

A Geographical Study of Keoladeo National Park, Bharatpur (Rajasthan) with Using Remote Sensing and GIS

Ashish Sharma

Abstract

Keoladeo National Park (KNP) (27°7'6"N – 27° 12'2"N and 77° 29'5" E – 77° 33'9"E) is a 29 km sq. area situated on the extreme western edge of the Gangetic basin that was once confluence of Rivers Gambhir and Banganga in Bharatpur district in the State of Rajasthan. It is a wet land. Wetlands play a vital role in the ecosystem by creating unique biodiversity which is of ecological and environmental significance. Wetlands play vital functions for humans such as water storage, flood mitigation, storm protection, ground water recharge & discharge, erosion control and also provides many services and commodities to humanity. Knowledge of changes in wetlands is a very important issue for natural resource management. Wetlands of India, (estimated to be 58.2 million hectares) are important repositories of biodiversity. Therefore, Monitoring and Conservation of Wetlands is very important. The present study aims at changing environment of Keoladeo National Park with use of Remote Sensing and GIS. It has been also observed that most of the villagers in the nearby area are much more aware about the conservation of biodiversity, importance of the Keoladeo National Park in terms of biodiversity conservation, its charisma for migratory birds, and specially the importance of the world heritage site tag. The study demonstrates the integration of satellite remote sensing and GIS was an effective approach for analyzing the direction, rate, and spatial pattern of land use changes. Integration of these two technologies was found to be more beneficial in describing and analyzing land use change process.

Key Words: Ecosystem, Keoladeo National Park, Biodiversity Conservation, Land Use Changes.

Introduction

Keoladeo National Park (KNP) (27°7'6"N – 27° 12'2"N and 77° 29'5" E – 77° 33'9"E) is a 29 km sq. area situated on the extreme western edge of the Gangetic basin that was once confluence of Rivers Gambhir and Banganga in Bharatpur district in the State of Rajasthan. KNP has a unique mosaic of habitats that include wetlands, woodlands, scrub forests, grasslands that supports an amazing diversity of both plant and animal species. Keoladeo National Park's flora consists of over 375 species of angiosperms of which 90 species are wetland

species. The fauna includes more than 350 species of birds which include 42 species of raptors and 9 species of owls, 27 species of mammals, 13 species of reptiles, 7 species of amphibians, 58 species of fishes and 71 species of butterflies, more than 30 species of dragonflies and more than 30 species of spiders inhabit the park. Owing to the abundance of the birds, KNP is often referred as 'Birders Paradise'.

¹Corresponding Author Email: ashishsharma2424@rediffmail.com

The land use map of part of *KEOLADEO NATIONAL PARK, BHATATPUR (RAJASTHAN)* has been generated at Department of Geography, University of Rajasthan. Digital techniques of remote sensing were followed in interpretation of Rabi season data and it's aggregation to develop a map showing complete picture of land use in the study area. Major categories include built-up land, agriculture land, forest, waste land and water bodies were interpreted.

Objective

The objective of the present study is to map the landuse/ landcover pattern of *KEOLADEO NATIONAL PARK, BHATATPUR (RAJASTHAN)* with the help of Erdas 9.1 for image georeferencing and ArcGIS 9.2 for onscreen digitization in Shape file along with statistical analysis of LU/LC categories.

Remote Sensing

Remote sensing is the science and art of obtaining information about an object, area or phenomenon through an analysis of the data acquired by a device which is not in contact with object, area or phenomenon under investigation. In the present context, information about the object area or any phenomenon must be available in a form that can be impressed on a carrier vacuum. The information carrier, or communication link, is electromagnetic energy. Remote Sensing Data basically consists of wavelength intensity information acquired by collecting the electromagnetic radiation leaving the object at specific wavelength and measuring its intensity.

Remote Sensing of earth's environment comprise measuring and recording of electromagnetic energy reflects from or emitted by the planets surface and atmosphere from a vantage point above the surface, and relating of such measurements to the nature and distribution of surface materials and atmospheric condition. Sensor mounted on aircraft or satellite platforms measure the amounts of energy reflected from or emitted by the earth's surface. These measurement are made at a large number of points distributed either along a one dimensional profile on the ground below the platform or over a two-dimensional area on either side of the ground track platform.

