GEO-INFORMATICS

By Dr. N. Rama krishnan, Research Associate, CGARD-NIRDPR, Hyderabad.
Geoinformatics has been described as "the science and technology dealing with the structure and character of spatial information, its capture, its classification, its storage, processing, portrayal and dissemination, including the infrastructure necessary to secure optimal use of this information."
Branches of Geoinformatics Include:

- Geographic Information System (GIS)
- Remote Sensing (RS)
- Photogrammetry
- Global positioning System (GPS)
- Light Detection and Ranging (LiDAR)
- Cartography
Remote Sensing
we must be second to none in the applications of advanced technologies to the real problems of man and society.
Applications driven programme
Self reliance in building & launching satellites

November 21, 1963

22 LV Missions
46 + 6 S/C Missions
Remote Sensing refers to gathering and processing of information about earth’s environment and its Natural & Cultural Resources through Aerial photography and Satellite scanning.
The information needs a physical carrier to travel from the objects to the sensors through an intervening medium.

The **ELECTROMAGNETIC RADIATION** is normally used as an information carrier in remote sensing.

The output of a remote sensing system is usually an **IMAGE** representing the scene being observed.
PASSIVE REMOTE SENSING SYSTEM

The eyes passively senses the radiation reflected or emitted from the object. The sensing system depends on an external source of illumination.
The sensing system provides its own source of illumination.
In airborne remote sensing, sensors are mounted on an aircraft.

An advantage is the capability of offering very high Spatial Resolution images (20 cm or less).

The disadvantages are low coverage area and high cost per unit area of ground coverage.
In space borne remote sensing, sensors are mounted on-board a spacecraft (Satellite) orbiting the earth.
SPACE TECHNOLOGY
AND ITS APPLICATIONS

NATIONAL SPACE SYSTEMS

COMMUNICATION

- INSAT SERIES OF SATELLITES
  - METEOROLOGY, RADIO/TV BROADCAST, DISASTER WARNING

REMOTE SENSING

- IRS SERIES OF SATELLITES
  - NATURAL RESOURCES MONITORING AND MANAGEMENT
## ISRO LAUNCHERS

### CAPABILITY

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>PSLV</th>
<th>GSLV</th>
<th>GSLV-MkIII</th>
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<tbody>
<tr>
<td>WEIGHT (t)</td>
<td>294</td>
<td>400</td>
<td>629</td>
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<tr>
<td>PAYLOAD (t)</td>
<td>1.5 SSO / 1.1 GTO</td>
<td>2.0 GTO</td>
<td>4.0 GTO / 10 LEO</td>
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<td>FLIGHTS</td>
<td>(93–07)</td>
<td>(2001-04)</td>
<td>2007-08</td>
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Types of satellite orbits

- **Geostationary**

- **Polar**
GEOSTATIONARY ORBITS

These satellite appears stationary with respect to the Earth's surface. Generally placed above 36,000 km from the Earth.
Communication Satellites are in **GEOSYNCHRONOUS ORBIT**

(\text{Geo} = \text{Earth} + \text{synchronous} = \text{moving at the same rate}).

This means that the satellite always stays over one spot on Earth. The area on earth that it can “SEE” is called the satellite’s “**FOOTPRINT**”
A Polar Orbit is a particular type of Low Earth Orbit. The satellite travels a North–South Direction, rather than more common East-West Direction.
As a Satellite orbits in a north-south direction, Earth spins beneath it in an East-West direction. As a result, a satellite in polar orbit can eventually scan the entire surface.

It is like pealing an orange in one piece. Around & around, one strip at a time, and finally you’ve got it all. For this reason the Remote Sensing Satellites are in this orbit to get a thorough a coverage of the Earth.
The Process of Remote Sensing

A. Radiation and the atmosphere
B. Interaction with target
C. Energy recorded and converted by sensor
D. Reception and processing
E. Interpretation and analysis

Text by the Canadian Centre for Remote Sensing
Panoramic View of Earth Station at Shadnagar
What is an image?

- Data that are organized in a grid of Columns and rows
- Usually represents a geographical area
Measuring Light

- Light can be classified according to the length of the wave

- The Electromagnetic Spectrum (EMS)
  - Visible: \(~ 0.4 \) to \(~ 0.7 \) micrometers
Measuring Light: Bands

- Human eyes only ‘measure’ visible light
- Sensors can measure other portions of EMS
Spectral Signatures

- Signal received by sensor depends on land cover

Green - Highest reflectance hence we see green trees

Spectral Signature unique to healthy vegetation

Bare Earth

Water
Spectral Response of Earth Surface Features

![Graph showing reflectance versus wavelength for different features: Silty Clay Soil, Muck Soil, Water (Shallow/Deep), Vegetation.]

