

GEOSPATIAL DATABASE FOR PROTECTED AREAS OF NISHORGO SUPPORT PROJECT (NSP)

**Dated
December, 2005**



Center for Environmental and Geographic Information Services

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Acronyms

AOI	Area Of Interest
AST	Agricultural Sector Team
BARC	Bangladesh Agricultural Research Council
BBS	Bangladesh Bureau of Statistics
BIWTA	Bangladesh Inland Water Transport Authority
BPDB	Bangladesh Power Development Board
BRRI	Bangladesh Rice Research Institute
BTM	Bangladesh Transverse Mercator
BWDB	Bangladesh Water Development Board
CARE	Co-operation for American Relief Everywhere
CEGIS	Center for Environmental and Geographic Information Services
DGPS	Differential Global Positioning System
DLRS	Department of Land Record and Survey
EGIS	Environment and GIS Support Project for Water Sector Planning
ETM	Enhanced Thematic Mapper
FAO	Food and Agriculture Organization (A division of the United Nations)
FAP	Flood Action Plan
FD	Forest Department
GCP	Ground Control Points
Geocode	Geographic Area Code
GIS	Geographical Information Systems
GOB	Government of Bangladesh
GPS	Global Positioning System
HQ	Head Quarter
IKONOS	Satellite-based imagery acquisition systems, 4m multi spectral and 1m panchromatic
IRG	International Resources Group
IRS	Indian Remote Sensing Satellite
LANDSAT	Satellite-based imagery acquisition systems
LGED	Local Government Engineering Department
MPO	Master Planning Organization
MS	Multi Spectral
MSI	Multi-Spectral Imager

NSP	Nishorgo Support Project
NWRD	National Water Resources Database
PA	Protected Area
PAN	Panchromatic
PAT	Polygon Attribute Table
RHD	Road and Highway
RIMS	Resource Information Management System
SHP	Shapefile
SoB	Survey of Bangladesh
SPOT XS	Multi spectral SPOT imagery from the HRV sensor
SPOT	System Pour Observation de la Terre
SRDI	Soil Resource Development Institute
TM	Thematic Mapper
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
WARPO	Water Resources Planning Organization

Chapter 1

Introduction

1.1 Introduction

The Nishorgo Support Project (NSP) of the Forest Department (FD) launched in 2004 is engaged in establishing co-management in 6 Protected Areas (PA) in Bangladesh. The project will develop a formal co-management mechanism between FD and the stakeholders at the PAs. In addition the project will also improve the management of the PAs. For improved management a prerequisite is to build an accurate database on different management issues, natural and socio-economic dimensions.

Under these circumstances it is necessary to develop a consistent GIS database from the existing data and to improve the accuracy of the existing GIS data layers, which are derived from different sources from different organizations. The GIS database will be used by the Forest Department for various activities and also to develop Base Maps suiting their purpose.

Nishorgo has requested CEGIS to prepare the basic GIS database to be used for different activities along with preparation of Base Maps of the 6 PAs. The GIS database were developed in two phases:

The Design Phase

The Preparation Phase

This is a report on the activities carried out in the Preparation Phase.

The Design Phase was conducted during June 2005 to August 2005. The objective of the Design Phase was to collect data from different organizations, make a comparative statement, prepare a cost and time estimation for improving the data quality. To fulfill the objectives all the data were collected from the different sources namely LGED, CGIS, NWRD, RIMS. These GIS data layers were compared and an assessment was made of how much time and cost would be involved for doing the necessary corrections and adjustments. Subsequently in the Preparation Phase the necessary adjustments and corrections were done to the GIS data layers. Field verification of the data was also done where required.

1.2 Objectives of the Preparation Phase

The main objectives of the Preparation Phase are to

- i. Develop a consistent GIS database from the existing data focusing on infrastructure, settlement, administrative boundaries, various important location which were collected in the Design Phase from various organizations namely LGED, CEGIS, NWRD, RIMS
- ii. Improve the potential accuracy of the data quality through applying different GIS techniques
- iii. Prepare a Report and archive document.

1.3 Study area

In addition to the 6 PA boundaries, NSP's activities are involved in 5 kilometer buffer area of each of the PA boundaries of the Forest Department. Therefore the study area comprised of 5 kilometer buffer area of each PA. Figure 1.1 shows the location of the PAs with 5 kilometer buffer area. Table 1.1 shows the total areas of the PAs, area of the 5 kilometer buffer and areas within Bangladesh. The 6 PAs under the NSP project considered under this phase are:

- Lawachara National Park
- Satchuri National Park
- Rema-Kalenga Wildlife Sanctuary
- Chunati Wildlife Sanctuary
- Teknaf Game Reserve
- Sitakundu Eco-park

Table 1.1: PA area with 5 km buffer (in ha)

Name of PA	Area of PA (ha)	Area of PA with 5 km buffer (ha)	Area of PA with 5 km buffer inside Bangladesh (ha)
Lawachara National Park	1,221	18,310	18,310
Rema-Kalenga Wildlife Sanctuary	1,785	23,201	13,322
Satchuri National Park	565	14,640	9,422
Chunati Wildlife Sanctuary	8,444	41,447	41,447
Teknaf Game Reserve	11,445	54,490	44,365
Sitakundu Eco-park	1,635	19,118	19,118

1.4 Data sources

In the Design Phase data was collected from various sources and an accuracy assessment was made among the data. Among the organizations CEGIS, LGED, NWRD, RIMS data are used. Table 1.1 shows on the various GIS data sources. With the help of fieldwork and IRS image the accuracy of these collected data were improved for the Forest Department for developing the Base Maps.

Table 1.1: Data sources

Organization	Name of the layers
CEGIS	IRS image reference layer
	Administrative boundaries
	Settlements
	Road network
	Railway network
	Data collected through field visit
NWRD	Road network
	Railway network
LGED	Road network
	Growth centers
	Educational institutes, community and public institutes
	Drainage network
	Settlements
Forest Dept	Forest vegetation layer
	Road, rivers
	Various forest related offices
	Protected Area (PA) boundary

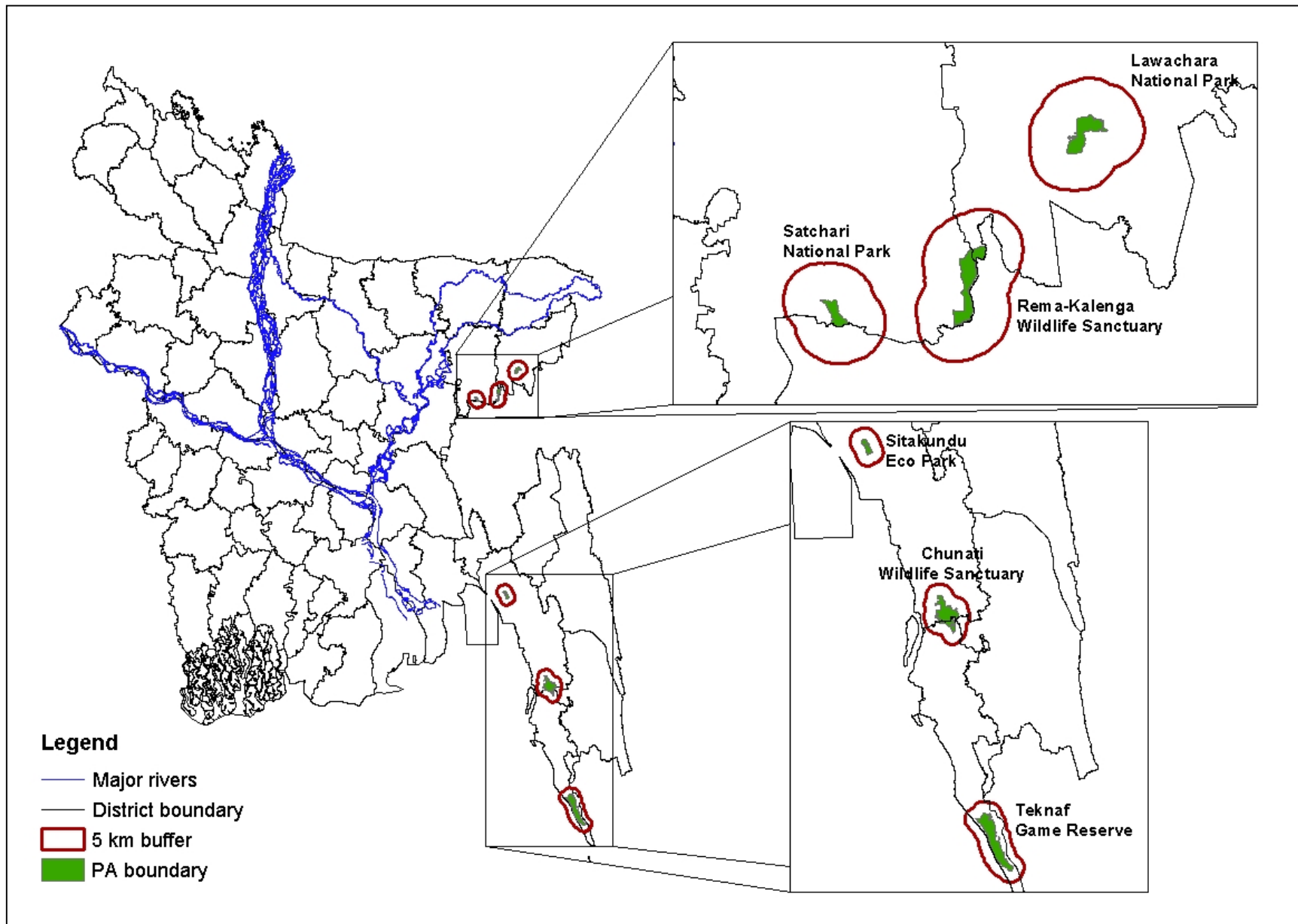


Figure 1.1: Location of the Protected Areas under NSP project

Chapter 2

Brief Methodology

2.1 Introduction

As mentioned in Chapter 1 the whole activity involved two phases. The Design Phase activities involved examining the various data sources and status of the datasets. The Design Phase Report contains short description of the GIS data layers and the activities to be adopted to improve the data quality. Based on the Design Phase report, the methodology for Preparation Phase was adopted are given in the subsequent sections.

2.2 Data layers

The following data layers were prepared for the 6 PAs. The description of the GIS layers is presented in detail in Chapter 3.

- DGPS corrected IRS image
- Protected Area (PA) boundary
- Forest administrative boundary
- Administrative boundary
- Settlements
- Roads
- Railway line
- River
- Growth center
- Educational institutes
- Forest and other office locations
- Health centers
- Others
- Vegetation
- Socio economic data

2.3 The Design Phase

In the Design Phase several steps were involved which lead into developing the layers for the Forest Department for preparing the Base Maps. In Figure 2.1 the steps involved in Design Phase are shown in a flow chart. Detail of the Design Phase is given in the Design Phase Report.

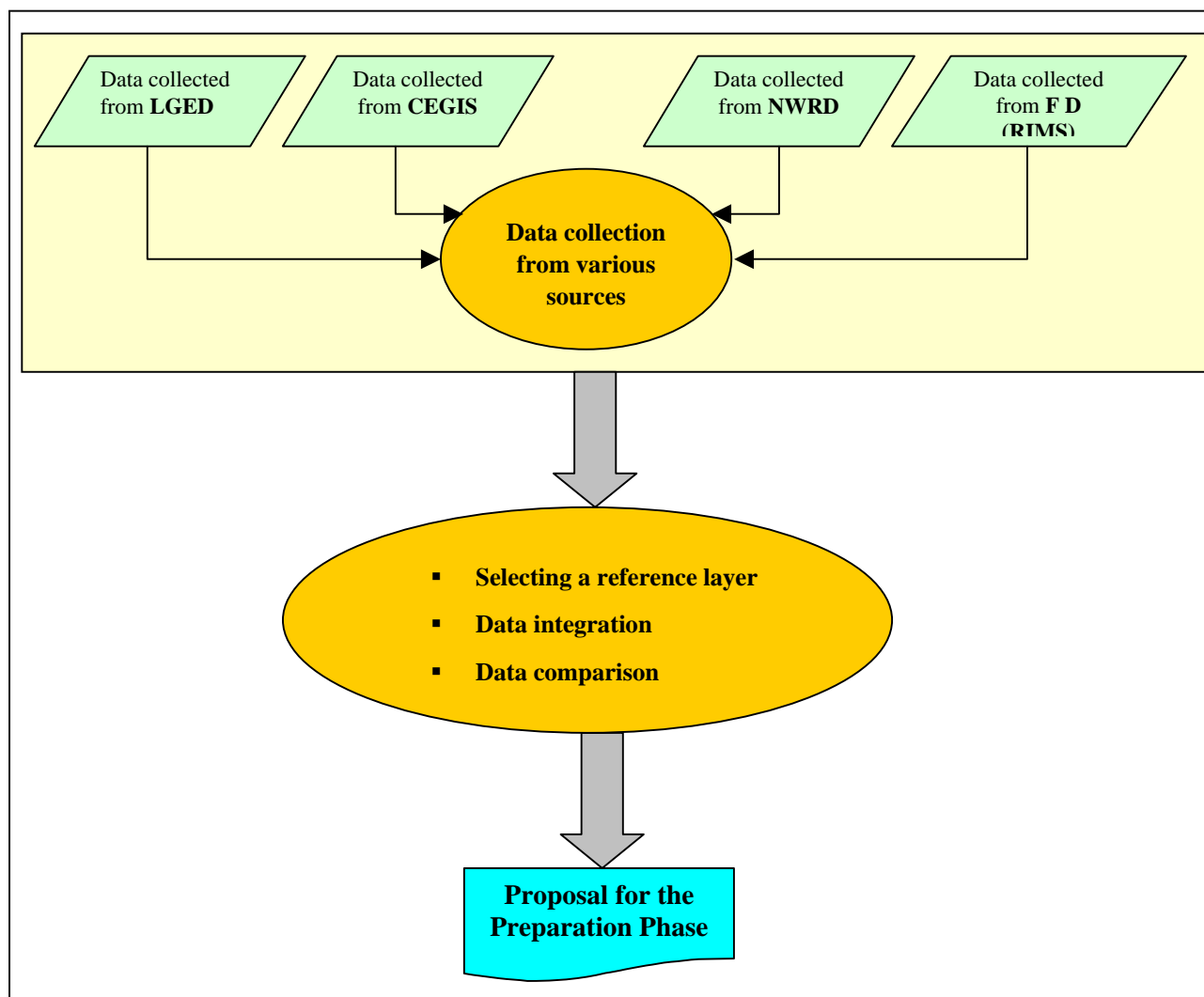


Figure 2.1: Flow chart showing all the activities and the processes involved in the Design Phase.

2.3.1 Data collection

The above-mentioned data was collected from various organizations namely LGED, CEGIS, NWRD and FD. Nishorgo carried out all necessary formalities such as getting permission to use the data and also to collect some of the data from various organizations.

2.3.2 Selecting a reference layer

In the Design Phase a reference layer was selected for the accuracy assessment of the other layers, which has been also used as a base and for calculating the deviation of the features of the various data layers.

After studying all the data sources it was decided that the IRS Panchromatic images of CEGIS would be used as the reference layer because of its high resolution and documented accuracy mentioned in the Design Phase Report and also in subsequent sections. Great care was taken to prepare this dataset so that it could be used for georeferencing other data layers in the future. They were georeferenced using ground control points, the coordinates of the GCP were collected using different GPS having accuracy of +/-2 meter. CEGIS has an archive of IRS images covering the whole country dating from 2000 onwards upto 2004. The pixel size of the IRS images is 6 meter x 6 meters. The accuracy of these images is +/-10 meters. All the images are in Bangladesh Transverse Mercator (BTM) projection system.

2.3.3 Data integration and comparison

All the collected data were integrated and they were compared. Both alignment and the data content were checked. All the GIS data were displayed layerwise, the accuracy was compared with the reference layer. Accuracy was also compared among the sources. For example, Road network data was collected from NWRD, CEGIS, LGED and RIMS. Keeping the IRS image as a backdrop all the roads were displayed and observations were noted. Based on these observations field visits were performed in the Preparation Phase. More detail can be found in the Design Phase report.

2.3.4 Field data collection

Fieldwork was done in one of the PAs ---- Lawachara National Park and the data collected from the field is used to verify the accuracy of the data collected from different sources. Here it may be noted that other fieldwork for the rest of the 5 PAs were done in the Preparation Phase.

2.3.5 Proposal preparation

Based on the data comparison, observations and other supporting information recommendations were made for the activities to be covered in the Preparation Phase. Recommendations were also made which data will be used to overlay the GIS database, which will serve the operations of NSP. The time and cost estimates were also assessed and presented in the proposal.

All recommendations of the Design Phase were discussed in detail by NSP and FD several times in several meetings. NSP and FD accepted the recommendations and the Preparation Phase activities started.

2.4 The Preparation Phase

The Preparation Phase had a span of two and a half months. In this phase the main activities were related to developing a consistent database, which the Forest Department can use to prepare Base Maps. These GIS database can be used in any GIS analysis. Figure 2.2 shows a flow chart of the activities involved in the Preparation Phase.

