Integrated Watershed Development for Optimal Land And Water utilisation

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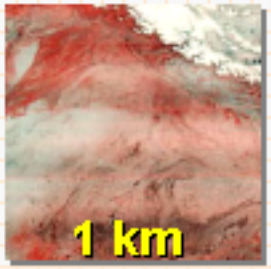
Indian Space Research Organisation, INDIA

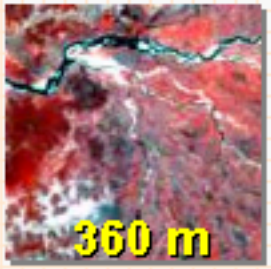
UN/Austria/ESA Symposium on Space Applications for Sustainable Development

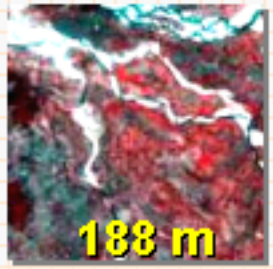
GRAZ, Austria, 13-16 Sep, 2004

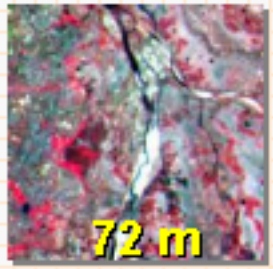
Water for the World: Space Solutions for Water Management

Indian Imaging Systems – Evolution

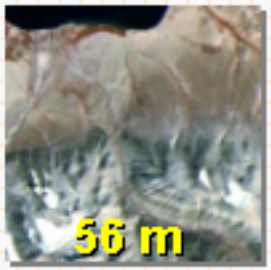


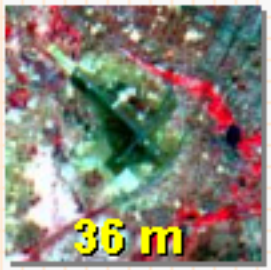


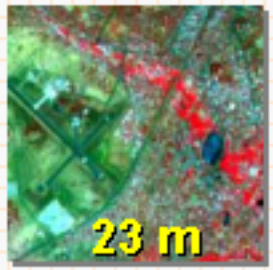




IRS-P6
resourcesat
LISS-3: 23 m, 4 XS,
LISS-4: 5.8 m, 3-XS,
AWiFS: 56 m, 4-XS







IRS-P4
oceansat
OCM, MSMR

INSAT-2E
operational Met
CCD (1 km res;
every 30 min)

IRS-1C/1D
operational-2G
LISS-3: 23/70 m, Steerable
PAN: 5.8 m, WiFS: 188 m

IRS-P2
LISS-2

IRS-P3
research
WiFS, MOS,
X-Ray

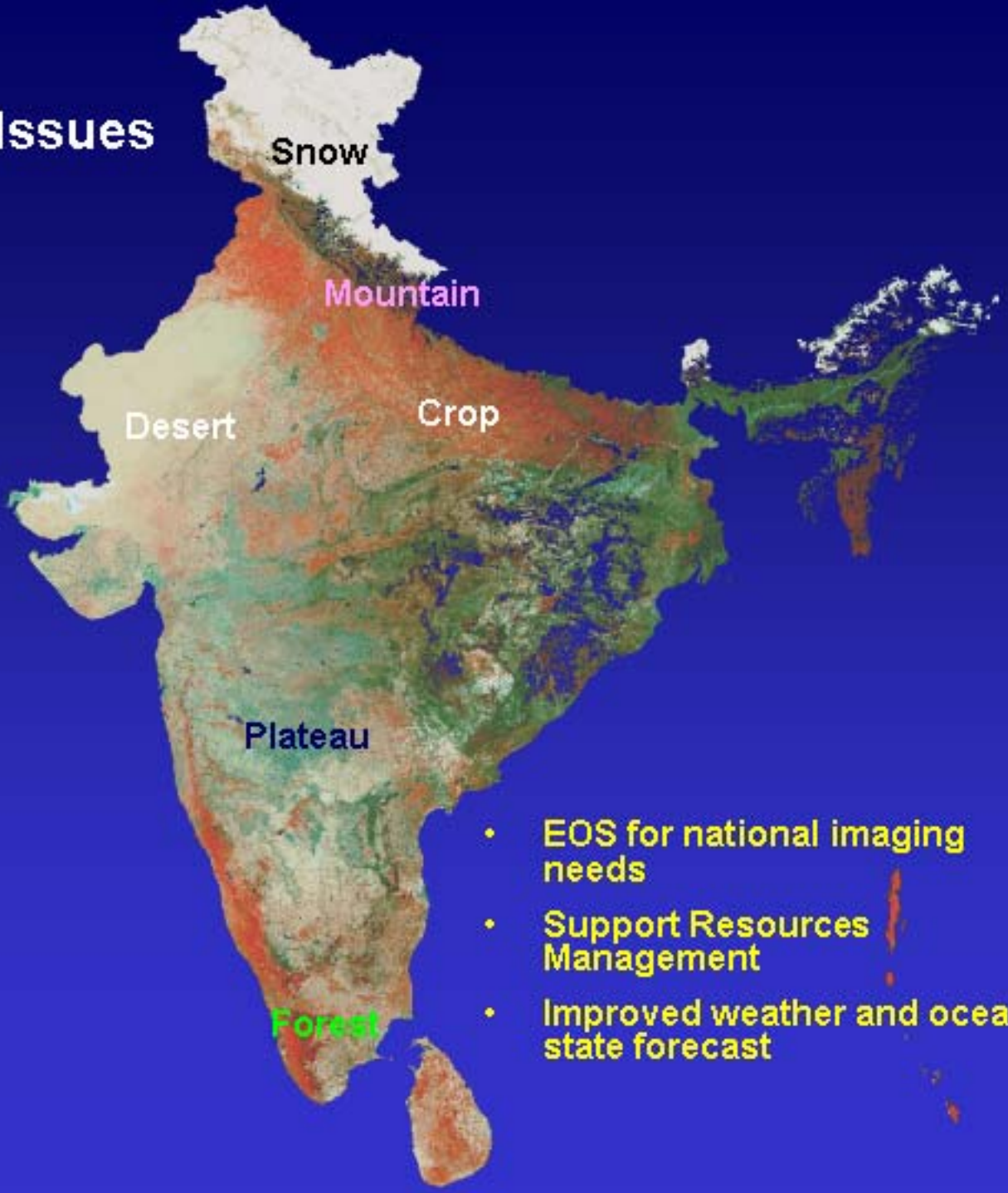
IRS-1A & 1B
operational-1G
LISS-1&2: 72/36 m,
4 Bands, VIS & NIR

