



Short Communication

BASELINE MAPPING USING GEOSPATIAL TOOLS FOR D'ERING WILDLIFE SANCTUARY IN ARUNACHAL PRADESH, INDIA

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ABSTRACT

D'ering Wildlife Sanctuary (WLS) in Arunachal Pradesh, is extremely rich in biodiversity and forms a part of the biodiversity hotspots in the Eastern Himalayas. There is inadequate knowledge about the natural resources in the remote inaccessible protected areas of North East Region (NER) of India and thus necessitates its detailed exploration. It is therefore crucial to create spatial database that can contribute to the conservation of its unique natural resources. In this regard, remote sensing and geographic information system (GIS) play an important role. This project is an attempt to develop a spatial database (slopes, elevation, drainage maps) including land use /land cover (LULC) map and vegetation map.

KEY WORDS: D'ering Wildlife Sanctuary; land use /landcover (LULC); baseline maps

INTRODUCTION

Worldwide, the principle conservation strategy depends upon development and management of protected areas (PAs) (Hockings, 2003; Torri, 2011). PAs are essential providers of ecosystem services and biological resources. The establishment and management of protected areas has become a key strategy to help conserve threatened species and natural ecosystem processes (Hossain *et al.*, 2016). The International Union on Conservation of Nature (IUCN) defines a protected area as “a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values”. To understand the underlying ecological dynamics impact of human pressure on changing vegetation patterns, constant monitoring of PAs is required (Southworth *et al.*, 2016). In India there are various categories of PAs namely National Parks, Wildlife Sanctuaries, Conservation Reserves, Community Reserves and Marine Protected Areas (http://www.wiienvis.nic.in/Database/Protected_Area_854.aspx). For conserving biological diversity in WLS, proper management is crucial in terms of inventory, evaluation, planning and management at scales ranging from the local and regional to national, continental and global (Nix *et al.*, 2000). Further Land use/land cover assessment is one of the most important parameters to meaningfully plan for land resource management. The knowledge of spatial land cover information are assuming increasing importance in various resource sectors like agricultural planning, settlement surveys, environmental studies, planning and monitoring of natural resources (Zhu, 1997). Remote

sensing and geographic information system (GIS) has given a new dimension to the management of protected area. 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 (Areendran *et al.*, 2010). With this background, this study was carried out with the objectives of: (i) mapping land use /land cover (LULC) and vegetation cover; and (ii) to develop a spatial database for the D'ering Wildlife Sanctuary in Arunachal Pradesh. Although the sanctuary is located in remote and inaccessible areas, the technological advances in the field of geospatial science have overcome physical limitations.

D'ering Wildlife Sanctuary (Figure 1) lies roughly between 95°22' to 95° 29' East longitude and 27°51' to 28°05' North latitudes, in the East Siang district of the state of Arunachal Pradesh. The sanctuary was subsequently renamed as Daying Ering Memorial Wildlife Sanctuary after an eminent prominent leader of the area. D'ering is divided into three ranges –Anchalghat, Sibiamukh and Barghuli, and is administered by the divisional Forest officer based at Pasighat. The sanctuary is approachable from Anchalghat range headquarters which is 35 km from Pasighat. During dry season it becomes approachable from Borguli also which is approximately 25km from Mebo sub-division headquarter.

The entire sanctuary area is riverine plain criss-crossed by River Siang and Sibia forming several riverine islands. The altitude ranges from 135 m to 140 m above mean sea level gradually decreasing from north to south. The Sanctuary experiences tropical climate with distinct hot and cold season. The winter months start from November to March with very low rainfall and humidity. Summer months are characterized by heavy rainfall and high temperature. June, July and August are the wettest months. Lowest average rainfall for the month of January and highest is for the month of July with 1433.20 mm of rainfall. The *Adi* tribe are the resident community around D'Ering. There are no villages inside the protected area. However villages can be found in the vicinity within 10 km from the WLS. The local population except Pasighat is tribal belonging to Minyong and Padam sub-tribes of *Adi*. Several ethnic groups inhabit the Pasighat township area but it has very little influence over the sanctuary (<http://arunachalforests.gov.in>)

