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Site Suitability Evaluation of Ecotourism Potentials for Sustainable Natural Resource Management and Community Based Ecotourism Development: *The Case of Bench Maji Zone, South Western Part of Ethiopia*

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Abstract: The main purpose of this study was to identify and prioritize the potential ecotourism sites in Bench Maji Zone, Southwestern part of Ethiopia. This work was assessed the potential suitable areas for ecotourism based on bio-physical characteristics of the land ecosystems and socio-economic data. These are landscape (land use land cover), vegetation density (species diversity), topography (elevation and slope) and accessibility (distance from roads). These criteria and factors were selected according to the professional expert's opinions. First, a resource inventory and a list of ecotourism criteria were developed using the Analytical Hierarchy Process method. At the next stage Geographic Information System techniques were used to measure the ranking of different sites according to the set criteria and thus identify those with the "best" potential. Subsequently, the land suitability map for ecotourism was created, based on the linear combination of the criteria and factors with their respective weights. The degree of suitability of each factor was classified as highly suitable (S_1), moderately suitable (S_2), marginally suitable (S_3) and not suitable (N) for ecotourism. Based from the suitability map, the areas of highly ecotourism potential (S1) are located in north eastern and western part of the zone especially Shay Bench, North Bench, south western part of Guraferda, western part of Maji and, some parts of Sheko and Bero. These areas can be used for education as well as natural resource management and community based ecotourism development. It could serve as main ecotourism attractions but with the use of certain limitations and guidelines. The areas of moderately ecotourism potential (S2) are located in north Guraferda, Sheko, Minit Shasha and Goldiya districts. It can be developed as ecotourism destination by facilitating proper ecotourism infrastructure and services. These areas can still be considered for ecotourism attractions. The marginally suitable areas are appropriate for tourism development in general. These areas are located in southern part of Maji and western part of Surma and Minit Shasha. They are the most appropriate areas for development. However, the not suitable areas are currently not suitable for ecotourism, including areas with several effects of development and degraded environment. As concerns of their utilization, they may have some environmental problems but these are controllable. These are located in the central parts of Guraferda, Maji, South Bench, Minit Goldiya, Minit Shasha and eastern part of Surma.The methodology proposed was useful in identifying ecotourism sites by linking the criteria deemed important with the actual resources of the Zone. This study result helped to identify whether the land has been used by optimally or renovate for future development within Bench Maji Zone. The result appears practically useful for tourism facilities development and ecotourism resource utilization where ecotourism could be more developed in near future. Geographic Information System can then subsequently evaluate dynamic patterns of land use land cover as well as, providing a new tool for ecotourism planning in Bench Maji Zone. Analytic Hierarchy Process was effectively used to calculate the details of the factors and class weights. Likewise, this study can be used as a basis for evaluating the suitability of other areas for ecotourism. Additionally, it may also serve as a starting point for more complex studies in Bench Maji Zone.

Keywords: Suitability, Community Based Ecotourism, Natural Resource Management, Geographic Information System, Analytic Hierarchy Process, Multi Criteria Process and Bench Maji Zone.

Background: Relevance and the State of Knowledge

We did not inherit the earth from our grandparents. Rather, we have borrowed it from our grandchildren (Native American proverb).

Throughout the world millions of people live in extreme poverty, struggling each day to meet the bare necessities for survival while lacking access to education and employment. Thanks to tourism industry, many developed and developing countries get a lot, but it does not operate in a predictable and mechanistic environment and is influenced by unpredictable circumstances [1]. It has long been recognized for its dynamic character and economic potential for boosting trade and opening up regions that lag behind in their

development. According to Frangialli [2], tourism in the 21st century [is] the world's fastest and biggest industry. The majority of tourist receipts go to developed countries, but the developing countries' share has been rising steadily since the late 1960s [3].

Frangialli [2] further argues that along with its phenomenal growth and size, the tourism industry will also have to have more responsibility for its extensive impacts, not only its economic effects, but also the impacts on the environment and societies of host populations. To the host population, tourism is often a mixed blessing. Tourism is bound to bring about changes in society, since it is a powerful medium affecting change. These changes can be both socioeconomic and cultural as well as changes in access to and use of the natural resource base, which many resources should be initiated by the tourism industry than any sector [5].

Many reasons may tend to influence a researcher's choice of a particular topic. In this case, site suitability evaluation of ecotourism potentials for sustainable natural resource management and community based ecotourism development in Bench Maji Zone and its environs is the choice of the study. The presence of tourists has become an important feature in everyday life of many Ethiopians, in both rural and urban areas [6]. However, the first problem is when the rationale for tourism development has been discussed within the country; it is often conceived in macroeconomic terms: generation of foreign exchange, government revenue and employment. Because the word *tourism* was first introduced or understood as a factor in economic development and the term *socio-cultural and environment* were absent in much tourism literature during the 1960s and 1970s. Mainstream theories of development focused mostly on the economic processes in material transformation. They devoted less attention to the ecological, cultural and socio-political context within which the economy operates. This has contributed to the dominance of economic policies in the political arena, with governments often paying slight attention to the impact of such policies on culture and nature. The proponents of alternative development want to change that situation and thereby give a new meaning to development [7].

The second problem is that Ethiopian tourism's environmental and social footprint is particularly troubling in light of its speedy growth and predictions for continued expansion. It has detrimental environmental and social impacts to natural resources, historical sites and cultural heritage if it is not planned and controlled. However, the tourism industry must be the more concerned than any other sector in the environmental protection and cultural preservation since people in the third world are dependent upon for their livelihood [4].

The growing concern for the adverse environmental effects of mass tourism, coupled with the emergence of alternative forms of tourism such as *ecotourism*, has initiated an immense debate on whether the latter could, indeed, lead to greater sustainability in the long term. As a matter of fact, ecotourism is an alternative form of tourism that has been constantly gaining ground at a global scale during the past few years. Its fundamental principles refer to minimizing negative impacts on the environment, respecting the local cultures and actively contributing to the economic and social well-being of host communities, as well as conserving the natural environment. Therefore, sustainable use of these

the survival is rely upon the existence of natural and manmade resources [8].

Thirdly, Bench Maji Zone and its environs are not very well exploited in terms of ecological and sociological tourism destination which is very important to have the knowledge of the area and to undertake proper planning and management of natural resources [9].

Finally, ecotourism development is one of the missions of Mizan - Tepi University and analysis of different literatures indicated that most of the studies have not been focused on sustainable management of natural resources and community based tourism development relating to ecotourism in and around Bench Maji Zone. Even the studies that have been made are sketchy and isolated; they shed very little light on the subject matter. In order to promote the development of an appropriate kind of tourism, *ecotourism*, which prevents or minimizes cultural and environmental degradation, more in-depth studies are needed for an understanding and smooth running of the tourism industry with other sectors. For these reasons, exploratory research on site suitability evaluation of ecotourism potentials for natural resource management and community based ecotourism development is conducted to understand the problems and how it should be adapted to the sustainable development framework in this huge ecotourism potential destination.

This study is a modest attempt to highlight site suitability evaluation of ecotourism potentials for sustainable natural resource management and community based ecotourism development in and around Bench Maji Zone, because tourism potential is not an end by itself to the sustainable development of Ethiopian tourism and no one lives on potential alone. Therefore, in order to show ecotourism potentials and

its contribution for sustainable natural resource management and community based ecotourism development, the researcher formulated the following basic research questions.

1. How to identify and prioritize suitable potential sites for ecotourism development in Bench Maji Zone?
2. How to map ecotourism potential sites in Bench Maji Zone and its environs?

Therefore, the main objective of the study is to identify, prioritize and map the potential ecotourism sites for sustainable natural resource management and community based ecotourism development in Bench Maji Zone, south western part of Ethiopia.

