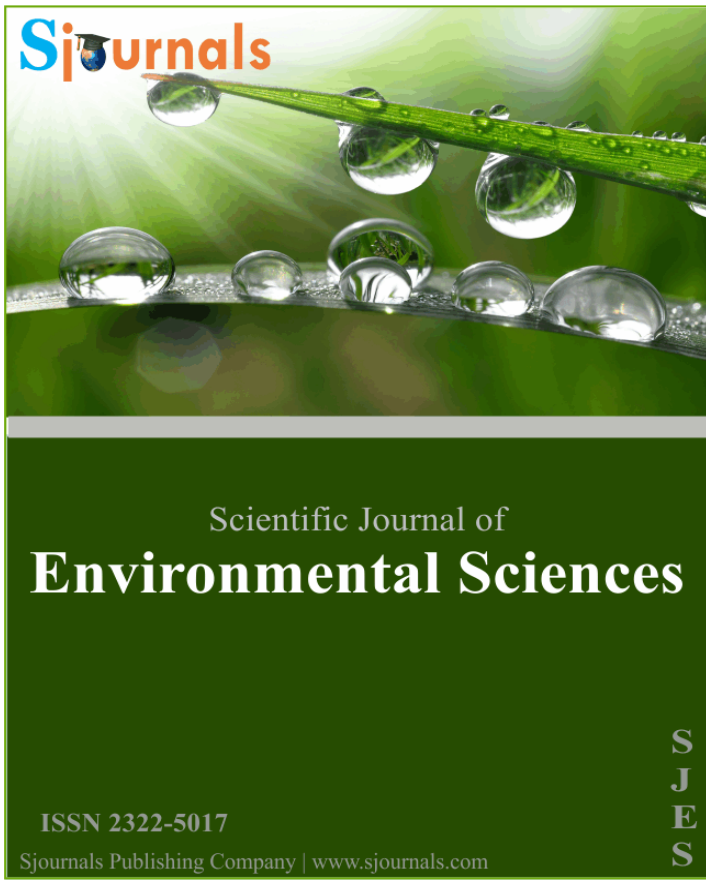

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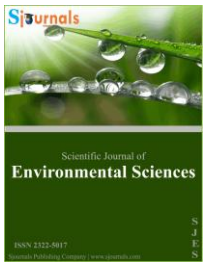

Short communication

Land cover/use classification using remotely sensed imagery from Google earth

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ABSTRACT

Google has emerged as a critical tool in land use mapping. The free remotely sensed satellite imagery availed in Google earth plays a crucial role in land use/cover mapping. This study, therefore mapped the land cover types for Victoria Falls. To achieve this, land cover data was obtained through digitizing satellite images made available through Google earth. Land cover classification was achieved through on screen digitizing. Land uses were classified through visual interpretation of satellite imagery availed through Google earth. The land covers were converted into polygons, point and vector data formats which are compatible with GIS software. The GIS vector and polygon data was imported into ILWIS where it was georefenced to UTM coordinates system. Map showing the spatial distribution of different land cover types was produced using ILWIS GIS. Results indicate that the major land uses in Victoria Falls include settlement, national parks and roads. It is recommended that informed land use planning decisions should take cognicence of the land use map. This may assist land use planners to integrate elephant conservation issues and infrastructural development in the area.

1. Introduction

Mapping land use types using GIS and remote sensing techniques remains largely unexplored in Zimbabwe. This is despite the fact that land use maps are critical tools in planning. Land use planning is critical as it has been observed to be the basic human-elephant conflict management strategy which offers the best chance of long term success. Unlike strategies for mitigation and protection, land use planning tackles the root cause of the problem. It is a preventative approach designed to alleviate human-elephant conflict by creating landscapes in which people and elephants can co-exist sustainably.

