



Geospatial Driven Forest Monitoring and Management



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Odisha Forestry Sector Development Project



GIS in Forest Management

- Assists in systematic organization of **forest land resources**
- Provides solutions for effective **planning** and **forest land management**.
- GIS based Land Information System can be used as a **digital repository** of key **forestry datasets**
- Systematic organization of thematic data layers
 - topography, forest administrative boundaries,
 - forest management units, forest infrastructure
 - forest working plans.



GIS in Forest Management

- High resolution **satellite images** to accurately delineate
 - ground features, vegetation type, density through land use analysis.
- **DGPS surveys of forest blocks** and accurate georeferencing
 - notified forest blocks, boundaries for JFM treatment areas,
 - forest infrastructure.



Planning for forestry interventions



Prioritizing forest lands for treatment

- Identification of degraded forests based on land use and vegetation maps.
- Analysis by ground truthing and verification by field information

Survey and Mapping of individual forest treatment sites.

- Selection of individual treatment site by field units
- Demarcation and survey of each treatment site
- DGPS Survey of the site
- Development of GIS based thematic data layers
- Ground truth and Field Verification of maps.
- Maps provided to field staff for detailed micro level planning.

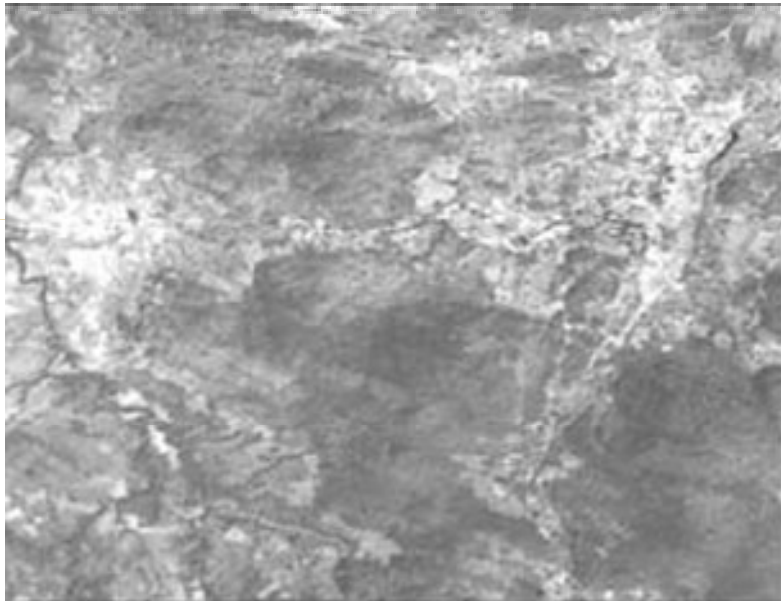




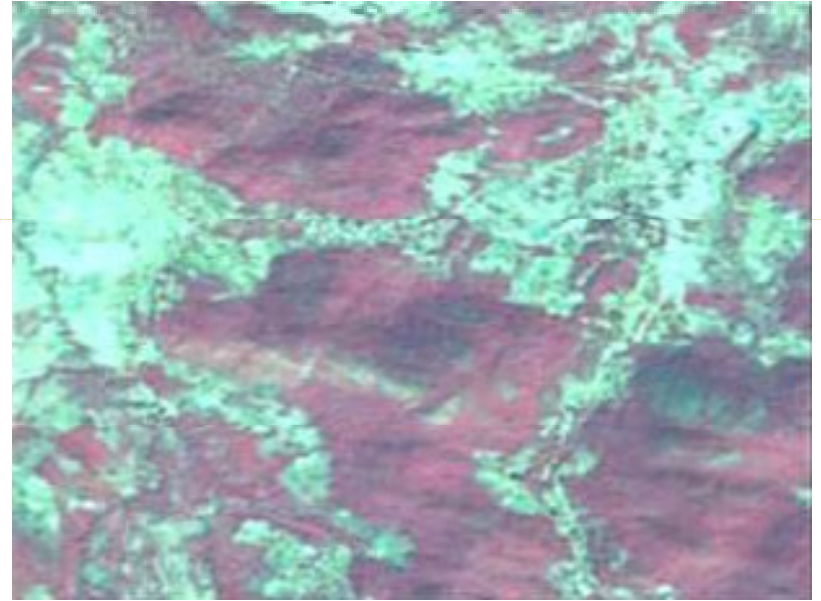
Development of thematic data layers

- Preparation of large scale maps of 1:4000 scale for site wise planning.

- Generation of **vegetation map** and **land use map**
 - High resolution satellite images with multi-spectral characteristics
 - *Cartosat Satellite image - 2.5 m resolution*
 - *LISS IV Resourcesat satellite Image -5.8 m resolution*

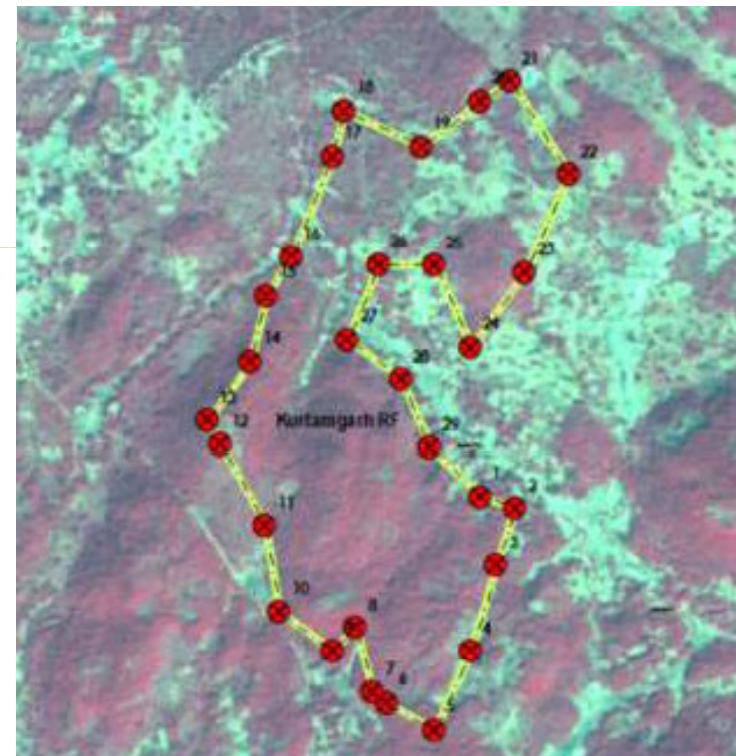
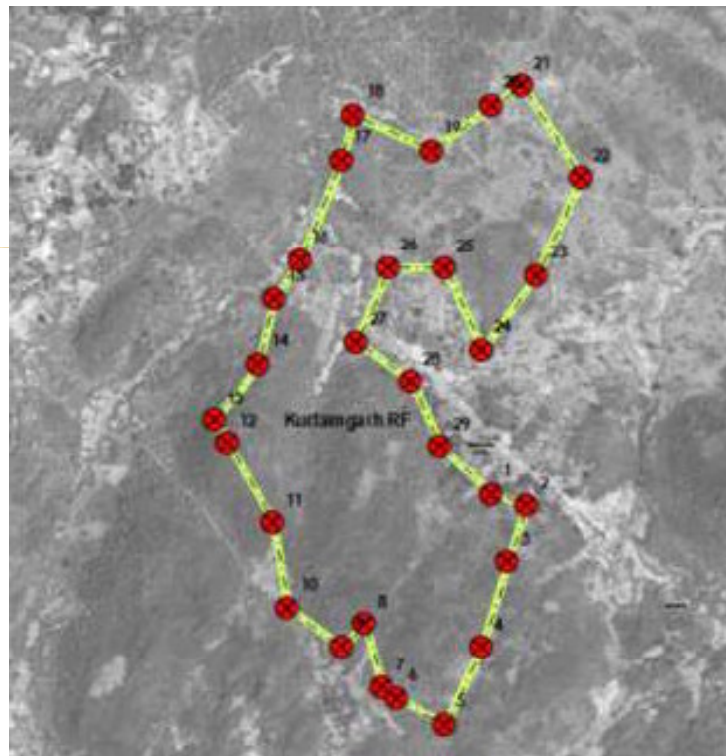


Cartosat Image
(2.5m resolution)