**SILTY CLAY SOIL**

**MUCK SOIL**

**WATER (Shallow/Deep)**

**Vegetation**

**True Color Composite**

**False Color Composite**

**BLUE BAND** (0.4-0.5 µm)

**GREEN BAND** (0.5-0.6 µm)

**RED BAND** (0.6-0.7 µm)

**NEAR IR** (0.7-0.9 µm)

**1- SAND**

**2- VEGETATION**

**3- WATER**
GENERATION OF FALSE COLOUR COMPOSITE

GREEN BAND WITH BLUE FILTER

RED BAND WITH GREEN FILTER

IR BAND WITH RED FILTER

STANDARD FALSE COLOUR COMPOSITE
Viewing images

- Three bands are viewable simultaneously
Band Combinations

- Features can become more obvious

Urban

Vegetation
Spectral Reflectance curves

Reflectance (%) vs. Wavelength (µm)

- Vegetation
- Soil
- Water
- Snow
TYPICAL SPECTRAL REFLECTANCE CHARACTERISTICS OF A GREEN LEAF

- Leaf pigments
- Cell structure
- Water content

Chlorophyll absorption

Water absorption

Wave length (um): 0.4, 0.6, 0.8, 1.0, 1.2, 1.4, 1.6, 1.8, 2.0, 2.2, 2.4, 2.6
Resolution

It refers to picture element or pixel discernible on the image of the smallest area resolvable or identifiable on ground.

Spatial Resolution

Spectral Resolution

Radiometric Resolution

Temporal Resolution
• Spatial Resolution – The smallest object that can be discerned

• Spectral Resolution – No. of bands

• Temporal Resolution – Periodicity of data collection

• Radiometric Resolution – Quantization levels of data
Remote sensing is the process of gathering information about an object from a distance.

Remote sensing data has basically three components:

Spatial

Spectral

Temporal

IRS WIFS Data for Punjab State Year 1998–99
## India’s Earth Observation Missions

### Sun Synchronous

<table>
<thead>
<tr>
<th>Year</th>
<th>Satellite</th>
<th>Instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1988/91</td>
<td>IRS-1A &amp; 1B</td>
<td>LISS-1&amp;2 (72/36m)</td>
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<tr>
<td>1995/1997</td>
<td>IRS-1C/1D</td>
<td>LISS-3 (23/70m); PAN (5.8m); WiFS (188m)</td>
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<tr>
<td>1999</td>
<td>IRS-P4</td>
<td>OCM (360m), MSMR</td>
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<tr>
<td>2001</td>
<td>TES Step&amp; Stare PAN (1m)</td>
<td></td>
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<tr>
<td>2003</td>
<td>IRS-P6: Resource Sat</td>
<td>LISS 3 (23m) LISS 4 (5.8m); AWiFS (55m)</td>
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<tr>
<td>2005</td>
<td>IRS-P5</td>
<td>PAN-2.5M, Carto-1, 30 km, F/A</td>
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<td>2007</td>
<td>IRS-P6</td>
<td>PAN-0.9M, Carto-2, 11 km, F/A</td>
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### Geo Stationary

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<th>Year</th>
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<th>Instruments</th>
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<tr>
<td>1990</td>
<td>INSAT-1D</td>
<td>VHRR</td>
</tr>
<tr>
<td>1992</td>
<td>INSAT-2A</td>
<td>VHRR</td>
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<tr>
<td>1993</td>
<td>INSAT-2B</td>
<td>VHRR</td>
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<tr>
<td>1999</td>
<td>INSAT-2E</td>
<td>VHRR, CCD (1 km)</td>
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<td>2002</td>
<td>KALPANA-1</td>
<td>VHRR</td>
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<td>2003</td>
<td>INSAT-3A</td>
<td>VHRR, CCD</td>
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</table>
IRS 1C Sensors overview

PAN

LISS III

WiFS
### Sensors on Board IRS 1C/1D

<table>
<thead>
<tr>
<th>Sensors</th>
<th>WiFS</th>
<th>LISS-III</th>
<th>LISS_IV</th>
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<tr>
<td><strong>Spatial Resolution</strong></td>
<td>188 meters</td>
<td>23.5 meter</td>
<td>6 meter</td>
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<tr>
<td>(Pixel Size)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Spectral Bands</strong></td>
<td>Band 1 (Red)</td>
<td>• Band 1 (Green) • Band 2 (Red) • Band 3 (NIR) • Band 4 (MIR)</td>
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<tr>
<td>(Micrometers)</td>
<td>• Band (NIR)</td>
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<tr>
<td><strong>Dynamic Range</strong></td>
<td>7 Bit</td>
<td>7 Bit</td>
<td>7 Bit</td>
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<tr>
<td><strong>Swath Width</strong></td>
<td>810 km</td>
<td>141 km</td>
<td>14 km</td>
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</table>

**Images:**
- **LiSS-III Camera**
- **LiSS-III Image**
- **LiSS_IV Image**
SPATIAL RESOLUTION - DISCRIMINABILITY

- Ikonos Pan - 1 m GSD
- Ikonos Colour - 4 m GSD
- IRS-1C Pan – 5.8 m GSD
- SPOT Pan - 10 m GSD
- SPOT XS - 20 m GSD
- LANDSAT TM - 30 m GSD
Aerial Photograph of Los Angeles
Normal Color and Color Infrared Aerial Photograph of University of Wisconsin
IRS 1C PAN IMAGE OF VIZAG STEEL PLANT, 1996
IRS 1C LISS III IMAGE OF VIZAG STEEL PLANT, 1996
IRS 1C PAN, LISS III MERGED IMAGE OF VIZAG STEEL PLANT, 1996
0.6 m Resolution Space Image
1 m Resolution Space Image
Parliament house, Rashtrapati Bhawan as seen from satellite.
This image shows part of Mecca.
View of Palm Island - Dubai by Resourcesat-1 MX
Part of Qatar, captured by CARTOSAT-1
Better than 2.5 m resolution
Two Pan cameras - fore with 26 deg. and aft with -5 deg. Tilt (500 nm - 850 nm)
Swath 27.5 km for stereo and 55 km for monoscopic mode.
8 km overlap between adjacent paths
10 bits
Facility for across track tilt to give better revisit
Remote Sensing Application
SATellite remote sensing applications

