of balance environmental, communal, and economic objectives, it may lead to ecological damage. Furthermore, envisioned as an optimistic approach towards sustainable development, unplanned or poorly planned and implemented ecotourism can have severe harmful effects, offsetting the importance it was planned to offer (Rome, 1999). Therefore, if the environment has not at least achieved a net benefit toward its sustainability and ecological integrity, then the activity is not ecotourism rather it is a risk.

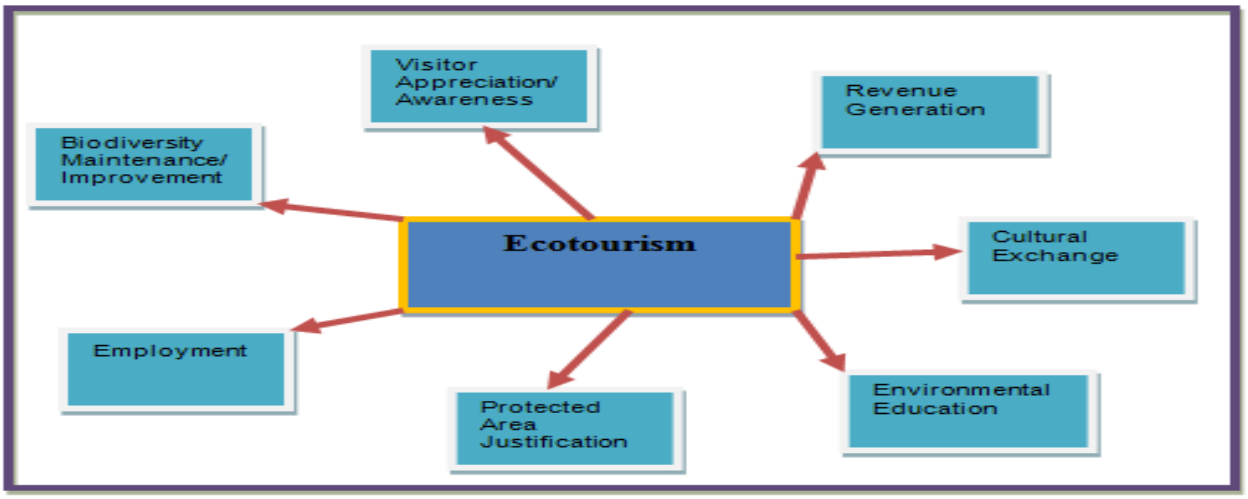

Figure 1: Importance of ecotourism (Rome, 1999**)**

According to Rome (1999) if ecotourism is inappropriately planed it results to:

- Environmental impacts such a threat of degradation, increase of contamination, and damage of natural resources,
- Developmental problems like failure to fulfill the community's view of improvement and rise the density of transportation,

- Ecologically problems such as interruption to habitats and species threats posed by dangerous animals,
- Cultural impacts like falsification and degradation of cultures and way of life is changes, and
- Economic impacts such as unequal benefit distribution between partners, decrease employment opportunities, and threat to small businesses. Therefore, potential ecotourism to be sounded as economic benefits to the local communities and conserving of the natural and cultural resources; it must planned and managed in terms of sustainability of development.

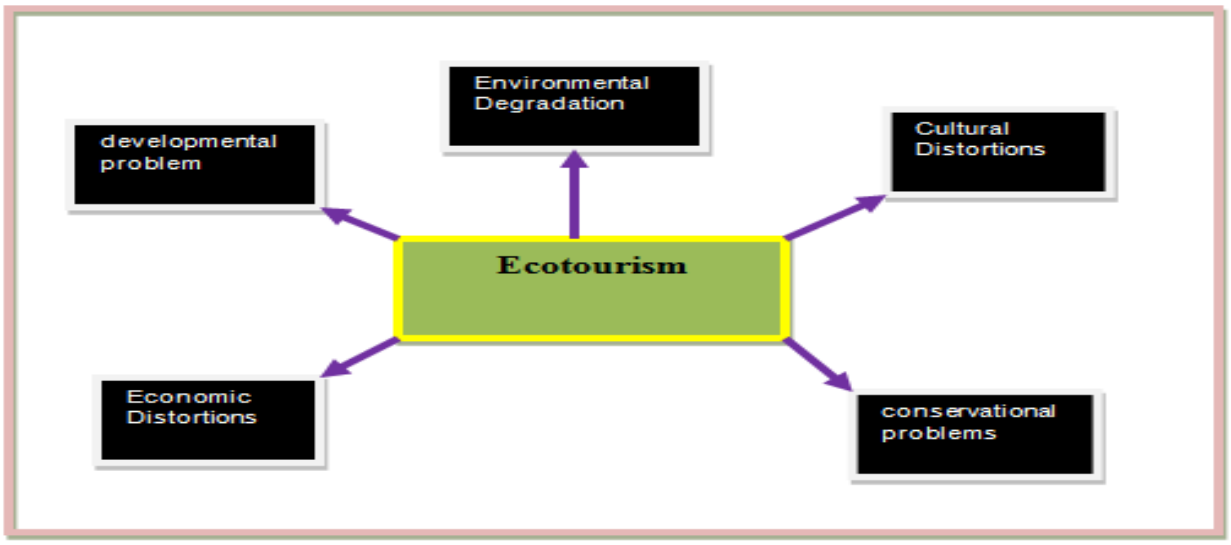

Figure 2: Impacts of ecotourism (Rome 1999)

2.1.6. Strategies to mitigate negative impacts of ecotourism

Environmental depilation and natural resource degradation linked with ecotourism actions are severe problems in tourism-rich countries. Balancing ecotourism within the limit of the carrying capacity of the environment can be accomplished through sounded administrative techniques or the use of financial tool like entry charge, a variety of taxes and limiting number of travelers (Anderson, 1996 cited in Eshetu, 2014).

In order to reduce the negative impacts of ecotourism, government intervention at different levels is needed in the following ways (Tisdell 1997):

- The carrying capacity of the area must be concerned by limiting the number of tourists and tourist operators,

- Developing technologies for tourism movements to reduce environmental effects,
- Giving fitted environmental teaching to tourist operators and tourists because education is one of the most essential elements of ecotourism because it can change the way people think about the environment,
- Imposing restrictions on buildings,
- Due concentration should be given for the participation of local communities in ecotourism projects so as they can develop a common sense of ownership with the project.

2.2. Empirical Review of Related Literature

2.2.1. Trends of Tourism and Ecotourism at the World level

Tourism is the biggest business sector of the world economy, providing 10% of global GDP and 35% of the world's export services. Since 1985, tourism has raised an average of 9% per year. At 2005, receipts from global tourism reached US$ 6.82 trillion, a raise of $49 billion over 2004. The United States is the world's biggest producer and beneficiary of tourism, which accounting about 15% of total spending. Tourism is also acting as the most important task in the economies of 125 countries in the world (Honey and Krantz, 2007).

International tourism in rising and developing markets has grown at an average rate of 6-8% over the past decade which is twice the rate of growth in industrialized countries. Between 1996 and 2006, international tourism in developing countries expanded by 6% as a whole, by 9% for Least Developed Countries, and 8% for other low and lower-middle income economies because the sector will be more and more recognized as a key agent in national poverty reduction strategies and in development financing (UNWTO, 2016). Tourism is one of the major export sectors of developing countries, and is the primary source of foreign exchange earnings in 46 of the 49 Least Developed Countries. Now a day's up to 70% for the world's poorest countries income was generated from this sectors and more than 80% of low income countries included this sector in the Poverty Reduction Strategies (UNWTO, 2014).

Beginning of 1990s, ecotourism has been raised 20% - 34% per year. In 2004, ecotourism /nature tourism was increasing internationally 3 times quicker than the tourism industry as a whole. Nature tourism is increasing at 10% - 12% per annum in the global market. Tourism has now matured as a market and its growth is projected to remain flat. In contrast, experiential tourism, which includes nature, cultural, heritage, ecotourism and soft adventure tourism, as well as sub-sectors such as

rural and community tourism is among the sectors projected to rise more rapidly over the next two decades (TIES, 2006).

More than two-thirds of U.S. and Australian travelers, and 90% of British tourists, believe the active preservation of the environment and maintain of local communities to be an element of a hotel's accountability. In Europe: 20%-30% of travelers are alert of wanting and principles of sustainable tourism. 10%-20% of travelers give the impression of green options and 5%-10% of travelers demand green holidays. In Germany, 65% of travelers suppose environmental quality; 42% "think that it is mainly significant to find ecologically aware accommodation." Surveys in Britain tourist travel to a business that had written regulations to guarantee good working environment, preserve the environment and maintain local charities in the tourist target (Honey and Krantz, 2007).

2.2.2. Potential Ecotourism in Africa

Many countries in Africa with attractive tourist attraction which can battle with what is achieved in the rest part of the globe. Tourism is gradually attracting national and international investment, and profits on investments in the sector stay among the maximum in the world. International hotel chains are growing across Africa, recognize investment potential and commit millions of dollars in new projects over the next few years to fulfill the increased requirements from both international tourists and national own fast-growing middle class (Cooper *et al,* 2008). Africa is house to some of the quickest expanding economies, and Africa's revenue from tourism is representing more than double the quantity of donor aid. Remarkable opportunities exist to further expand tourism in the African is yet challenges remain. Africa's tourism sector has not well developed because the need for solid infrastructure, limited high-quality roads and transportation corridors, limited airline connections, and fewer visas to cross African boundaries are among the main reasons that make the continent less benefited from this sector (Eruotor, 2014).

Africa attracted 33.8 million visitors, up from a low 6.7 million visitors in 1990, and its receipts from tourism for the same year amounted to over $36 billion, or 2.8 per cent of the region's GDP. With these figures it shows how Africa's tourism returns is growing and viewing optimistic enhancement in the sector. If the tourism sector is well urbanized and planed correctly, tourism has the potential to speed up Africa's economic development and job formation (Khuoje 2013). The economic potential of tourism is remarkable, with direct and indirect impact on employment. In

Africa alone, travel and tourism generated 8.2 million direct jobs in 2012.The government in different African countries aims to encourage tourism through the improvement of cross border infrastructure and national transportation corridors, which will accelerate the movement of people and goods on the continent. Africa's future hope looks brilliant given the vast development in adventure and ecotourism, joined with the continent's rich cultural heritage and natural beauty (Eruotor, 2014).

2.2.3. Potential Ecotourism in Ethiopia

Ethiopia possesses abundant tourist attractions which diverse in varied and pleasing to a extensive range of attention. The attractions include chronological, educational, cultural, archaeological, anthropological, pretty, climatic, beneficial, flora and fauna resources. Such a distinctive mixture of attractions within a single country has no equivalent on the African continent, or rarely wherever (Martin, 2008).

According to Ethiopian Tourism Commission, 1995; Berhanu, 2003 and Briggs, 2003 as cited in Eshetu's study (2014) eleven heritages of Ethiopia have been registered as world heritage sites by United Nations Economic and Social Council Organization (UNESCO), namely Simien Mountain National Park (1978), Rock-hewn Churches of Lalibela (1978), Fassil Ghebbi (1979), Lower Valley of the Omo (1980), Axum (1980), Tiya (1980), Lower valley of the Awash (1980) and the fortified Historical town of Harar Jugol in 2006; and recently, the cultural landscape of Konso and *Meskel* festival (the finding of the true cross), Gada System which is intangible world heritage (2017) and beauty and attractive Sheka forests (2012) have been included as a world heritage by UNESCO.

Ethiopia is gifted with the huge tourism resources, in the form of cultural, chronological, archaeological and natural resources which is great potential for the improvement of sustainable ecotourism (UNWTO, 2016). Some of these resources includes exciting Ethiopian mountains which are finest places for individual trekkers, mountain climbing and for expert climbers; Ethiopia's lakes have diverse features of vast interests to ecotourists like birds, wildlife, flora, multicolored cultural groups, famous churches and monasteries and geologic features; wide and pleasant Ethiopia's nationwide parks are impressive places for ecotourists to observe the actual enormous and huge wild life and enjoy with wonderful surrounding landscapes (MoCT, 2006).

The underground caverns and rock arts are also seats to admire the works of nature, rock paintings and carvings of people and animals; fight sites and places of important political actions like Boru Meda, Entoto, and Ankober are most exciting areas for history loving ecotourists; the varied cultures of the people are places of motivating attractions for culture oriented ecotourists; the Afar areas, Danakil depression areas and lower Awash as well as Omo valley areas are places of fantastic natural scene and actions for archaeologists, geologists and nature loving ecotourists (MoCT, 2006).

However, ecotourism is still in its infancy in Ethiopia, but it holds important potential for development. The country's biodiversity is absolutely distinctive compared to bordering countries, some of which are prominent safari destinations. Ethiopia's protected area, which includes national parks, game reserves, wildlife sanctuaries and controlled hunting grounds, covers about 14% of the country. The protected areas propose ecotourism and relaxation actions such as flora and fauna looking, trekking, mountain climbing and bird watching (Girma and Malede 2015).

2.2.4. Factors Affecting Ecotourism Site Selection

Passmore (1974), stated that the demand for ecotourism will rise extensively with the following factors like growing levels of education, population growth, easier, less costly, quicker and safer access to ecotourism sites, rising income levels, increased relaxation time, shifting community attitudes towards nature, superior isolation of mankind from nature due to increasing in urbanization and supremacy of man by economic and technological systems and more comfortable lodging at ecotourism sites, superior security of tourists at such sites, mobile communication systems.

2.2.5. Application of GIS and Remote Sensing in Ecotourism planning

Ecotourism planning requires exploring different types of natural and cultural attractions along with demographic characteristics of local people in order to differentiate it from the mass tourism standard. In ecotourism planning, the environment and its conservation are the two issues that must considered before the development of ecotourism in one area. An ecotourism destination must in no way be developed without planning in terms of environmental concern (Banerjee *et al*, 2002).

Geographic Information System (GIS) and Remote Sensing (RS) as an integrated tool are one of the most remarkable technological advances in the planning of ecotourism. Both ecotourism and these technologies share in common characteristics like crossing the application areas and the

boundaries of disciplines. The ecotourism field uses GIS and RS as a decision supporting tool in many ecotourism issues such as visitor flow management, ecotourism site selection, impact evaluation and sustainable tourism plans. The strength of ecotourism planning can be improved by GIS and RS applications. They can be regarded as providing a toolbox of techniques and technologies of broad applicability to the achievement of sustainable ecotourism development (Rahman, 2010).

Ecotourism development is a very sensitive issue in a particular destination in terms of complex ecosystem and local inhabitants. GIS application in ecotourism development includes ecotourism-based land management, recreational facility inventory, visitor impact assessment, recreation-wildlife conflicts, mapping wilderness perceptions, tourism information management system, identification of suitable site and decision support systems (Rahman, 2010). To select suitable areas for ecotourism the evaluation of land ecological suitability for ecotourism is a very important issue. In other words, identifying suitable sites for ecotourism is the first vital step to ensure the roles and functions of the ecotourism sector in the development process (Bo *et al,* 2012). Recently, this land suitability process for ecotourism is based on spatial analysis and modeling because of the development of powerful tools that is a geographic information system. GIS plays a vital role in the selection of a potential ecotourism site by using spatial analysis tools in GIS environment (Chang *et al,* 2008).

In remote sensing collecting images of earth surface features is a key aspect using aircraft or satellites. Multi-spectral scanning instruments and radar techniques, providing us with a unique capability to 'see' through cloud cover. It provides us features distribution on the surface of the earth and changes in those features over time. The remotely sensed data is applicable in GIS for its land use land cover classification. An important stage of processing remotely sensed data for mapping is classification. Finally, GIS-generated LULC maps that are designed to focus on specific themes of potential ecotourism site selection (Pareta, 2010).

Multi-criteria decision-making methods are a subdivision of a common class of operations study models that is appropriate for addressing complex problems featuring high uncertainty, contradictory objectives, various types of data and information, multi interests and perspectives and evolving biophysical and socio-economic systems (wang *et al,* 2010). It's mainly designed to analyze decision problems, generate useful alternative solutions, and to evaluate the alternatives based on a decision maker's values and preferences. It is also a valuable tool in many disciplines

such as manufacturing, economics, military, material selection, constructional, etc. As such useful techniques it helps to solve various ecotourism site selection problems (Boroushaki and Malczewski, 2008). The decision making process usually includes five main stages: defining the problem, generating alternatives and establishing criteria, selecting criteria, weighting criteria, evaluation, selecting the appropriate multi-criteria method and finally ranking the alternatives (Opricovic and Tzeng 2004).

An Ecotourism suitability site selection involves different factors such as natural and cultural resources, existing land policies and availability of community infrastructure. The suitability technique analyzes the interaction between location, development action and environmental elements to classify the unit of observation, according their suitability for ecotourism development (Malcztewki, 2004). Many MCDM techniques have been used in GIS base analysis, but the AHP is the commonly used MCDM techniques that incorporate with GIS in land suitability analysis of potential ecotourism site selection. AHP is a method that allows the consideration of both objective and subjective factors in ranking alternatives. It has been applied in a wide variety of practical applications in various fields since its introduction in the mid 1970s by Thomas Saaty. The principle of comparative judgment requires assessment of pairwise comparisons of the elements within a given level of the hierarchical structure, with respect to their parent in the next-higher level (Malczewski, 1999).

2.2.5.1 Related works on a potential ecotourism site selection

In previous studies, the integration of GIS, RS and AHP were the powerful tools for the selection of ecotourism site. These studies have been made to identify potential ecotourism areas by embedding the above three tools (Daniel, 2009; Tewodros, 2010; Samanta and Batialik, 2015; Suryabhagavan *et al* 2015 etc.).

Daniel (2009) was carried out his work on the application of GIS and RS for potential ecotourism site selection in Addis Ababa and its surroundings area. He used seven factors, namely LULC, soil, slope, elevation, vegetation density, temperature and rainfall for suitable site selection of ecotourism. His main limitation was only *kebeles* near by the city included in the study. In other word the *kebeles* he was selected is not based on the availability of a potential ecotourism area rather based on their proximity to Addis Ababa.

Tewodros (2010) was conducted, his study on the geospatial approach for ecotourism development, a case of the Bale mountain national park. To select potential lodge site for ecotourism development, he employed seven factors: LULC, river, settlement, elevation, slope, geology and wild campsite. The exclusion of accessibility by road as factor for optimum lodge site selection was the gap in his study.

Samanta and Batialik (2015) were applied GIS and RS technologies in potential ecotourism site selection for Blocks in Bangladesh districts using LULC, soil, elevation, slope, vegetation, road network, drainage, temperature and rainfall as determinate factors to locate an appropriate place for the development of ecotourism.

Suryabhagavan *et al* (2015), were conducted their research on multi criteria evaluation in identification of potential ecotourism sites in Hawassa town and its surroundings. To undertake their studies, the information is acquired from different experts. Based on the data they collect, multi criteria evaluation was done on five criteria: a) landscape, b) flora and fauna, c) topography, d) accessibility and e) climate characteristics. In additional, the evaluation process for ecotourism site was conducted based on eleven factors: proximity to cultural sites, visibility, LULC, conservation, elevation, and slope, proximity to natural resource, distance from the road, distance from the lake, temperature and rainfall. Generally, most of the research conducted on ecotourism related issues, lack GIS based analysis, but those studies applied GIS restricted themselves to study in and around the urban area rather than conducting the investigation in rural areas where abundant ecotourism potentials are available.