MATERIALS AND METHODS

The project intended to generate spatial database relevant to the management of the WLS, which includes maps showing classified vegetation, LULC, drainage, slope and elevations maps (Figures 2-6). Secondary data for preparation of current vegetation cover/type map was obtained from various sources. In addition, satellite data was acquired and interpreted (visually/digitally) to generate such maps. The interpretation has been fully supported with adequate ground truth. The above information formed the basis to prepare documents for interpretation of the maps consisting of extent, status and

species composition of various vegetation types in the PA. Data regarding slope was derived from DEM with 20 m interval using Arc GIS 9.3 software. Most of the sanctuary area is relatively flat. Most part of the park area lies within 0° - 1° and 1° - 4°, which is 38% each. Almost 22% of the area falls within the least slope category of 5° - 15°, which is approximately 72.81 sq km.

Input Data

The Survey of India (SOI) 1:50,000 scale topographic maps were used for preparing the baseline data. The topographic maps were procured from the respective Forest Departments. In addition, a protected area management map from the Forest Department was used as ancillary data. All the maps have been converted into digital format and overlaid on the same scale. Indian Remote Sensing (IRS) satellite IRS-P6, LISS-III data for December 2010 was procured from the 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 ArcGIS were used in the study. ERDAS Imagine was used for digital image processing and for extraction of LULC classes for the WLS. Geometric correction was done to correct geometric distortions due to sensor, earth geometry variations and conversion of the data to real world coordinates (e.g., latitude and longitude) on the earth's surface. The satellite imagery was geometrically rectified with reference to the geo-referenced topographic maps and vector data. The classification of the imageries was performed by using unsupervised classification.

