LANDUSE/LANDCOVER MAPPING AND GIS DATABASE OF MODHUPUR NATIONAL PARK FOR NISHORGO SUPPORT PROJECT

Dated
June, 2008

CEGIS

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Introduction

1.1 Introduction

The Nishorgo Support Project (NSP) of the Forest Department is engaged in establishing co-management in Protected Areas of Bangladesh. The Project visions improved management of the selected Protected Forest Areas (PFAs), where an accurate database on different management aspects, administrative and socio-economic dimensions in and around the PAs is identified as a key step. Center for Environment and Geographic Information Services (CEGIS) has already provided NSP with basic data layers for basemaps from existing sources and field information and produced landuse maps for 6 other PA's under NSP. Modhupur National Park has recently been included under NSP. NSP is now in need of all the GIS data layers to produce basemaps and landuse maps for Modhupur National Park.

NSP has involved CEGIS to develop landuse / landcover maps, analyze changes in the landcover in and around the national park over the last few decades and develop a GIS database for the Madhupur National Park (MNP).

1.2 Ecological background of the Madhupur National Park

The Madhupur forest tract is part of the eco-region of the 'moist deciduous forests of the Lower Gangetic plains'. It is a tropical moist broadleaf forest eco-region of Bangladesh and eastern India. Historically, these tropical moist deciduous forests, represented by this eco-region, once stretched along the lower reaches of the Ganges and Brahmaputra river plains across the Indian states of Bihar, West Bengal, Assam, Uttar Pradesh, and Orissa, and most of Bangladesh. At present, the Madhupur forest covers an area of 8,436 ha.

The area is also known as "Madhupur Garh" and forms a slightly elevated tract not exceeding 20 m in height over the general surrounding lands. The ridges locally known as "Chala" are not continuous and are covered with forest formations. There are numerous depressions with gentle slopes intercepting the ridges. Almost all the depressions, commonly known as "Baid", are cultivated for growing rice.

The vegetation is semi-deciduous; the upper canopy contains the deciduous species, and the second story is dominated by evergreen species (Puri et al. 1989). Sal (*Shorea robusta*) is the dominant species of the upper canopy. The common associates of Sal at the top canopy are Ajuli (*Dillenia pentagyna),* Amlaki *(Phyllanthus emblica)* and *Terminalia* sp. Some Shimul (*Bombax ceiba),* Koroi (*Albizzia procera)* and Palas *(Butea monosperma)* can also be found in this stratum. The second story contains *Mallotus philippinensis, Mimosa rubricaulis, Bauhinia* sp, *Wrightia tomentosa* and *Zizyphus rugosa*. The undergrowths are of a few species. These are *Holarrhena antidysenterica*, *Glycosmis arborea*, *Randia* sp., *Chromolaena odorata*, *Clerodendrum viscosum, Curcuma* sp. *Elephantopus scaber, Oplismenus compositus* and *Asparagus acerosus*. A few leguminous herbs such as *Desmodium laxiflorum* and *Desmodium triflorum* are also present in this area. The common climbers are *Spatholobus roxburghii, Dioscorea pentaphylla, Smilax macrophylla* and *Scindapsus officinalis*.

Previous records show that the Bengal Tiger (*Panthera tigris*) and the One-horned Rhinoceros (*Rhinoceros unicornis*), both of which are now extinct from this forest tract, were previously many in number. Other large mammals, which include Samber (*Cervus unicolor*), Swamp deer (*C. duvauceli*), Hog deer (*Axis porcinus*), Barking deer (*Muntiacus muntjak*), Rhesus macaque (*Macaca mulatta*) and

Wild boar (*Sus scrofa*) were also common. Among the smaller wildlife the common Mongoose (*Herpestes edwardsi*), small Indian Mongoose (*H. autopunctatus*), small Indian Civet (*Viverricula indica*), Hispid Hare (*Caprolagus hispidus*), jackal (*Canis aureus*), fox (*Vulpes bengalensis*), Fishing Cat (*Felis viverrina*), squirrel and porcupine are still present, although they are now seriously reduced in number. Amongst the reptiles, the Bengal Grey Lizard (*Veranus negalensis*), the Common Skink (*Mabuya carinata*) and the Garden Lizard (*Calotes versicolor*) can be commonly found in the open areas of the forest patches. Madhupur tract is also a good habitat for snakes, especially cobras. The diversity of avi-fauna is also rich, although important species like the Common Peafowl have become extinct from the forest. Streams flowing between the ridges support a special group of fish species which depend on these clean and fast flowing waters.

The overall health of the Madhupur 'Sal' forest is extremely poor. It has been generally observed that the forest is greatly disturbed by human activities through encroachment, tree felling, burning and grazing. The extent of encroachment is huge and vast tracts of forestland have been converted into fruit orchards and human settlements. In many cases, the disturbance created by humans and their domestic animals is so great that it altogether changes the appearance of the forest in the course of time. There are virtually no primary Sal trees in the forest, as the existing ones are all coppices. Trees produced from this kind of successive coppices and under such disruptive conditions are deformed and do not produce any good quality timber. Due to the clearing and degradation of forest cover, incidences of invasion from invaders, such as the *Chromolaena odorata,* are very high. Ismail and Mia reported the presence of this invader in Madhupur forest tract as early as in 1972.

The dense human population is still growing rapidly. The urbanization, industrialization, and agriculture associated with this growing population and its resource and economic needs pose serious threats to the remaining forest fragments. The small, protected areas are vulnerable to this tidal wave of human growth and are inadequate for conserving the biodiversity of this eco-region. Finding additional habitats for protection will be challenging. Therefore, the existing protected areas should be effectively managed and protected, and critical habitat restoration should be considered where necessary.

1.3 Objectives

The overall objective of the assignment was to assist or facilitate co-management for the Madhupur National Park through development of a GIS database of the park and analyzing recent trends in landuse and landcover change. The specific objectives were as follows:

1. Identify landuse and landcover in and around the Madhupur National Park;
2. Document and show the spatial degradation of forest areas over a period of last 40 years; and
3. Develop a consistent digital GIS database using existing secondary data and harmonize various data layers from different sources to produce a base map for MNP.

1.4 Study Area

MNP is located in the northeastern part of Tangail Forest division along the boundary with and extending marginally into Mymensingh district (Figure 1.1). MNP boundary, shown by white line on Figure 1.1 is provided by NSP. The total gazette area of MNP is 8,437 ha and it covers 4 ranges and 7 beats. GIS and image analysis to identify landuse/ cover trend included an extra 1km buffer around the MNP boundary.

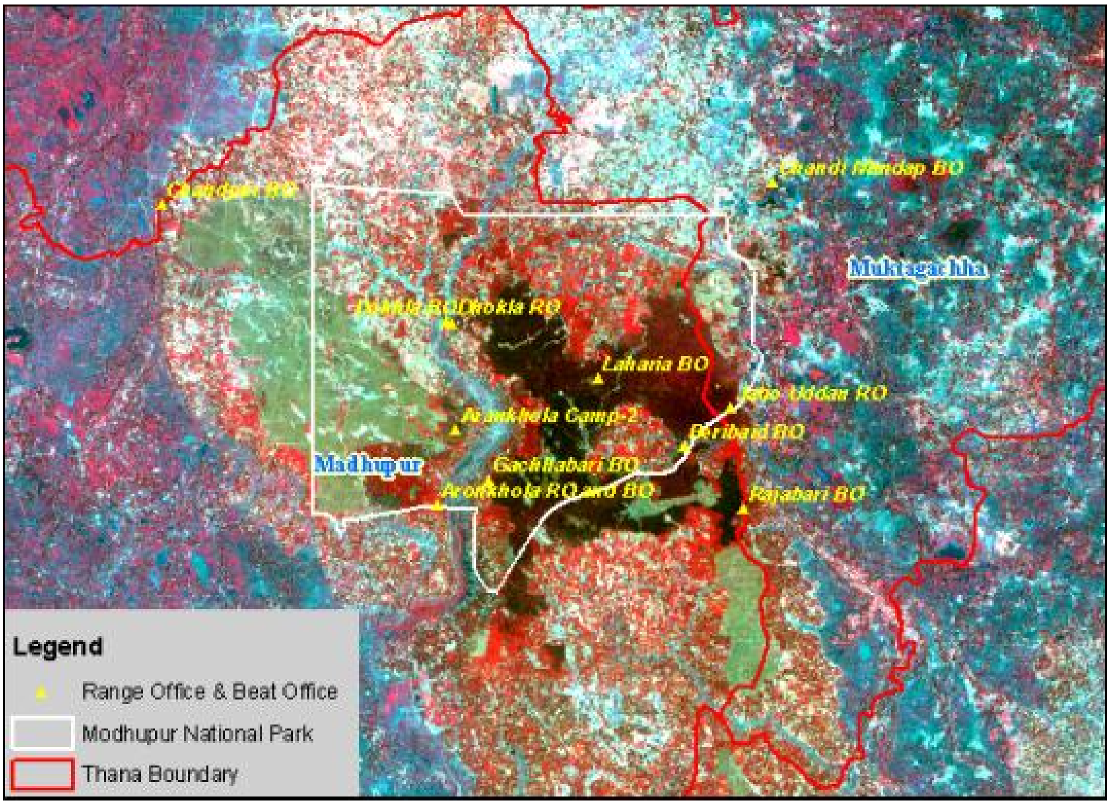


Figure 1.1: Location of the Madhupur National Park (MNP)

1.5 Scope of work

The scope of work was as follows:

1. Preparation of a detailed landuse landcover map from the latest available high-resolution satellite image including:

- The landuse landcover classes from the QuickBird satellite image of 2003
- FD building/offices, eco-park boundaries, areas under other government organizations including Air force and Military for security or training purposes as well as other identifiable establishments, either from secondary sources or through field data collection.

2. Analyzing changes in landuse/landcover over a period of last 40 years by

- Collecting and processing remotely sensed data of 1967, 1973, 1989, 1999 and 2007
- Identifying changes in forest cover over the mentioned period of time.

3. Development of a detailed and accurate GIS database of MNP by

- Collecting data from various sources
- Bringing data layers to the same GIS platform
- Editing data layers based on a reference layer and field data in order to make an accurate and consistent dataset

Chapter 2

Landuse and Landcover Analysis

This chapter describes the methodology involved in the analysis of the remote sensing data. It also describes landuse and landcover classification results obtained from the satellite imagery of different dates from 1967 to 2007 and the changes that occurred during this period.

2.1 Methodology

2.1.1 Satellite image procurement and time series data preparation

Dry season optical images, which were available for different past years and from a variety of different sensors were used to analyze historical trend of landuse/cover of the study area. Table 2.1 shows the list of satellite images used in this study along with their acquisition dates. This time series data covering the MNP area and 1 km buffer of MNP area were selected for trend analysis of landuse/cover in the study area.

A high resolution QuickBird image was acquired for preparing a detailed landuse and landcover map for MNP area. Both multispectral and panchromatic QuickBird satellite images were procured for the study area. The image acquisition date was 14th October 2003. The detailed specifications of the satellite image are given below:

- Image: QuickBird Satellite image
- Date: 14 October 2003
- Product type: Bundle product (Panchromatic & Multispectral-4 bands)
- Resolution: 0.60m & 2.4m

The Corona satellite image of 1967 is a high-resolution (ground resolution 12 m) one-channel image. Landsat Multi Spectral Scanner (MSS) acquired images in four wavelength bands: two in the visible spectrum at the 0.5 to 0.6 (Green Band) micrometers and 0.6 to 0.7 (Red Band) micrometers and two in the near infrared at 0.7 to 0.8 and 0.8 to 1.1 micrometers. The ground resolution of Landsat MSS images is 80m. The Landsat Thematic Mapper (TM) provides imagery in seven spectral bands, covering the visible and near, middle and thermal infrared parts of the electromagnetic spectrum. TM has a 30 m ground resolution for all bands except Band 6, which has a 120 m resolution.

The IRS P6 LISS-III is a multi-spectral camera operating in four spectral bands, three in the visible and near infrared and one in short wave infrared (SWIR) region.