Materials and Methods of the Study

Bench Maji Zone has a total area of 24, 554.16 square kilo meters and astronomically, it lies between 5.33^0 to 7.21^0 north latitude and 34.88^0 to 36.14^0 east longitudes with an elevation ranging from 374 meters to 2639 meters above sea level. Relatively, it is located within the Southern Nations, Nationalities and Peoples Region (SNNPR), in the South Western part of Ethiopia. It is bordered on the south by the Ilemi Triangle, on the west by Sudan, on the northwest by the Gambela Region, on the north by Keficho Shekicho and on the east by Debub Omo. It comprises eleven districts (Sheko, Guraferda, Debub Bench, Shay Bench, Meinit Goldeya, Meinit Shasha, Maji, Bero, Surma, Semen Bench and Mizan Aman town woreda). Regarding the agro-Ecology of the zone, out of the total land size 28.042% is kolla, 15.44% weinadega and 56.74% dega. The main food crops in this Zone include maize, godere (Taro root), and enset, while sorghum, teff, wheat and barley are cultivated to a significant extent. Although cattle, shoats and poultry are produced in limited numbers, meat and milk are very much appreciated. Cash crops include fruits (bananas, pineapples, oranges) and spices (coriander and ginger); honey is also an important local source of income. However, coffee is the primary cash crop. The terrain of the area is extremely diverse: it is surrounded by mountains, deep gorges and rivers. All these natural elements host a very rich biodiversity in terms of flora and fauna. A special attraction of the area is the existence of some rare species of mega-fauna and flora. Yet, the remarkable natural and ecological value of the area is not the only feature that attracts high numbers of visitors from Ethiopia and abroad. The area of Bench Maji constitutes, at the same time, one of the most original and well preserved forest areas in the country and these makes the area preferable for ecotourism development.

Based on the 2007 census conducted by the CSA, this Zone has a total population of 652, 531, of whom 323, 348 are men and 329, 183 women. It has a population density of 33.89. While 75,241 or 11.53% are urban inhabitants, a further 398 or 0.06% are pastoralists. A total of 157,598 households were counted in this Zone, which results in an average of 4.14 persons to a household, and 151,940 housing units. The built up environment of this area is also unique, with local architecture being deeply influenced by tradition and the natural environment. The preservation of the authentic character of the built environment in Bench Maji is required by law, since all buildings in the area must be constructed with the use of local materials and in compliance with the local architecture.

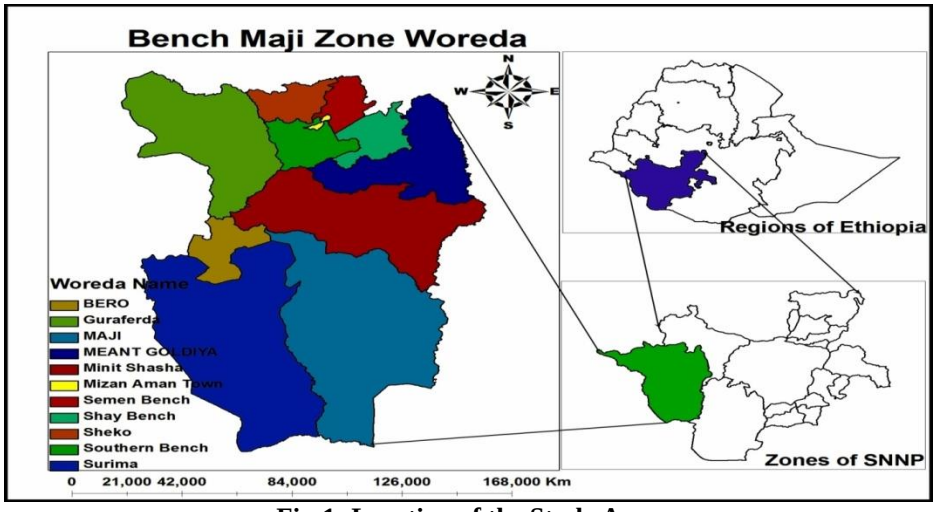

Fig-1: Location of the Study Area

Materials

Data Used and Thematic Maps

This study focuses on land suitability evaluation of ecotourism in Bench Maji Zone and its environs using GIS and AHP techniques. Data used were collected to assess the indicators of land utilization in various altitudinal ranges. Data gathering included field surveys, laboratory analysis and secondary data

collection from various organizations and individuals. A collected material includes annual reports along with statistical data, and other documents related to tourism projects and research.

Firstly, the primary data from the field survey were collected through interviews and questionnaires. The experts were selected according to their knowledge in sustainable development and their experience in tourism, ecology, economic, wildlife conservation, social science, natural resource management and GIS. Majority of the secondary data were gathered from land use land cover map 2007 and topography map of the study region. Majority of the demographic and socio-economic figures are based on the population census of 2007 from the Central Statistical Agency. In addition, national and international institutions are also contacted of GIS datasets for the collection of necessary information and literatures. The thematic maps were prepared and edited, overlaid and visualized on the basis of the suitability analysis for ecotourism using ArcGIS 10 software of ESRI. The application of GIS for overlaying thematic layers to establish land databases requires that all the layer maps need to be converted into a common coordinate system.

Interview, Meeting and Discussion

As mentioned above, the primary data collection was accomplished by using a survey questionnaire which is one of the important social research methodologies. Direct and indirect unstructured interviews were also done with the experts. Formal and informal interviews and group discussion were also conducted during the field survey to gather more information. A first round survey using questionnaires were used to converge and identify priority criteria and factors for the sustainable management of ecotourism in Ethiopia. The information derived from this study was used to develop a set of criteria and factors of land suitability evaluation for ecotourism in land ecosystems of Bench Maji Zone and its environs. It is also used to identify problem in the study area. Conclusion was derived from attribute data. A final round survey using questionnaires were used to identify and prioritize the potential ecotourism sites.

Distributed Questionnaire to Contracted Experts

In order to produce land suitability map, actual factor weight and class weight (or rating) for parameters involved in the study are needed. These were determined systematically based on the AHP. The priority of each factor involved in the AHP analysis is determined based principally on the expert's opinions. The method is implemented using the pair wise comparison technique that simplifies preference ratings among decision criteria. The first step of this procedure is to make pair wise comparisons between the vendors for each criterion. The standard scale for making these comparisons is shown in Figure 2.

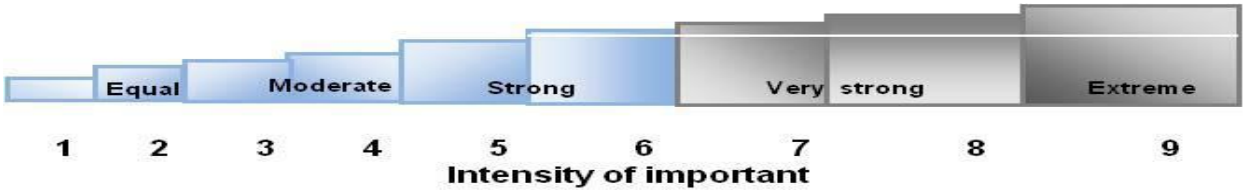

Fig-2: Preference scale for pair wise comparison in AHP

The first step of the analysis was designing questionnaires (Table 1) where expert opinions were asked to determine the relative importance of the involved criteria and factors. Results of the comparison (for each factors pair) were described in term of integer values from 1 (equal value) to 9 (extreme different) where higher number means the chosen factor is considered more important in greater degree than other factor being compared with. Moreover, to ensure the credibility of the relative significance used, AHP also provides measures to determine inconsistency of judgments mathematically. In this study, the questionnaires were distributed to experts and follow up interviews were conducted in all cases, to ensure that the respondents understood the contents of the questionnaire.