The definition of Remote Sensing is restricted to mean the process of acquiring information about any

object without physically contacting it in any way regardless of whether the observer is immediately adjacent to the object or millions of miles away it is further required that such sensing may be achieved in the absence of any matter in the intervening space between the object and the observer. Consequently, the

At present, CARTOSAT 1&2 data is currently used for better image interpretation because it provides high resolution both in mono and stereo mode. The resolution of CARTOSAT-2 is 80 cm. It is approximately similar to IKONOS(1meter), Quickbird(60cm) and Geoeye(41cm) satellite sensor resolution.

Geographical Information System (GIS)

GIS is a decision support computer based system for collecting, storing, presenting and analysis of geographic data. This system uses spatially referenced database and giving users the capability to control queries over space, and usually through time. GIS is much more advanced than Computer Aided Design (CAD) or any other spatial data system. The basic output of GIS or spatial data analysis system is a map. The need to analysis maps to compare and contrast pattern of earth related phenomena, is confirmed by the long standing tradition of doing so with traditional maps.

Many geographical phenomena are best described scientifically as field survey. Good example is topographic elevation, air temperature, and soil moisture content. A two dimensional field may be defined as any single valued function of location in a two dimensional space and discrete field, with nominal dependent variables. It appears that any geographical phenomena can be represented either as a field or as a collection of digital object.

Creation of Shape File

It is a tool for data storage in the form of shape file (.shp)

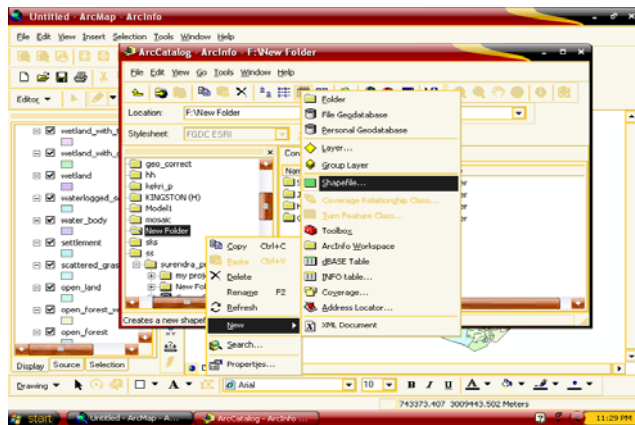
It has many tools for storage the data such as.

- 1 point
- 2 polyline
- 3 polygon
- 4 multipatch

5 multipoint

HOW TO CREATE SHAPE FILE IN ARC MAP 9.2 SOFTWARE (STEPS):-

1. First open Arc map and double click on Arc catalog on main menu bar.
2. Select a desired folder, right click on there, select a new shape file and feature types.
3. Feature type may be point, polyline, polygon, multipatch, multipoint.

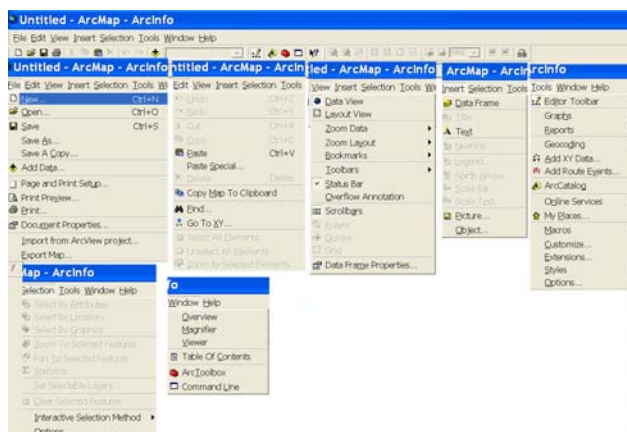


Arc Map

1. Click the start button on the Window taskbar.
2. Point to Programs.
3. Point to Arc GIS.
4. Click Arc Map.

Arc Map Basic General Used Tools and Menu

[a] Menu



[b] General Use Tools in Arc Map

ArcMap Standard toolbar buttons and their functions

Button	Name	Function
	New map file	Creates a new map
	Open	Opens an existing map
	Save	Saves the current map
	Print	Prints the current map
	Cut	Cuts the selected element(s)
	Copy	Copies the selected element(s)
	Paste	Pastes the clipboard contents into your map
	Delete	Deletes the selected element(s)
	Undo	Undoes the last action
	Redo	Redoes the previously undone action
	Add Data	Adds new data to the map's active data frame
	Editor toolbar	Shows the Editor toolbar so you can edit the map's data
	ArcCatalog	Launches ArcCatalog

