

STATUS OF DATA BASES AT RIMS WITH SPECIAL REFERENCE TO FIVE NISHORGO PILOT PROTECTED AREAS

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EXECUTIVE SUMMARY

In order to facilitate sustainable forest management, the RIMS was set up in the FD under the IDA funded Second Forestry Project, 1984/85 to provide the planners with reliable up-to-date statistical data for realistic planning. It was later expanded by integration of Geographic Information System (GIS) in mid 90's.

While the objectives of RIMS-GIS unit remained the same, i.e., to provide consistent data, but no initiative has been taken since it's establishment to regularly assess data quality, check consistency and compatibility across various non-spatial and spatial data bases acquired under regular management activities or different projects. Hence inconsistency in the spatial or non-spatial data sets exists even today and it often undermines adoption of the RIMS system.

The Nishorgo Support Project (NSP) working at the 5 pilot PAs in the country realized that it is vitally important to check existing databases at RIMS-GIS Unit, identify problems and layout strategies for improvement of the same. The problems in the spatial and non-spatial databases identified below apply not only for the five PAs, but also for all others, except for three wildlife sanctuaries in Sundarbans.

The problems are in general – RIMS-GIS Unit has developed lots of spatial databases without (1) consistency among themselves, and (2) these are not updated. Non-spatial data (inventory and natural resource survey, socio-economic data) generated under different projects are not (3) incorporated into the system. More detailed problems and probable solutions are as follows:

Hard and Software

With regard to available hardware, all most all are in working condition except two digitizers. Alternatively for current digitizing purposes, RIMS is scanning the maps then followed by on screen digitization. Current GIS software although not updated, but is adequate for NSP activities.

Manpower and Centralized Structure

Lack of manpower always hinders RIMS activity, working currently with only 7 members in total. To support mapping and database updating activities under the Forest Department more hands is required. However for NSP, it is suggested to decentralize operations of RIMS activities to the Division level for the five PAs. At least two persons from each PA can be trained in computer, database maintenance, GIS/GPS handling and mapping.

Standard Platform for Spatial Data

RIMS-GIS Unit archives were generated from aerial photographs, satellite images, earlier maps of various time and GPS. Consequently these varied sources are attributed as different projection systems (e.g. BTM, STM, LCC etc) with their varied values for different parameters. At the onset of NSP's GIS assignments, it is thus needed to bring all the spatial data into a harmonize platform. A technical level consultative meeting can resolve the issue.

Boundary and Area of PAs

Inconsistency in PA boundary & differences in notified and estimated area (from GIS database) exist. Boundary layers of northern PAs match natural features relatively more

accurate than the southern PAs. Differences in areas are as follows: 11 ha for Rema-Kalenga WS, 29 ha for Lawachara NP, 165 in Teknaf GR and 46 ha for Chunati WS. Boundary demarcation/ delineation can be re-evaluated under NSP with especial emphasis on Satchari RF (proposed NP).

Geo-rectification of Aerial Photos

As the available controlled air photos for Chunati WS (1995) and Teknaf GR (1990) with most detailed resolution are readily available in RIMS-GIS Unit, these can be scanned and georectified for future use. For Satchari NP (proposed), Rema-Kalenga WS and Lwachara NP aerial photos are not available; however SPOT XS of 1996 can be taken as primary digital data source for these areas.

Non-spatial data

The available non-spatial as well as non-digital datasets relevant e.g. FRMP forest inventory, 1998, TSP data etc for the said PAs can be incorporated into the RIMS-GIS system. Data generating under NSP endeavors are also to be incorporated in collaboration of NSP experts.

Developing Base Maps for NSP

Available RIMS data, after standardization, can be used to develop base maps for the 5 PAs. As RIMS maps are not up to date, adequate field visit and updating GIS databases is necessary. Later, additional spatial data required (e.g. contours, growth centers, settlements in and around the PAs etc), can be procured and or digitized from other sources like SoB, LGED and incorporated into the system.

A set of Satellite Images needs to procure at the later stage of the project to identify the project interventions viz. change in vegetation composition, infrastructures developed in the PAs and other relevant spatial analysis.

Plans for GIS activities under NSP

- Harmonizing Existing RIMS Data layers for 5 PAs to bring into a common platform
- Preparation of Base Maps for 5 PAs
- □ Scan and geo-rectification of Air photos for 2 southern PAs
- □ Procurement of some equipments for
- □ Updating GIS database for 5 PAs based on available information from the field; a coordinated effort for re-survey of PA boundaries alongwith survey of proposed Satchari NP boundary will be conducted.
- □ All relevant data, based on the requirements of NSP consultants, will be acquired and incorporated into the RIMS-GIS database.
- Selection and procurement of a suitable satellite dataset for the PAs.

LIST OF ABBREVIATIONS

ACF	Assistant Conservator of Forest
CEGIS	Center for Environmental & Geographic Information System
DCF	Deputy Conservator of Forest
FD	Forest Department
FRMP	Forest Resource Management Project
IRG	International Resources Group
LGED	Local Government and Engineering Department
MOEF	Ministry of Environment and Forests
NSP	Nishorgo Support Project
PA	Protected Area
RIMS	Resource Information Management System
SoB	Survey of Bangladesh
USAID	United States Agency for International Development

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1. Introduction

Bangladesh Forest Department (FD) is the legal custodian of national forest resources. Since its 150 years of endeavor, it has been contributing to production forestry, involved in conservation as well as social forestry activities in forested and non-forested areas of the Country.

In order to facilitate sustainable forest management, the RIMS was set up in the FD under the IDA funded Second Forestry Project, 1984/85 to provide the planners with reliable up-to-date statistical data for realistic planning. It is basically a computer based data retrieval system which was later upgraded and expanded by integrating it with a Geographic Information System (GIS) with financial and technical help from the IDA financed Forest Resource Management Project (FRMP) in mid 90's.