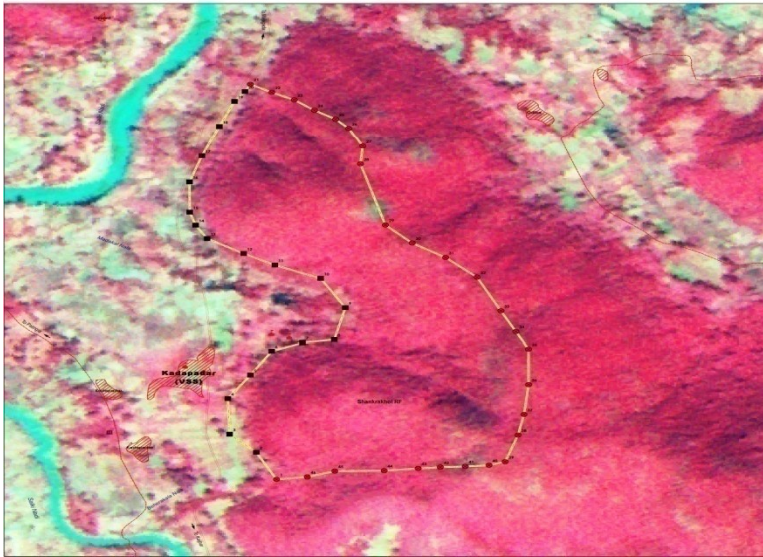


Resourcesat LISS IV
Image
(5.8m resolution)

DGPS/GPS survey data on satellite imagery



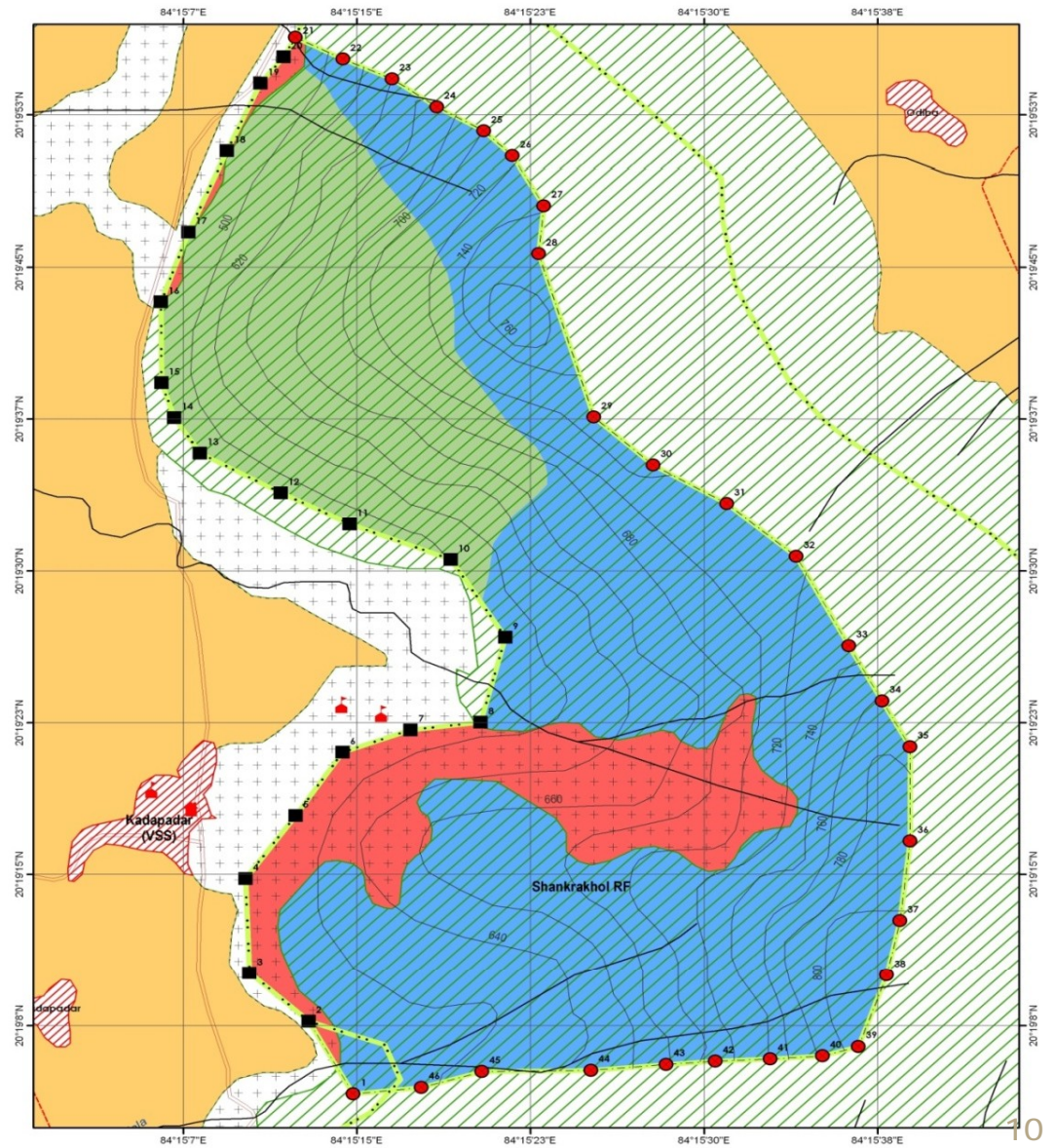
SITENAME: KADAPADAR (84.669 Ha.) DIVISION: PHULBANI
SCALE 1:5000 0 100 200 300 400 500 1000 METER



Forest Map of JFM Site

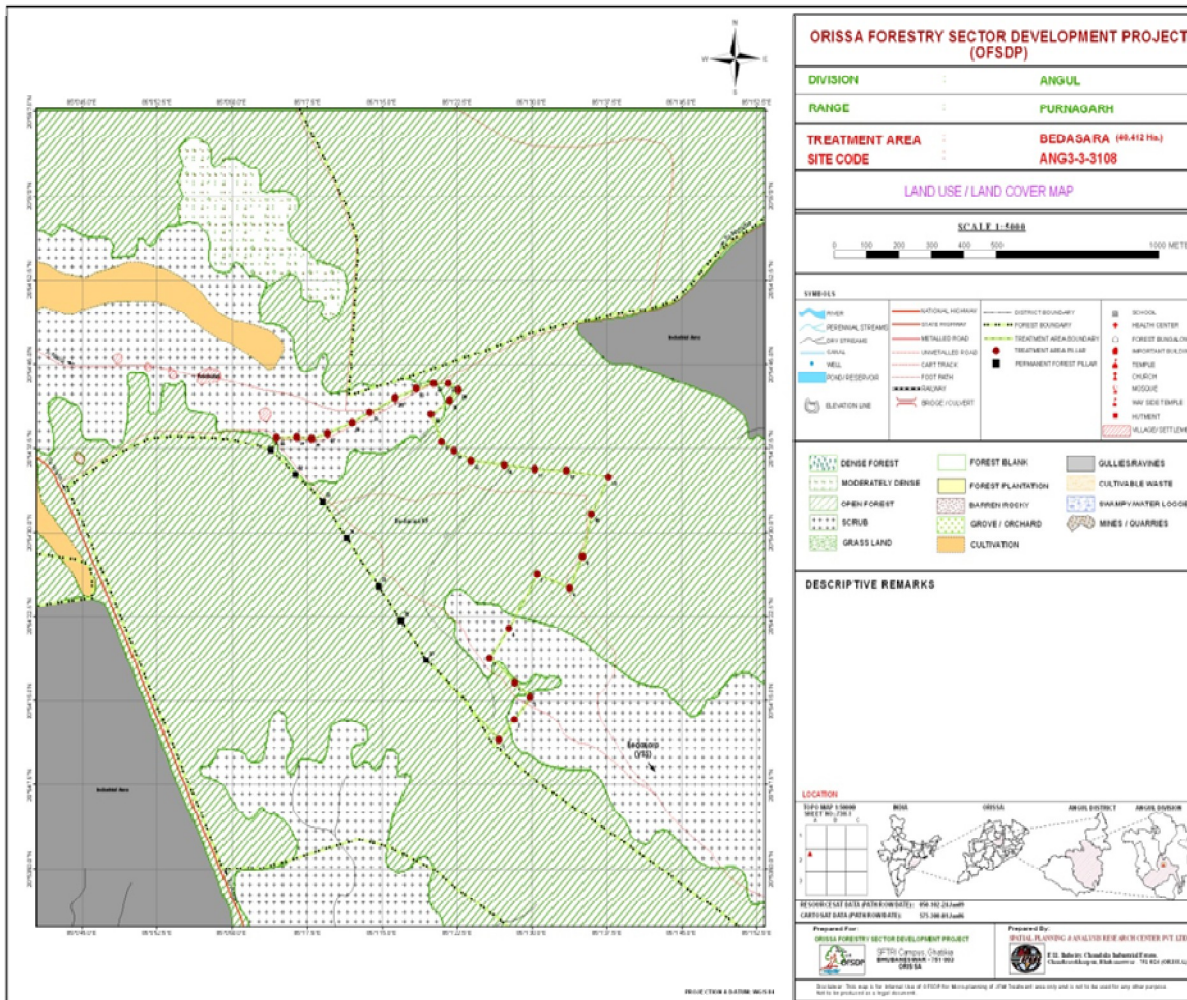
SITENAME: KADAPADAR (AREA: 84.669 Ha.) DIVISION: PHULBANI

SCALE 1:5000 0 100 200 300 400 500 1000 METER

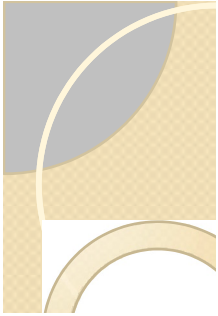




Land Use Map (Land Use features of JFM Treatment Area)