RS-D1
BHASKARA
experimental

1979 1981 1982 1988 1991 1994 1995 1996 1997 1999 2003

India – Priority Issues

- Low Productivity
- Land Degradation
- Wastelands
- Depleting water resources
- Glacier retreat
- Forests & Biodiversity
- Degrading Coastal Resources
- Cyclones
- Floods
- Landslides
- Demographic pressure



- EOS for national imaging needs
- Support Resources Management
- Improved weather and ocean state forecast

GROUNDWATER EXPLORATION & RECHARGE

BASE MAP

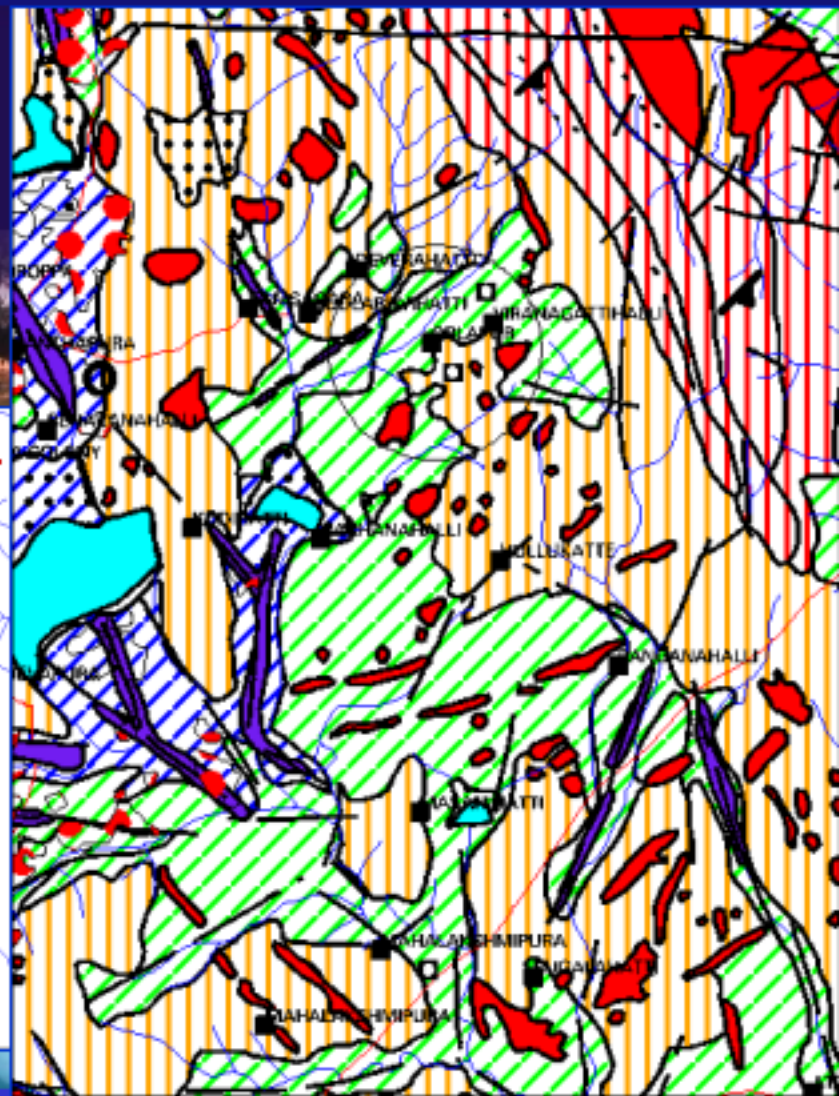
LITHOLOGY

STRUCTURAL FEATURES

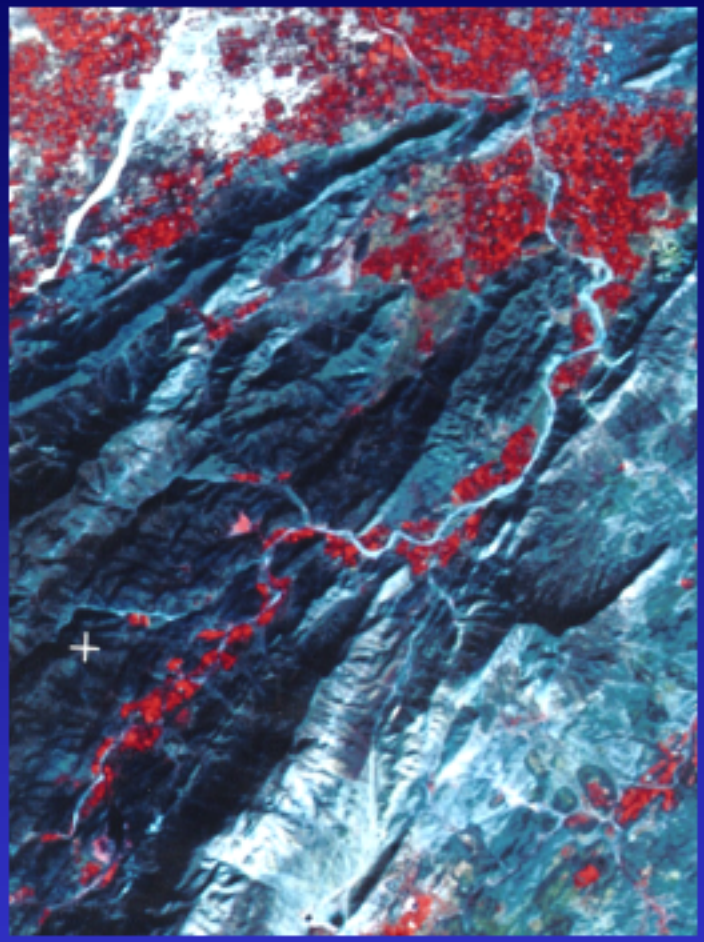
GEOMORPHO-LOGICAL MAP

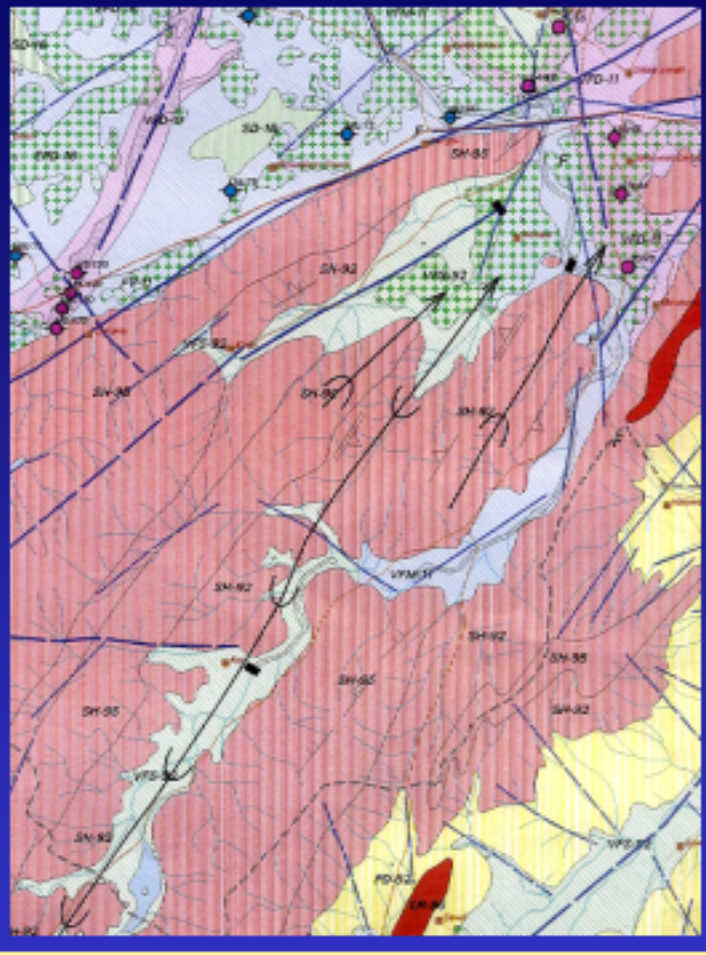
