

Generation of Digital database using ArcGIS software for preparation of Wildlife Management plan of Similpal Biosphere Reserve, Odisha

D.K.Rout¹, Ch Sobhabati Devi², and A.K.Mohapatra³

Odisha Space Applications Centre, Bhubaneswar (ORSAC), Odisha

1 – dkrout15@gmail.com, 2 – sobhabati.ch@gmail.com, 3 - amiya55@sify.com

Abstract

Similpal Biosphere Reserve is the largest contiguous patch of tropical forest located in the Mayurbhanj district of Odisha. The uniqueness of Similpal as a centre of biodiversity in its important geological formation, phyto-geological advantages and mixture of floristic and fauna from north & south India and Andamans. The biodiversity rich Similpal which has enormous influence on the climate of the state is a vast store house of a number of natural resources such as timber, honey, tasar, medicinal plants, sabai grass, orchids etc. Sal is the most prolific of all species in Similpal though piasal, asan, simal, jamun, mango, gambhari, sidha, anla, nageswar, champa, kusum etc. are seen in large numbers. There is large variety of grasses though bamboo is conspicuous by its absence. Besides Similpal is a natural habitat for various wild fauna namely elephant, sambar, tiger, wildboar, gaur, sloth bear, rhesus macaque, langur etc. Besides there are many reptiles and avifauna are found in this habitats. Similpal sanctuary lies between 21°28'29" N to 22° 08' 18" N latitude and 86° 04' 35" E to 86° 37' 45" E longitude covering 2750 sq. km. of forest land. Similpal Tiger Reserve which lies in the center of the core area covers 845.70 sq. km. is declared as the "Similpal National Park". As per norms and conditions, the Similpal Biosphere Reserve has been divided into three zones e.g. core zone, buffer zone and transitional zone. The core zone is strictly prohibited region where no activity is entertained. This region is strictly reserved for wildlife habitat development. But the buffer zone which is around 1354.30 sq. km. is partially prohibited and is used for different activities like research, education and tourism etc. On the other hand the transitional zone which lies in the peripheral region covering 77.07 sq. km. is allowed for research and settlements of the tribal people, tourism and other environment friendly activities. Similpal Biosphere Reserve comes under the jurisdiction of the Baripada and Karanjia Forest Divisions and Similpal Tiger Reserve. Similpal Biosphere Reserve comprises of 17 forest ranges and 221 compartments.

Due to large scale exploitation of forest resources by biotic and abiotic interferences, the endangered and rare species are vanishing from this ecosystem. The possible causes of eco-degradation are mainly due to encroachment, unauthorized clear felling, overgrazing, forest fire, erosion, diseases etc. The ever increasing biotic pressure due to presence of 65 villages inside the sanctuary and 1121 villages around 10 km. of its boundary is a potential threat to its existence. The progressive exploitation of Similpal has opened up the forest and loss of flora and fauna which are irreparable to replace the accompanying change in ecological balance and climate of whole of north-east and south-west Orissa. Besides, a balance has to be struck between development and conservation. Minimum biotic interference can not be avoided to maintain the sanctity and natural wealth of this diversity rich biome. Conservation oriented forest development methodology should be introduced into such a unique region for its preservation as well as conservation.

Habitat management is one of the most important activities in any protected area. Because of large extent and enormous biodiversity characters the biome should be controlled by a suitable management body. Since there is no ideal forest management map available today, it is very difficult to monitor such a huge ecosystem easily. Moreover for the preparation of forest map using conventional method is time taking and cost effective. Therefore the study was carried for the preparation of different thematic and forest resources maps using ArcGIS (ver.10.1) for preparation of forest management plans for conservation and eco-restoration. Arc map 10.1 has been used for preparation of forest land use map using Cartosat-1, IRS-P6 LISS-IV data of 2004 and 2012. Different forest density classes, encroachments, wastelands, water bodies have been delineated in the study area. Different spatial layers namely settlement, road network, drainage network and forest management layers namely sanctuary, tiger reserve, division, range, section, beat, compartment and demarcated notified forest boundaries have been prepared separately using ArcGIS (ver.10.1) software and depicted on the forest land use map. Besides the point data base showing the locations of forest management headquarters, wireless stations, watch towers, anti-poaching camps, salt licks, check gates, rest sheds etc. have been shown on the map. The non-spatial data base showing the demography of the people residing inside the sanctuary, cattle population etc. have been analysed. The spatial and non-spatial data base have been linked at compartment level in GIS environment. A change detection study has been attempted in respect of forest land use classes, encroachments of the forest lands. The forest management map prepared using remote sensing and GIS technique will provide all type of forest resource information at any hierarchical order of the forest administration.