Table 2.1: List of historical satellite images

Sl No.	Satellite/Sensor	Date	Resolution
1	Corona Space Photo Satellite	1 March 1967	12 m
2	Landsat MSS	9 February 1973	80 m
3	Landsat TM	16 March 1989	30 m
4	Landsat TM	10 January 1997	30 m
	SPOT Multispectral Image	1999 (RIMS)	20 m
5	IRS P6 LISS-III	24 February 2007	23.5 m

2.1.2 Georeferencing and Coregistration of Satellite images

Geo-referencing was undertaken to avoid any geometric distortions. The high-resolution QuickBird image was geo-referenced using DGPS corrected ground control points (GCPs). The intersection of roads or corners of well-shaped rectangle ponds having clear visibility and accessibility were selected as ground control points. A total of 25 GCPs were selected within the study area. A number of hardcopy maps had been printed and the selected ground control points were marked on them. During field survey these selected points on the maps were identified on the ground and coordinates were collected using DGPS. Figure 2.1 shows the distribution of GCP in the study area. After collecting the reference coordinates of the GCPs the corresponding input coordinates were collected from digital QuickBird images and a transformation matrix was developed using the 1st order Polynomial option. Finally, this matrix was used for transforming the image coordinates into the Bangladesh Transverse Mercator coordinate system. The pixels were resampled using the Nearest Neighbor Resampling method. The accuracy of geometric correction was ± 2 meters.

DGPS corrected IRS Panchromatic image (resolution 5 m) was used as reference for the geometric correction of the time series satellite images of 12 meter, 20 meter and 30-meter resolution. For geoereferning the MSS image (80 meter resolution), the Landsat TM image of 30 meter was used as reference image. The accuracy of georeferencing for time series data was less than 30m. After geometric correction all images were co-registered to each other to properly match with each other.

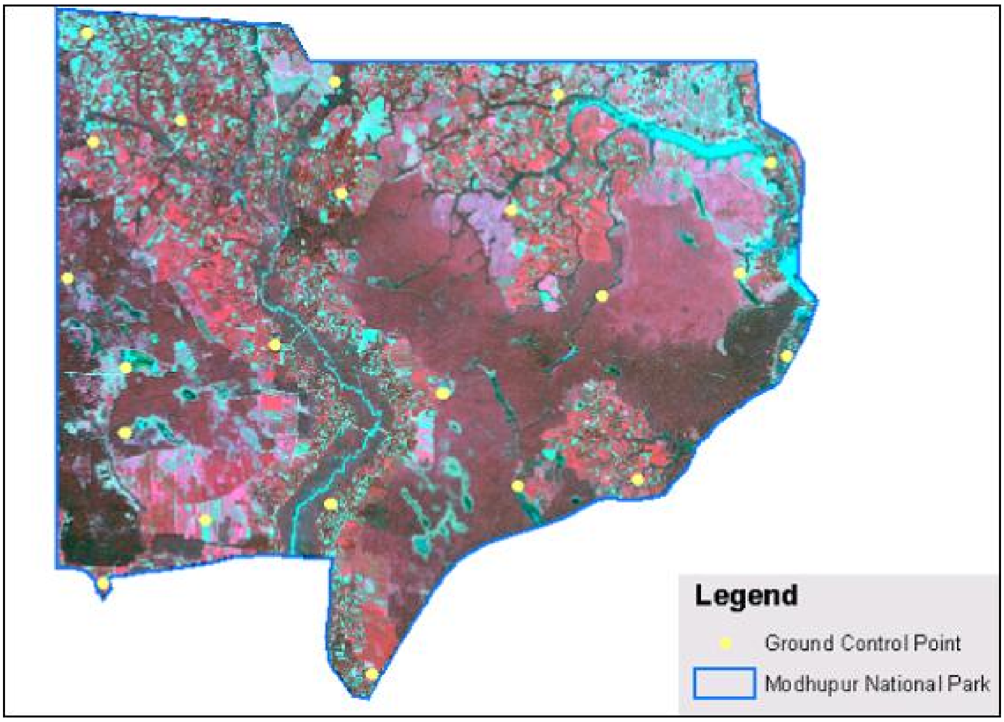


Figure 2.1: Distribution of Ground Control Points collected for geo-referencing

2.1.3 Ground truth data collection

Ground truth data was collected both for digital classification of time series satellite images as well as visual interpretation of the QuickBird image. In order to collect ground truth data and to better understand the study area, a field survey was carried out on 23 October 2007for a period of five days. Considering the required classes, different sites were visited and relevant information was collected from those sample sites. Figure 2.2 shows the distribution of the field sample sites. The information that was collected for each site includes landuse practice, land cover, forest types and x,y coordinate. Historical information on land use and land cover was collected from the local people and the forest officers and staff working in the study area.

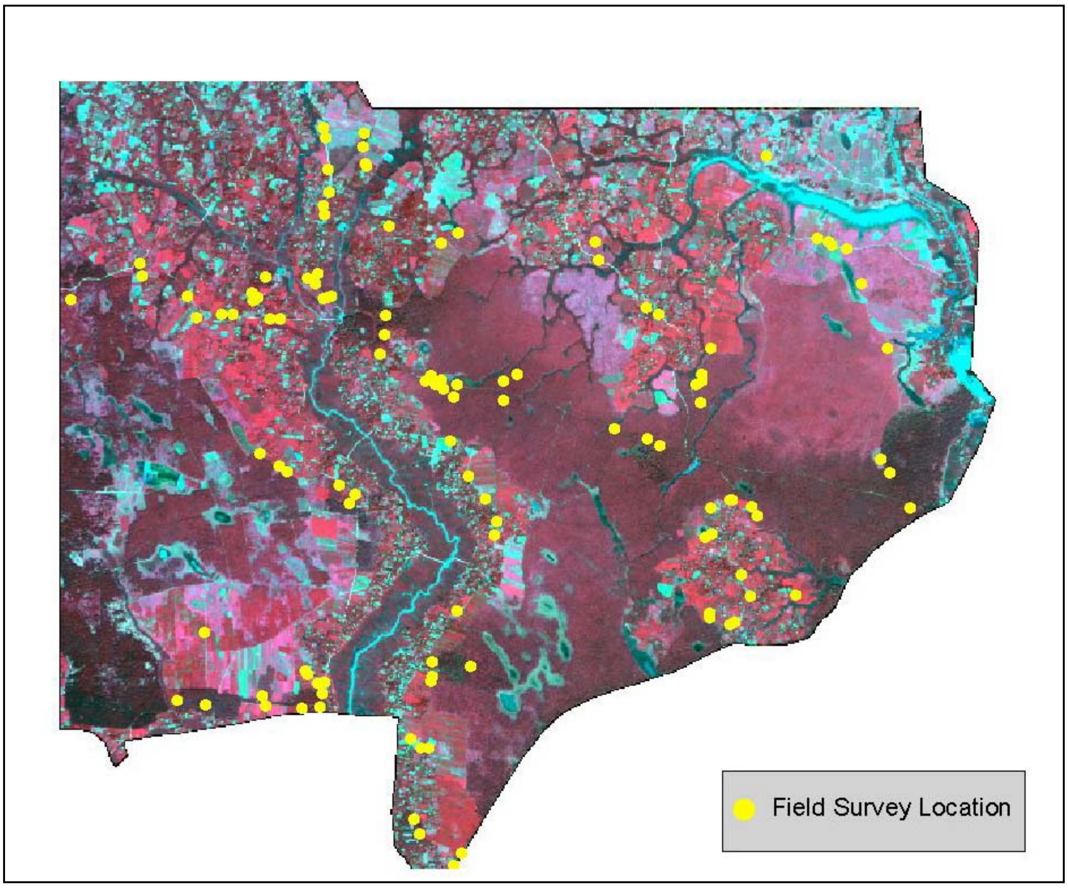


Figure 2.2: Distribution of ground truth data collection site

2.1.4 Preparation of Landuse and Landcover maps

The detailed landuse/ landcover map was derived from high-resolution QuickBird satellite images. The different tones, colors and textures in a satellite image represent different landuses/covers on the ground. These tones, colors and textures were identified on the QuickBird images using visual interpretation. Based on the field information, an interpretation key was developed. This interpretation key was used to identify different landuses/ landcovers from the image. The on-screen digitization technique was used to delineate the boundaries of each class. Both multispectral and high-resolution panchromatic images were used to identify the classes and to delineate their boundaries. After extracting the required landuses/covers from images, another field trip was conducted on 15 November for a period five days for field verification of the map. Figure 2.3 shows the landuse and landcover map that was finalized after field verification.

2.1.5 Time series satellite image data analysis

Selected satellite images from different years (Table 2.1) were used to derive historical landuses/covers of MNP. The study area for the trend analysis of landuse/cover includes 1 km buffer around the MNP area. Before classification, images were coregistered so that they spatially aligned correctly to each other.

The Corona satellite image of 1967 was classified into two classes: "Forest Cover Area" and "Others". The Landsat MSS image of 1973 was having four-channels or bands but with very coarse

(80 m) resolution. Due to this reason it was also classified into two classes: “Forest Cover Area” and “Others”. The satellite images of 1989, 1999 and 2007 were classified into seven classes: Forest, Rubber Plantation, Settlements with Homestead Vegetation, Water, Seasonal Water Bodies and Others.

While analyzing the panchromatic Corona image of 1967, it was found that the DN value ranging from 40 to 120 represent forest cover area. The multispectral images were classified using an unsupervised classification method. The ISODATA algorithm techniques were used to perform an unsupervised classification. ISODATA stands for ’Iterative Self-Organizing Data Analysis Technique’. The ISODATA clustering method uses the minimum spectral distance formula to form clusters. It begins with either arbitrary cluster means or the means of an existing signature set, and each time the clustering repeats, the means of these clusters are shifted. The new cluster means are used for the next iteration. The ISODATA utility repeats the clustering of the image until either a maximum number of iterations has been performed, or a maximum percentage of unchanged pixels has been reached between two iterations. Each spectral class was verified with ground truth data. The similar spectral classes were grouped together and labeled with a land use / land cover based on ground truth data. Finally, information classes such as Forest Cover Area, Rubber Plantation, and Settlements with Homestead Vegetation, Water, Seasonal Water Bodies and Others were derived.

During classification of timeseries data it was found that some minor areas could not be assigned to any class. In some cases, the tone of the degraded forestland and fallow lands ware similar in the panchromatic corona satellite image causing some misclassification. Also due to seasonal variation in acquisition of images the color and tone of some classes ware different in different images. All the problems that were found during classification of time series data were discussed with the professionals of RIMS unit of Forest Department. RIMS unit shraed their valuable experiences and helped to finalize the landuse and land cover classification maps of time series data.

2.2 Landuse/Landcover 2003

The different landuses/covers that were extracted from the images of 2003 are Natural Forest, Rubber plantation, Agro Forestry, Woodlot, Bamboo, Cultivated land, Rural Settlements, Built-up areas, Rivers, Ponds and Water bodies and Seasonal Water bodies. Figure 2.3 shows the landuse/landcover map derived from the QuickBird image 2003.