HYDROLOGICAL MAP

GROUNDWATER PROSPECTS MAP



Groundwater Exploration and Recharge





- Around 2000 G W Prospect & Recharge maps prepared on 1:50,000 scale
- 65,000 wells drilled with around 90% success rate
- 3500 recharge structures constructed

Development of spatial information system on groundwater resource
Over 50% of India's TGA spread over 10 states being mapped on 1:50,000 scale
Thematic information on lithology, structure, geomorphology & hydrology
> 90% success rate reported in drilled sources

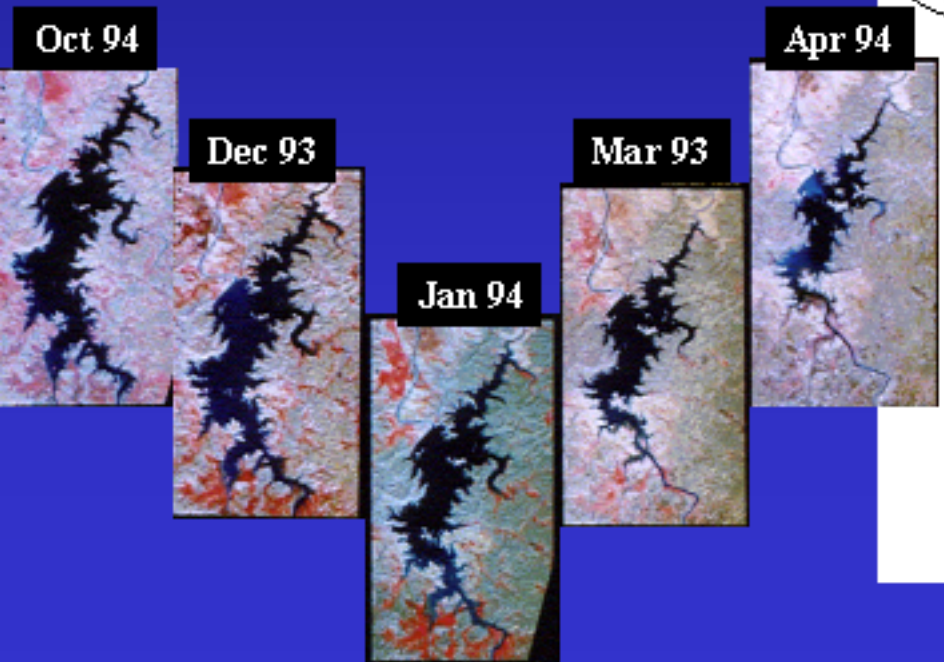
Remote Sensing based sedimentation analysis for selected reservoirs in India - for CWC