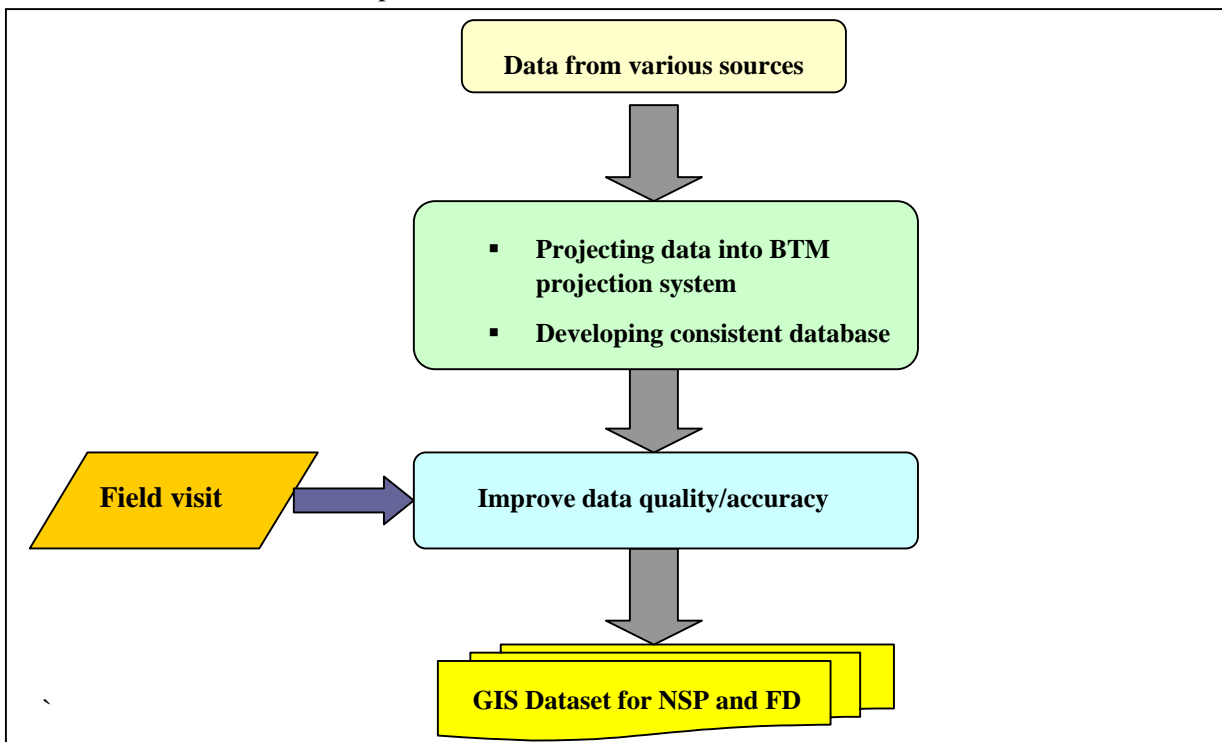


Figure 2.2 Flow chart showing all the processes involved in the Preparation Phase

2.4.1 Development of consistent database

The data collected from various sources in the Design Phase were studied and the inconsistencies between the datasets were identified. The inconsistencies were either corrected or new data was collected from the field and added in the dataset. The extensive fieldwork helped to improve the quality of the GIS data layers collected from various sources. DGPS corrected IRS images was also considered as one of the major sources for improving the quality of the collected datasets. Alignments of roads, rivers, settlements, railway lines were developed on the basis of field work as well as IRS image. In addition In some cases especially in the case of road, rivers, data collected from different sources was combined together to get an improved layer. All the datasets were projected into Bangladesh Transverse Mercator Projection system. All GIS data layers were made consistent both spatially and attributewise. This was done for all the PAs as well as the 5 km buffer areas.

2.4.2 Field work

Extensive fieldwork was done in the Preparation Phase of 5 PAs shown in Figure 2.3. Fieldwork of 1 PA (Lawachara National Park) was done in the Design Phase. DGPS survey was performed in the field to collect the coordinates of the sites. While collecting locational data for growth centers, health centers, education institutes, offices LGED data and RIMS data were used as base data. In addition detail description of the points were also collected. All these information are collated in the spatial database, which are described in detail in Chapter 4. In some cases roads and river alignments was also checked by taking DGPS coordinates. While developing the databases these coordinates were used. The detail information collected from the field was incorporated as attribute information in the respective GIS data layers. Here it may be mentioned that the CEGIS field team got all necessary logistical support from NSP. CEGIS field team tried to survey all the points but had to leave out a few due to accessibility problem. Annex –1 highlights on some of the field findings in the PAs.



Figure 2.3: Fieldwork in Teknaf with the support of NSP

2.4.3 Post field activities

After accomplishing extensive fieldwork in the PAs and their 5 km buffer zones, post field activities were undertaken to make the data usable for GIS analysis. The various GIS layers were generated by using different GIS techniques and GIS softwares. Each data layers were spatially and attributewise made consistent for NSP's use.

2.4.4 Report

At the end of the Preparation Phase a report is produced where the methodology and the datasets are discussed in detail. An archive document is also prepared describing the data layers and their attributes.

Chapter 3

Description of source data

In the Design Phase Report of August 2005(Chapter 6), it was recommended that the following data layers would be developed for NSP using the sources mentioned in Table 3.1. These recommendations were based on an investigation of Lawachara National Park data. It was also decided that DGPS corrected IRS images would be used as a reference layer for extracting features. Data from different sources are collected and used to develop the dataset for NSP. In the Preparation Phase some changes were made based on data availability and requirement of NSP. Description of these GIS data layer is present in the subsequent sections.

Table 3.1: Proposed outputs in the Design Phase Report

Layers	Data sources					Sources recommended
	RIMS	NWRD	CEGIS	LGED	CIMMYT	
1. National highway	✓	✓	✓	✓	✓	CEGIS
2. Regional highway	Not present in Lawachara National Park area					
3. Feeder road type A	✓	✓	✓	✓	✓	Combination of CEGIS, NWRD and LGED
4. Feeder rod type B		✓	✓	✓		Combination of CEGIS and LGED
5. Rural road	✓	✓	✓	✓		Combination of CEGIS, NWRD, LGED and RIMS
6. Railway line	✓	✓	✓	✓		CEGIS
7. Administrative boundary			✓	✓		CEGIS
8. Growth centers				✓		LGED
9. Education/ community and public institutes				✓		LGED
10. Settlements		✓	✓	✓		CEGIS
11. Drainage	✓	✓	✓	✓	✓	Combination of CEGIS, NWRD, LGED and RIMS
12. Vegetation	✓					RIMS
13. Socio-economic data						BBS

3.1 Reference layer

As mentioned in section 2.3.2 DGPS corrected IRS image was selected as a reference layer. A brief outline of how the IRS images were processed is given below.

3.1.1 Ground control points (GCPs)

GCPs are the identifiable points of a feature on images and also on the ground. As many GCPs as

possible were selected keeping a reasonable distribution over the image. The type of identified feature location in terms of stability, seasonal variation, visibility, sharpness influenced the accuracy of the GCPs. Accessibilities of the points, location of the point, image visibility are also taken into consideration. Possible choices included the corners of a medium to large size ponds, road and railroad intersection, embankment, large bridges, corner of a field and many more.

3.1.2 Field data collection

The location of the selected points was identified in the field with the help of field maps and other supporting maps. The coordinates of the GCPs are collected using DGPS and accordingly stored with other necessary attributes.

3.1.3 GCP Organization

All the collected information was down loaded from the DGPS and was saved district-wise. The editing and sorting out of good GCPs were conducted immediately after the completion of the survey. A GCPCODE was added which consists of the feature type, serial number finally the database files were added with the global database.

3.1.4 Using the surveyed GCPs for georeferencing

The GCPs are used in the raw IRS panchromatic images to georeference it to BTM projection.

3.1.5 Accuracy assessment of georeferenced IRS image using surveyed GCPs

For accuracy assessment the IRS images were compared with the DGPS surveyed locations. Some of the surveyed point locations were used as GCPs for georeferencing the images and the rest were used for investigating the accuracy assessment of the georeferencing activities.

3.2 Protected Area (PA) boundary

The only source for the PA boundaries is the RIMS database from Forest Department. The boundary of the Protected Areas was demarcated by traverse survey based upon Gazette Notification. The Gazette Notification dates are given in Table 3.2. It has not been updated since then. Forest Department has used their "Field Maps" to spatially capture them and develop the GIS databases. In Lawachara and Satchari the National Park boundary has been generated from the DGPS surveyed Gazette Notification. The boundaries do not coincide with natural features like foothills or administrative boundaries. Matches and mismatch between administrative boundary and the PA boundary are shown in Figure 4.1.

Table 3.2: PAwise Gazette notification dates

Name of PAs	Notification dates
Lawachara National Park	07, July 1996
Rema-Kalenga Wildlife Sanctuary	22 Dec 1981 07 July, 1996
Chunati Wildlife Sanctuary	18 March 1986
Teknaf Game Reserve	01.November 1983

3.3 Forest administrative boundary

The forest administrative boundary consists of Range boundary, Beat boundary and Block boundary.

Under each PA there are these boundaries which demarcates the different administrative units of the forest areas. Figure 4.2 shows some of the forest administrative boundaries. The forest administrative boundaries are only available in RIMS dataset.

3.4 Administrative boundaries

Administrative boundaries upto the mauza level is one of the requirements of NSP as part of the GIS data layers. The mauza is the lowest demarcated administrative unit in Bangladesh. There are several organizations who have developed the administrative boundaries upto the mauza level namely CEGIS and LGED. The administrative boundaries of NWRD is upto the union level. The RIMS data does not have any administrative boundary layer. The LGED dataset has some inconsistencies in shape and orientation which are now being taken care off by them. Therefore administrative boundaries of CEGIS was chosen for NSP database. The development process of the administrative boundaries of CEGIS are given below

Sources of data

To build the seamless mauza database the data and maps were collected and collated from the following sources

- Thana Maps in 1 inch = 1 mile scale published by DLRS excluding the Chittagong Hill Tracts
- Thana boundary Index Map in 4 miles = 1 inch scale published by DLRS for the Chittagong Hill Tracts
- 1991 census geocode file from BBS

DLRS Thana Maps excluding the Chittagong Hill Tract

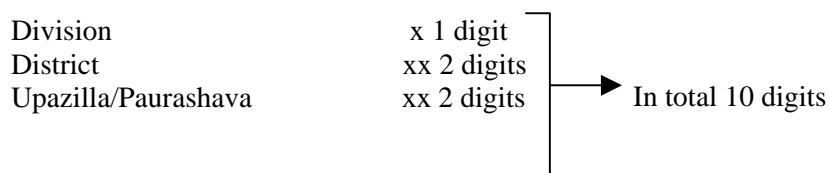
The only authentic source for constructing the seamless mauza database is the Thana Maps of DLRS in 1 inch = 1 mile (1:63360). These maps were prepared during different periods from 1905 to 1945. These maps are still being updated as and when new upazillas are created. But the splitting of upazillas and creation of new ones due to various administrative decisions are not properly updated. The physical changes taking place as a result of river meandering – erosion, accretion or char development are not updated in the maps. All these maps are in Cassinii projection system, which is similar to BTM projection system.

DLRS Thana boundary Index Map for the Chittagong Hill Tracts

No upazillawise map has been produced by DLRS for the Hill Tracts. The only available map is the Thana Index Map in 4 mile = 1 inch scale. The map consists of all the mauza boundaries of 25 upazillas of the Chittagong Hill Tracts together in one sheet. The map dates back to the 1960's. Furthermore, the map does not have any longitude/latitude graticules which could be used for georeferencing.

BBS 1991 census geocodes

BBS developed a standard Geographic Area Code (Geocode) for each mauza for identifying the mauza uniquely and to integrate various data series of a given area. As the 2001 census report was not yet officially published, the geocodes of 1991 were used in the mauza database. The following is a list of the geocode scheme assigned to different levels of administrative boundaries:



Union/Ward	xx 2 digits
Mauza/Mahallah	xxx 3 digits

To identify a mauza, all of the above-mentioned 10 digit geocodes are required. For example the geocode of the mauza, Kumra Kapan under Kamalganj upazilla is 6- 58 – 56- 38 - 501. The first digit identifies the Sylhet division, the 2nd and 3rd digits identify the Maulvibazar district, the 4th and 5th digits identify the Kamalganj upazilla, the 6th and 7th digits identify the Kamalganj union and finally, the last 3 digits 8th to 10th identify the Kumra kapan mauza.

Methodology

BARC developed a database of 300 upazillas where the administrative boundary upto the mauza level was spatially captured from the DLRS Thana Maps. EGIS and BARC came to an understanding that EGIS would cover the rest. Eventually, all would be mosaiced together to construct the intended seamless mauza boundary for the entire country. Digitizing was done using the Arc/Infos' Arc Edit module. For the Chittagong Hill Tracts a different digitizing technique was followed since the Index Map does not have any geographical reference. In the Polygon Attribute Table (PAT) of the mauza database a field named "geocode" was added where geocodes for all the mauzas were assigned. A separate database file was maintained with other additional information on mauzas i.e. division code and name, district code and name, upazilla code and name, union code and name, and finally mauza name and JL number. This database file was then linked with the relevant PAT with the common item "geocode". For mosaicing the roads were used for rubber sheeting the adjacent upazillas. Roads are stable features that do not shift like rivers. Common roads were identified from the Thana Maps, LGED/CARE road database and Topo sheets. Linking points were established between the roads, based on which the boundaries were adjusted. Thus a seamless administrative boundary upto the mauza level was developed shown in Figure 3.1.

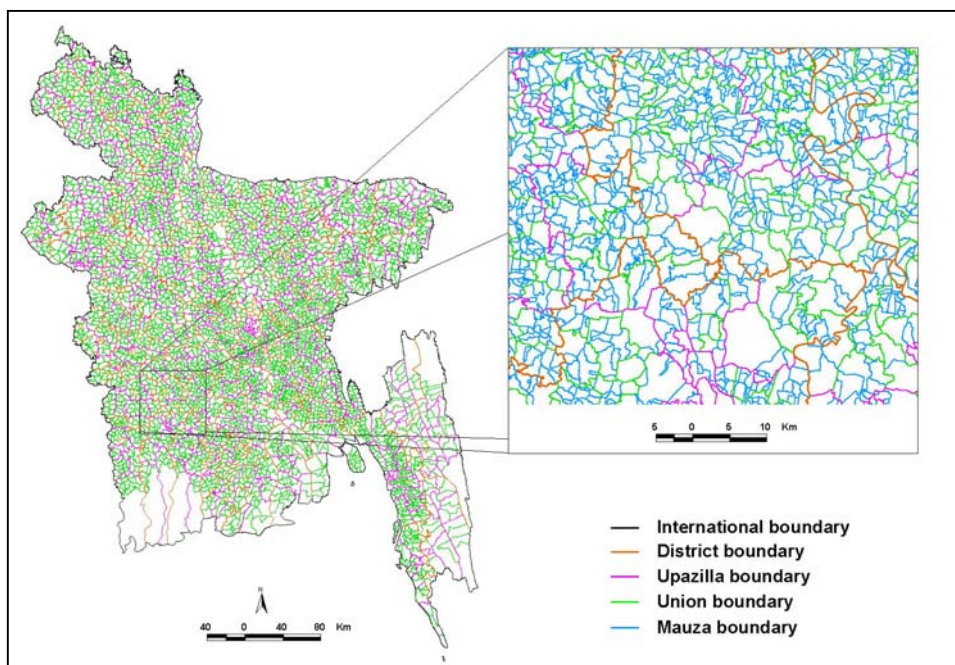


Figure 3.1: Seamless administrative boundary of Bangladesh developed by CEGIS

3.5 Settlements

Settlement is defined as a clustered area including (a) Houses, (b) Orchard/ Trees/ Fruit garden [vegetation], (c) Backyard (d) Homestead Pond around etc. and separated from agriculture land. In

other words a settlement is a contiguous area around rural house containing trees, nursery ground, garden vegetation and which is also separate from agricultural land. Sources of settlement pattern are CEGIS, LGED, and NWRD.

In CEGIS, settlements (Figure 3.2.B) have been extracted from the IRS panchromatic images with 6-meter resolution. The date of the IRS images ranges from the year 2000 to 2004 (Figure 3.2.A). The images are of dry season. The multi-spectral LANDSAT image of 30-meter resolution of 1997 has been used as guideline and a supporting image when settlement was difficult to identify. Using the above-mentioned IRS images visual interpretation was done to delineate the settlement boundary (mixed area having patches of very high and very low intensity). Visual assistance has been taken from the Landsat TM mosaic of 1997 with the backdrop of road and other necessary data layers. The scale while digitizing was 1:30,000. The minimum size of the settlement, which was captured, was 0.25 hectare.

From Figure 3.2.C, it is noticed that the LGED settlements do not match well with the IRS image therefore for NSP settlement from CEGIS is taken and is discussed here in detail. The other sources were discussed in detail the Design Phase report.

