Relevance of RS and GIS in Wildlife and Biodiversity Management

Shanila
M.Sc. (Biodiversity Studies and Management), Department of Wildlife Sciences, Aligarh Muslim University, Aligarh

Danish Faizan
Scientist, National Informatics Centre, U.P.

ABSTRACT
Wildlife and Biodiversity management require a reliable and relevant data on the distribution of species, abundance, their habitats, as well as threats. Therefore, RS (Remote Sensing) and GIS (Geographic information system) Assists in data collection and to analyse the abundance of wildlife as well as provide suitable data for conservation management and planning. This paper reviews the relevance of RS and GIS in wildlife and biodiversity Management.

General Terms
GIS application and its relevance in the wildlife and biodiversity, Development of GIS in the field of information system, GIS data, Types of GIS data, Data structures of GIS, Data models of GIS.

Keywords
Relevance of RS and GIS in wildlife and Biodiversity Management, what is GIS?, GIS data, Types of GIS data, Data structures of GIS, Data models, Raster data models, Vector data models.

1. INTRODUCTION

1.1 What is GIS (Geographic Information System)?

We are living in the 21st century with the fast-growing trends in the technology of computer information systems to acquire data of the cultural and physical worlds, and to utilize these data for the research work or to resolve the practical problems. The active analogue and digital electronic devices assist the record of assets and the fast execution of logical or arithmetic operations. The information system is enduring much upgrading, and they can manipulate, create, store, and apply spatial data much more rapidly and at a hasty rate as evaluated with the conventional methods.

An information system is a set of tools and data for functioning with the data, which includes data in the form of analogue or digital about the occurrence in the existent

world. Our acuity of this world via selection, generalization, and synthesis provide us representations & information of these information i.e. the information comprise a replica of the phenomena. As a result, the compilation of data i.e. the database is a substantial depot of different observations of the existent world depiction our data at one point within time. Plagiaristic information of the individual information essentials in a database, the data directly evident i.e. formed data from information by the process of our thought, association or whatsoever based on our acquaintance. Consequently, in a context of database the terms information, data, & knowledge are discriminated. It be able to be summarizing that the information is very crucial and further assessment as we growth from information to data, to knowledge. The information that has many forms and origins, might be any one of the subsequent:

- Real i.e. the landscape conditions, etc.
- Captured, for example trace digital data of an area through RS(remote sensing) satellites or the Aerial photographs.
- Interpreted, for example land use from the data of RS, profundity of perfect data, etc.
- Organized or structured i.e. tables concerning the conditions of an individual watershed.

1.2 Development Of Gis In The Field Of Information System

Geographic Information Management Technology encompasses many fields including Computer Science, Cartography, Information Management, Telecommunication, Geodesy, Photogrammetry & Remote Sensing and flavoured with its applications of engineering, environmental analysis, land use planning, natural resource development, infrastructure Management, and many others. Geographic Information Management Technology has almost As many names as their uses. One widespread name is GIS i.e. Geographic Information System.

"A powerful set of tools for collecting, storing, retrieving at will, transform, and presenting spatial data commencing the existent world" (Burrough, 1987).

Sometimes GIS is also identified as 'Spatial Information System' because it includes with the positioned data, for substance located in any area, not only geographical, a name for globe space.

For any of the application, a GIS can give answer of five standard questions:

1. Location: What subsists at a scrupulous location?
2. Condition: Spot locations where convinced conditions are exist.
3. Trends: What has been changed ever since?
4. Patterns: What spatial patterns are exist?
5. Representation: What if?

2. RELEVANCE OF RS AND GIS IN WILDLIFE AND BIODIVERSITY MANAGEMENT

According to the IUCN (1996), "The main purpose of wildlife conservation is to maintain maximum plant and animal diversity through genetic traits, ecological functions and bio-geo-chemical cycles, as well as uphold aesthetic values." "For

over a century national parks and reserves have been the dominant method of wildlife conservation," said by Western and Gichohi (1993). They further said, "Because most of these areas are not complete ecological units or functional ecosystems in themselves, they have experienced a range of management problems. The main problem is the general decline in plant and animal diversity."