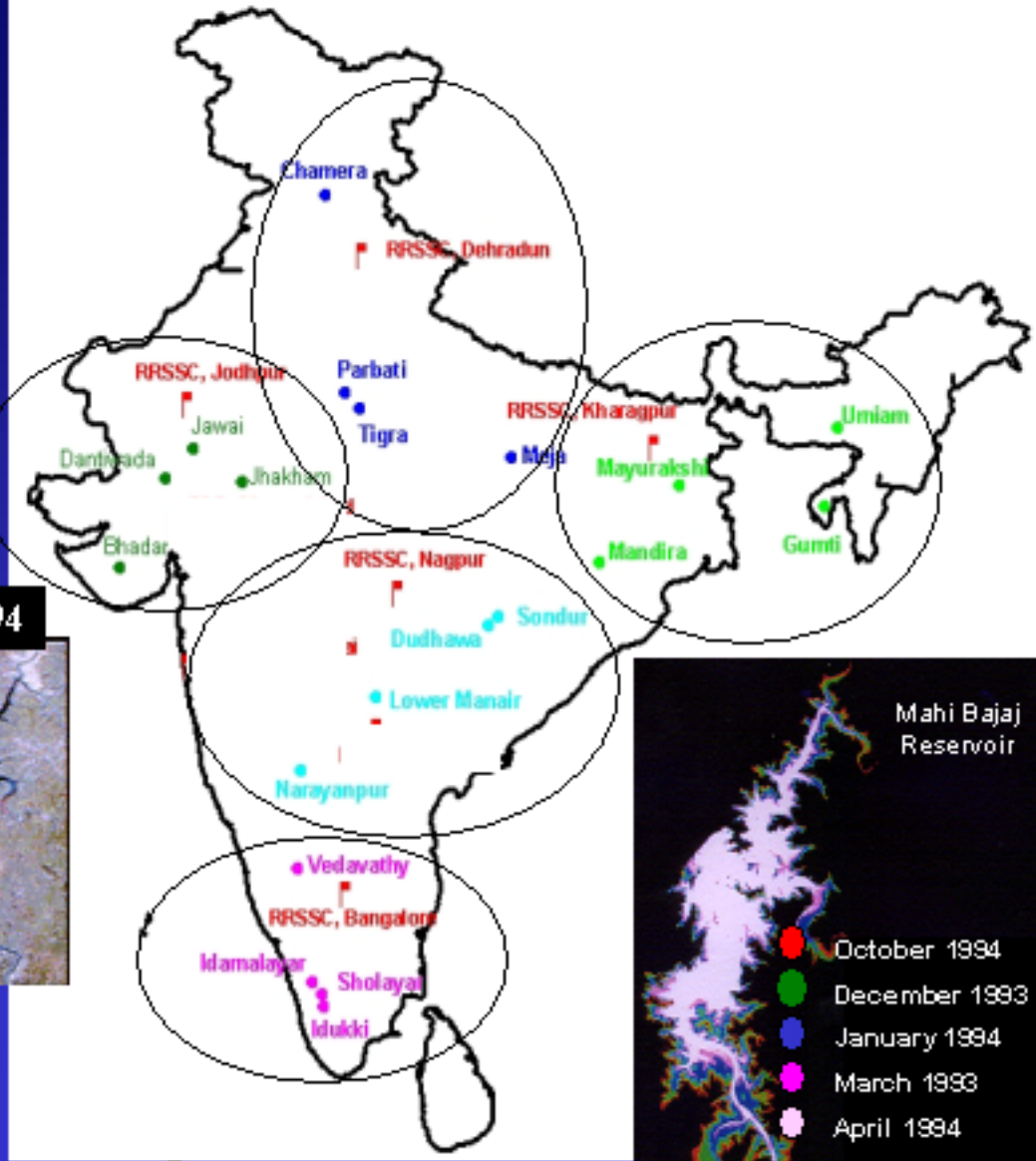
Objectives

- Updation of elevation-area-capacity curve
- Estimation of storage loss due to sedimentation
- To provide database for rational planning of future reservoirs

Outcome for each reservoir

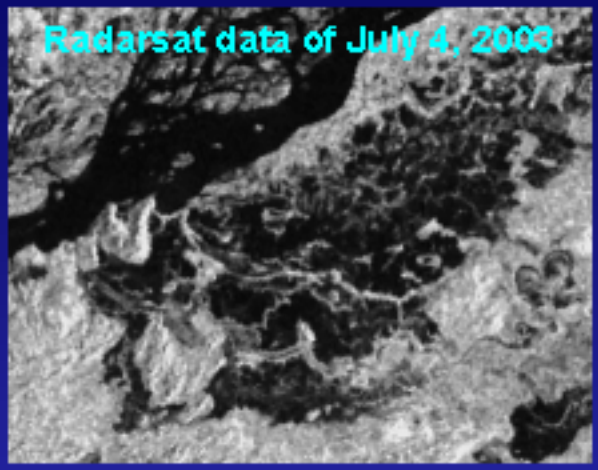
- Elevation-area-capacity Curve from MDDL to FRL and table

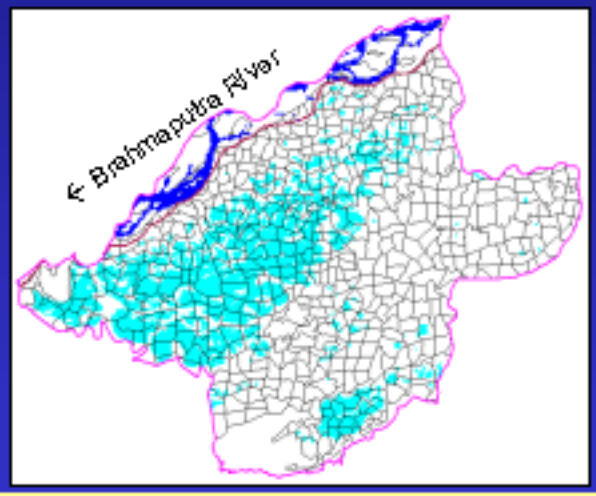




Information System for Flood & Drought Management

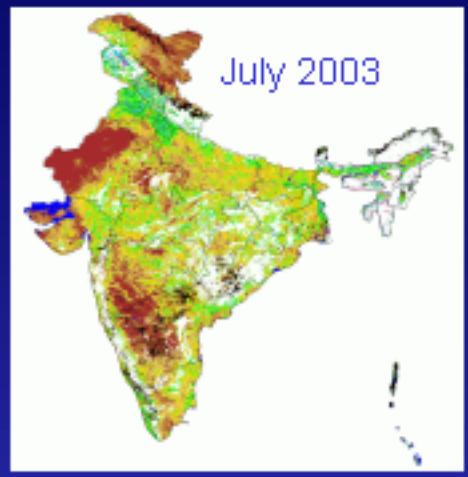
Flood Monitoring

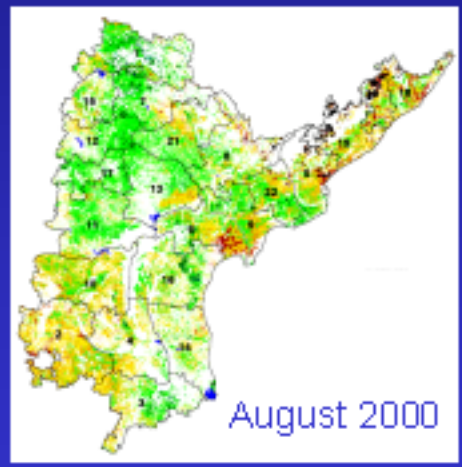


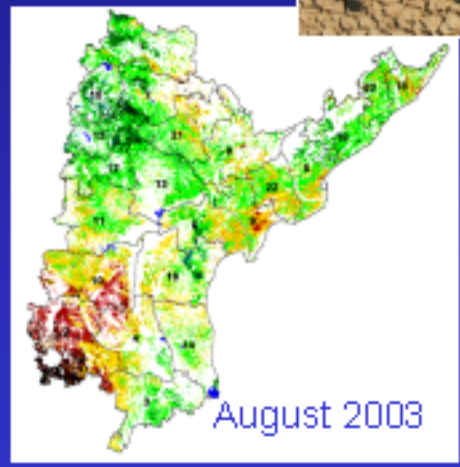


- Near-real time operational flood monitoring
- Damage assessment
- Information dissemination