2.2.6 Parameters for Ecotourism site selection

In today's society, ecotourism site selection problems are characterized by their complexity of the selection process and the existence of numerous factors. The process of site selection begins with identification of sophisticated determinant criteria that affect the selection process. These parameters include physical, social and economic factors that are used to site selection. Sites that fulfill the screening criteria are subjected to a more detailed assessment and are compared as possible alternative sites for ecotourism (Angela and James, 2005). Due to the complexity of site section and existence of different criteria different regions use different criteria for selection. Thus, different researchers applied different parameters for potential ecotourism site selection. Some of the commonly used criteria for optimal ecotourism site selection are as follows:-

2.2.6.1 Land Use and Land Cover type

LULC are often used interchangeably, but their meanings are quite different. Land use refers to the purpose for which the land serves like built up, wildlife habitat, recreation, agriculture and others. However, land cover refers to the surface cover on the ground, whether forest, vegetation, water, soil, etc. (Canada Center for Remote Sensing). The information from LULC is used to identify priority areas for ecotourism and whether future land uses can be modified for future development within the province. Existing of forest cover in one area is an important tourist attraction. They are rich in both flora and fauna that attracts many tourists (Yechale and Leul, 2015). Tourists are fascinated to see and learn information about new and unique features of those biodiversity. Therefore, the sites which are closed to forest area are highly suitable for potential ecotourism site selection (Zarkesh *et al*, 2011).

2.2.6.2 Elevation

Elevation is the height of a place above or below mean sea level. Like latitude, it has an effect on climatic conditions that exert a major influence upon the distribution and abundance of biodiversity (Samanta and Baitalik, 2015). It is one of the criteria that should be considered during selection of suitable sites for ecotourism. This is because the distribution of plants and animal species is mainly affected by the elevation of the area which is the base for ecotourism development. It is also vital to consider the positions and stages of a place to evaluate whether natures and elements of landscape are suitable or not for ecotourism attraction. In this sense, digital elevation models are commonly used to represent the surface of a place through grid data sets of elevations in GIS. The lowest elevation is not having a suitable environment for a lot of human beings due to its high temperature. Therefore, the highest elevation is suitable for ecotourism because of its favorable environmental condition (Yechale and Leul, 2015).

2.2.6.3 Land slope

Slope represents the gradient of an area expressed either in percent or in degree. It is computed as the vertical increase divided by horizontal increase. A Slope can also be classified as gentle and steep slopes. Those experiencing little variations are gentle slopes and those experiencing extreme variations are steep slopes (Samanta and Baitalik, 2015). This steep slope was resulted due to the cliff and hanging wall landscape that creates a nice scenic beauty which is highly suitable for ecotourism development. On the other hand, gentle slopes are given a little weight for potential

ecotourism site selection due to the absence of cliff and hanging wall landscape (Yechale and Leul, 2015). The convexity and concavity of terrain characteristics can create undulation in slope form that helps to observe across the wider geographical area.

2.2.6.4 Road networks

Ecotourism requires a good connectivity over land and its surrounding area. This is because any tourists are travelling from their origin to the destination in pursuing of tourism related activities. The only means one can access from one tourist potential area to another is with the road networks. They also connect major tourist transit to the interior parts of the region that provides facility for easy and faster movement. The tourist resort needs to be accessible to people. If it is not fairly accessible, there will be low benefaction for ecotourism development (Ouiambao, 2001). Therefore, the road is also considered as one factor for suitable ecotourism site selection as they are the most convenient means of transport (Pareta, 2013).

2.2.6.5 River

Water bodies are the base for ecotourism development as they provide a recreational space, appreciation and enjoyment of tourism related activities. Rivers are potential recreational site and can be developed into active sports and water-based recreational sites such as water rafting, fishing, swimming and bird watching sites, etc. Many researchers considered it as a parameter for optimal site selection of ecotourism (Pareta, 2013). Therefore, it is recommended that the ecotourists site should be at a walking/trekking distance of the river that is 2km (Macdonald, 2000; Surendran *et al*, 2003).

CHAPTER THREE

METHODS AND MATERIALS

3.1. Description of the study area

3.1.1. Location

Masha district is located in Sheka administrative zone in Southern Nation Nationalities and Peoples' Regional State (SNNPRS) in the southwestern part of the Ethiopia. It is located at a distance of about 676 km southwest of Addis Ababa, the national capital. Astronomically, it extends between 07º32'0" - 07º56'0" North latitudes and 35º6'0" - 35 º 48'0" East longitudes. The district borders with Dedu lalo district in north, Andracha district in the South, Gesha district from East and Sele-Nonoo district from west. The total area of the district is about 81656.56 hectares (MDARDO, 2016).

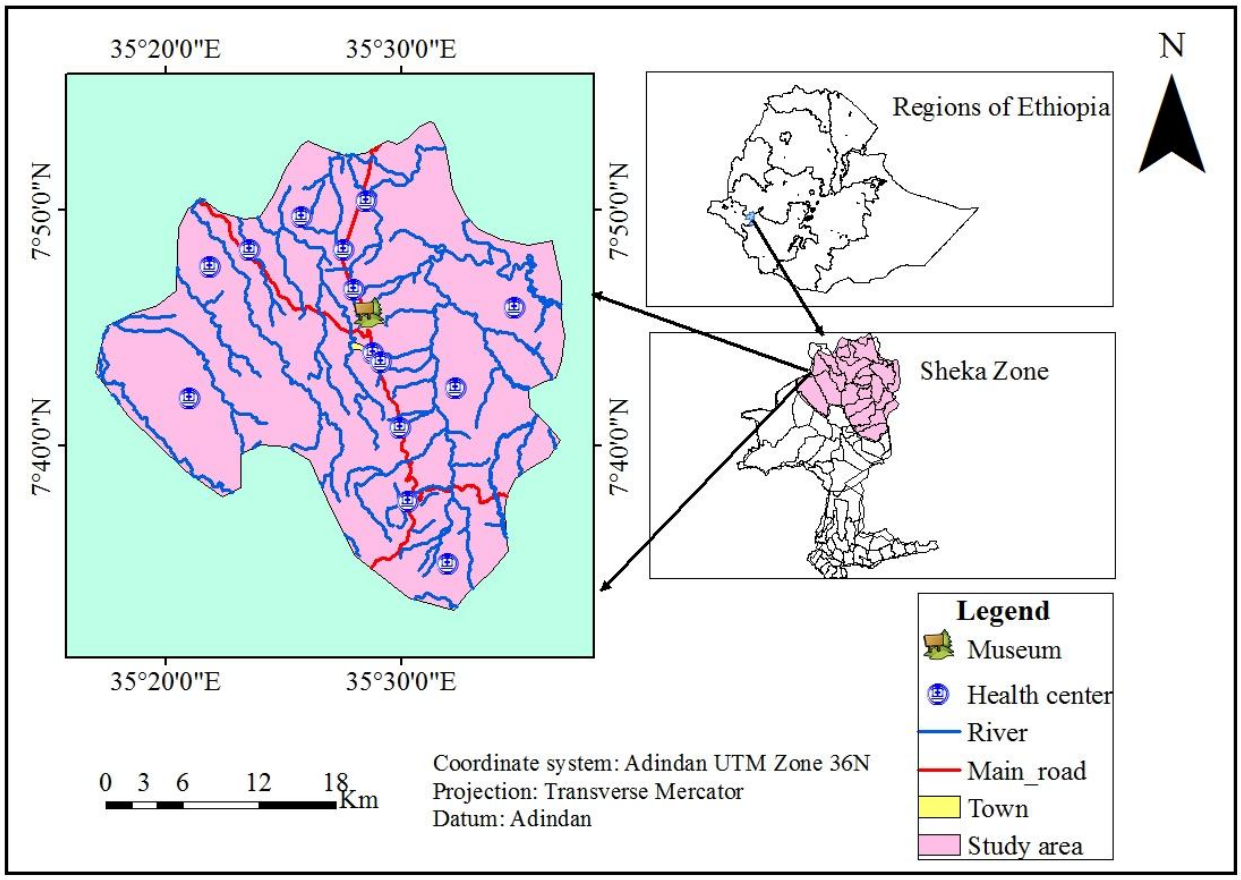

Figure 3: Location map of the study area

3.1.2. Topography

The area is characterized by a rolling topography which imposes their respective influence on agricultural practice and settlement patterns. The southern and some southwestern part of the district is characterized by steep slopes while the western and northeastern part of the area has a gentle slope. The district lies within a range between 1410 -2655 meter above sea level.

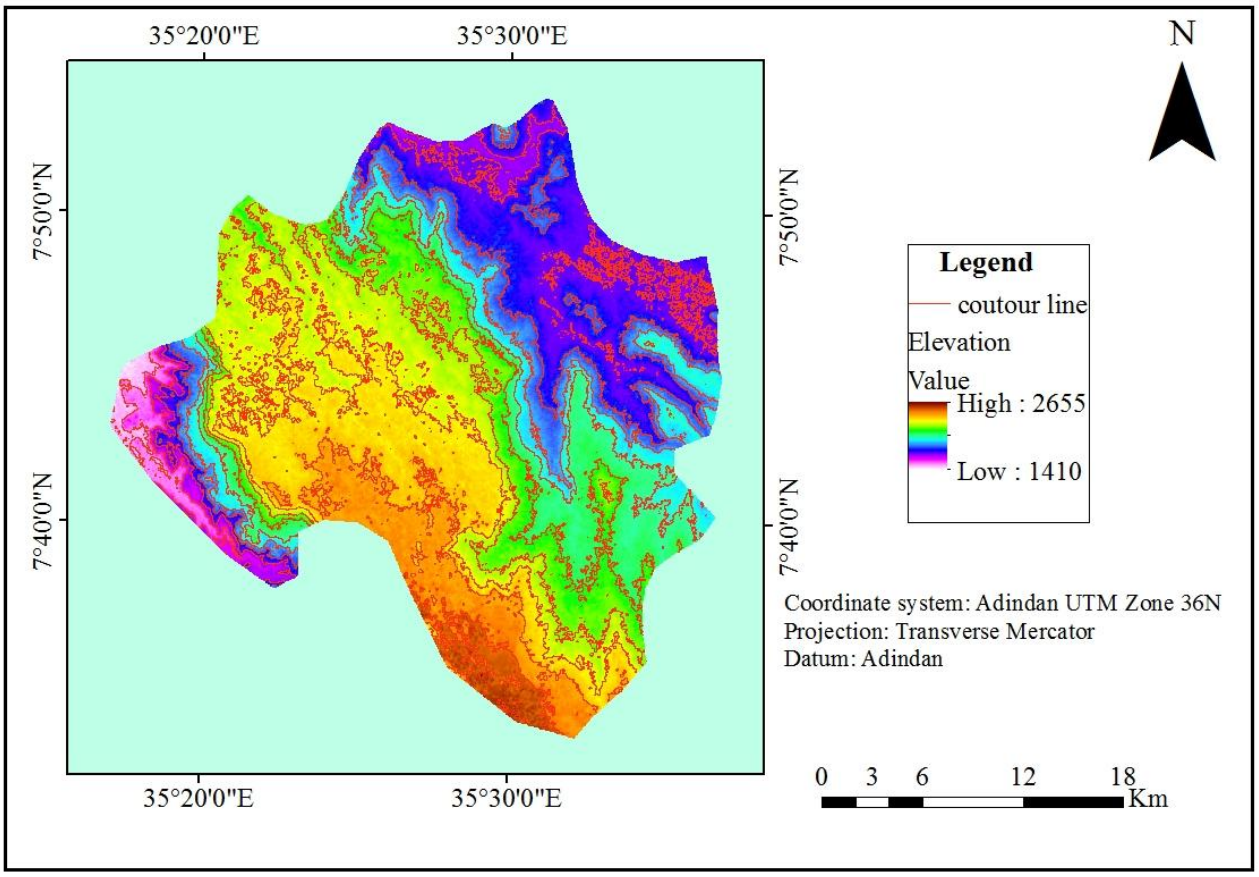

Figure 4: Elevation map of the study area (extracted from SRTM DEM (30*30m), 2017)

3.1.3. Climate

Agro climatically, the area is largely woina Dega (midland) type comprising about 75% of the total area, 22% and 3% are in dega (highland) and kola (lowland) types. In the district there is no weather station that makes difficult to get reliable climate data. However, based on the data from the nearby stations like Gore, Teppi and Mizan Teferi, the mean annual rainfall is estimated to be well over 2200mm. The mean maximum temperature is estimated to be between 25°C and 34°C, and the mean minimum is between 10°C and 15°C. Uni- modal rainfall distribution is common in the district due to it's topography. The highest rainfall is between June and September with

minimum and maximum rainfall of about 70mm and 220mm respectively throughout the year (Tadesse *et al,* 2011).

3.1.4. Geology and Soils

Like other parts of the southwestern Ethiopia, the area is dominated by Cenozoic and Proterozoic volcanic sediments. The soil is characterized by red and brownish ferrisols which derived from volcanic parent material. Other soil forming factors are covered due to the occurrence of high rainfall in the district. Nitosols, Acrisols, Vertisols and Cambisols are also other soil types in the area (Tafesse, 1996).

3.1.5. Drainage

In Shekachos (Sheka people) culture there is a strong relationship between the wetlands, rivers and forests in their environment. Such beliefs are emanated from their spiritual values and understanding of their ecological functions for the existence of human beings and other living things. The people in the district understand that wetlands are the sources of rivers, streams, lakes and other water bodies that keeps them from drying. They also understand that over exploitation of these wetlands and forest leads to degradation and drying up of streams and springs. Because of such nice beliefs and brilliant understanding of Shekacho people, the district has a number of seasonal and perennial rivers that constitutes the drainage network. The relief of the district is highly dissected by several small streams like Meneshi, Wonani,Tatamayi and Gahamayi, which drain into the Baro river. Therefore, due to such cultural beliefs and the existence of attractive water bodies really the area has a potential for ecotourism development (MDARDO, 2016).

3.1.6. Biodiversity

The district contains high habitat diversity. As we know forests represents some of the most species rich ecosystems on the earth. The dominant forest type in the area is Afromontane rainforest. It constitutes of broadleaf forests, wetlands, bamboo forest, moorland, riverine forest. It is in this forest type that wild *Coffea arabica* shrubs are occurring in the shrub layer (Woldemariam and Fetene, 2007). The forests are rich in fauna species of highland and forest bird species like Abyssinian cat, birds, Abyssinian woodpecker, Wattled Ibis and Thick billed Raven. The most common mammals are bushbuck, lion, porcupine, several cats, buffalo, bush pig, wild boar, black duicker, leopard, waterbuck, colobus monkey and Anubis baboon. Some other

amphibians, reptile, butterfly and orchid species are also common in the area. Such huge amounts of diversified biodiversities make the district as a potential for ecotourism development (Tadesse *et al,* 2011). Generally, Masha district is blessed with unique biodiversity that can be developed in ecotourism. As discussed above, the area is rich in plant and animal species as well as other attractive natural and cultural resources. Among the natural attraction, there are about 29 amazing and attractive waterfall, 23 mineral waters, caves and others are exist in the districts (MDCTCO, 2016). These natural environments provide a range of recreational opportunities that is harnessed for ecotourism development because tourists usually visit particular locations because of some attraction or series of attractions.

3.1.7. Population, religion and ethnic composition

The district has a total population of 40,810: out of which 20,116 are men and the rest 20,694 women. 16.63% of its population are urban dwellers whereas the remaining 83.37% of them are rural dwellers. The majority (56.5%) of the inhabitants were Protestants, 32.82% practiced Ethiopian Orthodox Christianity, 7.15% practiced traditional beliefs, and 1.56% were Muslim (CSA, 2007). The ethnic composition of the district constitutes Shekacho, Oromo, Kafacho and Amhara. Although many ethnic groups live in Masha, the dominant native ethnic groups in the district are the Shekacho people (MDCTCO, 2011).

3.1.8. Economic activity

The economic activity in the area is mixed farming, i.e., crops production and livestock husbandry. Both annual and perennial crops are grown. Enset (*Ensete ventricosum*), a perennial crop, is the source of staple food in most parts, characterizing the agricultural landscape in the area. Shifting agriculture and land fallowing is experienced to preserve soil productiveness. Crops growing regularly in shifting cultivation are cereals followed by pulse and vegetables. Intercropping is not frequent, but sometimes practiced in *ensete* (*Ensete ventricosum*) plots where maize, bean, anchote and sweet potato are intercropped. Maximum harvest per year is two times, often harvest of maize followed by teff. Other than the traditional agricultural practices, there are large scale plantations of coffee and tea in the area. Livestock husbandry is also an important sector. Cattle, goat, sheep, horses and chicken are among the most commonly kept animals in the district (Tadesse and Fite, 2011).

3.2. Research Methods

3.2.1. Research Design

The present study used a mixed research approach which involves integration of qualitative and quantitative research methods. The quantitative or technical and qualitative phases occur one after the other, with the technical phase being given higher priority and mixing occurring at the data interpretation stage (Powell *et.al*, 2008). From the mixed method, an exploratory sequential method was employed to explore the views of participants regarding ecotourism. The qualitative phase was used to build an instrument that best fits the sample for ecotourism site selection and to identify appropriate instruments to use in the follow-up quantitative phase (Johnson and Onwuegbuzie, 2004). The technical phase of the study was related to the identification of the available potential ecotourism site using different parameters. The local experts from governmental and nongovernmental offices together with reviewing of literature were used in the ranking of the factors that employed in this study.

3.2.2. Data Types and Sources

The current study obtained the data from both primary and secondary sources. Primary data were collected using Garmin GPS, digital camera, observation, and questionnaires. Secondary data were also gathered from different published and unpublished sources such as; books, journals, internet sources, research reports and articles documents etc.

3.2.2.1 Spatial data

The spatial data that were used in the current study includes satellite image of Landsat8 OLI-TIRS (30*30m) 2017 to generate land use land cover map, STRM DEM (30*30m) data to extract slope, elevation and river map. Other data, such as road map, town map and Museum map were also used for proximity analysis of ecotourism site. GPS data were also employed to validate the result.

3.2.2.1 Socioeconomic data

The socio economic data which were employed in the study includes population data and economic activity data which are used to describe the background of the study area that helps any reader to have detailed information about the target where the research was conducted. Data from the questionnaires like the type and status of existing potential ecotourism was also employed in this research.

3.2.3. Software

In the current study collection of available data, field work and data analysis use different software and techniques. The following table shows that the types of software and their function in the analysis of this study.

Table 1: Types and functions of software (own processing, 2017)

No	Software	Function
1	Map source	Link GPS data to ArcGIS software
2	ERDAS 2010	Image preprocessing and classification
3	IDRISI selva version 17	Pairwise comparison and multi criteria evaluation
4	ArcGIS 10.3	Spatial analysis and suitability evaluation

3.2.4. Sample size and Sampling techniques

The current study employs non probability sampling techniques to select key informants and kebeles to obtain data for the study. For the non probability sampling technique the researcher used purposive sampling method. By conducting this method of sampling 7 experts were selected from governmental and nongovernmental offices. Three from Masha district cultural, tourism and communication office, 3 from Masha district agricultural and rural development office and one expert from MELCA were participated in interviews. These selected experts were well experienced and have a knowledge regarding ecotourism. The KII was prepared to analyze and evaluate both physical and socioeconomic factors that affect potential ecotourism site selection prior to made suitability evaluation and classification. Before using the classified LULC of the district the researcher purposely selected four *kebeles* out of 19 based on availability of attraction sites to validate how the result reflects the reality on the ground. The questionnaires were prepared in English and translated into Amharic for simplicity and precision purposes.

Table 2: Type and sources of data (own processing, 2017)

No.	Data types	Sources	Remark
1	Landsat8OLI-TIRS (30*30m) 2017	USGS	Path 170 & row 055
2	SRTM DEM (30*30m) resolution	GLCF	Path 170 & row 055
3	Elevation	Extracted from DEM	
4	Slope	Extracted from DEM	
5	River	Extracted from DEM	
6	Road map	Regional road & transport bureau	
7	Town map	ZoFEDD	
8	Museum map	X, Y coordinates of Museum area	

3.3. Methods of data analysis

3.3.1 Criteria for potential ecotourism site selection

Selecting best criteria to locate ecotourism in most suitable area is important to minimize the negative effects of development on the environment and to give much emphasize on the positive impacts of such development. Selecting factor for analysis is not an easy task rather it is tedious and need much concentration because it considered both physical and socioeconomic factors. In order to meet the goal of this study different literature were reviewed by the researcher and then best factors were selected as criteria. These selected criteria were also approved by the interviewed experts. Therefore, the following parameters are selected to achieve the objective of the present study.

