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Multi-criteria evaluation in identification of potential ecotourism sites in Hawassa town and its surroundings, Ethiopia

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Abstract: Hawassa town and its surroundings have high ecotourism potential due to the presence of abundant natural and cultural resources including landscape, and a lake. The main objectives of the present study were to evaluate and identify ecotourism potential using multi-criteria techniques for optimal exploitation of the area for tourism. Integrated approaches of multi-criteria techniques were used to generate maps of visibility, land-use/land-cover, slope, elevation, proximity to the lake, natural and cultural attraction sites, fauna and flora conservation, rainfall, temperature and proximity to road. These factor maps were overlaid to evaluate the ecotourism suitability of the study area. The results were classified into four ecotourism potential areas, *viz*., highly suitable, moderately suitable, marginally suitable and not suitable. The results were further verified by ecotourism potential sites point data collected in the field and pervious reports. The largest part of the area was identified as moderately suitable for ecotourism. Hence, this study concludes that Hawassa town and its surroundings can contribute for the national development through sustainable use of ecotourism potential of the area.

Keywords: Ecotourism, Remote sensing, Site suitability, AHP

1. Introduction

Tourism is among the fastest growing industries globally, and is one of the major sources of foreign exchange earnings of many of the developing countries (Megan, 2002). As one of the largest economic sectors in the world, tourism accounted for US$919 billion worldwide in international tourism receipts in 2010 (WTO, 2011). In the recent past, ecotourism has developed as a driving force for economic advancement all over the world. It contributes substantially to economic growth, creation of skilled and semi-skilled jobs, greater export returns, foreign investments and economic well-being and social stability of local people (Ceballos-Lascurain, 1996; World Tourism, 2000). Ecotourism can integrate environmental responsibility with economic benefits. It can be considered as both an establishment for economic development and a motive for environmental protection (Daily, 1997; Wilkie and Carpenter, 1999; Wilks and Moore, 2004). To protect the environment, economic stimulus is necessary particularly in remote regions with weak government supports (Wunder, 2000). Ecotourism is environmentally responsible travel and visitation to relatively undisturbed natural areas in order to enjoy and appreciate nature and associated cultural features that can promote conservation of natural resources. Ecotourism has low negative visitor impact on environment (Obadiah, 2012). However, it may contribute negatively on ecosystems and on local culture, if visitors are more.

In Ethiopia, there were 427,000 and 468,000 arrivals of tourists in 2009 and 2010, respectively. This amounts to 9.6% growth rate in 2009/2010 at an estimated revenue value of US 329$−$522 million (UNWTO, 2012). Tourism is one of the focal sectors of the five-year development plan of Ethiopia (UNESCO, 2012). Long-term vision of the Government is to make Ethiopia one of the top ten tourist destinations in Africa by the year 2020, with an emphasis on maximizing the poverty-reducing effects of tourism, and utilizing tourism to transform the image of the country (World Bank, 2003; Eplerwood, 2004).

Geographic Information System (GIS) and Remote Sensing (RS) techniques have developed as useful tools in analyzing and establishing tourism potential, especially in the context of ecotourism developments. These modern techniques have accelerated research processes, and enhanced accuracy with less expense. To determine the potentials of tourism activities of a given area, a broad ecotourism evaluation through ground surveys, RS and GIS techniques are required. Thus, a meaningful relation can be established among various tourism activities (Jafar and Delavar, 2010). The capability of GIS has accelerated spatial aspects of conservation through prioritization and selection of potential areas for conservation. Geographic information system is a valuable tool for investigating specific questions that relate to tourism development including location, condition of the area, trends and changes, routing to and through the site and patterns associated with resource uses (Azizur, 2010). The objective of this study was to determine suitable sites relevant to ecotourism in Hawassa town and its attractive surroundings in relation to ecotourism resources and its ability to satisfy tourists, and in the socioeconomic development of the region.