Drought Monitoring

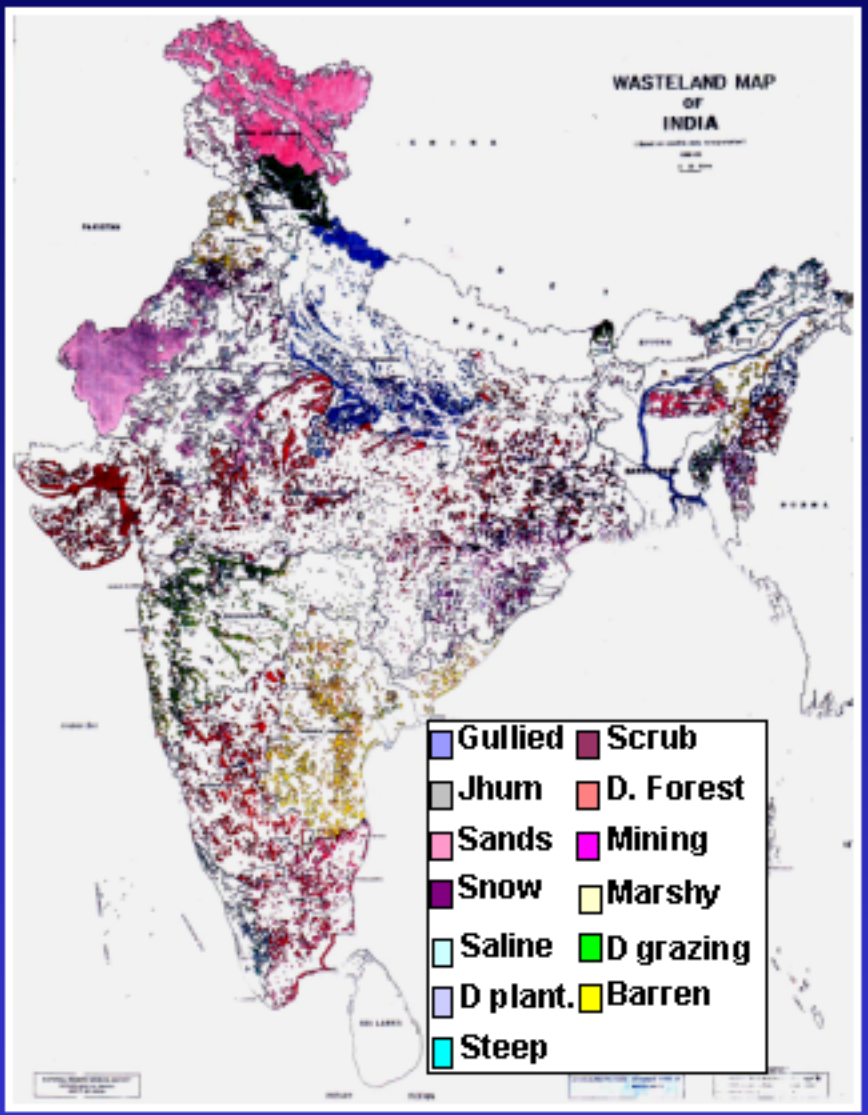






- Operation monsoon season agricultural drought monitoring based on NDVI
- National, state and district level information

WASTELAND MAPPING

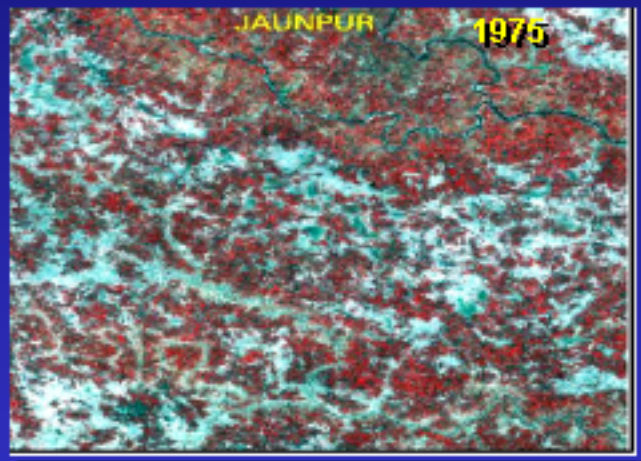


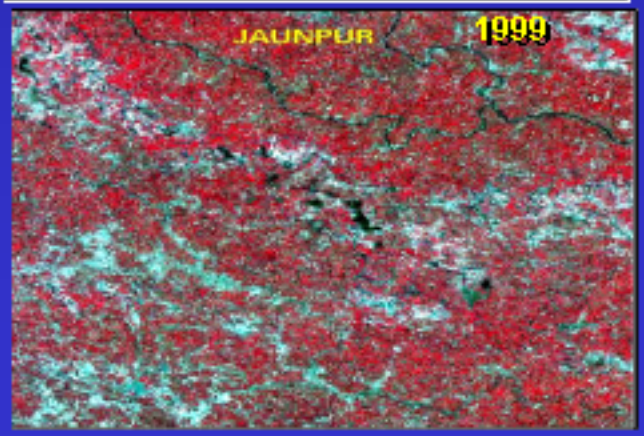
- Total wastelands in the country is estimated to be ~ 64 Mha (~ 46 Mha culturable).
- Wasteland Atlas of the country has been released.
- Digital database has been generated

RECLAMATION OF SALINE SOILS IN INDO-GANGETIC PLAINS - JAUNPUR (UP)

1975 – 46,029 ha

1999 – 28,749 ha





EO in Agricultural Drought Management

Seasonal Forecasting:

- Understanding of land-air-ocean interactions
- Establishing Global Tele-connections

Early Warning, Monitoring and Assessment

- Agro-informatics: In-season crop monitoring/ condition assessment/acreage estimation/ production forecast
- Impact/ damage assessment for relief & rehabilitation

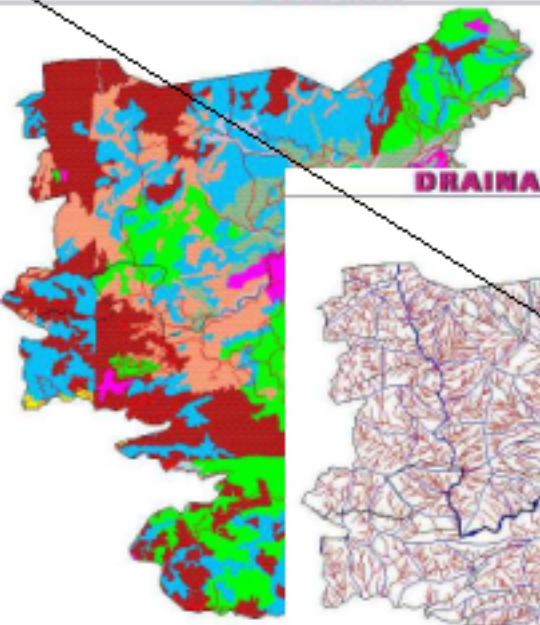
Drought Mitigation:

- Watershed Management: Ridge-to-valley treatment in dryland
- Land/ Crop Suitability: Diversification/ Intensification of Agriculture
- Land & Water use Efficiency: Salinity/ waterlogging mapping for reclamation & better water use

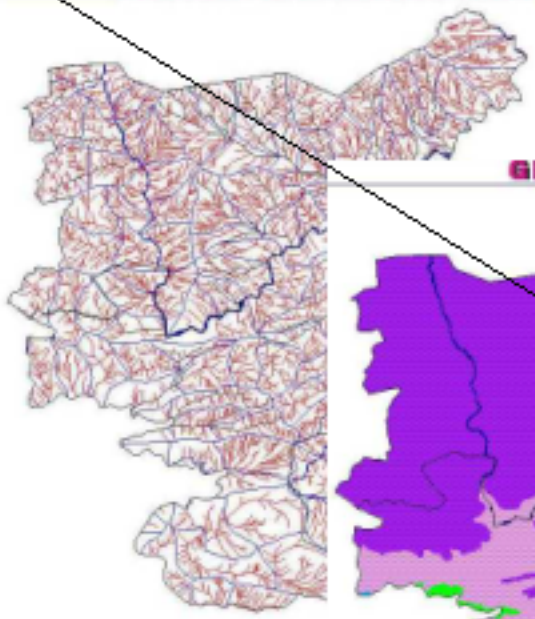
Captures spatial variability, vulnerability and dynamism quantitatively