3.3.1.1 Land use land cover

Pre-processing of satellite imagery

To generate land use land cover map of the district, landsat8 OLI_TIRS image of 2017 was downloaded freely from USGS. This acquired satellite image was not complete enough for direct use so it is necessary to make it ready for further uses. Landsat8 has both panchromatic band with resolution of 15m*15m and multispectral bands with resolution of 30m*30m. The panchromatic image has high spatial resolution with poor spectral resolution, while the multi spectral image has a low spatial resolution with high spectral resolution. MS image used to differentiate land cover types where as to determine boundaries of objects and shapes high spatial resolution was

employed. Therefore, the researcher fused both panchromatic and multi spectral bands to enhance the visual interpretation of features and to improve the accuracy of image classification using ERDAS imagine 2010 software. After the fusion of the image, area of interest was masked on shape files of the study area boundary. Then, this masked image was ready for classification.

Image classification

In the analysis of land use land cover for potential ecotourism site selection, the current study has employed the supervised image classification technique. A supervised image classification with the maximum likelihood statistical approach is selected because it is the most sophisticated and achieves good separation of classes. It also requires a strong training set to accurately describe mean and covariance structure of classes. The LULC map of the study area was generated by using ERDAS 2010 software. Before using the generated map for analysis accuracy assessment was done by using the collected ground truth point from selected four kebeles in the district. At the end LULC map was imported into ArcGIS 10.3 software and grouped according to its appropriate class for suitability analysis as highly suitable, moderately suitable, marginally suitable and not suitable. To evaluate land use land cover suitability for ecotourism site selection different researcher used different suitability standard. However, for the current study the following standards (Table 3) were employed by the researcher depending up on pervious researchers.

Table 3: LULC suitability standard for ecotourism site selection (own processing, 2017)

Criteria	Suitability standard	Sources
Land use land cover	Forest -highly suitable Agricultural fields- avoid Other LULC-not potential	Samanta and Baitalik, (2015)
	Irrigated farming, urban area and flood zone as unfavorable Forest area as very important Other LULC as intermediate	Bali *et al*, (2015) and Pareta, (2013)
	Forest and water bodies as highly suitable, Wet land as moderate and Built up area, farm land as marginal and others as not suitable.	Yechale and Leul, (2015)

Accuracy assessment of LULC map

Land use land cover maps generated from remote sensing image contain some sort of errors. In order to use such maps for ecotourism site selection it is vital to quantity errors in terms of classification accuracy. For this purpose sufficient number of ground control points were selected from each land class of the study area. The commonly used assessing accuracy of classified image is the preparation of confusion matrixes. Congalton (1991) defined confusion matrix as a square array of numbers structured in rows and columns which express the number of section units assigned to a particular class relative to the actual class as indicated by reference data. These tables produce overall classification accuracy, the percentage and the kappa coefficient.

The overall accuracy indicates a number of ground truth pixels which are classified correctly, whereas the kappa coefficient value is a measure of the agreement between classification and reference data with the agreement due to chance removed. Its value ranges between -1 to 1, into three groups of ranges. The value greater than 0.80 represented as a strong agreement between the classification and reference data, but the value between 0.40 and 0.80 and less than 0.40 represented as moderate and poor agreement respectively (Landis and Koch, 1977). In the current study, ground control points were collected from sample *kebeles* to validate the results.

3.3.1.2. Elevation

Elevation is one of the determining factors for potential ecotourism site selection. It is considered as criteria because it has an effect on distribution of flora and fauna. It is also one of the major environmental variables that determine the convenience of a certain area for various uses, including human settlement (World Bank, 2011). According Yechale and Leul, (2015) the area which has lowest elevation is not suitable for ecotourism because the existence of biodiversity is low due to high temperature. For this study, the elevation of the study area is extracted from the DEM by using extraction tools in GIS environment which was downloaded from GLCF. Its suitability evaluation for ecotourism is based on Yechale and Leul's (2015) suitability class. Accordingly, the area with high elevation is much suitable for ecotourism site selection and vise versa. During the reclassification time their agreement together with the opinions of the experts is needed for suitability analysis process. Finally the researcher was reclassified the elevation map of the district as highly suitable (S1), moderately suitable (S2), marginally suitable (S3) and not

suitable (S4) for potential ecotourism site selection based on expert opinions and pervious works that were done on ecotourism by using a spatial analyst tool in ArcGIS environment.

3.3.1.3 Land slope

Types of land slop have an influence on areas potentiality for ecotourism development. Due to this fact land slope is considered as a criteria for site selection. Different slope types have different suitability classes for ecotourism site selection. Thus, gentle slope is not much suitable for ecotourism due to the absence of cliff and hanging wall landscape which creates nice scenic beauty that attracts many tourists. In other word steep slopes are highly suitable for ecotourism attraction site screening (Yechale and Leul, 2015). Land slope of the study area is generated from the DEM using ArcGIS10.3 software. For evaluation purpose the slope map of the study area is reclassified in to highly suitable, moderately suitable, marginal suitable and not suitable by using a spatial analyst tool. Here the researcher employed the following slope suitability standard for the present study.

Table 4: Land slope suitability standard for ecotourism site selection (own processing, 2017)

Criteria	Suitability standard	Source
Slope	0 - 2.86 º not suitable 2.86 - 7.15 º marginally suitable 7.15 - 13.58º moderately suitable 13.58 - 45.74 º highly suitable	Yechale and Leul, (2015)

3.3.1.4 Proximity to River

It was essential to analyze the relationship between ecotourism and river proximity because water bodies can provide recreation and other enjoyment for ecotourism activities. Rivers are rich with both flora and fauna that can attract tourists. Because of these rivers are taken as criteria for ecotourism suitability evaluation. River map of the study area is derived from DEM and buffered according to their distance from the ecotourism site by using proximity tool in ArcGIS environment. Then by using spatial analyst tool four river proximity suitability classes were selected. In the current study, to determine the distance between river and ecotourism sites, Samantan and Baitalik, (2015) standard was used for proximity analysis. Accordingly, the areas in the near distance to water bodies are more suitable for ecotourism than far apart areas. In general

truth, sites within 2km from rivers are very important for summing pull and bottling (Macdonald, 2000; Surendran *et al*, 2003). Some of the standards for rivers suitability evaluation for ecotourism site selection are indicated in the following (Table 5).

Table 5: River suitability standard for ecotourism site selection (own processing, 2017)

Criteria	Suitability standard		Source
River	>76m and & >1000m unfavorable 50-500m favorable 500-1000m intermediate		Bali *et al*, (2015)
	500m 1km 2km 3-5km	highly important very important important low potential	Samanta,and Baitalik, (2015)

3.3.1.5. Proximity to road networks

Any ecotourism destination area must be accessible by road because without accessibility it is very difficult to reach that area. The Road is considered as the only means one can access from one tourist potential area to another in the district. The tourist area accessible to the road is higher potential for ecotourism than inaccessible one. Therefore, any ecotourism planer must take road as a parameter for the potential ecotourism site selection. To analyze its suitability for ecotourism site selection, the road map of the study area was converted into raster feature and reclassified into four classes according to their proximity distance from attraction sites by using a spatial analyst tool. Based on the standards of Samanta and Baitalik (2015), the road networks of the district were analyzed for the current study.

Table 6: Road suitability standard for ecotourism site selection (own processing, 2017)

Criteria	Suitability standard		Sources	Remark
Road	1km	highly important	Yechale and Leul, (2015)	10km not suitable
	2km	moderate		
	5km	marginal		
	1km	highly important	Samanta and Baitalik, (2015)	
	2km	moderate		
	3km	low potential		
	3-4km	very low potential		

3.3.1.6. Proximity to Urban area

Proximity from an urban area is also a key factor for potential ecotourism site selection. During site selection it is recommended that the tourist site is not within 3km from urban area to avoid urban noise and contestation and create a serene environment (Banerjee *et al*, 2002 and Surendran *et al*, 2003). For further analysis of suitability, urban map of the study area is buffered according to their distance from the tourist attraction site. Then for reclassification purpose the buffered map was converted in raster by employing conversion tools in the ArcGIS environment. Finally, it was reclassified as highly suitable, moderately suitable, marginally suitable and not suitable by using a spatial analyst tool.

3.3.1.7. Proximity to Museum

As we know the museum is any building in which objects of historical, scientific, or cultural interests are stored and exhibited. Because of this fact the ecotourism site closes to the museum is very important where any tourist can relax with cultural and other historical objects with minimum cost in a short period of time. The closeness to museums and historical site enhances the patronage of the tourist resort. 1km of walking distance from museums or other recreational site is recommended as minimum distance to attract tourists (Mejia *et al*, 2000). The proximity buffering of museum site is done using proximity tool to analysis how the areas were accessible to museum and converted to raster by using conversion tools in ArcGIS software to make it ready for reclassification of the area according to their suitability for potential ecotourism site selection.

3.3.2 Proximity analysis

Proximity analysis is one of the data analysis system in GIS environment. It can be done through buffering, i.e. identifying a zone of interest around parameters for potential ecotourism site selection. Multiple ring buffers are a common spatial analysis process performed on GIS that answers which area is nearest to a region of interest. In the current study a distance of factors like road, river, the urban area and museum is determined by multiple ring buffers from potential ecotourism site. The buffering distance is done based on standards mentioned above for each factor. The buffered maps of each factor were converted to raster format for reclassification purpose.

3.3.2 Weighted overlay analysis

A weight overlay analysis tool solves multi criteria problems like potential ecotourism site selection. Therefore, the present study performs an overlay operation in a GIS environment to produce suitable ecotourism site. Before the researcher proceeds to overlay analysis each raster layer is assigned a weight and values in the raster are reclassified to a common suitability scale. This assigning weight to each raster in the overlay process controls the influence of different criteria in the suitability model. Finally, all reclassified maps of LULC, elevation, slope, river, road, urban area and museum were computed by the weighted overlay tool in a GIS environment and produced a suitable potential ecotourism site as highly suitable (S1), moderately suitable (S2), marginally suitable (S3) and not suitable (S4).

3.3.3. Multi Criteria Decision-Making (MCDM)

Multi Criteria Decision-Making (MCDM) is the study of identifying and choosing alternatives to find the best solution based on different factors and considering the decision-makers' expectations. Every decision is made within a decision environment, which is defined as the collection of information, alternatives, values and preferences available at the time when the decision must be made (Hwang and Yoon, 1981).

MCDM combined with Spatial Multi Criteria Evaluation (SMCE) which are many popular techniques now a day due to extend of GIS technologies. GIS based MCDM techniques are mostly found for potential ecotourism site selection by using Analytical Hierarchy Process. It is one of the most popular MCDM techniques developed by Saaty. The Analytic Hierarchy Process (AHP) in

MCDM exercises was found to be a useful method to determine the weights for each individual factor. It deals with inconsistent judgments and provides a measure of the inconsistency of the judgment of the factors. It is also used to identify the best one from a set of alternatives with respect to several criteria. The principle utilized in AHP is to solving problem by forming hierarchies (Ullah, 2013). Spatial MCDM is more complicated and hard in contrast to conventional MCDM, as large numbers of factors need to be identified and considered, with high association of relationships among the factors. The spatial decision problem is the difference between the desired state in a geographical system and an existing state in real world.

The basic step of AHP is to prepare comparison matrices. The score for comparison matrices are calculated from relative importance between each pair of criteria, that is pairwise comparison. To calculate scores for pairwise comparison, Saaty suggested a 9 degree scale where available values are member of the set: {9, 8, 7, 6, 5, 4, 3, 2, 1, ½, 1/3, ¼, 1/5, 1/6, 1/7, 1/8, 1/9}, 9 represent the absolute importance and 1/9 the absolute triviality. The final basic step in the AHP is an evaluation of the comparison matrices under measurement theory. IDRISI weight module was utilized to prepare pair-wise comparison matrix that helps to develop a set of factor weights that will sum to 1. A standardize eigenvector is extracted from each comparison matrix. It helps to assign weights to criteria. Consistency ratio (CR) was calculated in order to determine whether the judgment was consistent or not during the comparison of criterion. According to Saaty (1908), if consistency ratio is less than 0.10 it is within acceptable limit. Assembling the weights allows us to make priority, ranking of our alternatives and decisions (Ullah, 2013).

Therefore, to identify potential ecotourism site in Masha district, a multi criteria decision making approach were employed in the current study. The criteria that were used for the decision making are both physical and socioeconomic factors. The following (Table 7) was clearly depicted Saaty's degree of scale which was developed in 1980.

Table 7: Saaty pairwise comparison scale

Extent of weight	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective.
3	Moderate importance of one over another	Experience and judgment slightly favor one activity over another
5	Strong importance	Experience and judgment strongly favor one activity over another
7	Very strong importance	An activity is strongly favored and its importance demonstrated in practice
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation
2,4,6,8	Intermediate values between the adjacent judgments	When compromise is needed

Source: Saaty, (1980)

By considering above Saaty's argument in mind, all parameters were converted in to raster. Then all raster data were changed into similar resolution of 30*30 by using the resample extension tool in ArcGIS environment. All raster data were also reclassified according to their suitability class for further suitability analysis. After reclassification process weights were assigned to each factor based on saaty comparison matrix because each parameter has different degree of influence for potential ecotourism site selection. The task of assigning weights (deciding the importance of each factor) is performed outside GIS on IDRISI decision wizard software. Finally, based on their assigned weight all factor maps were computed in the ArcGIS environment to generate the final suitable ecotourism site. The following model builder (Figure 5) clearly indicates that how the researcher operates proximity and spatial analyst tool in GIS environment for screening of potential ecotourism sites in the study area.

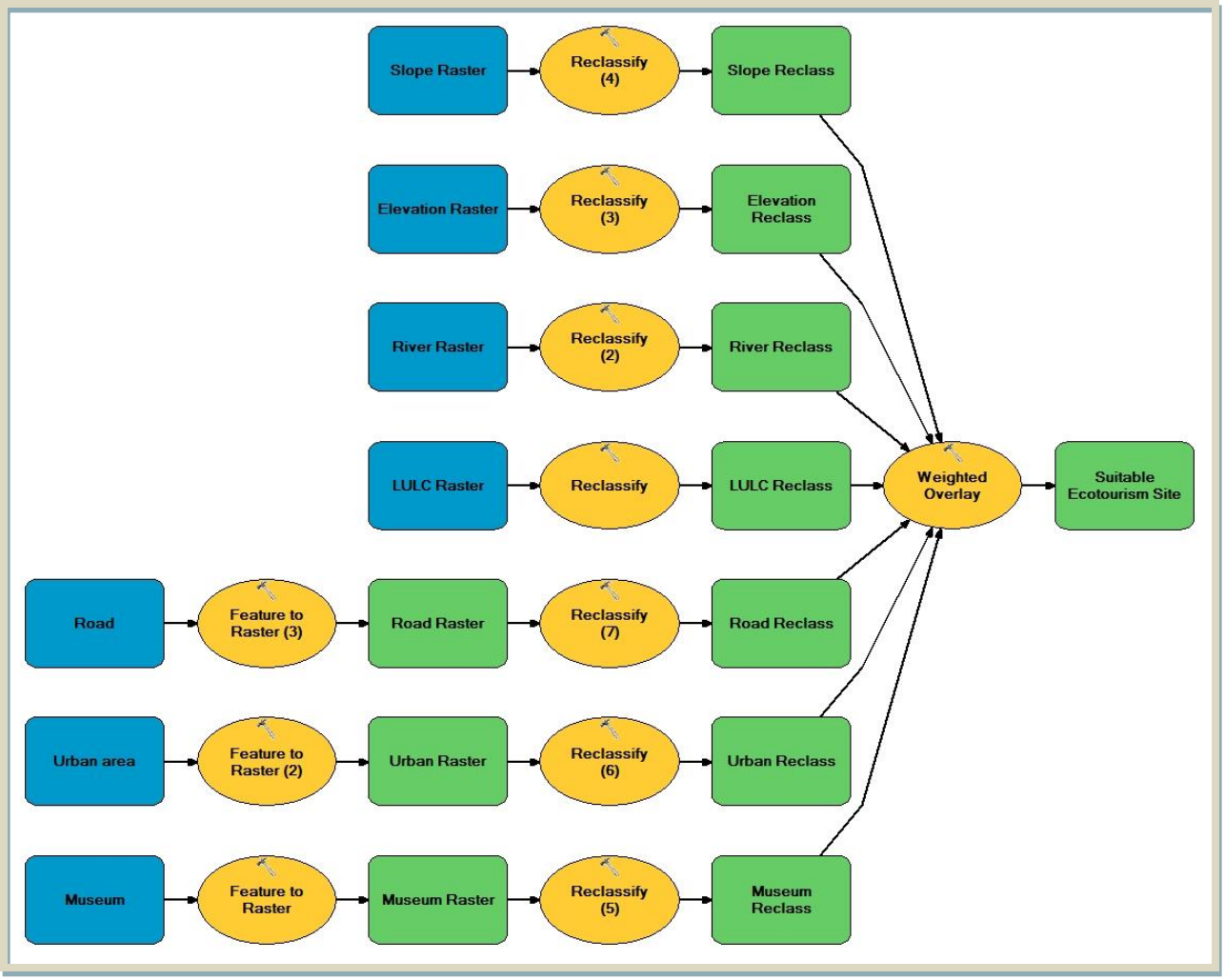

Figure 5: Procedures to select potential ecotourism sites

The above model builder show that road, urban area and museum layers were in line, polygon and point feature formats respectively. Thus to use them for suitability analysis the researcher, converted them into raster format which is computable in spatial analyst tools. Whereas the remaining layers such as LULC slope, river and elevation were in raster format so no need of building the model from feature to raster. After converting feature map to raster, all factor maps were ready for reclassification purpose. Afterward, the researcher reclassified all seven factor maps according to their suitability class. Next assigning weight for all factors outside of GIS environment in IDRISI software, weighted overlay operation is performed for all criteria to produce the final suitability site for ecotourism. The above process was all done in ArcGIS software model builder interface.

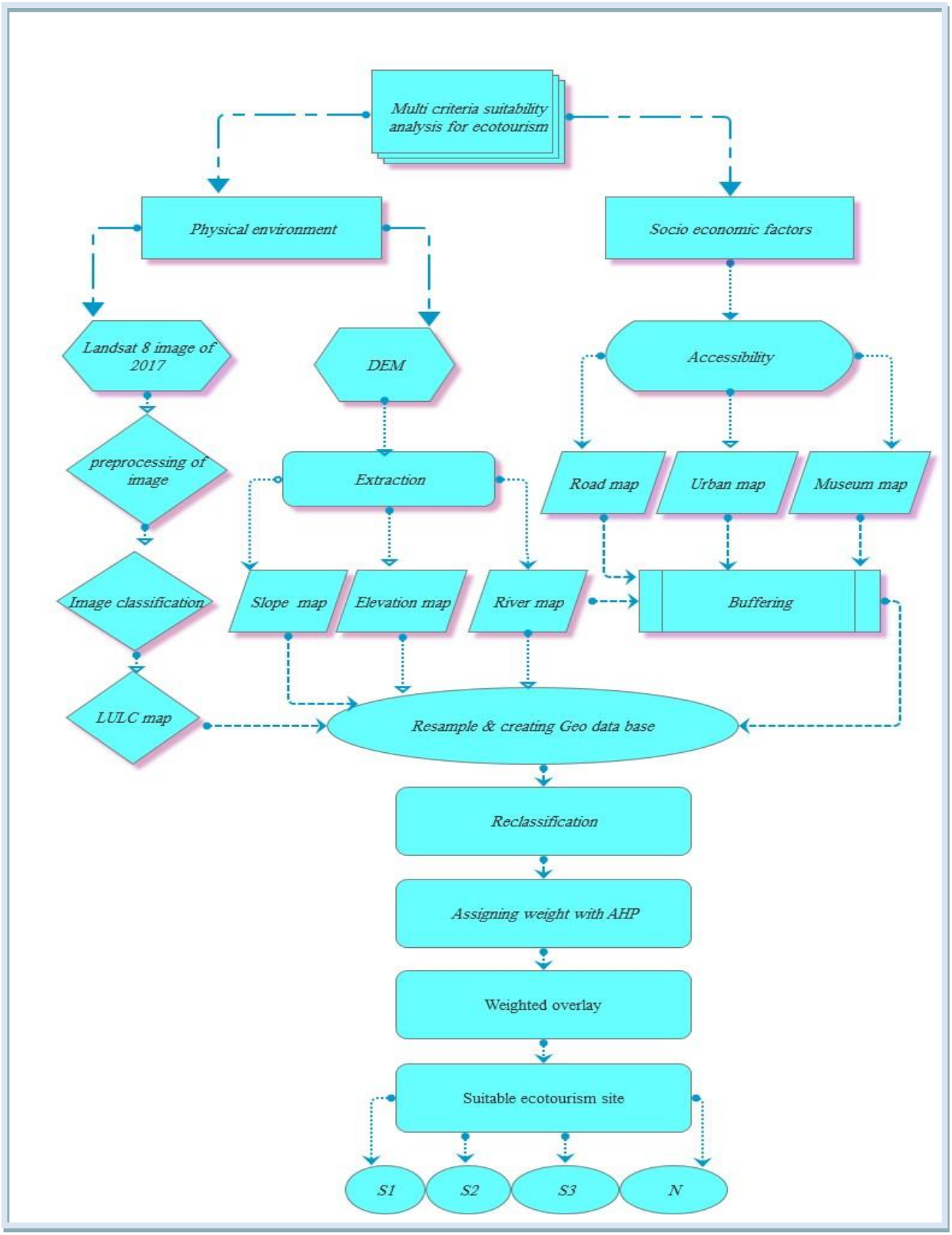

Figure 6: Conceptual framework

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1. Parameters for Potential Ecotourism Site Selection

4.1.1. Land Use and Land Cover

To analyze the land use land cover of the Masha district for potential ecotourism site selection, landsat8 OLI-TIRS image of the study area was classified to obtain land use land cover of the area. The satellite image was classified by the supervised image classification technique. Accordingly, four major types of land use land cover units were obtained; namely forest, open land, crop land and built up area. The following (Table 8 and Figure 7) clearly shows the land use land cover types and their respective areal coverage in the district.