Table 2.2 shows the areas of these landuses/covers in hectares and percentage of total area within the Madhupur National Park (MNP). The Natural Forest class includes Sal (*Shorea robusta*) Forest, which comprises about 25% of the MNP area. It is mainly distributed under Arankhola mauza and a little potion under Rasulpur mauza. The Woodlot class comprises about 12% of the total MNP area. Woodlot of Teak plantation was found under the Arankhola Beat Office. Only 1% of the total MNP area is under agroforestry. The western part of the MNP area is dominated by rubber plantations, which occupies about 10% of the total MNP area. The rubber plantations are mainly distributed in Pirgachha mauza under Madhupur upazila. The major land use within the MNP area is “Cultivated Land” which is about 37% of the total MNP area. It includes both rice and non-rice cropped areas, which include pineapple, banana and other vegetables. The rural settlement within the MNP area is about 12% of the total MNP area

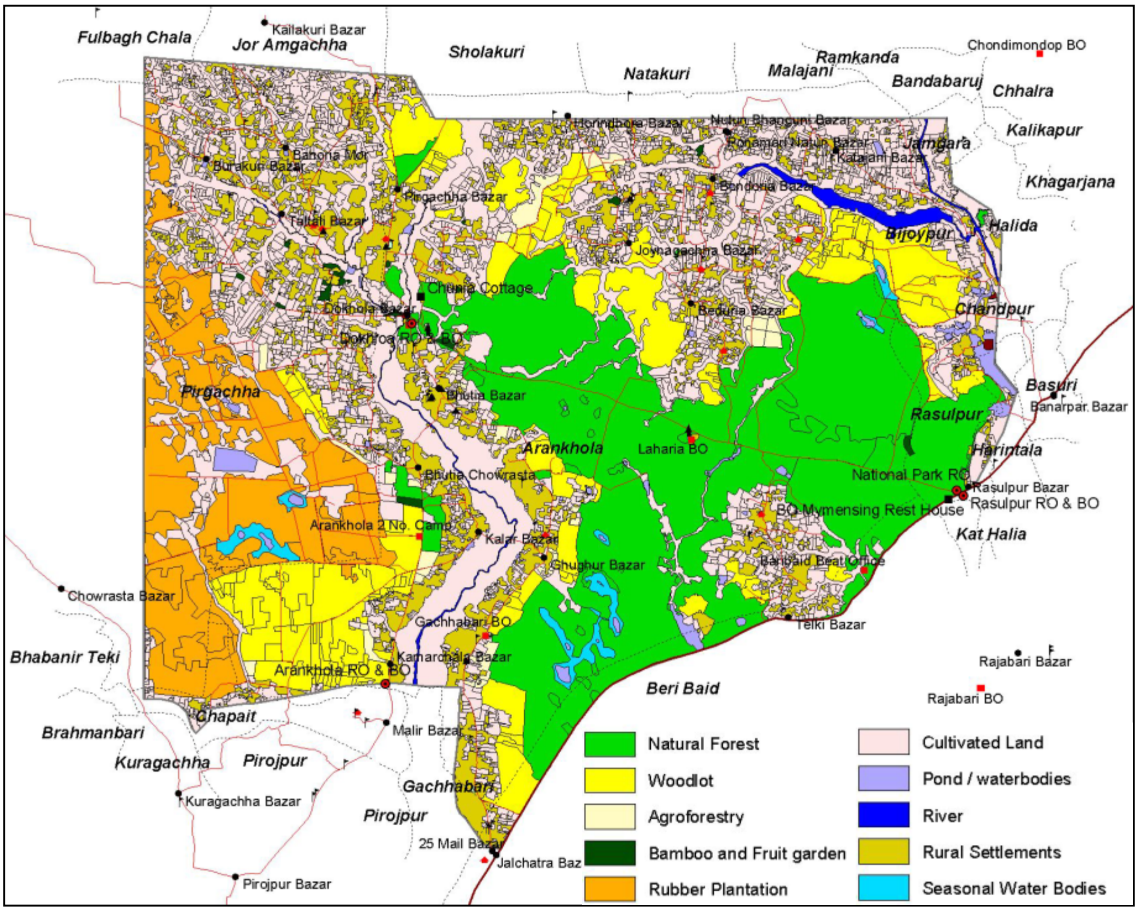


Figure 2.3: Landuse and landcover derived from QuickBird satellite image for MNP

Table 2.2: Areas of Landuse/Landcovers within MNP, 2003

Landuses/Covers	Area (Ha)	%
Cultivated Land	3103	36.51
Natural Forest	2114	24.88
Woodlot	1042	12.26
Rural Settlements	1030	12.12
Rubber Plantation	878	10.33
Pond/WB	96	1.13
Agroforestry	93	1.10
River	64	0.75
Seasonal Water Bodies	51	0.60
Bamboo	15	0.18
Fruit Garden	6	0.07
Built-up Area	3	0.03
Park	2	0.02
Open Space	1	0.01
Total	8,499	100

2.3 Changes in Landuse/Landcover 1967-2007

Landuse/cover maps derived from satellite images of 1967, 1973, 1989, 1999 and 2007 are shown in Figure 2.4, 2.5, 2.6, 2.7, and 2.8 respectively. The statistics of landuse/cover of the selected years derived from the time series satellite images are given in Table 2.2. The Table shows areas under different landuses/cover classes within the MNP area and a 1-km buffer around the MNP boundary.

In 1967 the total forest cover within the study area was found to be 8,875 ha which is about 68.3% of the total study area. Between 1967 and 2007 it was found that the forest cover area gradually depleted and in 2007 it was found to comprise only 29.8% of the total study area. Most of the forest cover area has been converted to rubber plantations and some brought under agriculture practice or converted to rural settlements with homestead vegetation. It was found that the forest area had reduced by about 22.5% between 1967 and 1973. It should be noted that the 1967 image has a resolution of 12 m whereas the 1973 image is of very coarse resolution i.e. 80 m. Therefore the area calculated from the 1973 image is much less than that of the 1967 image. An analysis of the image acquired in 1989 revealed that some forest areas that could not be identified from the coarse resolution satellite image of MSS (80 m) acquired in 1973 were actually visible in the 1989 image. This kind of difference is expected when images of diffirent resolution are used for comparision. Images of 1989, 1999 and 2007 are of very similar resolution and hence are more comparable. It found that between 1989 and 2007 there is a further reduction in forest area of 14%.

The rubber plantation area increased from 4.7% in 1989 to 12.7% in 1999. A large amount of forest cover area was converted to rubber plantations during this period. Between 1999 and 2007 there was no significant increase in the area of rubber plantations. From further analysis of the image it was found that the rubber plantation area has actually reduced by about 1% during this reporting period. But additional investigations have revealed that the image of 2007 had been acquired in January, a time when rubber trees shed their leaves. That is why it has been difficult to identify the full coverage of rubber plantation from the image of 2007. The image of January 2007 was used as it was available free of charge from the CEGIS archive. It is recommended that image of April be used for better identification of rubber plantations as at that time the rubber trees have full leaf coverage.

Within the study area, in 1989 the study area had about 44.5% agricultarul land. After that there was no major increase (i.e about 1% between 1989 and 1999 and 2% between 1999 and 2007). Settlements with homestead vegetation were found to comprise 4.2% of the total study area in 1989. It increased to 6.7% in 1999 and 8.9% in 2007. Other landuse/cover such as water bodies and seasonal water bodies have not changed significantly between 1989 and 2007.

Table 2.2: Areas of Landuse/cover in different years

Landuses/covers	Year									
	1967		1973		1989		1999		2007	
	Area (Ha)	%	Area (Ha)	%	Area (Ha)	%	Area (Ha)	%	Area (Ha)	%
Forest cover area	8875	68.3	6011	45.7	5718	43.8	4360	33.5	3879	29.8
Rubber Plantation	-	-	-	-	612	4.7	1656	12.7	1537	11.8
Agriculture land	-	-	-	-	5808	44.5	5901	45.3	6172	47.3
Settlements with Homestead Vegetation	-	-	-	-	545	4.2	874	6.7	1165	8.9
Water	-	-	-	-	211	1.6	101	0.8	115	0.9
Seasonal Water Bodies	-	-	-	-	94	0.7	68	0.5	95	0.7
Others	4128	31.7	7128	54.3	76	0.6	69	0.5	73	0.6
Total	13,003	100	13,139	100	13,064	100	13,029	100	13,036	100