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2. Study area and methods

2.1 Study area

The study area is located in the Great Ethiopian Rift Valley basin of the Regional State, Southern Nations, Nationalities and Peoples Republic of Ethiopia. Hawassa is the capital town of this Regional State, which is located 273 km to the south of Addis Ababa, the capital of the nation. It is bounded by latitudes 06° 49' 54" N–07° 9' 54"N and longitudes 38° 12' 49"–38° 34' 22"E, covering a total area of 724.97 km^2 (Figure 1). The elevation of the area ranges from 1664 m to 2163 m asl. Hawassa Zuriya District and Shebedino District are the other study areas that surround Hawassa in the west and south directions.

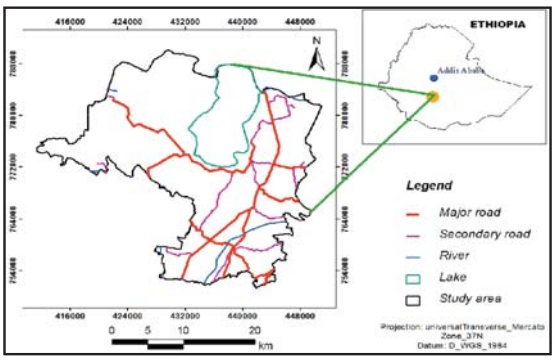

Figure 1: Location map of the study area

2.2 Climate

The temperature of Hawassa town and its surroundings fluctuate from January to December. The end of September to October is the coldest season and June–September is the hottest. The average annual maximum temperature recorded was 27°C and the average minimum temperature recorded was 12.9°C. In Hawassa town and its surroundings, 48% and 34% of the monthly rainfall occurs during the summer and spring seasons, respectively. Monthly average rainfall over the last 20 years ranged from 29 mm in December to 117 mm in July. Highest rainfall was recorded in July–August (172 mm). The highest and lowest average annual rainfalls were 1197 mm (2006) and 703 mm (2009), respectively. The 20 years average humidity of Hawassa town and its surroundings was 69 mb (1990–2010). The maximum humidity of Hawassa town and its surroundings for the above period was in May (95 mb) and the minimum was in February (42 mb).

2.3 Flora and fauna

The areas of Hawassa town and its surroundings are covered with natural forest woodlands, and the lake. There is a complex mangrove cover, which has great number of species diversity in the study area. The dominant species of vegetation are *Ficus vasta, Balanitetes egyptica, Chroton Machrostachys, Chordia africana* and *Dodonia viscosa.* Natural forest and woodland trees dominate in the surroundings of the lake. Mangroves of Hawassa town and its surroundings are unique compared to other habitats, and are home of different species of birds and mammals. A number of endemic birds and mammals are seen in the area, especially in and around the lake. The habitat provides high avian biodiversity such as the marabous stock, great white pelican, Egyptian geese, wattle ibis, and storks. Hippopotamus is the largest aquatic animal in this lake. In Hawassa town and its surroundings, baboons, hyena, fox and rabbits are found.

2.4 Lake Hawassa

The Hawassa catchment represents a large collapsed caldera bordered by highlands to the north and the east. The center of the caldera is occupied by the lake Hawassa. The lake is located at an altitude of 1664 m asl. The floor of the caldera is faulted and dotted by volcanic hills such as Tabor and Alamura.

Lake Hawassa is one of the major sources of fish for locale people. The fishing lake shores, especially at Amora Gedel, Tikure Wuha and Yefiker Hayqe, during the commercial fish grasp being landed and sold are impressive to see. In addition to this, the wetland zone is extensive and has abundant aquatic vegetation, which serves as one of the destinations for tourists with high value for the development of ecotourism activity. Lake Hawassa is highly endowed with views of animals such as hippopotamus and birds like storks, herons and Egyptian geese. This lake provides an ideal spot for fishing and boating. Hawassa town is an attraction by itself, with full of life and an attractive outdoor market that gives something of the flavor of the life and commercial activities of the region with its green area.