Editor toolbar buttons and their functions

Button	Name	Function
	Edit	Selects and edits features and their geometries
	Sketch	Adds points to the edit sketch
	Split Tool	Splits a linear feature
	Rotate Tool	Rotates the selected feature
	Attributes	Shows the feature property editor
	Sketch Properties	Shows a dialog box for editing properties of the edit sketch geometry

Draw toolbar buttons and their functions

Button	Name	Function
	Select Elements	Allows you to select, resize, and move text, graphics, and other objects placed on the map
	Rotate	Rotates the selected text or graphics
	Zoom To Selected Elements	Zooms the map display to the selected elements
	New Rectangle	Draws a rectangle
	New Text	Allows you to add text to the map by typing it in
	Edit Vertices	Allows you to edit the vertices of the selected line, polygon, or curve
	Bold	Toggles bold font on and off
	Italic	Toggles italic font on and off
	Underline	Toggles underline font on and off
	Font Color	Allows you to change the font color
	Fill Color	Allows you to change the fill color
	Line Color	Allows you to change the line color
	Marker Color	Allows you to change the marker color

Study Area

Location & Introduction of study area KEOLADEO national park is situated between (27°7'06" N – 27°12'02" N latitude and 77°29'05' E – 77°33'09" E longitude) with an elevation of 572 m amsl. It is 2 km South-east of Bhatatpur city, 38 km South-west of Mathura and 50 km West of Agra and 180 km from Delhi in Bharatpur district of Rajasthan .

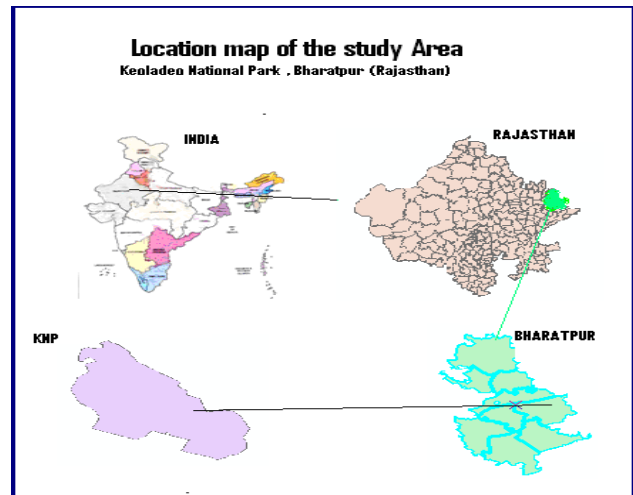
Masonry around the border separates the park the surrounding agriculture fields. There are about 15 villages around the park.

The KNP is part of that Indo Gangetic plain with elevations ranging from 173-176 meters above sea level. The area is semi arid with an average rainfall of 500-700 mm, though rainfall can vary greatly from year to year.

The KNP has exceptionally high biodiversity. The Park contains 100 species of plants, about 50 species of fish, seven species of turtles, five lizard species, and thirteen snake species. The KNP is also rightly known as a "bird paradise" with over 354 species. Birds from Siberia and Europe come here in the winter. The Siberian crane (*Grus leucogeranus*) commonly known as "snow wreath" or "lily of birds", visits this Park. In fact, this is the only reported wintering ground of the Siberian crane in the Subcontinent. However, their numbers in the KNP recently declined from 2300 to almost none during the last two decades. In February 1996, four Siberian cranes re-appeared after two years of absence, much to the relief of the conservation community. During the winter of 1999 two Siberian cranes visited the park.