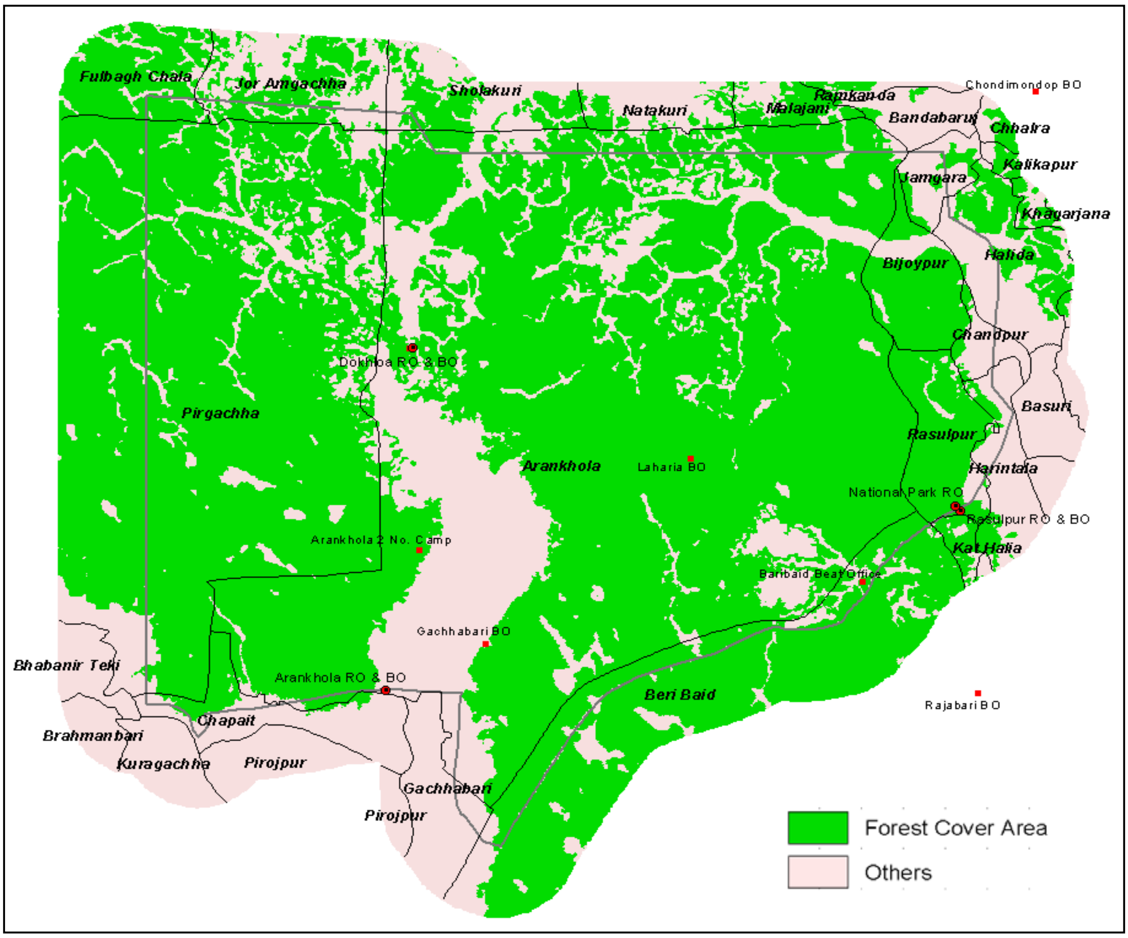


Figure 2.4: Landuses/covers derived from Corona satellite image of 1967

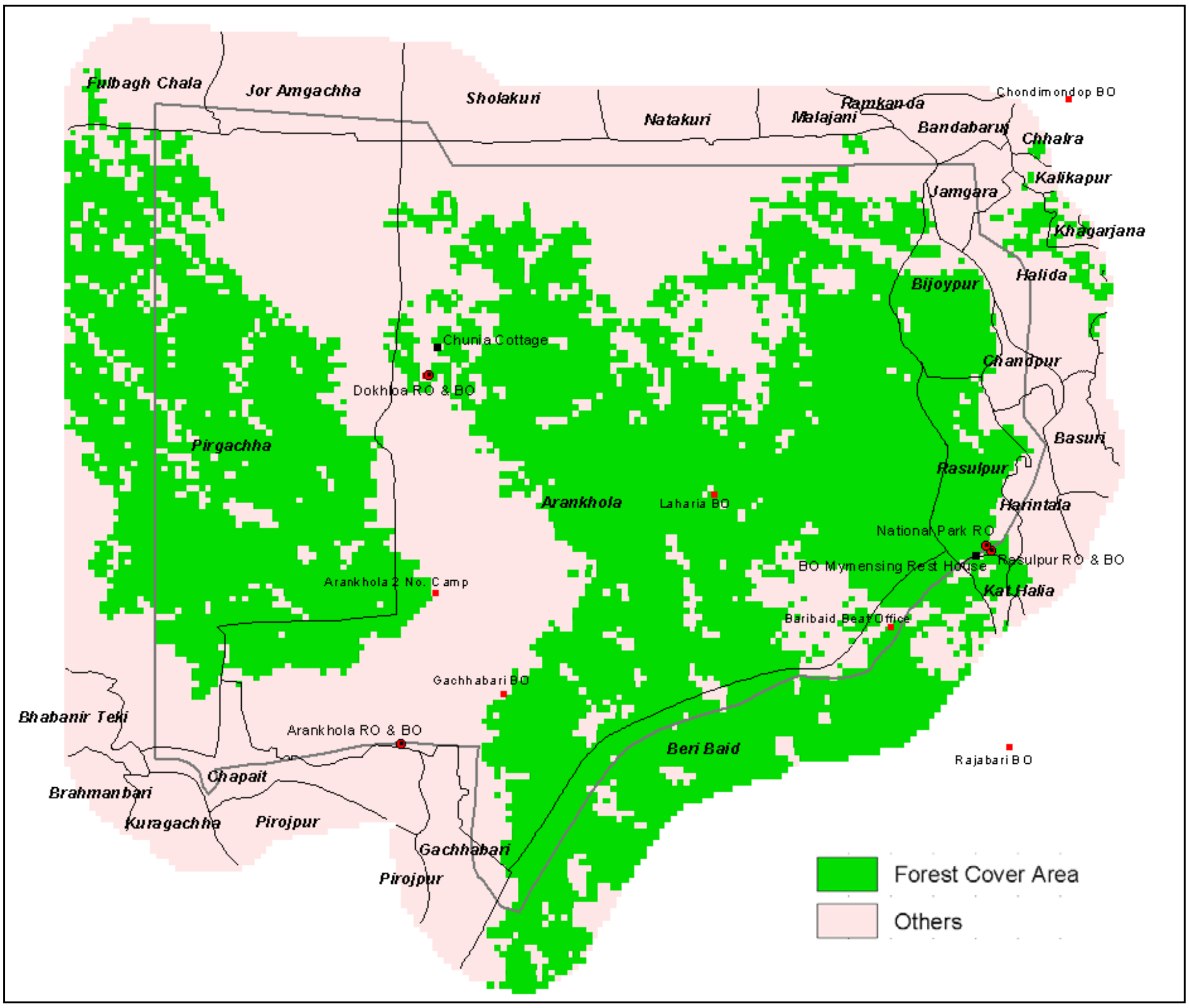


Figure 2.5: Landuses/covers derived from Landsat MSS of 1973

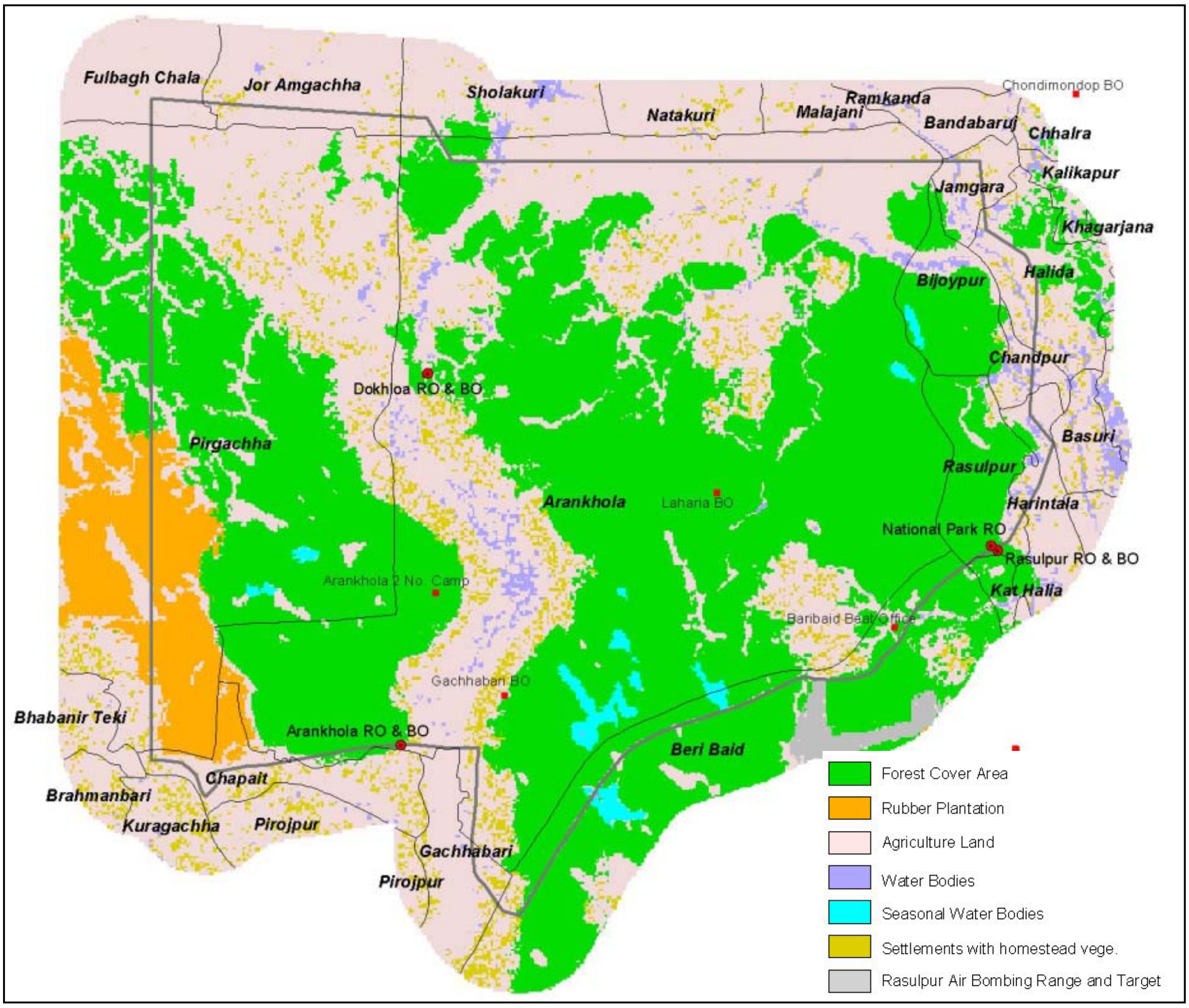


Figure 2.6: Landuses/covers derived from Landsat TM of 1989

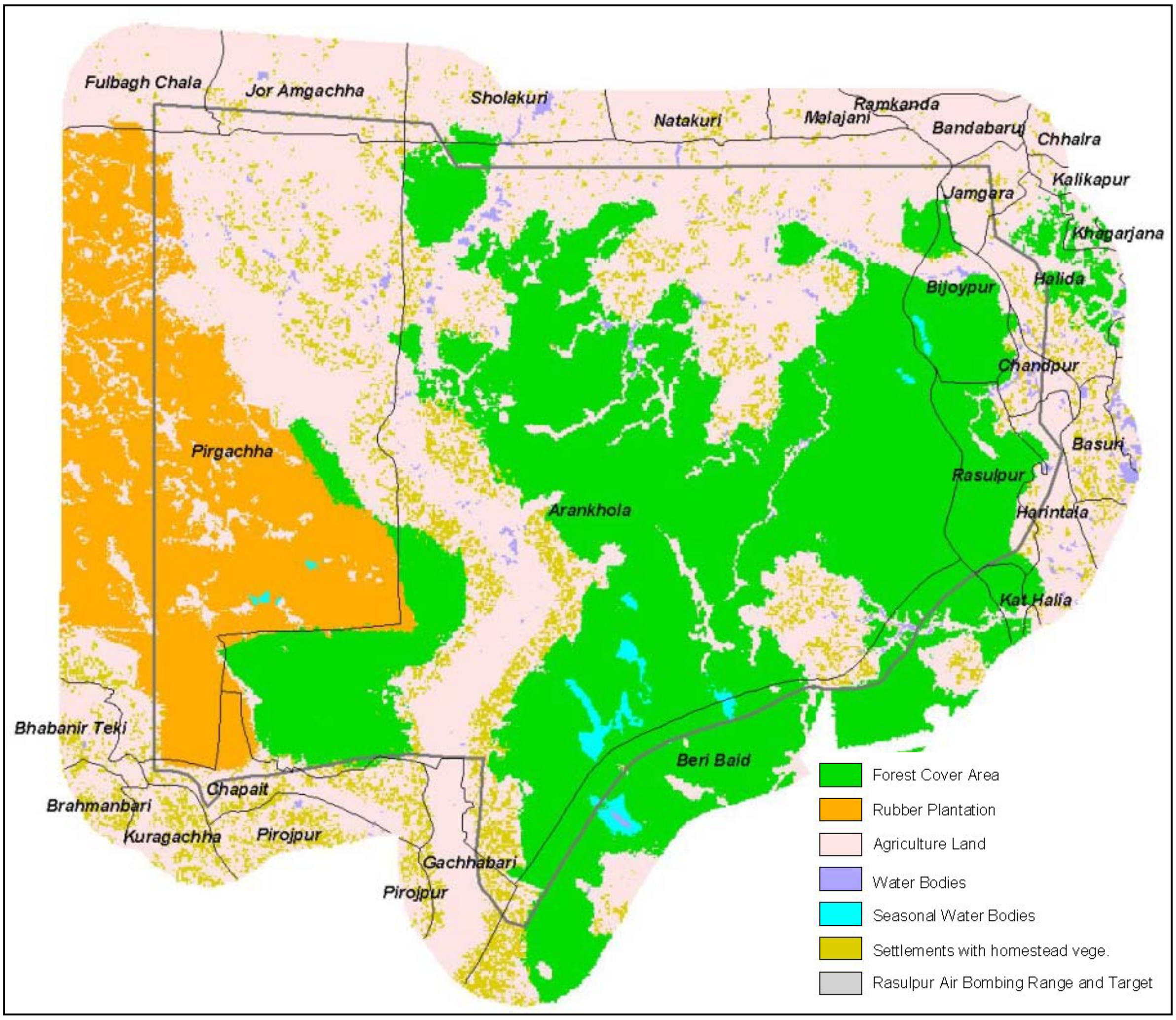


Figure 2.7: Landuses/covers derived from Spot of 1999

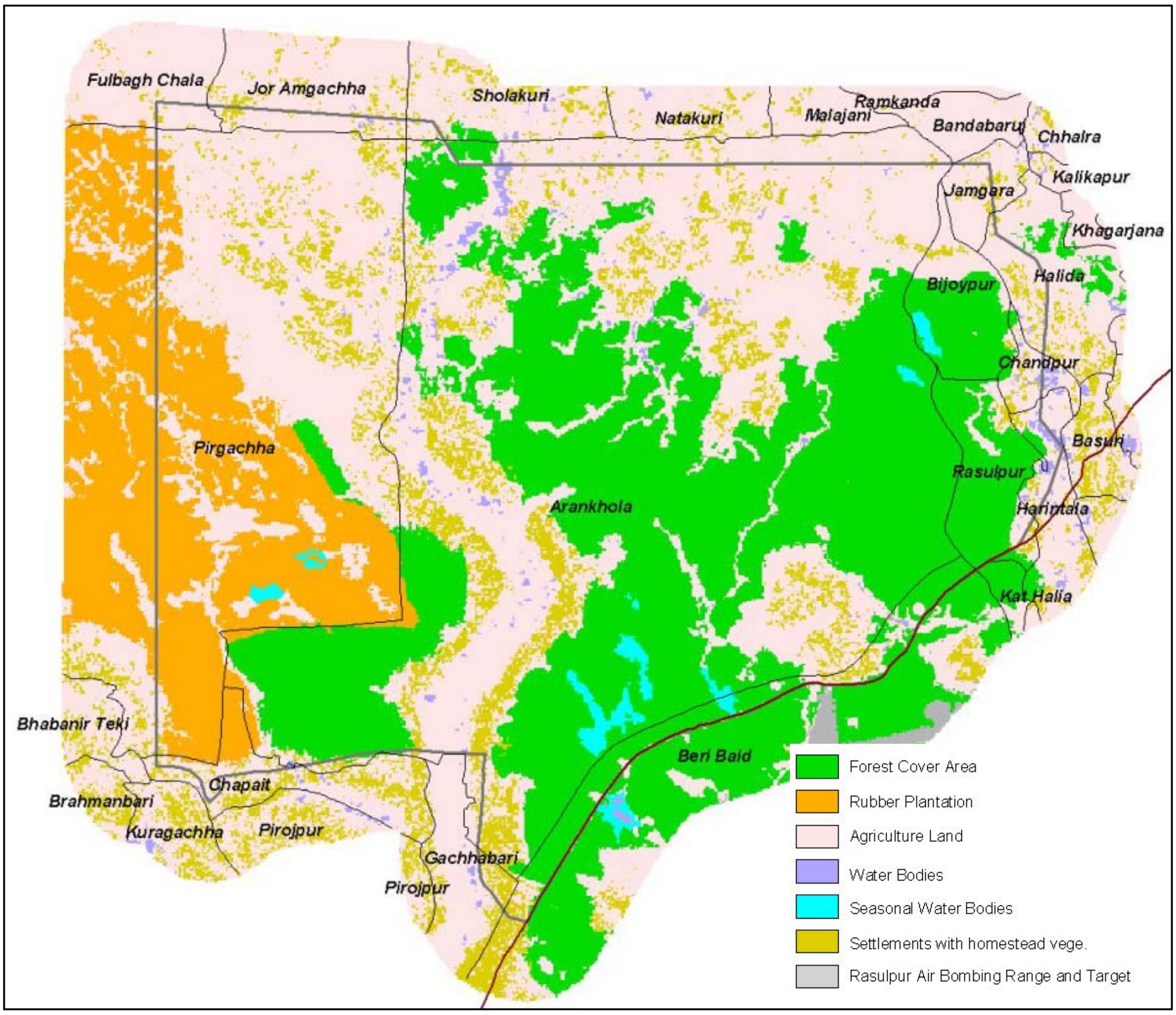


Figure 2.8: Landuses/covers derived from IRS P6 LIS III of 2007

Chapter 3
GIS Database

This chapter briefly describes the methodology involved in the preparation of GIS data layers. It also gives a description of each of the output data layers.