Methods

Software Used for Data Management

Research methods include collection of available data and a new field work data, data analysis using various tools and techniques. Microsoft word was used for the write up this paper setting. Macro created on Microsoft Excel software was used for multi criteria analysis (weighting, rating) based on the AHP method [10]. ArcGIS 10 software was used to analyze all the factors represented by GIS thematic layers and to produce the ecotourism suitability map. The map overlay approach was applied following the concept of Weighed Linear Combination (WLC).

Mapping Determination Criteria and Factor Involved

The decision criteria and factors are evaluated based on socio-economic factors and bio-physical characteristics of the land suitability evaluation for ecotourism. Based on the acquired information, MCE is done based on four criteria/five factors as indicators of suitability within the land ecosystem of Bench Maji Zone:

1. Landscape (Land Use Land Cover)
2. Vegetation Density (Species Diversity)
3. Topography (Elevation and Slope) and
4. Accessibility (Distance from Roads)

These criteria and factors were chosen based on the opinion experience and expertise of experts and information from various sources. Knowledge acquisition was accomplished through discussions with experts of related fields of study, surveying of authenticated literatures and analysis of historical data. MCDM was applied to incorporate decision maker's judgment and preferences to evaluations regarding to AHP technique. Each factor received a weight and a score which represented its relative importance in the suitability evaluation. The overall results recorded were in form of a pair wise comparison matrix.

The first step in the hierarchy is to set the objective that is to identify and prioritize the potential ecotourism sites. The hierarchy contains decision criteria and factors of this study based on bio-physical characteristics and socio-economic factors. At the second and third levels, the decision of criteria and factor of this study are evaluated based on four criteria and five factors for the suitability analysis for ecotourism. These are landscape/ naturalness (Land Use/Cover), Vegetation Density (Species Diversity), Topography (Elevation, Slope), Accessibility (Distance from Roads). The reclassified factor maps are exported in to **IDRSI** and through pair wise comparison the weight of the factors are obtained. At the fourth level, on running weight overlay modeler using the derived weight on **IDRSI**; suitability raster map were produced and the degree of suitability of each factor classified as highly suitable (S_1), moderately suitable (S_2), marginally suitable (S_3) and not suitable (N).

Table 1: Ecotourism Site Suitability Mapping Criteria and their Use in Analysis

No.	Criteria/Map	Relevance for Ecotourism Site Suitability Map
1	Land Use Land Cover	To consider ecological risk from infrastructure development
2	Vegetation Density	To determine vegetation cover and their attraction
3	Elevation	To stratify elevation suitability for human survive and Preferred
4	Slope	To determine areas which is easily accessible
5	Road	To determine sites that are distance from Road

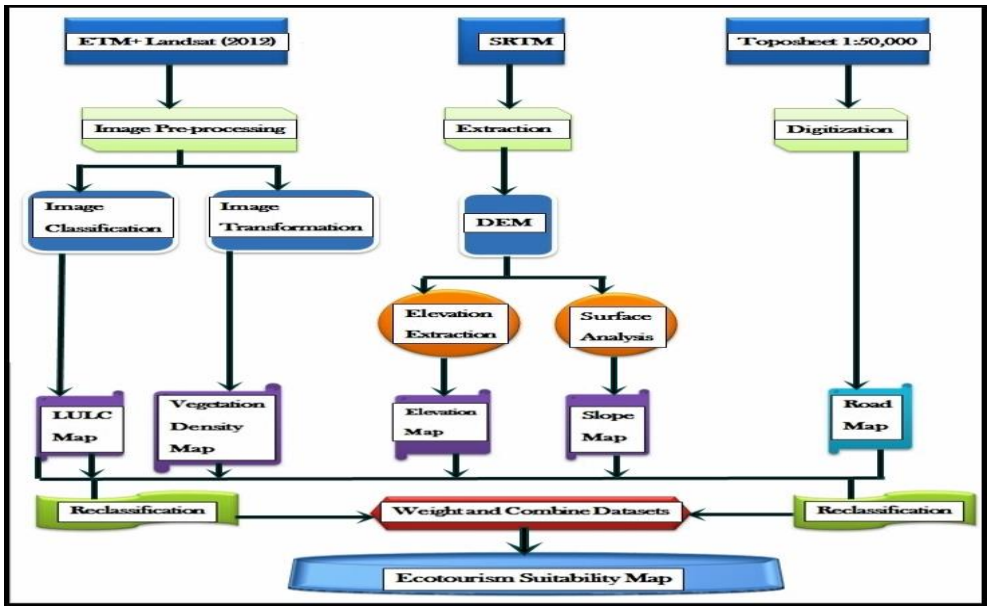

Fig-3: Research Methodology Flow Chart

Land Use Land Cover Mapping

The terms land use land cover has been combined as one entity for the description of the landscape within the area of study. Landsat ETM+ satellite image of the year 2007 was classified using an unsupervised classification method. Figure 4 is show the Landsat ETM+ imagery in true color composition of the study area in 2007.

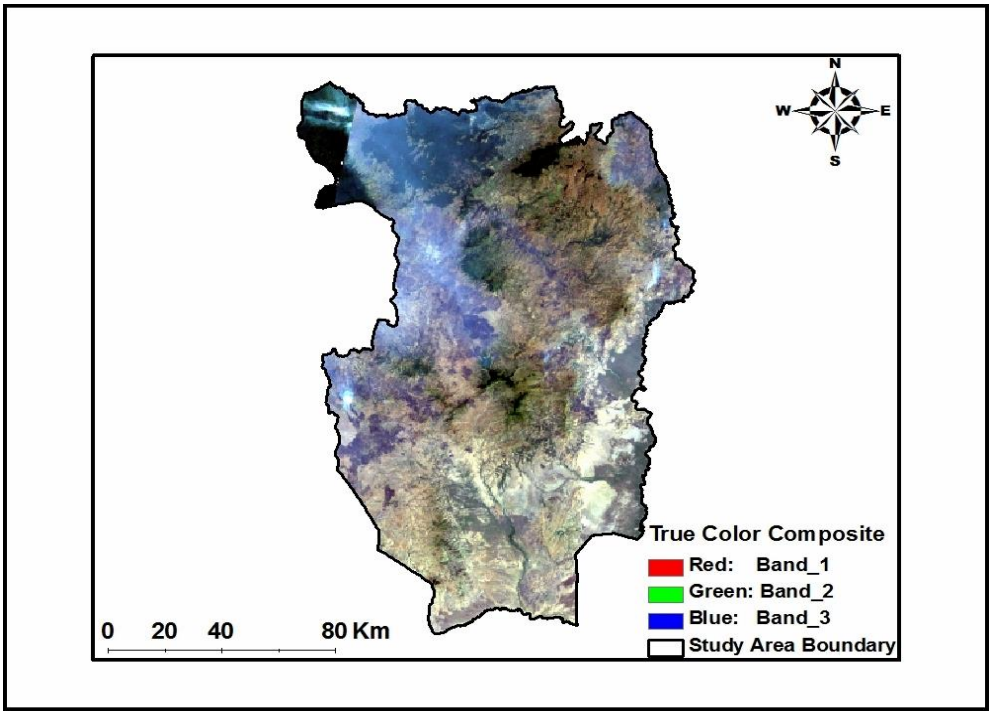

Fig-4: Lands at ETM+ Satellite Imagery in True Color Composition

Land use map in 2007 was classified and reclassified into eight classes of land use/ cover according to bio-physical vegetation characteristics of ecotourism potential resources. These are dense forest, water body, wetland, woodland, grassland, farm land, urban and built-up land, bare land.

Dense Forest: Highly importance for ecotourism, can serve as major ecotourism attraction, area need to be conserved.

Water Body: Active recreation as parks and natural zoological parks

Wetland: Areas around water body (marsh land)

Woodland: Tree cover is sparse with incomplete canopy, a high inter-tree distance and only a single canopy layer for the most part.