The GIS based RIMS unit is responsible for capturing, managing and updating databases and developing maps related to silvicultural operations and providing input to the preparation of Forest Management Plans for Forest Divisions.

While the objectives of RIMS-GIS unit remained the same, i.e., to provide consistent data, but no initiative has been taken since it's establishment to regularly assess data quality, check consistency and compatibility across various non-spatial and spatial data bases acquired under regular management activities or different projects. Hence inconsistency in the spatial or non-spatial data sets exists even today and it often undermines adoption of the RIMS system.

The Nishorgo Support Project (NSP) launched in 2004 with a view to develop a formal co-management mechanism between FD and stakeholders at the 5 pilot PAs in the country. These pilot PAs are - Lawachara National Park (LNP), Satchari Reserve Forest (SRF, *proposed*), Rema-Kalenga Wildlife Sanctuary (RKWS) in Sylhet Division, Chunati Wildlife Sanctuary (CWS) in Chittagong and Teknaf Game Reserve (TGR) in Cox's Bazar Forest Division.

The Project also visions improved management of the aforesaid PAs, prerequisite of which is to build an accurate database on different management aspects, natural and socio-economic dimensions in and around the PAs. Before creating new a database, the Project realized that it is vitally important to develop a consistent dataset from the existing ones and to bring these to a common platform and has taken initiatives to look into and to correct the existing databases to the extent possible relating to their five Protected Areas.

As such the present assignment explores the available spatial and attribute database, their extent & structure, quality and compatibility, RIMS capacity and future data needs explicitly for the 5 pilot PAs. The challenge of such undertaking is enormous and

complicated and time consuming. Nevertheless, this is a timely and appreciable approach for generating quality data of forest resources, which subsequently can be replicated to other PAs and Forested areas of the country at large.

2. Forests of Bangladesh

Forest Department under the Ministry of Environment and Forests (MoEF) is being administered by 41 Forest Divisions and responsible for conservation, expansion and management of forest resources all over the country. A few educational, research and other technical institutes are backstopping her efforts.

Out of 2.53 million ha of forestlands of various kinds, the Department has been managing 1.53 million ha of forestlands, which consists about 10.30% of country's total landmass (Table 1). Of 1.53 million ha, Reserved and Protected Forests consist of 89.54% and 2.61% respectively. According to forest types, the Hill forests, inland Sal forests, and Tidal forests consists of 44.08%, 7.89%, and 48.02% respectively.



Figure 1: Forests of Bangladesh.

Category	Area (in million ha)
State Lands	
Under the control of the FD	1.53
Reserved Forest	1.37
Acquired Forest	0.01
Vested Forest	0.02
Protected Forest	0.04
Transferred Khas Land	0.09
Under the control of District Admin.	
Un-classed State Forest	0.72
Private Lands	
Homestead / village forest	0.27
Others	
Community forest plantations	0.01
Total	2.53

Table	1:	Distribution	of Forest A	Area b	ov I	legal and	Owr	ership	Classes
Lanc		Distribution	UL L UL USU I	M Cu N	/ y _	Jugai anu		ci sinp	Classes

Source: FMP 1992

The Hill forests composed of species like garjan (*Dipterocarpus turbinatus*), civit (*Swintonia floribunda*), chundul (*Tetrameles nudiflora*), narikeli (*Sterculia alata*), boilam (*Anisoptera glabra*), telsur (*Hopea odorata*) etc., and also have several species of bamboo and other NTFPs.

The inland Sal forests predominantly composed of sal (*Shorea robusta*) occurring in pure patches, sometimes associated with koroi (*Albizzia procera*), kumbhi (*Careya arbora*) etc.

The Tidal forests composed of sundari (*Heritera minor*), gewa (*Excoecaria agallocha*), passur (*Carapa moluccensis*), goran (*Ceriops roxburghii*), kakra (*Brugiera gymnorizha*), keora (*Sonneratia apetala*), and baen (*Avicennia officinalis*).

Conservation of biological diversity, natural environment of all forest types and bioecological zones have received special attention of the Govt. and FD has so far established 16 protected areas, within the 1.52 million ha of forestland under the frame of National Parks, Wildlife Sanctuaries and Game Reserve. These PAs covers an area of 2,41,675 ha and was established under the Bangladesh Wildlife (Preservation) (Amendment) Act, 1974.

3. Protected Areas of Bangladesh

The total area of Bangladesh is 14.4 million ha. Of this around 227800 ha. has been established as Protected Area. Bangladesh has 16 Protected Areas distributed in 4 Biogeographic Zones, namely tropical evergreen and semi evergreen Forest Biogeographic Zone, Moist Deciduous Forest Zone, Mangrove Forest Biogeographic Zone and Reedland or Wetland Biogeographic Zone over a total area of 227800 ha. There are at present 3 categories of Protected Areas in Bangladesh viz. 5 National Parks, 8 Wildlife Sanctuaries and 1 Game Reserve. All of these Protected Areas are within the Government owned Reserved Forests managed by the Govt. Forest Department. FD has taken repeated attempts to develop scientifically based management plans for the PAs. Some milestones are:

- Defining the PAs as 'Preservation Working Circles' from 'Production Working Circles' in the management plans of Syhlet, Chittagong and Cox's Bazar Forest Divisions during 90's
- Conservation management plans for 3 Wildlife Sanctuaries in the Sundarbans, Bhawal NP, Rema-Kalenga WS and Teknaf GR under FRMP
- Guidelines for preparation of Conservation Management Plans under FRMP
- Participatory Conservation Management Plans for Modhupur NP, Chunati WS, Himchari NP and Rema-Kalenga WS under Forestry Sector Project (FSP).