Evolution of the Ecosystem

The history of the KNP is as fascinating as its biodiversity. The area was a natural depression, and the wetlands have existed on some form or other for several centuries. The Keoladeo was re-designed by the local kings to attract more migratory birds. The present wetland sites are reported to have been designed around 1750 after the construction of a small dam, Ajan Bund, up stream by the famous local king Suraj Mal. The Ajan bund is to facilitate complex water management in retaining soil moisture, supplying water to crops, maintaining the ground water levels, etc. The historical highlights of the Park are shown in below. The dykes in the Park date back to 1700 and were built to retain water. The Park was owned by the local king who used it as a bird, particularly duck, hunting ground. Even today the hunting records of the then rich and famous are displayed inside the Park on stone carvings. The successful hunters included kings, British viceroys and princes. These dykes were also used by the local elites to shoot the birds during winter. Most of the Park consists of dykes, trees, water gates, etc, - and are part of a conscious design. So this present shape and form of wetlands are result of meticulous design and management.



About Study Area

Historical Highlights Of Keoladeo

1726 – 1763	Ajan Bund constructed
1850 – 1899	Natural depression presently occupied by Park converted into a hunting preserve
1901	Reserve flooded for the first time
1902	Reserve inaugurated with an organised duck shoot
1919	Boundaries of the duck shoot reserve notified
1925	1925 Bharatpur Forest Act. Passed. Shikar Department brought under Forest Department. Rules for protection of wildlife and forests of Rajasthan framed for 1930-1935
1926	Rulers hand over reserve to Rajasthan Government but retain hunting rights. Is declared a Bird Sanctuary
1927	Last leopard shot
1928	Declared as a Protected Forest under the Rajasthan Forest Act.

	1953
1929	Ruler's hunting rights withdrawn
1977-1981	Wall around the Sanctuary site was built
1981	Declared as a Ramsar site
1982	Notified as a National Park – Grazing banned
1983	Declared a World Heritage site.

Location

KEOLADEO national park is situated between (27°7'06" N – 27°12'02" N latitude and 77°29'05' E – 77°33'09" E longitude) with an elevation of 572 m amsl.

Topography

The area of KNP is about 29 sq. m. it is a low-lying depression with a gentle slope towards the centre forming a depression. The total wetland area is about 6 sq. km. this is a main submersible area of the park. The average elevation of the area is about 174 meter. The submersible area has divided into various unequal compartments by means of dykes. Occasionally some ditches fo varying sizes occur in the rest of the area. A metalled road , which is now closed to traffic, passes directly through the park.

Soil

Soil at KNP is thick alluvium, overlying kanker path and some clay formation. The periodic inundation dominant the area. Patches of saline soil are common in the terrestrial area.

Temperature

Bharatpru experience extremes of climatic conditions as the annual temperature varies from 1° C to 50 °C.

Rainfall

Bharatpur receives most of its precipitation from southwest monsoon, which usually sets in towards the end of June or early July and extends up to

September, at times to even October. The annual average rainfall ranged varied from different year.

Climatic Condition

The climate is hot in the summer, hot humid in mansoon, cold and foggy in the winter. Hot dry weather dust stroms, low humidity and scanty drizzles of only a few millimeters characterize the pre-monsoon season in Bharatpur.

Data Database and Methodology

Data Used

Satellite data

For delineation and mapping of land use land cover, multitemporal orthorectified IRS LISS-IV (5.8m) path and row 202-59 and date 19 Jan. 2007 and Cartosat PAN (2.5)path and row 528-272 and date 27 jan. 2007 have been used.

Secondary Data

In the form secondary data, Survey of India (SOI) topographic sheets were used. These topographic sheets on 1: 50,000 scales are used for identification of the base feature. The toposheets falling in the study area,

They are of KNP is covered in toposheet No. 54E/8 and 54E/12.