Introduction

The Similipal Biosphere Reserve was notified by Government of India on the 22nd June, 1994. It comprises of the entire Similipal sanctuary (core and buffer together), the adjoining Natio and Satkoshia Reserve Forests forming additional buffer and a belt of approximately 10 KM width all around the entire buffer designated as the 'transition zone'. The total area of this Biosphere Reserve is 5569 Sq. KMs. The Similipal hill ranges, a densely forested area constitute the core and a part of the buffer zones of the Biosphere Reserve, and there are also 65 villages within these two zones including four in the core zone.

Similipal is in the eastern end of the eastern hills and classified in the Chhotanagpur biotic province of the Mahanadian biogeographical region. The transition zone of the Reserve has 1200 villages whose total population is about 4.5 lakh. The tribals constitute about 73% of this population. The forests and the biodiversity resources to a great extent sustain the livelihood of these people. The forest and wildlife in the sanctuary, and the human population and cattle living in close proximity impact on each other. The Management Action Plan for the Biosphere Reserve seeks to put emphasis on suitable programmes of eco-development in the transition zone and also to a limited extent in buffer zone, to promote various alternative livelihood options, and thereby to reduce people's pressure on the forests. Nevertheless, Similipal was declared as "Tiger Reserve" in 1973, though a Tiger Reserve, like a Biosphere Reserve has no legal stature, it is of management importance. In order to undertake activities relating to biodiversity conservation and development of sustainable management aspects, Biosphere Reserve are demarcated into three zones, namely core, buffer and transition zones. The core zone is absolutely undisturbed and secures legal protection and management and research activities. In this zone, management and research activities that do not affect natural processes and wildlife are allowed. The core zone is to be kept free from all human pressures external to the system. The buffer zone adjoins the core zone. In this zone, only those activities which protect the core zone are allowed. The activities allowed include limited recreation, tourism, fishing, grazing which are permitted to reduce its effect on core zone. Research and educational activities are to be encouraged. The transition zone is the outer most part of BR. This is a zone of collaboration where conservation knowledge and management skills are applied primarily to foster alternate livelihood and reduce dependence on consumptive use of the forest.

The diversity rich Similipal which has enormous influence on climate of Odisha is a vast store house of number of natural resources such as timber, honey, tasar, medicinal plants, sabai grass, orchids etc. As per Champion and Seth (1968) Similipal forest comes under the broad category of 'North Indian deciduous forest' with moist peninsular sal as the predominant species. There are around six type of forests e.g Northern tropical Semi-evergreen forests, Northern tropical moist deciduous forests, Dry deciduous forests, Dry deciduous hill forests, High level sal forests and the grass lands are present in this forest.

Due to overexploitation of natural resources by biotic and abiotic interferences, the endangered and rare species are in critical stage of their survival. The possible causes of eco-degradation are mainly due to encroachment, unauthorized clear felling, over grazing, forest fire, soil erosion, diseases etc. There are no pollution-causing industries in Mayurbhanj district that could affect the ecological soundness of Similipal. Thus, the ecological vulnerability is only from the current living styles and dependence of people on Similipal. About 4.5laks people constitute the 80,000 families who live within or close to Similipal, and about 50% of them earn a part of or the complete livelihood from Similipal.

Because of large extent and enormous biodiversity characters the Similipal forest ecosystem should be monitored regularly. Since there is no comprehensive forest map of the ecosystem are available today, it is very difficult to monitor such a huge biome. Preparation of forest maps using conventional method is very cost effective as well as time taking. Therefore remote sensing and GIS technique has been used for the preparation of forest management maps for preparation of forest and wildlife management plan.