3.1 Methodology

A detailed and accurate GIS database for Madhupur National Park (MNP) has been developed under this project. The data were collected from different sources and brought into the same GIS platform. All these data were brought under the same reference system, which is the Bangladesh Transverse Mercator (BTM). This ensures that the data can be used in GIS analysis. An intensive field survey was carried out with DGPS to correct and verify location and alignment of features such as roads and other infrastructures. During this field survey, locations and attribute information was also collected of those features, which were not present in the existing maps. This includes growth centers, schools, NGO offices, etc. The location and alignment of the spatial data were also checked and verified using the georeferenced QuickBird image. The attributes collected from field were added to the dataset. The whole GIS database has been developed as an accurate and consistent dataset. The GIS software ArcGIS and ArcView were used to develop the GIS database. This project follows the methodology used by CEGIS for developing GIS database of other Protected Areas (PAs) under NSP. The detailed methodology can be found in the report "Geospatial Database for Protected Areas of Nishorgo Support Project (NSP)" dated December 2005. The data sources and outputs formats are summarized and presented in the Table 3.1.

Table 3.1: Data summary table

Layers	Data sources				Selected Data source	Output format
	RIMS	NWRD	CEGIS	LGED		
MNP boundary					RIMS	.SHP
1 km buffer area					Generated based on MNP boundary	.SHP
Forest administrative boundary					Generated from " Forest boundary" layer	.SHP
Administrative boundary					CEGIS	.SHP
Settlement					CEGIS	.SHP
Roads					All the sources and field data combined	.SHP
Railway line					CEGIS	.SHP
River					All the sources and field data combined	.SHP
Growth center					Data collected from field	.SHP
Education/ community and public institutes					Data collected from field	.SHP
Health centers					Data collected from field	.SHP

Layers	Data sources				Selected Data source	Output format
	RIMS	NWRD	CEGIS	LGED		
NGO offices, Cooperatives, Youth clubs, social welfare clubs					Data collected from field	.SHP
Others					Data collected from field	.SHP

3.2 Description of GIS layers

3.2.1 Modhupur National Park Boundary Delineation

The boundary of Modhupur National Park was delineated based on the gazette published by the Government of the People's Republic of Bangladesh, Ministry of Agriculture, dated 24 February 1982. SA (State Acquisition) mauza maps of the mauzas listed in the gazette were collected jointly by NSP and CEGIS officials from the forest beat office. The mauza maps were geo-referenced to the Bangladesh Transverse Mercator (BTM) projection with the help of GCP (Ground Control Points) coordinates collected from the field, and then mosaiced to create a larger map.

From the mosaic map, the boundary was drawn based on the plot boundary listed in the published gazette. After the boundary delineation, it was crosschecked with the hand drawn maps and other documents collected from MNP forest office. Some adjustments were made to the boundary using coordinates of features on the ground (collected with GPS), which were identified by forest officials as part of the boundary. The MNP boundary was finalized jointly by FD and NSP officials.

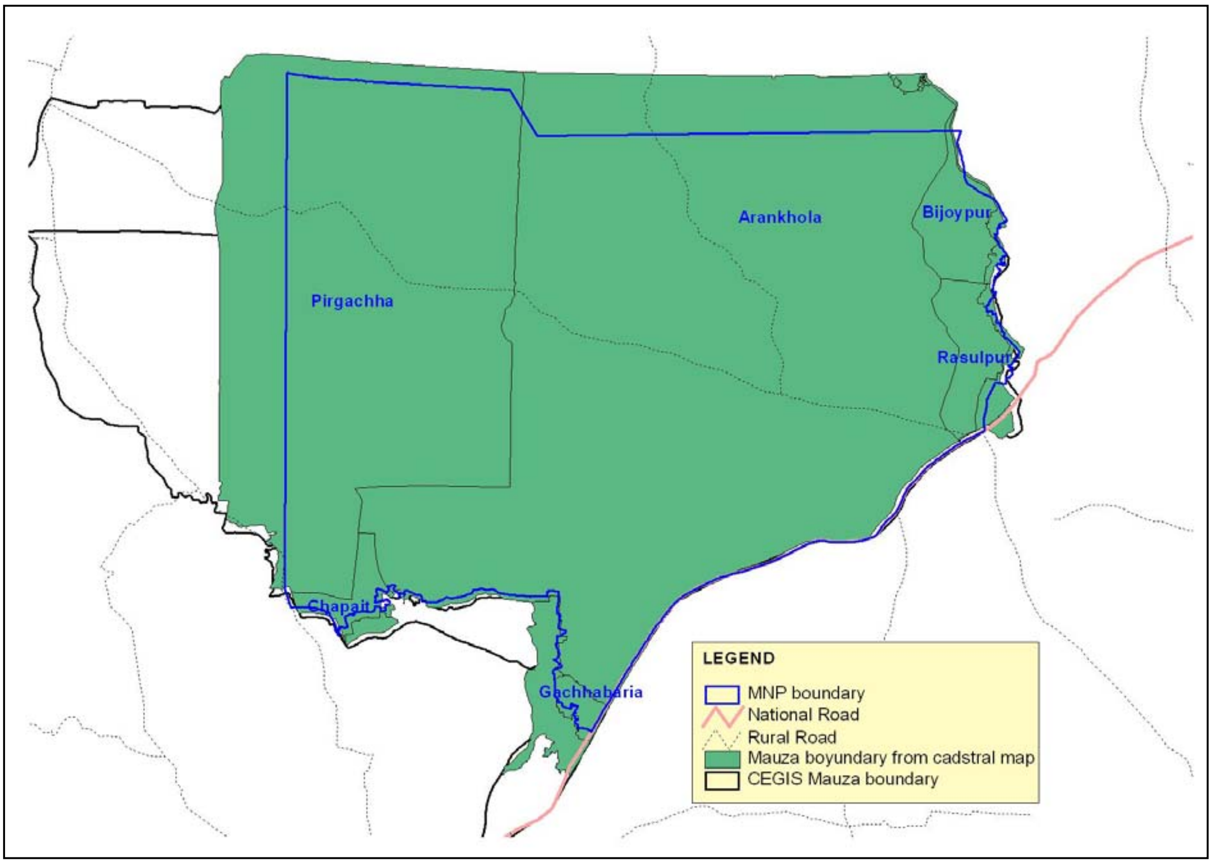
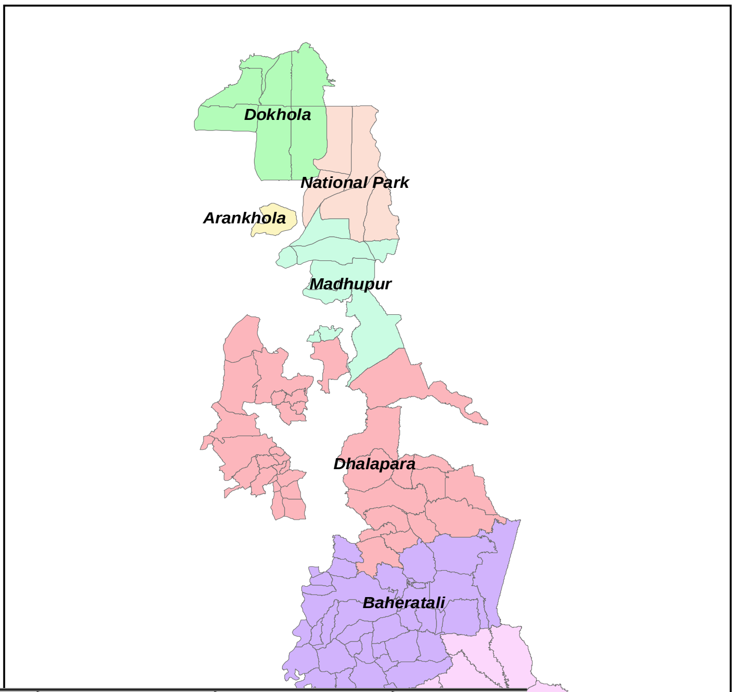


Figure 3.1: Modhupur National Park Boundary delineated from Cadastral map (SA mauza map)

3.3 Forest administrative boundary

The forest administrative layers have been extracted from the RIMS dataset. Only this layer had the information of ‘Range’ and ‘Beat’ name. (Shown in Figure 3.2) The spatial boundaries have been extracted by applying GIS techniques. The available attributes have been attached in the spatial dataset. The attributes contains information on:

- *Range name,*
- *Beat name*



Associated attributes

MAUZA_NAME	THANA_NAME	BEAT	RANGE	DIVISION
Sholakuri	Madhupur	Dokhola sadar	Dokhola	Tangail
Jore Amgachha	Madhupur	Dokhola sadar	Dokhola	Tangail
Jore Amgachha	Madhupur	Chandpur	Dokhola	Tangail
Fulbagchala	Madhupur	Chandpur	Dokhola	Tangail
Pirgachha	Madhupur	Chandpur	Dokhola	Tangail
Pirgachha	Madhupur	Dokhola sadar	Dokhola	Tangail
Arankhola	Madhupur	National Park Sadar	National Park	Tangail
Arankhola	Madhupur	Dokhola sadar	Dokhola	Tangail
Arankhola	Madhupur	Laharia	National Park	Tangail
Arankhola	Madhupur	Gachabari	National Park	Tangail
Beribaid	Madhupur	Baribaid	National Park	Tangail
Beribaid	Madhupur	Rajabari	National Park	Tangail
Pirojpur	Madhupur	Charaljani	Arankhola	Tangail

Figure 3.2: Forest administrative boundary and associated attributes

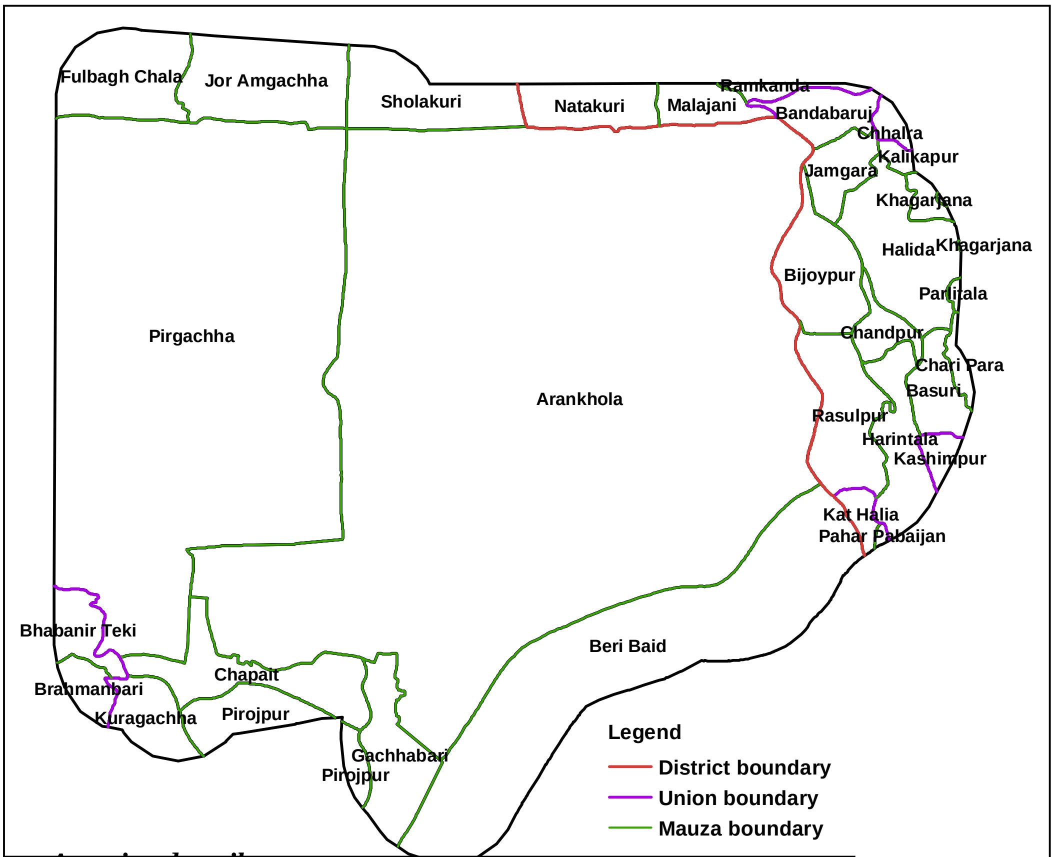
3.4 Administrative boundaries

The information on the administrative boundaries collected from CEGIS was used for NSP GIS dataset. The administrative boundaries have been clipped according to the MNP boundary. The spatial boundaries and the attribute information are shown in Figure 3.3. The basic attribute information in the database contains:

- Division name and number
- District name and number
- Upazilla name and number

- Union name and number
- Mauza name
- 1991 census geocode from BBS.