Grassland: Area which is covered with grasses

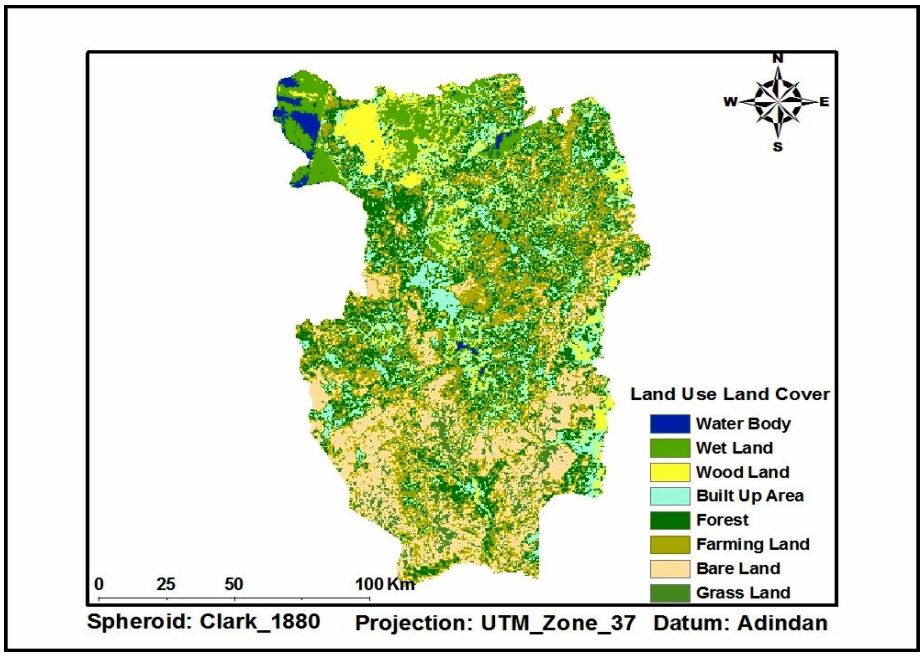

Fig-5: Land Use Land Cover Map of Bench Maji Zone

Cropland and Farmland: Area under agriculture and farm should not be converted to other schemes. Any infrastructure development should be restricted.

Urban and Built-Up Land: Suitable for eco-tourist infrastructure development

Bare Land: Bare land is the land which is devoid of vegetation**.**

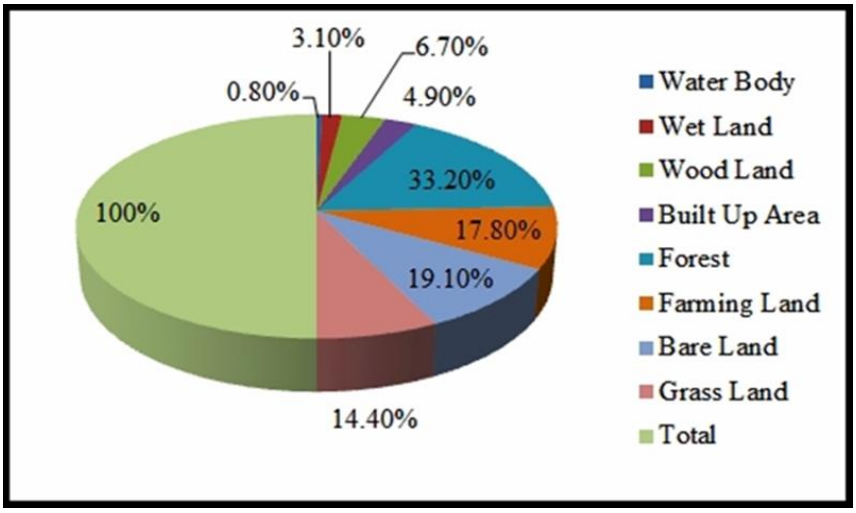

Fig-6: Percentage Share of Land Use Land Cover

Forest is the leading by its area coverage while water body and wetland share the lowest area coverage in Bench Maji Zone. Area coverage of each land use land cover class is shown in the above figure 6 by percentage share. As show in figure 5; forest is occupy 33.2% of land cover, bare land 19.1%, grassland 14.4%, farming land 17.8%, woodland 6.7%, built up area 4.9%, wetland 3.1% and water body 0.8% cover respectively.

Decision Rule and Multi Criteria Evaluation

A geographical information system (GIS) is an information system technology that is used to store and retrieve geographical data, and provides the tools that used to manipulate, analyze and present geographical data. In recent years, it have made a contribution to various facets of tourism resource management and planning. These contributions range from a simple resource inventory to building a spatial decision support system. The development of geospatial-based inventories has introduced flexibility, objectivity and efficiency in managing the spatial database of tourism resources. It provides procedures and tools for acquiring spatial information as well as making data more accessible, repeatable and useable.

Decision rule is a procedure by which criteria are selected and combined to arrive at a particular evaluation, and by which evaluations are compared and acted upon. Decision rules typically contain procedures for combining different criteria in to a single composite index and a statement of how alternatives are to be compared using this index. Base map over the study area were created and used to produce several criterion maps. Each criterion is represented at a map as a layer. Every map represents one criterion and it is called a thematic layer or data layer. They represent in what way the attributes are distributed in space and how they fulfill the achieving of the objective. In other words, a layer represents a set of alternative locations for a decision.

Criteria Used for Ecotourism Site Suitability Analysis

A criterion (factor) is basis for a decision that can be measured and evaluated. It is the evidence upon which a decision is based. Selecting/formulating criteria that need to be fulfilled in order to make the right decision is one of the difficulties in multi-criteria evaluation. For the last three decades, geographic information system (GIS), and multi criteria evaluation techniques have been used in solving site selection problems [11].

The site suitability analysis for ecotourism development map of the study area achieved based on various interrelated components of the environment. Based on literature search, previous works, and interviews with tourism experts; the following criterions are identified.

Land Use and Land Cover Suitability

The entire study area Lands at ETM+ image was classified into eight classes of land use land covers:

water body, wet land, bare land, grassland, forest, farming land, built up area and woodland.

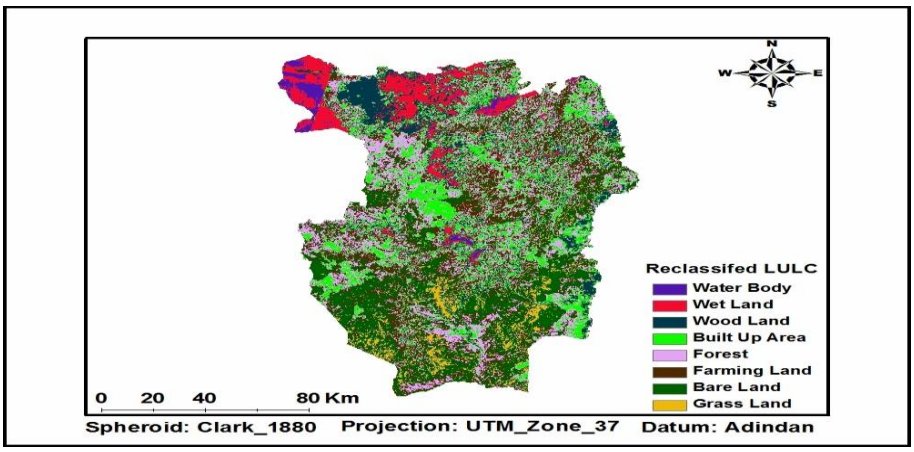

Fig-7: Reclassified Land Use Land Cover Map

Due to its high and diverse ecology carry potential of forest, forest land use/cover is considered as the highest suitable for ecotourism development. Therefore, the highest rank one were given to forest cover, water body was given rank of two, wet land rank three, woodland rank four, grassland rank five, farm land rank six, built up area rank seven and the least suitability eight rank was given for Bare land.

