Gis -Based Cartographic Approach To Mapping Of Eco-Tourism Zones In Enugu State

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Abstract
Ecotourism is a responsible trip to natural environments, that sustains the well-being of local people and also involves temporal local language interaction. Geographic information system Application in ecotourism in Enugu State is a key determinant in unraveling personal choices of tourism. The multiple criteria decision analysis provides key dependent variables which were ranked based on respondent focused group inputs. The derived weights of each variable such as elevation, slope, aspect, road density, river density, forest reserves were obtained. In this line the weighted inputs (which is a mark of influence of each variable) was computed by pair-wise comparison technique and Analytical Hierarchy Process (AHP) classification method. These were superimposed on the shape file of Enugu state with the Application ArcGIS10.8 software. The extension command of the Arc GIS 10.8 software, the Arc toolbox identified five classes- very low, low, medium, high, very high potential. The result shows that the areas with the highest potential for ecotourism in Enugu state presents abundant attractive climatic and weather conditions, elevation and slope, scenic beauty, appealing terrain and abundant biological diversity. We recommend a more robust tourism policy that seeks to conserve nature in its pristine state as well as an effective funding of managers of these touristic centers in Enugu state. This will assist in developing more centers of interest as well as tap on the vast benefits for the local and international community in Enugu state.
Keywords: Geographic Information Systems, Cartography, Eco-tourism Conservation, Development, Enugu State.

I.   Introduction

Ecotourism is defined as "responsible travel to natural areas that conserves the environment, sustains the wellbeing of local people and involves interpretation and education" (International Ecotourism Society, 2015).

Ecotourism is a form of tourism involving responsible travel (using sustainable transport) to natural areas, conserving the environment, and improving the well-being of the local people. Its purpose may be to educate the traveller, to provide funds for ecological conservation, to directly benefit the economic development and political empowerment of local communities, or to foster respect for different cultures and for human rights. Since the 1980s, ecotourism has been considered a critical endeavour by environmentalists, so that future generations may experience destinations relatively untouched by human intervention. Ecotourism may focus on educating travelers on local environments and natural surroundings with an eye to ecological conservation. Some include in the definition of ecotourism the effort to produce economic opportunities that make conservation of natural resources financially possible.

Over the past six decades, tourism has been steadily increasing worldwide. It has been increasing through different platforms including advocacy, cautionary, adaptation and alternative tourism (Mehmetoglu, 2007). According to the World Tourism Organization (WTO,2016), the number of international arrivals across the globe has been increasing significantly over the years and would continue to increase.

In today's reality economically developed and developing countries alike are paying special attention to tourism development which is an integral part of the economic sector. Today, ecotourism is the most intensively developing tourism industry, according to the WTO (2016), "the annual growth of ecotourism is 30 %, and its share in global tourism revenues is 10-15 %".

The application of GIS technique for ecotourism potential mapping has been applied by different scholars in different parts of the world because of its ability to collect, store, retrieve, manage, display and

analyze the spatial data. Over the past two decades, MCDA has been used as an effective tool for the identification of ecotourism potential zone and site (Ghamgosar 2011; Kumari et al. 2010). There are various methods of MCDA, and among them analytical hierarchy process (AHP) is an efficient and widely used method
(Chandio et al. 2013; Fung and Wong 2007) which is based on pair-wise comparison in ratio scale (Saaty 1980). This study aims to apply the Geo-spatial technique for Eco-tourism development in Enugu state. AHP was used to assign criteria weights to be used in Ecotourism potential zoning. The study thus highlighted the following objectives. Which are to examine factors or Criteria/Constrains that affect suitability of tourism sites and identify suitable sites for Ecotourism.