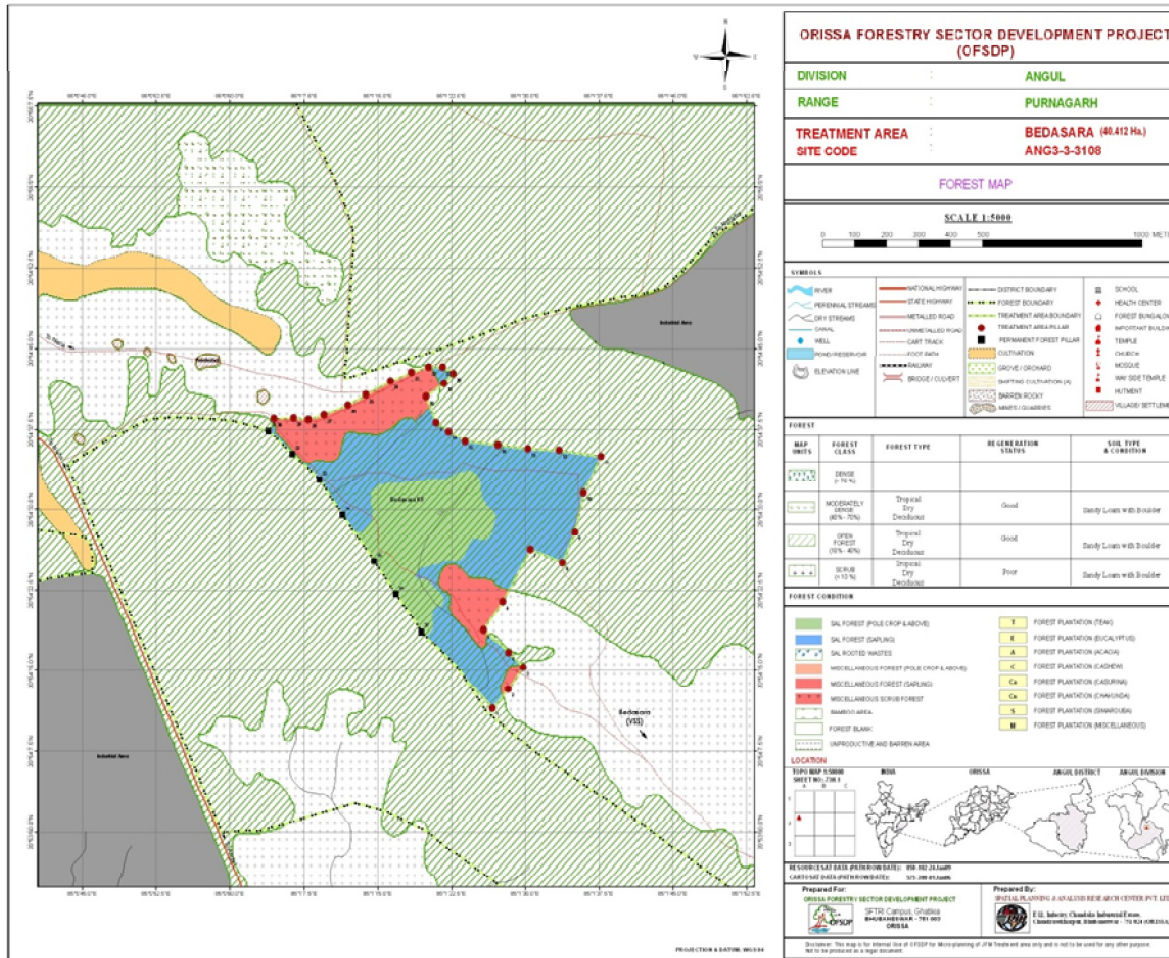


- Forest densities (Dense, moderately dense, open, forest blanks)
- Agriculture, Scrubs, abandoned shifting cultivation, barren rocky, gullies, mines, quarries, etc.
- Plantations, groves, orchards, grass lands, etc
- Elevation Lines



Forest Map

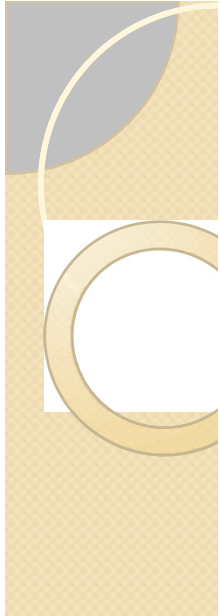
(Vegetation details of JFM Treatment Area)



- Stock type with age class
- Forest densities
- Forest details (root stock, regeneration status, soil type)
- Elevation Lines
- Drainages
- Major topographic features