Study Area

The Similpal Reserved Forest is located in the Mayurbhanja district of Odisha which lies between 21° 28' 29" N to 22° 08' 18" N latitude and 86° 04' 35" E to 86° 37' 45" E longitude covering 2750 sq km of forest land. Similpal Biosphere Reserve comes under the jurisdiction of Baripada and Karanjia Forest Divisions and Similpal Tiger Reserve. Similpal Biosphere Reserve comprises of 17 forest range and 221 compartments. The topography of similpal is undulating varying from hillocks of mountain peaks. Meghasini is the largest peak with an altitude of 1166 m from M.S.L. One of the peculiarity of these hills is that they arise abruptly from the coastal plains from southern (Udala) and eastern (Baripada) sides and arise steeply to heights of 700 to 800 m above M.S.L. extends towards north and north western side and merge with the Chhotanagapur plain. There are many perennial streams which originate from Similpal forest are Budhabalanga, Sono, Khadkei, East Deo, Sanjo, Palpala, Gangahar etc. Khairi, Bandhan, and west Deo flow west ward and Join Baitarani River. Salandi River flowing in south western direction drains into Bay of Bengal Khadkei joins the river Subarnrekha in the north eastern side. Similpal experiences three distinct climates i.e. summer, monsoonal winter. The summer season is confined from March to May with a maximum temperature of 30 °C and is very pleasant. The rainy season starts from June and continues upto October. The maximum precipitation is 2000 mm. In winter season, November to February, temperature goes upto 2.5 °C with experience of frost in pockets

The vegetation cover of Similpal is of much importance as it contains rich tropical broad leaved forest type classified by Champion and Seth as "3C North Indian moist deciduous forest." The forest comprises of a compact contains semi-evergreen forest with climatic climax type of vegetation. The gregarious occurrence of sal in the hills and plains in western similpal constitute 90 per cent of crop. Sal sheds leaves and becomes leafless for 10 to 15 days in summer. The diversified topography as elucidated spread over a wide range of diverse habitats. The park is a treasure house of 1076 species of plants belonging to 102 families. 96 species of orchids have also been identified here. It has a mixed type of vegetation known as Odisha semi-evergreen forests with tropical moist broadleaf forest and tropical moist deciduous forests with dry deciduous hill forest and high level Sal forests. The grasslands and the savannas provide grazing grounds for the herbivores and hiding place to the carnivores. The forest boasts of innumerable medicinal and aromatic plants, which provide a source of earnings for the tribal people. Eucalyptus, planted by the British during the 1900 are also found.

A total of 42 species of mammals, 242 species of birds and 30 species of reptiles have been recorded in Similpal National Park. The elephant population of Similpal is the major surviving concentration of the Central-Indian population. The cat fauna, including the many colour aberrations noticed in tigers and the occurrence of black panthers, are of academic and conservation interest. The cats comprise of Fishing cat, Jungle cat, Leopard cat, and the Leopard. The four-horned antelope or chowsingha is found in certain patches of Similpal. The stream Mahasheer that is characteristic to hilly streams of peninsular India continues to inhabit streams of Similpal, though it is rare. Among the birds, recent additions include Red breasted falconet, Grey-headed fishing eagle, Slender billed scimitar babbler, White eared bulbul, East-Himalayan long-tailed minivet and Common sand piper. Similarly, the Ruddy mangoose (*Herpestes smithi*) has been an addition after several sightings. Apart from the large number of mammals and bird species, the park has a sizeable population of reptiles, which includes snakes and turtles. The "Mugger Crocodile Management Programme" has helped the Mugger crocodile (*Crocodylus palustris*) to survive and flourish on the banks of Khairi River.

Methodology

The ideal classification for forest management for wildlife is one which satisfies the needs of the forest administration planners with up-to-date information at minimum time, cost and also to improve the ability of the planner and appraise him of the condition, characteristics, the resource potential and the environmental constraints in the management of the forest. In



classifying the multispectral data different classification technique are available for use to discriminate forest cover types and other landuse categories. In the present study ArcGIS 10.1 has been used for onscreen interpretation for the preparation of forest landuse classes and also generation of different spatial data base.

a. Preparation of forest landuse map

Two date's satellite data e.g. Cartosat-1 and IRS P6 LISS IV data of 2004 and 2012 was used for preparation of two dates forest landuse maps on scale 1:50,000 using ArcMap (Ver. 10.1). The forest classes are mainly segregated into four classes:

1. Very dense forest (Crown cover >70%)
2. Moderately dense forest, (Crown cover between 40-70%)
3. Open forest, (Crown cover between 10-40%)
4. Degraded forest (Crown cover <10%), along with other landuse classes namely agricultural land, barren rocky area, grass land, habitation, water body. (Fig -1& 2)

b. Preparation of layer information

ArcGIS 10.1 has been used for generation of different layers from the forest administrative units, forest management units and other secondary data bases.

i. Forest administrative boundary

Forest administrative boundaries namely Division, Range, Section and Beat are digitized from the forest department maps.