Study Area
Enugu State is one of the states in the south eastern part of Nigeria. It is located approximately within latitude $6^0 30^!$N and $6^0 50^!$N and within longitude $7^0 30^!$E and $7^0 50^!$E. The state shares borders with Abia state and Imo state to the south, Ebonyi state to the east, Benue state to the Northeast, Kogi state to the Northwest and Anambra state to the West. Enugu state consists of 17 Local Government Areas, occupying total land area of 7,161 km^2.
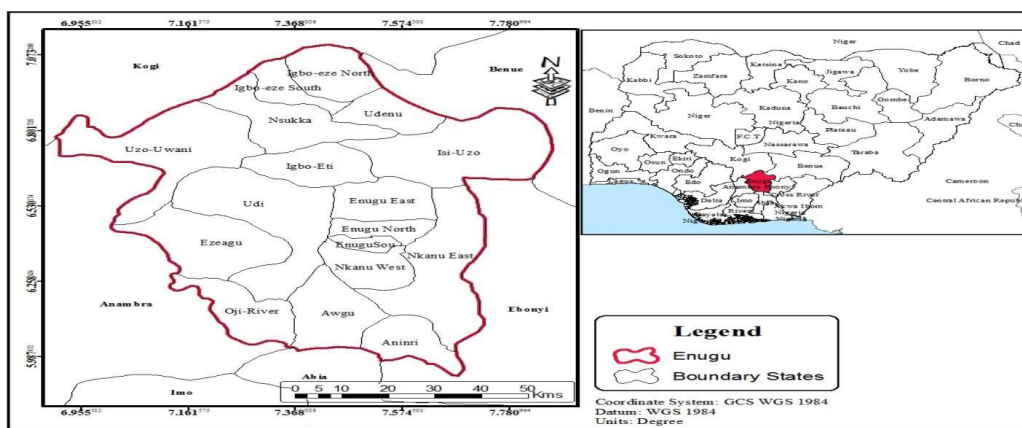

Fig 1: Nigeria showing Enugu State

II. Data And Materials

The required data for the study were collected from two major sources such as Satellite imagery and Available maps. To obtain information and data related to DEM, Slope, Aspect USGS, SRTM 30m spatial resolution was used. Elevation, slope, aspect were processed using land Sat 8 satellite imagery 30m spatial resolution 2021.

Dataset	Data type	Data shape	Data source
Elevation	Raster	Polygon	SRTM(DEM) 30m spatial resolution
Slope	Raster	polygon	SRTM(DEM) 30m spatial resolution
Aspect	Raster	Polygon	SRTM(DEM) 30m spatial resolution
Rivers	Vector	polygon	Google Maps
Forest reserves	Vector	Point	Literature
Proximity to roads	Vector	Line	Google Maps
Existing Tourist sites	Vector	Point	Literature/
GPS	Vector	Point	Field survey

Table 1: Data sets for the study

III.   Methodology

Analytical Hierarchy process (AHP) procedure

AHP is one of the most popular MCDM techniques developed by Saaty, (1980). It is used to identify the best one from a set of alternatives with respect to several criteria.

The principle utilized in AHP is to solve problem by forming hierarchies. According to Ullah and Hafiz (2014), the whole process of site suitability evaluation for ecotourism based on AHP and GIS follows the following steps:

1. Making pair-wise comparison.
2. Preparing comparison matrices.
3. Standardizing the matrix values.
4. Checking consistency ratio and finalizing the relative weight values.
5. Transforming the weight values into spatial database.
6. Overlaying operations and preparing composite map.
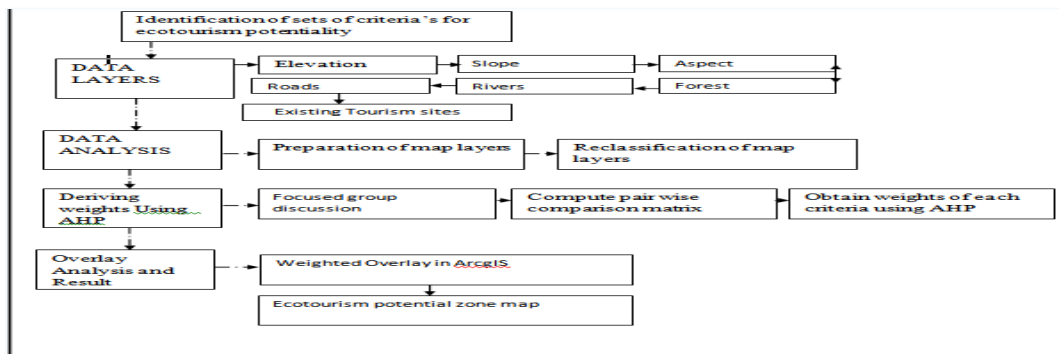7. Classifying the composite map into different suitability zones based on relative importance.