Agriculture
- Crop acreage and production estimation

Soil Resources
- Soil mapping
- Land capability, land irrigability
- Soil moisture estimation
- Mapping water-logged areas
- Salt-affected soils, eroded lands, shifting cultivation

Landuse/Land Cover
- Land use/land cover mapping
- Wasteland mapping
- Urban sprawl mapping

Geosciences
- Geological / geomorphological mapping
- Ground water potential zone mapping
- Mineral targeting

Forestry and Environment
- Forest cover mapping
- Forest management plan - RS inputs
- Biodiversity conservation
- Environmental impact assessment
- Grassland mapping
SATELLITE REMOTE SENSING APPLICATIONS

WATER RESOURCES
- SNOWMELT RUNOFF FORECASTING
- RESERVOIR SEDIMENTATION

OCEAN APPLICATIONS
- COASTAL ZONE MAPPING
- POTENTIAL FISHING ZONE (PFZ) MAPPING
- CORAL REEF MAPPING

DISASTER ASSESSMENT
- FLOOD / CYCLONE DAMAGE ASSESSMENT
- AGRICULTURAL DROUGHT ASSESSMENT
- VOLCANIC ERUPTION, UNDERGROUND COAL FIRE
- LANDSLIDE HAZARD ZONATION
- FOREST FIRE AND RISK MAPPING

INTEGRATED MISSION FOR SUSTAINABLE DEVELOPMENT
- SUSTAINABLE WATERSHED DEVELOPMENT
Flood due to cyclone (29th October 1999) off Orissa coast
WHAT CAN BE SEEN FROM SATELLITE IMAGES?

Banana  Maize  Tobacco
Chillies  Cotton  Paddy
Salt affected  Water logged
WHAT CAN BE SEEN FROM SATELLITE IMAGES?

- ROCK TYPES
- GEOLOGICAL STRUCTURES (LINEAMENT /FAULT/DYKE)
- VALLEY FILL WITH VEGETATION
- BLACK SOIL COVER
- SALT AFFECTED LAND
WHAT CAN BE SEEN FROM SATELLITE IMAGES?

- HILLY TERRAIN WITH FOREST
- AGRICULTURAL LANDS - DELTA
- RIVER COURSES
- COASTLINE

- MANGROVE FOREST
- WET LANDS
- WATER TURBIDITY
WHAT CAN BE SEEN FROM SATELLITE IMAGES?

- RESERVOIR
- RIVER COURSE
- RIVER CONFIGURATION
- FLOOD PLAIN
AGRICULTURE APPLICATIONS

- Crop Acreage & Production Estimation (CAPE) - Rice, Jowar, Cotton
- Horticulture - Coconut, Coffee
- Sericulture – Mulberry
Farm level Resource Inventory

Farm level information in Hirakud Irrigation Command Area
(0.60 m)

Gap Detection in Mango Orchards
High resolution satellite data 20 February 2000
Shadnagar, Mahbubnagar District, AP
(2.5 m)
WASTELAND MAPPING

- 1:50000 scale entire country
- Digital database
- Input to MRD for development
WASTELAND ATLAS OF INDIA

- On 1:50,000 scale digital at village/micro-watershed level
- Co-existence of poverty and environmental degradation (wastelands) at village level
- Wasteland, if restored to health, to produce additional income and employment

Total wasteland: 63.8 Mha
Cultivable wasteland: 45 Mha
WASTELANDS IN INDIA FROM SPACE

DISTRICTS COVERED - PHASE WISE

LEGEND

INTERNATIONAL BOUNDARY
STATE BOUNDARY
DISTRICT BOUNDARY

Wasteland Mapping

(1:50,000), 584 Districts
<table>
<thead>
<tr>
<th>STATE</th>
<th>NO. OF DIST.</th>
<th>TOTAL GEO AREA (IN SQ. KM)</th>
<th>TOTAL WASTELAND (IN SQ KM)</th>
<th>PERCENT</th>
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<tr>
<td>ANDHRA PRADESH</td>
<td>23</td>
<td>275068</td>
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<td>16</td>
<td>83743</td>
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<td>ASSAM</td>
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<td>GUJARAT</td>
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<td>KERALA</td>
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<td>21081</td>
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<th>STATE</th>
<th>NO. OF DIST.</th>
<th>TOTAL GEO AREA (IN SQ. KM)</th>
<th>TOTAL WASTELAND (IN SQ KM)</th>
<th>PERCENT</th>
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<tr>
<td>NAGALAND</td>
<td>7</td>
<td>16579</td>
<td>3709.40</td>
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<td>SIKKIM</td>
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<td>WEST BENGAL</td>
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<td>4.95</td>
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<td>UNION TERRITORY</td>
<td>20</td>
<td>10973</td>
<td>314.38</td>
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<td><strong>TOTAL</strong></td>
<td><strong>597</strong></td>
<td><strong>3166414</strong></td>
<td><strong>552692.25</strong></td>
<td><strong>17.45</strong></td>
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WASTELANDS IN INDIA