The demand for the knowledge of acquiring geographic data has recently increased as the need to understand the position of geographic data relative to the earth's surface and other phenomena is rising. Such information is becoming critical for various land use planning activities which includes road construction, urban planning, siting sewer pipes, water pipes, dump sites, construction of residential areas and other critical infrastructure. In this regard, Google earth has recently emerged as an important source of geographic information system vector data sets which consist of points, lines and polygons which represent features from the map. Google earth provides information which is geo referenced. Overlay analysis of different vector data layers in GIS software has proved to be a crucial tool in decision making. Knowledge of the position of geographic features in relation to each other is important when it comes to land use planning purposes and citing of various infrastructure. Land use is a long term process which requires government support, legislation and policy changes (Larmaque et al., 2009). The process of land use planning should be designated through a coordinated approach involving all stakeholders concerned, such as elephant managers, Ministry of Lands and Rural Resettlement, village herds and councilors. Coordinated planning promotes planning with both the ecological and socio-economic development vision.

Land use planning that entails identification and zoning of separate areas for farming, settlements, elephant habitats and restriction of agricultural development in known elephant corridors (Larmaque et al., 2009). This has a great potential for offering effective solutions to the problem of human-elephant conflict. Once people are settled near the parks, it is difficult to address the negative consequences. In this case humans suffer the negative consequences more because they are not protected as the wildlife policy of Zimbabwe does not mention anything to do with compensating humans for the loss and damage caused by elephants. Elephants are, however, legally protected by CITES and retaliatory killing may attract imprisonment. It is better to tackle the root cause of the problem of human-elephant conflict by revising the land use planning policies because dealing with the consequences of human-elephant conflict appears to be more complex. This study, therefore, mapped the spatial distribution of human land uses. It is hoped that the results can guide land use planners to take cognisance of both the ecological and socioeconomic development vision so as to create a scenario where humans and elephants co-exist sustainably.

2. Methodology

2.1. Digitizing instrument

The location of the human land use and natural variables were obtained through digitizing satellite images made available in Google Earth (www.Googleearth.com). Digitizing involves converting an analogue map from Google earth into a computer compatible and computer readable format (digital data). The major advantage of the digitizing technique is that it is regarded as the best method for geo-referencing. The technique has got limitations which should be taken care of in order to produce reliable data. The methods used to create digital data need extensive checking and correcting to produce a reliable product. The quality of the data depends on the age and resolution of the maps used. Validating digital maps requires extensive ground truthing. The errors should be reduced by using the best data sources and trained personnel to collect and process this information. To overcome these limitations, the researcher had to do extensive ground truthing in order to validate the digitized images and to verify the mapped unit attributes or the correctness of desk top visual interpretation (Kusena, 2009). The main purpose of ground truthing was to verify the digitized classes against the ground scenario. Ground truthing was carried out during the field survey.

2.2. Global Positioning System (GPS) instrument

The GPS Garmin was used to record information on the location human-elephant conflict sites, as well as the position of spatial factors such as fields, settlements, water points, forests and the park. The strengths of GPS lies in that it is a reliable GIS data source. The GPS is accurate in locating the position of an object on earth. It can provide the GIS system with data on the location of geographic objects. Such information can be used for spatial analysis. However, it is impossible to produce error free spatial data. Errors occur when measuring geographical location which depends on the accuracy of the instruments used and surveying skills of the people involved (Smith and Kasiki, 2000). This limitation was not applicable to the researcher as she has the skills of using the GPS. During data collection the researcher recorded the coordinates of features when the GPS error was less than 3 meters. Another limitation of the GPS is that it is usable everywhere except where it is impossible to obtain signals for instance under water, inside most buildings and caves. For this research this limitation was not relevant because the GPS was used in open space not inside buildings or under water.

2.3. Geo referencing spatial data in ILWIS GIS software

Geo referencing is the process of assigning coordinates from a known reference system such as latitude and longitude to the coordinates of a raster map. It is also referred to as the way features and information are assigned location near the earth's surface. The earth is not a sphere, but rather a lumpy ellipsoid. A datum is a simplification of the sphere of the earth, which defines how latitude and longitude and elevation values are associated with particular points on the surface of the earth. Google earth uses WGS 84 which is the world geodetic system of 1984. Creating Google earth features defines spatial positions of points using three values of latitudes X, longitude Y and altitude Z.

In order to transform the 3 dimensional maps, some distortions of areas, distances, angles, and directions occur. A projection is a way of compromising to achieve this flattening, causing distortions in particular parts of the world. Google earth uses a simple cylindrical projection known as the lat/long WGES 84 (Crossley, 2008). This is because geographic coordinates represent the earth as a curved surface. Hence, to represent the curved part of the earth on a flat piece of paper or computer screen, the geographic coordinate system of the shape files were transformed to plane/Cartesian coordinates using the Universal Transverse Mercator (UTM) projection which results from warping the cylinder round the poles. This means that all spatial data for this research used the projection WGS 1984 and UTM zone 35k.