These layers also include different identification numbers for each of the hierarchies of the administrative unit.



UNICODE	DIVNAME	DISTNAME	THANAME	UNINAME	MAUZNAME	JL_NO
3935719	Dhaka	Tangail	Madhupur	Arankhola	Pirojpur	223
3935719	Dhaka	Tangail	Madhupur	Arankhola	Pirojpur	223
3935719	Dhaka	Tangail	Madhupur	Arankhola	Kuragachha	215
3935776	Dhaka	Tangail	Madhupur	Madhupur	Brahmanbari	113
3935719	Dhaka	Tangail	Madhupur	Arankhola	Gachhabari	224
3935719	Dhaka	Tangail	Madhupur	Arankhola	Chapait	222
3935776	Dhaka	Tangail	Madhupur	Madhupur	Bhabanir Teki	216
3616525	Dhaka	Mymensingh	Muktagachha	Daogaon	Pahar Pabaijan	193
3616525	Dhaka	Mymensingh	Muktagachha	Daogaon	Kat Halia	192
3935719	Dhaka	Tangail	Madhupur	Arankhola	Beri Baid	225
3616551	Dhaka	Mymensingh	Muktagachha	Kashimpur	Kashimpur	197
3616543	Dhaka	Mymensingh	Muktagachha	Ghoga	Harintala	227
3616543	Dhaka	Mymensingh	Muktagachha	Ghoga	Basuri	226
3616543	Dhaka	Mymensingh	Muktagachha	Ghoga	Rasulpur	228

TNODE1	LPOLY1	RPOLY1	LINE_	LINE_ID
2	1	2	1	11
4	2	1	2	16
5	3	1	3	16
2	2	1	4	16
7	3	1	5	16
8	1	3	6	11
4	1	2	7	11
10	2	3	8	14
9	1	2	9	16
7	1	3	10	16
6	2	1	11	16
11	1	2	12	16
15	3	1	13	15

Figure 3.3: Spatial administrative boundaries and associated attributes

3.5 Settlements

From the Figure 3.4 it is clear that the settlement pattern developed by CEGIS is consistent with the QuickBird image. Settlement pattern of MNP were extracted from CEGIS settlement database and corrected using the georeferenced QuickBird image. The settlements are in a shape file. The shape file contains spatial data and attribute information including village or para names.

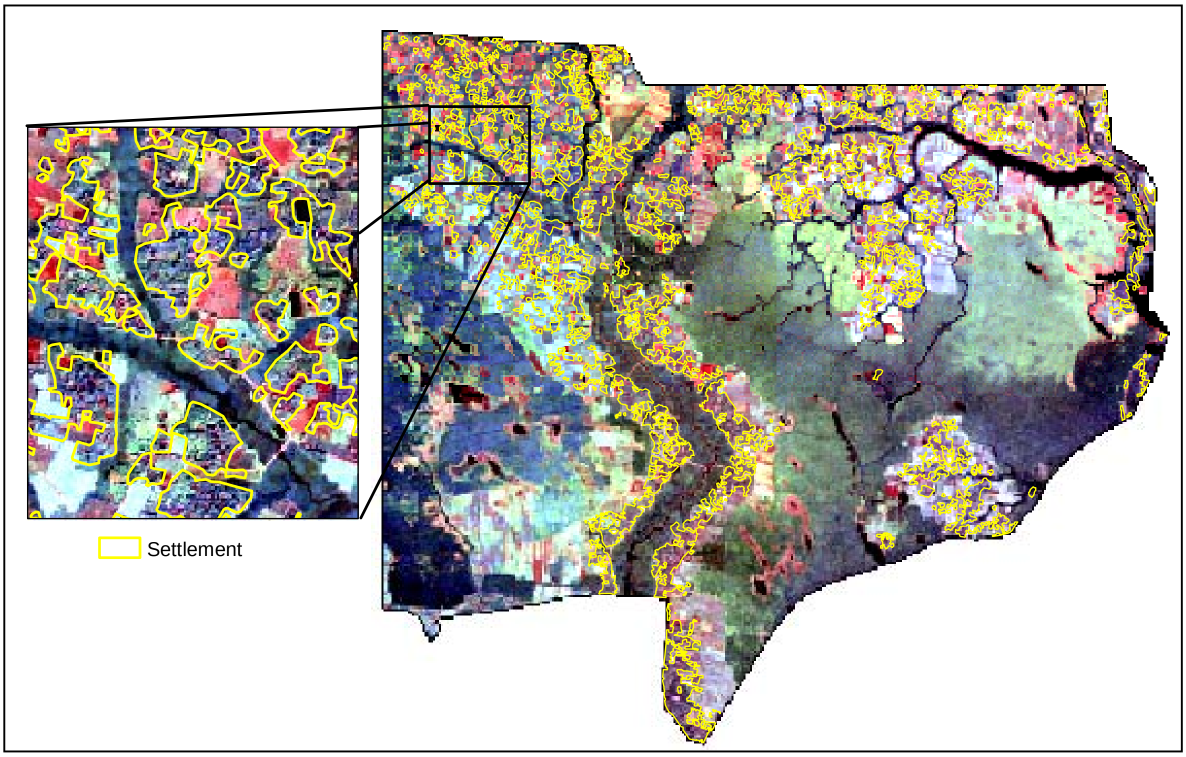


Figure 3.4: Settlement pattern in MNP

3.6 Roads and railway network

Roads

The road network in and around the MNP was identified from images as well as during the field survey and subsequently both were compiled together. roads inside the forest were surveyed using DGPS. From the data it is seen that there is only one national highway, which passes through the southeastern boundary of the MNP, and no regional highway within the MNP. The roads are mostly rural (kutcha) roads. They match well with the satellite image.

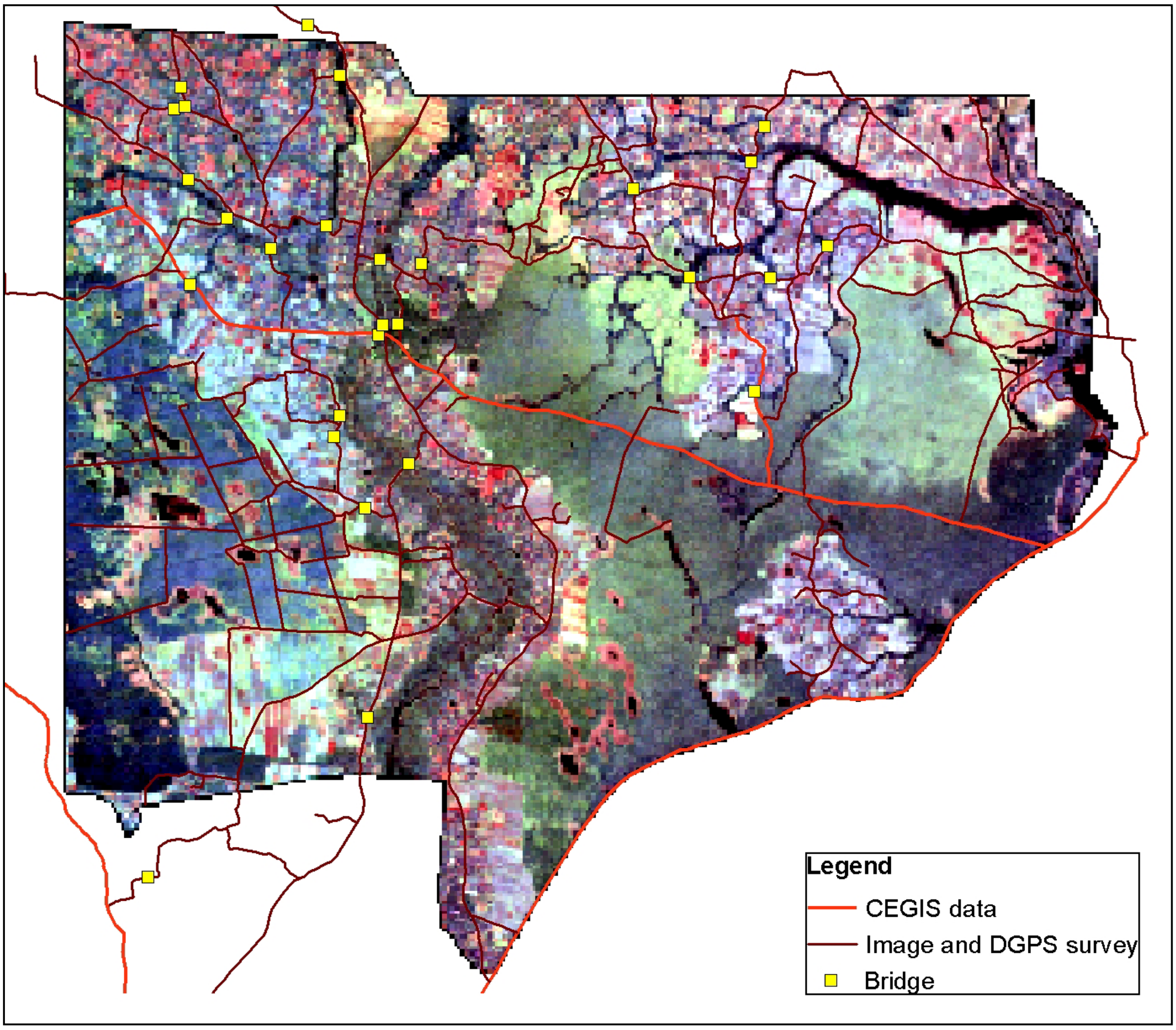


Figure 3.5: Road network in MNP developed from different sources

Railway network

There is no railway network within the MNP and within its one km buffer area.