A new effort is the 'ecosystem effort' is to be promoting for biological diversity from outside these traditional protected areas. The loss of wildlife species and their habitats has been continuously increasing, which is origin by the different type of human activities.

RS and GIS are the most efficient means for management of our natural resources. Respective coverage from various satellites provides an excellent geographic database for future planning of our resources. Resource information system is the primary need for planning management and its valuable implementation. However, the trends indicate that we are pursuing sectoral planning in managing most of our resources including biodiversity and wildlife management. This process did not take into account spatial realities mainly due to the unavailability of the relevant, up-to-date information. As a result, the plans have not been meeting success up to the desired extent, inequalities (over, under or improper utilization) at national, regional and local levels.

Wildlife and Biodiversity Management has emphasized the need of having updated spatial information for (a) decision-making, and (b) implementation of plans. Remote sensing has a definite role in providing updated spatial information. But, the information derived from remote sensing data will have to be merged into the conventional database as and when necessary.

Geographic Information System can provide spatial information with relevant conventional statistics when data is made computer readable. It can help in changing the very approach of wildlife management based more on current information and location oriented.

Factors, which are to be given fresh look at the conventional information system in the forest department, are:

1. Operational deficiencies in the existing system due to various strains on it resulting in

- lack of uniformity, standardization, and timeliness
- the information generated being not in a readily usable form

2. Change in the perspective of the forest department role from mere maintenance and preservation of the jungle to planned development and change in areas of nature conservation and ecology.

3. The requirement that have arisen subsequently to cater to planning, fundamental and other agencies calling for economic assessment, evaluation of the contribution of forestry to an economy and other benefits.

3. CURRENT STATUS OF INFORMATION ABOUT FOREST RESOURCES

Currently, information about the forest resources is obtained by forest administrations at various levels by manual methods with little mechanical aids such as calculating machines etc. This information is store in Operation Records, History sheets, Control forms, or periodical returns and reports. However, in few states the use of a personal computer is also in vogue for storing the above information. The level of data collection is the forest range/division. In most of the cases, the lowest administrative level where the data is collect by forest range officer and conservator of forests take decisions at much higher level. The data requisite at the time of intriguing management conclusions cannot be recover due to the lack of consistency in the procedure of storage and make easy for the recovery of data.

The requirement of information at various administrative levels is different. At the national level, normally the information about the forested and non-forested areas may be ample the point whereas at the state level the information of forest type i.e., qualitative or quantitative may be necessary. At further lower level i.e., forests divisions, detailed quantitative information such as height, density, fire line management, growing stock, social forestry, Afforestation, working plans and Wildlife & Biodiversity Management may be necessary. Forest range level, which is the lowest administrative level where execution of various forest plans is done need information about the status of fire lines, wildlife position, fire incidences, soil conservation measures, watershed management, plantation areas, protection of forests, site class and couple, cost of extraction, etc.

The information needed on these topics can be obtain by MIS for generating computerized database as input to the information system. Later these, the database can be accessed by respective state's forest department for making management decision as and when needed. There would necessarily be a requirement of the host computer for the creation of a geographic database for forest resource planning and management. The following process could achieve this:

- Data collection and generation of the resource base.
- Data digitalization and processing
- Data analysis/modelling/output generation.

Data input in GIS is in the form of map. Hence primary ground information is to be convert into map format. Forest resources data layers as required in Information System concept could be digitize for making them computer readable. However, there could be even possibility of linking tabular data, point information with maps, etc. for further modelling & analysis. The models for prescribing various forest administration decisions based on available forest resource database can be use for efficient planning and management.

4. ROLE OF REMOTE SENSING IN WILDLIFE AND BIODIVERSITY MANAGEMENT

Remote Sensing techniques (both satellite image and aerial photo interpretation) play a vital role in wildlife and biodiversity management because of its unique Characteristics of synoptic view, repetitive coverage, and uniformity. The forest management objective where the Remote Sensing has a significant roles to play a revision and updating of working plan, wildlife management, logging planning, fire control, land utilization studies, grazing land management, soil and water conservation, mapping of sites suitable for social forestry (fuel & fodder plantations) and for other important species of general Afforestation programmes.