ii. Forest management boundaries

Forest management boundaries namely, Similpal tiger reserve, sanctuary, core, demarcated forest boundaries, compartment boundaries are digitized from the forest department maps. Besides the locations of forest administrative as well as management headquarters, rest sheds, watch towers, wireless stations, anti-poaching camps, salt licks, check gates etc. are taken from the forest department maps at GIS environment.

iii. Preparation of village boundaries

The village boundary maps are digitized from the Census map. There are 65 villages are identified in the Similpal Sanctuary area.

iv. Preparation of drainage layer

The perennial and dry drainage layers along with water body features are delineated from the satellite data.

v. Preparation of road-network layer

The road network map has been prepared from the satellite data. The road network comprises of National Highway, State High way and other roads.

vi. Preparation of settlement layer

The settlement spread area layer was prepared from the satellite data

vii. The demography and cattle population data from the sanctuary area has been collected.

After preparation of different spatial and non-spatial data base, they are superimposed on the forest land use maps at GIS environment. The non-spatial database such as demography, cattle population have been collected and interlinked with the spatial data base at GIS environment.

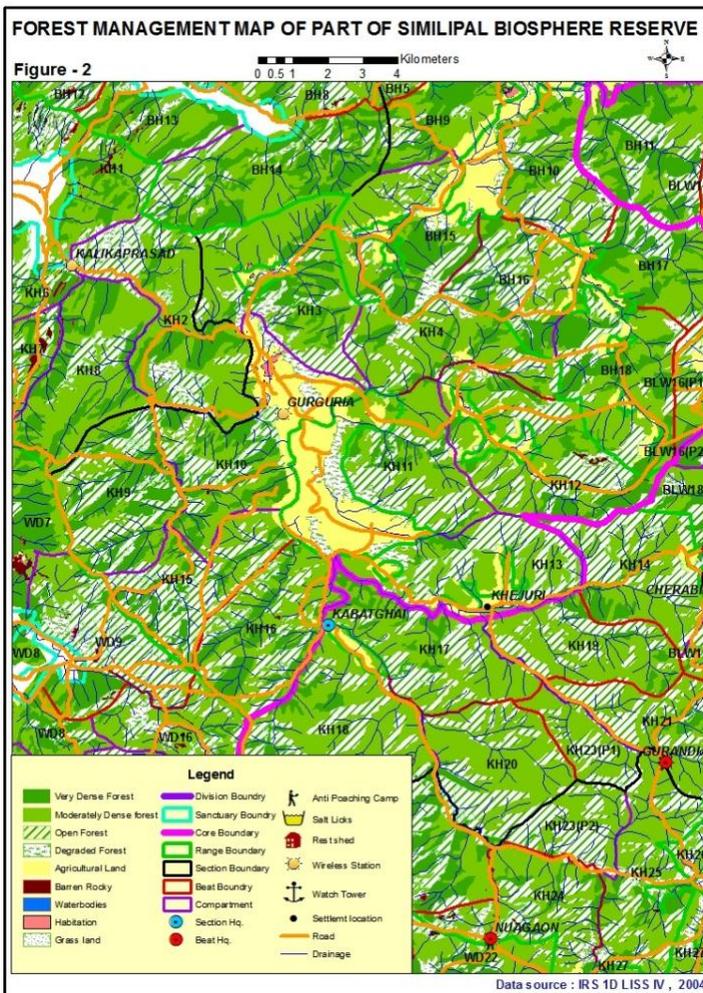
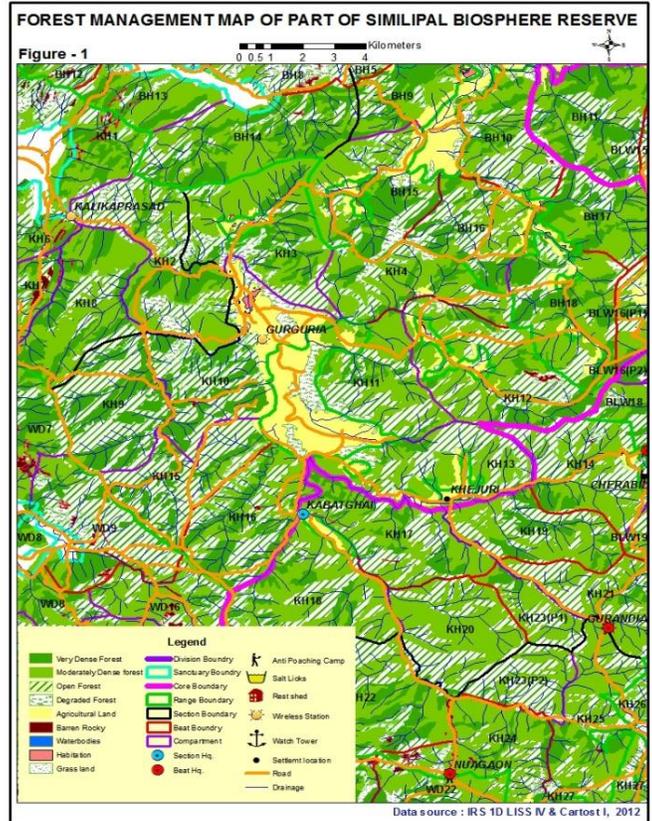


