

Short communication

A Geospatial Study to assess the Land Use Land Cover Of Mehao Wildlife Sanctuary In Arunachal Pradesh, India

ABSTRACT

There is inadequate knowledge of the natural resources in the remote inaccessible protected areas of North East Region (NER) of India. The state of Arunachal Pradesh in NER is extremely rich in biodiversity and forms a part of the biodiversity hotspots in the Eastern Himalayas. However due to number of factors such as planned infrastructure development, changing socio-economic patterns, and other external pressures, the biodiversity is under threat. It is therefore crucial to map the current biodiversity of the state as well as potential threats, which can contribute to the conservation of its unique natural resources and create detailed databases. The present paper demonstrates the use of geospatial tools used in mapping the land use and land cover of Mehao Wildlife sanctaury (WLS) situated in Arunachal Pradesh. The study uses IRS LISS III satellite imagery of the period 2010. Images were classified using hybrid classification. ERDAS Imagine and Arc GIS software have been used in the study. Further this project was an attempt to develop a spatial database such as classified vegetation, land use/land cover, drainage, major contour and spot height, elevation distribution maps of Mehao WLS.

Keywords: Land use, land cover, Mehao Wildlife Sanctuary, Arunachal Pradesh, Hybrid classification, natural resources

1. INTRODUCTION

Proper management of national parks and sanctuaries is crucial for conserving biological diversity and utilisation of natural resources for human welfare. Being a large country with huge population, India faces daunting challenges with respect to conservation of natural resources and poverty alleviation [1]. Sustainable management of natural resources requires that ecological goods and services be used to meet current and future generations' needs by adapting to the inevitable biophysical limitations and interdependences [2, 3]. Environmental degradation makes it more difficult to meet our long-term basic human needs of food and clean water [4]. To understand the underlying ecological dynamics impact of human pressure on changing vegetation patterns, monitoring of Protected Areas (PAs) is required [5].

Most of the PAs In India, as elsewhere, are located in remote and inaccessible areas and hence, detailed survey of such areas is a difficult task to achieve. In such cases, acquiring reliable baseline data, for developing effective management policies, is both time consuming and expensive. However, technological advances in the field of geospatial science have overcome such physical limitations. Geospatial tools of remote sensing and geographic information system (GIS) has given a new dimension to the management of protected area. Effective management of protected area and conservation of biodiversity in general

demands inventory, evaluation, planning and management at scales ranging from the local and regional to national, continental and global [6].

Previously, protected area managers combined topographical maps with their knowledge of local climate, species distributions, topography and land use to define management zones and strategies. Today, all this data can be analysed in digital databases to provide more efficient, accurate and informed decision-making. Protected area mapping is an important aspect of protected area management. It serves as baseline for ecological modelling and future monitoring and assessment [7].

Multi-temporal high-resolution, remotely sensed data and geographic information systems (GIS) can be used to produce ecological inventories and monitor LULC changes at local, regional and global scales [8]. Land use land cover mapping using geospatial tools is an area of interest that has been conducted for proper management, planning and monitoring of natural resources. In the protected areas of Arunachal Pradesh, this technique has been used as they are located in remote and inaccessible areas [9,10]. The present study aims to obtain the information on the land use land cover pattern in Mehao Wildlife Sanctuary (WLS) in Arunachal Pradesh which includes major portion of Eastern Himalayas, using remote sensing and Geographic Information System (GIS).

2. STUDY AREA

The state of Arunachal Pradesh in Northeast India occupies a unique place in the eastern Himalayan biodiversity hot spot because of its rich bio-diversity. However, the state's biodiversity is yet to be explored and documented scientifically to a great extent.

The Mehao Wildlife Sanctuary (281.5 km²) is in the Lower Dibang Valley district of Arunachal Pradesh (93°30'– 95°45'E, 28°05'–8°15'N) (Fig. 1). The topography is undulating and hilly, and altitude ranges from 400 to 3,568 m above sea level.