Figure 2 :Conceptual Frame Work

The selection of criteria maps for identification of Ecotourism zones, such as elevation, slope, aspect, proximity to roads, proximity to rivers, forest reserves and existing tourism sites. These elements are responsible for ecotourism potentiality in Enugu state and have been selected based on its importance and literature.

Some earlier scholars have suggested that Elevation is one of the most important dimensions of attractiveness in the landscape (Chernet, 2009; Rahman, 2010). The higher the elevation ranges the higher suitability value for scenic attraction. Accordingly, the highest rank was assigned to the highest elevation, and vice versa. Elevation is reclassified from 1-5, with 1 depicting areas with the lowest elevation value while 5 depicting areas with the highest elevation value.

Slope has a warm relationship with elevation. Slope is important for ecotourism because all terrain features are derived from complex landmass. Steep slopes create good scenic beauty; it is more suitable for ecotourism than a gentle slope. The highest rank is assigned to the highest slope value, while the lowest rank is given the lowest slope value.
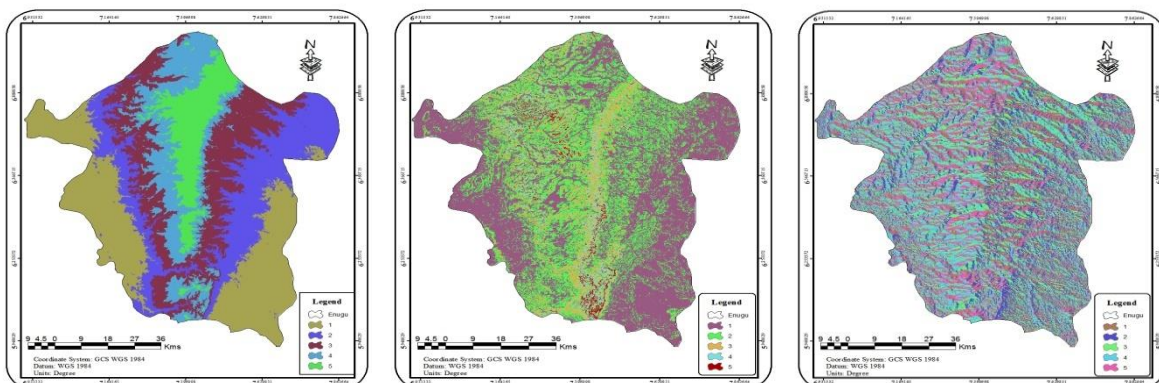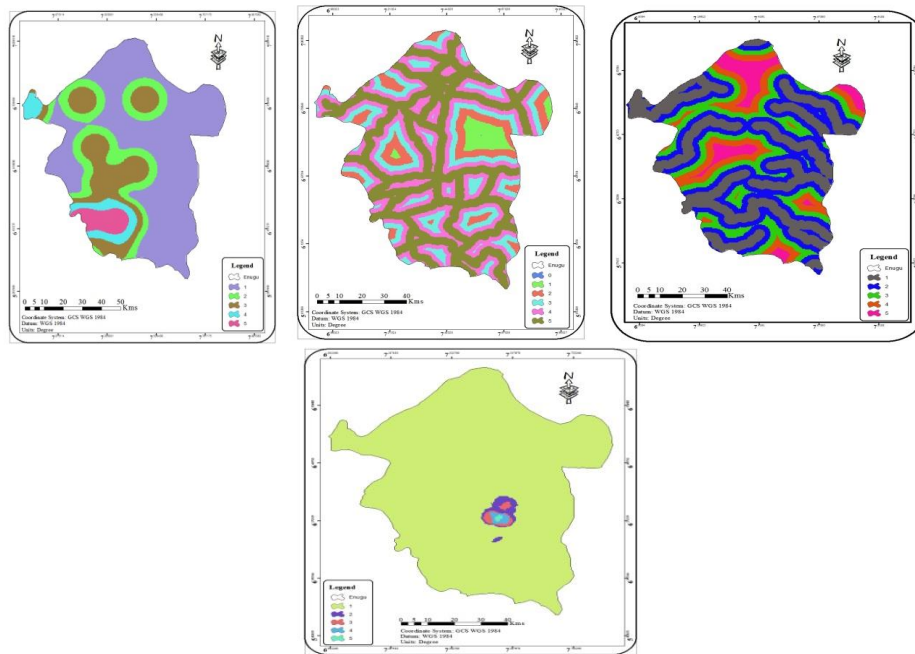
Figure 3; Criteria Maps for Ecotourism Potentiality