Monitoring forestry interventions



Teak Plantations

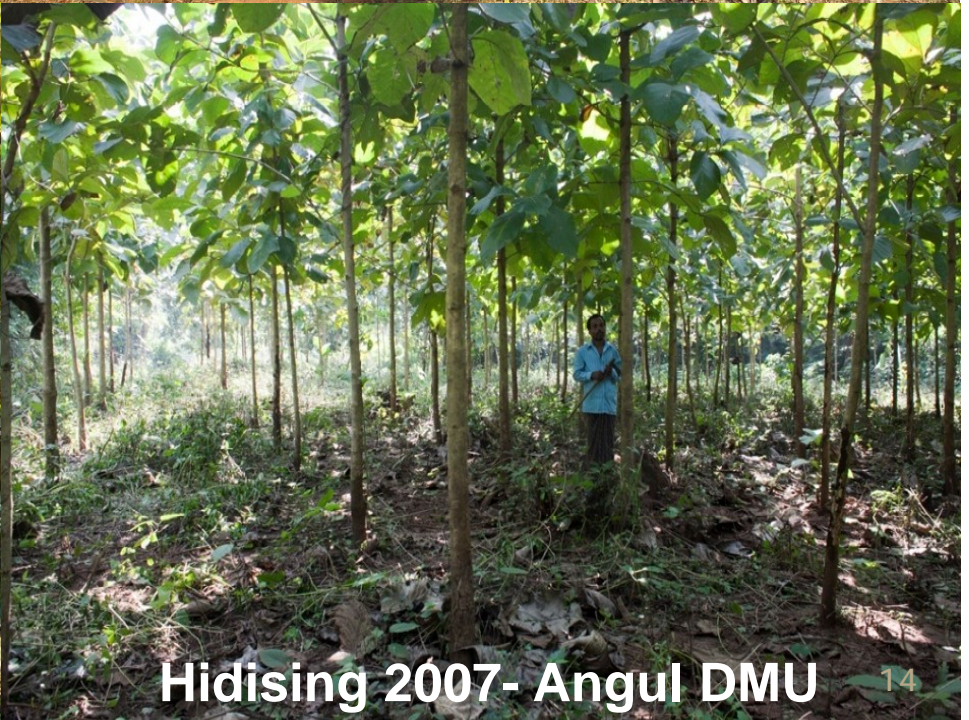
Banbira DPF- 2008 Deogarh DMU



Patamara, 2010-11, Balliguda DMU



24 10 2011 09 40



Hidising 2007- Angul DMU



Casuarina Plantations





Restoration of Mangrove Forests



Restoring degraded forest lands

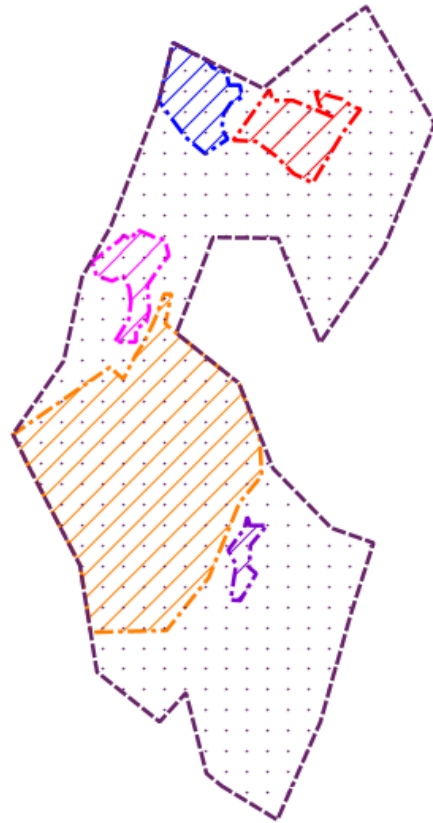




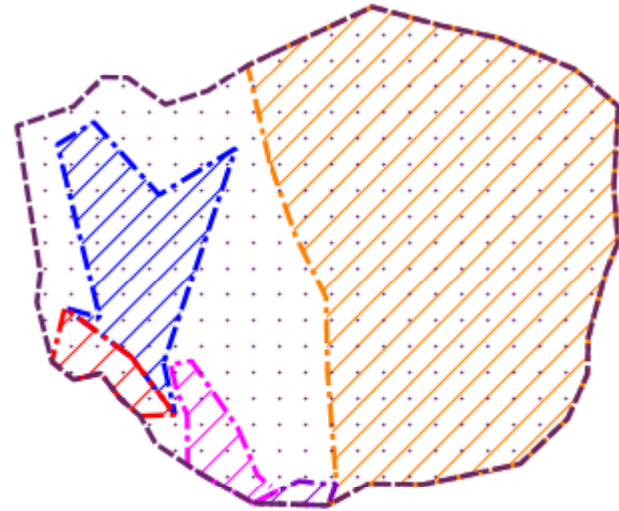
GIS Based Activity Monitoring

- Project interventions captured systematically by collecting **location data** using GPS devices
- GPS readings collected by field staff
- **Non spatial data** collected in tabular form
- Large GPS data collected by various forest divisions sent to Forest Geomatics centre.

GPS data collected for treatments undertaken



Benemilla VSS, Baliguda Division



Malangi VSS, Baliguda Division



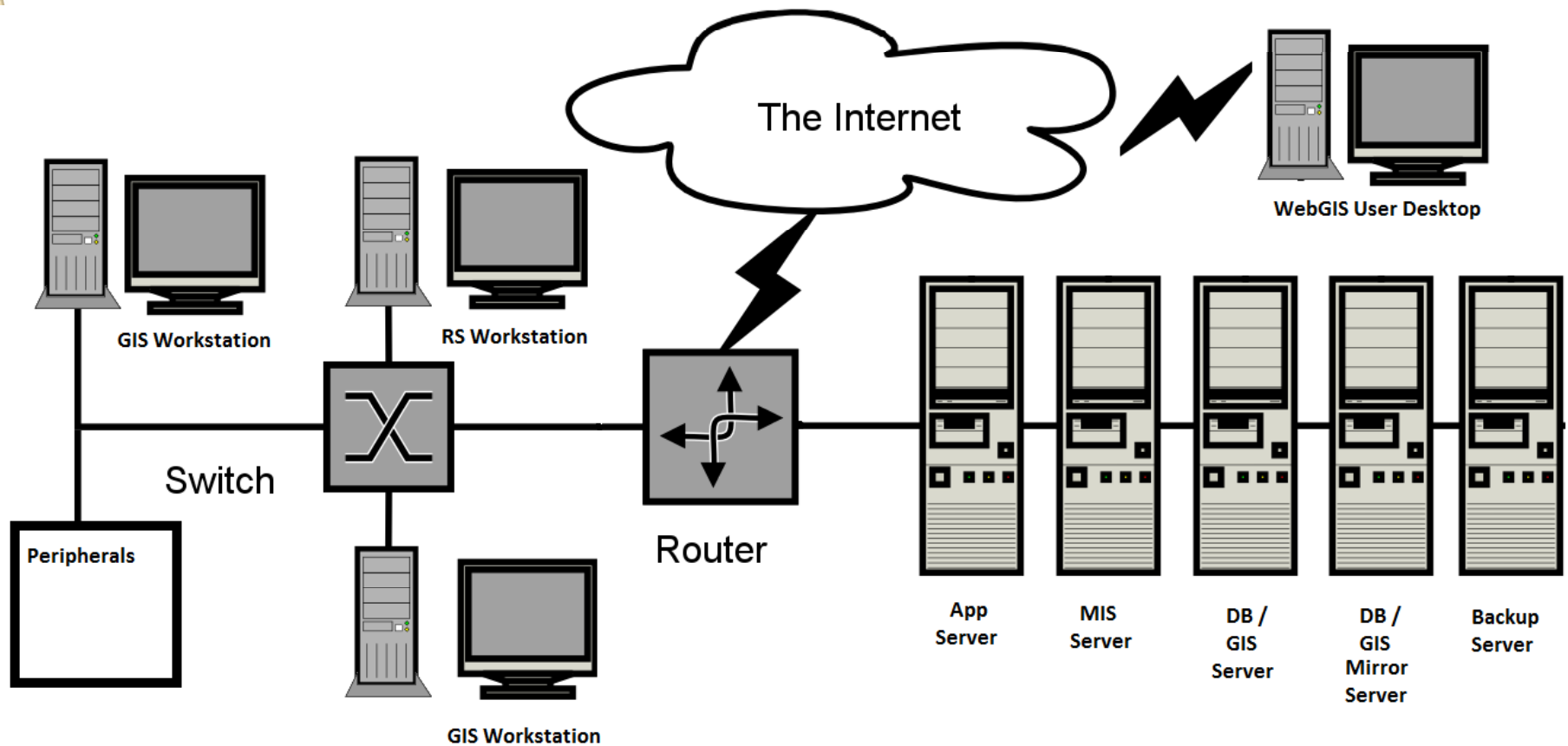
Forest Geomatics centre Bhubaneswar



Evolution of Forest Geomatics Centre

- Data was stored in multiple formats and at multiple places
- There were multiple versions of same data
- Searching and viewing relevant data for a particular site/ parameter was difficult
- Datasets were standardized and consolidated into one large coherent database

Server / Network Architecture





Spatial Database

- All vector GIS data stored in a Master Spatial Database

- Master Database is updated with data from the WebGIS and GIS Workstations regularly
- Master Database is queried by the GIS server/ Application server for generating Web and Map Content



Image Library

- Raster data including satellite imagery, scanned maps are properly geo-referenced, catalogued and stored on the GIS server
-
- This data is integrated with Spatial Database and the WMS server directly for delivery through WebGIS portal



Evolution of Web enabled Decision Support System

- GIS data initially remained confined to Geomatics centre.
- Field staff could not visualize errors in GPS data collection.
- Use of GIS data for planning, monitoring and supervision of forestry works was limited.
- Data was not accessible to non-technical users



WebGIS

- A web portal was developed to facilitate layered map and **data visualization**.
- Ideal for **non-technical users** through a web browser



WebGIS Portal facilities

- viewing multiple map layers
- multiple backgrounds, satellite imagery, forest cover themes
- Repository of all treatment activities
- updating spatial/non-spatial /multimedia data directly by field staff in the GIS portal
- hierarchical validation and authentication mechanisms in built
- Integration of MIS data
- portal navigation based on map or MIS data

WebGIS Interface

The screenshot displays the OFSDP WebGIS interface within a browser window. The browser's address bar shows the URL 'OFSDP WebGIS'. The interface includes a top navigation bar with various application icons and a user profile dropdown for 'jpdime'. On the left, a 'Map Layers' panel lists several categories of layers, including 'OFSDP Layers', 'Base Layers', 'JFM Treatment', 'Soil Moisture Conserva...', 'Other JFM Activities', 'Bio Diversity', 'Non JFM Plantations', 'Other Non JFM Activitie', 'Infrastructure', 'Forest Deptt Layers', 'Admin Boundaries', 'Division Boundary', 'RF/PRF Boundary (E', 'Range Boundary', 'Data Layers', 'Political Boundaries', 'Roads and Railways', 'Water Features', 'Geography/Environmer', and 'Others'. A central map area shows a geographical region with green dashed outlines and purple data points. To the right of the map, a 'Select BG' dropdown menu is open, listing options: 'FSI 2011', 'Google Satellite', 'Google Terrain', 'Google Map', 'Bing Map', 'Bing Satellite', 'Bing Hybrid Maps', and 'Open Street Maps'. Below the map, there are buttons for 'Layer Combinations' and 'OFSDP Units'. The footer contains the copyright notice '© 2014. All rights reserved.' and a 'Terms of Use' link. The page number '87.42236, 19.50133' is visible in the bottom right corner.