Vegetation Density Suitability

Vegetation density of the study area was generated using NDVI image of the study area. The NDVI is a non-linear transformation of the visible (Red) and NIR bands of satellite image. Healthy vegetation will have high NDVI values ranging from +1 to -1. However, no green leaves give a value close to zero. A zero means no vegetation and close to 1 (0.8-0.9) means the highest possible density of green leaves. Bare soil and rock reflect similar levels of NIR and Red and so will have high NDVI values near zero. Clouds snow and vegetation are the opposite of vegetation in that they reflect more visible energy than infrared energy, and so they reflect negative NDVI values [12]. To produce vegetation density of the study area, the NDVI image was classified using the supervised method of image classification using the maximum likelihood algorithm.

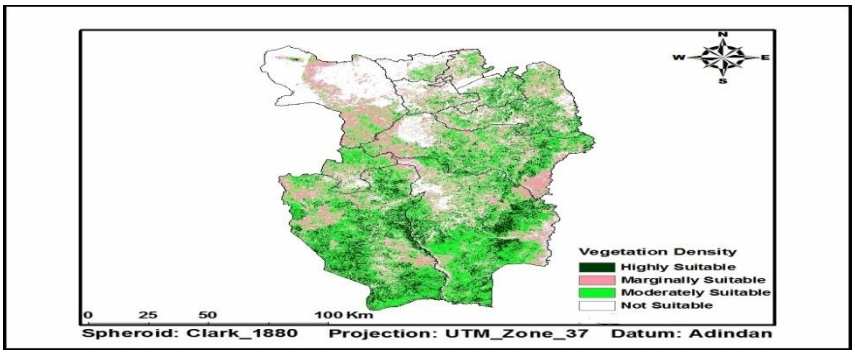

Fig-8: Vegetation Density Map

About 76% of the study area is covered by vegetation. Vegetation in this sense indicates all plant communities (Eucalyptus, Scattered trees, Shrub, Rangelands, Wetlands etc,) in the landscape that share similar characteristics. As it is indicated in figure 6, 7 & 8, dense vegetation (forest and grassland) accounts the largest share which is 47.6% followed by less dense vegetation (woodland and farming land) that accounts for 24.5. Sparse vegetation (water body and wetland), on the other hand, accounts for a minor percentage share which is 3.9%. Vegetation density of the study area is categorized in to three as dense, less dense and sparse vegetation. For ecotourism suitability highest vegetation density is preferable. Accordingly, highest vegetation density is assigned the highest possible rank, and lowest vegetation density is assigned the lowest possible rank. Dense vegetation is ranked as 1; less dense vegetation as 2; and, sparse vegetation as 3. Figure 9 depicts reclassified vegetation density map of the study area.

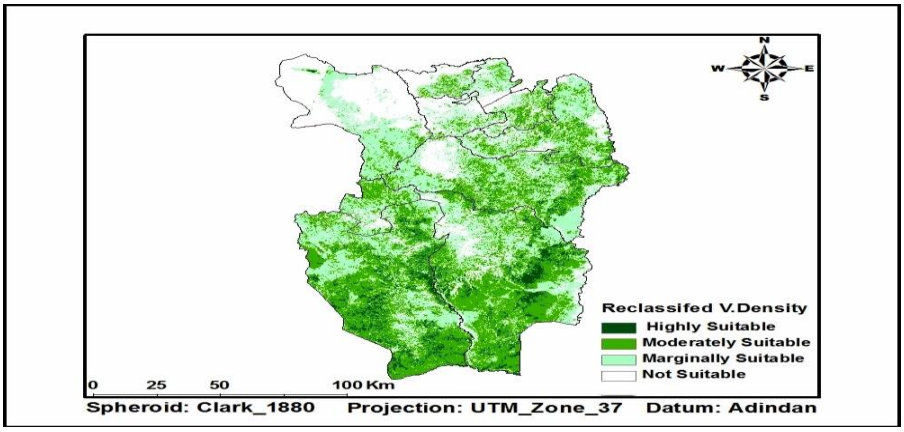

Fig-9: Reclassified Vegetation Density Map

Elevation Suitability

Elevation called altitude is the height of place above or below a reference level such as mean sea level. To evaluate the nature and element of an area making the landscape what areas is suitable for tourism, it is necessary to consider the position, angle and stage. In this study, elevation factor was generated from a Digital Elevation Model (DEM). The digital elevation model (DEM) is a raster based digital dataset of the topography of the Earth. The pixels of the dataset are each assigned an elevation value, and a header portion of the dataset defines the area of coverage, the units each pixel covers, and the units of elevation. The elevation classes are evaluated based on the basis of attractiveness in landscape or the topographic attractiveness for tourism significant feature.

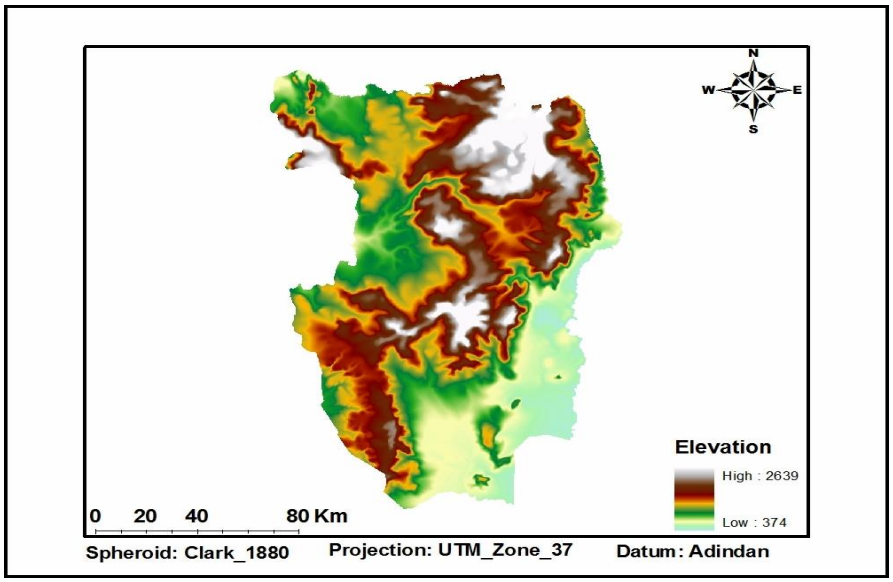

Fig-10: Elevation Map in Meter

To generate the study are digital elevation model; the raw SRTM data is patched on 3D Visualization software in order to fill the missing data and exported into Arc map environment. While this vector elevation map was converted into raster grid format using Arc GIS conversion tool extension of DEM to raster module, which applies the spatial resolution value stored in the DEM. Then study area DEM is extracted by masking of study area shape file with help of extraction tool; the resulting raster had elevation value which is revealed in Figure 11.