Software Used

Basically, five software were used for this project viz;

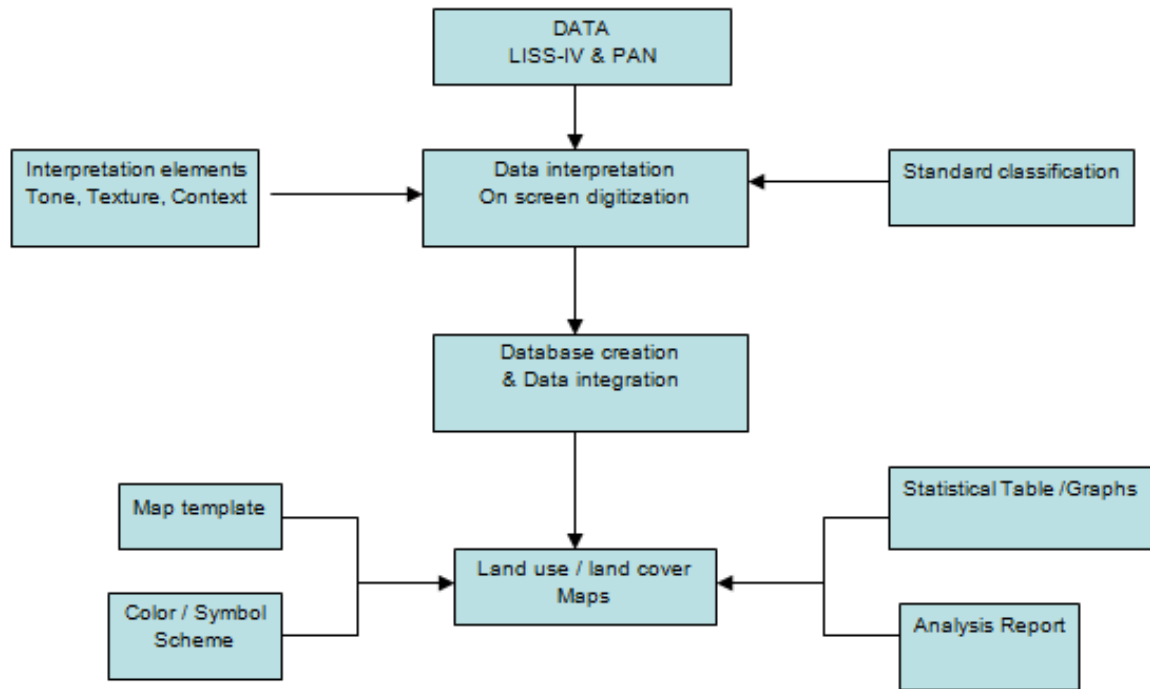
- (a) ArcView 3.2a – this was used for displaying and subsequent processing and enhancement of the image. It was also used for the carving out of Ilorin region from the whole Kwara State imagery using both the admin and local government maps.
- (b) ArcGIS – This was also used to compliment the display and processing of the Data
- (c) Erdas Imagine 9.1for subset and Georeference
- (d) Microsoft word – was used basically for the presentation of the research.
- (e) Microsoft Excel was used in producing the bar graph.

Database

Database is a collection of interrelated information, usually stored on some form of mass storage system.

A GIS database includes data about the position and the attribute of geographical feature that have been coded as point, line, areas and pixels.

Methodology



Steps

Georeference of data

- Generation of FCC (False Color Composite)
- Onscreen generation. Digitization of image.
- Computation and analysis of various vegetation indices.
- Statistical analysis and report.
- Remote Sensing Data Interpretation

Data Interpretation

Image interpretation

Image interpretation is defined as the ‘art of examining image for the purpose of identifying object or surface feature and judging their significance’. Interpreter studies the remotely sensed data and attempts through logical process in

detecting and identifying, classifying, measuring and evaluating the significance of spatial relationship.

Image interpretation Key

The image interpretation key provides a critical reference base for advanced interpretation. It helps the interpreter in evaluating the information in an organized and consistent manner. The image interpretation key consists interpretation elements viz., Tone, Texture, Size, Shape, Association, Pattern, etc. The interpretation key has been used as per the guide line given in the manual.