Aspect preferences are selected for each class following the importance where the high aspect positively influences the ecotourism potentialities (Ryngnga, 2008; Karki et al., 2020). Here, the aspect is reclassified into 5 classes, and following the above principle, they are coded as 1,2,3,4, and 5 respectively. As the aspect increases also ecotourism potentiality increases.

The presence or absence of roads is not the only factor that governs impacts on Ecotourism. The major impact of roads is related to their function as a key route way. The density of the road network, the volume of traffic on a roadway or road segment, the road surface, and other engineered features also affect the extent of the ecological effects of an area. As much as roads provide access for tourists and developments of tourism areas, it also leads fragmentation of habitats. The roads layer was processed in Arc GIS environment with the Kernel density feature. Then after the kernel density operation, it was changed to raster to make it more compatible with mulch-criteria evaluation. Finally, it is reclassified based on their suitability. Water resources play a determining role in tourist destinations. Tourists prefer to spend their leisure time somewhere; possibly a place which has the closest distance from water sources such as springs, rivers, wetlands, lakes, etc. Tourists are very attracted to water sources. Since, it would have a greater potential for ecotourism development. Drainage map is represented by line feature and then a kernel density operation is carried out which makes the rivers compatible as a raster data with MCE (multiple criteria evaluation). Then, reclassified based on their suitability (Tewodros, 2010). The forest density map shows the density of forest locations in Enugu state, it was prepared on ArcGIS with the Kernel density tool in the spatial analyst tool bar. Here the forest density is reclassified into 5 classes. The denser the forest the higher its contribution to the value of Ecotourism potentiality.

Proximity to existing tourism sites in the study area plays a great role in harnessing new and unexplored tourist destinations, sites and attractions that have the capacity to support Ecotourism, with proximity to existing tourism destinations, Ecotourism potentiality is positively accelerated. Here the existing tourism sites are reclassified into 5 classes with 1 having the least density of tourism sites and 5 having the most dense tourism sites.

Criteria weights via AHP

Criterion	Weight
Elevation	0.40
Slope	0.26
Aspect	0.10
Proximity to Roads	0.10
Proximity to Rivers	0.10
Forests reserves	0.10
Existing tourism sites	0.02

Table 2: Criteria weights

IV. Results

This study has utilized an integrated GIS approach to assess potential zones for ecotourism in Enugu state, Nigeria, which is characterized by a number of magnificent ecological and topographical sites that need more efforts to develop suitable and sustainable ecotourism.