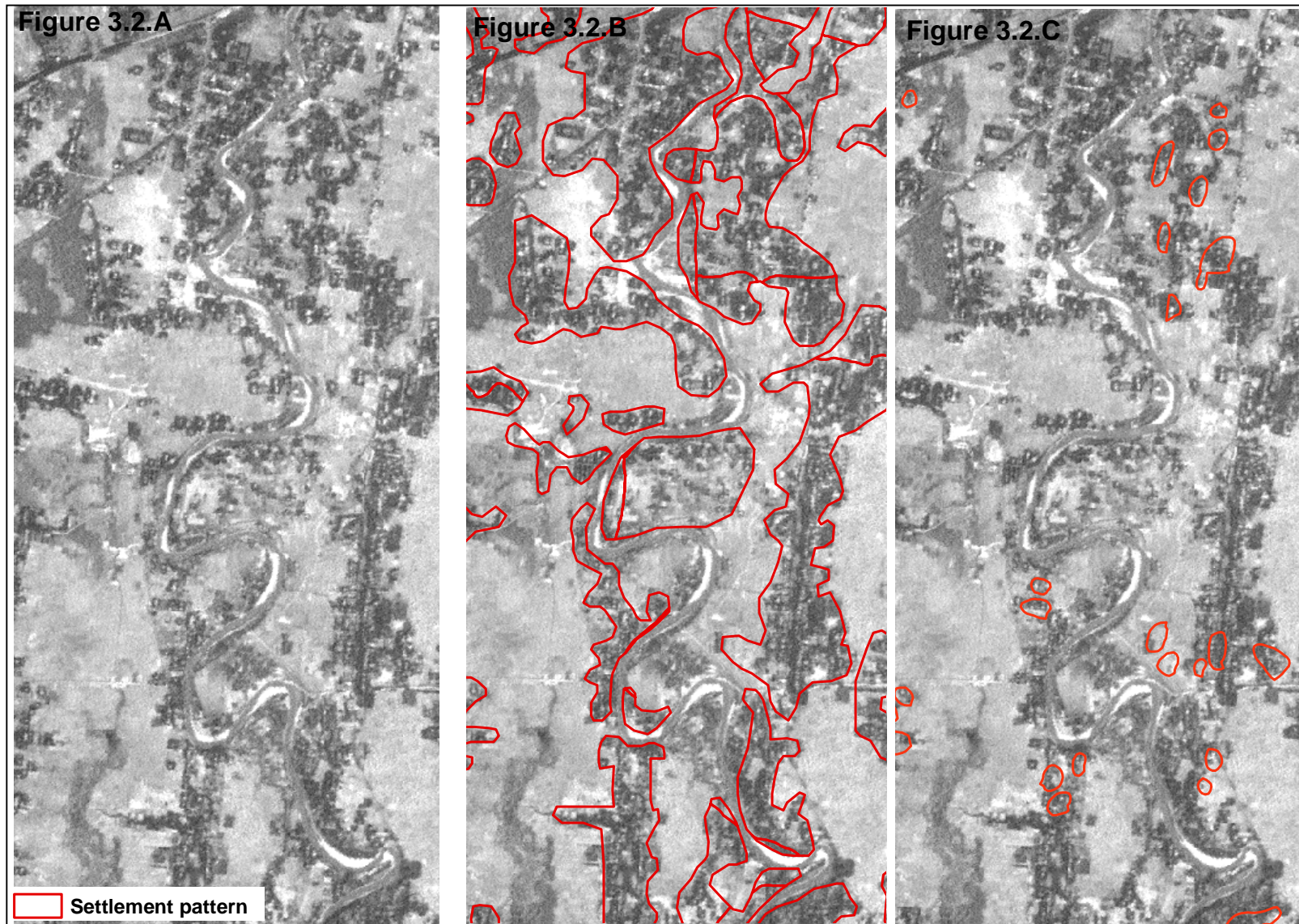


Figure 3.2: Inset A: Sample of an IRS image from where the settlement has been captured. Inset B: Settlements captured by CEGIS is overlaid on the IRS images. Inset C: Settlements captured by LGED is overlaid on the IRS image.

3.6 Road and rail network

The road network database has been developed by various agencies. Namely, Roads and Highways Department, NWRD, LGED-CARE, CEGIS and Forest Department. These organizations have developed roads upto various levels, some upto Feeder Road, some upto rural road and many more. The sources for the roads database are also different among the organizations. For NSP, roads from all the mentioned sources are combined as and when necessary. For National, regional road CEGIS has been considered as the source; they match well with the reference layer. As all the other detail roads (Feeder Road A, Feeder road B, Rural road) which are not totally covered in the CEGIS dataset and on the other hand which match well from other sources has been considered. As a result Feeder road A, Feeder road B, Rural road has been extracted from LGED, RIMS. Extensive fieldwork is also another source of information. Roads alignments were taken through DGPS and detail attribute information was gathered regarding the road type and surface. In the dense forest cover areas where the roads are not visible on the image, are taken from the RIMS and LGED dataset. Therefore for NSP the road dataset is a combination between various sources and GIS techniques.

3.6.1 Roads developed by CEGIS

Different organization such as CARE, LGED, Road and Highway (RHD) has the road database. But there is a lack of consistency between these databases because of the different sources. CEGIS has used the 6-meter resolution IRS image from its archive and extracted a detail road database upto R1 road type as shown in Figure 3.3. The database also includes the railway lines of Bangladesh. Table 3.3 shows a description of the various types of roads and railway lines.

Table 3.3: Description of various type of road

Road type	Description
Major roads	National and regional highways including feeder road type A. The road names are taken from the available road maps.
Rural roads	Rural Roads: All rural roads maintain by Local Government Engineering Department (LGED) visible in IRS panchromatic image, some from RIMS dataset and field survey. This includes Feeder Road <i>Type B</i> and Rural Road <i>Type R1</i> .
Railway lines	All railway line in Bangladesh both Broad Gauge and Meter Gauge

Methodology

A systematic methodology has been followed to develop these databases. Keeping the IRS images as a backdrop the road and rail database has been captured at a scale of 1:30,000 scale as the rails, roads (national, regional, Feeder road type A and B, Rural road R1) are visible at this scale. Help was also taken from the Topographic maps of Survey of Bangladesh while capturing the data from the IRS images.

The database

There are 5 different types of roads in the road database developed by CEGIS. The definition of the roads is taken from Bangladesh Transport Sector Study (Project BGD/89/086), Main Report Volume -1. In Table 3.4 the classification is highlighted. Figure 3.3 shows the spatial Road Database and its associated attributes covering some of the PA boundaries.

Table 3.4: Types of roads in the Road Database

Type	Definition	Reference
National Highway	Highways connecting National capital with Divisional HQs or seaports or land ports or Asian Highway.	Roads and Highway Department (RHD).
Regional Highway	Highway connecting district HQs or main river or land ports or with each other not connected by national highways.	Roads and Highway Department (RHD).
Feeder Road <i>Type A</i>	Roads connecting district HQs with upazillas HQs Road connecting one Upazila HQ to another Upazila HQ by a single main connection with national or regional highway through shortest distance.	Roads and Highway Department (RHD).
Feeder Road <i>Type B</i>	Road connecting Upazila HQs with Growth Centers. Growth center with another growth center by a single main connection. Connecting growth center to the national or regional or Feeder Road <i>Type A</i> .	Local Government Engineering Department (LGED)
Rural Road <i>Upto Type R1</i>	Roads connecting union HQs with Upazila HQs. Roads connecting growth center to local markets or with each other.	LGED

Several attributes are associated with road database e.g. length, surface, road type etc as shown in Figure 3.3. The detail list of attributes in road database is given in Table 3.5. Further road name were added into road data sets from the available information. The Rail and national level road name were incorporated from the road attributes available in National Water Resources Database (NWRD). Attribute from CARE and LGED road data has also been used for regional and rural roads. It can be mentioned that the sufficient road names were not available in those sources. Further the Topographic maps of SoB and Mauza database CEGIS have been used to add the road name.

Table 3.5: Attributes of Road Database

Field Name (item)	Attribute name and description	Remarks
Shape	Generated by GIS software	
Length	Field generated by GIS software to define the length	
From	Starting point or junction of road as defined by Roads & Highway Department (RHD)	
To	End point or junction of a road as defined by Roads & Highway department (RHD)	
Surface	Road surface condition e.g. metal or non metal (earthen) and this attribute is for feeder road <i>type B</i> and Rural road upto <i>type R1</i>	
Road Type	Road type or class as mentioned in Table 3.2	
ID	Unique identification number for each road generated by CEGIS.	
CEGIS_From	Starting point or junction of road as defined by CEGIS.	From Topographic maps of Survey of Bangladesh and Mauza database of CEGIS
CEGIS_To	End point or junction of road as defined by CEGIS.	From Topographic maps of Survey of Bangladesh and Mauza database of CEGIS
Road_name	Road name generated from <i>CEGIS_From</i> and <i>CEGIS-To</i> field (example: Kalikair – Tangail road)	

3.6.2 *Roads developed by LGED*

LGED has numerous GIS layers developed over time. The road layer of LGED is quite extensive. The database includes roads up to the rural level. The roads have been captured from the SPOT Image 1989-90, Aerial Photograph 1983-84, Topographic Maps, Thana Maps, and DGPS Survey (2000-2001). The Feeder road type B and the rural roads have been incorporated in the NWRD (Figure 3.4) but they were later on updated by LGED.

3.6.3 *Roads developed by NWRD*

Different types of roads are in the NWRD. They are National and regional highway, feeder road type A and B, rural roads. The sources for the various types of roads also vary from each other.

National and regional highway, feeder road type A

The national and regional highway, Feeder road type A has been incorporated in NWRD from the Roads and Highways Department. Parts of the highways were updated from the IRS image of 2000 onwards with 6-meter resolution.

Feeder road type B and rural road

The Feeder road type B has been collected from LGED. These roads were developed by using GPS and they cover the whole country. Under NWRD the digital copy was collected and appended to make a single database for the whole country.

3.6.4 *Roads developed by RIMS*

The RIMS database consists of some roads. Some of the roads are the internal roads, which leads into the forest. These roads are categorized by “Footpath”, “Road motorable”. These roads are taken from Topographic maps of SOB and Forestry Cover Maps of 1:15,840 prepared by Forestry Sector Project II, UNDP/FAO Project BGD/85/085.

3.6.5 *Rails developed by CEGIS*

Railway lines have also been captured from the IRS images by CEGIS. While capturing the railway lines from the IRS images help was also taken from the existing railway lines in the National Water Resource Database (NWRD).

3.6.6 *Railway lines*

Railway network of Bangladesh was captured by the AST (Agricultural Sector Team) This data layer has been updated in September 2000 by NWRD using recent Railway Maps collected from Bangladesh Railway. Furthermore NWRD has updated the location of the railway lines using IRS image of 2000 onwards and LANDSAT Image 1997.

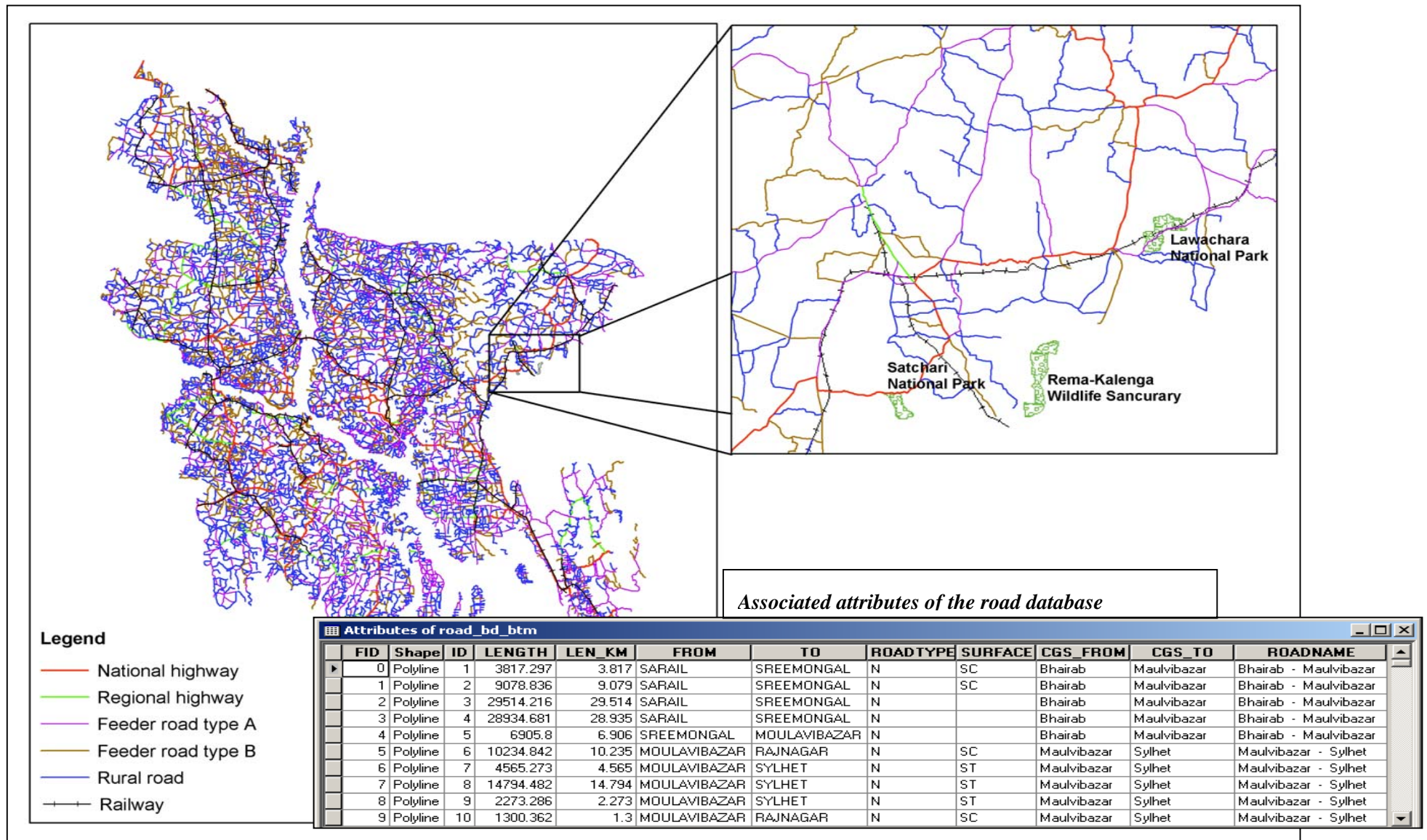


Figure 3.3: The Road Database of CEGIS

3.7 River network

For NSP river network from various sources has been taken. Rivers from NWRD, LGED and RIMS has been combined to make the layers for the PAs. Information from extensive fieldwork has also been added to develop the river network. The rivers from the above mentioned sources that matched well with the IRS images were kept. In addition extensive fieldwork was also done to get more details on the river courses. All these were combined and a dataset was developed for NSP using various GIS techniques.

3.7.1 River network from NWRD

This layer contains rivers, channels and khals of Bangladesh of NWRD (Figure 3.4). In EGIS-I the rivers were captured which are equal to or greater than 50 meter wide from SPOT multi-spectral image 1989 with 20m ground resolution. NWRD has captured the rivers of Chittagong region from LANDSAT TM image 1997 with 30 m ground resolution. Moreover NWRD has checked the other parts of the dataset and updated in accordance with the changed river courses using the same source. Nomenclatures have been attached according to the Toposheets published by SoB and other published maps of Bangladesh Inland Water Transport Authority (BIWTA) and Bangladesh Water Development Board (BWDB).

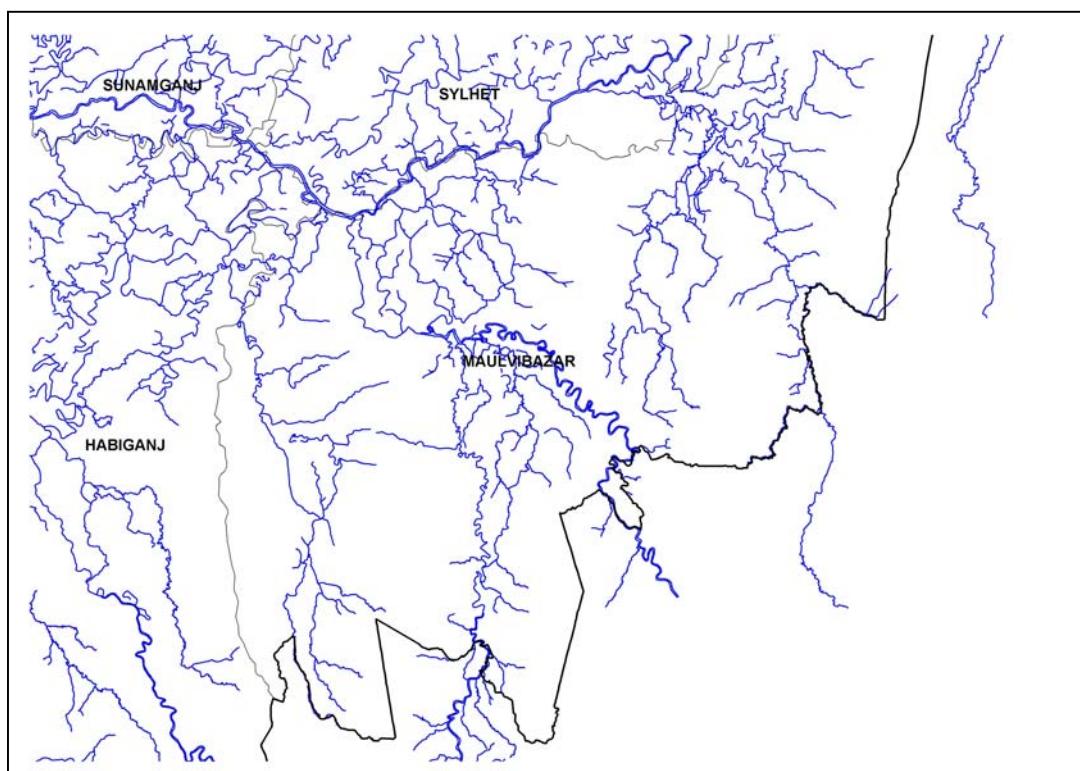


Figure 3.4: An example of the river network in NWRD (Moulvibazar district)

3.7.2 River network from LGED

The river network of LGED is quite extensive. The rivers have been captured from the SPOT Image 1989-90, Aerial Photograph 1983-84, and Topographic Maps. Figure 3.5 shows the river network of Moulvibazar district. The figure has been taken from LGED's website (http://www.icimod-gis.net/website/Lged/Moulvibazar_District/viewer.htm).