In biodiversity management, maps like management, stock, and working plan maps play a very significant role, and these maps are update at each revision of the arrangement. Remote Sensing data has much scope in fulfilling this objective, which takes a lot of time while revising the management plan.

Satellite RS has cooperated as a main role in offering information with reverence to vegetation type, forest cover, and their changes at global, regional, national, or micro level studies (Roy et al. 1987, Unni at al. 1985, Porwal and Pant, 1986). The Remote Sensing data has a scope of its relevance in Biodiversity and Wildlife Management.

The application of RS & GIS has been demonstrate in many institutions through some Case studies. Some application spots are following:

- Revision and updating of stock maps
- Preparation of working plan
- Fire risk Zonation
- Planning response routes
- Wildlife habitat analyses
- Protected area management
- Wasteland development planning
- Site suitability analysis for Afforestation
- Identification of JFM (Joint Forest Management)
- Areas and participatory forest
- Fire line and Management
- Soil and water conservation

5. GIS DATA

GIS does not hoard a map in several straight logic, nor does it contain an individual view or image of any geographic area. As an alternative, the GIS supplies the data as of which we are able to illustrate the required view to ensemble a exacting rationale known as Geographic data.

6. TYPES OF GIS DATA:

Geographical data consists primarily two types of data i.e. Spatial as well as Non-Spatial or Attribute.

6.1 Representation of spatial information

Spatial data is the data which has geographic locations and physical dimensions on the earth's surface. Some examples are a state boundary, a river, a state capital, a lake, etc. Geographical features can be represent on a map by the POINT, LINE & POLYGON.

6.1.1 Point feature- A discrete location depicted by a singular symbol or label. A single x, y co-ordinates e.g. oil well could be represented by a point entity consisting of x, y coordinates.

6.1.2 Line feature- Represents a linear mark. A set of ordered x, y coordinates e.g. a road could be represented by a series of x, y coordinates.

6.1.3 Polygon feature- An area feature where boundary encloses a homogenous area e.g. a floodplain could be represent by a vicinity entity covering a set of x, y coordinates plus the label 'flood plain.'

The labels might be the real names as shown here, or they might be unusual symbols.

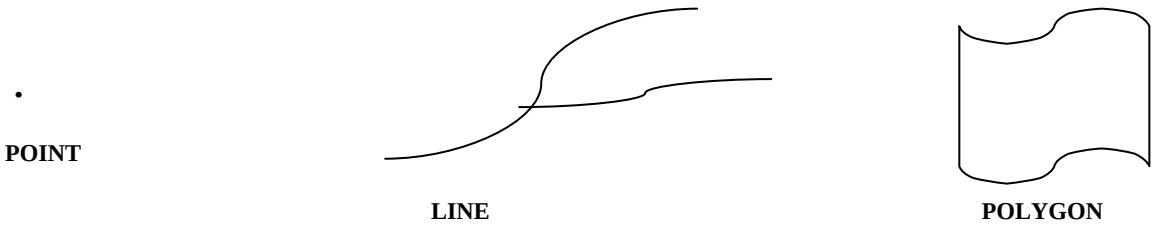


Fig 1: Types of geographical features on a map

6.2 Representation of non-spatial information

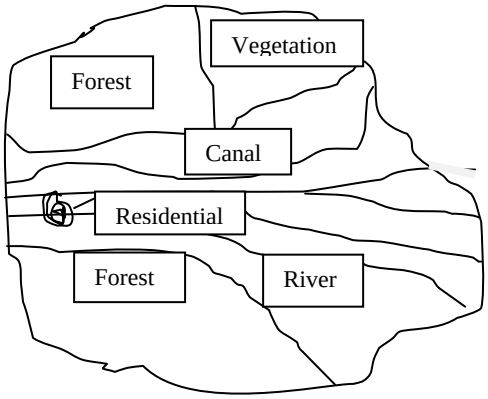
Non-Spatial data include information about the features. For example, the name of roads, schools, forests, etc., population or census data for the region concerned, etc. Non-Spatial data is that qualifies the spatial data. It describes some aspects of the spatial data, not specified by its geometry alone.