The human population living around the sanctuary is primarily of the local Idu and Padam tribes of Arunachal Pradesh. Mehao is a sanctuary for numerous threatened species of the Indian flora and fauna, and much has yet to be explored and properly documented [11]. This Sanctuary consists of four forest types: Tropical Evergreen Forests (Up to 900m), Sub-Tropical & Temperate Forests (Above 900m to 1800m), Temperate Broad Leaf Forest (1800M to 2800m) and Temperate Conifer Forest (2800m to 3500m).

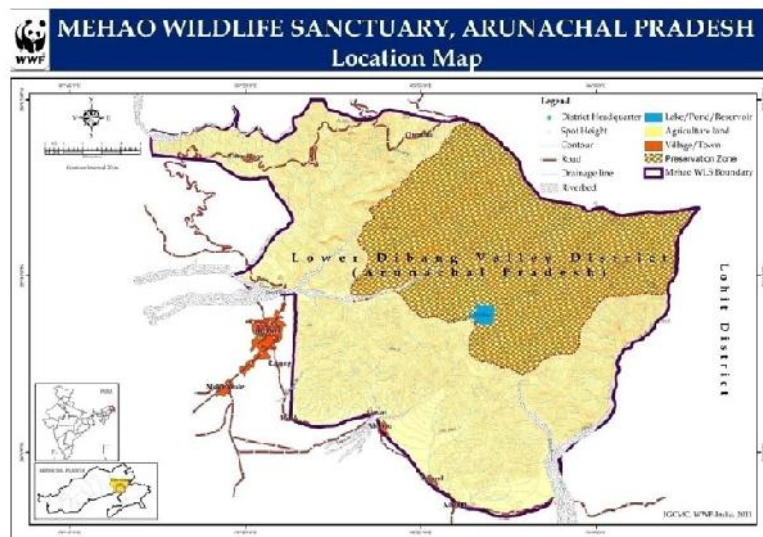


Fig. 1. Location Map

3. Methodology

Spatial databases relevant to the management of sanctuary were generated including maps showing classified vegetation, land use/land cover, drainage, major contour and spot height, elevation distribution (maps enclosed in Fig. 2 to 6). Visual and digital interpretation in satellite images was done to generate such maps which was supported with adequate ground truth. The Survey of India (SOI) 1:50,000 scale topographic maps have been used for preparing the baseline data viz. drainage, road network, settlements, forest divisions and other relevant features. Indian Remote Sensing satellite IRS-P6, LISS-III data for December 2010 was procured from National Remote sensing Centre (NRSC) Hyderabad. LISS-III is a multispectral camera operating in four spectral bands, three in the visible and near infra-red and one in short wave infra-red (SWIR) region, with the Spatial resolution 23.5 m.

ERDAS Imagine and Arc GIS software were used in the study. ERDAS Imagine was used for digital image processing and for extraction of land use/land cover classes. The satellite imagery was geometrically rectified with reference to the geo-referenced topographic maps and vector data. The images were then mosaiced and clipped on the basis of the sanctuary boundary using subset technique in Erdas. Classification was done using a hybrid method, wherein the study area image was classified first using unsupervised classification and then using the recode technique the classes were merged into required number of classes. The classified images were compared with the respective satellite image and using visual interpretation technique the classified data was cleaned by recoding. For water body and built-up area, separate AOIs were prepared and then recoded.