WebGIS Background Layers

The screenshot displays the OFSDP WebGIS interface. The main map area shows a satellite view of a region with several overlaid layers: a bright green boundary, a cyan boundary, and purple/pink shaded areas. The interface includes a top navigation bar with the title 'OFSDP WebGIS', a user profile 'jpdlime', and a background layer dropdown menu currently set to 'Bing Satellite'. The dropdown menu lists options: 'Select BG', 'FSI 2011', 'Google Satellite', 'Google Terrain', 'Google Map' (highlighted), 'Bing Map', 'Bing Satellite', 'Bing Hybrid Maps', and 'Open Street Maps'. On the left, a 'Map Layers' panel lists various categories such as 'OFSDP Layers', 'Base Layers', 'JFM Treatment', 'Soil Moisture Conserva...', 'Other JFM Activities', 'Bio Diversity', 'Non JFM Plantations', 'Other Non JFM Activitie', 'Infrastructure', 'Forest Deptt Layers', 'Admin Boundaries', 'Division Boundary', 'RF/PRF Boundary (E', 'Range Boundary', 'Data Layers', 'Political Boundaries', 'Roads and Railways', 'Water Features', 'Geography/Envionmer', and 'Others'. Below the map panel are buttons for 'Layer Combinations' and 'OFSDP Units'. The bottom left corner contains the copyright notice '© 2014. All rights reserved.' and a 'Terms of Use' link. The bottom right corner shows the coordinates '87.34546, 17.68960'.

Online repository of thematic layers

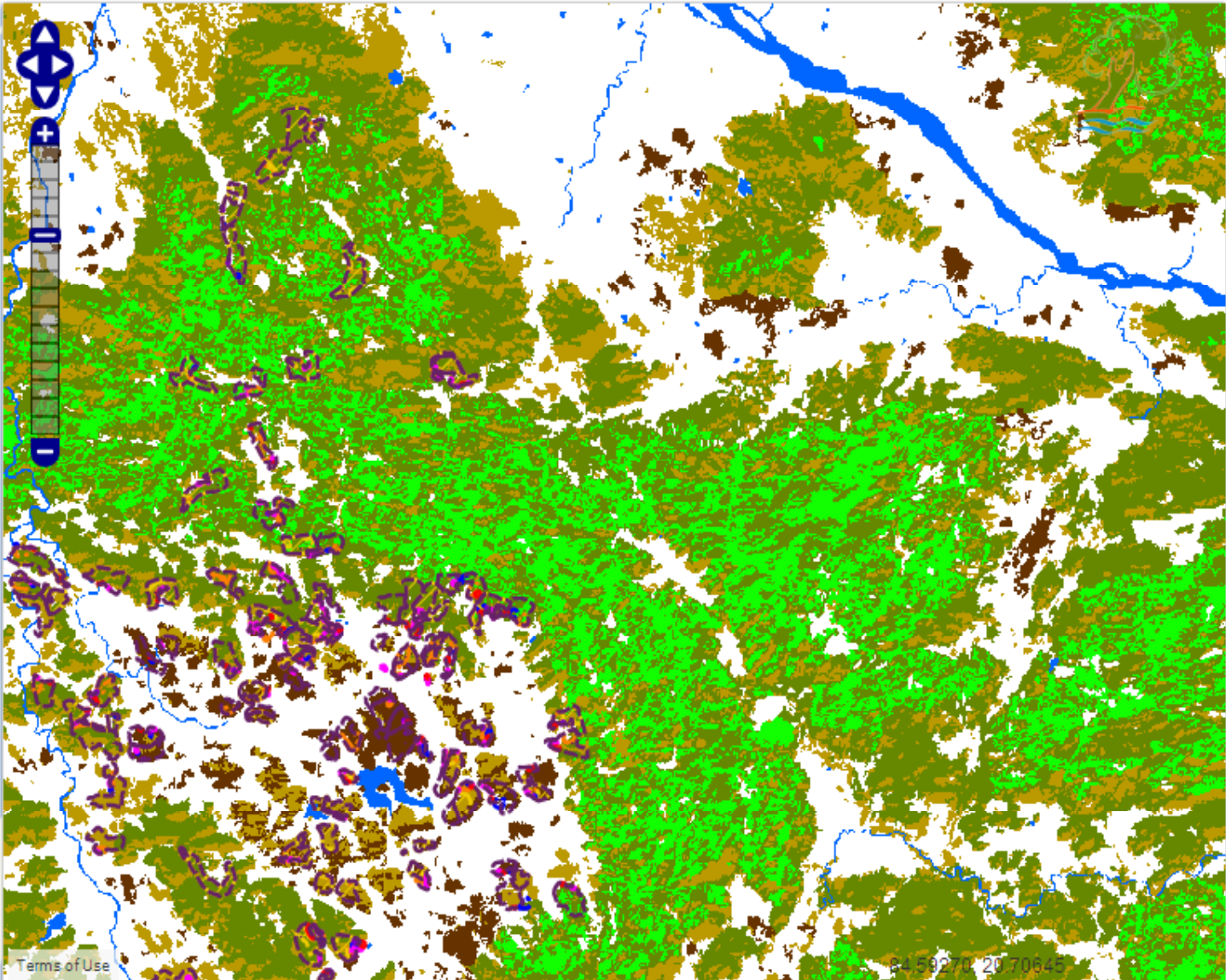
OFSDP WebGIS

FSI 2011

jpdlime

Map Layers

- OFSDP Layers
 - Base Layers
 - JFM Treatment
 - Soil Moisture Conserva
 - Other JFM Activities
 - Bio Diversity
 - Non JFM Plantations
 - Other Non JFM Activitie
 - Infrastructure
 - Forest Deptt Layers
 - Admin Boundaries
 - Division Boundary
 - RF/PRF Boundary (S
 - Range Boundary
 - Data Layers
 - Political Boundaries
 - Roads and Railways
 - Water Features
 - Rivers
 - Drainage Lines
 - Water Bodies
 - Wells
 - Canals
 - Geography/Environmer
 - Others