Table 8: Types and areal coverage of LULC in the district (own processing, 2017)

No	Types of LULC	Area in hectare	Area in (%)
1	Forest	50937.04	62.4
2	Built up area	1673.24	2.0
3	Open land	1578.08	1.9
4	Cropland	27468.2	33.6
	Total	**81656.56**	**100**

The land use land cover analysis is such a useful analysis in GIS and RS technologies to know which types of land use land cover class cover the largest and the smallest area in the district. Therefore, the classification result of the 2017 image revealed that forest land constituted the largest proportion of land in the study area with a value of 62.4%, followed by crop land which accounts for 33.6%, while the smallest land of the district is occupied by 2% of built up area and 1.9% of open land respectively. This indicates that the ratio of land use land cover type which is highly essential for ecotourism covers a largest area of the district.

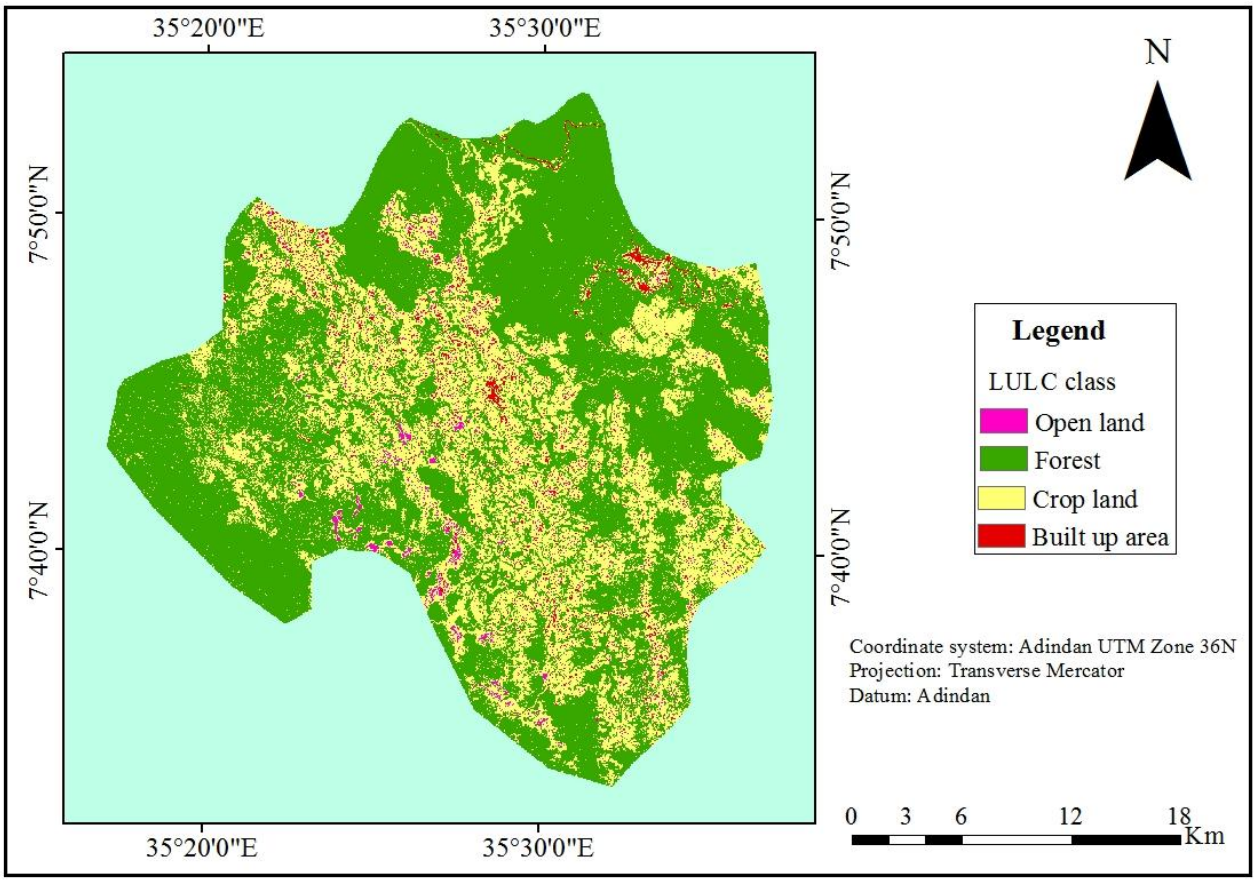

Figure 7: Land use land cover map of the study area

In the above LULC, the overall accuracy of 85% with a kappa coefficient of 80.4% was achieved in the classification process means there is strong agreement between classification and referenced data than by chance alone.

Table 9: Confusion matrix of LULC classification of 2017 (own processing, 2017)

Class Name	**Reference data**				
	Forest	Cropland	Built up area	Open land	Raw total
Forest	**19**	2	0	0	21
Cropland	1	**19**	2	1	23
Built up area	0	2	**15**	0	17
Open land	1	1	2	**17**	21
Total column	21	24	19	18	82
Producer accuracy	90%	79%	79%	94%	

The result in the (Table 9) indicates, diagonal number value shows correctly classified land use pixel. Then the overall accuracy was calculated by dividing the total sum of correctly classified pixels for total sum of to pixel value in the confusion matrix. Forest and open land areas were classified with 90% and 94% of accuracy levels. Whereas the classification of crop land and built up area was 79% of accuracy levels due to the interfered of other land use and land cover. The result obtained for this study fits the minimum level of accuracy in the classification of Land use land cover types of remotely sensed data which should be at least 80% of the kappa coefficient (Sharifi, 2001). Therefore, the classification of LULC was performed by 85% of the overall accuracy level with a kappa coefficient of 80.4% indicates the result of classification was best and acceptable.

4.1.1.2. Land Use Land Cover Suitability

Different researcher uses different land use land cover types for selection of ecotourism site. In the present study, the views of Daniel (2009), Pareta (2013), Bali *et al* (2015), Samanta and Baitalik (2015),) and Yechale and Leul (2015 were the base for ranking of land cover class from ecotourism perspectives. Accordingly, Forest, open land, built up areas and crop lands are considered as highly suitable (S1), moderately suitable (S2), marginal suitable (S3) and not suitable (S4) for ecotourism development respectively. The reclassification process is achieved by spatial analyst tool in GIS environment by applying spatial analyst tool. As mentioned aboves its weight was assigned based on standard formulated by different researchers. During reclassification phase the highest rank (1) was given for forest cover because of its high and diverse ecology carry that they provide for biodiversity. Forest cover is also highly important for ecotourism and sustainable environment which serves as a main ecotourism attraction. The highest density of the forest cover is located to the northern, northeastern, western and southern tip of the study area. The least rank (4) was given for crop land because such lands were used for land reclamation, agriculture and urban development rather than ecotourism development. The majority of this types of land use is situated to the centeral and southeastern part of the district. Whereas open land and built up area of the district was given the rank of 2 and 3 respectively. Finally, LULC map of the study area is reclassified and analyzed in term of their suitability class for potential ecotourism site selection.

Table 10: Land use land cover suitability class and areal coverage (own processing, 2017)

No	LULC types	Suitability class	Rank	Areal in (ha.)	Areal in %
1	Forest	Highly suitable	1	50937.04	62.4
2	Open land	Moderately suitable	2	1578.08	1.9
3	Built up area	Marginal suitable	3	1673.24	2.0
4	Cropland	Not Suitable	4	27468.2	33.6
Total				**81656.56**	**100**

The reclassified map of the study area raveled that (Table 10), the largest part of the study area (50937.04 ha) were found as highly suitable for ecotourism development because these huge portions of the area were covered by dense and evergreen forest which was served as the home for different biodiversities that can catch the attention of many domestic and foreign tourists. Whereas the smallest portion of the district; about 1578.08 and 1673.24 hectares of the area were moderates and marginally suitable for potential ecotourism site respectively because the areas were covered by open land and built up area. But, the remaining 27468.2 hectares (33%) of the district were found as not suitable for ecotourism development as the areas were very important for agricultural activities than ecotourism.

This study is inline to the arguments of Bali *et al* (2015), Bunruamkaew and Murayama (2012), Daniel (2009), Pareta (2013), Samanta and Baitalik (2015) and Yechale and Leul (2015) that they give more weight for forest cover of the land since there is strong relationship between forest and ecotourism. Forest serves as a home for wild life, a pleasant place where people expect to visit, learn and enjoy because landscape attractiveness increases with variety in forest species that enhances biodiversity which serve as the base for ecotourism development. In the same way Tewodros (2010) was also argue that forest is the home for many biodiversity that can attract both domestic and foreign tourists. Variety in forest type in the landscape can create spatial patterns that may hold higher scenic values for a visitors. In consistent with the above researchers, the present study considered crop lands as not suitable for ecotourism development because these lands were more suitable for growing crops that can serve as the means of food and income for the community rather than ecotourism activities.

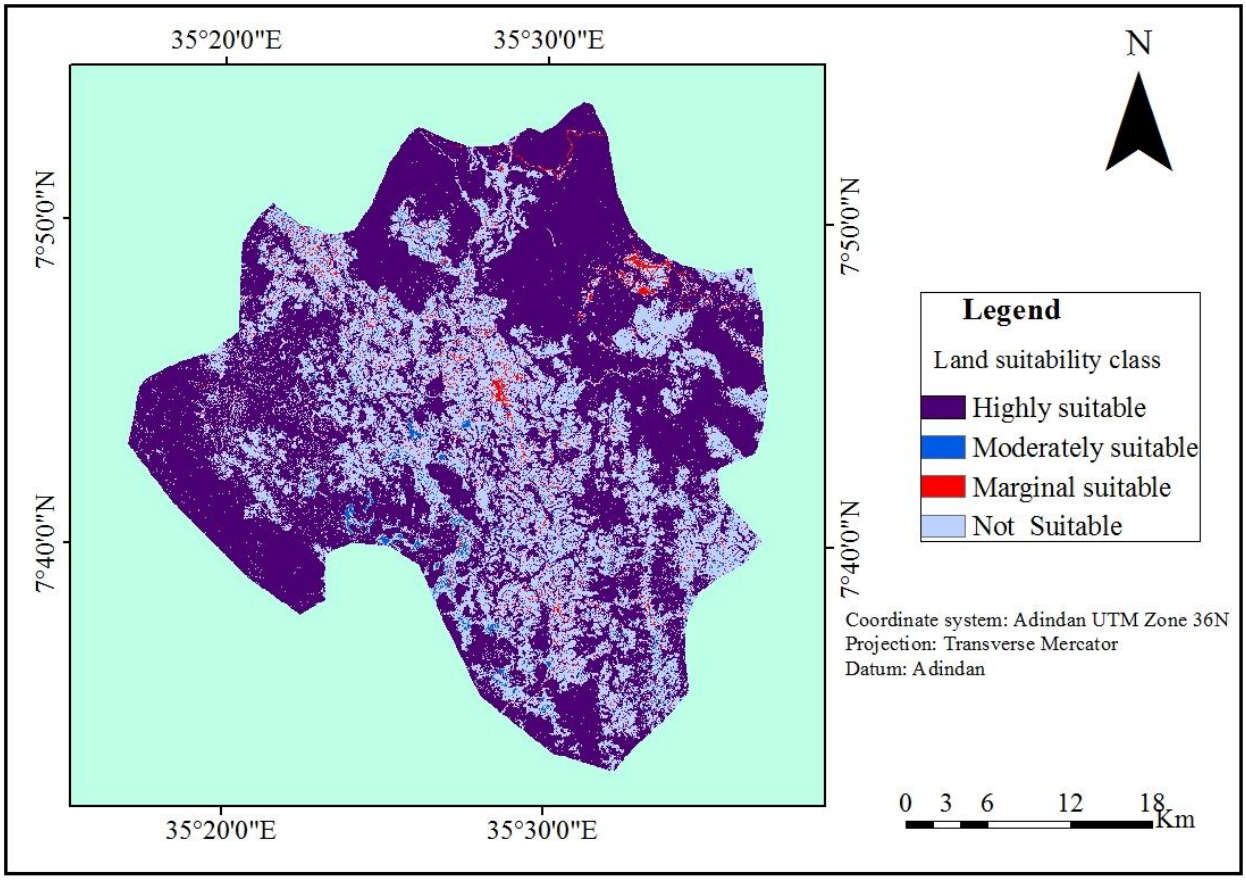

Figure 8: Suitability map based on Land use land cover criteria

4.1.2. Altitude

The elevation of the district is derived from the study area SRTM DEM by using extraction tools in GIS environment. Based on the elevation of the district, majority part of the district is high land with an altitude range from 1410 meters below sea level to 2655 meters above sea level. In the (Figure 9) below, southern and southwestern tips of the district is characterized by the high elevation array. Most of the central, northern and northeastern parts of the district have a medium altitudinal range. A western tip of the district, which is bordered by Gambela region has a high temperature due to its low altitude. Generally, area with higher elevation is considered to be highly suitable for ecotourism development whereas places with lower elevation is not suitable for potential ecotourism development because altitude as environmental factor has strong influences on the climate of a given place that determines the amount of temperature and rainfall received in specific geographical area.

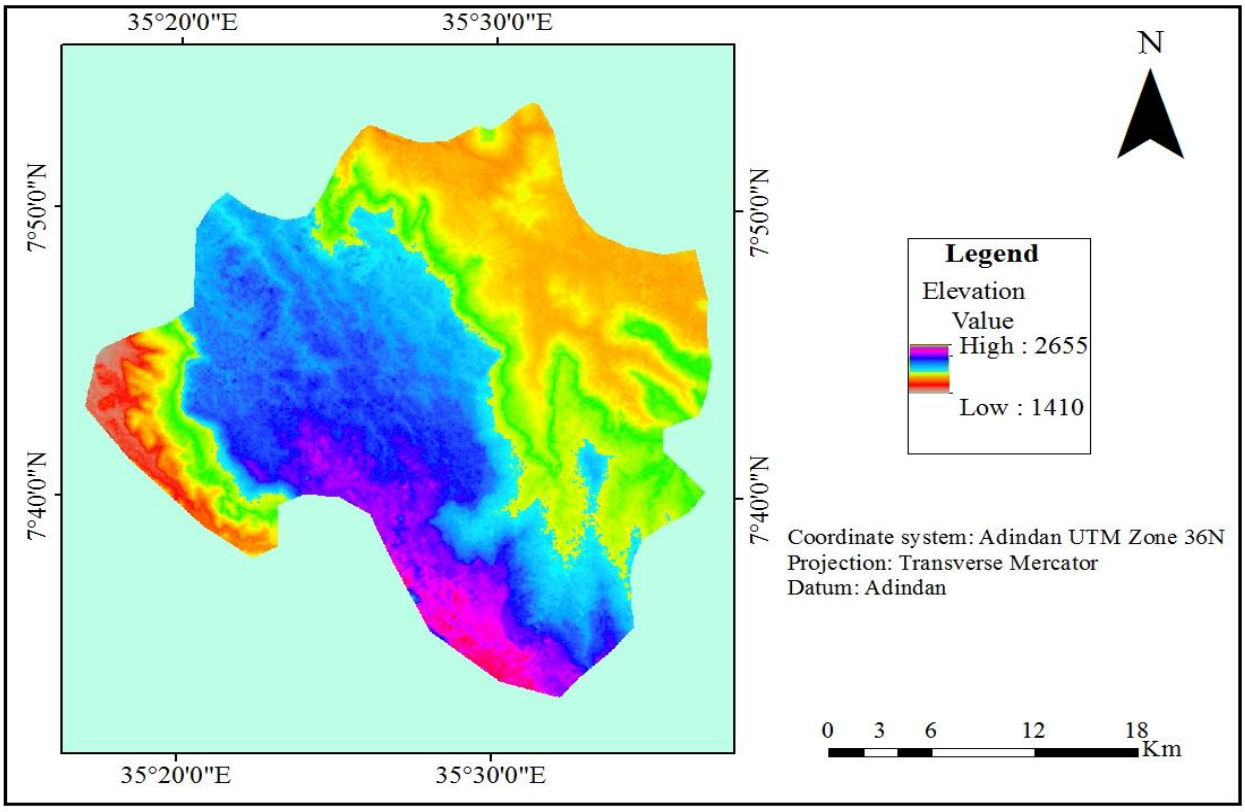

Figure 9: Elevation map of the district

4.1.2.1. Elevation Suitability

The patterns of land cover, the presence of endemic and attractive biodiversity is closely related to the topography of the area. The rainfall and temperature patterns are also influenced by the elevation. This in turn exerts a major effect on the distribution and abundance of biodiversity due to its effect on climatic conditions. In fact, the highland area is more suitable for the existence of living things, including human beings because of its favorable climatic conditions. Thus, it is necessary for analysis elevation suitability classes for identification of suitable sites for ecotourism. Different researchers set a different elevation suitability class for screening of potential site. In this study, the analysis of elevation is based on the standard formulated by Yechale and Leul, (2015) and an expert's knowledge. The area with the altitude range between 2322 meters to 2655 meters was taken as highly suitable, because the area in this range has a good climatic condition for tourists and rich with both flora and fauna whereas the area found between 1410 meters up to1864 meters are not suitable due to its unfavorable environmental conditions.

Table 11: Elevation suitability analysis (own processing, 2017)

No	Altitude in meters	Suitability class	Rank	Areal in (ha.)	Area in %
1	2322- 2655	Highly suitable	1	16924.6	20.7
2	2118 - 2322	Moderately suitable	2	23782.4	29.1
3	1864 -2118	Marginally suitable	3	17446.6	21.4
4	1410 - 1864	Not Suitable	4	23502.96	28.8
	Total			**81656.56**	**100**

Based on the above (Table 11), during reclassification phase the highest rank (1) was given in elevation ranges from 2322 to 2655 meters due to its suitable environment for living things, whereas the least rank (4) was given in elevation ranges from 1410 to 1864 meters relatively due to its perilous climate conditions. The result of the analysis reveals that 16924.6 hectares (20.7%) of the study area is taken as highly suitable areas for ecotourism. On the other hand 23782.4 hectares (29.1%) of the district were moderately suitable while 17446.6 hectares (21.4%) and 23502.96 hectares (28.8%) of the study area were marginally suitable and not currently suitable for potential ecotourism site respectively. The suitability classes of elevation are clearly shown in the following (Figure 10) of the district.