Land Use Land Cover Interpretation

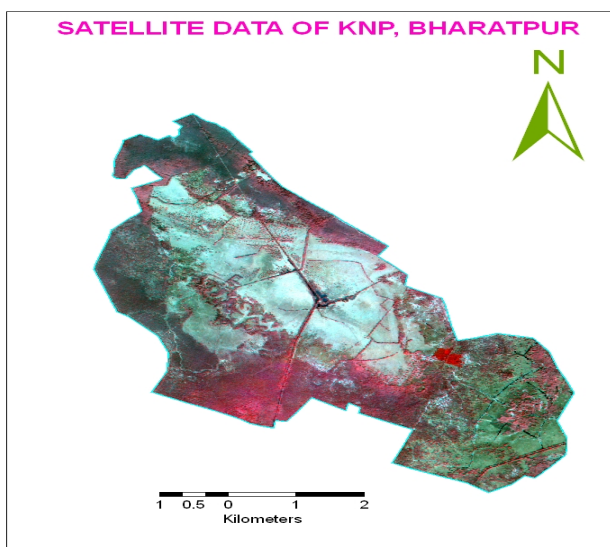
1. Using the interpretation key prepared, land use land cover class has been delineated by using onscreen interpretation procedure.
2. Relevant satellite image(s) has been displayed on the computer screen at 1:5000 scale.

3. The grid has been used for each of the scene 5'x5' tiles as control grid.

Land Use Land Cover Classification

During the interpretation of Land use Land cover of KEOLADEO NATIONAL PARK, BHATATPUR (RAJASTHAN) following categories was observed in the study area.

1. Dense forest: comprised of mitragyna parvifolia along with Acacia nilotica or zizipus mauritiana, the under groth showe the presence of kirganelia reticulate and capparis sepiaria. The low grass cover had cynodon dactylon.
2. Open forest: open or scattered forest includes thorny scrub with Mitragyna parvifolia as under growth with low cynodon dactylon grass cover.
3. Grassland: scattered vetiveria zizanioides cover the area with Desmostachya bipinnata from in the low stratum.
4. Grassland with scattered trees: Low grassland with scattered tree also presence stray and scattered trees and shrubs. The ground substratum support low grass.
5. Open water: This comprise of mostly free floating and suspended aquatics.
6. Settlements: In this category mostly constructed areas like guest house, temple, canteen etc. are include.
7. Wetland: There are mainly water logged areas with aquatic vegetation.etc.



Result, Discussion and Conclusion

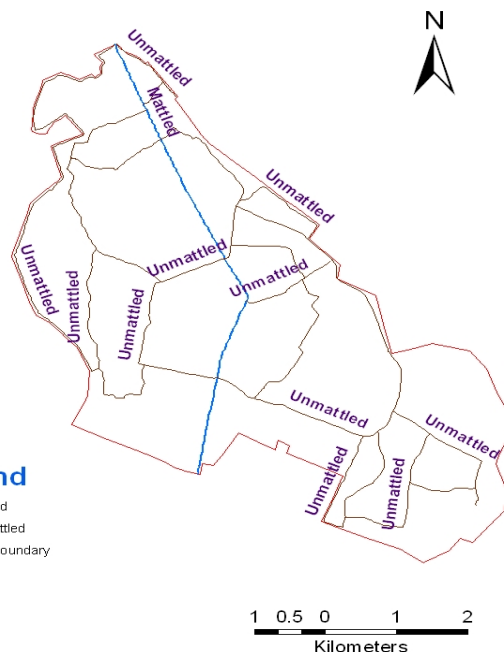
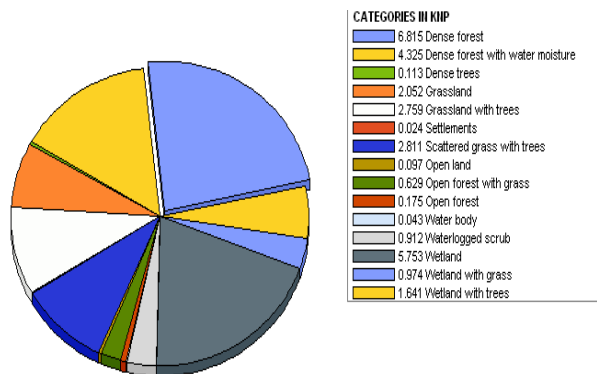
The landuse/ landcover map generated while interpreting the satellite image has 15 classes. The area falling in each category is given below-

LU/LC CATEGORY THEIR AREA IN sq.km AND %.