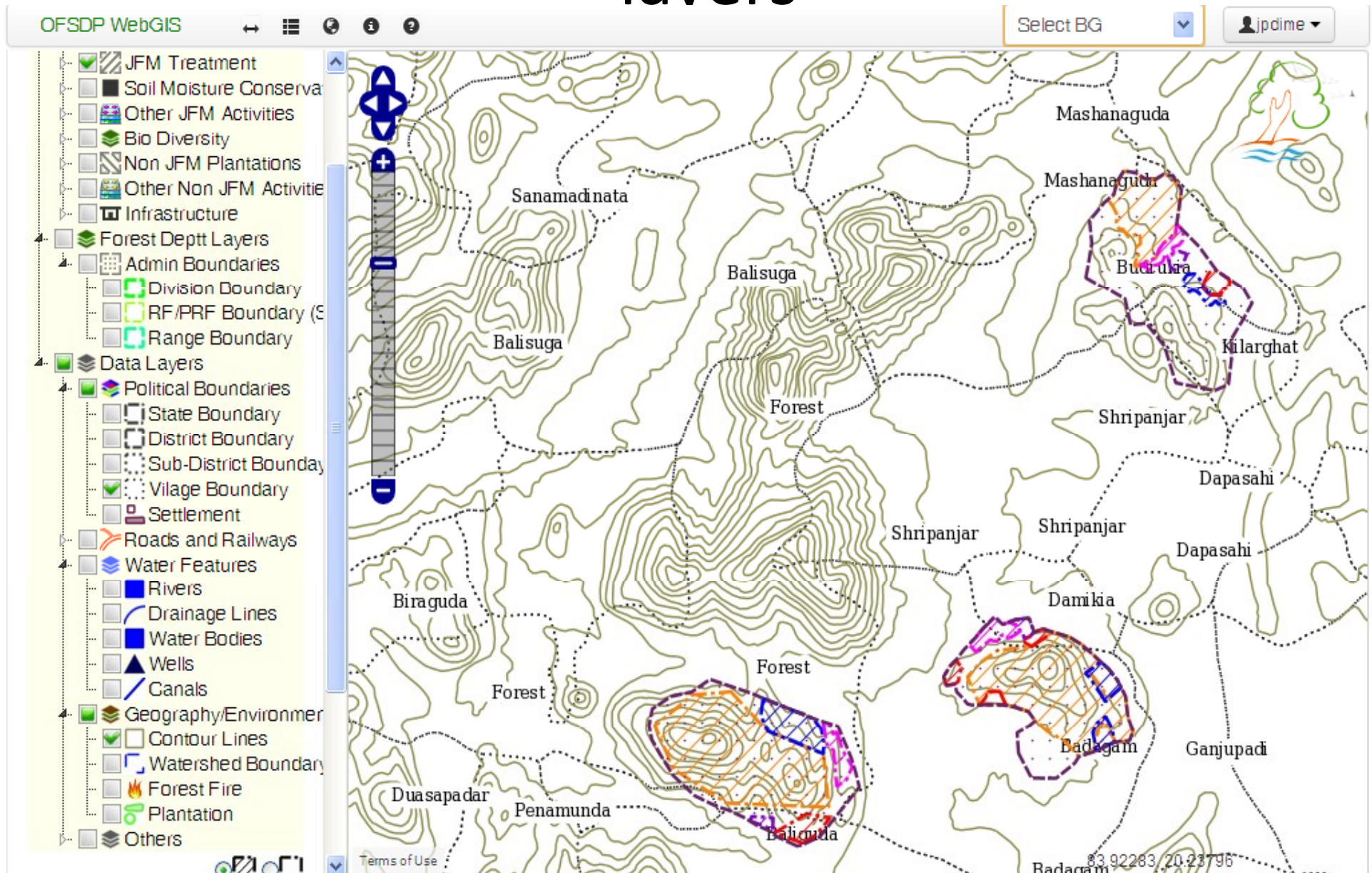


Layer Combinations

Terms of Use

8459271_2070648

Online repository of thematic layers



Map Feature Information

OFSDP WebGIS → ☰ 📍 🔍 ? Select BG ▼ jp dime ▼

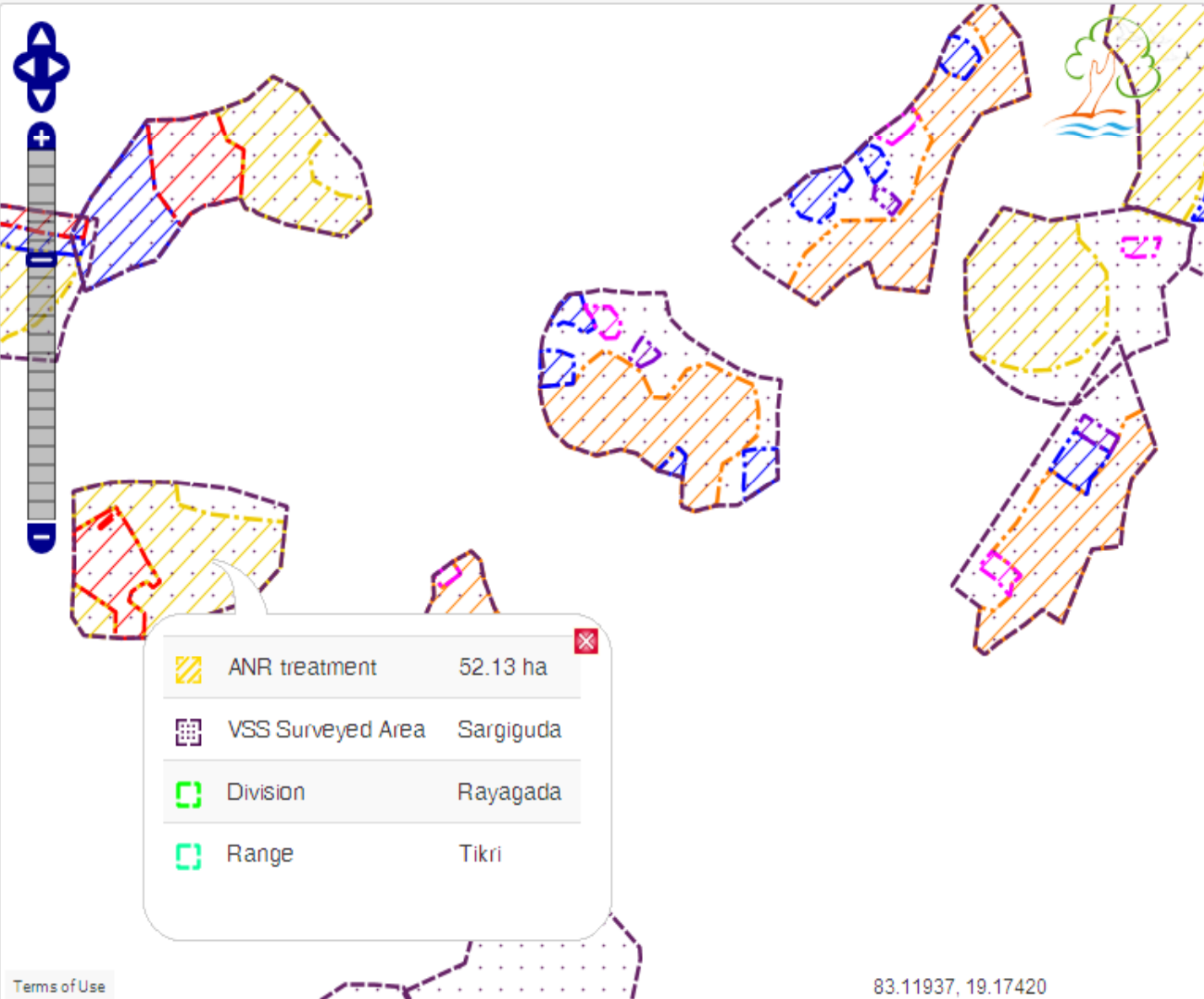
Map Layers

- OFSDP Layers
 - Base Layers
 - VSS Treatment Area
 - JFM Treatment
 - Soil Moisture Conservation
 - Other JFM Activities
 - Bio Diversity
 - Non JFM Plantations
 - Other Non JFM Activities
 - Infrastructure
 - Forest Deptt Layers
 - Admin Boundaries
 - Division Boundary
 - RF/PRF Boundary (SOI)
 - Range Boundary
 - Data Layers





Layer Combinations

OFSDP Units

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The map displays several irregularly shaped areas with different patterns and colors. A popup window is open over one of the areas, showing the following information:

	ANR treatment	52.13 ha
	VSS Surveyed Area	Sargiguda
	Division	Rayagada
	Range	Tikri

Terms of Use 83.11937, 19.17420

User friendly navigation based on Administration Units

The screenshot displays the OFSDP WebGIS interface. The main map area shows a geographical region with several administrative units outlined in purple. A green dashed line represents a path or boundary across the map. The left sidebar contains a tree view of administrative units, with 'Jarda' selected and highlighted in blue. The interface includes a top navigation bar with the title 'OFSDP WebGIS', a user profile 'ang3ranger', and a 'Select BG' dropdown. The bottom of the interface shows 'Data to be Saved', 'Data Verification & Certification', and a 'Terms of Use' link. The coordinates '77.84116, 19.86362' are displayed in the bottom right corner.

OFSDP WebGIS

Select BG

ang3ranger

Map Layers

Layer Combinations

OFSDP Units

Show Info?

- Angul
- Balasore
- Balliguda
- Bhadrak
- Bonai
 - Barsuan
 - Bonai
 - Jarda
 - Burda
 - Ghantiali
 - Jalei
 - Jarda
 - Kainsibahal
 - Kansar
 - Kello
 - Kundheidiha
 - Kunjaria
 - Kusumnali
 - Niktimal
 - Regedabahal
 - San-Balia (Balia)
- Kuliposh
- Sole
- Tamra
- Deogarh
- Jepore
- Keonjhar
- Koraput
- Parlakhemundi
- Phulbani
- Rayagada
- Rourkela
- Satkosia

Data to be Saved

Data Verification & Certification

Terms of Use

77.84116, 19.86362

Online Spatial Data Entry

The screenshot displays the OFSDP WebGIS interface. The top navigation bar includes the title 'OFSDP WebGIS', navigation icons, a map style selector set to 'Google Satellite', and a user profile 'ang9ranger'. On the left, a sidebar contains sections for 'Map Layers', 'Layer Combinations', 'OFSDP Units', and a tree view of administrative units. The 'Purunagarh' unit is selected. The main map area shows a satellite view of a forested region with labels for 'Kandhakule', 'Forest', 'Balijeranga', 'Pokunda', 'Manikajori', 'Kulasara', 'Bruti', 'Jaganathpur', and 'Hinsrida'. A data entry form titled 'ANG3' is overlaid on the right side of the map. The form includes a dropdown menu for 'Plantation' (set to 'Plantation'), a dropdown for 'Select Plantation Type', and input fields for 'Area in Hectares', 'Name of Site', 'Name of Coupe', 'Name of Working Circle', and 'Name of RF/PRF'. There is also a text area for 'Paste GPS Data from Excel' and another for 'Additional Information about the Activity'. A blue 'Add Activity' button is at the bottom of the form. The bottom of the interface shows 'Data to be Saved', 'Data Verification & Certification', and a copyright notice '© 2014. All rights reserved.'