- GULLIED
- SCRUB
- WATERLOGGED
- SALINE
- SHIFTING CULTIVATION
- AGRICULTURE
- DEGRADED
- SANDS
- MINING & INDUST. WASTELANDS
- BARREN
- STEEP
- SNOW
## CATEGORY WISE WASTELANDS OF INDIA -2003

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>TOTAL WASTELANDS (IN SQ.KM)</th>
<th>% TO TOTAL GEOG. AREA COVERED</th>
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<tbody>
<tr>
<td>GULLIED / RAVINOUS SHALLOW</td>
<td>10283.06</td>
<td>0.32</td>
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<tr>
<td>GULLIED / RAVINOUS – MEDIUM</td>
<td>4685.43</td>
<td>0.15</td>
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<tr>
<td>GULLIED / RAVINOUS – DEEP</td>
<td>4070.85</td>
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<tr>
<td>LAND WITH SCRUB</td>
<td>150566.60</td>
<td>4.76</td>
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<tr>
<td>LAND WITHOUT SCRUB</td>
<td>37382.89</td>
<td>1.18</td>
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<tr>
<td>WATERLOGGED/ MARSHY – PERMANENT</td>
<td>5341.15</td>
<td>0.17</td>
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<tr>
<td>WATERLOGGED/ MARSHY – SEASONAL</td>
<td>4403.82</td>
<td>0.14</td>
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<tr>
<td>SALINE/ALKALINE – STRONG</td>
<td>2569.69</td>
<td>0.08</td>
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<tr>
<td>SALINE/ALKALINE – MODERATE</td>
<td>5349.64</td>
<td>0.17</td>
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<td>SALINE / ALKALNE – SLIGHT</td>
<td>4104.72</td>
<td>0.13</td>
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<td>SHIFTING CULTIVATION – ABANDONED</td>
<td>12218.99</td>
<td>0.39</td>
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<tr>
<td>SHIFTING CULTIVATION – CURRENT</td>
<td>6546.87</td>
<td>0.21</td>
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<td>DEGRADED FOREST – SCRUB DOMIN.</td>
<td>108417.76</td>
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<tr>
<td>AGRICULTURE LAND INSIDE NOTIFIED FOREST</td>
<td>18134.05</td>
<td>0.57</td>
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<td>DEGRADED PASTURES / GRAZING LAND</td>
<td>19344.30</td>
<td>0.61</td>
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<tr>
<td>DEG. LAND UNDER PLANTATION CROPS</td>
<td>2138.24</td>
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## Category Wise Wastelands of India - 2003

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>TOTAL WASTELANDS (IN SQ.KM)</th>
<th>% TO TOTAL GEOG. AREA COVERED</th>
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<tr>
<td>SANDS – FLOOD PLAIN</td>
<td>1945.55</td>
<td>0.06</td>
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<td>SANDS – LEAVES</td>
<td>32.24</td>
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<td>SANDS - COASTAL SAND</td>
<td>943.14</td>
<td>0.03</td>
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<tr>
<td>SANDS – SEMI STAB. TO STAB. (&gt;40m)</td>
<td>2672.88</td>
<td>0.08</td>
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<td>SANDS – SEMI STAB. TO STAB. MOD. (15-40m)</td>
<td>16380.70</td>
<td>0.52</td>
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<tr>
<td>SANDS – SEMI STAB. TO STAB. LOW (&lt;15m)</td>
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### Statewise Wastelands of India (New States)

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* Unsurveyed Area (Jammu & Kashmir) 120849
  Total Geog. Area 3287263
WASTELANDS IN INDIA
(PERCENT WISE)

Gullied Scrub Marshy Saline Jhum
D. Forest D grazing D plant. Sands Mining
Barren Steep Snow

Gullied: 0.68
Scrub: 6.70
Marshy: 0.96
Saline: 0.91
Jhum: 1.13
D. Forest: 4.61
D grazing: 0.87
D plant: 0.19
Sands: 1.27
Mining: 0.04
Barren: 1.24
Steep: 0.22
Snow: 0.93

1.13 + 0.91 + 0.96 = 2.99 (Total Wastelands in India)

6.70 (Approximately 67%) is the percentage of wastelands in India.
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## DEGRADED LANDS

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WATERSHED CATEGORIZATION

1. Indus Drainage
2. Ganga Region
3. Brahmaputra Region
4. Flowing into Bay of Bengal
5. Flowing into Arabian Sea
6. Ephemeral Drainage

Basins - 35
Catchments - 112
**Stages of Delineation**

All India Soil and Land Use Survey (AISLUS, 1990) 5 Stage Delineation System

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<tr>
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<td>5</td>
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<td>(0.2 - 3 Lakh.ha.)</td>
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Delineation and Codification of Watershed into Sub, Mini & MicroWatershed - KSRSAC

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Catchment (Pennar)
Sub catchment (Kunderu LB)
Watershed (Pali, Peddvanku)
Watershed Layer

(Part of Mandsaur District, M.P.)