Generally, the district is characterized by high elevation ranges which creates an interesting landscape matrix that is crucial for a potential ecotourism site. This in turn makes tourist to have a bird's eye view of downstream plain and scenic beauties. Due to its suitable environment, the area contains a high habitat diversity such as broadleaf forests, bamboo forest, moorland, riverine forest, wetlands, agricultural land and rural areas that makes the district as home for many endemic and threatened biodiversity. To sum up the above elevation suitability of the district, 49.8% of the area is found within highly and moderately suitable class whereas the remaining 50.2% of area in the district were marginally and not currently suitable class from the context of ecotourism perspectives.

This finding is consistent to the works of (Daniel, 2009; Samanta and Baitalik, 2015; Tewodros, 2010; Yechale and Leul, 2015). Hence, the highest elevation is an important and preferable for ecotourism suitability. This indicates that the areas with lowest elevation are less likely suitable for potential ecotourism site selection. In a similar fashion in the current study, highest rank was assigned to highest elevation, and vise versa.

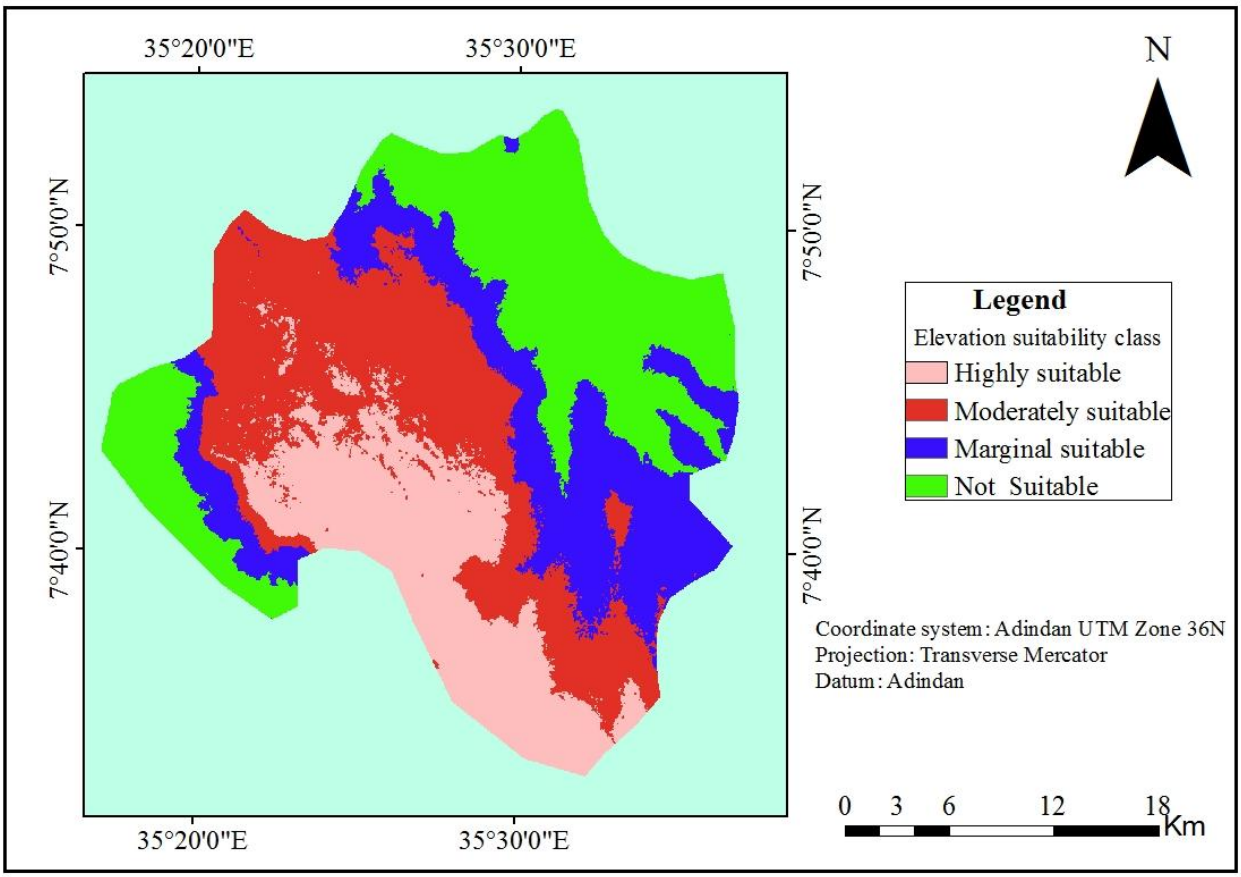

Figure 10: Suitability map based on elevation criteria

4.1.3. Slope of the Study Area

The slope profile of the study area varies from 0 to 68.12º. Its slope is extracted from the study area SRTM DEM in ArcGIS environment by using a spatial analyst tool that is explained in terms of degree units. It is important for ecotourism because all terrain features are derived from a complex landmasses. Therefore, expressing the complexity of the area in terms of the slope is an imperative factor in the suitability analysis for ecotourism.

In the previous studies, different researcher sets different standards to evaluate slope suitability for ecotourism because the variation in the slope types affects the area's suitability for ecotourism. For this study, the slope suitability class was analyzed based on Yechale and Leul, (2015) standards. Accordingly, the areas found between 0 - 2.86º were taken as not suitable, because the areas within this slope range are characterized by less variation in its slope profile, whereas the areas found between 13.58º - 68.12º were taken as highly suitable, because the areas in this slope range were rich by cliff and hanging wall landscape that creates nice scenic beauty which attracts many

tourists. Areas found between 2.86º - 7.15º were taken as marginally suitable and areas within slope range between 7.15º - 13.58º were moderately suitable for ecotourism site due to their medium slope ranges.

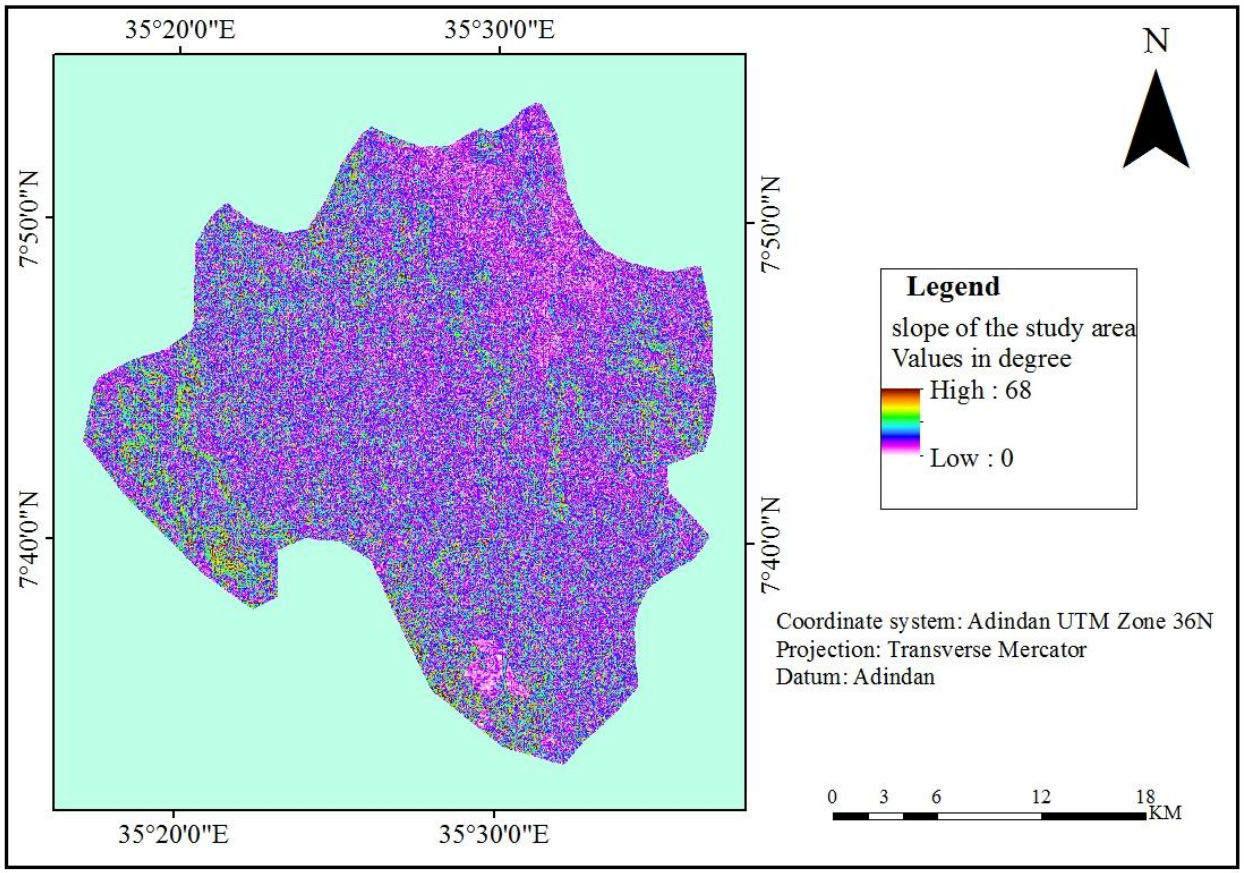

Figure 11: Slope map of the study area

4.1.3.1. Slope Suitability

To evaluate the slope suitability of the study area for potential ecotourism site selection, the slopes were reclassified into four classes in the Arc GIS environment using spatial analyst tools specifically (reclassify tool). Areas with highest slope ranges were considered as highly suitable whereas the area with the lowest slope ranges were taken as not suitable for selection of ecotourism site. As mentioned above, the standard used by Yechale and Leul, (2015) was the base of categorizing slopes according to its suitability class. During slope reclassification process the highest value (1) was assigned to steep slopes due to it's complexity of the land features that creates cliff and hanging wall landscape that attracts many tourists whereas, the lowest value (4) was assigned to gentle slopes due the absence of nice scenic beauty that attracts tourists. The areal coverage and suitability class of the study area are depicted in (Table 12 and Figure 12) as follows.

Table 12: Slope suitability analysis (own processing, 2017)

No	Slope in degree	Suitability class	Rank	Areal in (ha.)	Area in %
1	0 - 2.86	Not Suitable	4	4020.96	4.9
2	2.86 - 7.15	Marginally suitable	3	17723	21.7
3	7.15 - 13.58	Moderately suitable	2	28442.48	34.8
4	13.58 - 68.12	Highly suitable	1	31470.12	38.5
	Total			**81656.56**	**100**

The result in the above (Table 12), revealed that 38.5% of the total area (31470.96 ha) are in the slope range between 13.58 - 68.12 degree which is highly suitable for ecotourism and 28442.48 hectares (34.8%) of the study area is in the slope range between 7.15 - 13.58 degree which is also considered as marginally suitable for screening of potential site for ecotourism. The remaining 21.7% of the total area (17723 ha) is found within marginally suitable class, whereas 4020.96 hectares (4.9 %) of the district are considered as not currently suitable site and found within the slope range of 0 - 2.86 degree. This indicates the ratio of slope suitability class which is highly and marginally suitable for ecotourism covers a large area (59912.6 hectares) in the district. In other word, the smallest portion of the district (21743.96 hectares) is occupied by marginally and not currently suitable class of slope from the ecotourism point of view.

Results in the present study is consistent to the works of (Bunruamkaew and Murayama, 2012; Daniel, 2009; Tewodros, 2010; Yechale and Leul, 2015). Accordingly, slope is considered to be an important factors that affects the suitability of area for potential ecotourism site selection thus, many contemporary studies take up different slope classes as a major factor mostly in relation to suitable site selection. These studies share a common interest in exploring slope as a vital factor in the suitability analysis for ecotourism. Inline with the current study, the above researchers were given the highest rank for the highest slope ranges and the lowest rank was given for the lowest slope ranges during reclassification phases of their studies.

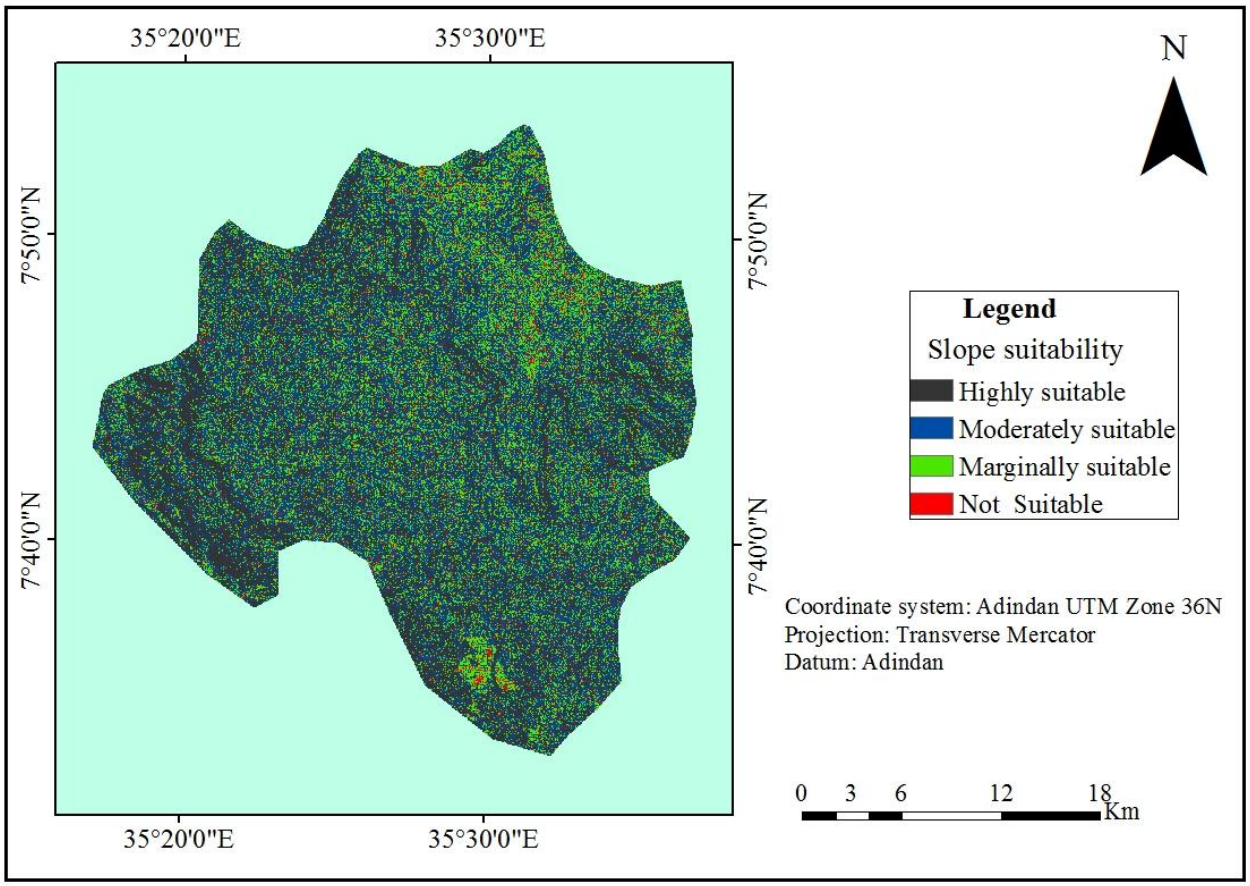

Figure 12: Suitability map based on slope criteria

4.1.4. Proximity to River

The proximity of the attraction site to river is one of the vital parameters in the evaluation of rivers suitability for the ecotourism site selection as they provide recreation and other enjoyment for ecotourism activities due to their richness with biodiversity. In the current study, to determine the distance between the river and ecotourism sites, Samantan and Baitalik, (2015) standard was used for proximity analysis. Accordingly, the selected potential ecotourism sites should be near to river because the existence of water in a stunning form in landscape like waterfall may increase the aesthetic value of landscape that can attracts many visitors. The presence of river in a landscape also creates variety and diversity of biodiversity that is interesting to many tourists. On the other hand, areas too far to river is not recommended for ecotourism attraction site due to the absence of visually attractive geomorphologic features because tourists usually visit particular locations for the scenic attractiveness of that landscape. Therefore, the following (Table 13 and Figure 13) were clearly depicted proximity analysis of the river in this study.

Table 13: Proximity analysis of river and its respective areal coverage (own processing, 2017)

No	Suitability class	Buffer distance in km	Area in (ha.)	Area in (%)	Rank
1	Highly suitable	0 - 0.5	40552.84	49.7	1
2	Moderately Suitable	0.5 - 1	24535.16	30.0	2
3	Marginally suitable	1 - 2	14443.92	17.7	3
4	Not suitable	2 - 5	2124.64	2.6	4
	Total		**81656.56**	**100**	

Based on the above (Table 13), areas in close proximity to the river are more suitable for potential ecotourism sites. During the reclassification process the highest suitability rank (1) was assigned to areas within a buffer distance between 0 to 0.5 km, because the area at close distance to the river are highly suitable for scenic beauty and bottling whereas the lowest score (4) was assigned to areas out of 2 km buffer distance from the rivers for their low potential attraction site. Areas within a buffer distance between 0.5 to 1 km and 1 to 2 km were under moderately and marginally river suitability classes respectively. To sum up, the above table, the largest portion of the district was found as highly suitable with a value of 40552.84 hectares (49.7%) whereas, the smallest part of the district is not suitable for selection of potential ecotourism sites with a value of 2124.64 hectares (2.6%). But, the remaining 24535.16 hectares (30%) and 14443.92 hectares (17.7%) of the district were found as moderately and marginally suitable for potential ecotourism site screening as the areas were found in intermediate distance between highly and not currently suitable areas.

In similar fashion to the current study, the finding by (Bali *et al*, 2015; Macdonald, 2000; Samanta and Baitalik, 2015; Surendran *et al*, 2003), argue that the proximity of an area to river: indicates that the closes the area to river are more likely suitable to potential ecotourism sites than the areas far away from river. This is because river is the most essential natural resources for all life on the earth. The place where people can live and their quality of life is mostly determined by the availability and quality of river at a given area. These all available plenty of fresh river on the earth is not limited in one specific area. That means when and where any users needed, it is not always been available and at suitable quality for all users. Due to this inignorable and acceptable facts, the proximity of river from attraction site is one of the vital parameters in the evaluation of rivers suitability for ecotourism site selection in the current study.