2.5 Methods

LANDSAT 8, 2013 was obtained from Global Land Cover Facility. Satellite images of the study area were rectified and processed for preparing different thematic maps, *viz*., land-use/land-cover for identifying ecotourism potential areas and attractive sites using ERDAS Imagine 9.2. Besides the satellite data, Ethiopian Mapping Agency (EMA) topographic maps of 1:50,000 scale were also used. SRTM data were used as inputs to develop elevation, slope and visibility maps of the study area. Information on roads, settlements, district boundary, cultural and natural attraction sites, wildlife areas and view points for ecotourism were collected from the City Administration Culture and Tourism Office, Hawassa.

The involvement of criteria and factors were determined based on natural factors and cultural characteristics in the study area for ecotourism potential suitability. Based on the acquired information, multi-criteria evaluation was done following five criteria as indicators of suitability in Hawassa town and its surroundings: (1) landscape, (2) flora and fauna, (3) topography, (4) accessibility and (5) climate characteristics (Satty and Vargas, 2001; Kumari, 2008; Kumari et al., 2010). In addition, the evaluation process for ecotourism site was conducted based on 11 important factors, *viz*., (1) visibility, (2) land-use/land-cover, (3) conservation, (4) elevation, (5) slope, (6) proximity to cultural sites, (7) proximity

to natural resources, (8) distance from roads, (9) distance from the lake, (10) temperature and (11) rainfall. All these criteria and factors were chosen based on the opinion and reviewing of different literatures and information from various sources. Multi-criteria decision making was applied to integrate decision maker's judgment and preferences using multi-criteria techniques. Weight and score were given to each of the factors depending upon its relative importance in ecotourism suitability. Pair-wise comparison matrixes were implemented to record the results. The first step was extraction of data to set the objectives that was used to identify and evaluate potential ecotourism sites. The extraction was done based on ecotourism potential evaluation criteria and factor elements. At the second and third levels, five criteria and 11 factors were overlaid for suitability evaluation of ecotourism sites. At the third level, the scale of suitability of each factor was reclassified as highly suitable, moderately suitable, marginally suitable and not suitable.

3. Results

The factors that are involved in classification of ecotourism potential sites in this study takes into account the cultural and natural resources that are directly related to the ecosystem characteristics. In consideration of the acquired information, there were 11 important factor attributes in terms of their extent of coverage and percent share performed individually in the suitability of ecotourism potential sites (Table 1).

Table 1: Criteria and factors involved for evaluation of ecotourism potential site in this study area

Ecotourism Requirement			Factor Suitability Ranking			
Criteria/Factors		Unit	Highly Potential (1)	Moderately Potential (2)	Low Potential (3)	Not Potential (4)
Landscape	Visibility	Visibility Value/lines of site	7−12 High Visibility value	3–6 Middle Visibility value	1–3 Low Visibility value	0 −1 (Invisible)
	Land-use/land-cover	Class	Highly potential	Moderately potential	Marginally potential	Not potential
Wildlife	Conservation	Protected areas class	Highly potential	Moderately potential	Marginally potential	Not potential
Topography	Elevation	Meter	1800−2000	1700−1800	> 2000	<1700
	Slope	Degree	0−5 %	5−25 %	25−35 %	> 35 %
Accessibility	Proximity to cultural sites	Kilometer	0−5 km	5−10 km	10−15 km	>15 km
	Distance from the lake	Kilometer	0−5 km	5−8 km	8−12 km	>12 km
	Proximity to natural sites	Kilometer	0−5 km	5−10 km	10−15 km	>15 km
	Distance from roads	Kilometer	0−2 km Buffer	2−4 km Buffer	4−8 km Buffer	8−12 km Buffer
Climate Characteristics	Temperature	°C	17°C−18°C	18°C−18.5°C	18.5°C−19°C	19°C−20°C
	Rainfall	mm	>1250 mm	1200 mm–1250 mm	1150 mm–1200 mm	927 mm–1150 mm

Landscape

Landscape/naturalness in the study represents the degree of variation of the natural landscape or the valued landscape character. Naturalness in this study area was explained in terms of its landscape and therefore, the degree of landscape of the area is expressed as follows:

Naturally unique places were located using Global Positioning System (GPS) in the form of point feature data. A visibility (scenic attractiveness) factor was produced from Digital Elevation Model (DEM) data integrated with the location of natural uniqueness by on the basis of visible or not visible (from lines of sight). This was carried out by visibility values (lines of sight). In this study, high visibility values (7−12) were ranked as high, middle visibility values (3−6)

were ranked as moderate, low visibility values (1−3) were ranked as marginal and invisible were ranked as not suited for ecotourism.