	Protected Areas	Forest	Bio-	Area (ha)	Established ²
		types	ecological		
			zone		
Α	National Parks				
1.	Bhawal National Park	Sal forest	3	5,022.00	1974/1982
2.	Modhupur national Park	Sal forest	3	8,436.00	1962/1982
3.	Ramsagar National Park	Sal forest	1	27.75	2001
4.	Himchari National Park	Hill forest	9a	1,729.00	1980
5.	Lawachara National Park	Hill forest	9b	1,250.00	1996
6.	Kaptai National Park	Hill forest	9a	5464.00	1999
7.	Nijhum Dweep National Park	Coastal mangrove	8b	16352.23	2001
8.	Medha Kachapia National Park	Hill forest	9a	395.92	2004
В.	Wild Life Sanctuaries				
9.	Rema-Kalenga WS	Hill forest	9b	1795.54	1996
10.	Char Kukri-Mukri WS	Coastal mangrove	8b	40.00	1981
11.	Sundarbans (East) WS	Mangrove forest	7a	31226.94	1960/1996
12.	Sundarbans (West) WS	Mangrove forest	7a	71502.13	1996
13.	Sundarbans (South) WS	Mangrove forest	7a	36970.45	1996
14.	Pablakhali WS	Hill forest	9a	42087.00	1962/1983
15.	Chunati WS	Hill forest	9a	7761.00	1986
C.	Game Reserve				
16.	Teknaf GR	Hill forest	9a	11615.00	1983
D.	Proposed				
17	Satchari Reserve Forest	Hill forest	9a		

Table 2: List of Protected Areas

Note: 1- Nishat et al. 2002; 2- subsequent years indicated change in areas of PAs.



Figure 2: Protected Areas of Bangladesh

4. **RIMS-GIS Unit: A Glimpse**

Computer based RIMS were developed to produce reports and maps relevant to all aspects of the management plan, silvicultural prescriptions and to provide information on available and predicted yields from relevant operations. This was designed as an aid in intensive forest resources management of all Forest Divisions through management plans and also in perspective planning in forestry.

RIMS Unit is a two-way information system. After performing silvicultural operations in the field level, raw data are supplied to the RIMS Unit. These data are fed to the computer for updating the database through prescribed formats. Then the processed information containing activities including afforestation, intermediate cutting, tending operations etc. are sent back to the field Divisions from the RIMS Unit.

In line with technological development RIMS Unit adopted Geographical Information System (GIS) for computer aided data management, mapping and analysis system of spatial information.

This unit also actively participated in planning of various inventories in Chittagong, Cox's Bazar, Sundarbans, Sylhet, sal forests, natural resources surveys, PSPs and so forth; besides participating in development of some project based MIS e.g. Planning, Budgeting and Monitoring System (PBMS) and Participatory Benefit Sharing Agreement (PBSA), the data processing and analysis of both spatial as well as non-spatial data are another major tasks done by the Unit.

4.1. Infra-structure of RIMS

The GIS based Resources Information Management System (RIMS) is established at Ban Bhaban, Forest Department headquarter with 600sft room space (room 316-317) and equipped with GIS hardware, software and technical personnel. The equipments and other facilities available at RIMS-GIS Unit are as follows:

Table 3: Hardware used by RIMS-GIS Unit						
Equipments	Quantity	Specification	Remarks			
PC with DCF, RIMS	1	Pentium III	Internet connection			
			and LAN			
PC, GIS workstations	5	Pentium III	PC based LAN			
PC, RS Workstation	1	Pentium III	PC based LAN			
PC, FRMP Server	1	Pentium III	PC based LAN			
PC, FRP Server	1	Pentium III	PC based LAN			
Digitizer	2	Calcomp (A1) &	Both out of work			
		Summa grid IV (A0)				
Design Jet Plotters	2	HP 650C (A1) & HP	HP 650C is out of			
-		750C (A0)	work			

4.1.1. Hardware

Equipments	Quantity	Specification	Remarks
Laser Printer	2	HP 4M Plus & HP Laser	
		Jet 2100	
DeskJet Printer (A4)	1	HP Desk Jet 820Cxi	Colour printer
De-humidifier	1	Frost control machine	
IPS	1	1250VA	Black Cat (Rahim
			Afroz)
Mirror Stereoscopes	3		Aerial photo
			interpretation.
Field Instruments			
Sunnto Clinometers	20		
GPS	0		
Diameter Tape	20		

This unit is connected by a Peer-to-Peer network, whereby the computers are connected with an Ethernet cable (RG 58 cable). The OS is Windows 98 and all GIS software is PC based as well.

4.1.2. GIS and Remote Sensing Software

Table 4. OID and ND Boltware used by Minib-OID Onit						
Software	Quantity	Specification	Remarks			
GIS Software						
PC ARC/INFO for windows	3 licenses	Version 3.5				
PC ArcView	2 licenses	Version 3.1				
Remote Sensing Software						
Erdas Imagine	1 licenses	Version 8.4				

Table 4: GIS and RS Software used by RIMS-GIS Unit

4.1.3. Manpower & Capabilities at RIMS Unit, Dhaka

Table 5. Manpower and GIS Capabilities at KIMS-GIS Unit						
Posts/Ranks	Permanent	Dev.	GIS Capabilities			
		Project				
Deputy Conservator	1		Basic GIS understanding with 6			
of Forest (DCF)			years of working experience.			
Asstt. Computer						
Programmer						
Assistant Conservator		1	GIS/GPS/RS basics with 8 years			
of Forest (ACF)			of working experience.			
Research officer	1		Proficient in ArcView GIS with			
			2 years at RIMS.			
Draftsperson	1	1	Basic GIS understanding and			
_			cartography			
Computer Operator	1		Text processing and Data entry			
			experience			
Data Operator	1		DBMS, Text processing and			
_			Data entry experience			
Total	5	2				

Table 5: Manpower and GIS Capabilities at RIMS-GIS Unit

4.1.3.1 Problems & Suggestions:

Problems

- It is to be noted that RIMS-GIS Unit updates data for 14 Management Divisions with the help of only 7-person at Dhaka. And thus yearly updating of data (mapping of planting, thinning, clear-felling, failure plantation and data entry etc) sent from field level (e.g. PAs) takes considerable amount of time.
- Moreover, Management Divisions do not send yearly updates (silvicultural interventions), rather, data of 2-3 years are sent once at a time making such activity burdensome. Hence data at RIMS-GIS Unit are not up-to-date.
- Problems related to lower manpower and suggested recommendations are discussed further more in later section (4.2.1.6).