Integration of Natural Resources Information

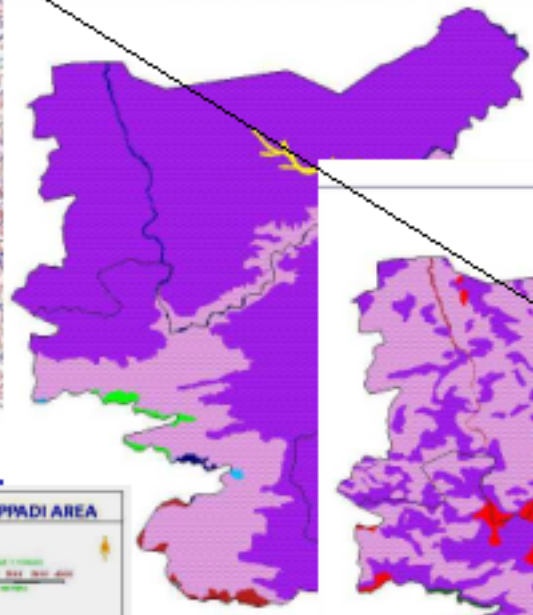
SOIL MAP



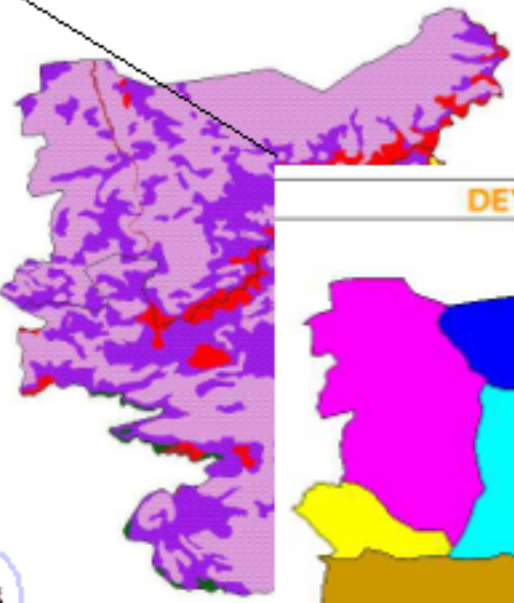
DRAINAGE & WATERSHED

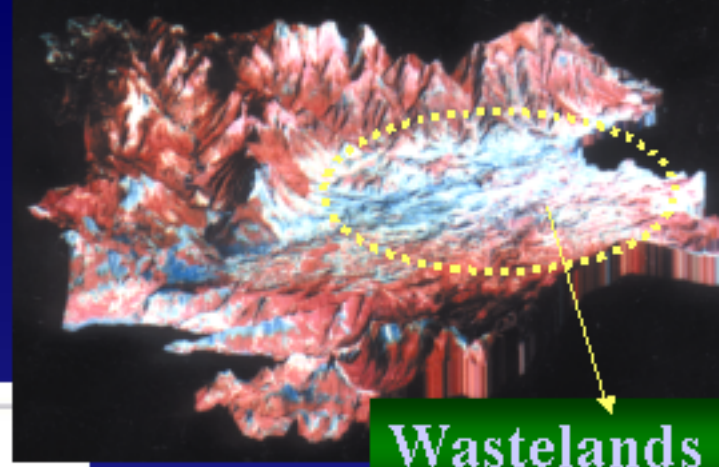


GEOMORPHOLOGY



SLOPE MAP





Wastelands

Action Plan Map

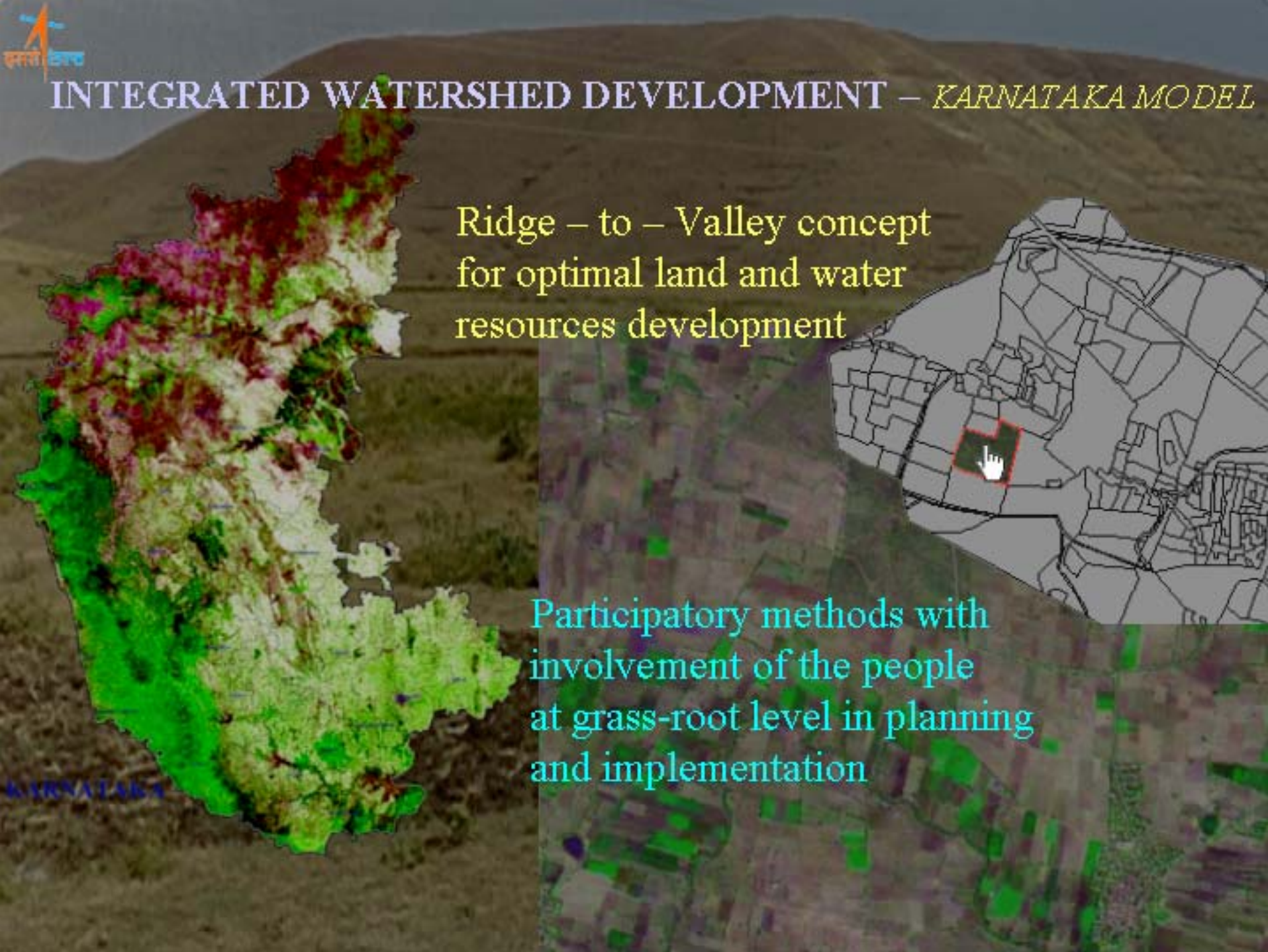
ACTION PLAN

ATTAPPADI AREA

Palakkad District

DEVELOPMENT UNITS

INTEGRATED WATERSHED DEVELOPMENT – *KARNATAKA MODEL*



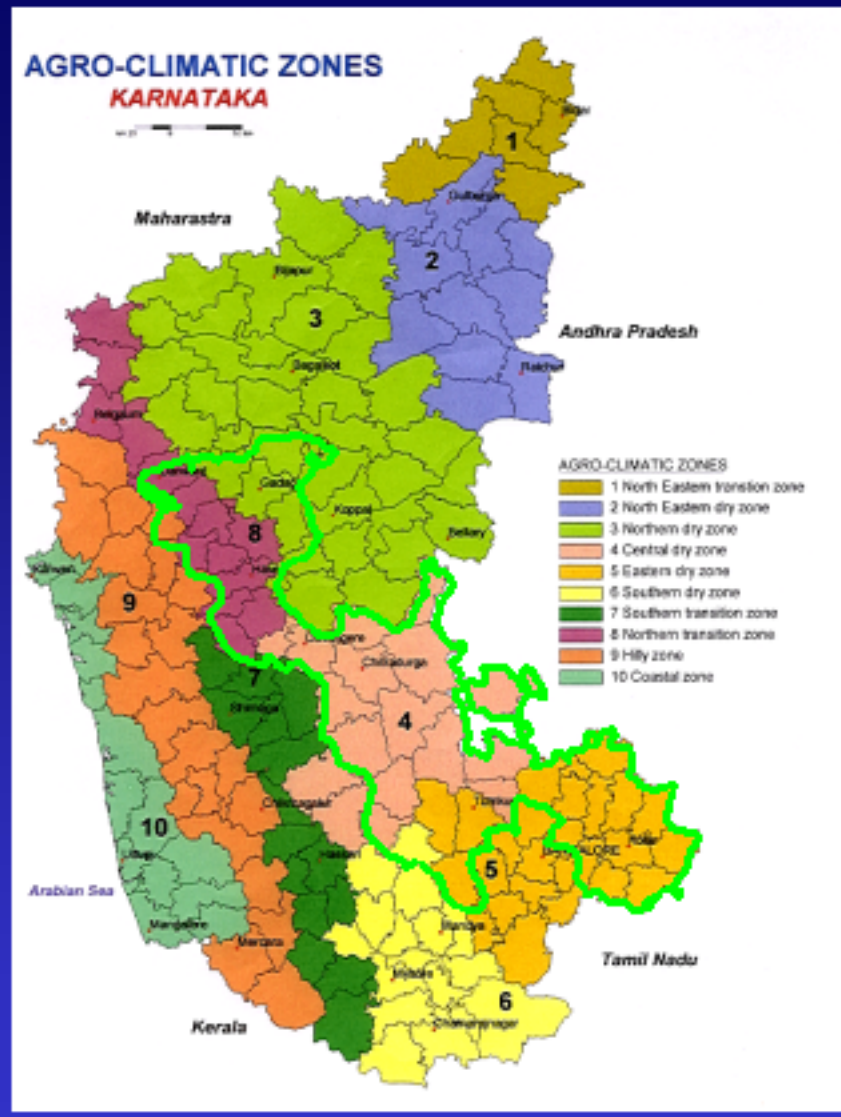
Project Overview

KARNATAKA STATE

- Total Geographical area: 190.49 L Ha.
- Cultivable land 56 % of which 78% is dryland

PROBLEMS OF THE TERRAIN:

- *Frequent occurrence of Drought*
- *Low Soil Fertility & Poor Crop Yield*
- *Uncertain, Erratic & Uneven Rainfall Distribution*
- *Shortage of Fuel wood and Fodder*
- *Depleting Ground Water table*
- *Poverty, Unemployment, Migration*
- *Degraded forest & large tracts of Wasteland*



- NO. OF DISTRICTS – 5
  Eastern Dry Zone , Central Dry Zone & Northern Transition Zone
- NO. OF WATERSHEDS – 77 (4.26 L Ha)
- NO. OF VILLAGES – 1270 (3.5 L families)