LANDSAT 8 image of the year 2013 was classified into 10 classes of land-uses/land-covers according to the current vegetation characteristics of ecotourism potential resources. These are dense forest, open forest, enset (a tuber crop) farm, water body, plantation, crop land, cultivated land, urban and built-up land, degraded forest and grassland. According to the classification, areas of dense forest and water body were ranked as highly potential, open forest, enset farm and plantation were ranked as moderately potential, grassland and crop lands were ranked as marginally potential, built-up area and degraded forest were ranked as not potential for ecotourism. The status of flora and fauna in the area show conservation requirements, which are suitable for species diversity. Conservation factor was produced by reclassifying the land-use/land-cover map with areas of wildlife abundance with regard to habitat of wildlife, rare and endemic species.

In this study, topography was considered as one of the most important factors of attractiveness for ecotourism. Elevation and slope factors were considered for the selection of site for tourism projects as which areas are best suited for different types of ecotourism experiences. The elevation classes were evaluated based on the basis of attractiveness of the landscape for ecotourism and the significance for ecotourism potential was reclassified into four classes as elevation of 1800–2000 m as highly (1); 1700–1800 m as moderately (2); above 2000 m as low (3); and <1700 m as not potential (4).

Slope in this study represents the steepness of terrain features, calculated as the ratio of vertical distance to horizontal distance. In this study area, the flat landform was the most suitable for ecotourism. Therefore, 0^o–5^o was ranked as highly potential, 5^o–25^o as moderately potential, 25^o–35^o as marginally potential and >35^o as not potential for ecotourism.

Accessibility

Ecotourism often takes place in natural areas, in and around water bodies, and cultural, historical and traditional places. Therefore, accessibility to such sites is important factors for ecotourism. Roads provide accessibility of tourists to the locations of their choice. Proximity of natural attraction sites factor was classified through buffering analysis within different kilometer distance from natural attraction sites. Locations of water bodies, hot spring sites, mountains, aquatic, animal parks, birds and forests were considered as natural attraction sites in this study. Areas nearby natural attraction sites (0–5 km) were ranked as highly potential, 5–10 km as moderately potential, 10–15 km as marginally potential and >15 km as not potential. Cultural attraction sites were reclassified in to four classes based on the basis of distance to potential attraction sites. Cultural attraction sites within 0–5 km distance were ranked as highly potential, 5–10 km as moderately potential, 10–15 km as marginally potential and >15 km as not potential.

Areas within 2 km distance of any buffers around all roads were ranked as highly potential for ecotourism development, areas within 2–4 km distance buffer around main roads were ranked as moderately, areas within 4–8 km distance buffer around main roads were ranked as marginally, and areas within 8–12 km distance buffer around major roads were ranked as not potential. Areas near to water source (lake) <5 km was ranked as highly potential as it was easily accessible, 5–8 km ranked as moderately potential for distance, 8–12 km, >12 km as not potential for distance far as unsuitable for ecotourism site location.

Climate factor

The mean annual rainfall of the study area ranges between 927 and 1345 mm. Mean annual rainfall value between 927 and 1150 mm was ranked as not potential, between 1150 and 1200 mm as low potential, between 1200 and 1250 mm as moderately potential, and between 1250 and 1345 mm as highly potential as areas of high rainfall are characteristic of dense forest habitats supporting ecotourism. Based on the interpolation suitability of temperature for human recreation and ecotourism sites, lowest temperature was considered as more suitable. Lowest temperature values were assigned the highest possible rank and highest temperature values were assigned the lowest possible rank. Temperature values between 17°C and 18°C were ranked as 1, between 18°C and 18.5°C were ranked as 2, between 18.5°C and 19°C were ranked as 3 and between 19°C and 20°C were ranked as 4 (highly, moderately, low and not potential).