Suggestions

□ In general, the activities of RIMS/GIS Unit need to be decentralized by training more people at the Division level.

4.2. **RIMS Databases**

Since inception, RIMS has been taking active participation in planning field level forestry operations, growth and yield prediction & estimation, planning and implementation of forest inventories and developing Forest Management Plans for all forest divisions in association with the Management Plan Divisions. Consequently RIMS provide major database support and mapping to the forest stands.

RIMS databases can be divided into two types - (1) Spatial database (2) non-spatial database. Spatial database concerned with digital data produced from Aerial Photographs and Remotely Sensed data (e.g. Landsat TM, SPOT Multi-Spectral data) using GIS and Remote Sensing technologies. Non-spatial data concerned with data from forest inventories, natural resource surveys and data from Permanent Sample plots (PSPs).

4.2.1. Spatial Databases

RIMS/GIS Unit has developed digital database of forest area covering Chittagong, Cox's Bazar, Sylhet, Sundarban, Dhaka, Tangail, Mymnesingh forest divisions and 4 Coastal Afforestation divisions viz. Noakhali, Chittagong, Bhola & Patuakhali divisions. A regular updating of vegetation database and mapping is the ongoing activity of this unit. Important features among the spatial database are vegetation cover (with species, year of plantation and area etc), forest administrative units, road/drainage network and FD installations/offices.

Spatial Data	Source	Scale	Remarks
Forest Cover Maps	Aerial Photo 1981,	1: 15,840	A 1 sized Hardcopy
1986-87; Cox's	FAO/UNDP project	(4"=1 mile)	Map, not digitized.
Bazar Forest	BGD/79/017		
Division			
Forest Type Maps	Aerial Photo 1995,	1: 15,000	In digital version
1997-98; Cox's	FRMP		produced from the
Bazar Forest			Aerial Photo.
Division			
Cox's Bazar South	Controlled Air Photo	1: 10,000	A 1 sized Hardcopy
Forest Division	1990		Map, not digitize.
Forest Cover Maps	Aerial Photo 1981,	1: 15,840	A 1 sized Hardcopy
1986-87;	FAO/UNDP project	(4''=1 m1e)	Map, not digitized.
Chittagong Forest	BGD//9/01/		
Division	A 1 DI / 1005	1 15 000	x 1 1
Forest Type Maps	Aerial Photo 1995,	1: 15,000	In digital version
1997-98;	FRMP		produced from the
Chittagong Forest			Aerial Photo.
Division	A 1 DI + 1001	1 15 0 40	
Forest Cover Maps	Aerial Photo 1981,	1: 15,840	A I sized Hardcopy
1986-87; Sylnet	FAO/UNDP project	$(4^{n}=1 \text{ mile})$	Map, not digitized.
Forest Division	BGD//9/01/	1 50 000	T 1' '4 1 '
Forest Type Maps	SPUT XS images	1: 50,000	In digital version
1997-98, Sylnet	1990, FKMP		SPOT VS images
Forest Type Mana	Aprial photo 1059 by	1.21600	AO giza Hardaany
1061 Sundarbana	Forestal Forestry	1.51060	Au size natucopy
Pasarya Forests	rolestal rolestly		Map, not digitized.
Forest Type Mana	Aprial Dhota 1082 hy	1.50.000	A 1 Size: Deper Drint
1084 of the	ODA	1.50,000	and Digital
Sundarbans Reserve	ODA		
Forests			
Forest Type Mans	Aerial Photo 1995 by	1.50.000	A1 Size: Paper Print
2002 of the	ODA	1.50,000	and Digital
Sundarbans Reserve	ODIT		und Digital
Forests			
Forest Type maps	'Land Accretion and	1:25,000	In digital version.
of 4 Coastal Forest	Plantation Maps	,	
Divisions	1992' by SPARRSO		
3 Division Maps for	SPOX XS Scenes	1:150,000	In digital version.
Sal Forest Divisions	1999-2000; FSP	,	E .

Table 6: Existing Spatial Data sets at RIMS-GIS Unit of Forest Department

4.2.1.1 Problems in Spatial Databases and Recommendations

4.2.1.1.1 Inconsistency in Boundaries of the PAs: The traditional method – traversing used for Protected Area boundary demarcation based upon Gazette Notification did not have the luxury to re-validate using Aerial Photographs. As a result the notified boundaries often do not coincide with the natural features like foot of the hills (see Figure 2 for Chunati WS). Such inconsistency is more in Chunati WS and Teknaf GR, however, notified boundaries in northern two PAs (LNP and R-K WS) matches more with the

natural features. Note that, RIMS data base for boundary of proposed Satchari National Park needs to be developed.

Suggestion: Boundary demarcation needs to be re-exercised/re-evaluated under NSP.

4.2.1.1.2 Inconsistency in total Areas of PAs: Comparison between areas from GIS database and notified area shows that inconsistency exits (Table 7). This inconsistency may be due to human error during plotting the traverses and subsequent mapping. These field maps were used to generate GIS databases (administrative boundary layers) through digitization.