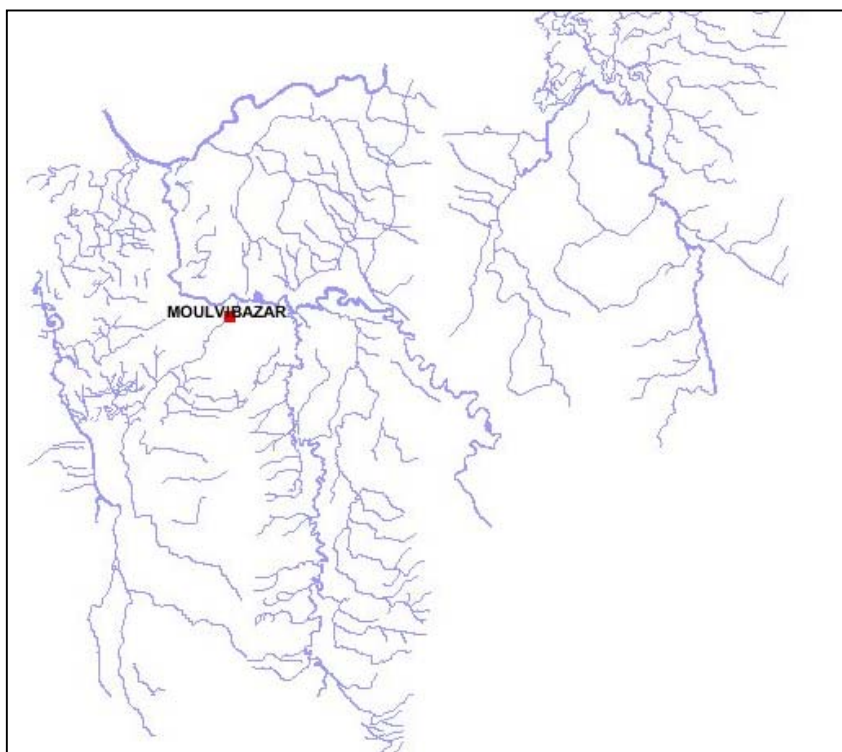


Figure 3.5: River network of Moulvibazar district of Sylhet in LGED database

3.7.3 Drainage network from RIMS

In the RIMS database there are some drainage network. Some of the networks are the creeks or khals inside the forest. These are taken from Topographic maps of SOB and Forestry Cover Maps of 1:15,840 prepared by Forestry Sector Project II, UNDP/FAO Project BGD/85/085.

3.8 Growth center and small hat/bazaars

Growth centers are those hat bazaars from where the government earns revenue. Among the sources only LGED has a database for growth center and small hat/bazaars of the whole country. NWRD growth center database is taken from LGED dataset. Other sources like CEGIS and RIMS do not have any information on this topic. Hence LGED has been chosen for growth centers and small hat/bazaars.

In the attribute of the LGED growth center dataset, there is one field named “TYPE”. In this field, identification numbers are assigned for growth centers and small hat/bazaars. But no additional information regarding their position (name of the place) or any other description is present. Figure 3.6 has an example of such LGED database. Keeping the LGED dataset as a base extensive field information has been collected to develop this dataset for NSP.

Attributes of kamal_pof_btm point							
	POF57601_	POF57601_I	\$POLYGONID	\$SCALE	\$ANGLE	TYPE	
	33		70	0	1	0	70
	34		70	0	1	0	70
	35		70	0	1	0	70
	36		70	0	1	0	70
	37		70	0	1	0	70
	38		80	0	1	0	80
	39		80	0	1	0	80
	40		80	0	1	0	80
	41		80	0	1	0	80
	42		80	0	1	0	80

Figure 3.6: Example of LGED growth center, small hat/bazar database

3.9 Educational institutes

In the educational institute database information related to the educational institutes are incorporated. Among the sources only LGED has database for education institutes. Other sources like CEGIS and RIMS do not have any information on this topic. NWRD has no spatial database, it is in tabular format where no locational information is present. Therefore information from LGED has been considered as a source in addition to extensive field operation.

The LGED database contains only the locations. In the attribute of the LGED dataset regarding education, there is one field named "TYPE". In this field, identification numbers are assigned for different types of education institutes (primary school, high school and many more). But no additional information regarding their position (name of the place) or any other description (name of the institute) is present. Keeping the LGED dataset as a base extensive field information has been collected to develop this dataset for NSP.

3.10 Offices

In the office database, information related to the different offices is incorporated. Only RIMS had the location of some of the institutes. These locations were verified in the field by DGPS and detail information was collected. The offices includes Range office, Beat Office, Rest House, NSP Office, Bhan Office, TNO Office, Union HQs, Post Office and many more. As a result different types of offices and their description are included in the present dataset developed for NSP, which covers 5 km buffer area of the PAs.

3.11 Health centers

In the health database, information related to the different types of health institutes are incorporated. Among the data sources only LGED database contains the locations. Other sources RIMS, CEGIS and NWRD do not have this kind of information.

In the LGED Health center database, information regarding hospitals and Family Welfare Centers are present. In the attribute of the LGED dataset regarding health centers, there is one field named "TYPE". In this field, identification numbers are assigned for different types of health centers (hospital and family welfare center). But no additional information regarding their position (name of the place) or any other description (name of the institute) is present. Other types of health centers are also not included in the LGED dataset. Keeping the LGED dataset as base extensive field information has been collected to develop this dataset for NSP.

3.12 Others

This database contains information regarding the location of other office sites or locations. For example, BDR check post, Buddhist temple, food godown and many more. In this database information related to their locations are incorporated. The locations were identified in the field by DGPS and detail information was collected which are incorporated in the attribute of the dataset. As a result different types of offices and their description are included in the present dataset developed for NSP, which covers 5 km buffer area of the PAs.

3.13 Vegetation

The vegetation layer has been taken from RIMS. Detail description of various types of vegetation is given in this layer.

3.14 Socio economic data

2001 census data of Bangladesh Bureau of Statistics has been digitally generated. Thanawise data of all the 6 PAs has been generated. Detail is provided in section 4.14.

Chapter 4

Description of GIS data for NSP

4.1 Introduction

In this report the description of the main output of the Preparation Phase is given. Anomalies, matches, mismatches are also presented in this chapter. Data collected from different sources were edited based on a reference layer. All the dataset were made consistent and the data are in GIS format and can be used in any GIS analysis. GIS software ArcGIS and ArcView have been used to develop the geospatial dataset for NSP. In future NSP can develop more based on these dataset and prepare base maps and perform other analysis as and when required. In Table 4.1 the data status and outputs are summarized. This is applicable for all the PAs. In Annex – 2 an archive document have been presented.

Table 4.1: Data summary table

Layers	Data sources				Remarks	Output format
	RIMS	NWRD	CEGIS	LGED		
1. Reference layer			✓		CEGIS	.IMG
2. PA boundary	✓				RIMS	.SHP
3. 5 km buffer area	✓				Generated based on PA boundary	.SHP
4. 5 km buffer area with international boundary	✓	✓			Generated based on PA boundary clipped by international boundary	.SHP
3. Forest administrative boundary	✓				Generated from “ Forest Vegetation” layer	.SHP
4. Administrative boundary			✓		CEGIS	.SHP
5. Settlement			✓		CEGIS	.SHP
6. Roads	✓	✓	✓	✓	All the sources and field data combined	.SHP
7. Railway line			✓		CEGIS	.SHP
8. River	✓	✓	✓	✓	All the sources and field data combined	.SHP
9. Growth center					Data collected from field	.SHP
10. Educational institute					Data collected from field	.SHP
11. Offices					Data collected from field	.SHP
12. Health centers					Data collected from field	.SHP
13. Others					Data collected from field	.SHP
14. Vegetation	✓				RIMS	.SHP
15. Socio economic data					BBS	.XLS

4.2 Reference layer

For the 6 PAs the IRS images have been clipped into smaller sizes for NSP. The IRS image covers the 5 km buffer area for each PA. The IRS images are panchromatic images with 6 meter x 6-meter ground resolution. Detail of IRS images is given in section 2.3.2 and section 3.1. The images are named according to the PA areas as shown in Table 4.1.

Table 4.1: List of IRS images used for the PAs.

PA Name	Path/row	Date
Lawachara	Path 111 row 54	26 February 2004
Rema and Satchari (one scene covers 2 PAs)	Path 111 row 55	02 March 2002
Chunati	Path 112 row 57	27 February 2003
Teknaf (2 scenes mosaiced together)	Path 112 row 57	14 Jan 2004
	Path 112 row 57	07 Feb 2004
Sitakundu	Path 112 row 56	02 February 2003

4.3 PA boundary

The only source of PA boundary is RIMS. The RIMS PA boundary has been used in this exercise. Detail on PA boundary is discussed in section 3.2. The existing PA boundary from RIMS has been kept but the attributes of each PA layer have been made similar. National Park boundaries of Lawachara and Satchari have been generated from DGPS surveyed gazette notification. Some of the matches and mismatches between the boundaries are shown in Figure 4.1. In the same figure the present attribute are also shown. At present the attribute of the PA boundary consists of

- *Area in hectare*
- *An identification number for the PA*
- *The name of the Protected Area*

Annex 2 has the detail of the spatial and attribute information.

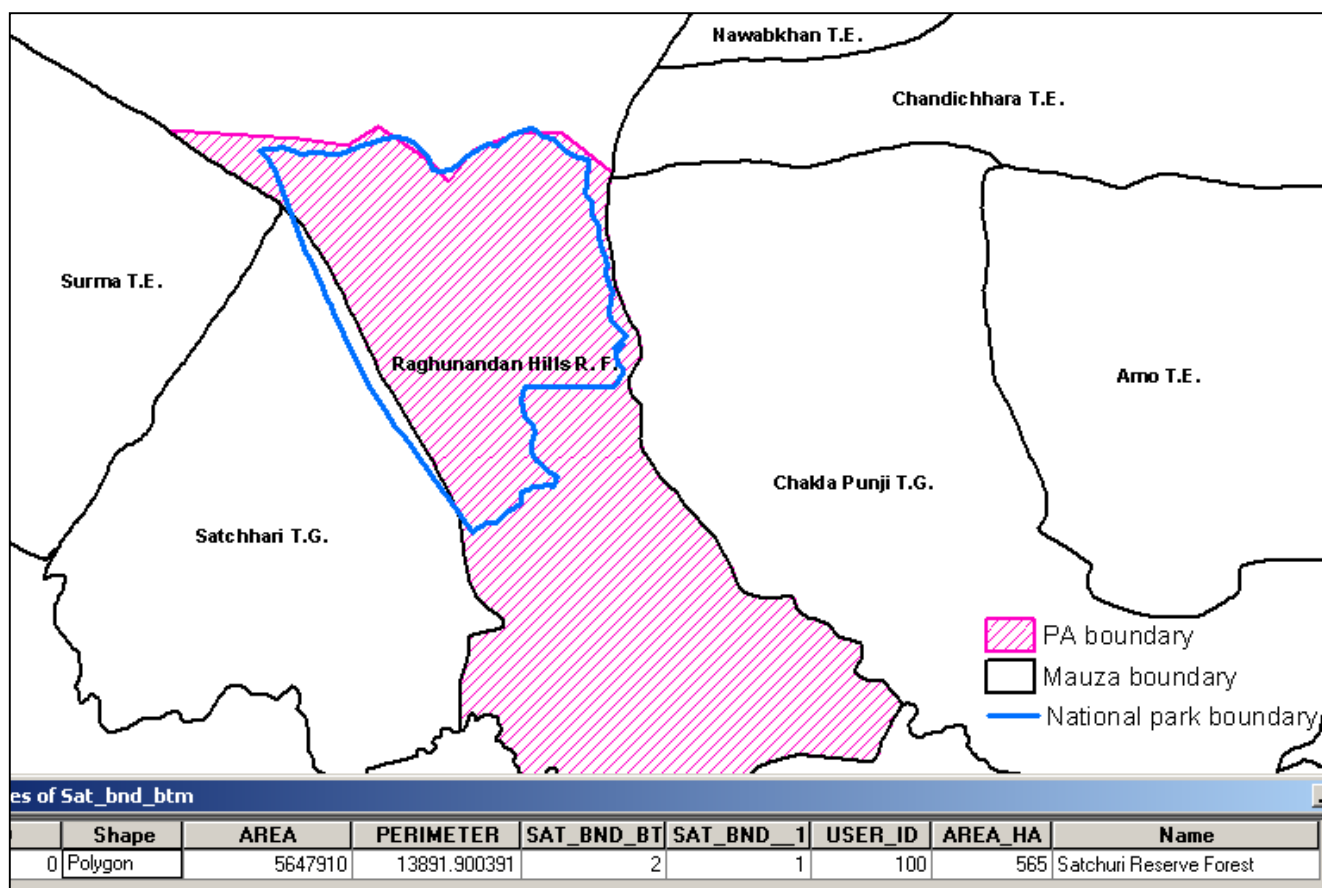


Figure 4.1: Match and mismatch between boundaries

4.4 Forest administrative boundary

The forest administrative layers have been extracted from the “vegetation” layer of RIMS (Section 3.3). Only this layer had the information regarding the Range name and number, Beat name and number and Block name and number shown in Figure 4.2. Applying GIS techniques, the spatial boundaries have been extracted and separated into different shape files for each PA boundary. The attributes have been made similar. The attributes contains information on:

- *Range name and number,*
- *Beat name and number,*
- *Block name and number*

Annex 2 has the detail of the spatial and attribute information.

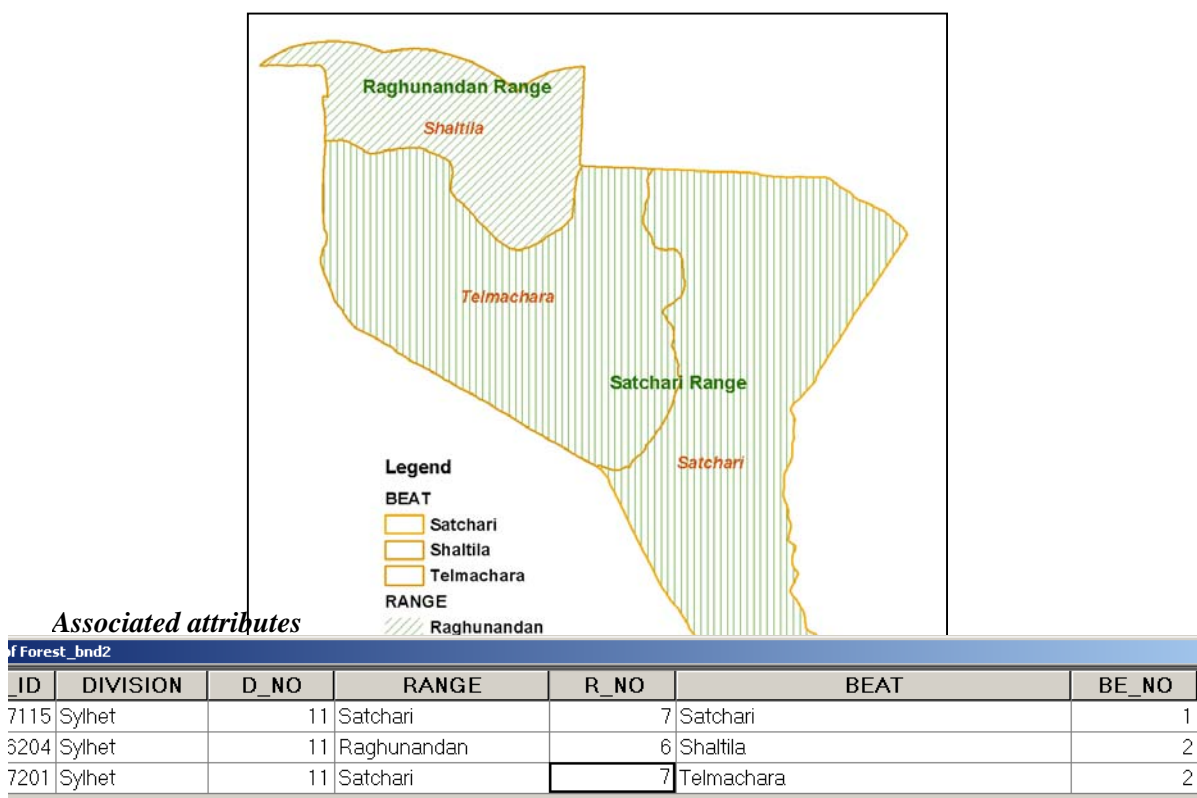


Figure 4.2: Forest administrative boundary and associated attributes of Satchari Wildlife Sanctuary

4.5 Administrative boundaries

The administrative boundaries from CEGIS was used for NSP GIS dataset. Detail on administrative boundaries is given in section 3.4. The administrative boundaries have been clipped according to the 5km buffer zone for each PA. The spatial boundaries and the attribute information are shown in Figure 4.3. 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.

The layers also include different identification numbers for each of the hierarchies of the administrative unit. Annex 2 has the detail of the spatial and attribute information.