Based on the above evaluation and applying equation 1, ecotourism potential class and the suitability map for ecotourism in the study area were prepared and presented in Table 2 and Figure 2.

Table 2: Extent of ecotourism potential suitability area

Suitability	Degree of ecotourism potential	Area (km^2)	Area (%)
I	High	42.79	6
II	Moderately	167.15	23
III	Low	503.47	69
IV	Not	11.56	2
Total		724.97	100

Ecotourism potential suitability =
(Visibility map) × 0.2056 + (Land-use/land-cover) × 0.2016 + (Lake proximity) × 0.1614 + (Protected area) × 0.1243 + (Elevation) × 0.0704 + (Slope) × 0.0811 + (Natural attraction sites point) × 0.0489 + (Cultural attraction sites point) × 0.0476 + (Mean annual rainfall) × 0.0273 + (Mean annul temperature) × 0.0171 + (Road proximity) × 0.0121 … (1)

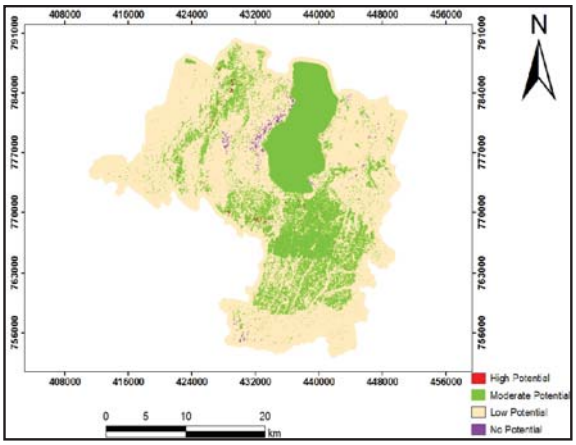

Figure 2: Ecotourism potential suitability map

Table 3 compares results of ecotourism potential model with attraction sites used for validation of the model. Accordingly the western part of the study area is highly suitable for ecotourism. It accounts for 42.79 km^2 (6%) of the total area. These areas are characteristically endowed with green forests and having visibility of the lake and park. Moderately suitable areas are mostly located in the central and southern parts of the study area, which accounts for 167.15 km^2 (23%) of the area. Most of these areas are free from urban settlements with natural beauty and attractiveness and hence having tourism potential. Marginally suitable areas are located in the southern, western and eastern parts of the Hawassa town, which is 503.47 km^2 (69%) of the area. Areas not suitable for ecotourism in the study area are located in the western parts of the lake and southern tip of the study area, which accounts for 11.56 km^2 (2%).

4. Discussion

As the study area is well connected by roads, accessibility plays an important role in attracting tourists. These areas are located between 1800 to 2000 m elevations, 0 to 5% slope, 0–5 km distance from the lake, and are characterized by very high level of environmental satisfaction value, moderate level of species diversity and ecosystem uniqueness. Flat, wet and cold areas play an important role for ecosystem suitability and hence having greater ecotourism capacity (Newsome et al., 2002). Such areas should be conserved and utilized in a sustainable way.

The lake and the central part of the study area are identified as moderately potential areas for ecotourism. Moderately suitable for ecotourism classes allows for moderate development but with high consideration for conservation of resources. Detailed assessments of environmental impacts are required in such areas especially in the lake side. These areas are free from cultivation, with large water body, high vegetation cover and have great tourism potential within its unique landscape. High biodiversity and ecosystem uniqueness can attract more tourists (Newsome et al., 2002). Hence, by facilitating proper ecotourism infrastructure and services under policy guidelines, these areas can be developed as suitable ecotourism sites. The ecosystem processes are maintained by natural species diversity and contribute on the way to the expansion of the destination (Peterson et al., 1998). This area is dynamic for recreation such as boating, lake, mountain, unique vegetation types and natural parks. Therefore, these areas can be considered for ecotourism, particularly for tourist activities such as trekking and bird watching.