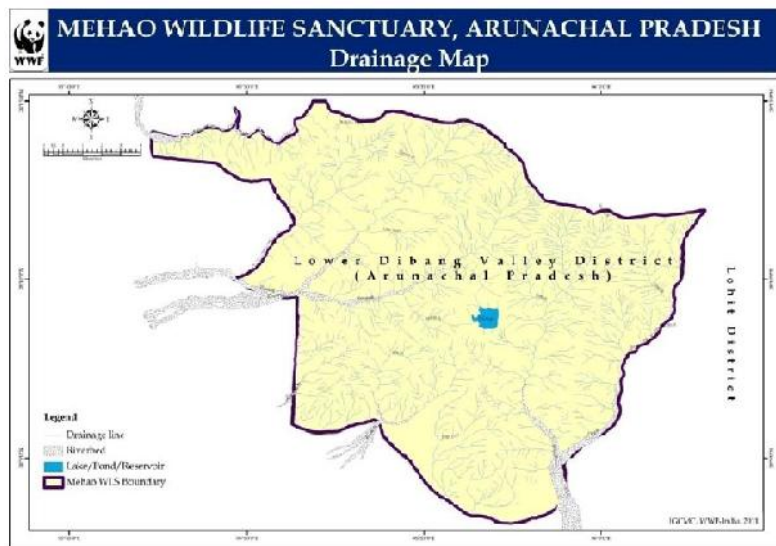


Fig. 2. Drainage map

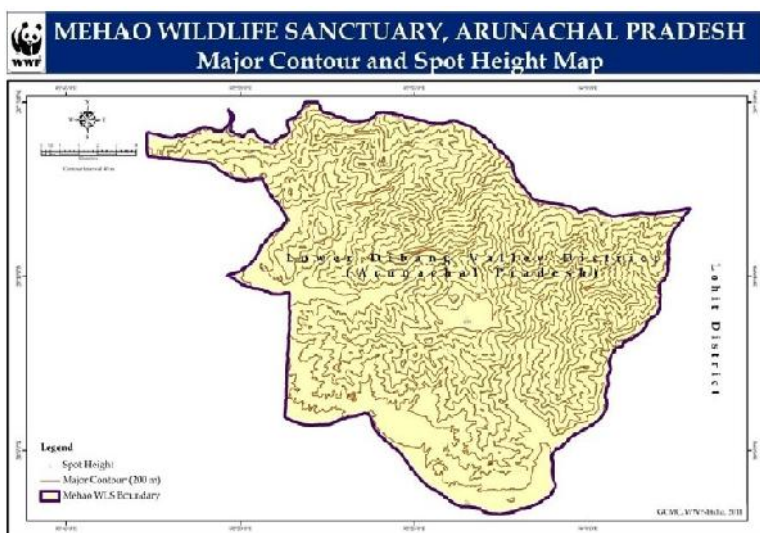


Fig. 3. Major contour and spot height map

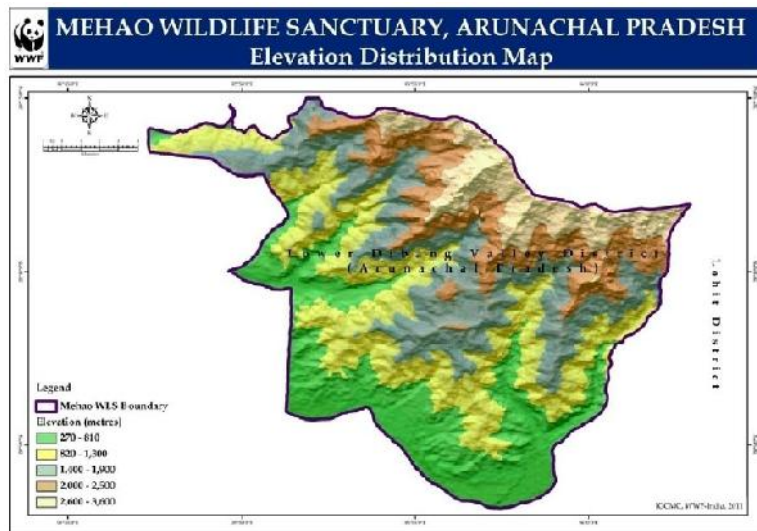


Fig. 4. Elevation distribution map

4. RESULTS

4.1 Land use land cover mapping: The LULC map (Fig 5) of the the sanctuary has been classified in terms of density as well as type of vegetation found in the area. The area was classified into Dense forest, Open Forest, Scrub land and non forested area. Dense forest refers to all lands of forest cover having a canopy density of 40 percent and above, Open forest refers to lands with forest cover having a canopy density between 10 – 40 percent, Scrub land are degraded forested lands having canopy density less than 10 percent. Non-forested area includes land without any kind of forest cover, in this case the nonforested areas derived are riverbed, water and cultivated areas. Area statistics (table 1) shows that the maximum area was under dense forest i.e 149.10 sq.km, whereas open forest and scrub land cover 80.30 sq. km and 47.82 sq.km respectively.

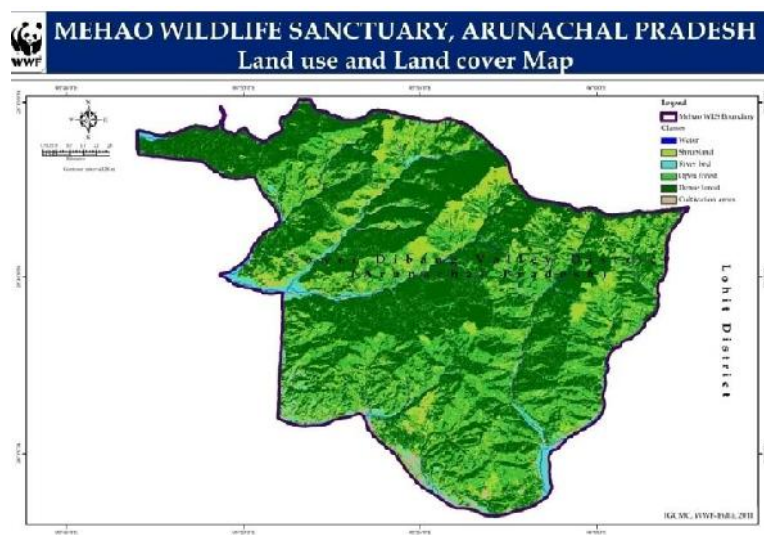


Fig. 5. LULC Map

Table 1. LULC area

S.NO.	PARTICULAR	AREA (SQ.KM)
1	DENSE FOREST	149.10
2	OPEN FOREST	80.30
3	SCRUBLAND	47.82
4	CULTIVATED AREAS	3.69
5	RIVERBED	7.96
6	WATER	2.54

4.2 Vegetation type mapping: To document the vegetation status of the area, vegetation cover mapping was also done which can be useful in future monitoring and assessment of natural resources of the sanctuary. Based on the satellite