2.4. Data presentation and analysis

GIS was also used to present spatial geographic information for this research. It is crucial to define this technical term before explaining how it was used by the researcher for data collection, analysis and presentation. GIS is a computer based system that provides the following capabilities for handling geo-referenced data: input, storage, analysis and presentation of geo-referenced information (Smith and Kasiki, 2000).

The major data input sources for GIS include digitizing, Global Positioning System (GPS) and remote sensing. GIS has data management capabilities for storage and retrieval of geo-referenced data. The geo-referenced information can be analysed using various GIS softwares. GIS also have capabilities of presenting spatial data in the form of maps. GIS can also produce quantitative geographic information which can be analysed using different statistical techniques. The spatial analytical capabilities of GIS provide an effective and efficient means to manage the information required to understand the spatial patterns of human-elephant conflict.

Recent technologies such as GIS are being used for the input, storage, manipulation, analysis and display of geographic information (Mutanga and Adjorlolo, 2008). Human-elephant conflict is a spatial phenomenon and so it is important to investigate the factors which influence human-elephant conflict from a spatial perspective. GIS should be incorporated in the analysis of human-elephant conflict. GIS allows the integration and manipulation of spatial data and can be used to predict the effects of human-elephant conflict mitigation measures. This research presents a GIS based analysis of human-elephant conflict in the area of Hwange. The strength of GIS lies in its ability to manipulate spatial data. Spatial reasoning has received limited attention in ecological studies. Data for the digitized points, lines and polygons of the predictive factors from Google earth were imported into Arc view GIS 3.2 and converted into shape files. The shape files were then imported into ILWIS GIS where they were geo-referenced to geographic coordinate system which is latitude longitude. The X, Y coordinates of presence/absence of human-elephant conflict were imported into ILWIS via Excel. The data were converted into shape files in ILWIS.

3. Results

Fig. 1. depicts the major land uses in the area of Matabeleland North. The spatial extent and spatial distribution of the main land uses in the study area is clearly depicted in Fig. 1.

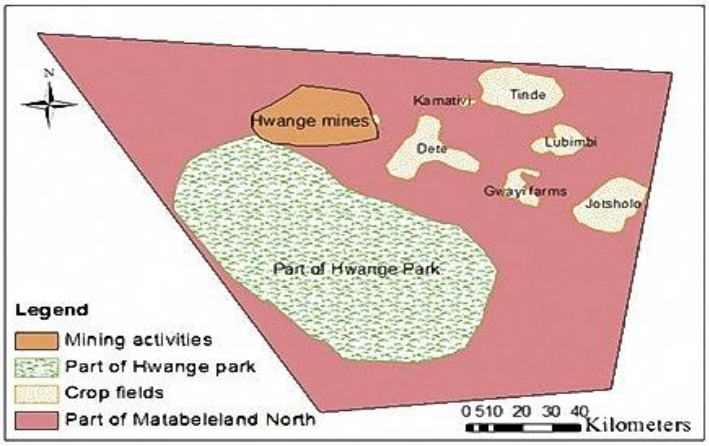

Fig. 1. Land uses in the area of Matabeleland North.

The main areas in Matabeleland North include Hwange National Park, Hwange town, Kamativi, Dete, Tinde Lubimbi, Gwayi Farms and Jotsholo. As shown in Fig. 1, the main land use in Matabeleland North is national park. The area is mainly designated for wildlife. These marginal lands are endowed with forests and a variety of wild animals. Coal mining activity is among the main land uses. The major companies which mine coal include Hwange Colliery, and Makomo. The other land use in the area of Matabeleland North is agriculture. However, there are few agricultural activities in the area. The poor, shallow Kalahari sandy soils and low rainfall activity makes the area unsuitable for agriculture and settlement.

The area is mainly designated for wildlife. It is recommended that developers should take cognizance of protected areas such as parks whenever planning settlements and other infrastructural developments. Such an approach is crucial as it does not jeopardize wildlife conservation issues.

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