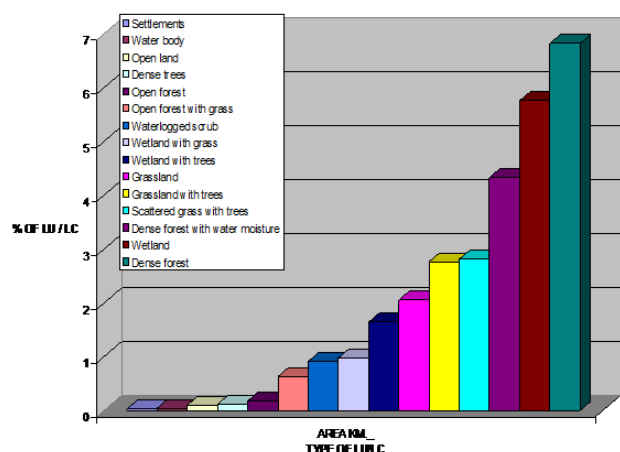
CATEGORIES	AREA sq.km.	Area in %
Settlements	0.02	0.08
Water body	0.04	0.14
Open land	0.09	0.33
Dense trees	0.11	0.39
Open forest	0.17	0.60
Open forest with grass	0.62	2.15
Waterlogged scrub	0.91	3.13
Wetland with grass	0.97	3.34
Wetland with trees	1.64	5.63
Grassland	2.05	7.04
Grassland with trees	2.75	9.47
Scattered grass with trees	2.81	9.65
Dense forest with water moisture	4.32	14.85
Wetland	5.75	19.75
Dense forest	6.81	23.40
Total	29.12	100

Graphical Representation (Pie Chart) Of Landuse/ Landcover of Keoladeo National Park, Bhatatpur (Rajasthan)

Pie Chart of KNP



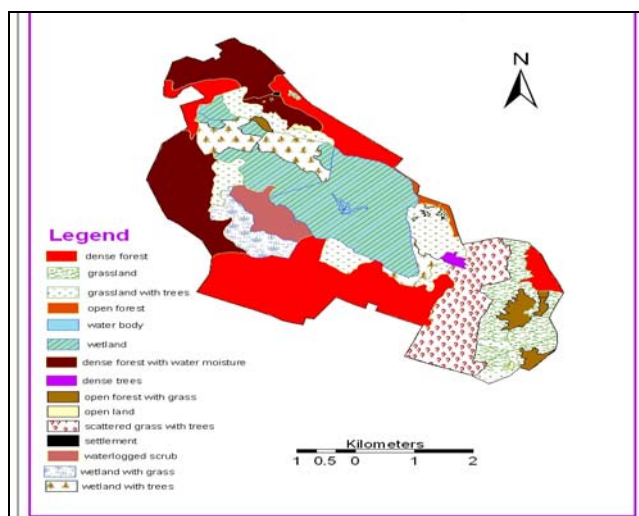
Bar Chart of LU / LC



Conclusion

Keoladeo National Park (KNP) popularly known as Bharatpur Ghana Bird Sanctuary is not only a bird paradise but is one of the best waterfowl reserves in the world for both resident as well as migratory birds. The Indian wetland is unique for being included under both the Ramsar and World Heritage Convention. KNP is one of the three place in the world, known to harbour wintering Siberian cranes (*Grus leucogeranus*) RS and GIS technique have emerged as a powerful tool for mapping and monitoring the natural resources. Its capabilities for mapping and monitoring seasonal changes and for habitat evaluation of wildlife have been already established.

Land Use/Land Cover Map of KNP, Bharatpur



Road Map of KNP, Bharatpur

The present study was carried out to study the distribution pattern of selected Land Use / Land Cover. And mapping and monitoring KNP's main features and an evaluation of selected features.

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Author's details

Research Scholar, Babu Shobharam Government Arts College, Alwar (Rajasthan), University Of Rajasthan, Email ID- ashishsharma2424@rediffmail.com

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