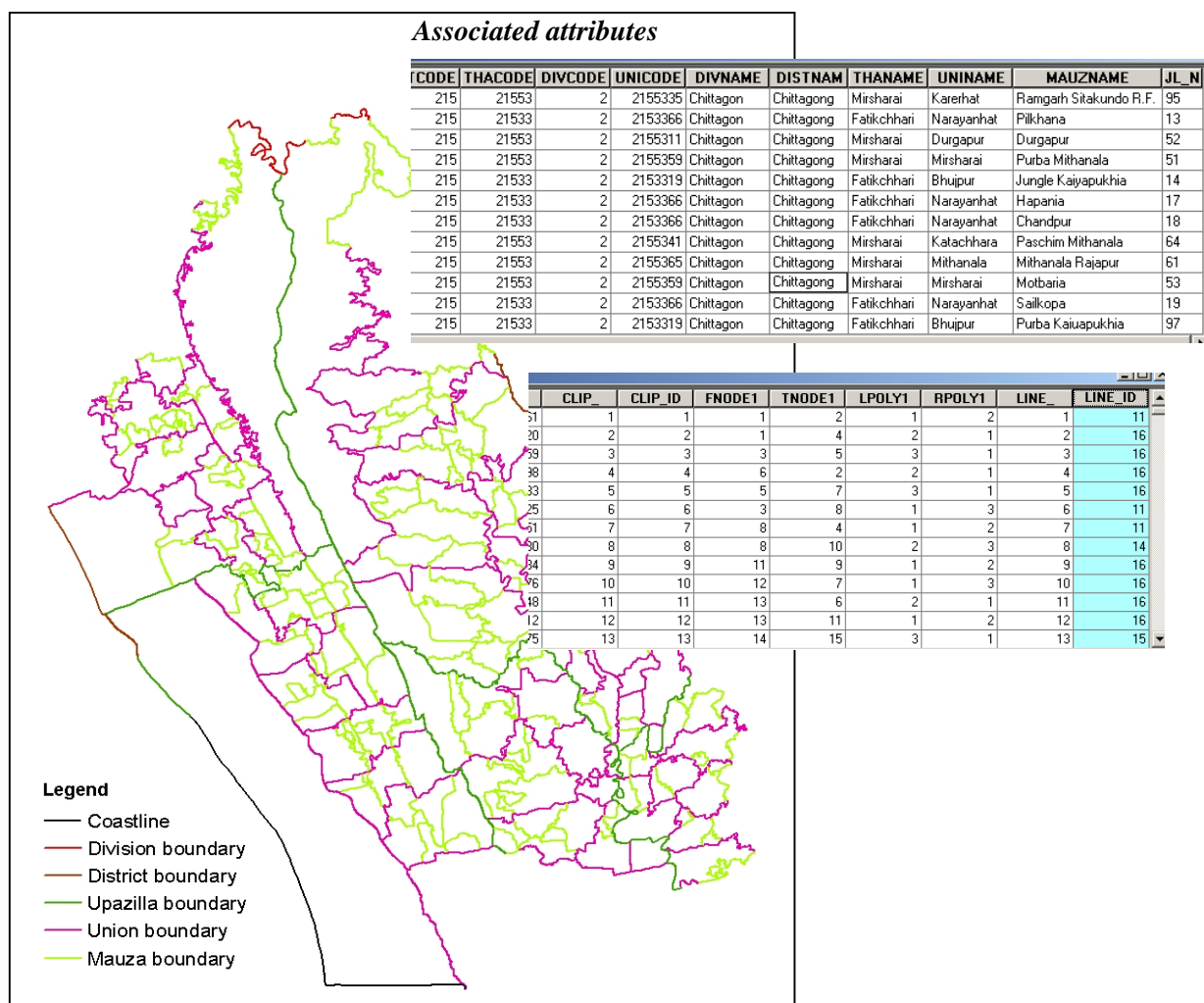


Figure 4.3: Spatial administrative boundaries and related attributes for the PAs.

4.6 Settlement

From the discussion in section 3.5 and Figure 3.2 it is clear that the settlement pattern developed by CEGIS matches well with the IRS image. Hence settlement pattern for each of the PAs were extracted from CEGIS’s settlement database. For each PA the settlement pattern has been clipped by the 5 km buffer area and made into separate shape files. In the shape files the spatial extent of the settlements are present with the attribute information, which is addressed by an identification number. Annex 2 has the detail of the spatial and attribute information.

4.7 Roads and railway network

4.7.1 Roads

For NSP, roads from all the sources (CEGIS, LGED, RIMS, NWRD) are combined as and when necessary using GIS techniques. For National, regional road, roads from CEGIS database has been considered as the source. For the other types the roads that match well with the IRS image has been considered as all the detail roads are not covered in the CEGIS dataset. As all the other detail roads (Feeder Road A, Feeder road B, Rural road) which are not totally covered in the CEGIS dataset and on the other hand which match well from other sources has been considered. As a result Feeder road A, Feeder road B, Rural road has been extracted from LGED, RIMS. In the dense forest cover areas where the roads are not visible on the image, are taken from the RIMS and LGED dataset. Data

collected from extensive fieldwork is also another source of information. It was observed that when existing roads were overlaid with on the IRS image, some of the rural roads were missing as shown in Figure 4.4, but clearly seen on the image. These missing roads were added following the alignment from the image. Efforts have been made to fine-tune the data according for NSP.

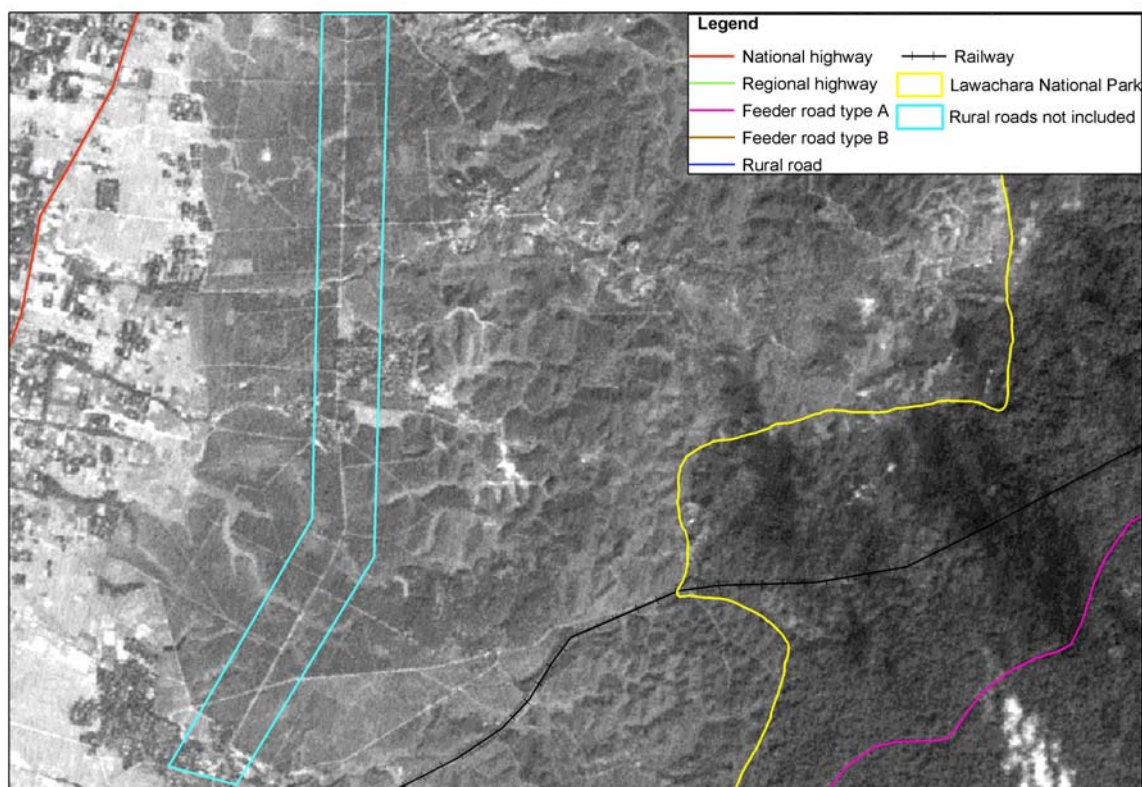


Figure 4.4: Rural roads not included in the database but seen in the image

For each PA such exercise was done. The database contains both spatial and attribute information. The attribute information contains

- Surface
- Road name (where available)
- Remarks (the source of the road CEGIS, LGED, NWRD, RIMS, IRS image)
- Road type (national, regional, FRA, FRB, rural road)

Annex – 2 has the detail description on the dataset.

4.7.2 *Railway network*

The railway network of CEGIS is a combination of NWRD existing network and IRS image. As mentioned earlier that the railway network has been captured at the scale of 1:30,000 from IRS Panchromatic images with 6 meter x 6 meter ground resolution. For NSP the CEGIS has been considered. The attribute information for the railway network is the “Gauge” information meaning whether the line is in meter gauge or broad gauge.

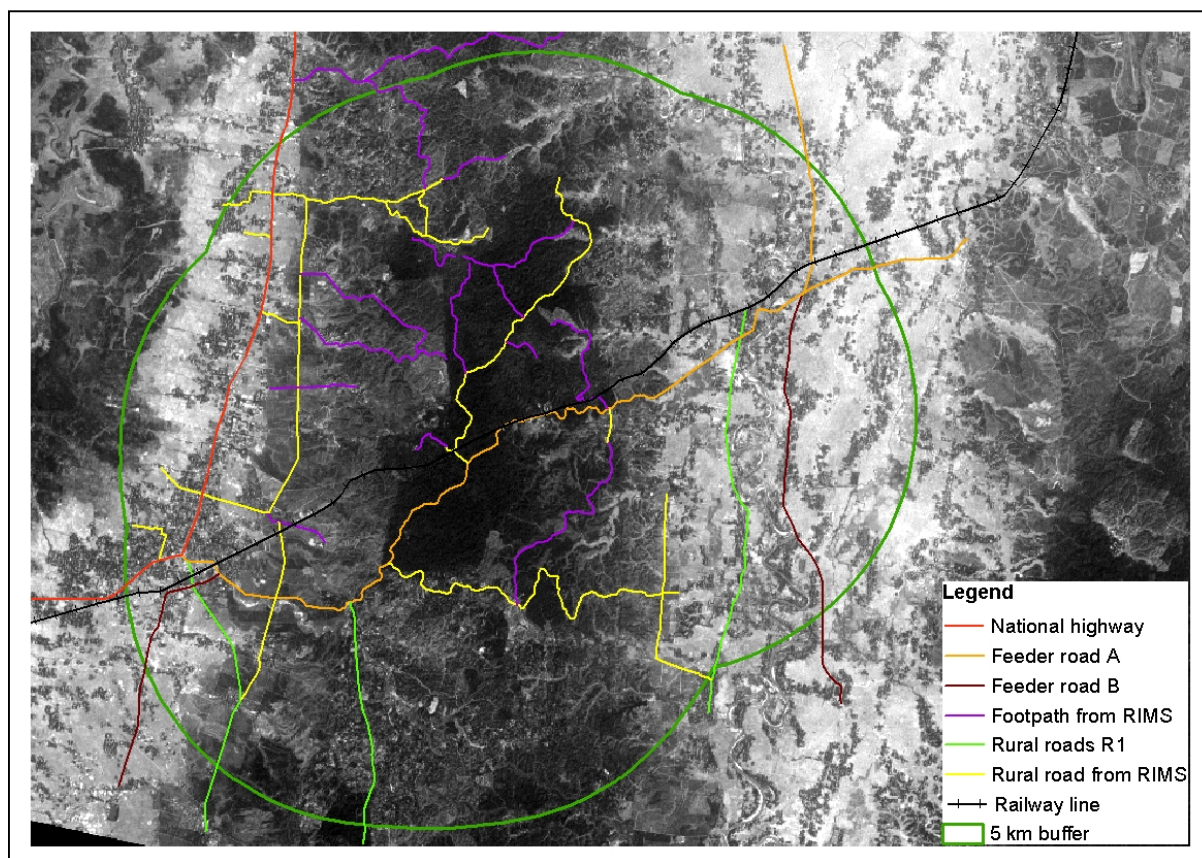


Figure 4.5: Roads and railway network developed by combining the different data sources and field visit in Lawachara

4.8 River

For NSP the river database has been developed using both spatial and attribute data from various different sources available. Rivers from CEGIS, LGED, RIMS are combined to develop this layer, detail in section 3.7. Extensive fieldwork has also been done in this context. In the field DGPS reading was taken to get the alignment of the rivers. The rivers that are present in the field but not visible in the IRS image due to dense tree cover are mostly taken from the RIMS and LGED dataset. Efforts have been made to fine-tune the data for NSP (Figure 4.6). Separate spatial layers for each PA have been developed supported with the attribute information mainly on

- Name of the river (where available)
- Remarks (the source of the road)
- Identification number

Annex – 2 has the detail description.

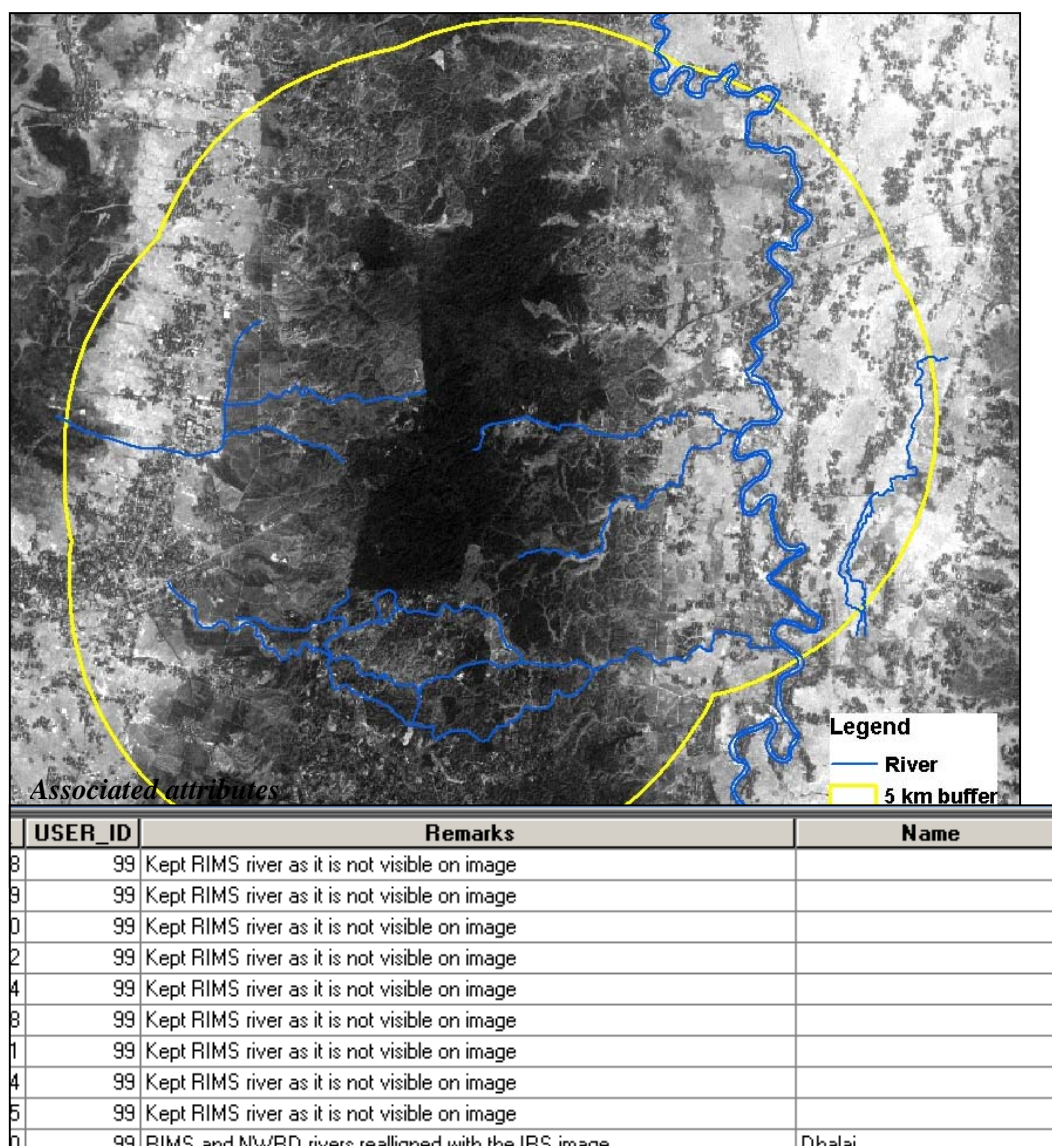


Figure 4.6: Rivers developed by combining different data sources and field visit in Lawachara

4.9 Growth center and small hat/bazar

As mentioned in section 3.8, LGED is the only source for growth centers and small hat/bazaars. Keeping LGED data as the base data, extensive field information was collected in the 5 km buffer area of all the PAs using DGPS. During fieldwork, positions of the growth centers and small hat/bazaars were taken along with the detail description of the same. These detail descriptions have been linked with the spatial data as attribute information as shown in Figure 4.7. It was observed that the positions taken by DGPS varied from the LGED positions. Hence for NSP, a new detail growth center and small hat/bazaar database was developed using DGPS reading from the field. The database does not only include spatial location, but is also enriched by the following attribute information.

- Type of the growth center (growth center/bazaar/small hat bazaar)
- Identification number for each type
- Remarks (name)

Annex – 2 has the detail description on the spatial dataset.

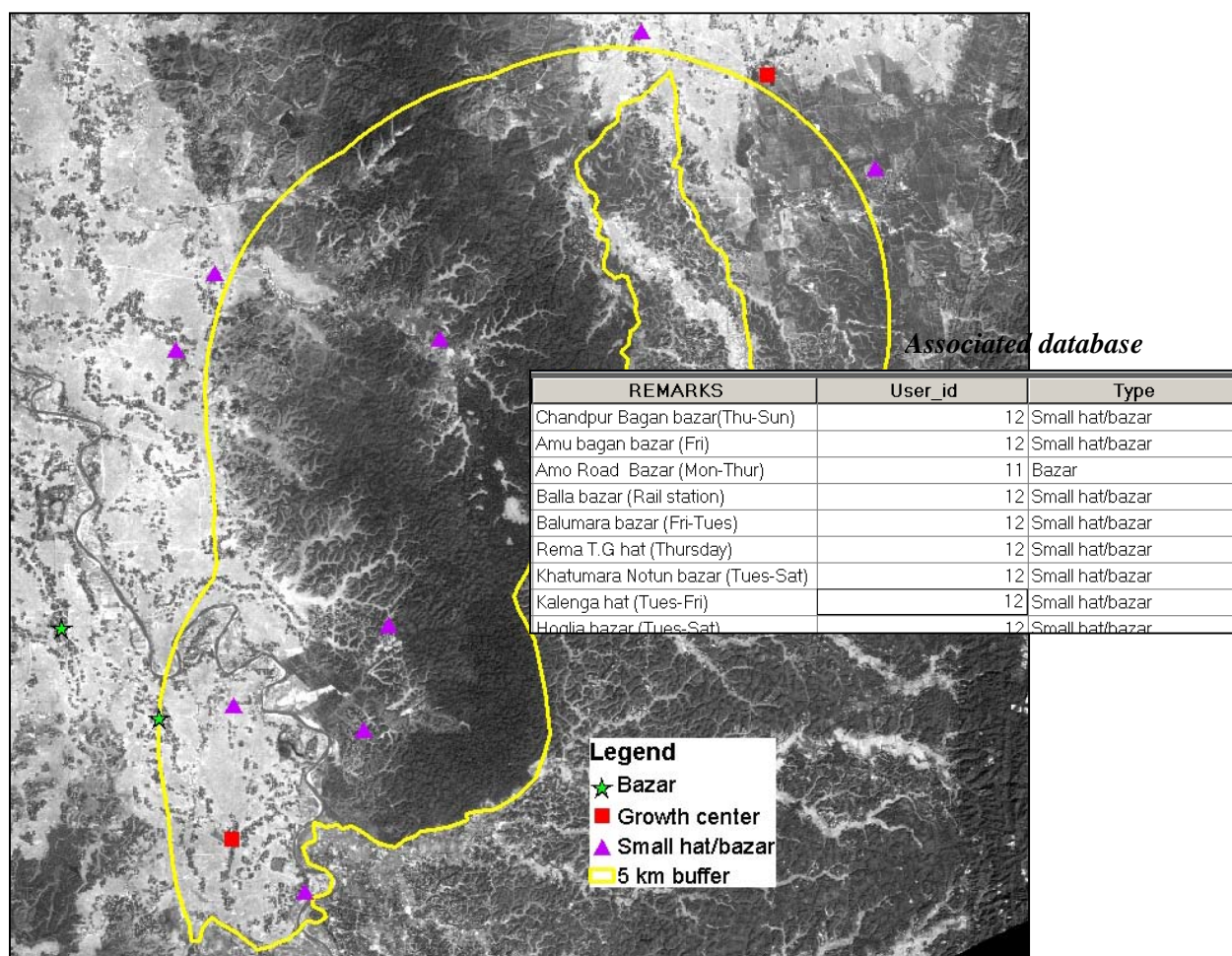


Figure 4.7: Growth centers developed by using LGED database and field visit in Rema Kalenga area.