Suggestion: To solve the problem, we can adopt two methods – traditional survey and mapping or mapping through DGPS guided survey using satellite technology. Traditional survey may incur time and costs (due to man power), and may not provide the targeted accuracy. Thus, in addition to the boundary re-evaluation mentioned above, DGPS survey (accurate to sub-meter; available locally) can be carried out with limited manpower and time.

Protected Areas	Notified Area (ha)	GIS data base (ha)	Differences (ha)
Chunati WS	7764	7810.5	46
Teknaf GR	11610	11445.0	165
Lawachara NP	1250	1221.2	29
Rema-Kalenga WS	1796	1785.0	11
Satchari NP	242.82 (proposed)	-	-

Table 7: Area differences between GIS database and Gazette Notification

(Note – in Figure 2: only two scenes of aerial photographs of CWS were georectified and used the boundary coordinates of the Sanctuary to assess current boundary of the PA).



Figure 3: Physical feature and boundary of WS (Chunati)

4.1.1.1.3 Geo-rectification of Aerial Photos: The aerial photographs are the most detailed remotely sensed data in terms of information and resolution (compared to satellite data) available with FD. From the existing Aerial Photos of Cox's Bazar and Chittagong Forest Division (1995 under FRMP; see Table 7) only the vegetation data were extracted, other data layers (e.g. administrative, infrastructure etc) were taken from Forest Cover Maps of the division, 1986-87 (BDG/79/017). All these data layers are now in vector format. It would be better to geo-rectify available air photos shown below (Table 8). It will then be the most detailed guide to orient field terrain and background of field maps as well.

Protected Areas	Digital Data	Scale	Remarks
Chunati WS	Aerial Photo 1995	1:15,000	Needs to geo-rectify
Teknaf GR	Controlled Air Photo 1990	1:10,000	Needs to geo-rectify
Lawachara NP Color Infra-red Aerial		1:30,000	Needs to geo-rectify
	Photo 1981		
Rema-Kalenga WS	SPOT XS image 1006	20 m	Geo-rectified
Satchari NP	51 OT AS intage 1990	resolution	

Table 8: Aerial photographs and remote sensing data for the PAs

Suggestion: Scanning the available photographs and geo-rectification. The controlled air photos of A1 size are to be scanned from commercial scanners and then RIMS-GIS Unit can geo-rectify these using Erdas Imagine.

4.2.1.1.4 Variation in Projections: A definite map projection is a pre-requisite for standardization and subsequent analysis of the spatial datasets. Existing GIS database in RIMS originated from a number of data sources under different projection systems or varied parameters or values (see Table 9 for different parameters). As such, GPS data often does not coincide with that of vector layers (causing problems to find those points in the field) and causing difficulties in spatial analysis and integration of other relevant layers.

The current PC Arc/Info layers in RIMS do not have Datum values whereas Satellite Images / GPS always maintain Datum (e.g. Everest, Indian Bangladesh, WGS84 etc.) resulting in irregular shifting in data layers (Figure 4).



Figure 4: Part of Monpura Island (Please note the Green Lines are Embankment around the island and the BLUE dots are GPS readings along the Embankment.)

Name of Projection	Bangladesh Transverse	Standard Transverse	Universal Transverse
5	Marcator (BTM)	Marcator (STM)	Marcator (UTM)
Unit	Meters	Meters	Meters
Spheroid	Everest	Everest	Everest
Datum	-	-	Indian Bangladesh
Central Meridian	90° E	90° E	90° E
Reference Latitude	0° (equator)	0° (equator)	0° (equator)
Scale Factor	0.9996	0.9998	0.9996
False Easting	5 00 000	5 00 000	5 00 000
False Northing	-2 000 000	0	-2 000 000
			UTM Zone: 54 / 46

 Table 9: Different Projections available with RIMS Spatial data layers

Name of Projection	Lambert Conformal Conic (LCC)
Units	Feet
Spheroid	Everest
Datum	-
1st standard parallel:	23 09 00
2nd standard parallel:	28 48 00
Central meridian	90 00 00
Latitude of projections	26 00 00
origin	
False easting	2743185.699
False northing	914395.233

Suggestion: A decision need to be taken with regard to the projection system and parameters to be adopted as a standard to homogenize the current spatial data sets. The author is not in a position to take this very important decision alone at the onset of data standardization stage. Technical decision or guidance is thus required for defining standard parameters. When such decision is taken, and spatial data projection parameters are defined, the author will be able to bring all available data into a uniform platform.

4.2.1.1.5 Map Updating Procedure: RIMS is the mapping unit of Forest Department. Existing procedure works in two stages:

- All field interventions/ silvicultural operations (e.g. new plantations, felling etc.) are mapped (Journal maps of scale 16" to 1 mile) by the field personnel in detail. These maps are reduced to scale 4" to 1 mile (i.e., 1:15,840) by photocopying to generate Block/Beat maps.
- □ Later these Block/Beat maps are superimposed to maps provided by RIMS at scale 1:15,000 and transferred all interventions. Due to such conversion of scale, features are deviated in shape, area and location compared to real field interventions.
- Block maps from the fields are digitized in RIMS and later incorporated into GIS thereby basically maintaining and compounding errors in databases. These maps once again are sent to the field for subsequent mapping.
- □ The reason for such procedure is due to shortage of professionally sound surveyors in the field level.

4.2.1.1.6. Status of Update

The procedure mentioned above seldom works systematically and thus hinders yearly updating of maps for all forest divisions. As such map updating of Cox's Bazar and Chittagong Forest Divisions having Teknaf GR and Chunati WS are currently updated up to the year 2000; whereas Sylhet Forest Division (three northern PAs) is updated to the year 1999 merely (without field verification).