Results and Discussion

In order to prepare a suitable administrative and management plan of any protected area the forest management map is the basic requirement of it. Since the preparation of forest management map by conventional method is time taking and cost effective Remote Sensing and GIS technique is used for preparation of forest management map with very less cost and time. The following maps are generated in the study.

1. Index map

The index map of the study area was prepared on scale 1: 1, 00,000 scale showing the administrative and management boundaries of the study area.



2. Forest landuse maps

Two dates forest landuse maps are prepared on scale 1:50,000 using the Cartosat-1 and IRS P6 LISS IV data of 2004 and 2012. There are 9 categories of forest landuse classes have been identified. The classes are very dense forest, moderately dense forest, open forest, degraded forest, agricultural land, barren rocky area, grass land, habitation, and water body. (Fig -1& 2) A change detection study has been attempted for the Simlipal Tiger Reserve and the Simlipal Wildlife sanctuary area using the two date data. (Table-1 and Table-2) The analysis report reveals that there is an increase trend in forest density cover in the Simlipal Tiger reserve area.

TABLE-1: FOREST LANDUSE AREA STATISTICS OF SIMILPAL TIGER RESERVE

Sl. No	Forest landuse class	Area in hect.(2004)	Area in hect.(2012)
1	Very Dense Forest	46129.82	50665.99
2	Moderately Dense Forest	85664.61	79808.71
3	Open Forest	89292.32	86617.3
4	Degraded Forest	33969.7	38227.19
5	Grass Land	851.32	764.92
6	Barren Rocky Area	5053.72	4944.63
7	Habitation	1380.87	1275.42
8	Agricultural Land	14243.12	14274.73
9	Water Body	378.43	384.71
	Total	276963.89	276963.89

TABLE-2:FOREST LANDUSE AREA STATISTICS OF SIMILPAL WILDLIFE SANCTUARY

Sl. No	Forest landuse class	Area in hect.(2004)	Area in hect.(2012)
1	Very Dense Forest	44627.13	49182.07
2	Moderately Dense Forest	79298.8	71935
3	Open Forest	70791.37	70320.07
4	Degraded Forest	20920.01	24346.15
5	Grass Land	851.05	764.65
6	Barren Rocky Area	4374.3	4256.52
7	Habitation	172.68	176.71
8	Agricultural Land	6220.83	6269.04
9	Water Body	33.28	39.24
	Total	227289.45	227289.45

3. Preparation of forest administrative map

The forest administrative layers namely Division, Ranges, Sections and Beats are used for the preparation of Forest administrative map Of Similpal Tiger Reserve area on scale 1:50,000.

4. Preparation of forest Management map

The forest management units namely STR boundary, Core boundary, Demarcated forest boundary, compartment boundary along with the management head quarter location are used for the preparation of the Forest management area. The area statistics of the forest landuse class are generated at compartment level.

5. Preparation of drainage map

The perennial streams and the seasonal streams are prepared on satellite data and the drainage map is prepared on scale 1:50,000.

6. Preparation of road network map

The road networks comprising of National High way, State Highway and other roads are delineated from the satellite data on scale 1:50,000.

7. Village boundary map

The village boundary map has been prepared from census map on scale 1: 50,000. The spatial layers prepared on different sources are superimposed on forest landuse map. It becomes very easy to monitor the status of each compartment and device the new policies for betterment of the ecosystem at compartment level. This will be very much helpful to extract the forest resource information at any hierarchical order of the forest administration.

Conclusion

Habitat management is one of the most important activities in any protected area. Because of large extent enormous biodiversity characters the biomes should be controlled by a suitable management body. Remote Sensing and Geographic Information System has been proved most suitable for preparation of forest management map for eco-conservation as well as eco restoration. The forest management map prepared using remote sensing and GIS technique will provide all type of forest resource information at any hierarchical order of the forest information.

References

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