- Sub-catchment Boundary
- Watershed Boundary
- Sub-watershed Boundary
- Mini-watershed Boundary
- Micro-watershed Boundary
WASTELAND LAYER

(Part of Mandsaur District, M.P.)

Legend:
- Gullied and/or ravinous land
- Land with or without scrub
- Degraded notified forest land
- Sands River bed
- Barren Rocky/Stone waste
- Rivers/Water Bodies
- Settlement
- Sand River bed
- Land with or without scrub
- Degraded notified forest land
- Barren Rocky/Stone waste
- Settlement
WASTELANDS
DIGITAL DATABASE
Andhra Pradesh

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**Nagar Karnul Taluk Mahbubnagar District**

![Map of Nagar Karnul Taluk Mahbubnagar District](image-url)
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Hasnabad Village
Kodangal Mandal
WATER RESOURCES APPLICATIONS
Ground Water-Targeting & Recharge

Phase-II (1998-2002) – 6 States being covered on 1:50,000 scale

- WELL SITE
GROUND WATER PROSPECTS MAP

PREPARED FROM SATELLITE IMAGE INTERPRETATION WITH LIMITED FIELD CHECKS

SCALE - 1:50,000

KHANPUR DISTRICT, ANDHRA PRADESH

GROUND WATER PROSPECTS

COMMON MAP INDEX

NATIONAL REMOTE SENSING AGENCY, DEPT. OF SPACE, GOVT. OF INDIA
Integrated Land & Water Resources Management

- Towards enriching the development planning process on watershed basis using satellite remote sensing data and GIS
- Integration of scientific knowledge, administrative acumen, local wisdom
- Covering 84 mha, mainly of rain fed areas
- Pilot results indicate arresting land degradation, increasing productivity and raising ground water table, generating rural employment and income

Areal extent of Vegetation (crop, horticulture, Medicinal plants....)
- 1992 - 1533 ha
- 1997 - 2321 ha
- Watershed area - 9160 ha
Upper Hatni Watershed
Jhabua dist., MP

IRS-1B  LISS II Feb, 1992

Location Map

study area

SCRUBLAND

HORTICULTURE

GRASSLAND
Upper Hatni Watershed, Jhabua dist. MP

Landuse/landcover Map
- Kharif
- Rabi
- Land w/wo scrub

Slope Map
- Nearly level
- Very gently sloping
- Gently sloping
- Moderately sloping
- Strongly sloping
- Moderate steep to steep slope

Soil Map
- Lo.skl.mix.hythmic.li.ue.tents
- Lo.skl.mix.hythmic.ly.ue.tents
- F.lo.skl.mix.hythmic.ud.uperpts
- Cl.skl.montmor.hythmic.li.ue.tents
- Lo.skl.montmor.hythmic.ly.uperpts
- F.lo.mix.hythmic.ly.uperpts
- F.lo.mix.hythmic.flu.uperpts

Hydrogeomorphology Map
- Valley fill
- Lava plain I
- Lava plain II
- Buried pediment-shallow
- Buried pediment-moderate
- Buried pediment-deep
- Pediment

ActionPlanMap
- Agro-forestry
- Agro-horticulture
- Intensive agriculture
- Sivipasture
- Existing double crop
Temporal images of Upper Hatni Watershed
Jhabua dist., MP

IRS-1B LISS II  Feb, 1992
IRS-1C LISS III  Feb, 1997

Vegetation change during 1992-97 (derived through NDVI technique)

Vegetation in 1992
Increase in vegetation during 1992-97 period

Areal extent of vegetation
1992 - 1533 ha
1997 - 2321 ha
Increase -788 ha (51.40%)
Watershed area - 9160 ha
Satellite Imagery of GV 130 WS, Ahmednagar Dist., MS

IRS 1B
Feb 1992

IRS 1D
Jan 1998
Status of wastelands in GV 130 WS

IRS 1B
Feb 1992

IRS 1D
Jan 1998
GV 130 Watershed
Area Statistics

Dense vegetation - 1992 - 50.72 ha
Sparse vegetation - 1992 - 69.12 ha

Dense vegetation - 1998 - 803.68 ha
Sparse vegetation - 1998 - 1058.08 ha
IRS IB IMAGERY OF SAMALPATTI WATERSHED DHARMAPURI DISTRICT, TAMIL NADU

Feb. 1992
DHARMAPURI DISTRICT, TN
IRS IMAGERIES OF
SAMALPATTI WATERSHED

IRS 1B
Feb. 1992

IRS 1D
Jan. 1998
Wastelands of Samalpatti Watershed derived from IRS 1B data

Feb. 1992
STATUS OF THE SAME WASTELAND PATCHES IN SAMALPATTI WS AS VIEWED BY IRS 1D IN 1998

Feb. 1998
VEGETATION CHANGE IN WASTELANDS OF SAMALPATTI WS DURING 1992-98

- Dense Veg. 92-98
- Sparse Veg. 92-98
- Dense changed to sparse
- New dense Veg. in 98
- New sparse Veg. in 98
- Other areas
Samalpatti Watershed
Area Statistics