3.7 Rivers

A spatial dataset of river network was developed by combining various sources. The available sources were CEGIS, LGED and RIMS. In addition data was collected from satellite images and DGPS survey. The river network is shown in Figure 3.6

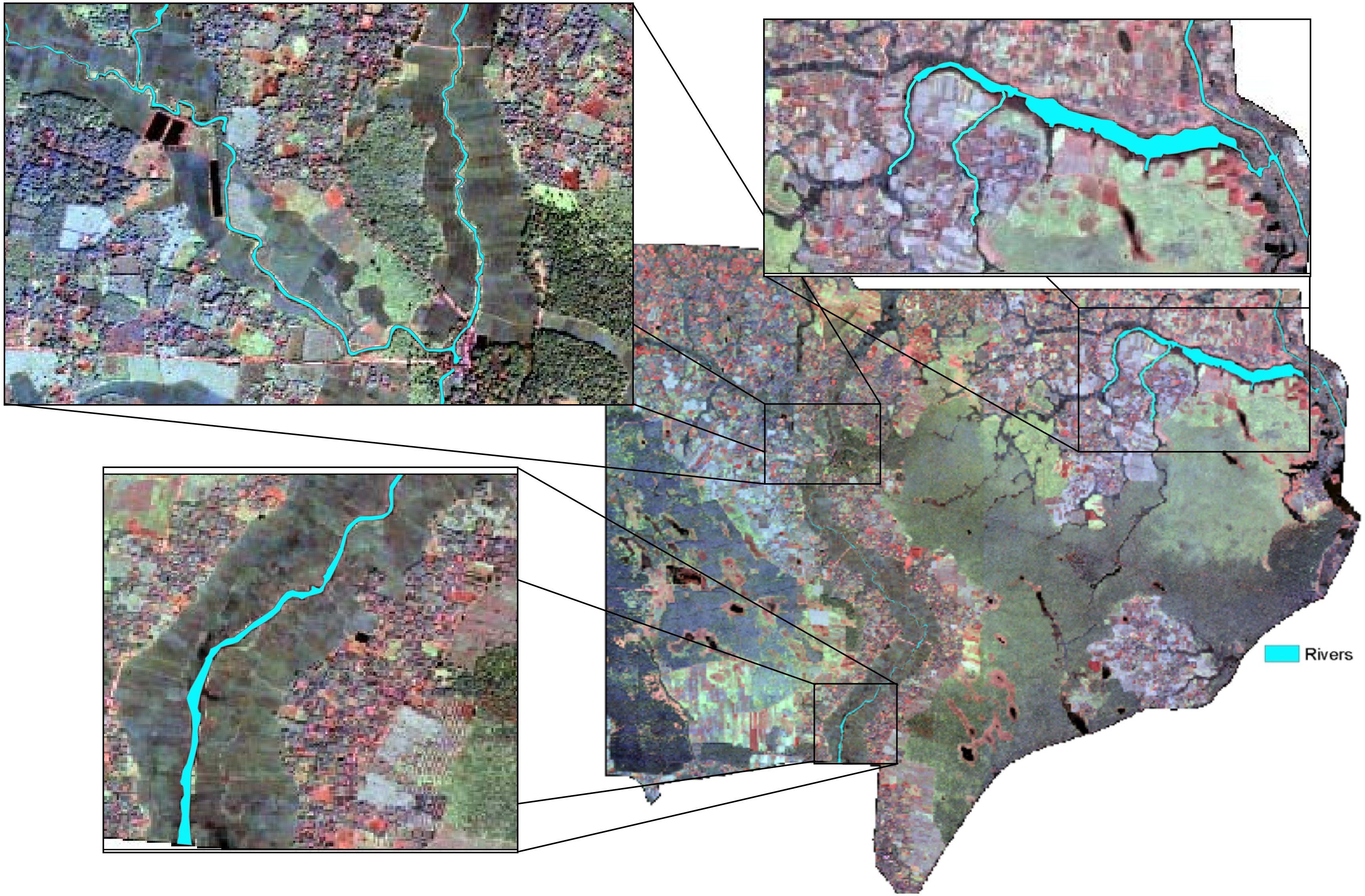


Figure 3.6: Rivers of MNP

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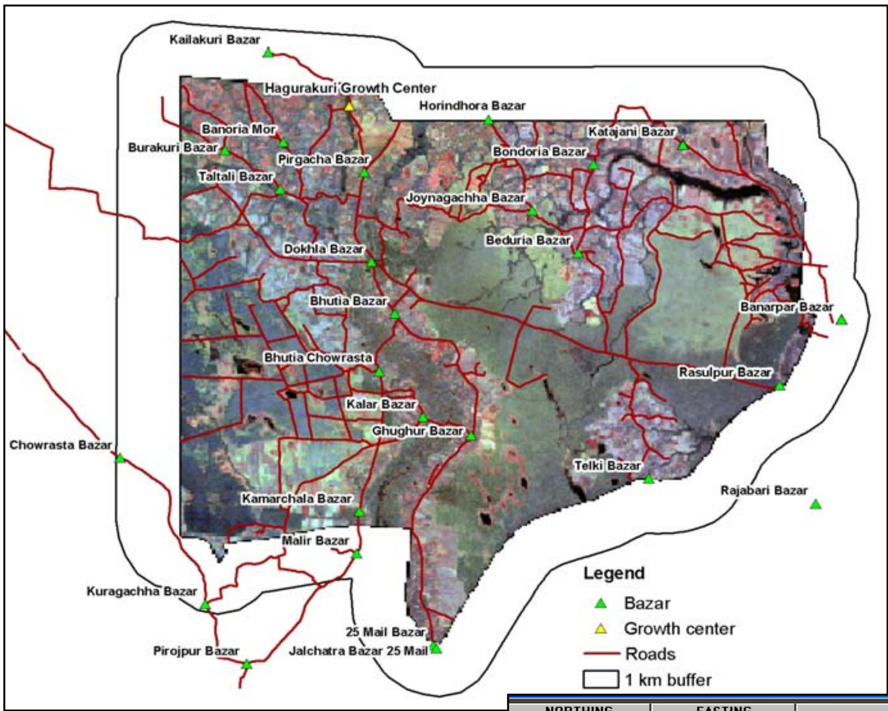
3.8 Growth centers and bazars

Extensive field visits were carried out in the buffer area of MNP to collect information on growth centers and bazars by using DGPS. During fieldwork, positions of the growth centers and small hat/bazaars were taken along with the detailed description of the same. These detailed descriptions have been linked with the spatial data as attribute information as shown in Figure 3.7. The attribute data includes

- Latitude, longitude
- Type of growth center (growth center/bazaar/small hat bazaar)
- Remarks (name)



Associated database

NORTHING	EASTING	REMARKS	TYPE	User_id
729692.168	507960.981	Kalar Bazar	Bazar	11
725095.762	504725.16	Pirojpur Bazar	Bazar	11
727149.6	506735.391	Malir Bazar	Bazar	11
726205.633	503963.656	Kuragachha Bazar	Bazar	11
728935.397	502398.557	Chowrasta Bazar	Bazar	11
730549.237	507154.413	Bhutia Chowrasta	Bazar	11
727933.048	506788.767	Kamarchala Bazar	Bazar	11
728083.357	515150.313	Rajabari Bazar	Bazar	11
725442.594	508146.494	25 Mail Bazar	Bazar	11
731608.609	507435.037	Bhutia Bazar	Bazar	11
729345.757	508851.226	Ghughur Bazar	Bazar	11
725384.328	508198.009	Jalchatra Bazar 25 Mail	Bazar	11
728553.955	512092.837	Telki Bazar	Bazar	11
731516.239	515624.621	Banarpar Bazar	Bazar	11
730290.907	514493.937	Rasulpur Bazar	Bazar	11
731503.981	515625.096	Banarpar Bazar	Bazar	11
734777.078	512726.902	Katajani Bazar	Bazar	11
735015.128	511288.46	Ponamari Natun Bazar	Bazar	11
734396.894	511082.215	Bondoria Bazar	Bazar	11
735033.698	511261.521	Nutun Bhanguni Bazar	Bazar	11
734764.323	512722.435	Katajani Bazar	Bazar	11
732742.02	510796.864	Beduria Bazar	Bazar	11
734660.617	504329.315	Burakuri Bazar	Bazar	11
0	0	Taltali Bazar	Bazar	11

Figure 3.7: Surveyed growth centers and bazars in MNP

3.9 Offices, educational institutes, public institutes

Extensive field visits were also carried out to collect information on offices (Figure 3.8), educational institutes (Figure 3.9), and public institutes (Figure 3.10) using DGPS. During fieldwork, positions of the offices, educational institutes and public institutes were taken along with detailed description. The descriptions have been linked with the spatial data as attribute information. The attribute data includes

- Latitude, longitude
- Type (Beat office, range office, NGO, training center, educational institutions, hospitals etc.)
- Remarks (name)

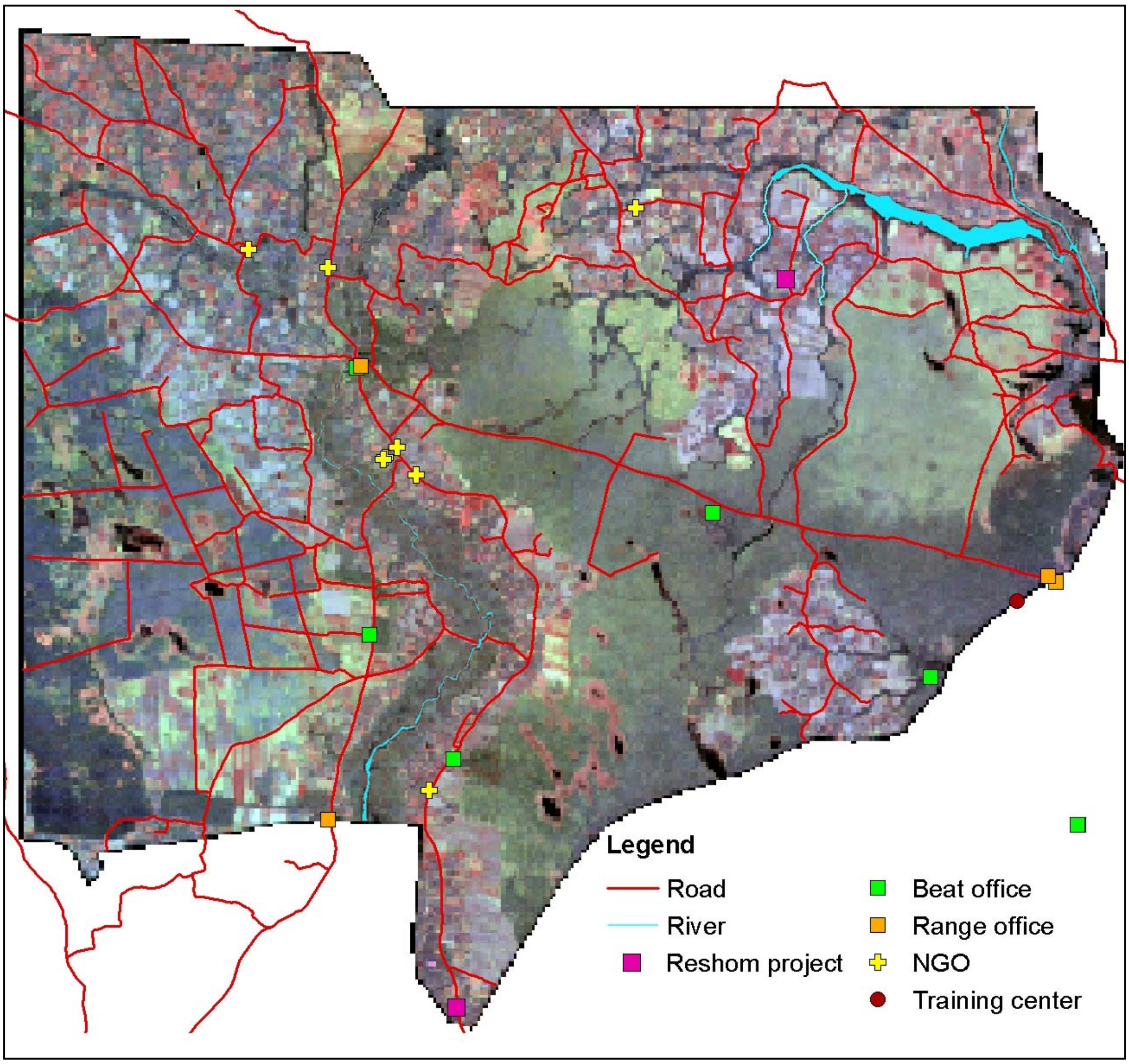
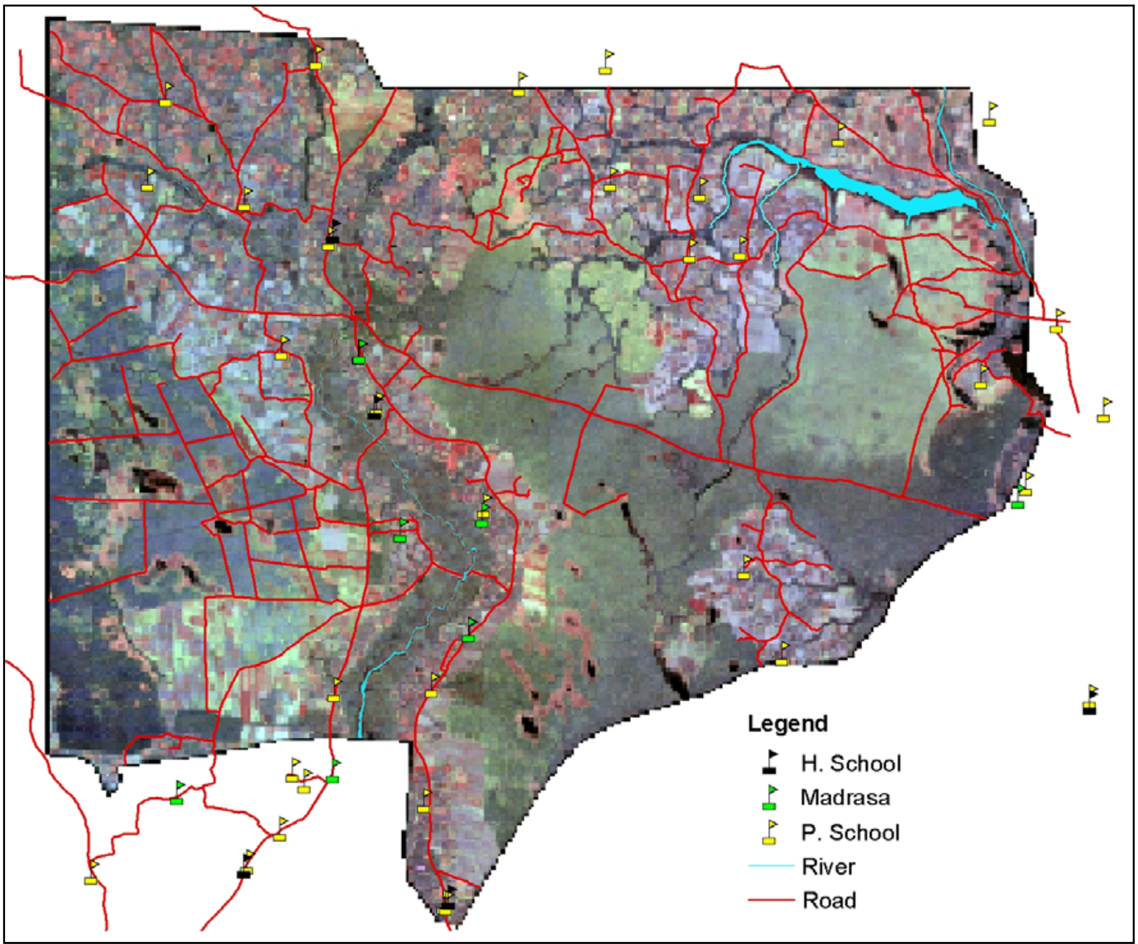