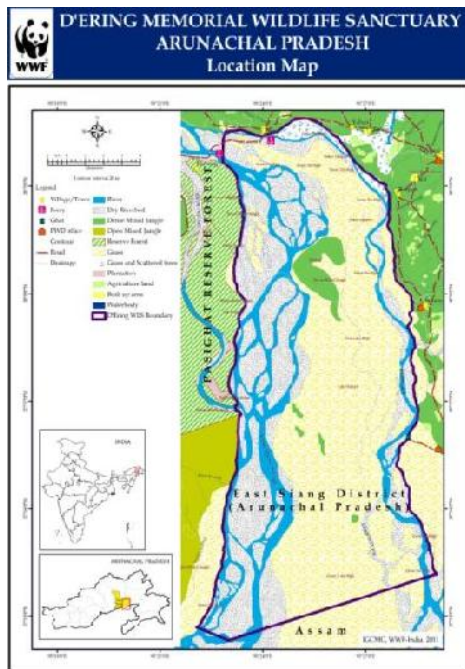


FIGURE 1: Study area

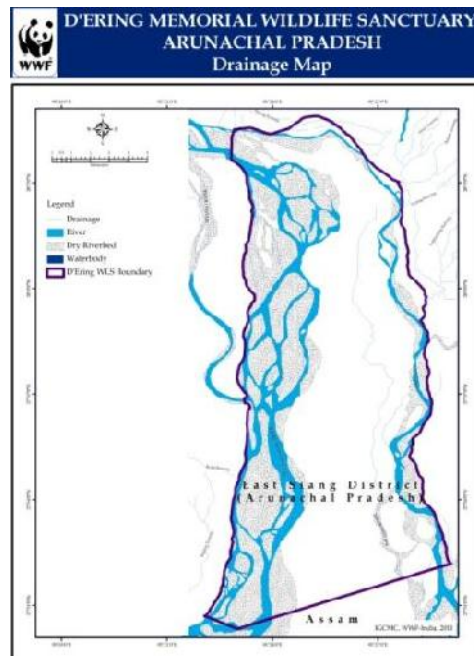


FIGURE 2: Drainage Map of WLS

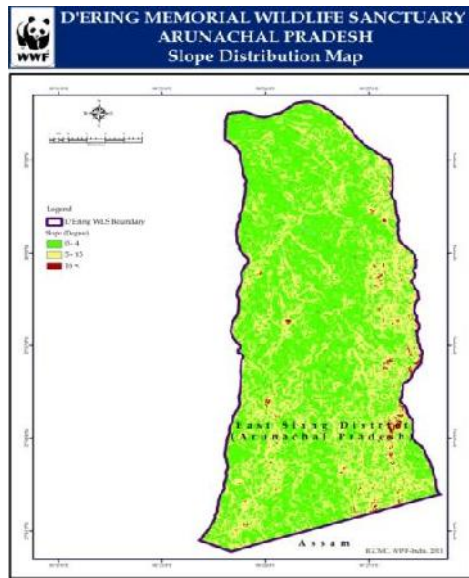


FIGURE 3: Slope Distribution Map of WLS

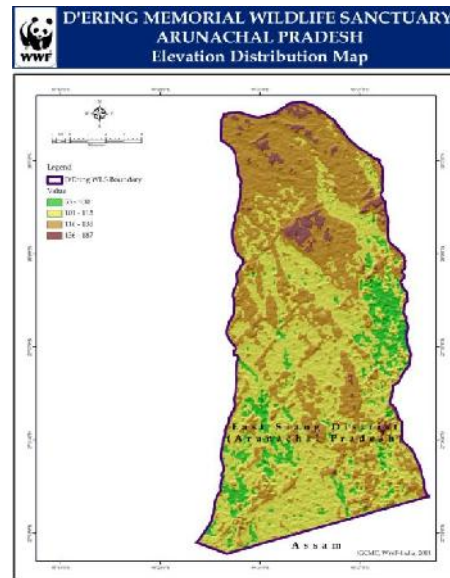


FIGURE 4: Elevation distribution map of WLS

RESULTS & DISCUSSION

LULC Mapping

The term land cover is distinct from land use despite the two terms often being used interchangeably. Land use is a description of how people utilise the land and socio economic activities. Land cover is the physical material at the surface of the earth. Land cover includes grass, trees, forests, bare ground, water, etc. The LULC map (Figure 5) of the WLS has been classified in terms of density as well as type of vegetation found in the park area. The area was classified into Dense forest, Open forest, Scrub forest, Grass land, Open land, River bed/sand and River. Dense forest refers to all lands of forest cover having a canopy density of 40% and above; open forest refers to lands with forest cover having a canopy density between 10-40%; scrub forests are degraded forested lands having canopy density less than 10%; and non-forested area includes land without any kind of forest cover, such as rivers, riverbed, grassland and snow cover. Area statistics can be seen from

the Table 1, wherein the area 56.07 sq. km is dominated by open land and scrub forest accounts for 17.93 sq.km whereas dense forests is only 9.44 sq. Km. Altitude and climatic conditions are the major factors that determine the vegetation of study area. In the north east region, the culture of jhum / shifting cultivation is practiced, wherein the forests patches are burnt resulting in forest fires that have become a threat to biodiversity in the north eastern states. It can have unwelcome consequences, and cannot be ignored. Literatures reveal that the cycle of shifting cultivation in northeastern states was reduced from 25-30 years to 2-3 years, breaking the resilience of ecosystem and causing increasingly deteriorating biodiversity. One important aspect for preventing future fire disasters is the level of awareness that can be gained by an early warning system. These maps can be used as inputs in identifying the forest fire prone areas and hence developing an early warning system.