4.10 Education institutes

As mentioned in Section 3.9 that LGED has an extensive database only on the location of the educational institutes. The LGED data served as a base data. Field visit were carried out to verify the locations with DGPS and also to collect detail information regarding the educational institute for each PA and its 5 km buffer area and also to collect new locations. It was observed that the location varied between the LGED dataset and the DGPS reading. Using the field information and applying various GIS techniques database on educational institutes was developed which focuses on the spatial location as well as the name and type of the institute. Figure 4.8 shows the distribution of the educational institutes gathered from fieldwork and its associated database, which is given in the following.

- Type (type of the educational institute: primary school, high school, college, madrassa etc)
- Remarks (Name of the institute)
- Identification number

Annex- 2 has the detail description on the spatial dataset as well on the attribute information.

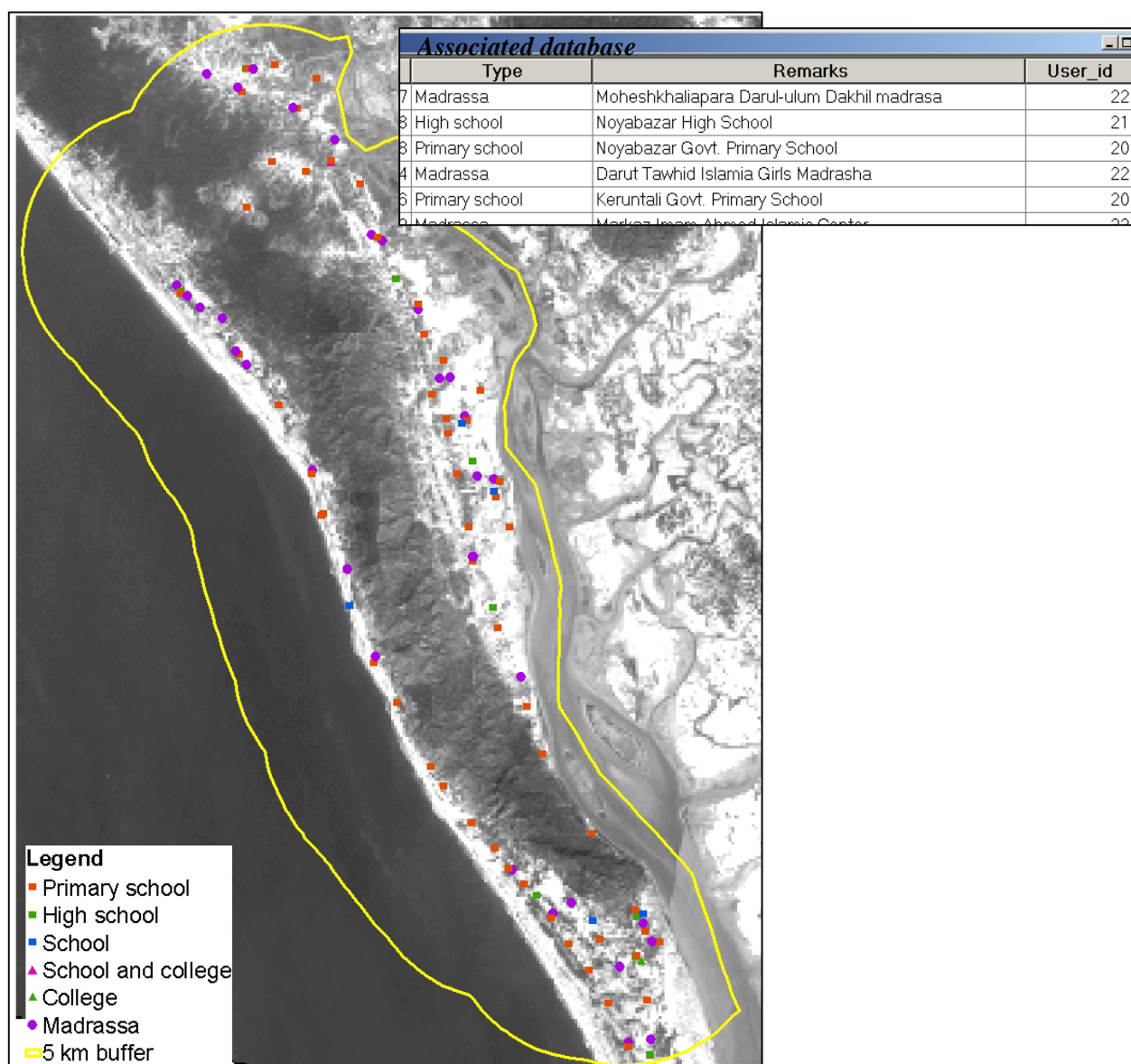


Figure 4.8: Location of educational institutes in Teknaf and its associated database

4.11 Offices

As mentioned in Section 3.10 that RIMS has database on the location of the offices. These offices consist of Beat offices, Range offices, NSP offices, Guest housed, Police stations and many more. Field visit were carried out to verify the locations with DGPS, collect new locations, which are not present in the existing dataset and get detail information regarding the offices. From the field it was observed that the RIMS data did not include all the office locations and the positional accuracy also differed from the DGPS reading. Hence a new database consisting the different types of offices was developed applying GIS techniques focusing on the spatial location as well as the descriptions (Figure 4.9). In the attribute different identification numbers were assigned for different types of offices. Annex 2 has the detail.

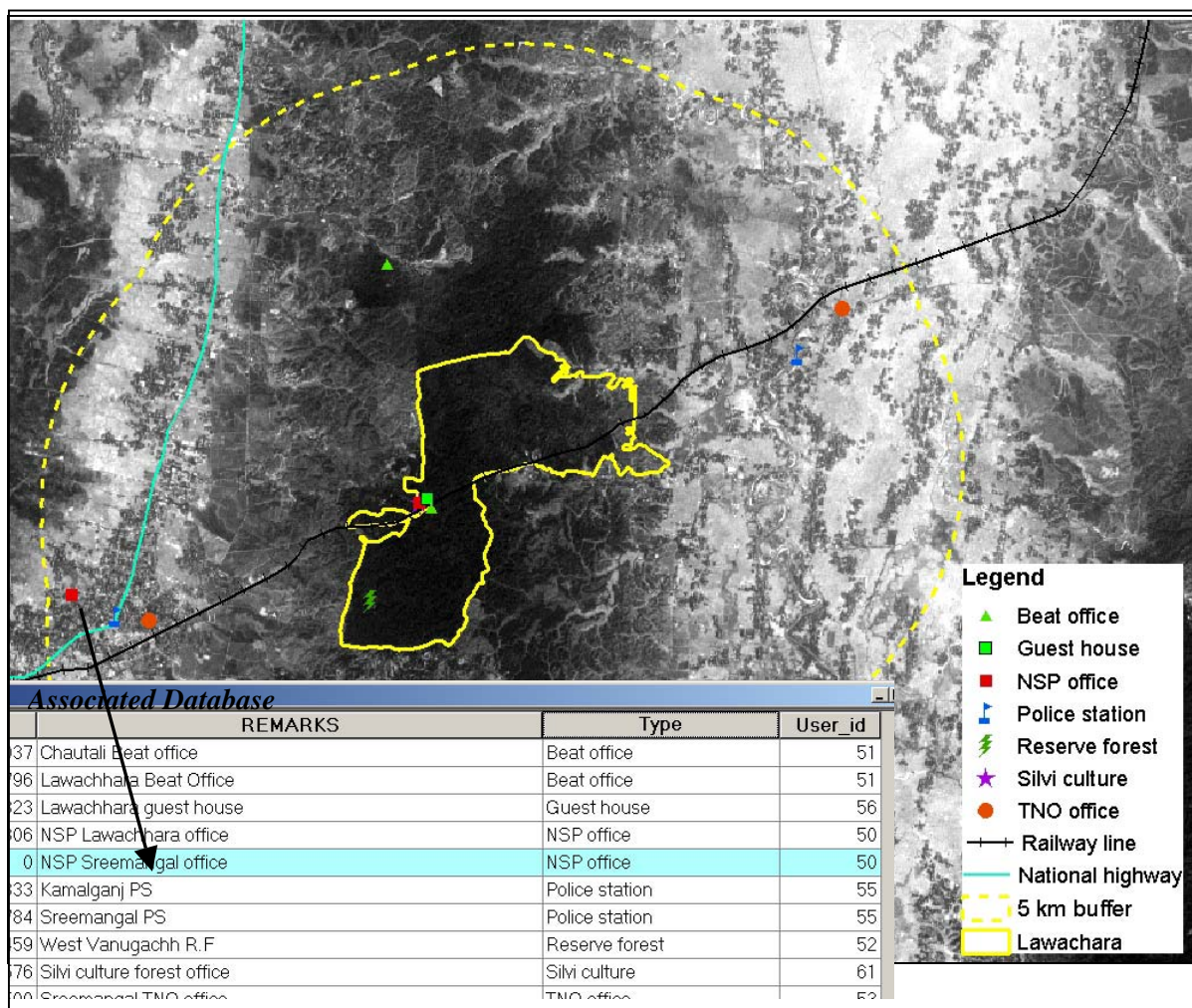


Figure 4.9: Various office locations in Lawachara and its associated database

The attributes of office database includes

- Identification number for each different type of office
- Type (describing the various types of offices)
- Remarks (name of the offices)

4.12 Health centers

As mentioned in Section 3.11 LGED has a database, which covers Hospitals and Family Welfare Centers. Field visits were carried out to verify the locations of the existing data of LGED, collect positions of other health centers in the area using DGPS which may not exist in the LGED dataset. The fieldwork also included for collecting detail information regarding the health centers for each PA and its 5 km buffer area. Using the field information and applying various GIS techniques database on health centers was developed which focuses on the spatial location as well as the name and type of the centers. As a result different types of health institutes their positions and description are included in the present dataset developed for NSP, which covers 5 km buffer area of the PAs (Figure 4.10). The database consists of various attribute information. They are as follows:

- Identification number
- Type (Hospital, clinic, family planning center etc)
- Remarks (name of the health center)

Annex – 2 has the detail.

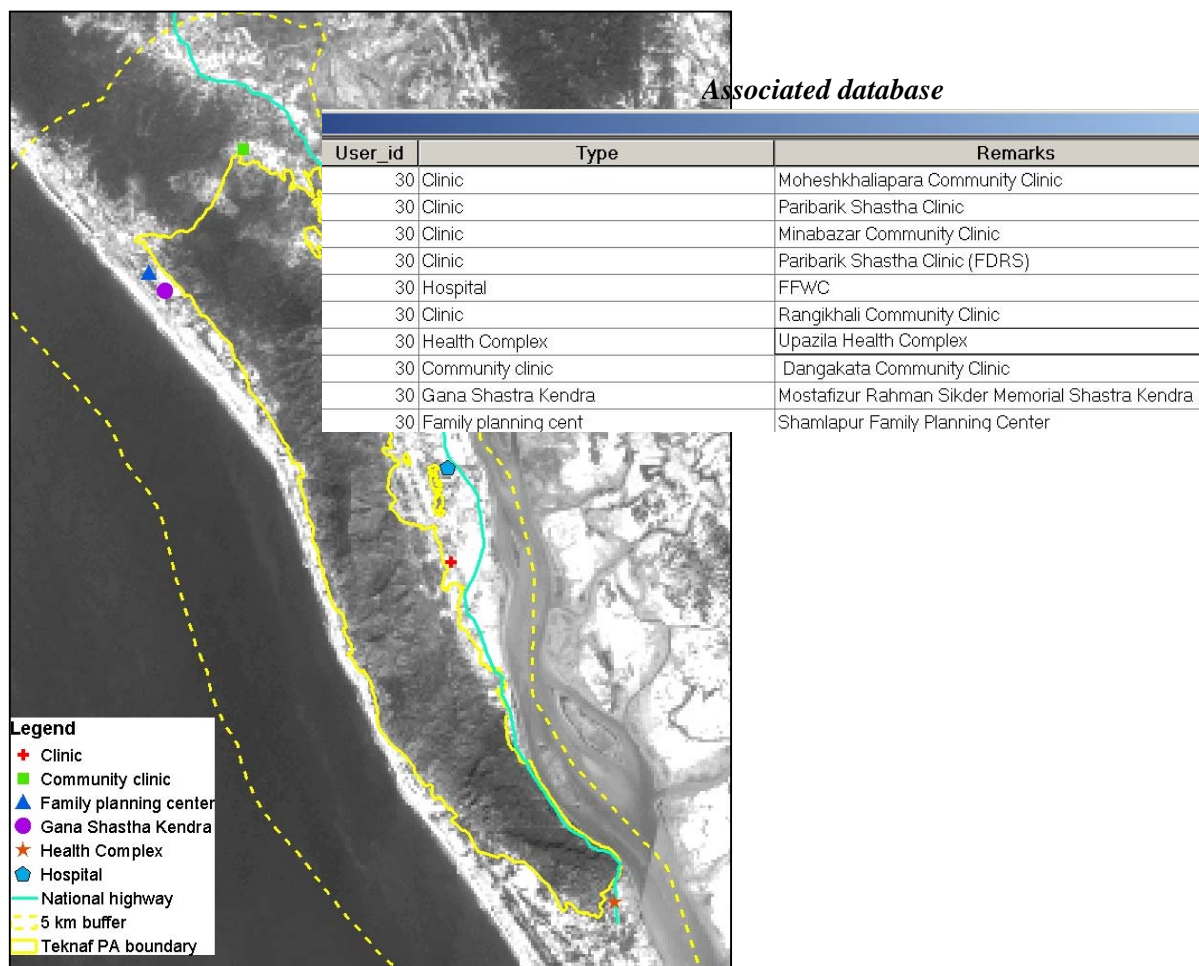


Figure 4.10: Location of health centers in Teknaf and associated database

4.13 Others

As mentioned in Section 3.12 the location of some other features (hatchery, jetty, eidgah, mondir, buddist temple, food godown, Parjatan hotel, railway station, petrol office, BDR camp and many more) were taken while conducting the field visit. DGPS readings were taken of the locations in addition to the description of the locations. Hence a new database consisting of the different types of offices/locations was developed focusing on the location as well as description (Figure 4.11). It may be noted that these locations/structures are not seen in every PA but only in Sitakunu, Chunati and Teknaf. The database consists of various attribute information. They are as follows:

- Identification number
- Type (BDR check post, Buddhist temple, food godown etc)
- Remarks (name of the structure, location)

Detail described in Annex – 2.