Figure 3.8: Location of offices in MNP



REMARKS	NORTHING	EASTING	TYPE	User_id
Arankhola Dakhil Madrasha	730076.406	507603.867	Madrasa	22
Madrasha	727277.156	506812.777	Madrasa	22
Chapaid Sub-Programetic Primary School	727277.156	506812.777	P. School	20
Chapaid Cathelic Mission Primay School	727286.247	506348.951	P. School	20
Seven-Day Advantic Missionary School	727298.538	506351.778	P. School	20
Mominpur Pirgachha Ideal Secondary School	727064.286	505025.252	P. School	20
Pirojpur Govt. Primary School	726220.969	505817.586	P. School	20
Ramjiban Sreeti High School	726174.988	505784.886	H. School	21
Kuragachha Gov. PS	726101.796	504008.018	P. School	20
Chapaid Alia Madrasa	727025.538	505008.958	Madrasa	22
Angaria Gov. Primary School	734230.661	499598.745	P. School	20
BRAC School	728219.297	506834.32	P. School	20
School	725751.627	508104.591	P. School	20
Missionary School	726925.936	507930.46	P. School	20
Ghachhabari Gov. PS	728269.806	507983.762	P. School	20
Pahar Pabaijan Gov.Primary School	728132.982	515603.528	P. School	20
SKM High School	728077.624	515606.321	H. School	21
Korpos Krishti Primary School	725743.11	508129.021	P. School	20
Korpos Krishti High School	725804.691	508162.684	H. School	21
Dakhil Madrasa	728913.48	508407.33	Madrasa	22
ST Francies Primary School	729645.494	511597.308	P. School	20
Dhaka KG School	728636.95	512036.615	P. School	20
Amlitola Reg.Primary School	730338.368	508573.151	P. School	20
Amlitola Madrasha	730252.325	508553.577	Madrasa	22

Figure 3.9: Location of educational institutions in MNP

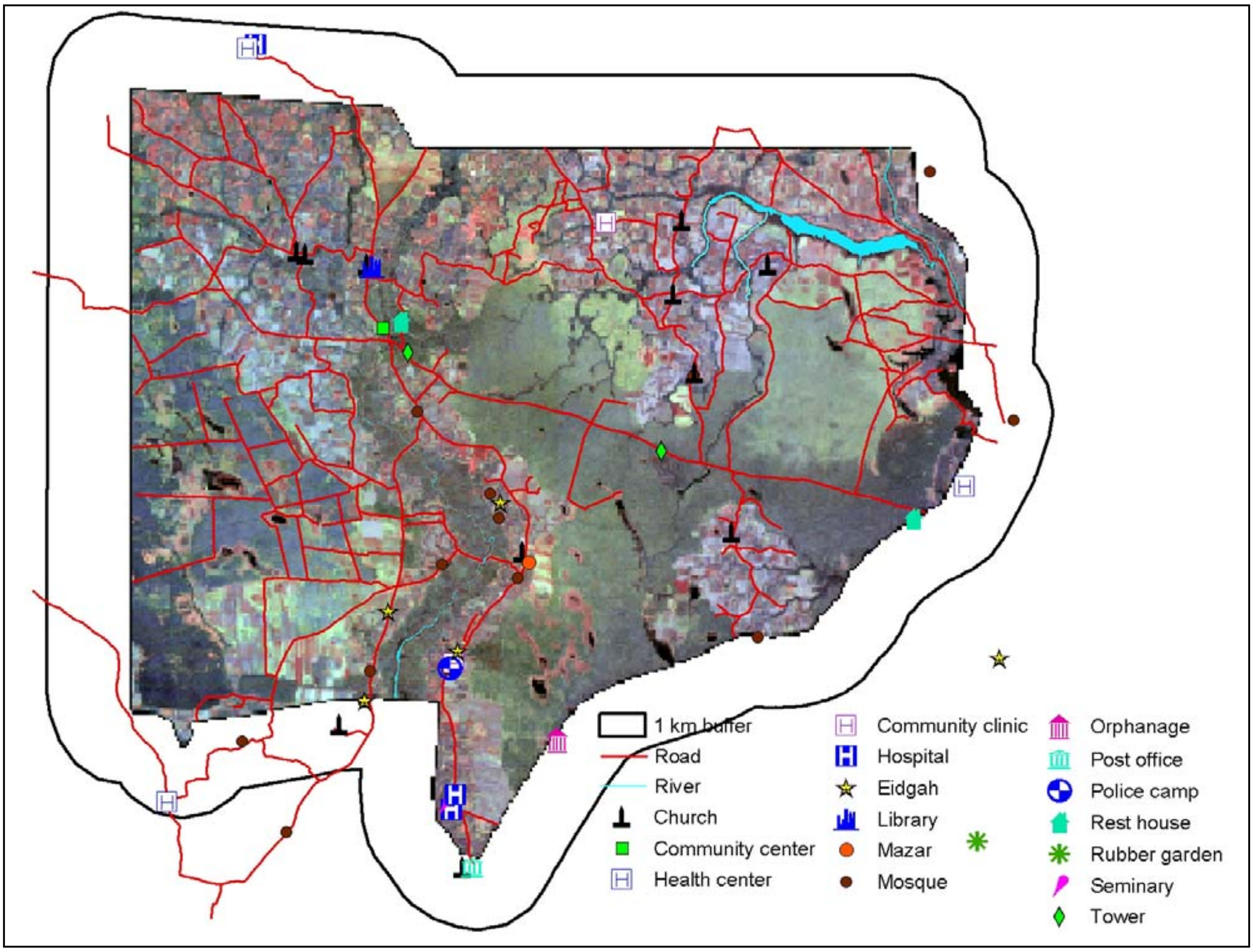


Figure 3.10: Public institutions in MNP

3.10 Villages

Village names were collected during the field visit. Discussions were made with the local people for identifying the village boundaries and respective names as shown in Figure 3.11. It is to be noted that the village boundaries and their names were not available in any database and hence they area based on the discussions as mentioned above.

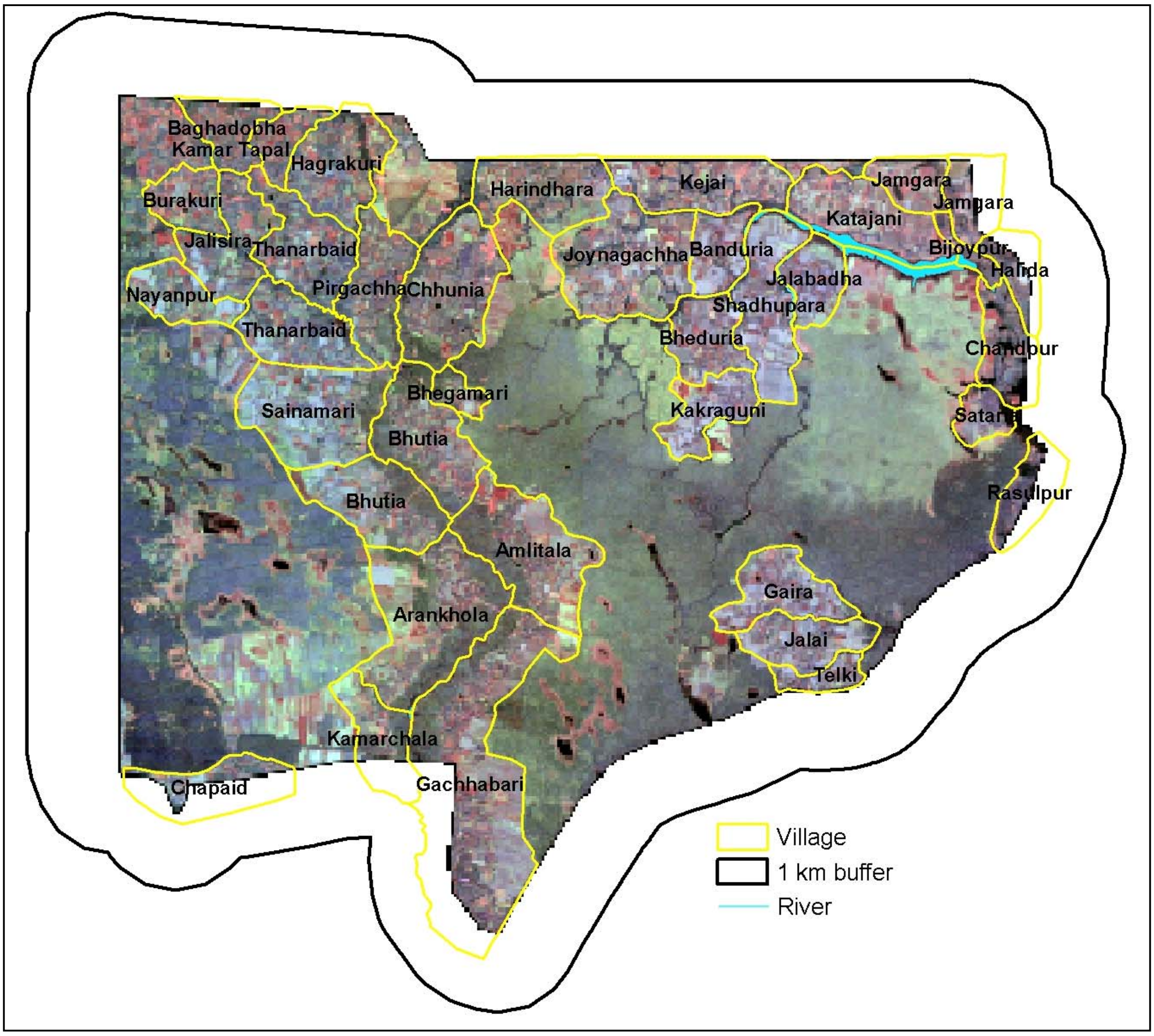


Figure 3.11: Village boundaries and names