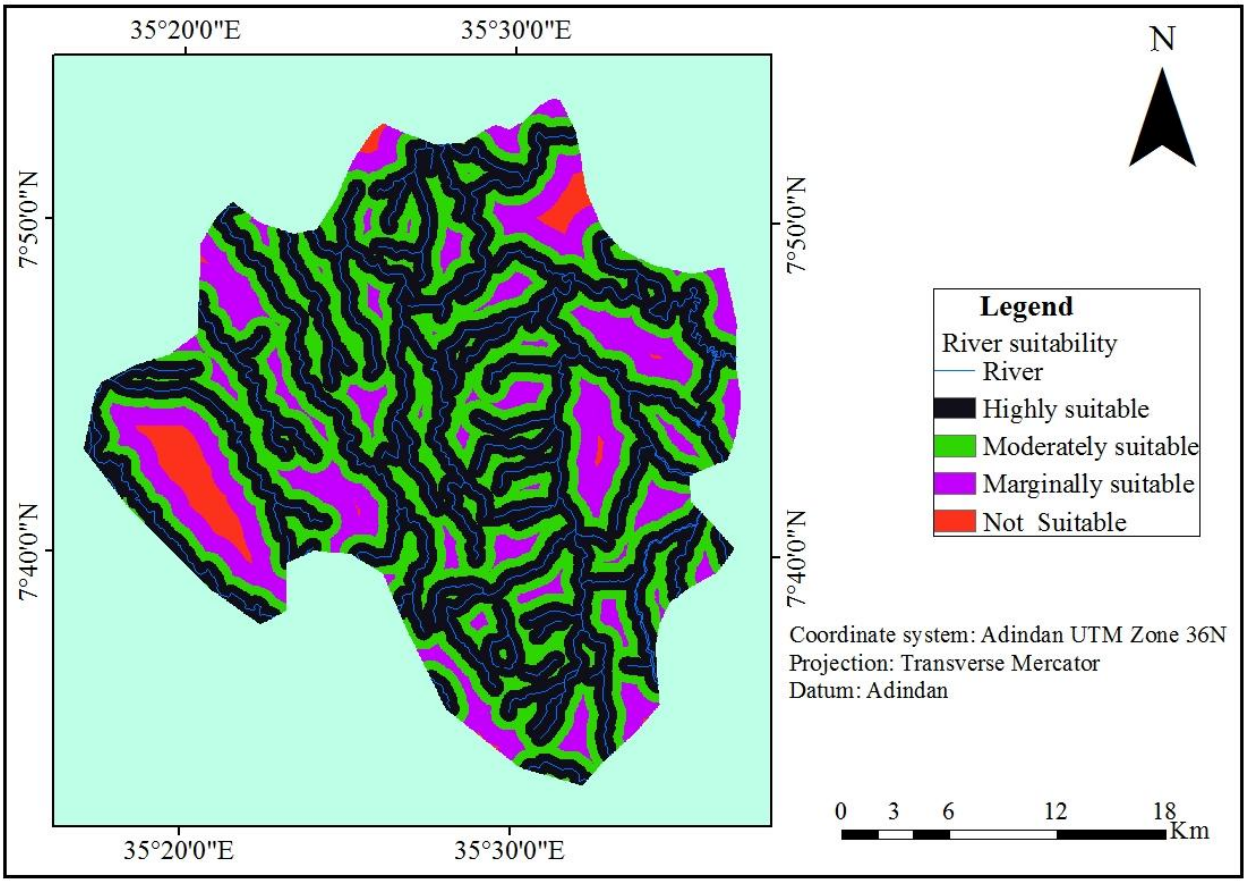

Figure 13: Suitability map based on river criteria

4.1.5. Proximity from Road Networks

The Road is a way or route on land between the origin of tourist place and a tourist attraction site that allows tourists to travel by foot or other means of transportation like a motor vehicle, bicycle or horse. This system makes a communication line between destination, accommodation and natural attractions. Since ecotourism is a form of tourism industry involving visiting of natural area, cultural or historic places, all spots must be connected by roads. During evaluation of the land suitability for a potential ecotourism site, considering its accessibility to the road network is one of the vital criteria to make a sound full decision regarding to suitable site selection for ecotourism. Accordingly, areas in close proximity to the road network are more suitable for potential ecotourism sites. But, those areas too far from the road networks are not recommended because of their inaccessibility to the attraction site. Therefore, road networks are one of the determinate factors that should be considered during suitability analysis of land for ecotourism site screening.

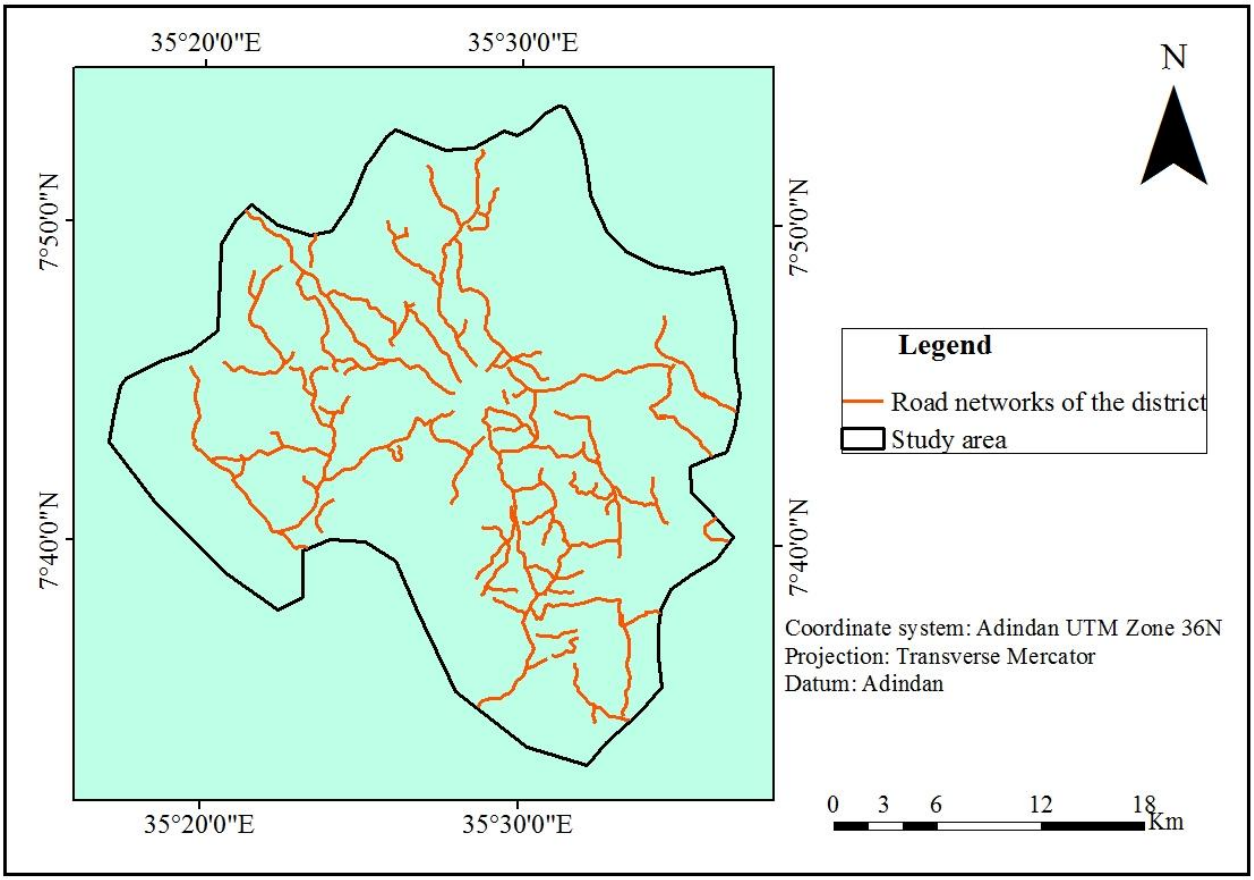

Figure 14: Road network of the district

4.1.5.1. Road Network Suitability

Road map in the above (Figure 15) was represented by the line feature which is not compatible for weighted overlay analysis. This line features were converted into raster feature and reclassified into four classes according to their proximity distance from attraction sites. Based on the standards of Samanta and Baitalik (2015), the area in close proximity to road networks (buffer distance from 0 to 1 km) were ranked as highly suitable for ecotourism because the area near to the road networks are easily accessible to the tourist which can save both time and cost related to transportation. The areas greater than a buffer distance of 3 km were considered as not suitable because the area far away from the road networks was inaccessible and resulted in high cost of transportation. However, the areas within a buffered distance of 1 up to 2 km and from 2 to 3 km were moderates and marginally suitable respectively. During reclassification, the highest value (1) was given to the areas in close proximity to road networks and the lowest value (4) was given to areas far away from the road.

Table 14: Proximity analysis of road and its respective areal coverage (own processing, 2017)

No	Suitability class	Buffer distance in km	Area in (ha.)	Area in (%)	Rank
1	Highly suitable	0 - 1	48107.00	58.9	1
2	Moderately Suitable	1 - 2	17718.68	21.7	2
3	Marginally suitable	2 - 3	7981.08	9.8	3
4	Not suitable	> 3	7849.8	9.6	4
	Total		**81656.56**	**100**	

The results from the above (Table 14) indicate, 48107 hectares (58.9%) of the area in the district were highly suitable which is followed by 17718.68 hectares (21.7%) of moderately suitable for selection of potential ecotourism sites. The remaining 7981.08 hectares (9.8%) and 7849.8 hectares (9.6 %) of the area in the district were marginal and not suitable respectively. In general, from ecotourism points of view, the largest portion of the study area was categorized under highly suitable class, but, only the smallest portions of the district were found within not currently suitable class.

This finding agrees with the study on the application of geographic information system and remote sensing technologies on potential ecotourism site selection for Blocks in Bangladesh, significantly reported almost all area in close distance to the road networks was highly suitable for potential ecotourism site screening but areas which were far from road networks were not currently suitable (Samanta and Baitalik 2015). Other studies in different countries also indicated that the selected suitable ecotourism site should not be too far from road networks. Because areas too far from the road networks incur high cost to tourists to rich ecotourism sites. On the other hand areas too near to road networks are recommended because these areas were easily accessible to the tourist (Yechale and Leul, 2015). Therefore, the road network proximity suitability map of the district is clearly indicated in the following (Figure 15).

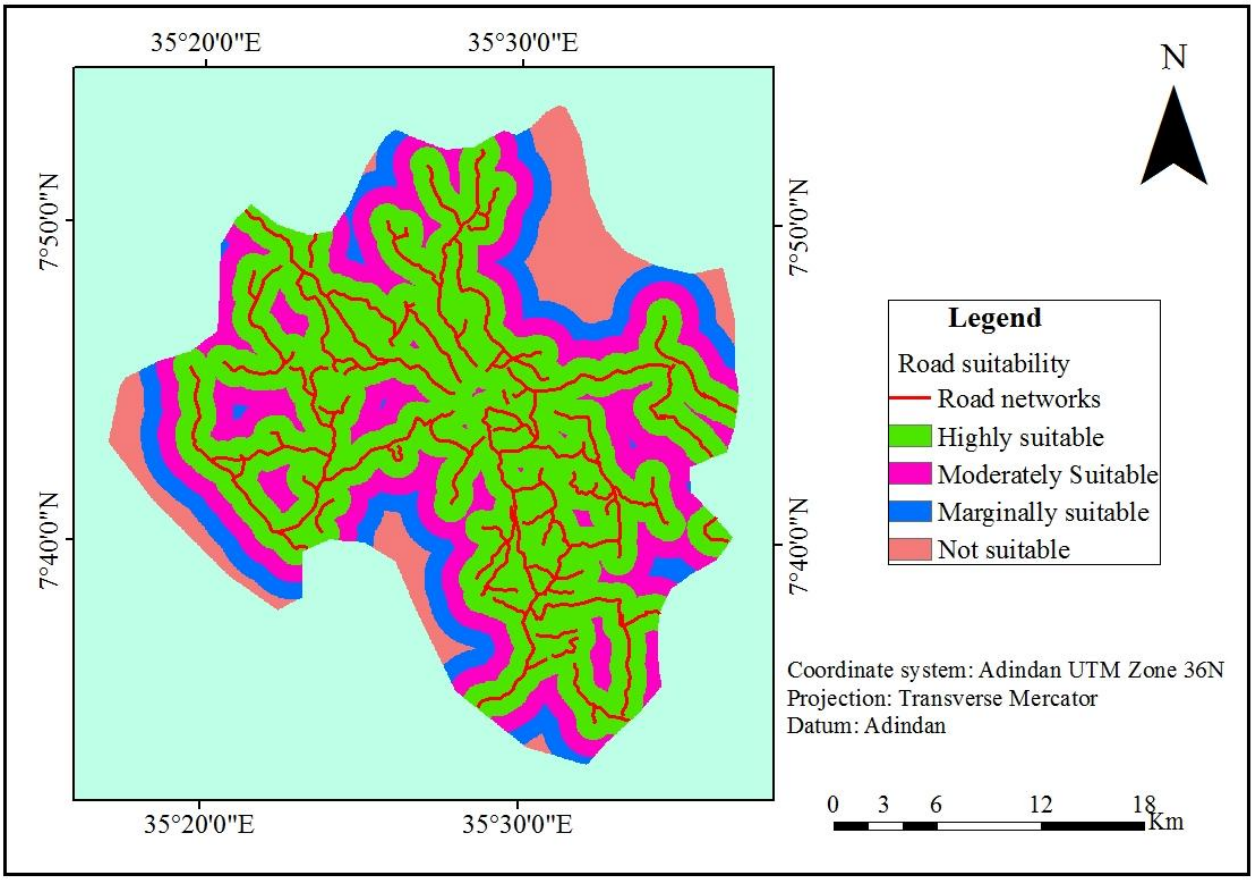

Figure 15: Suitability map base on road criteria

4.1.6. Proximity of Urban Area Suitability

An urban area is defined as a human environment with high population density and infrastructure of the built environment. To evaluate urban area's suitability for selection of potential ecotourism sites, urban map of the district represented by polygon format is not compatible for multi criteria evaluation (MCE). Firstly, the polygon feature was converted to raster formats and reclassified based on the distance from the town of the study area. According to the standard used by Banerjee *et al* (2002) and Surendran *et al* (2003), together with expert knowledge, the area within 3 km from the urban area is not recommended for ecotourism site selection to avoid urban noise and contestation. Based on the above standard, the area far away from the urban area was ranked as highly suitable for potential ecotourism site and represented by a value (1) because of their serene and healthy environment. Whereas, the areas near by urban center were ranked as not suitable and represented by the value (4) since they have high noise disturbance and urban pollution.

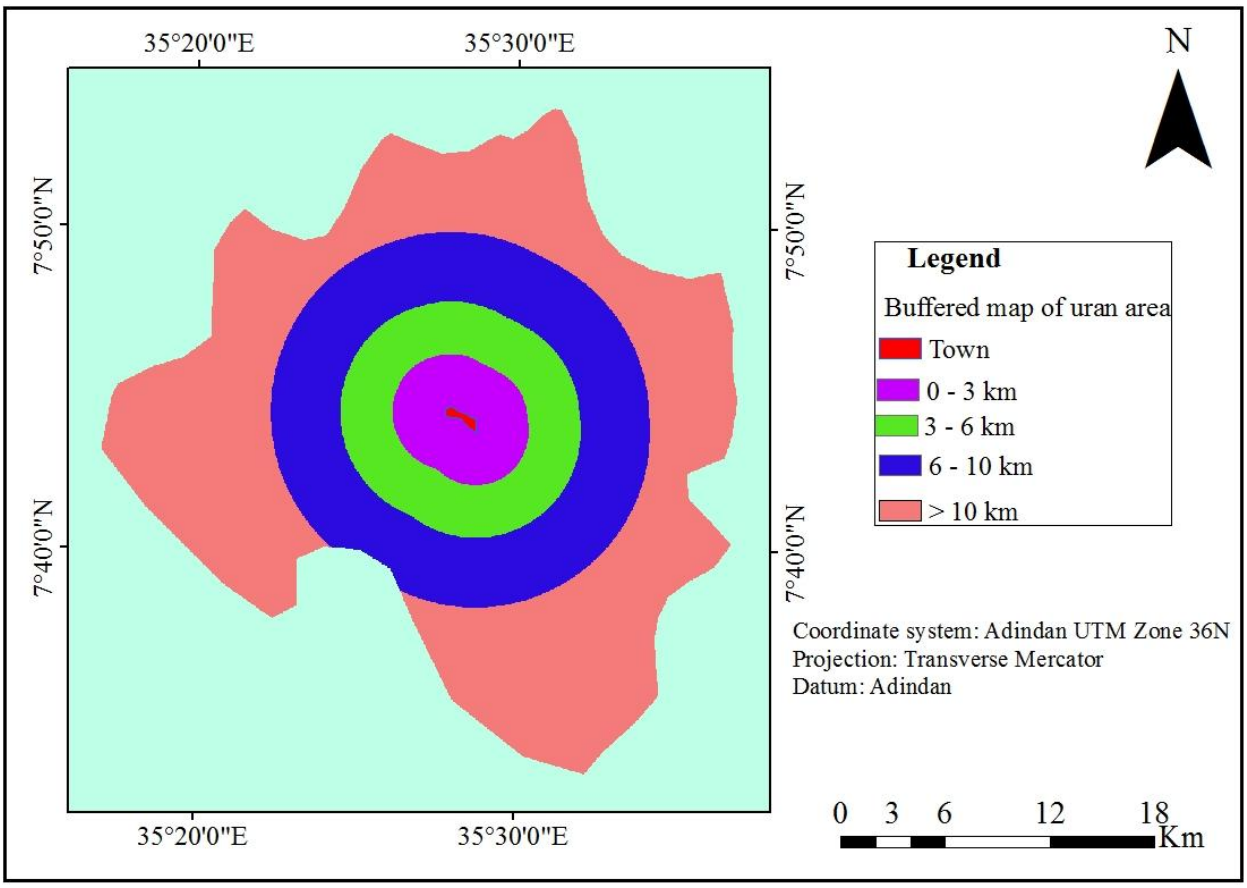

Figure 16: Proximity buffered map of the urban area

During the reclassification process, the areas within a buffer distance between 0 to 3 km and 3 to 6 km were under not suitable and marginally suitable class of urban area respectively. Whereas the areas within a buffer distance between 6 to 10 km were under moderately suitable class but areas above 10 km buffer distance were taken as highly suitable class for potential ecotourism sites.

Table 15: Proximity of urban area and its respective areal coverage (own processing, 2017)

No	Suitability class	Buffer distance in km	Area in (ha.)	Area in (%)	Rank
1	Highly suitable	> 10	45243.8	55.4	1
2	Moderately Suitable	6 - 10	21873.44	26.8	2
3	Marginally suitable	3 - 6	10027.68	12.3	3
4	Not suitable	0 - 3	4511.64	5.5	4
	Total		**81656.56**	**100**	

Based on the above urban area's proximity (Table 15), the largest part of the study area was dominated by highly suitable site which account about 45243.8 hectares (55.4%) and followed by

21873.44 hectares (26.8%) of moderately suitable site. Whereas, only 12.3% and 5.5% of the study areas were marginally suitable and not currently suitable respectively for the ecotourism potential site. The current study is inline with the study conducted by Banerjee *et al* (2002) and Surendran *et al* (2003). These studies briefly reported that the suitability of area is increased with increasing of the area's distance from urban area for selection of potential ecotourism site. On the other hand areas too near to urban area are not recommended for ecotourism site selection because of the existence of noise and pollution in urban area.