Suggestion:

- 1. Reorganize the current system by:
 - □ Training of FD personnel (Ranger/Beat Officer) in basic mapping at Range level and adequate supervision of the system.
 - □ Changing current 1:15,000 scale maintained at RIMS to 1:15, 840 and
 - □ Updating all existing maps of all the PAs.
- 2. Modernize the old system of mapping by:
 - Extending RIMS Unit at the Division level headed by an ACF who will be in charge of mapping, updating the databases (provided with Computers, software, and GPSs).
 - □ Such initiative will also help to provide the latest update in minimum time.

4.2.1.1.7. Coding regime: Due to change and splitting the Forest Administrative units at field level, existing codes available in RIMS need to be re-arranged. The Codes of Division, Range, Beat, Block etc. are sometimes misinterpreted by field level personnel during silvicultural operations. The same problems lie with the coding of forest tree species that was used for FRMP Forest Inventory and GIS database available at RIMS.

Suggestion: Re-arrangement of codes regarding forest administrative setups and forest species. Participation of relevant forest divisions in this effort and documentation is recommended.

4.2.2. Non-spatial data

Non-spatial data at FD comes from two sources -(1) from different Forest inventories (2) Permanent Sample Plots (PSPs) for vegetation.

4.2.2.1 Forest Resource Inventories: The existing non-spatial data (Table 10) contain valuable information about vegetation/wildlife abundance and distribution. However, right now these data sets are just stored and cannot be put into any management or scientific use. Integration of such data sets into GIS database is thus necessary. The NSP is also generating related non-spatial data (socio-economic, vegetational) and thus needs planning upfront to make use of such information for future references.

Non-spatial Data	Source	Remarks
1. Forest Inventori	es	
Forestal Inventory	Aerial photo 1958 with	Covering the Sundarbans Reserved
1961	ground inventory	Forests (SRF) and Chittagong Hill Tracts.
		Data available in hardcopy reports
ODA Inventory	Aerial photo 1984 with	Covering the SRF; data available in
1994	ground inventory	hardcopy reports
FRMP Inventory	Aerial photo 1995 with	Covering Cox's Bazar, Chittagong, SRF
1998	ground inventory	and Sylhet Forest Divisions; Hardcopy
		Documents are available
FSP Inventory	8 SPOT XS scenes with	Sal Forest Divisions e.g. Dhaka,
2000	ground inventory	Mymensingh and Tangail Forest
		Divisions, Hardcopy documents are
		available in FD
Biological Survey,	By BCAS and Forest	Natural Resources Survey conducted by
FRMP 1996	Department	BCAS are available as document in FD
Socio-economic	Socio-economic studies	Hardcopy documents are available in FD
Data	under FRMP and FSP	
2. Permanent	PSPs Field measurements	Data on PSPs are available in digital
Sample Plot		format covering Cox's Bazar, Chittagong,
(PSPs)		Sylhet and Sundarbans during 1992, 1994
		and 1997.

Table 10: Non-spatial data at RIMS GIS Unit

Suggestion: Non-spatial datasets available and that are going to be generated by NSP should be spatially attributed and to develop layers of information relating to their land uses/ species compositions etc.

4.2.2.2 Permanent Sample Plots: Bangladesh Forest Department has adopted maintaining some Permanent Sample Plots (PSPs) all forest divisions to monitor plantation growth and to develop growth models. With this view all the forest divisions like Chittagong, Cox's Bazar and Sylhet forest divisions has marked some 26 PSPs each. Unfortunately along the constant pace of deforestation during last decades, the PSPs have lost most of their trees. It hampered monitoring growth performance in one hand and on the other hand their disappearance exhibits the extreme intensity of loss of forest resources.

Suggestion: In this regard, an intervention of laying new PSPs can be adopted under Nishorgo initiatives, which will be dispersed over the degraded natural tracts as well as plantations, at least for the NSP project period. It might be well demarcated and yearly inventoried covering the entire mass of biodiversity (e.g. trees, herbs, shrubs and others). The RIMS Unit is ready to design and help in establishing PSPs for the 5 PAs for long term monitoring.

5. Relevant Spatial Data Needs at RIMS

The author visited some of the leading spatial data management organizations of the country regarding the availability, quality and costs of PA related data. Among them, Space Research and Remote Sensing Organization (SPARRSO) national remote sensing organization, Survey of Bangladesh (SoB)- national mapping agency, Department of Land Record and Survey (DLRS), Local Government and Engineering Department (LGED) and Centre for Geographic Information System (CEGIS) are notable. The assessment regarding each thematic area is as follows:

5.1. Vegetation: Forest Department usually maintains the detailed most database regarding forest classification and land use within. This ranges from the overview level down to discrete land unit (DLU) level, which is the lowest management unit of all silvicultural operations. Almost all other organizations maintain a tentative and broadheaded forest classification data. NSP can readily have these dataset from the FD archive.

5.2. Topography: The SoB developed Topographic Maps of scale 1:50,000 nationwide. As the said PAs are characterized by hilly terrains, the contour lines of 50' interval of Topographic maps can be acquired for developing schematic topography of the PAs. Such Topographic maps are also required for realistic PA management planning. A nominal price along with FD's formal request to the Surveyor General of Bangladesh is required to have a set of recent topo maps. It will then be used to scan, geo-rectification, digitize the contours and finally develop terrain maps for each PAs.

Protected Areas	Topo Sheet IDs	Scale	Number
Teknaf GR	84D1, 84D5, 84C3 & 84C4	1: 50,000	4
Chunati WS	79N16, 79O13, 84B4 & 84C1	1: 50,000	4
Satchari NP	78P8	1: 50,000	1
Rema-Kalenga WS	78P12	1: 50,000	1
Lawachara NP	78P15	1: 50,000	1

Table 11: Topographic maps from SoB for the PAs

5.3. Infrastructures/Growth Centers: Local Government and Engineering Department (LGED) Thana Maps of (scale 1:50,000) are very much suitable for this thematic area. Following Thana maps (Table 13) can be procured digitally from LGED archive with Tk. 1,000/each thana.