Dense vegetation - 1992 - 523.26 ha
Sparse vegetation - 1992 - 246.12 ha

Dense vegetation - 1998 - 1326.81 ha
Sparse vegetation - 1998 - 481.87 ha
Infrastructure Development

- Road – Prime Minister Gram Sadak Yojana
- Transmission Route Planning
- Small Scale Industry –
  - Rice Mill, Sugar Mill,
  - Sugar Cane Crushing Unit
  - Milk Chilling Centre
Progression of 2003-04 Rabi Season Crop Area

As captured by multi-date AWiFS data

Near-Real Time Monitoring
Near-Real Time Monitoring

Onset & extension of irrigation service as captured by multi-date AWiFS data

Prior to irrigation

19 Dec 2003

Irrigation supply initiated

03 Jan 2004

FCC – GRN SWIR NIR

Irrigation supply extended

12 Jan 2004
Hirakud Command Area

Through-the-years performance monitoring

Rabi 2001-02 | Rabi 1994-95 | Rabi 1992-93

Standard FCC

Crop Map

Barpali

Paddy Transplantation Variability

Area Irrigated per unit of Water (ha/M.cu.m)

- Paddy
- Non paddy

- Early
- Normal
- Late

<table>
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<th>Area (ha)</th>
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Hectare

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<th>Area (ha)</th>
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<td>1992-93</td>
<td>70.88</td>
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<td>1994-95</td>
<td>74.78</td>
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<td>2001-02</td>
<td>84.35</td>
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Impact assessment of improvement programmes

(2961 ha)
LANDSAT TM 16-Mar-1993

(3516 ha)
LANDSAT TM 07-Apr-1995

(4500 ha)
IRS 1C 14-Apr-2002

Legend
- Parmanpur
- Bargah
- Resam
- Bhimikra
- Canal
- River
Tank irrigation systems

Nanjur tank cascade

Open wells
Tank irrigation systems

Nanjur tank cascade

Cadastral map of Nanjur tank command

Crop map of Nanjur tank command

LEGEND
- Paddy
- Sugarcane
- Groundnut
- Maize
- Water
- Fallow/Scrub
Watershed Program for Livelihood sustenance
Village Level Planning

Digital Cadastral Map Base and Its Linkage with ROR

- Water Cess Collection
- Land Conversion

Village Index Data Base and Resource Data in Spatial Frame Work
DRAINAGE AND WATER BODIES
Revenue Parcel Boundaries overlaid on the satellite data
Very deep, fine loamy, slightly eroded Black soils on very gently sloping pediplain

Deep, loamy, slightly eroded, red soils on very gently sloping pediplain

Very shallow, loamy skeletal, moderately eroded soils on gently sloping sediments

Very shallow, coarse loamy skeletal, severely eroded soils on moderately sloping denuded hill with rock out crops

Soils of narrow valley
Deep, Fine textured

Shallow, loamy, severely eroded soils on moderately sloping land

rock out crop
Water & Land Resources development plans
Identification of degraded land parcels and its impact on associated resources
Facilitate participation of local people in generating beneficiary-oriented programs.
• Restoration of recharge mechanism
• Restoration of village tanks

Facilitate participation of local people in generating beneficiary oriented programs.

PMGSY, NREGS, SGSY

Interaction with district Officials, local people & field observation resulted in numerous applications

Identification of degraded land parcels and its impact on associated resources

• Soil conservation & Restoration of Farm Ponds
• Catchment treatment
• Sustainance of drinking water

• Suitable sites for energy plantations & Catchment treatment
• Restoration of Village tanks
• Suitable sites for energy / biofuel plantations
GEOREFERENCING OF VILLAGE (CADAstral) MAPS USING SATELLITE DATA

CADASTRAL MAPS AT 1:4000 SCALE

BASE VECTORS WITH GCPS

GIS COVERAGE

TOPOGRAPHICAL MAPS 1:50,000 SCALE

SATELLITE DATA AT 1:10,000 SCALE

LEGEND

SATELLITE DATA

ANNEXURE II

PETROL PUMP
THEATRE
MANSONI
HOSPITAL
MONUMENT
HOPE
ROAD
PHONE PREMISES
TELEPHONE
UNION PREMISES
MONUMENT
OFFICE
TEMPLE
DUTCH MILL
INDUSTRY
INDUSTRIAL PREMISES
SCHOOL
COLLAGE
GRASS
MOSQUE
WATER
MANSION
RESIDENCE
SILHOUETTE
SHADE
WATER
First order drainage lines cutting across individual farmers fields – seen in the satellite data not depicted in the cadastral maps which are normally used as base maps for preparing watershed development plans. Erosion along these drainages resulted in silting of the percolation tank, down stream. Delineation of such highly eroding drainage lines is possible using high resolution satellite data and cadastral overlay on such data facilitates in the identifying the affected farmers for providing appropriate soil conservation measures.
CADASTRAL REFERENCED DATABASE