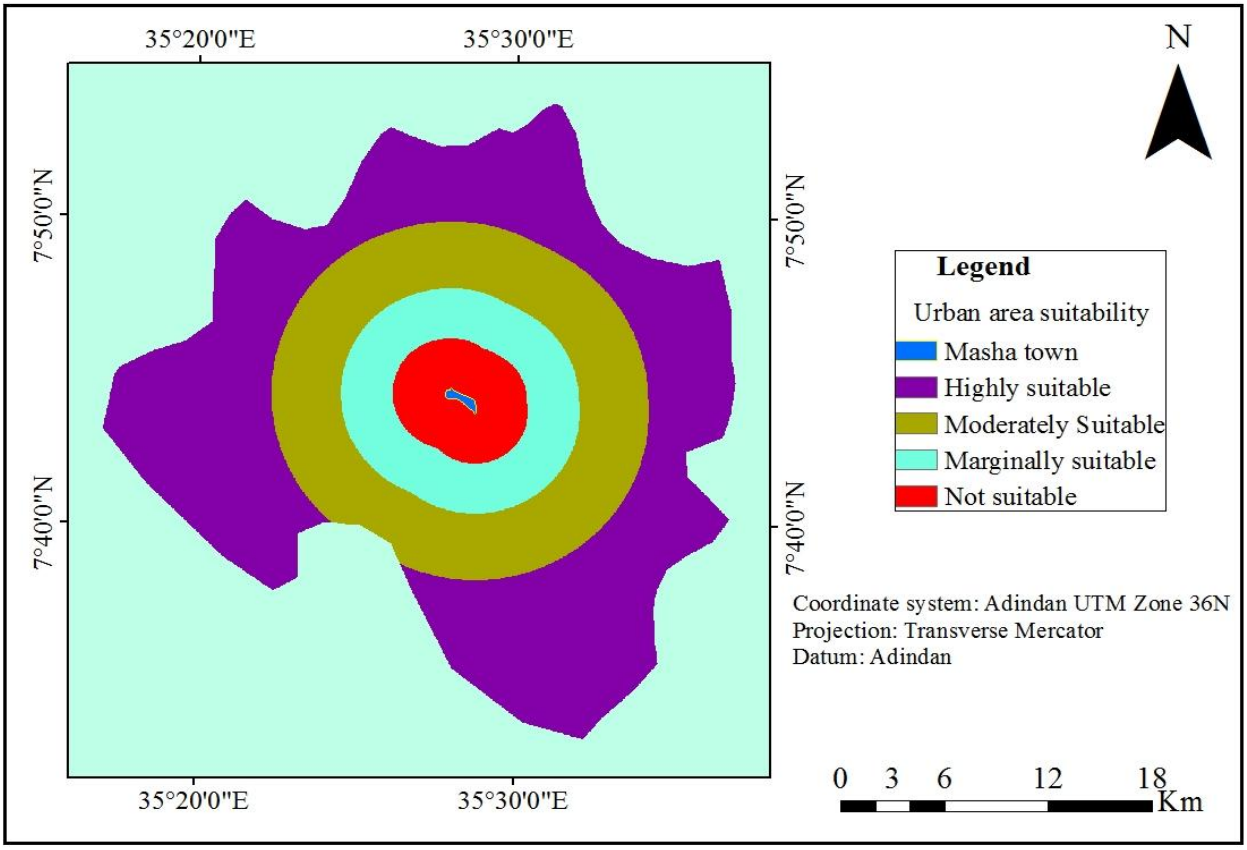

Figure 17: Suitability map based on urban area criteria

4.1.7. Proximity of Museum Area Suitability

The museum is a non-profit making and permanent organization in the service of society which is open to the public for the purpose of study, education, enjoyment, material evidence of people and their environment (ICOM, 2010). This means, it is a building which stored the culture and heritages of the society that helps the tourists to experiencing the arts, heritage and activities that truly represent the stories and people of the past and present. Because of this fact, the museum is strongly linked with ecotourism that educate their visitors about the history, natural and cultural

heritages of the destination area and preserving all these elements for future generation. In fact, the main role of the museums should be to protect cultural heritage and attract more tourists. Therefore, to select a potential ecotourism site, anyone should consider the proximity distance of the area from the museum.

To analysis the museum area suitability in the present study, a museum map of the district represented by point features was converted to raster format because point features are not compatible with the multi criteria decision making process. After conversion to raster format, it was reclassified according to its suitability class for selection of ecotourism potential site. For its suitability class, the standard used by Mejia *et al* (2000), was the base in this study. Accordingly, 1km of walking distance from museums or other recreational site is recommended as minimum distance to attract tourists.

During analysis of suitability class, the area nearby museum was ranked as highly suitable for potential ecotourism site and represented by a value (1) because tourist can relax with cultural and other historical objects with minimum cost in a short period of time and its closeness enhances the patronage of the tourist resort. Whereas, the areas far away from museum area were ranked as not suitable and represented by the value (4). During the reclassification process, the areas within a buffer distance between 0 to 1 km and 1 to 3 km were under highly and moderately suitable class of museum area suitability classes respectively. Whereas the areas within a buffer distance between 3 to 10 km were under marginally suitable class but areas above 10 km buffer distance were taken as not suitable class for potential ecotourism sites. This agrees with the study made by Mejia *et al* (2000) that his study findings clearly reported that the area in a minimum distance from museum has created more chances for tourists to interact with culture and history of local people. That makes the nearest area most suitable for site screening of ecotourism. On the other hand areas too far from museum are not recommended for potential ecotourism site selection.

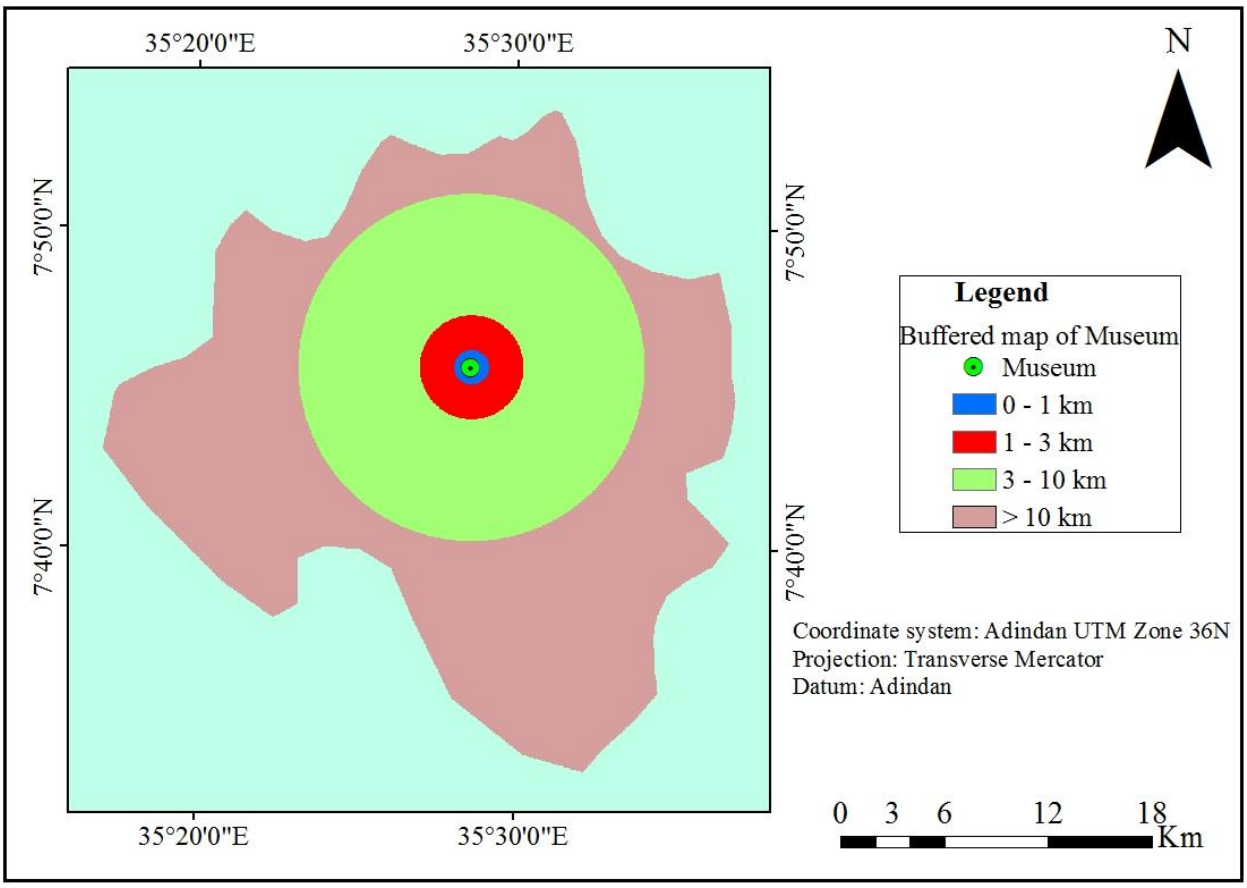

Figure 18: Proximity buffered map of museum in the study area

Table 16: Proximity analysis of museum and its respective areal coverage (own processing, 2017)

No	Suitability class	Buffer distance in km	Area in (ha.)	Area in (%)	Rank
1	Highly suitable	0 - 1	337.04	0.4	1
2	Moderately Suitable	1 - 3	2512.56	3.1	2
3	Marginally suitable	3 - 10	28588.84	35	3
4	Not suitable	> 10	50218.12	61.5	4
	Total		**81656.56**	**100**	

Based on the above museum proximity and suitability (Table 16), the largest part of the study area was dominated by not suitable site which account about 50218.12 hectares (61.5%) and followed by 28588.84 hectares (35%) of marginally suitable site. Whereas, only 0.4% and 3.1% of the study areas were high and moderately suitable respectively, for the ecotourism potential site. Because, the closeness of these areas to museum help the tourist to learn and relax with the culture and heritages of the people in the study area in cost and time effective manner. The following museum

suitability map of the study area was clearly present the above suitability classes of the museum from the perspectives of ecotourism site selection.

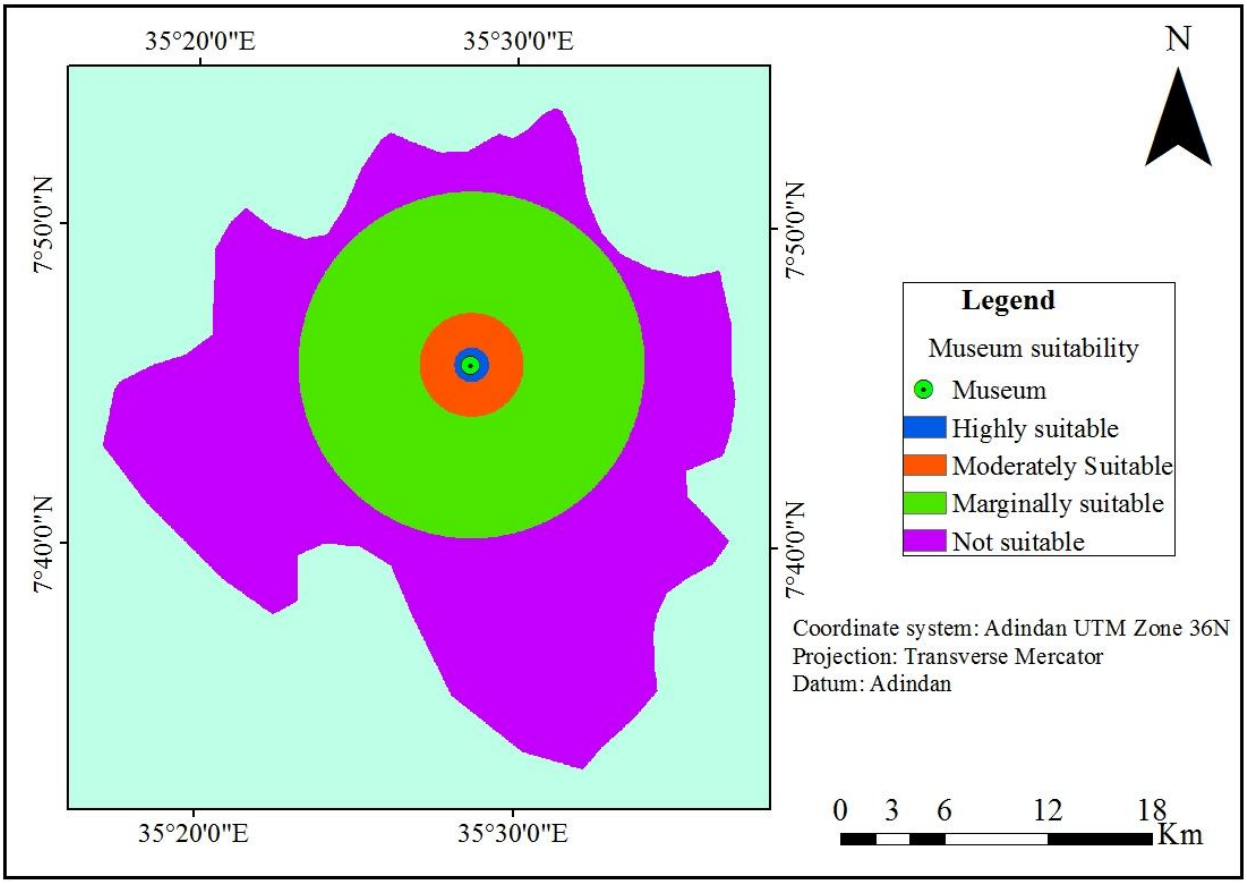

Figure 19: Suitability map based on museum criteria

4.2. Weighted overlay suitability analysis and multi criteria evaluation

4.2.1. Results of pairwise comparison matrices

Suitability evaluation is the process by which ecotourism suitable site was selected though actual applications of multi criteria evaluation of different factors that determine potential ecotourism site screening. In the present study, seven factor maps were produced and reclassified according to their degree of significance that they have to ecotourism suitability analysis. The weight for each factor maps was assigned based on reviews of pervious works together with the questionnaires distributed to selected experts. According to these questionnaires, most of the KII (85%) were prioritized the above seven factor maps in their descending order as follows: (Land use land cover map, road map, river map, elevation map, slope map, museum map and urban map). After prioritizing all the factor maps according to their relative importance, the task of assigning weight

for each parameter was performed outside GIS on IDRISI decision wizard software. The following WEIGHT- AHP weight derivation in (Table 17) clearly indicates the influences of each factor.

Table 17: Pairwise comparison matrix in IDRISI software (own processing, 2017)

Reclassified map layers	LULC	Road	River	Elevation	Slope	Museum	Urban area
LULC	1						
Road	1/2	1					
River	1/3	1/3	1				
Elevation	1/5	1/5	1/3	1			
Slope	1/5	1/5	1/3	1/3	1		
Museum	1/7	1/7	1/5	1/5	1/3	1	
Urban area	1/9	1/9	1/7	1/7	1/5	1/5	1

Based on the above pairwise comparison (Table 17), the river is less moderately important than land use land cover and road where as elevation is strongly less important than the road and land use land cover. Like elevation, slope is also strongly less important than land use land cover and road, but moderately less important than a river. In other hand, Museum is very strongly less important than land use land cover and road as well as very moderately less important than a river, but moderately less important than slope and elevation. At the end, the urban area is extremely less important than land use land cover and road, but very strongly less important than a river. It is also strongly less important than slope and elevation, but moderately less important than a museum. The diagonal cells in the matrix contain a number 1 because the variables were compared with themselves. Generally, in the above matrix only the lower left triangle half was evaluated because the upper right was symmetrically identical and the cells in the matrix were indicates the evaluation of each pair of comparisons.

The Eigenvector of weight generated in the IDRISI software module was used to produce a relative weight for all seven factor maps that was used to control their influence in weighted overlay tool in ArcGIS environments. As indicated in the following (Table 18), this module produced a set of weights for each parameter that sum to1 which was used as input for multi criteria evaluation.

Table 18**:** Eigenvector of factor map weights (own processing, 2017)

No	Factor maps	Eigenvector weight	Weight in (%)	Consistency ratio
1	LULC	0.3446	34.46	
2	Road	0.2845	28.45	
3	River	0.1545	15.45	
4	Elevation	0.0902	9.02	0.08
5	Slope	0.0651	6.51	
6	Museum	0.0412	4.12	
7	Urban area	0.0199	1.99	

The above (Table 18) consistency ratio of Eigenvector weight shows how each individual factor rating would have to be changed if they were to be perfectly consistent with the best fit weightings achieved. According to Saaty (1980) if consistency ratio is less than 0.1 the judgment is within the consistency limit and its value were consistent and acceptable. But, when its value is greater than 0.1, the judgment is out of the acceptable limit and should be reconsidered again to make a consistent rating between the factors that considered in the study. Therefore, the consistency ratio in the current study was 0.08 which was an acceptable one.

As indicated in the above Eigenvector weight, Land use, land cover is the most important determinant factor for selection of a potential ecotourism site with Eigenvector weight of 34.46%, which was followed by road and river with an Eigenvector weight of 28.45% and 15.45% respectively. Whereas the other remaining factors that were employed in this study includes elevation, slope, museum and urban area hold 9.02%, 6.51%, 4.12% and 1.99% of Eigenvector weights respectively.

The finding of this study is consistent to the works of (Ananda and Herath, 2009; Daniel, 2009; Jankowski, 1995; Tewodros, 2010; Yechale and Leul 2015). Accordingly, these studies share a common argument on the importance of integrating GIS and AHP techniques in solving potential suitable site selection problems as they considered both physical and socioeconomic factors in the suitable site screening. As suggested by the above researchers, the current study was also employed the integration of GIS and AHP methods to identify a potential ecotourism site in Masha district.

4.2.2. Results of weighted overlay

The weighted overlay tool is a vital tool in ArcGIS environment that helps to solve the problems which arise due to different influential value of the various criteria in potential ecotourism site selection. In the current study, all the weighted and standardized criteria that used in the analysis were combined together with weighted overlay tools to generate a final suitable ecotourism map of the district.

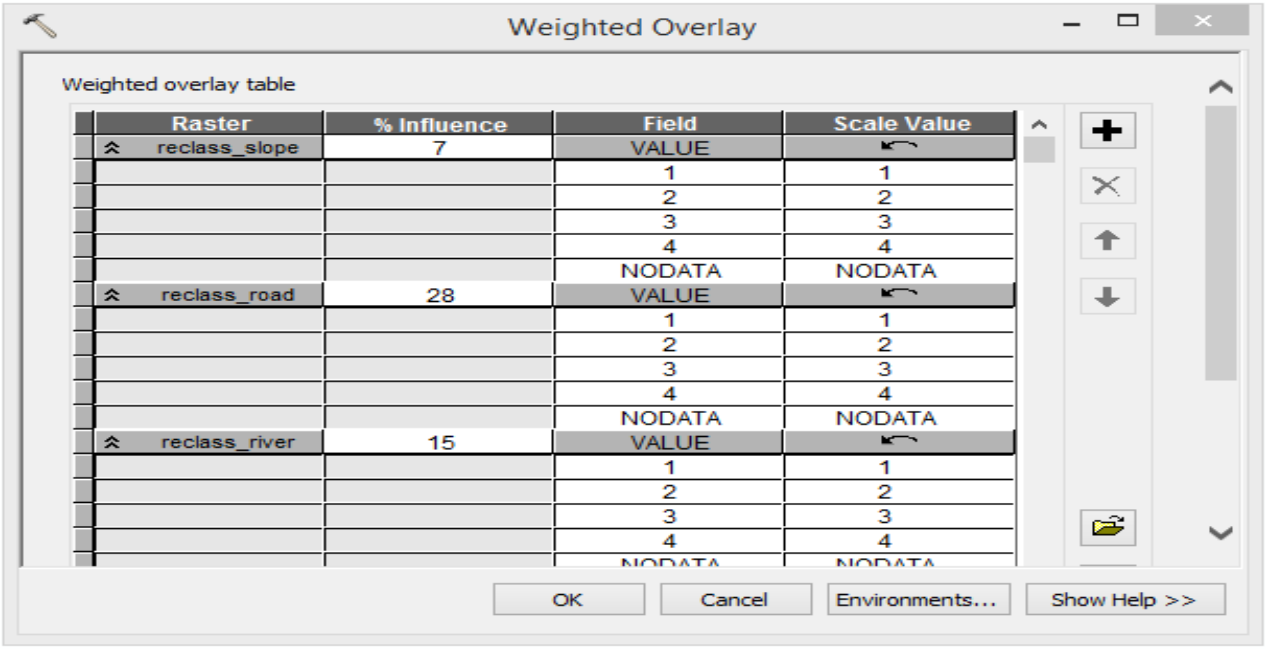

Figure 20: weighted overlay tool in ArcGIS environment

The following (Table 19) clearly indicates the suitability classes and percentage shares of final weighted overlay map of the district that paves the way which policies and strategies should be formulated for the development of ecotourism in the study area.

Table 19: Weighted overlay results for each suitability class (own processing, 2017)

No	Suitability class	Areal in (ha.)	Area in %
1	Highly suitable	17274.52	21.2
2	Moderately suitable	48140.20	59.0
3	Marginally suitable	15955.40	19.5
4	Not Suitable	286.44	0.4
	Total	**81656.56**	**100**

According to the obtained results from weighted overlay suitability (Table 19), the area with about 17274.52 hectares (21.2%) was found as highly suitable for potential ecotourism development

because these areas fulfilled both physical and socioeconomic criteria used in the current study. The largest part of highly suitable area lies in the central, northern, northwestern, southern, southwestern part of the district. These areas can be used as the main ecotourism attraction site because the area is endowed with evergreen forests, wildlife (both flora and fauna), and rich cultural and historical heritage. Whereas the area with about 48140.20 hectares (59%) was classified as moderately suitable for ecotourism development and lays all most all parts of the district excepts some extreme part of northeastern, northwestern, southeastern, and some central part of the district. The areas were also characterized by their green areas, forest covers and unique natural landscape. These largest portion of moderately suitable site in the district is also significantly important for conservation and environmental sustainability that can be developed in ecotourism through improvement of infrastructure and other ecotourism services.