Protected Areas	Name of Thanas	Districts	Scale	Number
Teknaf GR	Ramu, Nakhyangchari, Ukhia	Cox's bazar	1: 50,000	4
	& Teknaf			
Chunati WS	Satkania, Banskhali,	Chittagong	1: 50,000	5
	Lohagora, Chokoria & Lama			
Satchari NP	Chunarughat	Habigonj	1: 50,000	1
Rema-Kalenga WS	Chunarughat	Habigonj	1: 50,000	1
Lawachara NP	Kamalgonj	Moulavibazar	1: 50,000	1

Table 12: Thana maps from LGED for the PAs

5.4. Remote Sensing Data: CEGIS is one of the leading spatial data management organizations in the country. The level of expertise and spatial data resources are noteworthy. CEGIS is an official distributor here in Bangladesh for Indian Remote Sensing Satellite (IRS) data and that of RadarSat Image (an active sensor). CEGIS can be a source for procurement of quality data and services in this regard. It would be highly appreciating if one expert from CEGIS can be incorporated to evaluate as well as contribute to this report for NSP.

As long as the existing data with RIMS and acquired ones are brought in a harmonious platform, NSP can proceed for future spatial data requisition. It will help to assess the NSP interventions in the vegetation status during the project period. The author realizes the following features in this regard:

- 1. The PAs under NSP cover small patches of forestlands and high-resolution satellite data can be acquired e.g. IKONOS, SPOT Pan etc.
- 2. The existing spatial data are also sufficiently detailed (aerial photo). As such the future data to be acquired might be inconformity with earlier datasets.
- 3. Some other considerations are as follows:
 - Resolution of RS data (Spatial, Temporal, Spectral & Radiometric)
 - Number of Scenes required,
 - Cloud free and
 - Costs

Selection of sensors:

Selection of a suitable satellite sensor is an important landmark for resource monitoring. Among the most widely used satellite data sources, Landsat ETM+ with a spatial resolution of 30mX30m (pixel dimension) or SPOT6 XS (20mX20m) or IRS PAN with 6m resolutions can be procured under NSP for study vegetation dynamics in the said PAs. It requires a technical decision for choosing a suitable satellite sensor considering spatial resolution as well as costs and other features. Some features of these satellite images are given below:

Table 13: Different types of Satellite Images

Satelli te	Туре	Resolution	Band 1 (µm)	Band 2 (µm)	Band 3 (µm)	Band 4 (µm)	Band 5 (µm)	Band 6 (µm)	Band 7 (µm)
Name									
IRS	PAN	6m	0.50-0.75						
	LISS III	24m		0.52-0.59	0.77-0.86	0.62-0.68	1.55-1.70		
SPOT	PAN	10m	0.51-0.73						
	XS	20m	0.50-0.59	0.61-0.68	0.79-0.89		1.54-1.70		
Lands	XS	30m	0.45-0.52	0.52-0.60	0.63-0.69	0.76-0.90	1.55-1.74	10.40-	2.08-
at TM		B6-120m	Blue	Green	Red	NIR	MIR	12.50	2.35
								TIR	MIR

IKONOS:

Band Number	Spectral range	Spatial	Swath
	(frequencies, in µm)	resolution	
Band 1 - Blue	0.45 to 0.52 µm		
Band 2 - Green	0.52 to 0.60 µm		
Band 3 - Red	0.63 to 0.69 µm		
Band 4 - NIR	0.76 to 0.90 µm		
pan	0.45 to 0.90 µm		

7. Strategy for GIS activities under NSP

Sl	Assignments	Activities	Outputs
1	Harmonizing Existing RIMS Data for 5	i. Defining the Projection Parameters	1. Existing GIS database for
	PAs	ii. Scan Controlled Air Photos for Teknaf	5 PAs will be in the same
		and Chunati	platform.
		iii. Geo-rectification of scanned photos	
		iv. Bring all relevant data layers for 5 PAs	
		onto the Air Photos	
2	Preparation of Base Maps for 5 PAs	i. Using standard RIMS Data (output 1)	2. Five database and maps
		prepare new set of base maps for 5 PAs.	for PAs
3	Update database for 5 PAs based on	i. Procurement of Inventory / Survey	3. Updated database of all
	available information from the field.	Instruments (Please see Annex 1)	PAs up to year 2003.
		ii. Extensive field visits to all PAs	4. Map production and
		iii. Map updating onto the Mylars	printing.
		iv. Digitization	
		v. Building Updated GIS database	
4	Demarcation of PA Boundaries and area	i. Resurvey the boundaries of 5 PAs	5. More accurate boundary
	re-estimation	through extensive field visits	and area estimation of
		ii. Conduct DGPS survey.	PAs.
4.1	Survey the boundary of Satchari	i. Conduct DGPS survey	5.1 Develop GIS boundary
	Reserved Forest (proposed NP)		layer for Satchari NP
			(proposed area).
5	Acquirements of relevant data sets from	i. Procure digital thana maps from LGED	6. Data base having local
	other organizations.	ii. Procure hard copy topo maps from SoB	infrastructure and growth
		and digitization of contours.	centers.
			7. Data base with contour.

7. **Reference**:

Nishat, A. S., M. I. Haq, S. P. Barua, A. H. M. Ali Reza and A. S. M. Khan (eds.). 2002. Bioecological Zones of Bangladesh. IUCN-Bangladesh, Dhaka.141 pp.