The suitability map was produced by applying all method phases and represents five suitability classes, namely, **Very low, Low, Medium, High, Very High** (FIG 6)
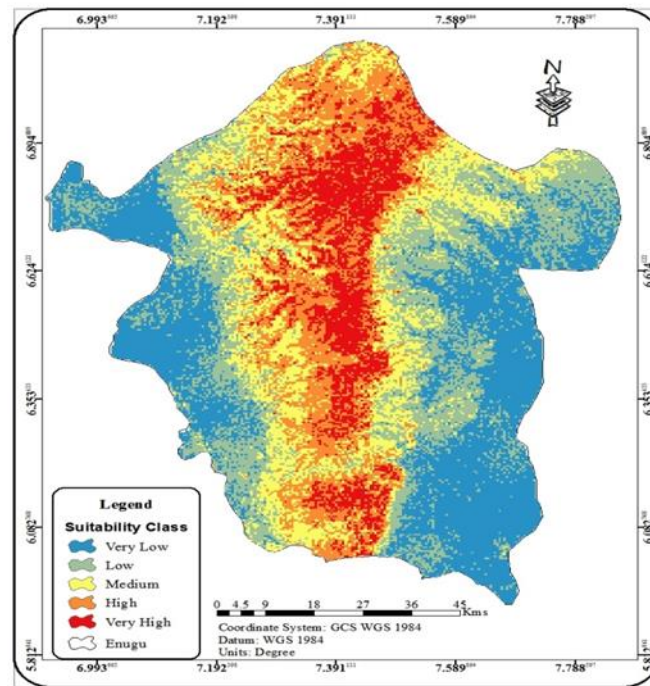

Fig 6; Ecotourism potentiality map

Therefore, the result of this study shows that most part of the very high suitable area lies in the central strip of the study area. This is an indication the elevation, slope; aspect contributes heavily to the potentiality of the study area. The findings specify that the very high and high suitable areas for ecotourism activities in Enugu state are characterized by attractive climatic conditions, steep elevation, amazing terrain and slope, also areas with abundant biological diversity. These areas have the most ecotourism attractions and are mainly characterized by very rich ecological diversity and wildlife. The high and moderate potential zones lay eastward and west ward from the central part of the study area. From the east and west of the study area, it could be observed that they fall in the low to very low potential zones.

V. Conclusion

This study attempted to develop ecotourism potential zones model that further supports decision-making process in Enugu state, Nigeria. In order to produce potential ecotourism zones, multi-criteria evaluation is done based on seven criteria and factor maps. These are Elevation map, slope map, aspect map, road proximity map, river proximity map, forest reserves map, existing tourism sites map, and Geospatial (GIS and RS) techniques were applied predominantly.

Even though ecotourism is still in its infancy as global and national phenomena, there are a variety of definitions for ecotourism forwarded by different individuals and organizations, each with a different perspective. However, there is considerable agreement that ecotourism must be beneficial to local communities and have a positive effect on protecting the environment and maintaining sustainability. Therefore, since ecotourism is contextual, it is defined in this study as "responsible travel to natural areas that conserves the environment, sustains the wellbeing of local people and involves interpretation and education" (International Ecotourism Society, 2015).

The Elevation slope, aspect map of the study area which is one of the factor maps was derived from USGS, and classified respectively. This process is also used for other factor maps.

The study has demonstrated the application of geospatial techniques and multi-criteria decision-making role in solving and identifying suitable sites for ecotourism development, and to efficiently use the available resources for economic development of Enugu state.

The advantage of applying MCE (Multi-criteria evaluation) and geospatial techniques helped us to analyze ecotourism suitability for better understanding, and to employ graphical user interface. This provides an easy way for decision-makers to manage and develop ecotourism through sustainable environmental protection, and management in Enugu state.

In the future, further studies should be conducted to include other socio-cultural criteria factors.

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