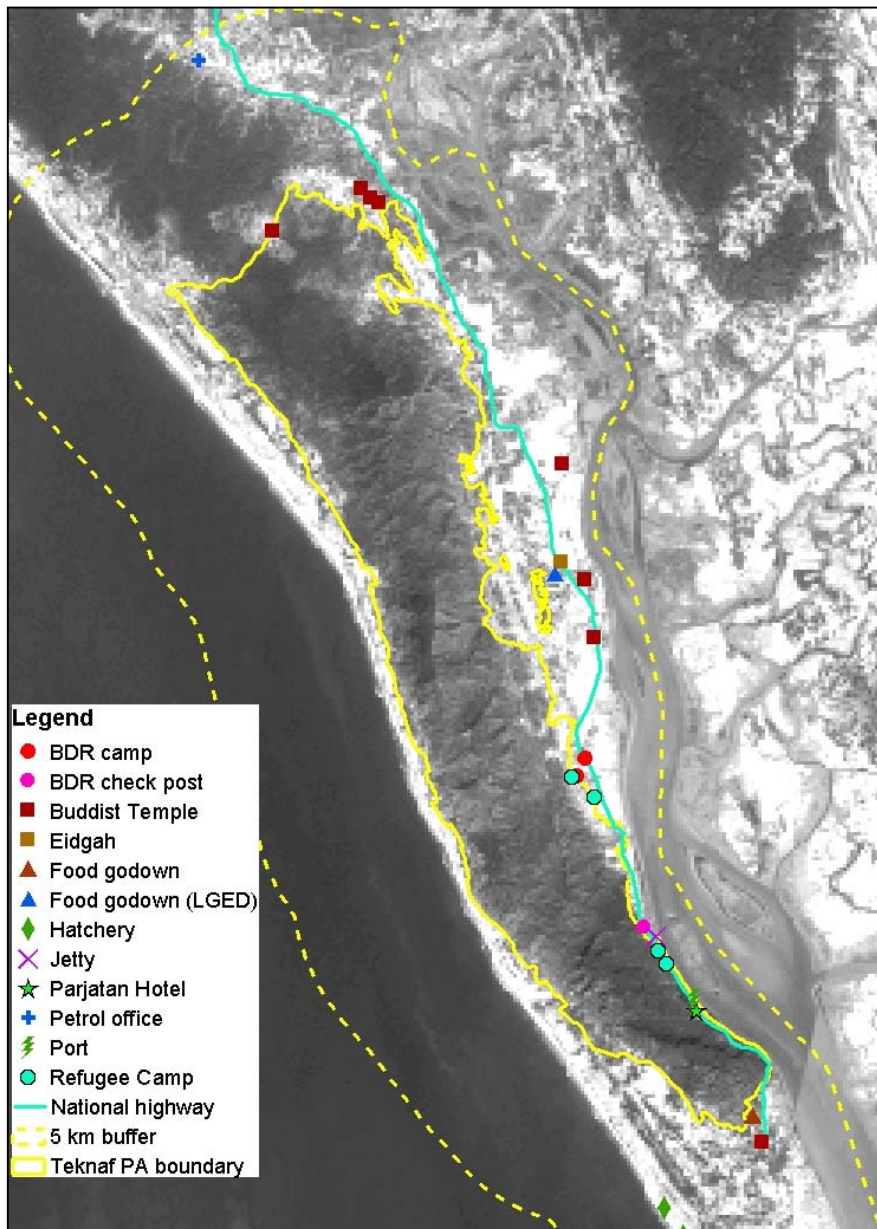


Figure 4.11 Location of other offices/sites

4.14 Vegetation

The vegetation layer has been taken from RIMS. RIMS has incorporated detail species composition list in the vegetation layer. Among other information plantation information, types of plantation, Area covered under specific plantation are all provided. Figure 4.12 gives an example of this layer.

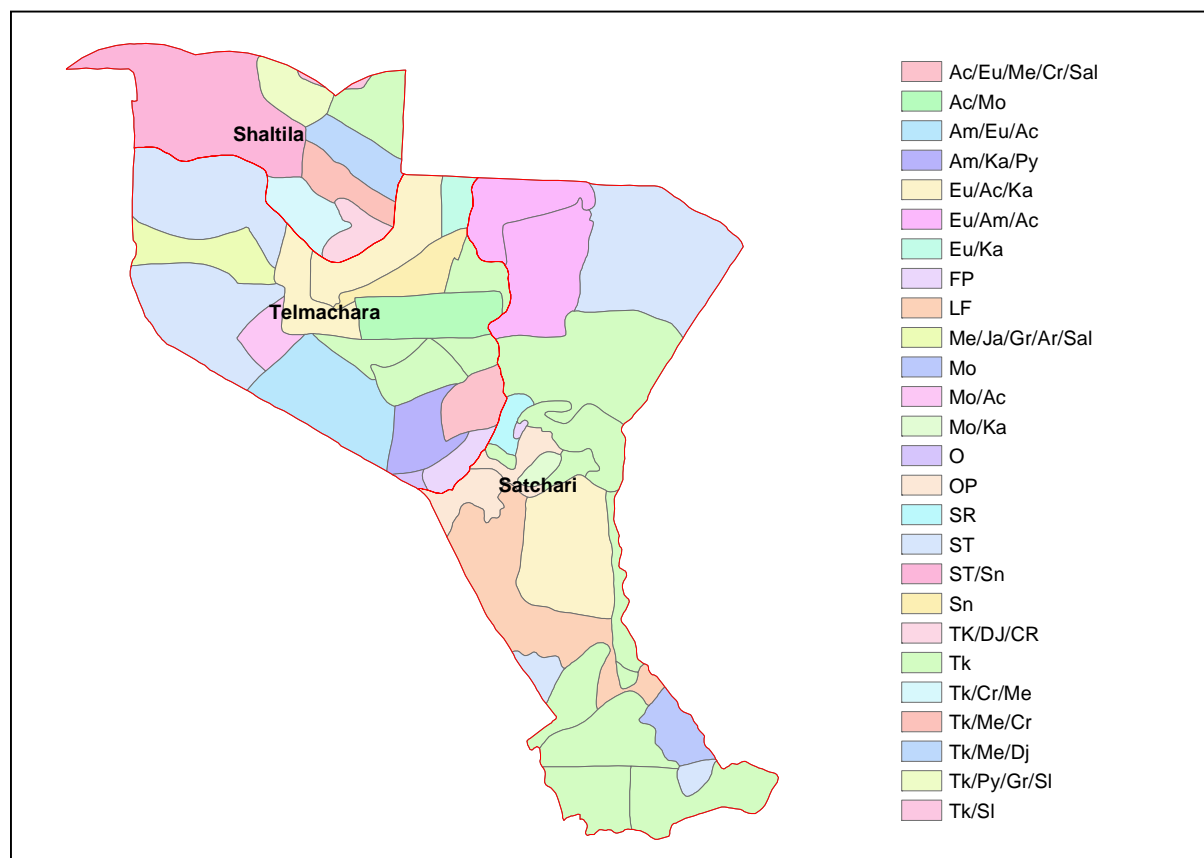


Figure 4.12: Species composition in Satchari National Park

4.15 Socio economic data

Socio economic data of 2001 census of BBS has been incorporated among the dataset. Thanawise information on various variables has been developed digitally. The data includes

- Population by age, sex, sex-ratio, birth and death rate
- Number of households, number of rooms, structure, by type of toilet, ownership
- Electricity supply
- Landownership
- Income/economic condition
- Sources of fuel (type of fuel)
- Literacy rate by sex
- Students currently attending school
- Employment (by type and sex)
- Law and order (occurrence of theft)

Chapter 5

Conclusion and Recommendations

A consistent geo spatial database for the 6 PAs (Lawachara National Park, Satchuri National Park, Rema-Kalenga Wildlife Sanctuary, Chunati Wildlife Sanctuary, Teknaf Game Reserve and Sitakundu Eco-park) has been developed under this initiative. This database can now be used for mapping and other GIS analysis of NSP and FD. In future FD can develop these databases further according to their requirements. For future it can be recommend that similar datasets can be developed for other PAs which will be very useful for Nishorgo as well as for FD to carryout necessary GIS activities and map generation.

Different types of GIS layers were collected from various sources, processed and developed into a geospatial dataset for NSP using various GIS techniques. The sources are CEGIS, NWRD, RIMS, LGED. Different data sources were identified, data were compared, and recommendations were made. Based on that several discussions took place between FD, NSP and CEGIS for developing the dataset.

As agreed upon by FD, NSP and CEGIS, the IRS Panchromatic images with 6 meter x 6 meter ground resolution was used as a reference layer for aligning the spatial layers. IRS Panchromatic images were used because it is available in CEGIS archive for all the PAs. The selected data layers were then matched with the alignments of the IRS images. Extensive fieldwork was also performed to collect detailed information, verify data and make edits. The fieldwork involved collecting positional data along with detailed information. The datasets for all PA are now made consistent in terms of identification numbers and the attribute information. The alignments were geocorrected with the IRS Pan images. All the data developed for NSP are projected in the Bangladesh Transverse Mercator (BTM) projection system.

DGPS survey was carried out and new GIS data layers were developed for growth centers and small hat/bazaars, educational institutes, health centers, office locations. Detailed attribute information was collected from the extensive fieldwork by CEGIS with the support of NSP.

The PA boundary and vegetation layer for all PA's received from RIMS are a part of this database. No edits have been made in the alignments of these layers. The RIMS alignment has been retained. However attributes have been edited to make all the layers consistent.

In order to verify roads, railways and rivers some survey was conducted using DGPS. However verification could not be done in dense forest as this required extensive fieldwork, which was not within the scope of the present study. As a result the alignment of some roads, and some rivers remained same as RIMS and LGED dataset. Further survey may be carried out to verify the data to make adjustments to the alignments and locations inside the dense forest. Alternatively higher resolution images can be used to identify more accurate location of all features in the dense forest as well as the rest of the area under the PAs. The high-resolution image may also help to extract smaller features, which were not identifiable in the lower resolution image currently used.

In Figure 5 comparison between different types images with different resolution are shown using the road and river alignment. Comparison has been made between IRS panchromatic image, high resolution Quick Bird image in the Whykheong Range in Teknaf PA. The comparison between images was possible in this area as the high resolution image are only available at CEGIS here at this moment. In Figure 5.A the IRS image is shown which is used as a reference layer under this initiative. Here it is found that the roads and rivers are not so clearly identifiable in the dense forest. In Figure 5.B high resolution Quick Bird Pan image is used which has a resolution of 60 cm. In Inset 5.C high resolution Quick Bird Multi spectral image is used which has a resolution of 2.4 meters. Both in Figure 5.B and Figure 5.C the above mentioned features are much clearly identifiable than in Figure

5.A. Thus it is clear that more detailed mapping for the PAs could be done using the High resolution images.

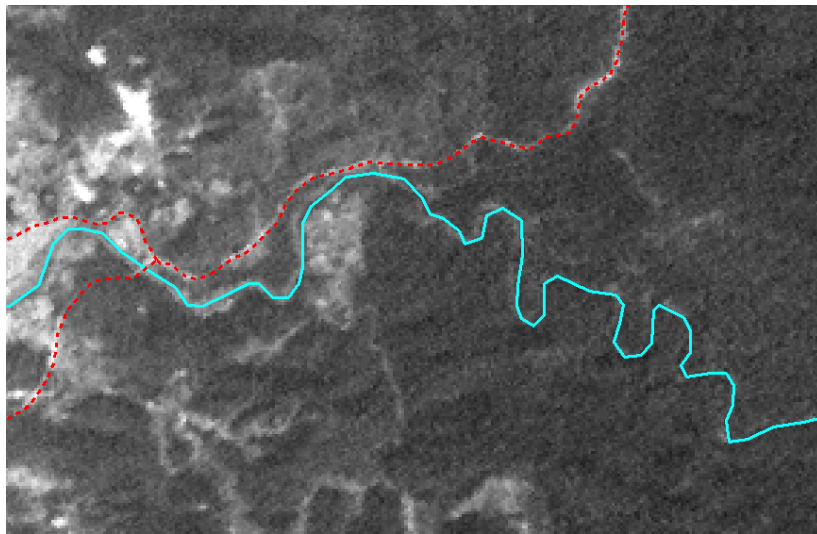




Figure 5.A

Features visible in IRS image used as a reference layer under this initiative

Figure 5.B

Features visible in High resolution Panchromatic Quick Bird image

-  River
-  Road

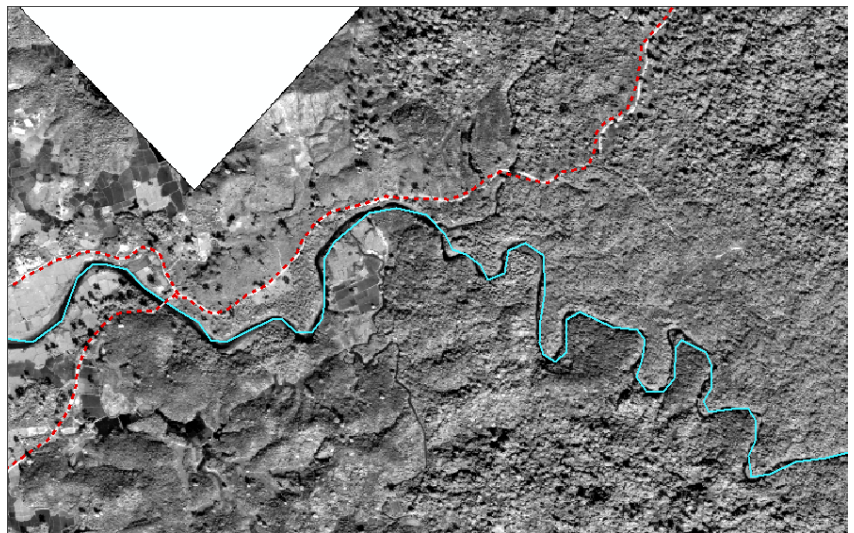


Figure 5.C

Features visible in High resolution Multispectral Quick Bird image

Figure 5: Comparison of features (rives and roads) visible in images of different resolution.

Annex – 1: Field findings

As mentioned earlier extensive field activities was done in different phases to cover the PAs. In Table A1.1 the time schedule for various field activities are given:

Table A1.1: Time schedule of fieldwork

Name of PA	Field work start	Field work end
Lawachara	Done in Design Phase & 30.10.05	
Satchari	25.10.05	26.10.05
Rema Kalenga	26.10.05	29.10.05
Teknaf	20.11.05	25.11.05
Chunati	26.11.05 18.12.05	29.11.05 19.12.05
Sitakundu	14.12.05	17.12.05

As shown in Table A1.1 field work has been done in phases. Some of the outputs from the fieldwork is highlighted here.

- NSP office: New finding. Satchari NSP office location. Location of Lawachara NSP office has also been taken by DGPS which varies with the existing RIMS location (Figure A1.1)



Figure A1.1: Location of NSP office at Lawachara.

- ❑ Bhan office: The location of two Bhan office Satchari and Talmachara is not the same between RIMS and the field survey
- ❑ Range office: New finding. Satchari Range office location not present in the RIMS data. The location of Kalenga Range office is not present in the RIMS dataset. Both of them are incorporated in respective datasets.
- ❑ Beat office: The location of the Beat offices varies with the RIMS data of office locations. It was found from the field that 3 BO are found in the RK 5km buffer area. They are: Rema BO, Kalenga BO, Channbari BO. Here it may be mentioned that the location of Channbari BO is not present in the RIMS dataset.

Two beat offices in Lawachara have been found from field observation Chautali Beat Office and Lawachara Beat office. These locations are also present in the RIMS dataset but there is some locational difference (Figure A1.2).



Figure A1.2: Location of Lawachara Beat Office.

- ❑ Post office: Location varies between LGED data and field verification
- ❑ Rest house: New finding. Location of the Satchari Forest Rest House not present in the RIMS data
- ❑ Guesthouse: The location of the Lawachara Guest House also differs from the RIMS data and that of the field data. A DGPS reading of the Guest House has been taken to locate the exact location (Figure A1.3)
- ❑ Rest house: New finding. Location of the Satchari Forest Rest House not present in the RIMS data
- ❑ Small hat/bazaars: Location differs between LGED and field verification. DGPS reading of the small hat/bazaars are taken and a new database has been created. One of the major problems of LGED database is that there are no names of the small hat/bazaar or even the locality name is missing. Only identification number is provided.



Figure A1.3: Location of Lawachara Guest House

- Growth center: In Rema Kalenga there are two growth centers. Assampara and Sindurkhan Bazaar. They do not match with the location given in the LGED data. In the LGED database the Assampara growth center location is in a settlement area (Figure A1.4). The actual growth center DGPS location has been taken and it varies about 120 meters.

There are some growth centers in the 5km buffer area of Lawachara Reserve Forest. DGPS location of the growth centers has been taken. In the LGED database. The location Vanugach growth center has been taken in the settlement (Figure A1.5)

In Teknaf new location for growth centers and small hat bazaars has been surveyed. It shows that the locations do not match with the LGED locations (Figure A1.6). But in some other PAs LGED data do match with the DGPS reading.



Figure A1.4: Location of Assampara growth center location as of LGED



Figure A1.5: Location of Vanugach growth center location

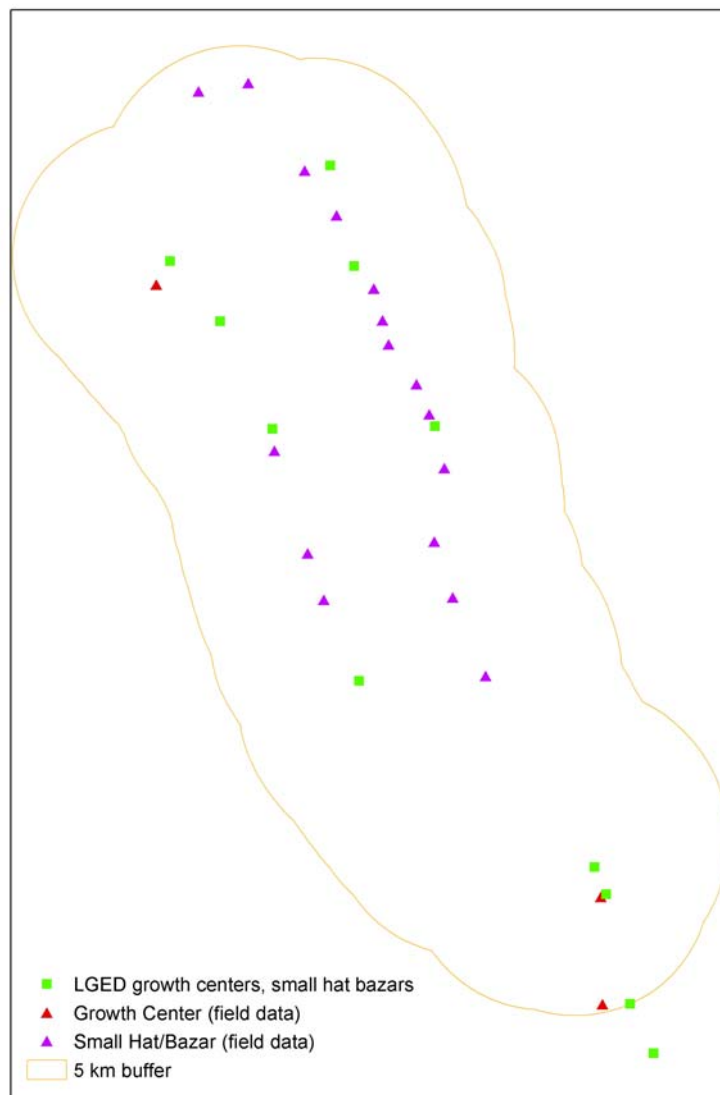


Figure A1.6: Locational mismatch between LGED and field observation

- Police station: In the RIMS database there are location as PS. But from the field trip it was found out that these are actually not PS location rather it is showing a point under the PS. From the field trip actual PS location has been brought for Sreemangal and Kamalganj.
- Primary school: The location varies with the DGPS and the field survey. Here it may be mentioned that due to time constraint all the LGED educational institutes (primary school, high school, college, madrassa) has not been surveyed. A few location has been collected which is shown in Figure A1.7.