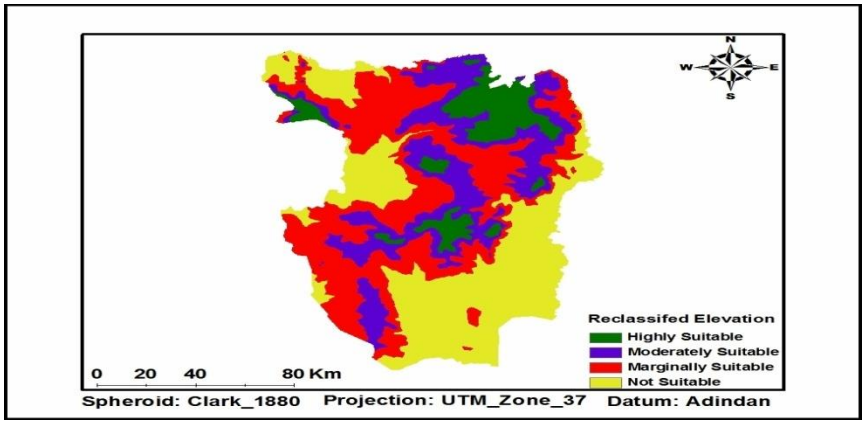

Fig-11: Reclassified Elevation Map in Meter

As depicted in Figure 11, elevation map derived from DEM data was reclassified based on altitude using natural breaks (jenks) technique to rank elevation suitability for human to stay. The layer was reclassified in to four classes and new values were assigned to each class and based on this classification 1, 2, 3 and 4, values were given to elevation ranges of 1690m – 2639m, 1255m – 1690m, 852m – 1255m, and 374m - 852 m respectively. The lowest elevation class is from 374m - 852m above sea level was given rank of 4, because this range of elevation is not having suitable environment for a lot human being due to high temperature. The highest elevation class from 1690m – 2639m above sea level was give 1 rank (highly suitable).

Slope Suitability

Slope profile appears visually attractive to observers across a wider geographical area. The complexity of the area in terms of slope is a vital factor in the suitability analysis for ecotourism. This factor is show a varying degree, a complexity of area and slope of area which effect to selected area by defining percentage of slope that related to site suitable of ecotourism. In addition, slope is a safety indicator implying the gentler the slope, the higher the safety factor and vice versa but mostly it is affected by its attractiveness (coverage). Slope of the terrain surface can be explained by degree or percent for change of slope. The slope of the study area is explained by degree measurement unit is shown in Figure 12.

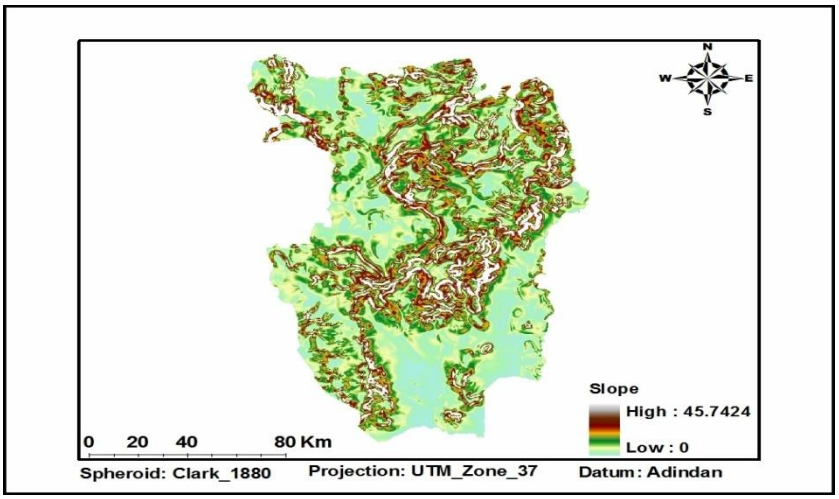

Fig-12: Slope Map in Degree

Terrain properties such as convexity and concavity generate undulation in slope profile that appears visually attractive to observers across a wider geographical area. Slope of the study area was reclassified in to four classes for the scenic ecotourism potential mapping on the basis of its degree. New classes are 0 - 2.86^0, 2.86^0 – 7.15^0, 7.15^0 – 13.58^0 and 13.58^0 - 45.74^0 were computed and assigned values of 4, 3, 2 and 1 respectively. Then, each class shown in Figure 13, beginning from the class with a gentle slope was given rank 4 which is less attraction value and value 1 was given for steep slope (45.74^0). Cliff and hanging wall landscape is result of steep slopes that create good scenic beauty.

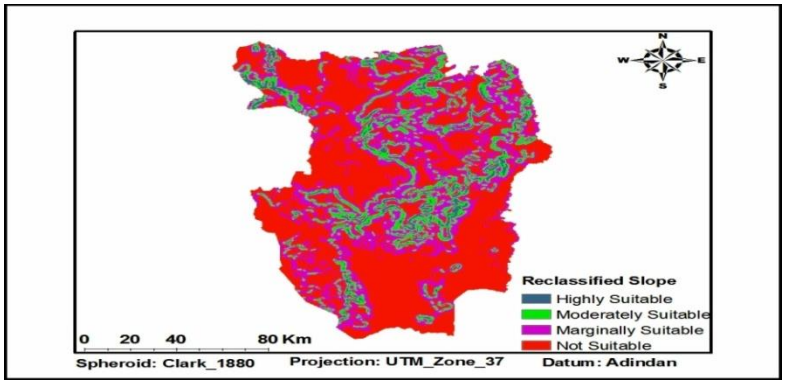

Fig-13: Reclassified Slope Map in Degree

Accessibility (Distance from Roads) Suitability

Ecotourism often takes place in natural areas, cultural or historical resources and traditional culture. Therefore, the accessibility to the cultural sites, historical sites, traditional and local community, includes the distance from road (with regards to the naturalness of the area) is both important factors for ecotourism.

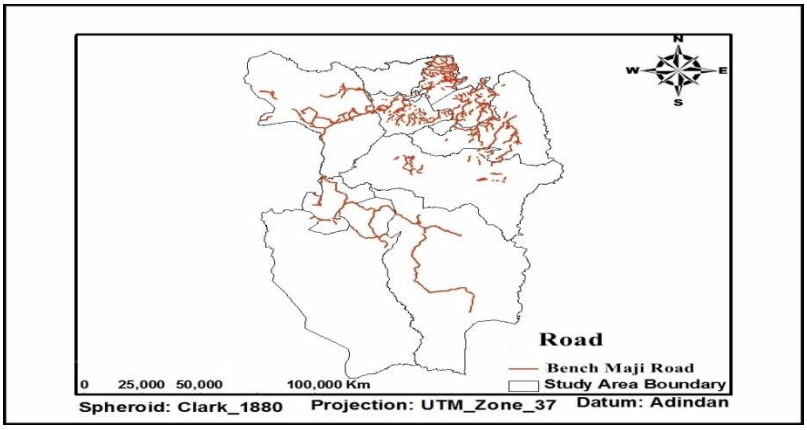

Fig-14: Road Map

This criterion was classified based on the transport condition by access types and distance from the road types according to remote areas are the best suited for ecotourism attractions and experiences. Therefore, the areas outside of any buffers around all roads are ranked as high potential for ecotourism development; the areas within 2 km buffer around third main roads are ranked as moderate; the areas within 5 km buffer around second main roads are ranked as marginal; and the areas within 10 km buffer around major roads are ranked as no potential that described by Boyd [13]. The result of the reclassified distance from the roads map is shown in Figure 15.

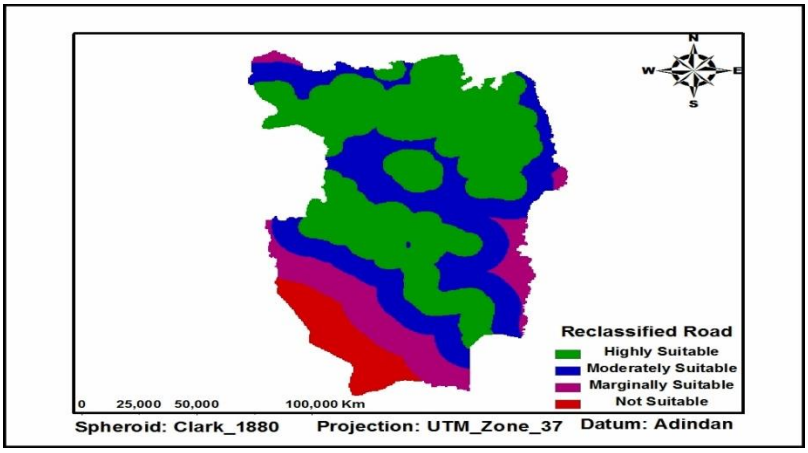

Fig-15: Reclassified Road Map

Road map is represented by line feature is not compatible for MCE. Firstly the line feature was converted in to raster feature and reclassified in to four classes based on the distance from the road (Figure 15). The area near to the road less than 7 km is ranked as high suitability for ecotourism represented by value 1, since it is easily accessible for the attractions in need; rank 2 for distance from 7 km – 17.9 km; rank 3 for distance from 17.9 km - 36 km and rank 4 was given for distance far from road 36 km – 71.9 km is unsuitability for ecotourism.