Maharashtra - Completed
Chhattisgarh - 90% Completed
Karnataka - In Progress
Gujarat - In Progress

Kerala, Rajasthan, Orissa, Jharkhand, Andhra Pradesh M.P. and U.P. - Taken initiative
Mapping and monitoring mangroves, coastal wetlands

IRS-1B LISS-I IMAGE, 1992

IRS-1C LISS-III IMAGE, 2000

P = Prawn cultivation
COASTAL & MARINE RESOURCES

- Coastal Zone Management Plan
- Shoreline Changes
- Coastal Wetlands
- Aquaculture sites
Sea Surface Temperature retrieval from NOAA-AVHRR data

PFZ Image

P4 - OCM

PFZ Map
**DISASTERS**

**Flooding**
- 40 M ha flooding
- 4.2 crore people in 2002

**Cyclones**
- 5700 km long coastline
- 15,000 people in 2002

**Landslides**
- Sub-Himalayan/Western Ghats
- 8% of TGA
- 5000 people in 2002

**Earthquakes**
- 55% of area in Seismic Zone III-IV
- 40,000 people in 2001

**Drought**
- 68% net sown area in 116 dist.
- 30 crore people in 2002

**Forest Fires**
- ≈65% of total forests under potential threat of ground fire
Inundation as on 02nd Nov, 1999
Inundation as on 04 Nov, 1999
Inundation as on 08 Nov, 1999
Inundation as on 11 Nov, 1999
Inundation as on 13 Nov, 1999

Inundation recession during 2-4 Nov, 1999
Inundation recession during 2-8 Nov, 1999
Inundation recession during 2-11 Nov, 1999
Inundation recession during 2-13 Nov, 1999
Flood inundated areas in Bhadrak district, Orissa
Based on the analysis of Radarsat data of 12-July-2007

Legend:
- Blue: Flood inundation
- Green: Coastal area
- Red: Major road
- Orange: Secondary road
- Purple: Sub-divisional road
- Yellow: Village road
- Black: Water body
- Grey: Settlement

State Level

District Level

Detailed Level
Flood inundated villages in Bhadrak district, Orissa as on 08-July-07

IRS-P6 LISS-III Image of 08-Jul-07

LEGEND

- Taluk boundary
- District boundary
- National highway
- Submerged national highway
- Submerged state highway
- Submerged district road
- State highway
- Submerged rail
- District road

Normal river / water body
Flood Inundation

Baitarani River
Flood waters
Tsunami - 2004
Part of Chennai City

IRS-P6 L4 MX Image of 12-Jan-04

IRS-P6 L4 MX Image of 27-Dec-04

Pre-Event
Post-Event
Post Tsunami Scenario of Nagipattanam, TN
AERIAL DATA FOR DAMAGE ASSESSMENTS

PART OF BHUJ - AFTERMATH OF EARTHQUAKE
Barren Island Volcano as seen by IRS-P6 AWIFS data with RGB= 432

Eruption date : 28, May,2005
3-D perspective views of Barren Island volcano generated through remote sensing data showing (a) pre-1991 eruption, (b) syn-1991 eruption and (c) post-1991 eruption. Corresponding field photographs depicting pre (d), syn (e) and post-eruption (f) views. (Photographs d, e & f - after Haldar et al., 1992).
Forest Fires

- 44 M ha (≈ 65%: Deciduous) of India’s 67.5 M ha (total) forest cover is prone to forest fires every year
- Annual expenditure for conventional forest fire patrolling and combating ≈ Rs. 75 crores
- Annual estimated loss is around Rs. 400 Crores (MoENF reports)

Watch report on large scale burning in different parts of the country is made
- Studies conducted for these three critical protected areas on pilot basis
- Results were submitted within one day from the reception of satellite data
Deliverables

- Active fire locations
- Burnt Area progression
- Precise location and assessment of burnt areas
- Fire Vulnerability identification

Utilization

- Effective squad movement for fire control operations
- Planning relief & rescue (of biologically rich species) and mitigation operations
FORESTRY APPLICATIONS

- BIENNIAL FOREST COVER ASSESSMENT
- FOREST FIRE AND RISK MAPPING
- ENVIRONMENTAL IMPACT STUDIES
- WILDLIFE HABITAT EVALUATION
- BIODIVERSITY CHARACTERISATION AT LANDSCAPE LEVEL
Different Vegetation types as viewed by IRS P6 LISS III satellite data

Parts of Uttar Kannada district, Karnataka

EG – Evergreen
SEG – Semievergreen
MD – Moist Deciduous
DD – Dry Deciduous
PLANTN – Plantations

Dec 2003

1:250 000
Mangrove and plantations

Long: 86 24 31 and Lat. 20 00 10

Casuarina plantation

Mangrove: Sonnerartia apetala and Acanthus ilicifolius In Jagatsinghpur
DRY DECIDUOUS SAL FOREST IN THE BARIPADA PLAINS (KC pur RF), Mayurbhanj district

86 47 22 and 21 46 49
SAL MOIST DECIDUOUS FOREST IN MAYURBHANJ DISTRICT
Different Plantations as viewed by IRS LISS III satellite data