Annex – I

Instruments required for NSP Assignment

Sl	Item	Specification	Unit	Remarks
1	Sunto		2	Available at RIMS
	Clinometer			
2	Diameter		2	Available at RIMS
	Таре			
3	Measuring	i. Length 100 meter	2	Not available at RIMS
	Tape	ii. width ½ "		
	(100 m)	iii. Open Reel Fibreglass Tape		
		iv. Metric Graduations bonded		
4	Mirror	i. Silva Ranger with built-in	2	Not available at RIMS
	Sighting	Clinometer		
	Compass	ii. Black rotating compass dial		
		iii. Clinometer reading of ±90°		
		iv. Lanyard and Instructions		
5	GPS	i. Garmin i. Garmin	5	Not available at RIMS
		GPS72 eTrix		
		ii. Carrying ii. Carrying		
		Case Case		
		iii. PC Cable iii. PC Cable		
		iv. Software iv. Software		
		(for data (for data		
		transfer) transfer)		
6	Flagging	i. Width 1"; Length 150'	25	Not available at RIMS
	Tag (roll)	ii. 4 colour fluorescent Vinyl		
		tag (pink,yellow, blue,red)		
7	Hard Disk	i. 40 GB hard disk with 72K	1 +	Need for NSP data base
	& flash	rpm.	1	storage.
	disk	ii. Flash disk		

Annex II: RIMS Archives

RIMS unit stores all her Division-wise final data layers in a well-structured archive. Some of these archives are:

Cox's Bazar Forest Division:

Name of layer	Contents	Projectio n	Remarks	
Cox_veg	Vegetation cum landuse	Geographic	Air photo 1995 and 1990	
Coxveg99	Vegetation cum landuse	Geographic	Updated in 2000	
Cox_2000	Vegetation cum landuse	Geographic	Updated in 2002	
Cox_bas	Land-water boundary	Geographic	Air photo 1995 and 1990	
Cox_blk	Administrative units	Geographic	Forest Cover Map 1982-84	
Cox_inf	Road-Rail networks	Geographic	Air photo 1995 and 1990 and Forest Cover Maps 1982-84	
Cox_riv	River-stream network	Geographic	Air photo 1995 and 1990	
Cox_off	Location of Forest offices & growth centre	Geographic	Forest Cover Maps 1982-84	
Overview map	Overview map of Cox's bazar Forest Division; scale 1:225,000; A1			
Map files (*.apr)	Block maps at scale 1:15,000			
Aerial photo	Hardcopy Photos Mosaic	-	Scale 1:10,000	
Forest Cover Map, 1982-84	Hardcopy maps of Scale 1: 15,840; 32 sheets		FAO/UNDP project BGD/79/017	

Chittagong Forest Division:

Name of layer	Contents	Projectio n	Remarks
Ctg_veg	Vegetation cum landuse	Geographic	Air photo 1995
Veg_2000	Vegetation cum landuse	Geographic	Updated in 2002
Ctg_bas	Land-water boundary	Geographic	Air photo 1995 and 1990
Ctg_blk	Administrative units	Geographic	Forest Cover Map 1982-84
Ctg_inf	Road-Rail networks	Geographic	Air photo 1995 and Forest Cover Maps 1982-84
Ctg_riv	River-stream network	Geographic	Air photo 1995
Ctg_off	Location of Forest offices & growth centre	Geographic	Forest Cover Maps 1982-84
Overview map	Overview map of Chittagong Forest Division; scale 1:275,000; A1		
Map files (*.apr)	Block maps at scale 1:15,000		
Aerial photo	Hardcopy Photos Mosaic	-	Scale 1:10,000
Forest Cover Map, 1982-84	Hardcopy maps of Scale 1: 15,840; 57 sheets		FAO/UNDP project BGD/79/017

Sylhet Forest Division:

Name of layer	Contents	Projectio n	Remarks	
Syl_veg	Vegetation cum landuse	Geographic	Visual interpretation of SPOT XS 96	
Sylveg99	Vegetation cum landuse	Geographic	Updated in 2000	
Syl_beat	Administrative units	Geographic	Forest Cover Maps 1982-84	
Syl_inf	Infrastructure (roads, rivers, railways etc.)	Geographic	Forest Cover Maps 1982-84	
Syl_off	Location of Forest offices & growth centre	Geographic	Forest Cover Maps 1982-84	
Img_Indx	SPOT XS index for Sylhet Forset Division			
Overview map	Overview map of Sylhet Forest Division; scale 1:275,000; A1			
Map files (*.apr)	Beat maps at scale 1:25,000			
SPOT XS	3 Bands; 5 Scenes	Geographic	FRMP	
Forest Cover Map, 1982-84	Hardcopy maps of Scale 1: 15,840; 24 sheets		FAO/UNDP project BGD/79/017	

Sundarbans Reserved Forests:

Name of layer	Contents	Projectio n	Remarks
Srf_veg	Vegetation types 1995	Geographic	Air photo 1995
Srf_Bas	Land water boundary and river network	Geographic	Air photo 1995
SRF_Com	Compartment, Block and Range boundaries	Geographic	From IRMP data base
PSP	Permanent Sample Plots SRF	Geographic	From PSP documentation, FD
Office	Location of Offices in SRF	Geographic	From IRMP data base
SRF_Riv	Name of Rivers as annotation	Geographic	From IRMP data base

Coastal Forest Divisions

Name of layer	Contents	Projection	Remarks
Coa_Veg	Vegetation of 4 Coastal Divisions	Geographic	
Coa_LW	Land use of non vegetated land of 4 Coastal Divisions	Geographic	Source: Land Accretion and Plantation Map 1992 by SPARRAO
Coa_Bas	Base Coverage of Coastal Forest Divisions	Geographic	
Coa_Ann	Name of Places & rivers	Geographic	
Coa_Off	Forest Offices in 4 Coastal Forest Divisions	Geographic	



Figure : Cox's Bazar, Chittagong, Sylher, Sundarbans and Coastal Forest Divisions







Name of the PA: Satchari Range, Hobigonj.