image interpretation and field survey, vegetation type map (Fig. 6) was classified into Sub-tropical Broad-leaved forest, Tropical Evergreen forest, Bamboo, River, River-bed, Cultivated areas, Alpine forest, Mixed Coniferous forest and Temperate Wet Evergreen forest. The main associate tree species in Tropical Evergreen Forests (Up to 900m) are *Terminalia Myriocarpa*, *Terminalia Bellirica*, *Altingia Excelsa*, *Jalauma Phellocarpa*, *Abizzia Lucida*, *Michelia Champaca*, *Messua Ferra*, *Dillenia Indica*, *Castanopsis Indica*, *Bischofia Javanica*, *Magnolia species*, *Ailanthus Grandis*, *Kedia Calycina*, *Bombax Ceiba*, *Schima Wallichii*, *Ficus Altissima*, etc. The common associate tree species in Sub-Tropical & Temperate Forests (Above 900m to 1800m) are *Ainusnepalensis*, *Populus Amblei*, *Castanopsis Indica*, *Castanopsis Spicate*, *Quercus Griffithi*, *Quercus Amellosa*, *Betula Ainnides*, *Albizia Mollis*, *Michelia Species*, *Magnolia Species* etc. The main associations found in Temperate Broad Leaf Forest (1800M to 2800m) are *Quercus Griffithii*, *Betula Alnoides*, *Cophis Teeta*(Medicinal plant), *R. Anthopogon*. Whereas in Temperate Conifer Forest (2800m to 3500m), the main associations found in this forest types are *Tsuga Abies*, *Pinus Roxburgii*, *Texas Baccata*, *Texas Abies*, *Lanx Griffithiane* Forests, *Picea Abies* Forest and gregarious bamboo forests [11]. Area statistics have been given in table 2. Vegetation pattern in the study area is influenced strongly by altitude, slope, aspect and other climatic factors.