- Bamboo
- Teak
- Arecanut
- Acacia
- Sal
- Tea
Parts of Virajpet district, Karnataka

IRS-PAN DATA SHOWING DIFFERENT FOREST CROWN DENSITY LEVELS

< 20%  20 – 40%  40 – 60%  60 – 80%  > 80%

1:25000
Forest Crown density mapping
Very high resolution B/W satellite Data over Sawantwadi Area, Maharashtra

Individual crowns, Plantation details Can be clearly interpreted
Forest Crown density mapping using IRS P6 Satellite Data

IRS P6 LISS-IV FCC
(Parts of Mudumalai Wildlife Sanctuary, Tamil Nadu)

IRS P6 LISS-IV data of MAR 2004

Crown density
- < 20%
- 20–40%
- 40–60%
- 60–80%

Crown density map
Panchromatic image of QUICKBIRD satellite showing agro-ecosystem level tree resources
Use of LIDAR for forest measurement applications

by Hans-Erik Andersen.

High-density LIDAR data within Capitol Forest study area

Same area in 1 ft orthophoto
GROUND PENETRATING RADAR (GPR)
INITIAL IMAGE OF CARTOSAT-1
3D PERSPECTIVE VIEWS OF KHED BRAHMA, GUJARAT
INDIAN IMAGING CAPABILITY

- EVERY 30 MIN. IMAGING
- 1M+ SCALES
- CLIMATE/WEATHER

- EVERY 2 DAYS IMAGING
- 1:250 K SCALES
- OCEAN APPLICATIONS

- EVERY 5 DAYS IMAGING
- 1:250 K SCALES
- NATIONAL SURVEYS
INDIAN IMAGING CAPABILITY

- EVERY 22 DAYS IMAGING
- 1:50 K SCALES
- DETAILED RESOURCES SURVEY

- EVERY 5 DAYS IMAGING
- 1:12500 SCALES
- LARGE SCALE MAPPING
- STEREO CAPABILITY

- LOCAL AREA IMAGING
- 1:2000 / 4000 / 8000 SCALES
- STEREO CAPABILITY
Satellite Image for Monitoring Road
Aerial View of Road Network

400 M
Imagery Showing Photograph of Road Network
Imagery Showing Photograph of Road Network
Imagery Showing Photograph of Road Network

Coordinates: N17°19'24.46"; E78°22'37.22"
Altitude: 528.0 m
Directions: To here - From here
Aerial View of Road Network
Actual Alignment

Satellite Image in the Year of June 2014
MONITORING OF PROGRESS

Concrete Cement Road as shown

Black top road as seen from the image

Black top road is from B to C during June 2014

Non-Black top road is from B to C during May 2013
Concrete Cement road is from A to B during June 2014.

Non-CC road is from A to B during May 2013.
MONITORING OF PROGRESS

Road lengths are
A to B = 0.21 kms
B to C = 0.44 kms
C to D = 0.13 kms
D to E = 0.08 kms
Total = 0.86 kms
Road Network with Culvert Location

Satellite Image in the Year of Feb 2016
Concrete Cement Road as shown in the Satellite Image (2016).

Black top road as seen from the image.
Black top road is from E to F during Feb 2016.

Non-Black top road is from E to F during April 2014.
Concrete Cement road is from B to C during Feb 2016.

Non-CC road is from B to C during April 2014.
Temporal Changes in Cross Drainage & CC Road Observed by Satellite Imagery

Cross Drainage & BT Road Observed in Feb 2016

No Cross Drainage & Earthen Road Observed in April 2013
Temporal Changes in Cross Drainage & CC Road Observed by Satellite Imagery

Cross Drainage & BT Road Observed in Feb 2016

No Cross Drainage & Earthen Road Observed in April 2013
Temporal Changes in Cross Drainage & CC Road Observed by Satellite Imagery

Cross Drainage & BT Road Observed in Feb 2016

No Cross Drainage & Earthen Road Observed in April 2013
MONITORING OF PROGRESS

Road lengths are:

A to B = 0.58 km
B to C = 0.59 km
C to D = 0.70 km
D to E = 0.40 km
E to F = 1.20 km
F to G = 0.08 km
G to H = 0.15 km

Total = 3.69 km
Watershed Monitoring and Evaluation

Before Construction of Check Dam in September 2013 in UP State

After Construction of Check Dam in July 2015
Watershed Monitoring and Evaluation

Before Pond Creation on October 2009

After Pond Creation on May 2015
Before Pond creation on August 2010

After Pond creation on May 2015

Watershed Monitoring and Evaluation
Watershed Monitoring and Evaluation

Before Apple Plantation on March 2015

After Apple Plantation on June 2015
Watershed Monitoring and Evaluation

Before Pomegranate Plantation on December 2014

After Pomegranate Plantation on June 2015
Watershed Monitoring and Evaluation

Before Pond Renovation on July 2010

After Pond Renovation on May 2015
PRE IMAGE
DATE: 21.12.2010
Year : 2009-10

Gully Erosion

Field bunding & Cashew Plantation

Year : 2012-13

Earthen Gully Control & Masonry check dam

Life saving irrigation
Thank you