OFSDP WebGIS

Google Satellite

ang9ranger

Map Layers

Layer Combinations

OFSDP Units

Show Info?

- Angul
 - Chhendipada
 - Durgapur
 - Kaniha
 - Purunagarh**
 - Raigoda
 - Talcher
- Balasore
- Balliguda
- Bhadrak
- Bonai
- Deogarh
- Jeypore
- Keonjhar
- Koraput
- Parlakhemundi
- Phulbani
- Rayagada
- Rourkela
- Satkosia

ANG3

Plantation

Select Plantation Type

Area in Hectares

Name of Site

Name of Coupe

Name of Working Circle

Name of RF/PRF

Paste GPS Data from Excel

Additional Information about the Activity

Add Activity

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Data Entry verification & Certification

OFSDP WebGIS ← ☰ 📍 🔍 🌐 👤 Google Satellite ▼ angStranger

Map Layers

Layer Combinations

OFSDP Units

Show Info?

- Angul
 - Ghendipada**
 - Durgapur
 - Kaniha
 - Purunagarh
 - Raigoda
 - Talcher
- Balasore
- Balliguda
- Bhadrak
- Bonai
- Deogarh
- Jeypore
- Keonjhar
- Koraput
- Parlakhemundi
- Phulbani
- Rayagada
- Rourkela
- Satkosia

Data to be Saved

Data Verification & Certification

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The map displays a large, irregularly shaped forest area in shades of brown and green. The forest is divided into 23 numbered points (1-23) arranged in a roughly rectangular grid. Each point is labeled with its corresponding number. The word 'Forest' is written in white text on a black background at several points, including 1, 3, 6, 7, 11, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, and 24. The map is overlaid on a satellite image showing a river and surrounding terrain. The interface includes a navigation toolbar on the left with a compass, a zoom slider, and a scale bar. The bottom of the map shows the Google logo, 'Imagery ©2014 DigitalGlobe', and a 'Report a map error' link.

Data Entry verification & Certification

The screenshot displays the OFSDP WebGIS interface. The main map area shows a satellite view of a forested region with a blue polygon overlaid. The polygon is defined by 23 numbered points (1-23) and is labeled "Forest" in several locations. The interface includes a sidebar on the left with the following sections:

- Map Layers
- Layer Combinations
- OFSDP Units
- Show Info?
- Location list (highlighted in yellow):
 - Angul
 - Chhendipada
 - Durgapur
 - Kaniha
 - Purunagarh
 - Raigoda
 - Talcher
 - Balasore
 - Balliguda
 - Bhadrak
 - Bonai
 - Deogarh
 - Jeypore
 - Keonjhar
 - Koraput
 - Parlakhemundi
 - Phulbani
 - Rayagada
 - Rourkela
 - Satkosia

At the bottom of the interface, there is a status bar with the text "© 2014. All rights reserved." and "Imagery ©2014 DigitalGlobe". The bottom right corner shows coordinates "84.30550, 21.07616" and a "Report a map error" link.

Online Uploading Spatial data in Database

The screenshot displays the OFSDP WebGIS interface. The main map area shows a satellite view with a large purple polygon overlaid, representing a forest area. The polygon is numbered 1 through 23. A popup window titled "Feature Details" is open, displaying the following information:

Feature Details	
Jurisdiction	F_ANG1
Name	Basantpur
Activity Type	ART
Reported Area	30
RF/PRF	Burti Reserve Forest
Working Circle	RWG
Coupe	BK 7
Description	Non JFM Teak PLantation, 2013
Calculated Area	35.7574 Ha
Feature Type	PLTN

Below the details are "Save" and "Delete" buttons. The interface also includes a left sidebar with "Map Layers", "Layer Combinations", "OFSDP Units", and a list of locations under "Show Info?". The top right shows "Google Satellite" and a user profile "ang3ranger". The bottom left has "© 2014. All rights reserved." and the bottom right has "Report a map error".

Online Data Verification / Validation

The screenshot displays the OFSDP WebGIS interface. On the left, there is a sidebar with the following sections: 'Map Layers', 'Layer Combinations', 'OFSDP Units', and 'Show Info?'. The 'Show Info?' section is expanded, showing a list of units including Angul, Chhendipada, Durgapur, Kaniha, Purunagarh, Raigoda, Talcher, Balasore, Balliguda, Bhadrak, Bonai, Deogarh, Jeypore, Keonjhar, Koraput, Parlakhemundi, Phulbani, Rayagada, Rourkela, and Satkosia. Below this list are buttons for 'Data to be Saved' and 'Data Verification & Certification'. At the bottom left of the sidebar, it says '© 2014. All rights reserved.'.

The main map area shows a satellite view of a region with several labeled locations: Markandahill, Parikote, Sibanarayanpur, Meturu, and others. A blue polygonal feature is highlighted on the map, and a 'Feature Details' popup window is open over it. The popup contains the following information:

Feature Details	
Jurisdiction	F_ANG2
Name	Kaniha-I
Activity Type	ART
Reported Area	35
RF/PRF	RF NAmE
Working Circle	W-1
Coupe	C-1
Description	
Calculated Area	23.4403 Ha
Feature Type	PLTN
Save Delete	

At the bottom of the map, there is a Google logo and the text 'Map data ©2014 Google Imagery ©2014 Cnes/Spot Image, DigitalGlobe'. In the bottom right corner, there is a small text '84.13549, 18.80938' and a 'Report a map' link.

Non Spatial data and MIS Overlay

OFSDP WebGIS Google Satellite angSranger

Map Layers

Layer Combinations

OFSDP Units

Show Info?

- .. Angul
- .. Balasore
- .. Balliguda
- .. Bhadrak
- .. Bonai
- .. Deogarh
- .. Jeypore
- .. Keonjhar
- .. Koraput
- .. Parlakhemundi
- .. Phulbani
- .. Rayagada
- .. Rourkela
- .. Satkosia

Data to be Saved

Data Verification & Certific

Phulbani (PHU)

• Economic	609 Ha	142	544.19 Ha	124
• Fuel and Fodder	476 Ha	146	392.61 Ha	122
• Bamboo	178 Ha	73	145.50 Ha	61
• NTFP	379 Ha	80	360.12 Ha	72
Soil Moisture Conservation	--	-	--	-
• Gully Plugging	0 Nos	0	0 Nos	0
• Contour Bund	0 Mts	0	0 Mts	0
• Contour Trench	0 Mts	0	0 Mts	0
• Half Moon Trench	0 Nos	0	0 Nos	0
• Mulching	0 Nos	0	0 Nos	0
• LBCD	0 Nos	0	0 Nos	0
• Percolation Pit	0 Nos	0	0 Nos	0

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Map data ©2014 Google Imagery ©2014 TerraMetrics

Map navigation using MISdata

Map Layers

Layer Combinations

OFSDP Units

Show Info?

- Angul
- Balasore
- Balliguda
- Bhadrak
- Bonai
- Deogarh
- Jeypore
- Keonjhar
- Koraput
- Parlakhemundi
- **Phulbani**
 - G.Udayagiri
 - Karada
 - Phiringia
 - Phulbani
 - Raikia
 - Sudrukumpa
 - Tikabali
- Rayagada
- Rourkela
- Satkosia

Data to be Saved

Data Verification & Certification

© 2014. All rights reserved.