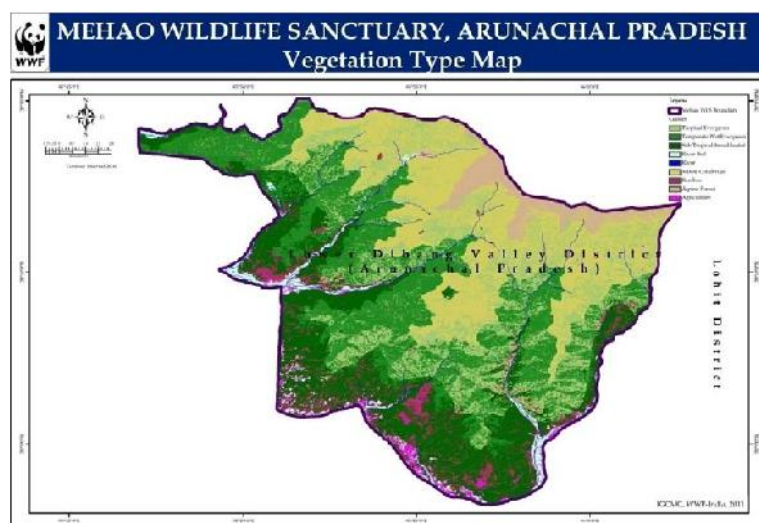


Fig. 6. Vegetation type map

154 **Table 2. Area statistics**
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S.NO.	PARTICULAR	AREA (SQ.KM)
1.	SUB TROPICAL BROAD-LEAFED FOREST	59.80
2.	TROPICAL EVERGREEN FOREST	52.98
3.	RIVER	2.54
4.	RIVERBED	7.96
5.	BAMBOO	15.04
6.	AGRICULTURE	3.69
7.	ALPINE FOREST	12.57
8.	MIXED CONIFEROUS FOREST	62.45
9.	TEMPERATE WET EVERGREEN FOREST	74.38

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Fig. 7. Degarded forest in sanctuary, picture taken during field visit on 14th – 19th February, 2011

5. Conclusion

165 Studies have shown that for mapping and formulation of conservation plans, satellite data in
166 association with GIS provides a cost effective tool. Basic information of the Wildlife
167 Sanctuary is an essential prerequisite for developing effective Management Plan. This WLS
168 is pristine untouched forest area with not much human interference except on southern
169 boundary line where there are human settlements. The deforestation for agricultural purpose
170 has greatly disturbed the original habitat of the species The water retention capacity of the
171 forest floor is affected due to jhum cultivation (Fig. 7). Habitat destruction is occurring as a
172 result of plantation activities being taken up by the residing population; wherein local species
173 of fruit bearing trees are being planted in place of native forested areas. Further Digital
174 Elevation Model was also generated using the digitised contour lines with an interval of 40 m
175 to analyze the altitudinal variations in topography. It was found that the elevation ranges
176 from a minimum of 270 m to a maximum 3600 m. Lowest elevation (270 m – 810 m) occurs
177 in the southern part of the park, mostly. The highest elevation (2600 m – 3600 m) occurs in
178 the northern portion. Other elevation ranges can be seen in the central part of the sanctuary.
179 This spatial database developed for WLS can be further used to understand the underlying
180 ecological dynamics impact of human pressure on changing vegetation patterns and thereby
181 providing better land management options for maintaining its unique richness of biodiversity.
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