In other hand, the area with about 15955.40 hectares (19.5%) of the district was found as marginally suitable for potential ecotourism site. The largest portions of this area located in the northeastern and southeastern part of the district. Its smallest portions were also lying in southwestern, northwestern and some central part of the study area. However, the area with only about 286.44 hectares (0.4%) of the district were considered as not currently suitable for potential ecotourism site and located in the extreme northeastern part of the district because these areas were unable to fulfill the standards used in the present study. The areas under marginally and not currently suitable categories are less important for ecotourism activities and environmental sustainability that should be developed to ecotourism through continuous impact assessment, reasonable environmental plan and management.

The suitability map of the district (Figure 21) clearly shows that the area has a great ecotourism potentials to be developed into ecotourism. The results of this study basically useful for the development of ecotourism and conserving its biodiversity from being destroyed. These areas can be used for research, education, natural resource management and community based ecotourism development with the certain limitations and guidelines for those areas involves the most sensitive areas. Some guidelines to protect the ecosystem in the area includes restricting the number of tourists, limiting the duration of accessing the area and reducing the amount of visitor pressure in these areas in order to keep the originality of the site because once they are destroyed it was difficult to rehabilitate. Similar to the present study, Bunruamkaew and Murayama (2012) and

Yechale and Leul (2015) were recommended to develop any necessary codes of conduct for the sensitive areas to conserve and manage in a sustainable way.

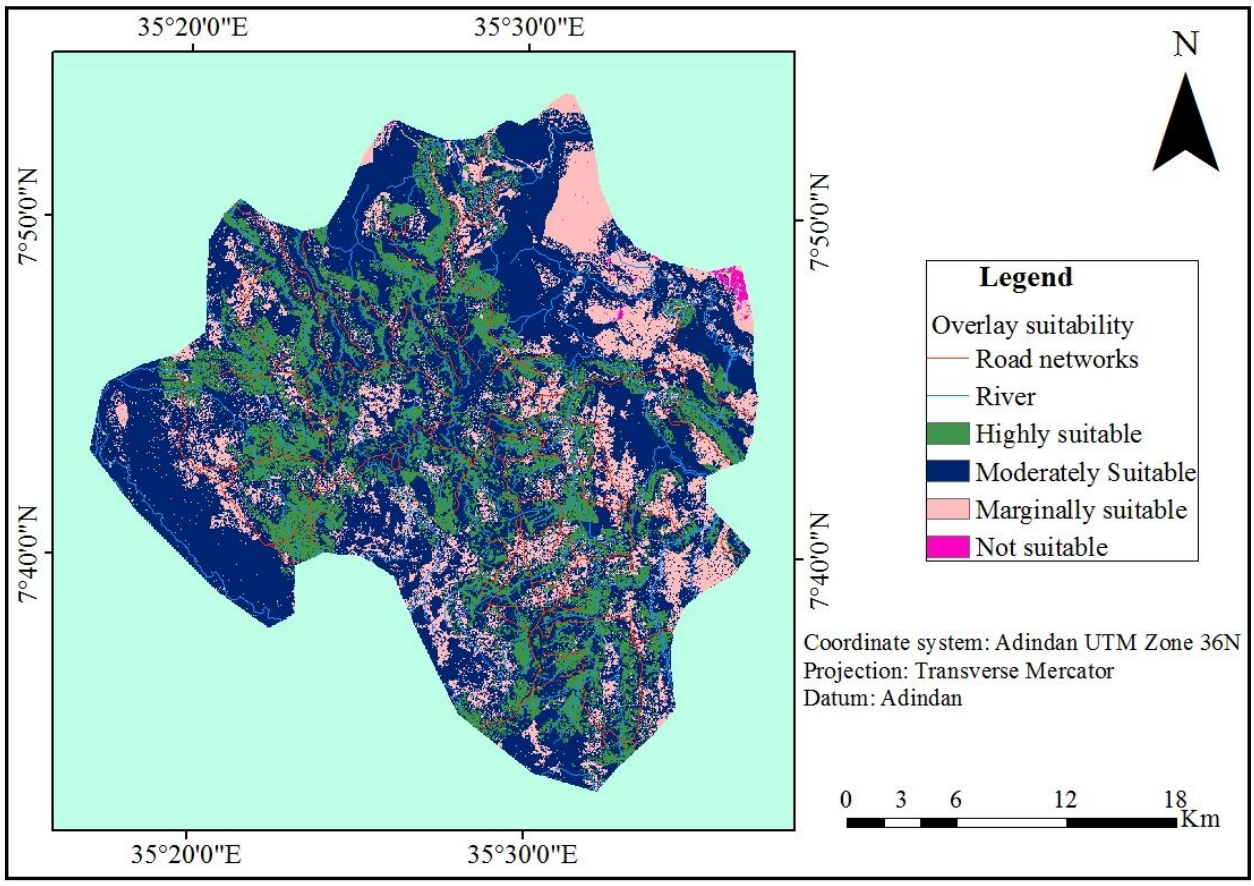

Figure 21: Weighted overlay suitability map

4.3. Thematic map of highly suitable ecotourism site

Thematic map is a type of map that is designed to show the distribution of the highly suitable potential ecotourism site in the district that fulfilled all the criteria that was selected for the current study. As shown in the above (Figure 21), weighted overlay ecotourism suitability map contains all suitability classes, namely highly suitable, moderately suitable, marginally suitable and not currently suitable for potential ecotourism site of the districts. Therefore, it is essential to show only highly suitable ecotourism site of the district to take a reasonable decision for the development of the ecotourism sector in the study area. In order to produce the thematic map of the selected suitability class, the raster map of weighted overlay result was converted into polygon by using the conversion tool in ArcGIS environment. After the conversion process, the shape file of highly suitable area was selected and exported in ArcGIS software to generate the final thematic map of highly suitable site as shown in the following (Figure 22).

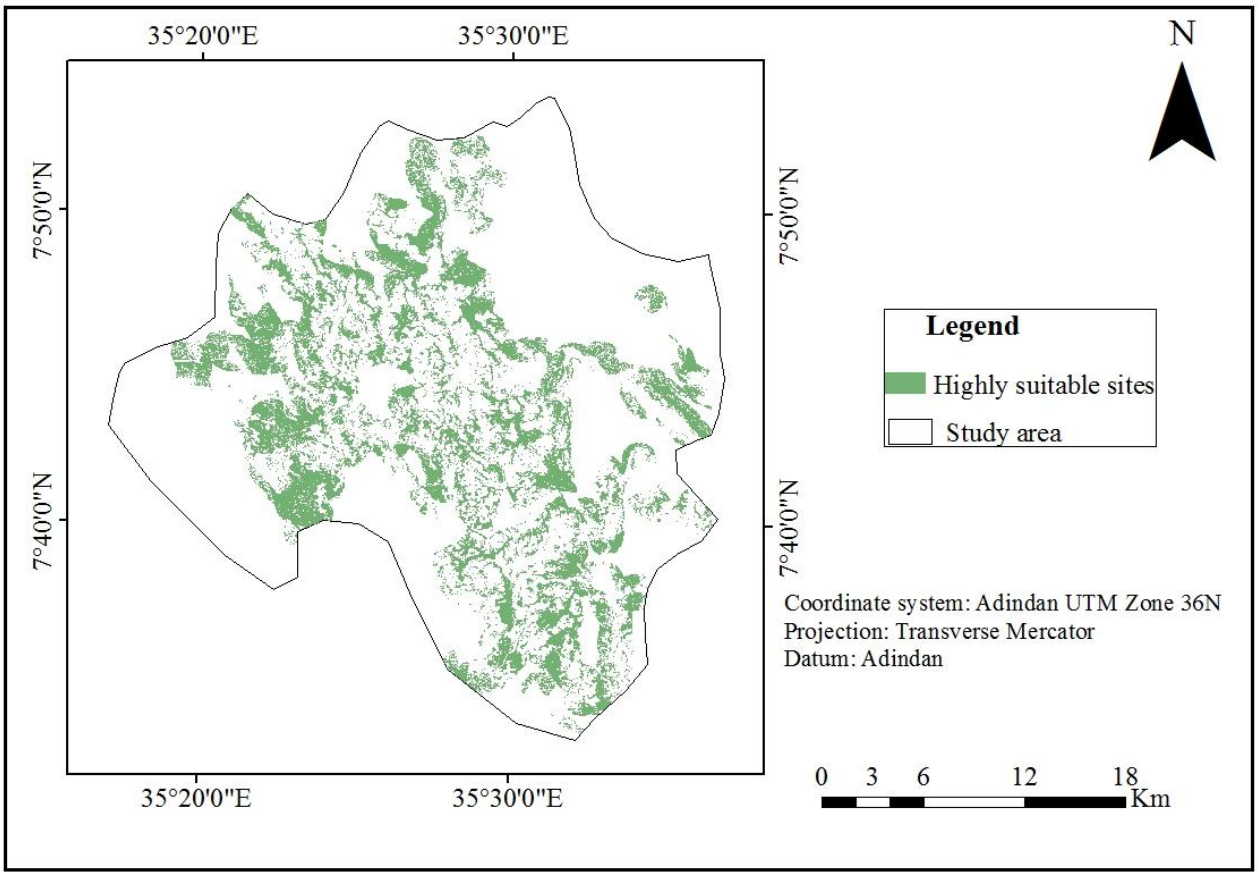

Figure 22: Thematic map of highly suitable ecotourism site in the district

4.3. 1. Types and status of potential ecotourism site in Masha district

According to the expert's opinion, the district was rich with historical, cultural and natural ecotourism attraction types. This is because there was a long history of protecting and managing these entire attraction sites, including the forests in the district. The people in the study area have also a deep rooted culture of conserving flora and fauna species. Forest and other landscape like steep slope, hill land and wetland have special cultural values among the communities in the district. Specially, forests have given a valuable consideration by the society due to their traditional and religious beliefs. For example, there is worshiping activities taken place in a protected forest area like sacrificing animals. These activities enhance the management and conservation of forest from being cut. Due to this kind of conserving and protecting habit of the people in the study area, the forests and other ecotourism attraction resources were well known in the district. Till now in the some parts of the district, there are few members of communities' practices these traditional systems of protecting the resources from being destruction. Such types of the traditional practices

have emphasized harmony between man and nature that plays an important role in biodiversity conservation.

On the contrary of the above paragraph, all respondents were arguing that this kind of protecting and conserving forests and resources within forest becomes diminished due to increasing of the communities who were not willing to participate in the practices of forest conservation in traditional and religious ways. Now a day, the forest and other endemic biodiversities in the district were under threat due to the increasing demands of the people for agricultural land, the rising demand of charcoals and increasing of large scale tea plantation in and around the forest area. These increasing of deforestation and other pressures on forest area resulted in diminishing of flora and fauna in both quantities and qualities in the district.

In order to rehabilitate and protect ongoing biodiversity and to keeping the traditional ways of conserving and managing the resources in the district, a development of ecotourism can play a vital role because its aim is to conserve natural environments and improving the economy of local communities through making the environment sustainable. Therefore, the development of the ecotourism sector in the study area can reverse the above situation of both natural and cultural resources which were at risk in the district.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1. Conclusion

Masha district is one of the most biodiversity rich areas in Ethiopia mainly for its endemic and threatened flora and fauna species. Despite these huge potential areas in the district, ecotourism is not well developed and its potential area remains untouched and delineated in terms of ecotourism destination.

This research was intended to identify the suitable site for ecotourism. Thus the integration of GIS and AHP based land suitability analysis has been used to determine the suitability of ecotourism in Masha district by using both physical and socioeconomic factors, namely land use land cover, elevation, slope, river, road, distance from the museum and urban areas. The overall consistency ratio (0.08) between these criteria was within acceptable limits which was less than 0.10. This implies each individual factor ratings were perfectly consistent with each other. Afterward the highly suitable ecotourism site of the district was selected.

The findings of the current study reveal that 21.2% of the study areas were highly suitable for potential ecotourism site. These selected sites were fulfilled all the standards used in the analysis and lies in the central, northern, northwestern, southern and southwestern part of the district. Only 0.4% of the district were considered as not currently suitable site and located in the extreme northeastern part of the district. Whereas the remaining 59% and 19.5% were classified as moderately and marginally suitable sites for ecotourism development respectively.

5.2. Recommendation

Based on the major findings of this study the following recommendations are forwarded:

- The current study shows that the district has 21.2% of highly suitable potential area for ecotourism development and the area is endowed with evergreen forests, endemic wild animal as well as rich with cultural and historical heritages. Therefore, a concerned body should develop the area as an ecotourism destination by facilitating proper ecotourism infrastructure and services.

- A demonstrative plan is needed for ecotourism development based on locally available natural and cultural resources. This will help to conserve and maintain the biological richness of the areas and provide employment opportunities for the local people.

- Sustainable development of ecotourism requires the balance between the tourists, people and the host community. Therefore, a management level government should involve local people along with NGO and private organization in planning and management of ecotourism.

- Types, distribution and location of both flora and fauna should be well studied and mapped because their benefit as an ecotourism attraction is vital.

- Additional investigation is needed for highly suitable ecotourism sites to abstain from travelling in sensitive areas which are easily affected and difficult to rehabilitate to its original conditions.

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APPENDIX 1

QUESTIONNAIRE TO BE FILLED BY EXERTS

JIMMA UNIVERSITY COLLEGE OF SOCIAL SCIENCES AND HUMANITIES POST

GRADUATE PROGRM DEPARTEMENT OF GEOGRAPHY AND ENVIRONMENTAL

STUDIES

Msc In GIS and RS

Annex 1: Questionnaire filled by selecting governmental office workers

The aim of this questionnaire is to gather information from experts regarding potential ecotourism sites in the study area. This research is undertaken purely for academic purpose. Thus, the fact that you have been selected is quite systematically and your participation in this questionnaire is voluntary. The information you provide will be treated as confidential. It will be processed in the computer in such a way that no personal identification will be possible. Since your response is valuable for the mentioned objective, the writer politely requests you to give your answers to the stated questions as much as possible as you can. To get accurate information and to reach the final goal of this study, the researcher politely asked you to answer questions honestly.

I greatly appreciate for your cooperation!

I. Background Information

1. Offices of the respondents----------
2. Address of respondents----------
4. Phone number----------
5. Sex of the respondents A. Male B. Female
6. Educational level of respondents----------
7. Position of the respondents. A. Expert B. Coordinator C. Head of department/office
8. Your growth monthly income ---------- Birr.

II. Ecotourism attraction site

1. Is there any potential ecotourism site found in Masha *woreda*?

   A. Yes B. No

2. If yes, what types of ecotourism sites are existing?

   A. Natural B. Historical C. Cultural D. All

3. How these ecotourism sites are conserved in your area----------
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4. What look like the distribution of ecotourism in your area?

   A. Densely distributed B. Moderately distributed C. Sparsely distributed

5. What are the major factors that determine potential ecotourism site selection in your area? ----------
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6. What is the status of a potential ecotourism site in your area----------
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7. Below the table, put '×' mark, list their names, location and distance from main the road if listed ecotourism attractions site exists in your *woreda*. Then rank these attractions site according to their degree of attractiveness (give least number like 01 for the most attractive site and highest number for poorly attractive site).

No.	Lists of possible ecotourism attraction sites	Does it exist in your area? If yes, put,"×"	Name	Location	Distance from main road Location	Rank	Remark
1	River						
2	Forests						
3	Protected area						
4	Reserve						
5	Unique species						
6	Wildlife						
7	Unique landscape						
8	Wetland						
9	Weather condition						
10	Mountain						
11	Grazing land						
12	Farm land						
13	Open land						
14	Waterfall						
15	Cave						

APPENDIX 2

Figure 23: Forest area around Kewo kebele (source: field survey)

Figure 24: Forest area around Abelo kebele (source: field survey)

Figure 25: Gaha mawo waterfall (source: field survey)

Figure 26: Foni waterfall (Source: field survey)

Figure 5: Evergreen forest (source: field survey)

Figure 28: Meneshi waterfall (source: field survey)

Figure 29: Attractive cave and waterfall (source: field survey**)**

Figure 30: Shekisheko waterfall and cave (source: field survey)



Figure 31: Traditional clothing style, jewelry and others (source: field survey)

Figure 32: Some of wild animal in the study area (source: MDCTCO, 2016)

APPENDIX 3: Ground control points

No	LULC and ecotourism attraction sites	X_ coordinate	Y_ coordinate	Elevation
1	Forest	773259	852387	2355
2	Forest	773168	853595	2323
3	Forest	769498	857713	2265
4	Forest	768125	864478	2117
5	Forest	767914	862784	2159
6	Forest	773406	853530	2319
7	Forest	775102	858844	2001
8	Forest	776228	868468	1734
9	Forest	775857	870351	1776
10	Forest	777398	872755	1772
11	Forest	779058	863457	1725
12	Forest	777207	858919	1792
13	Forest	776668	855909	1906
14	Forest	776393	853606	1956
15	Forest	775283	851427	2311
16	Forest	774904	849040	2374
17	Forest	774005	847924	2365
18	Forest	772913	845294	2406
19	Forest	772073	844283	2465
20	Forest	772303	845583	2428
21	Settlement	776348	844480	2390
22	Settlement	776549	844910	2396
23	Settlement	776609	844379	2379
24	Settlement	776704	844587	2365
25	Settlement	776081	843917	2412
26	Settlement	772634	857042	2265
27	Settlement	772749	856989	2277

28	Settlement	772954	856804	2269
29	Settlement	773004	856405	2241
30	Settlement	773527	856394	2222
31	Settlement	773837	856198	2208
32	Settlement	773631	855523	2268
33	Settlement	773750	855699	2249
34	Settlement	773008	856413	2241
35	Settlement	773059	856541	2262
36	Settlement	773001	856656	2274
37	Settlement	773033	856735	2278
38	Settlement	773111	857158	2270
39	Settlement	772926	857568	2250
40	Settlement	772851	857769	2237
41	Settlement	772728	857989	2224
42	Settlement	772924	857853	2228
43	Settlement	772929	857648	2247
44	Crop land	773008	857615	2243
45	Crop land	773365	857470	2232
46	Crop land	773280	857512	2234
47	Crop land	773391	857357	2239
48	Crop land	773265	857220	2247
49	Crop land	773237	857248	2255
50	Crop land	773396	856966	2229
51	Crop land	773315	856872	2243
52	Crop land	773274	856386	2237
53	Crop land	772858	855856	2277
54	Crop land	772822	856118	2256
55	Crop land	772712	856201	2252
56	Crop land	772036	855710	2302
57	Crop land	772117	855297	2290
58	Crop land	773000	853460	2325

59	Crop land	773107	853328	2326
60	Crop land	773138	853290	2329
61	Crop land	773582	852879	2332
62	Crop land	773771	852602	2334
63	Crop land	773709	852805	2326
64	Crop land	774212	852900	2316
65	Open land	768232	854154	2348
66	Open land	767960	855065	2336
67	Open land	768588	854477	2340
68	Open land	769118	853718	2346
69	Open land	769151	853155	2338
70	Open land	769768	853268	2330
71	Open land	770870	852641	2334
72	Open land	771849	851399	2373
73	Open land	773276	851283	2353
74	Open land	773501	850648	2372
75	Open land	772760	869058	1726
76	Open land	773654	867732	1739
77	Open land	774224	867998	1730
78	Open land	773940	866203	1763
79	Open land	773525	865188	1792
80	Open land	772415	864715	1884
81	Open land	773646	860544	1973
82	Open land	773941	860217	1965
83	Shato forest nearby Baro river	776292	869113	1688
84	Shekisheko water fall and cave	768945	864041	2161
85	Atile Abakaki cave and water fall	766264	855548	2278