Phulbani (PHU)

• ANR w/o Gap	17,849 Ha	241
Block	1,642 Ha	-
• Economic	609 Ha	142
• Fuel and Fodder	476 Ha	146
• Bamboo	178 Ha	73
• NTFP	379 Ha	80
Soil Moisture Conservation	- -	-
• Gully Plugging	0 Nos	0
• Contour	0 Mts	0

Bamboo Plantation (Phulbani)

FMU	Achievement	Uploaded
G.Udayagiri	8 / 4	6.91 / 3
Raikia	41 / 8	15.73 / 5
Phulbani	28 / 23	22.32 / 17
Karada	49 / 6	49.84 / 6
Sudrukumpa	7 / 5	7.56 / 5
Phiringia	24 / 16	21.47 / 14
Tikabali	21 / 11	21.66 / 11



Mobile GIS Application Features

- **Data collection** using built in sensors like GPS, Camera to improve efficiency, speed and accuracy
- Direct **data transfer** from field device to central server through wifi and mobile data interface
- Map and GIS data visualization with users current location on screen
- **Offline caching** and display of GIS data for usage in places without internet connectivity
- Automatic 2 way data synchronization on availability of server connectivity

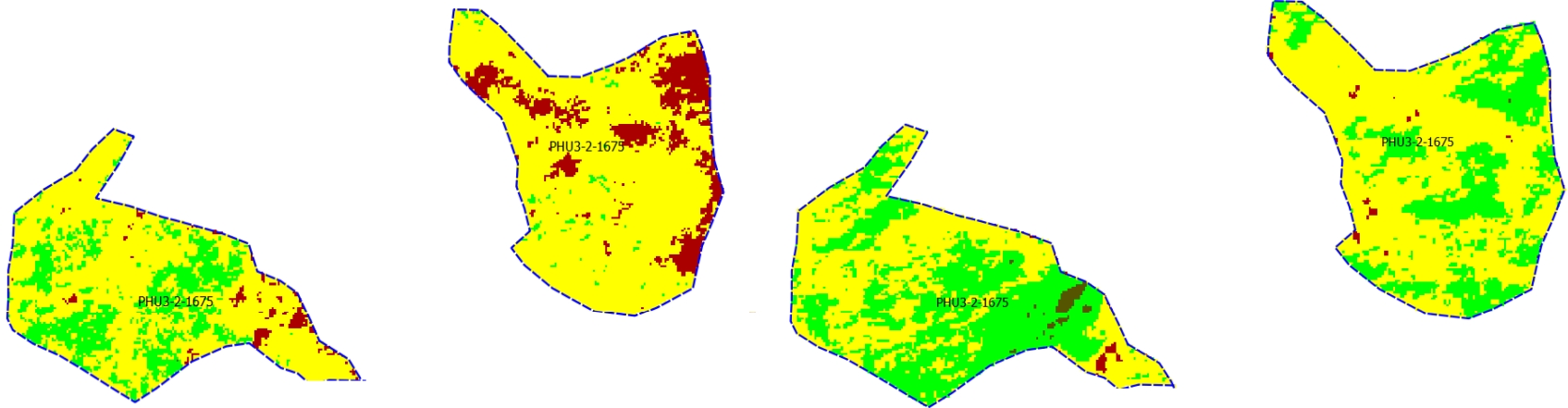


Vegetation Change Analysis

Change Analysis (Mindupidia VSS)

2005

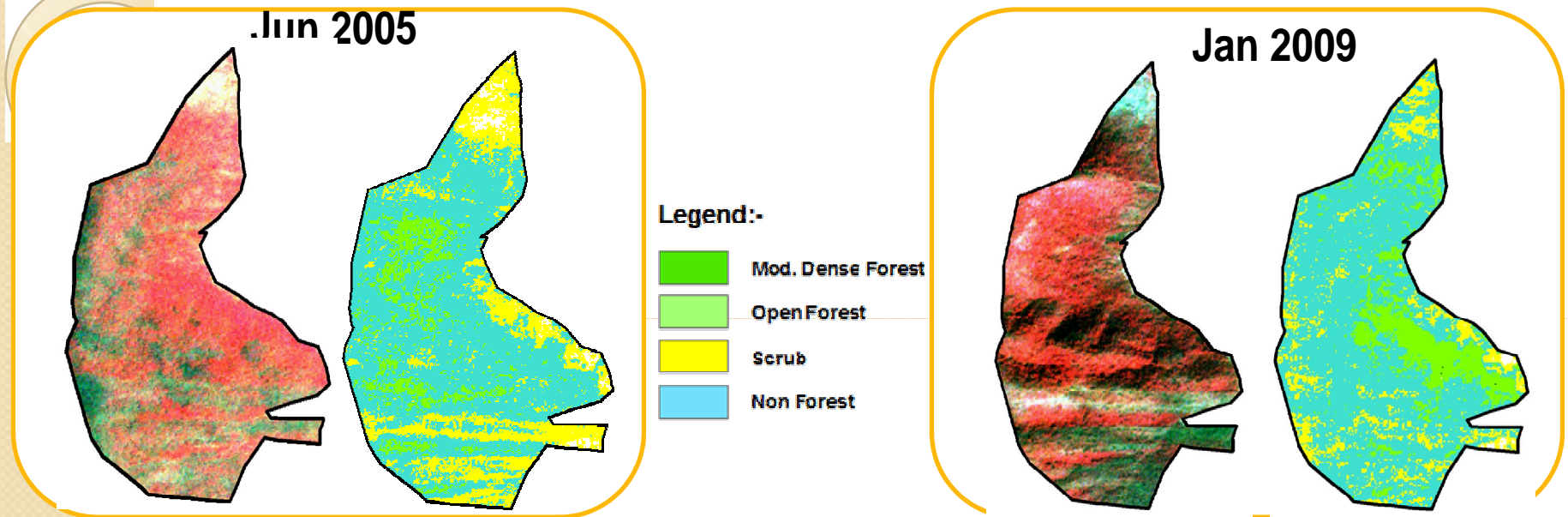
2010



Scrub
 Open
 Mod Dense
 Dense

Vegetation Type	Area Ha(2005)	% Area(2005)	Area Ha(2010)	% Area(2010)
Dense	0	0	0.34	0.47
Moderately Dense	7.67	10.58	23.99	33.10
Open Forest	54.46	75.14	45.37	62.59
Scrub	10.35	14.28	2.78	3.83
Total	72.48	100.0	72.48	100.0

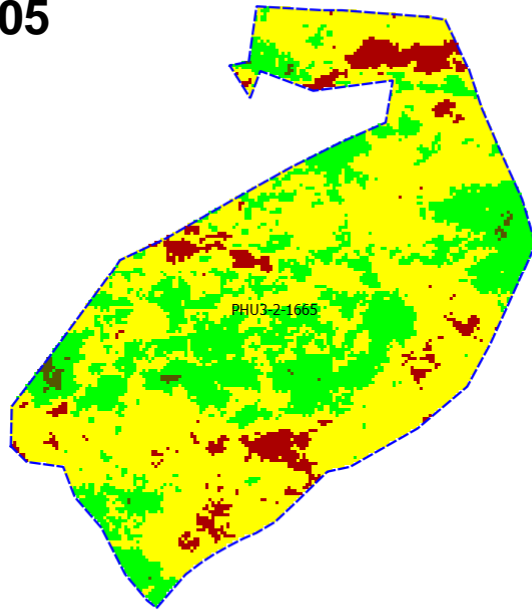
Site Code/ Name: ANG4-1-0202/Birbhuin



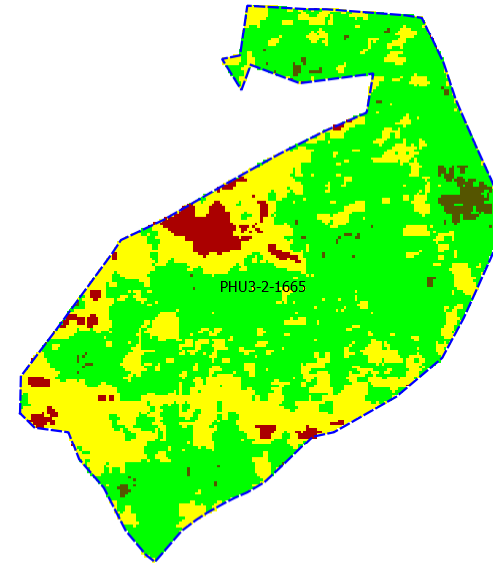
Vegetation Analysis	2005		2009	
Moderately Dense Forest	0.68	0.797	5.01	5.875
Scrub	38.38	45.009	24.48	28.708
Total	85.272	100.000	85.272	100.000

Change Analysis (Dadilai VSS)

2005



2010




Scrub
 Open
 Mod Dense
 Dense

Vegetation Type	Area Ha(2005)	% Area(2005)	Area Ha(2010)	% Area(2010)
Dense	0.29	0.49	0.75	1.25
Moderately Dense	16.77	27.95	36.99	61.65
Open Forest	38.49	64.15	19.76	32.93
Scrub	4.45	7.41	2.50	4.17
Total	60.00	100.0	60.00	100.0



Achievements

- Vast areas of forest lands easily monitored and plans drawn.
- Utility of GIS accessible to common users
- Large volume of cluttered data is consolidated and properly served
- GIS systems are now accessible to the field staff for regular use
- Impact of various forest interventions are now scientifically evaluated using satellite imagery and remote sensing techniques



Thank You