Weighting, Evaluation and Suitability Analysis

Suitability evaluation is the actual process of applying multi-criteria evaluation to different criteria's or factors in order to arrive at certain decision. For ecotourism suitability, five factor maps were produced and reclassified according to their degree of importance that they have to ecotourism and environmental sustainability. Weight for each factor maps was assigned based on the questionnaire developed and distributed to different experts. According to this questionnaire, the prioritizing of factor maps (or simply factors or criterion) from highest to lowest is as follows: vegetation density map, land use land cover map, elevation map, slope map, and accessibility (road) map.

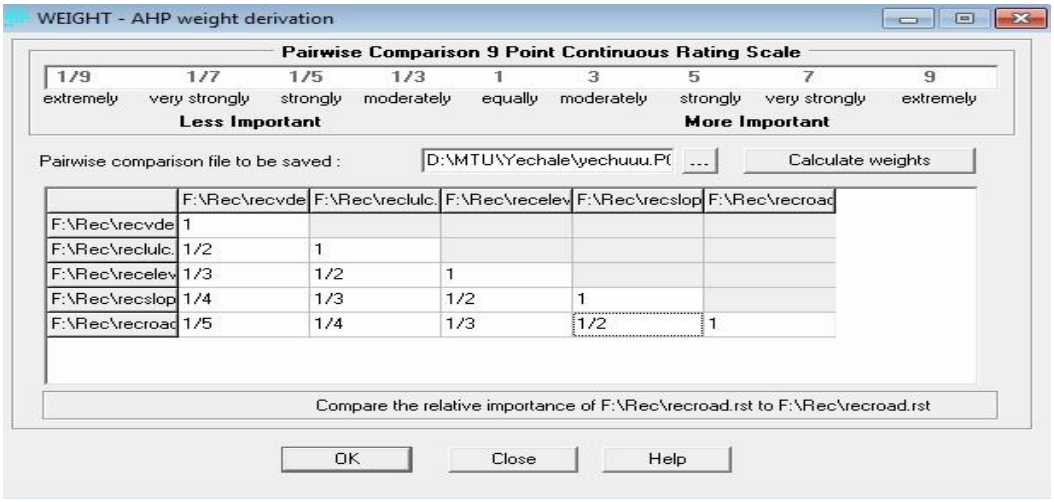

Fig-16: Pair wise Comparison of Factor Maps

The above matrix can be summarized in table 2 as follows:

Table 2: Pair wise Comparison Matrix

	Reclassified Vegetation Density	Reclassified Land Use Land Cover	Reclassified Elevation	Reclassified Slope	Reclassified Road
Reclassified Vegetation Density	**1**				
Reclassified Land Use Land Cover	½	**1**			
Reclassified Elevation	**1/3**	½	**1**		
Reclassified Slope	¼	**1/3**	**1/2**	**1**	
Reclassified Road	**1/5**	¼	**1/3**	**1/2**	**1**

As it is indicated in table 2, elevation is less moderately important than vegetation density and land use land cover. Slope is strongly less important than land use land cover and vegetation density, but moderately less important than elevation. Road, on the other hand, is very strongly less important than land use-land cover and vegetation density, and strongly less important than elevation, but moderately less important than slope. Finally, road is extremely less important than land use-land cover and vegetation density, and it is very strongly less important than elevation; strongly less important than slope.

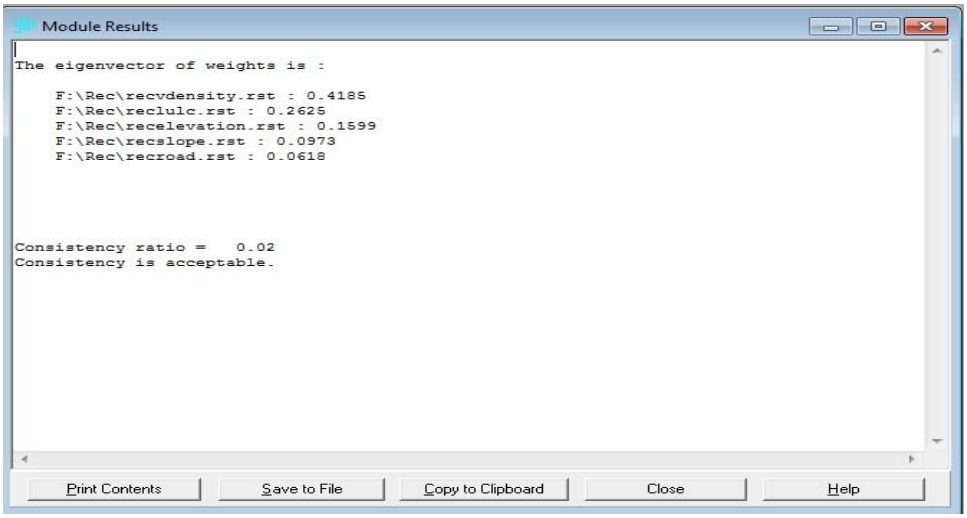

Fig-17: Eigen Vector of Factor Map Weights

The eigenvector of weights for vegetation density, land use land cover, elevation, slope and road is 0.4185, 0.2625, 0.1599, 0.0973 and 0.0618 respectively. Output evaluation was then computed by multiplying each factor map by these eigenvector weight values.

Suitability Map = *0.4185 (Vegetation density map) + 0.2625 (Land use-land cover map) + 0.1599 (Elevation map) + 0.0973 (Slope map) +0.0618 (Road map)*

Results and Discussion

Potential Ecotourism Sites of Bench Maji Zone

According to Food and Agriculture Organization [14], the land suitability map for ecotourism was classified based on four suitability classes as S_1, S_2, S_3 and N are seen in Figure 18. The results are based on the ranking of different sites according to the set criteria and thus identify those with the "best" potential for ecotourism. With regards to the typical and potential sites for ecotourism, the following data were considered that are the results of analysis in particular, the results of the survey in order to examine the existing tourism facilities, present situation of tourism, future possibilities of ecotourism, ecotourism requirement and the main policy of ecotourism development in the area. For purposes of identifying and prioritizing ecotourism sites, the typical and activities were proposed as follows:

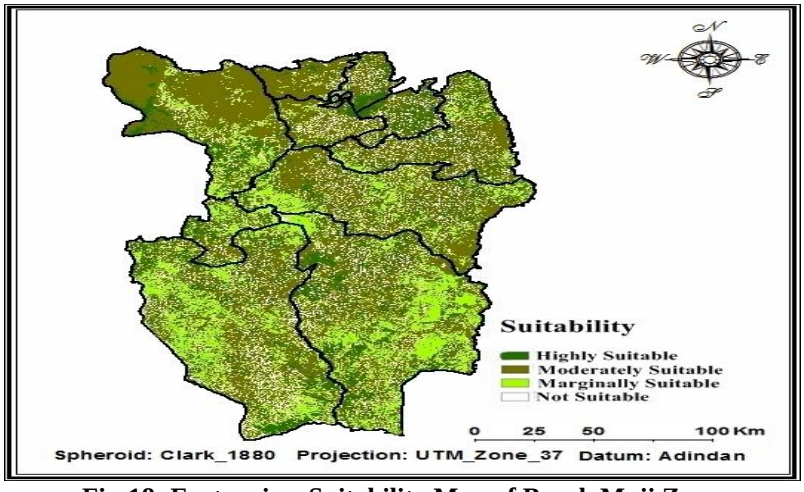

Fig-18: Ecotourism Suitability Map of Bench Maji Zone

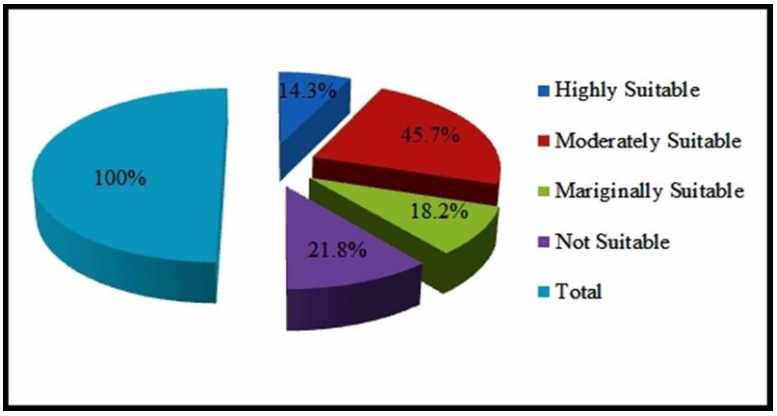

Fig- 19: Ecotourism Suitability Chart of Bench Maji Zone in percentage Share

Highly Suitable for Ecotourism Areas of Bench Maji Zone (S_1)

Based from the suitability map, the area with about 14.3 % was classified as highly suitable for ecotourism development and located in north eastern and western part of the zone especially Shay Bench, North Bench, south western part of Guraferda, western part of Maji and, some parts of Sheko and Bero. These areas can be used for education as well as natural resource management and community based ecotourism development. It could serve as main ecotourism attractions but with the use of certain limitations and guidelines. It involves the most sensitive areas and development activities within these areas will lead to disaster and threaten the natural characteristic of the areas. Likewise, ecotourism development must control and manage the resources in order to retain their original conditions as far as possible, and to avoid or to abstain from travelling in sensitive areas which are easily adversely affected and are difficult to rehabilitate. In addition, ecosystem protection is the first issue for ecotourism development in environmentally sensitive areas. The negative environmental impacts are also minimized. Therefore, these areas could serve as main ecotourism attractions but with the use of certain limitations and guidelines. These areas should be preserved or conserved and managed in sustainable way, unless the existing of ecotourism resources in sensitive areas is still usable. More specifically, the key element of ecotourism management is sustainably managed and environmental responsibility is promoted. The example of guideline to be used to limit the number and duration of access to the areas is the code of conduct. The area is characteristically endowed with lush green forests, wildlife sanctuary, as well as rich cultural heritage. Its high value of natural resources is suitable for research and education as well as conservation of biodiversity and maintenance of the ecosystem. The destination has nature attractions and unique qualities for ecotourism. Visitors are educated about the environmental and ecology of the site. Activities suggested for these areas include education and research related activities for sightseeing and trekking for limited the number of tourists.

Moderately Suitable for Ecotourism Areas of Bench Maji Zone (S_2)

The area with about 45.7 % was classified as moderately suitable for ecotourism development and located in north Guraferda, Sheko, Minit Shasha and Goldiya districts. It can be developed as ecotourism destination by facilitating proper ecotourism infrastructure and services. These areas can still be considered for ecotourism attractions and allows for mild development but with highly consideration on construction work and detail assessment of environmental impact. The S_2 areas have moderate potential for ecotourism. These are largely free from urban settlements with green area, vegetation cover and great tourism potential with unique natural resources. So this area can be developed as ecotourism destination by facilitating proper ecotourism infrastructure and services under policy guidelines. Environmental awareness is raised among tourists and stakeholders. The management system is comprehensive and addresses issues of resource conservation, environmental management, pollution control and disposal, and the control of tourism development. Profits from tourism contribute to the development of the destination. Therefore, these areas can still be considered for ecotourism attractions particularly for passive tourist activities such as camping, trekking, bird watching, sightseeing and any activities with minimum development or inference to the site includes educational method.

Marginally Suitable for Ecotourism Areas of Bench Maji Zone (S_3)

The area with about 18.2 % was classified as marginally suitable for ecotourism development and located in southern part of Maji and western part of Surma and Minit Shasha. They are the most appropriate areas for development. Marginally suitable for ecotourism but suitable for tourism development category, involves areas with low sensitivity and

available for exploitation. These areas are validating for usage, and they are both of the areas that already have a concession and concession requesting process. Therefore, the S_3 areas which are suitable for tourism development generally can be control and promote tourism services and the use of natural resources. Still, development should be conducted in an appropriate manner for ecotourism with respect to minimizing development impact. The most appropriate areas are mainly located in urban area. These areas could provide ecotourism services which take into account the condition of the natural environment, local society and culture. Therefore, these areas can accommodate physical structure to support ecotourism activities such as green hotels, eco-lodge, restaurants and public convenience facilities. These will increase opportunities for local people and communities to participate in ecotourism and will help to distribute income to them.

Not Suitable for Ecotourism Areas of Bench Maji Zone (N)

The area with about 21.8 % was classified as not suitable for ecotourism. These are located in the central parts of Guraferda, Maji, South Bench, Minit Goldiya, Minit Shasha and eastern part of Surma. This category involves having limitation which may severe as to preclude any possibilities of successful sustained use of the land in the given manner. These are included the areas with several impacts of development and degraded environment. Such areas are high risk for dealing with the problems; some are in a deteriorated condition or have been destroyed. As concerns their utilization, they may have some environmental problems but those are controllable.

Conclusion and Recommendations

Conclusion

The purpose of this study was site suitability evaluation of ecotourism potentials for sustainable natural resource management and community based ecotourism development in Bench Maji Zone. Multi Criteria Evaluation is done based on five criterion (factor) maps to produce ecotourism site suitability analysis. These are vegetation density map, land use land cover map, elevation map, slope map and road map. Land use land cover map is one of the factor map which was derived from Land sat ETM+ satellite imagery produced eight land use land cover. Produced suitability map for ecotourism site have four classes of suitability: highly suitable, moderately suitable, marginally suitable and not suitable. The study has demonstrated the use of geographical information system and multi-criteria decision making framework in solving a spatial multi-objective problem of selecting suitable sites for ecotourism development in Bench Maji Zone and its environs; based on the stated objectives and criteria for the development of community based ecotourism. The suitability model allowed formal analysis factor weight and their spatial sensitivity for tourism facilities development. While the problem addressed in this study appears to have been essential, it demonstrates the applicability of Multi Criteria Evaluation to similar but more complicated problems. The advantage of this methodology is that suitability analysis can easily be performed on the results by employing graphical user interface, which allows the decision maker to decide.

The development of ecotourism is further enhanced by geospatial approaches; which have proved beneficial for supporting decision-making and planning tourism facilities and ecotourism resource for sustainable development; as ecotourism is an activity which strongly implies the geographical dimension and Geographic Information System is a technology specifically developed for the management and study of spatial phenomena. Moreover, tourism is a complex phenomenon involving besides its spatial dimension, social and environmental implications. Results from this study appear practically useful for tourism facilities development and ecotourism resource utilization.

Recommendations

- ✓ Additional research is needed to refine the suitability; the ecological sensitivity and risky areas should be identified and considered as one factor in site suitability which is not included in this study due to absent of data.
- ✓ Detail study of ecological value of the selected suitable sites should be taken.
- ✓ On the identified suitable sites; ecotourism be developed and managed in a basis that is sensitive to the principles of natural resource management and community based ecotourism development.
- ✓ Map of the identified potential suitable sites is needed to check with the reality on the ground before making any decisions.

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