The marginally suitable area for ecotourism is occupied by crop farming practice, plantations, urban expansion and grazing. Such areas need special consideration to make suitable for tourism development. Azizur (2010) also recommended conservation of such types of land-use/land-covers and unique cultural heritages. Such areas could provide ecotourism services, which take into account the condition of the natural environment, local community and culture. Therefore, these areas are to be conserved and ecotourism can be developed. For this, transport, green hotels, eco-lodges and public facilities are to be established. Such facilities will provide employment opportunities for local people by way of community participation in the regional development.

Areas classified as not suitable for ecotourism accounted for an extent of 1157 ha of the total study area. In this study, the area with several impacts of development and degraded environment were identified as not suitable for sustainable ecotourism practice. These are areas within the scale factor of <1700 m elevation, > 35% slope and 0–1 visibility weight value. Areas characterized by such factors are highly risky for tourism industry development.

Validation of the output map was tested by overlaying the attraction sites data of cultural attraction, natural attraction and viewpoints collected from field surveys and available authorised reports. Out of such 37 attraction sites, eight sites were of cultural attraction, 10 sites belong to natural attraction and 19 sites were viewpoints observed with the ecotourism potential suitability model. Therefore, the ecotourism potential suitability map produced is in validation with different attraction sites of the area. In conclusion, the mainstream idea of ecotourism fits for sustainable development of Hawassa town and its surroundings, and for the development of local people. The present study also provides scope for future studies for identification of potential ecotourism sites in the region, using multi-criteria techniques, models, knowledge based approaches and field data.

Table 3: Comparison of ecotourism potential model result with attraction sites

Cultural Attraction Sites				
S.No	**Easting**	**Northing**	**Ecotourism potential model result**	**Name of the attraction sites**
1.	442140	779298	Low Potential (3	Sidama Cultural Auditurim
2.	441374	779883	Moderately Potential (2)	Timiket Bahir
3.	441435	779852	Moderately Potential (2)	Shebele Hotel
4.	442294	780097	Low Potential (3	Arab Sefer
5.	442938	779267	Low Potential (3	Mesekel Squere
6.	437314	771843	Moderately Potential (2)	Ras Menegesha
7.	447165	772968	Moderately Potential (2)	Burikitu
8.	439992	778810	Moderately Potential (2)	Chambalala ceremony place
Natural Attraction Sites				
9.	441126	777979	High Potential (1)	Tabor forest
10.	443577	774783	High Potential (1)	View point of mount Alamura
11.	430029	784748	High Potential (1)	Mekebesa
12.	428956	785333	High Potential (1)	Anole
13.	426661	789451	Moderately Potential (2)	Senkele
14.	443095	783105	High Potential (1)	Millennium Parak
15.	439900	778656	High Potential (1)	Amora Gedel
16.	441159	779791	Moderately Potential (2)	Fikir Lake
17.	447165	772968	Moderately Potential (2)	Hot spring
18.	437446	774783	Moderately Potential (2)	Lake
View Point				
19.	438712	760019	Low Potential (3	Leku Town
20.	441126	777979	High Potential (1)	Mount Tabor
21.	443577	774783	High Potential (1)	Ensete farm area
22.	429375	777564	Low Potential (3	Dore Town
23.	437446	774783	Moderately Potential (2)	Wetlands
24.	441092	775492	Moderately Potential (2)	View Point
25.	442202	780342	Moderately Potential (2)	Tulu
26.	441030	775001	Moderately Potential (2)	Werencha Kebele
27.	430029	784748	High Potential (1)	Mekebesa
28.	439992	778810	Moderately Potential (2)	Chambalala
29.	440115	779086	Moderately Potential (2)	Lewi Resort
30.	426661	789451	Moderately Potential (2)	Senkele Wilde Life Sanctuary
31.	433397	869342	Moderately Potential (2)	Cheichei
32.	434994	756001	Low Potential (3	Yamere Hotel Park
33.	442973	755347	Not Potential (4)	Random View Point 1
34.	413935	773350	Low Potential (3)	Random View Point 2
35.	435855	782960	Low Potential (3)	Random View Point 3
36.	418446	773527	Not Potential (4)	Random View Point 4
37.	441466	779975	Moderately Potential (2)	Haile resort hotel

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