7. DATA MODELS

Alteration of actual world geographical disparity into distinct objects can be done via data models. It symbolizes the relation between the domain of geographic data of real world and depiction of these features by computer. Data models considered here are for demonstrating the twisting information.

Data models can be of two types: Raster & Vector. **Raster** type of version of the geographical data, a collection of cells, positioned by synchronize is used, every cell is separately deal with the assessment of a trait. Every cell includes a particular value, and each position communicates with a cell. One collection of cell and related value is a LAYER. Raster Models are straightforward with which spatial scrutiny is faster and easier. Raster Data Models necessitate a huge amount of information to be accumulated, robustness of data is inadequate by the size of cell & productivity is less attractive.

Vector Data Model utilizes line sectors or points signify by its overt x, y synchronize to spot locations. Distinct objects are shaped by linking line segments. Vector Data Models need less outputs appreciable, and storage space. Inference of perimeter/area is precise, and suppression is convenient and faster. Spatial analysis is really difficult with reverence to inscription software program.



Point- Tower

Line- River, Canal

Polygon- Forest, Vegetation, Residential

Fig 2: Example of Raster Data

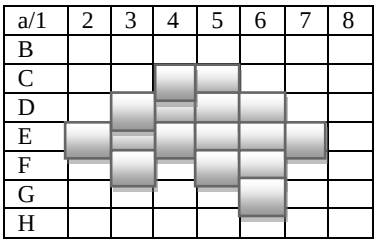


Fig 3: Example of Vector Data

8. DATA STRUCTURES

There are some of the different traditions to systematize the data within the information system. The selection of data structure influences both; Data Storage Volume and dispensation efficiency. So many GIS has particular abilities for manipulating and storing feature data in adding together to the Spatial Information. The three essential data structures are- Relational, Hierarchal and Network.

8.1 Relational Data Structure arranges the data in conditions of the two-dimensional charts where each chart is an individual file. Each line in the chart is a documentation, and each documentation has a collection of attributes. Each file in the chart is a trait. Different charts are correlated via the use of a universal identifier, which is called KEY. The information is take out through the relation that are distinct by the uncertainty.

8.2 Hierarchal data structure supplies data in a manner that a hierarchy sustained with the data items. Each knob can be divided many further knobs. Stored Data gets some more further knob. Stored Data gets more comprehensive as on undergrowth additional elsewhere on the tree.