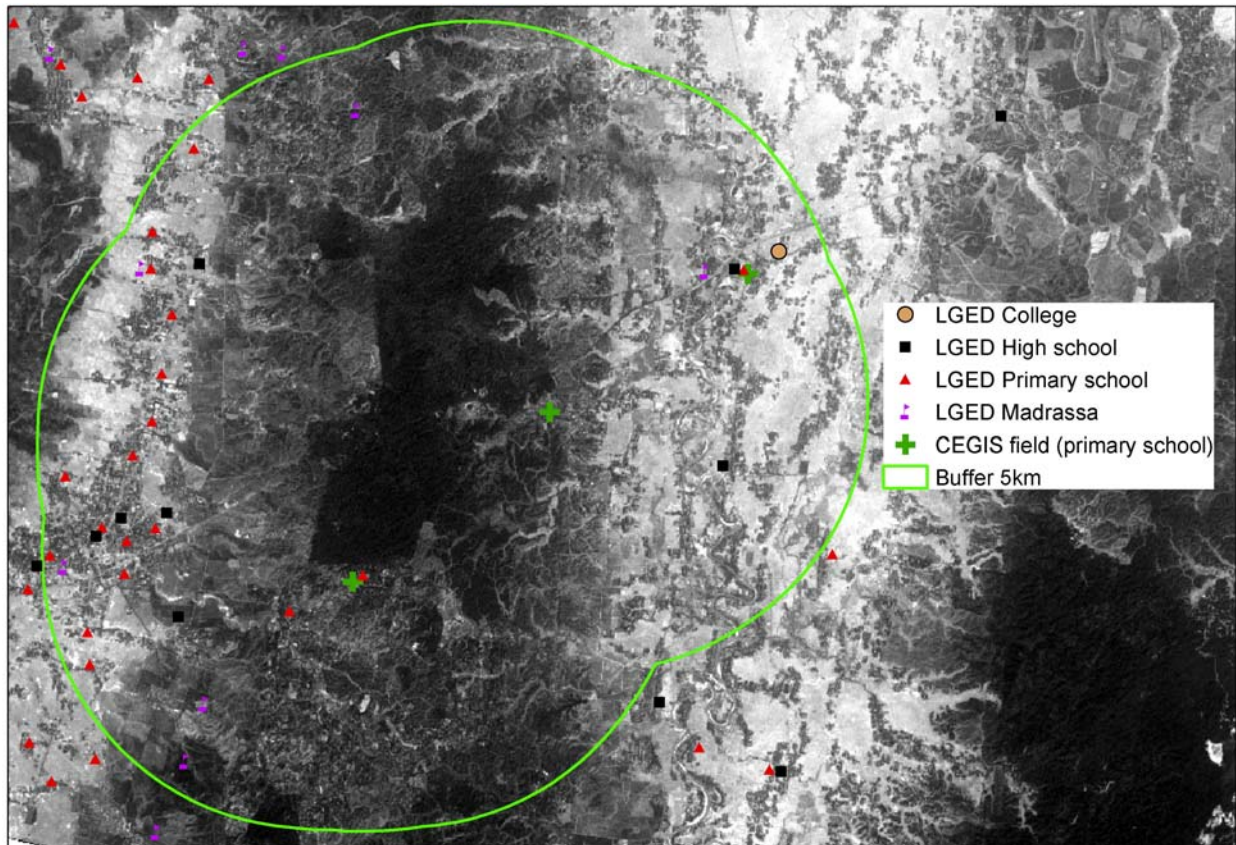


Figure A1.7: Location of LGED educational institutes and the surveyed ones

Annex – 2 Archive document

Spatial extent of the layers:

Each layer covers the 5 km buffer area of the PA boundary

Projection:

All the layers are in Bangladesh Transverse Mercator (BTM) projection

Parameters :-

Units meters
Xshift 500000
Yshift -2000000
Spheroid everest
Scale factor 0.9996
False Easting 90 00 00
False Northing 00 00 00

Output:

Image files are in .IMG format

Shape files are in .SHP format

Layer 1: DGPS corrected IRS image

All the IRS Panchromatic images are DGPS corrected and taken from CEGIS archive. Detail description in section 3.1 and in section 4.2

PA Name	Path/row	Date	File location	File name (.img)
Chunati	Path 112 Row 57	27 Feb 03	Forirg_dec05\ chunati\	Sub_chu_geo_dgps_irs1d_ 11257_panb_27feb03.img
Sitakundu	Path 112 Row 56	02 Feb 03	Forirg_dec05\ sitakunda\	Sub_sita_geo_dgps_irs1d_ 11256_panc_02feb03.img
Teknaf (2 scenes mosaiced together)	Path 112 Row 57 Path 112 Row 57	14 Jan 04 07 Feb 04	Forirg_dec05\ Teknaf\	Sub_tek_mosaic.img
Rema (one scene covers RK and Satchari)	Path 111 Row 55	02 Mar 02	Forirg_dec05\ Rema\	Sub_rema_geo_dgps_irs1d_ _11155_panb_2mar02.img
Satchari (one scene covers RK and Satchari)	Path 111 Row 55	02 Mar 02	Forirg_dec05\ satchari\	Sub_sat_geo_dgps_irs1d_ 11155_panb_2mar02.img
Lawachara	Path 111 Row 54	26 Feb 04	Forirg_dec05\ lawachara\	Sub_lawa_dgps_irsp6_111 54_14mc_40%down_26fe b04.img

Layer 2: Protected Area (PA) boundary

The Protected Area boundary from RIMS. Detail in section 3.2 and section 4.3

PA Name	File location	File name (.shp)
Chunati	Forirg_dec05\chunati\	Chun_bnd_btm
Sitakundu	Forirg_dec05\sitakunda\	Sita_bnd_btm
Teknaf	Forirg_dec05\Teknaf\	Tek_bnd_btm
Rema	Forirg_dec05\Rema\	Rk_bnd_btm
Satchari	Forirg_dec05\satchari\	Sat_bnd_btm
Lawachara	Forirg_dec05\lawachara\	Lawa_bnd_btm

Associated attributes:

User_id: Identification number: 100

Area_ha: Area in hactare

Name: Name of the Protected Area

- Chunati Wildlife Sanctuary,
- Sitakundu Eco Park,
- Teknaf Game Reserve,
- Satchari National Park,
- Rema-Kalenga Wildlife Sanctuary,
- Lawachara National Park

Layer 3: 5 km buffer area

For each PA boundary a 5 km buffer area has been generated by using GIS techniques.

PA Name	File location	File name (.shp)
Chunati	Forirg_dec05\chunati\	Buf5km_Chun
Sitakundu	Forirg_dec05\sitakunda\	Buf5km_Sita
Teknaf	Forirg_dec05\Teknaf\	Buf5km_Tek
Rema	Forirg_dec05\Rema\	Buf5km_Rk
Satchari	Forirg_dec05\satchari\	Buf5km_sat
Lawachara	Forirg_dec05\lawachara\	Buf5km_lawa

Associated attributes:

Area_ha: Area of the 5 km buffer area in hectare

Bufferdist: The buffer distance (5)

Layer 4: 5 km buffer area with international boundary

The 5 km buffer area has been clipped with international boundary for Teknaf, Satchari and RK.

PA Name	File location	File name (.shp)
Teknaf	Forirg_dec05\Teknaf\	Tek_buf5km_intbnd
Rema	Forirg_dec05\Rema\	Sat_buf5km_intbnd
Satchari	Forirg_dec05\satchari\	Rema_buf5km_intbnd

Associated attributes:

Area_ha: Area of the 5 km buffer area in hectare

Bufferdist: The buffer distance (5)

Layer 5: Forest administrative boundary

The forest administrative boundary consists of Range boundary, Beat boundary and Block boundary. Detail in section 3.3 and section 4.4

PA Name	File location	File name (.shp)
Chunati	Forirg_dec05\chunati\	Chu_forest_bnd
Sitakundu	Forirg_dec05\sitakunda\	Sita_forest_bnd
Teknaf	Forirg_dec05\Teknaf\	Tek_forest_bnd
Rema	Forirg_dec05\Rema\	Rema_forest_bnd
Satchari	Forirg_dec05\satchari\	Sat_forest_bnd
Lawachara	Forirg_dec05\lawachara\	Lawa_forest_bnd

Associated attributes:

Division:	Division name
D_no:	Division number
Range:	Range name
R_no:	Range number
Beat:	Beat name
Be_no:	Beat number
Block:	Block name
Bl_no:	Block number

Layer 6: Administrative boundary

The following layers contain polygon and line information on the administrative boundaries upto the mauza level with 1981 BBS geocode. Detail in section 3.4 and section 4.5

PA Name	File location	Polygon file name (.shp)	Line file name (.shp)
Chunati	Forirg_dec05\chunati\	Chu_mau_poly	Chu_mau_line
Sitakundu	Forirg_dec05\sitakunda\	Sita_mau_poly	Sita_mau_line
Teknaf	Forirg_dec05\Teknaf\	Tek_mau_poly	Tek_mau_line
Rema	Forirg_dec05\Rema\	Rema_mau_poly	Rema_mau_line
Satchari	Forirg_dec05\satchari\	Sat_mau_poly	Sat_mau_line
Lawachara	Forirg_dec05\lawachara\	Lawa_mau_poly	Lawa_mau_line

Associated attributes:

Geocode:	Geocodes from BBS census of 1981
Distcode:	District code from BBS 1981 census
Distname:	District name
Thacode:	Thana code from BBS 1981 census
Thaname:	Thana name
Unicode:	Union code from BBS 1981 census
Uniname:	Union name
Mauzaname:	Mauza name
JL_no:	Jurisdiction List number of DLRS

Associated attributes:

Unique arc feature identification numbers are used to identify the administrative boundaries at different hierarchies. The numbers are:

International boundary:	11
Division boundary:	12
District boundary:	13
Upazilla boundary:	14

Union boundary:	15
Mauza boundary:	16
Paurashava boundary:	17

Layer 7: Settlement

Settlement patterns are extracted from IRS Panchromatic images. Among different sources settlement patterns developed by CEGIS has been selected. Detail in section 3.5 and section 4.6

PA Name	File location	File name (.shp)
Chunati	Forirg_dec05\chunati\	Chu_settle
Sitakundu	Forirg_dec05\sitakunda\	Sita_settle
Teknaf	Forirg_dec05\Teknaf\	Tek_settle
Rema	Forirg_dec05\Rema\	Rema_settle
Satchari	Forirg_dec05\satchari\	Sat_settle
Lawachara	Forirg_dec05\lawachara\	Lawa_settle

Associated attributes:

User_id:	999:	Settlement
	0:	Not settlement

Layer 8: Roads

Roads are developed combining various sources CEGIS, LGED, NWRD, RIMS. Alignment has been checked with the IRS image. Information collected from extensive fieldwork has also been incorporated in the dataset. Detail in section 3.6 and section 4.7.

PA Name	File location	File name (.shp)
Chunati	Forirg_dec05\chunati\	Chu_road
Sitakundu	Forirg_dec05\sitakunda\	Sita_road
Teknaf	Forirg_dec05\Teknaf\	Tek_road
Rema	Forirg_dec05\Rema\	Rema_road
Satchari	Forirg_dec05\satchari\	Sat_road
Lawachara	Forirg_dec05\lawachara\	Lawa_road

Associated attributes:

User_id:	1-	National highway
	2-	Regional highway
	3-	Feeder road A
	4-	Feeder road B
	5-	Rural road
	6-	Footpath
	7-	Embankment
Surface:	Road surface (earthen or metal etc)	
Road type:	National, rural, footpath, and embankment	
Road name:	Name of the road where available	
Remarks:	source, editing source	

Layer 9: Railway line

Railway lines are captured from the IRS image. Help from NWRD railway line was taken while developing the dataset. Railway lines are not present in all the PAs. Detail in section 3.6 and section

PA Name	File location	File name (.shp)
Sitakunda	Forirg_dec05\Sitakunda\	Sita_rail
Rema	Forirg_dec05\Rema\	Rema_rail
Lawachara	Forirg_dec05\Lawachara\	Lawa_rail

Associated attributes:

Gauge: Meter gauge/broad gauge

Length: Length in meter

Len_km: Length in Km

Layer 10: River

Rivers are developed combining various sources CEGIS, LGED, NWRD, RIMS. Alignment has been checked with the IRS image. Information collected from extensive fieldwork has also been incorporated in the dataset. Detail in section 3.7 and section 4.8.

PA Name	File location	File name (.shp)
Chunati	Forirg_dec05\chunati\	Chu_river
Sitakundu	Forirg_dec05\sitakunda\	Sita_river
Teknaf	Forirg_dec05\Teknaf\	Tek_river
Rema	Forirg_dec05\Rema\	Rema_river
Satchari	Forirg_dec05\satchari\	Sat_river
Lawachara	Forirg_dec05\lawachara\	Lawa_river

Associated attributes:

User id: 99

Name: River name where available

Remarks: Source

Layer 11: Growth center and small hat/bazaar

Information was collected through extensive field survey and with help of LGED dataset. Detail in section 3.8 and section 4.9

PA Name	File location	File name (.shp)
Chunati	Forirg_dec05\chunati\	Chu_gcenter_hatbazar
Sitakundu	Forirg_dec05\sitakunda\	Sita_gcenter_hatbazar
Teknaf	Forirg_dec05\Teknaf\	Tek_gcenter_hatbazar
Rema	Forirg_dec05\Rema\	Rema_gcenter_hatbazar
Satchari	Forirg_dec05\satchari\	Sat_hatbazar
Lawachara	Forirg_dec05\lawachara\	Lawa_gcenter

Associated attributes:

User_id: 10 - Growth center

11- Bazar

12- Small hat/bazar

Type: Type of bazar (growth center, bazaar or small hat/bazaar)

Remarks: Name, place and other related information

Layer 12: Education institutes

Information was collected through extensive field survey and with help of LGED dataset. Detail in section 3.9 and section 4.10

PA Name	File location	File name (.shp)
Chunati	Forirg_dec05\chunati\	Chu_edu
Sitakundu	Forirg_dec05\sitakunda\	Sita_edu
Teknaf	Forirg_dec05\Teknaf\	Tek_edu
Rema	Forirg_dec05\Rema\	Rema_edu
Satchari	Forirg_dec05\satchari\	Sat_edu
Lawachara	Forirg_dec05\lawachara\	Lawa_edu

Associated attributes:

User_id: 20 – Primary school
 21 – High school
 22 – Madrassa
 23 – College
 24 – School
 25 – School and College

Type: Type of education institute (school, college etc)

Remarks: Name of the education institute

Layer 13: Offices

Information was collected through extensive field survey and with help of RIMS dataset. Detail in section 3.10 and section 4.11.

PA Name	File location	File name (.shp)
Chunati	Forirg_dec05\chunati\	Chu_office
Sitakundu	Forirg_dec05\sitakunda\	Sita_office
Teknaf	Forirg_dec05\Teknaf\	Tek_office
Rema	Forirg_dec05\Rema\	Rema_office
Satchari	Forirg_dec05\satchari\	Sat_office
Lawachara	Forirg_dec05\lawachara\	Lawa_office

Associated attributes:

User_id: 50 – NSP office
 51 – Beat office
 52 – Reserve forest
 53 – TNO office/ Thana HQ
 54 – Union HQ/ Union Parishad
 55 – Police station/camp/beat
 56 – Guest house
 57 – Post office
 58 – Rest house
 59 – Range office
 60 – Bhan office
 65 – Sliviculture
 66 – Dak bungalow/ Zilla Parishad Bungalow
 67 – Industry
 68 – DPHE
 69 – Tea garden office
 70 – Paurashava office

Type: Type of office (NSP office, Beat office etc)

Remarks: Name of the office

Layer 14: Health centers

Information was collected through extensive field survey and with help of LGED dataset. Detail in section 3.11 and section 4.12.

PA Name	File location	File name (.shp)
Chunati	Forirg_dec05\chunati\	Chu_hlthcenter
Sitakundu	Forirg_dec05\sitakunda\	Sita_hlthcenter
Teknaf	Forirg_dec05\Teknaf\	Tek_hlthcenter
Rema	Forirg_dec05\Rema\	Rema_hlthcenter
Satchari	Forirg_dec05\satchari\	Sat_hlthcenter
Lawachara	Forirg_dec05\lawachara\	Lawa_hlthcenter

Associated attributes:

User_id: 30 – Health center

Type: Type of health center (hospital, clinic, Thana health complex etc)

Remarks: Name of the health center

Layer 15: Others

Information was collected through extensive field survey and with help of RIMS, LGED dataset. Detail in section 3.12 and section 4.13. This is applicable for Chunati, Sitakundu and Teknaf

PA Name	File location	File name (.shp)
Chunati	Forirg_dec05\Sitakunda\	Chu_misc
Sitakundu	Forirg_dec05\Rema\	Sita_misc
Teknaf	Forirg_dec05\Lawachara\	Tek_misc

Associated attributes:

User_id: 80 – Buddhist temple

81- Eidgah

82- Food godown

83- Jetty

84- Parjatan Hotel

85- Petrol office

86- Port

87- Hatchery

88- Refugee camp

89- BDR camp

91- Mondir

92- Cold storage

93- Fire service

94- Rehabilitation office/ orphnage

95- Railway station

Type: Type of establishment (Jetty, cold storage, mondir, eidgah etc)

Remarks: Name of the establishment

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