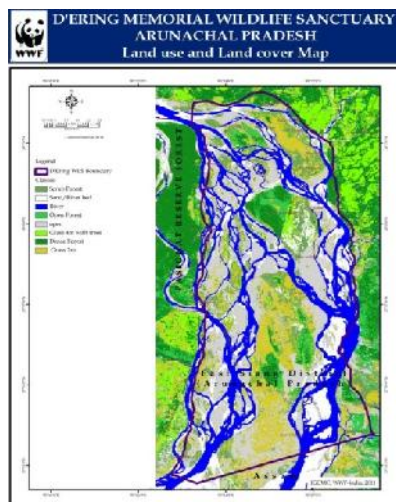


FIGURE 5: Map showing the LULC

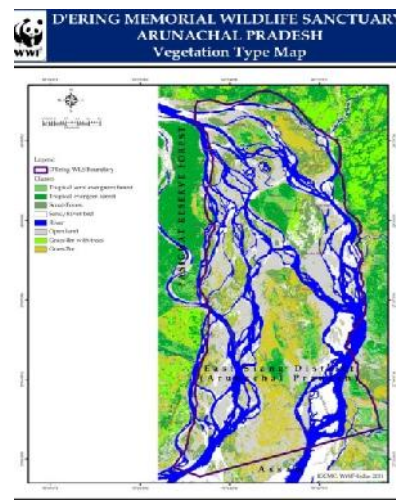


FIGURE 6: Map showing vegetation type

TABLE 1 : Areas of the LULC classes.

Classes	Area (km ²)
Dense forest	9.44
Open forest	8.34
Scrub forest	17.93
Grass land	33.42
Open land	56.07
River bed/sand	18.94
River	40.09

TABLE 2: Areas of the vegetation types

Classes	Area (km ²)
River	40.09
Tropical Evergreen Forest	9.44
Tropical Semi-Evergreen Forest	8.34
Scrub Forest	17.93
Grassland	33.42
Open land	56.07
Riverbed/Sand	18.94

Vegetation Type Mapping

Vegetation cover mapping was done to document the vegetation status of the area. These data can be useful in future monitoring and assessment. Vegetation type map (Figure 6) was classified into for Tropical Evergreen Forest, Tropical Semi-Evergreen Forest, Scrub Forest and Grassland. The area statistics are shown in Table 2. Literature reveals the vegetation in the sanctuary falls under the category Assam Alluvial Plain Semievergreen forest (2C 1-A) of Champion and Seth's classification. The sanctuary has extensive alluvial grasslands (about 75%). The remaining area is covered by patches of woodlands and water courses. *Saccharum spontaneum*, *S. arundinaceum*, and *Neyraudia reynaudina* are the main grass species, and sedges such as *Cyprus* sp. Also occur in the sanctuary area. Other habitat types include riverine forests, with tree species such as *Terminalia myriocarpa*, *Bombax ceiba* and *Dillenia indica*. D'ering WLS is a staging site for migratory birds and has some of the largest concentrations of waterfowl in Arunchal Pradesh, especially in winter. Other species of birds as woodland birds like the Bengal florican, swamp florican, black-breasted parrot-bill, Pallas sea eagle etc. has also been recorded. The grassy and forested area of islands are home to mammals like deer, wild buffalo, tiger, elephants and other rain forest species like the sambar deer and wild duck. The sanctuary's woodlands are an ideal habitat for a host of species like the leopard, civet cat, leopard cat, sambar, barking deer, hog deer, rhesus macaque, wild boar, porcupine, striped squirrel, pangolin, jackal, python and other animals. (http://apspcb.org.in/pdf/lower_siayang_eia_emp_report/downstream_impact_assessment_report/chapter20.pdf).

CONCLUSION

Basic information of the Wildlife Sanctuary is an essential prerequisite for developing effective Management Plan. Satellite data in association with GIS provides a cost effective tool for mapping and formulation of conservation and management plans. This project has been able to meet its intended objectives. A spatial database for WLS was created, which would be very valuable in both management and monitoring of resources and especially in regards to rugged terrain conditions coupled with inaccessibility of the park. The availability of spatial information at the forest range level is an important contribution of the project, which would help in improving the efficacy of protected area management. The project demonstrated the utility of LISS III satellite images in LULC and infrastructure. The established database can

thus be used for initiating detailed conservation action programme in the mentioned PA. This will help in prioritising areas to be included in the existing protected area network, and subsequently will be useful in devising more rationale management plans.

ACKNOWLEDGEMENTS

We take this opportunity to thank Mr. Ravi Singh, SG and CEO, WWF-India and Dr. Sejal Worah, Programme Director, WWF-India for giving us the encouragement to carry out this study and for their able guidance. Special thanks to the Ministry of Environment, Forest and Climate Change for funding this project, and to anonymous people who have directly and indirectly helped us in completing the project within the sanctioned timeline.

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