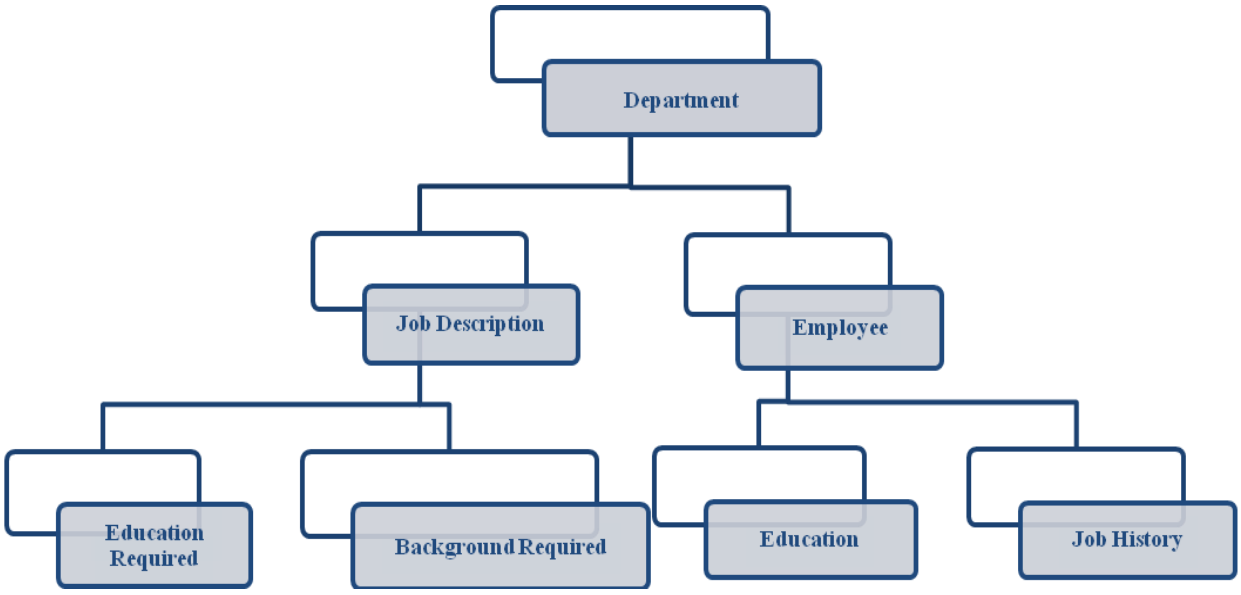


Fig 4: Hierarchal Data Structure

8.3 Network Data Structure is as same as the Hierarchy Structure with the exemption that in this type of structure a knob can have more than one parent. Each knob can also be divided into more further knobs. Knobs be competent of many

parents. The Network Data Structure has the restriction that the indicators must be rationalized every time a modify is made in the database, which cause extensive overhead.

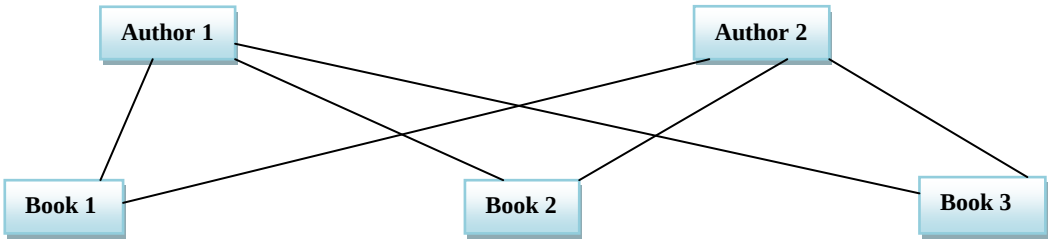


Fig 5: Network Data Structure

9. CONCLUSIONS

The perspective for the use of RS and GIS information system in biodiversity mapping, natural resource planning, and management are vast. These technologies are presently fully developed, and they are gradually more being applied in natural resource mapping, planning, and management. However, their relevance, predominantly in developing countries, is still limited by the shortage of proper scale of data, software, hardware, and expertise.

Future research in Wildlife and Biodiversity management should focus on developing more Realistic and dynamic management of Wildlife in space and time. Since the ecosystems to be managed can be considerably affected by stochastic events and the responses of wildlife are non-linear in form, management must be dynamic and aspire to supply predictions of known precision, which are testable.

GIS is also considerable as an important tool for making the decision to solve the problems of environment by dealing with the Geo-information.

The basic elements of the GIS includes software, hardware, live ware and data.

10. REFERENCES

[1] Hatten, J. R., Averill-Murray, A. & van Pelt, W. E. 2005. A spatial model of potential jaguar habitat in Arizona . Journal of Wildlife Management.

[2] Leeuw J.D., 2002. Application of remote sensing and geographic information systems in wildlife mapping and modelling. Environmental modelling with GIS and Remote Sensing**.**

[3] Raju, P.L.N. Fundamentals of geographical information system. Satellite Remote Sensing and GIS Applications in Agricultural Meteorology.

[4] Satyanarayana, K., Reddy U. R., 2010. Sample survey: A geospatial approach in tourism study.

[5] Yamada, K., Elith, J., McCarthy, M. & Zerger, A. 2003. Eliciting and integrating expert knowledge for wildlife habitat modelling. Ecological Modelling.

[6] http://www.esri.com/industries/conservation/about/wildlife

[7] http://wolvesonceroamed.com/2012/06/01/gis-in-wildlife-conservation/