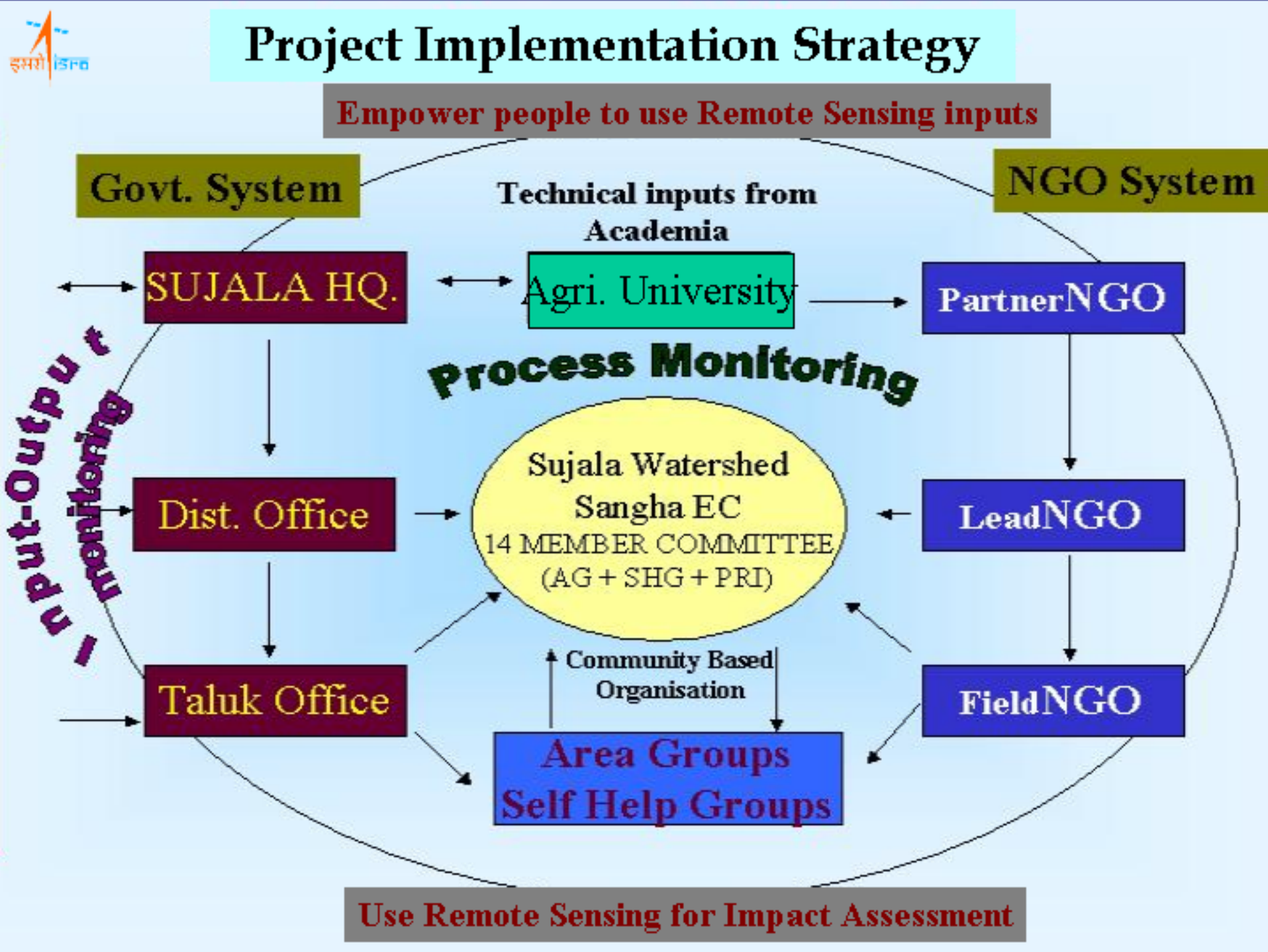
PROJECT OBJECTIVES

- Improve the productive potential & Reduce Poverty
- Improve the natural resources management
- Develop & strengthen community & local level Institutions
- Participatory approach – planning and implementation
- Ensure Sustainability of the assets created

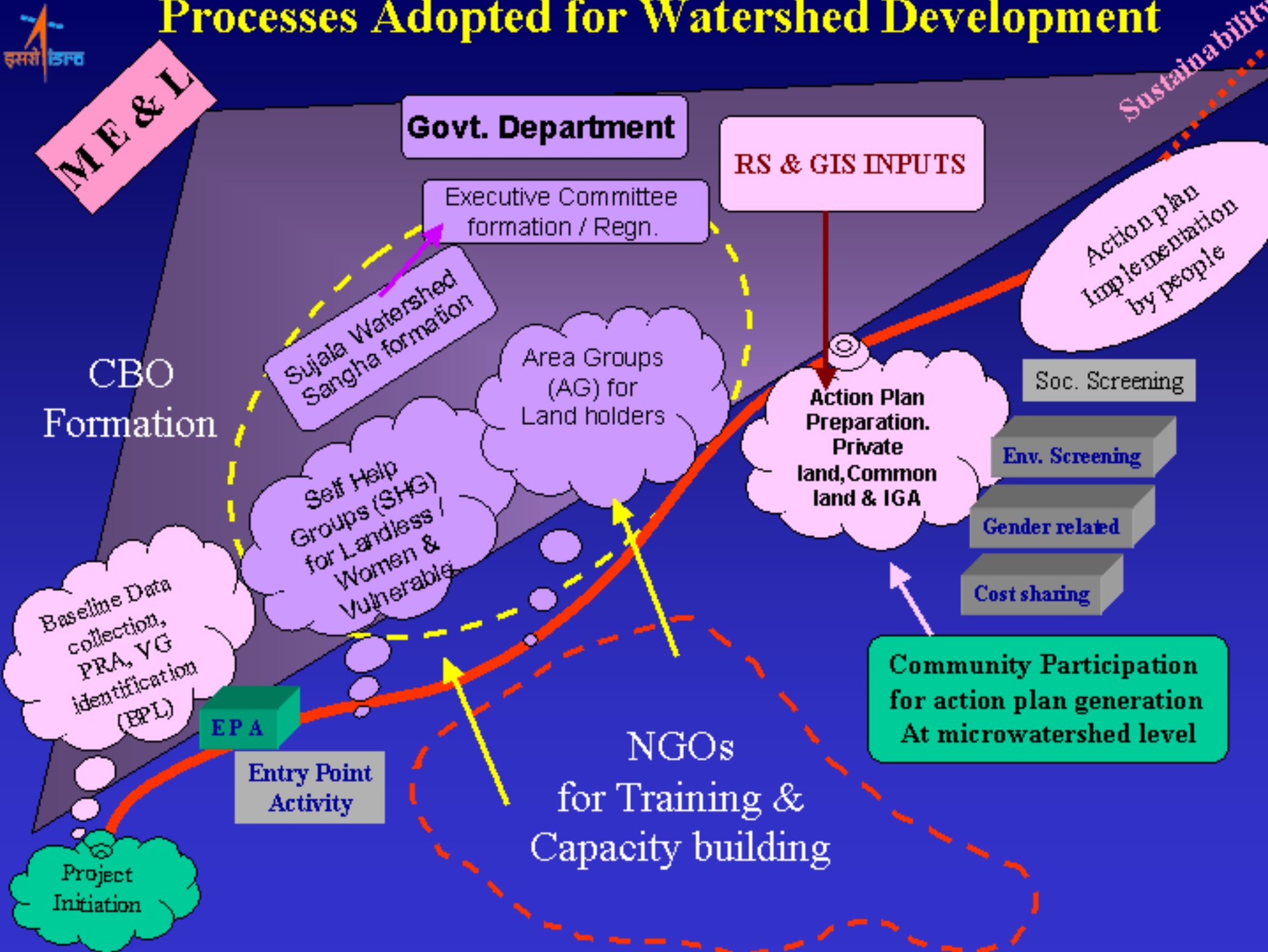
Uniqueness

- Holistic and integrated approach
- Participatory planning and implementation
- Community Based Organisations are decision makers
- Use of space technology through Remote Sensing & SatCom
- Concurrent monitoring and impact assessment
- I T Tools for planning and monitoring
- Financial transparency and accountability
- Gender sensitive and emphasis on equity
- Income Generating activities for Vulnerable Groups
- Role of NGOs & Govt. as facilitators
- Specific strategy for sustainability

Project Implementation Strategy

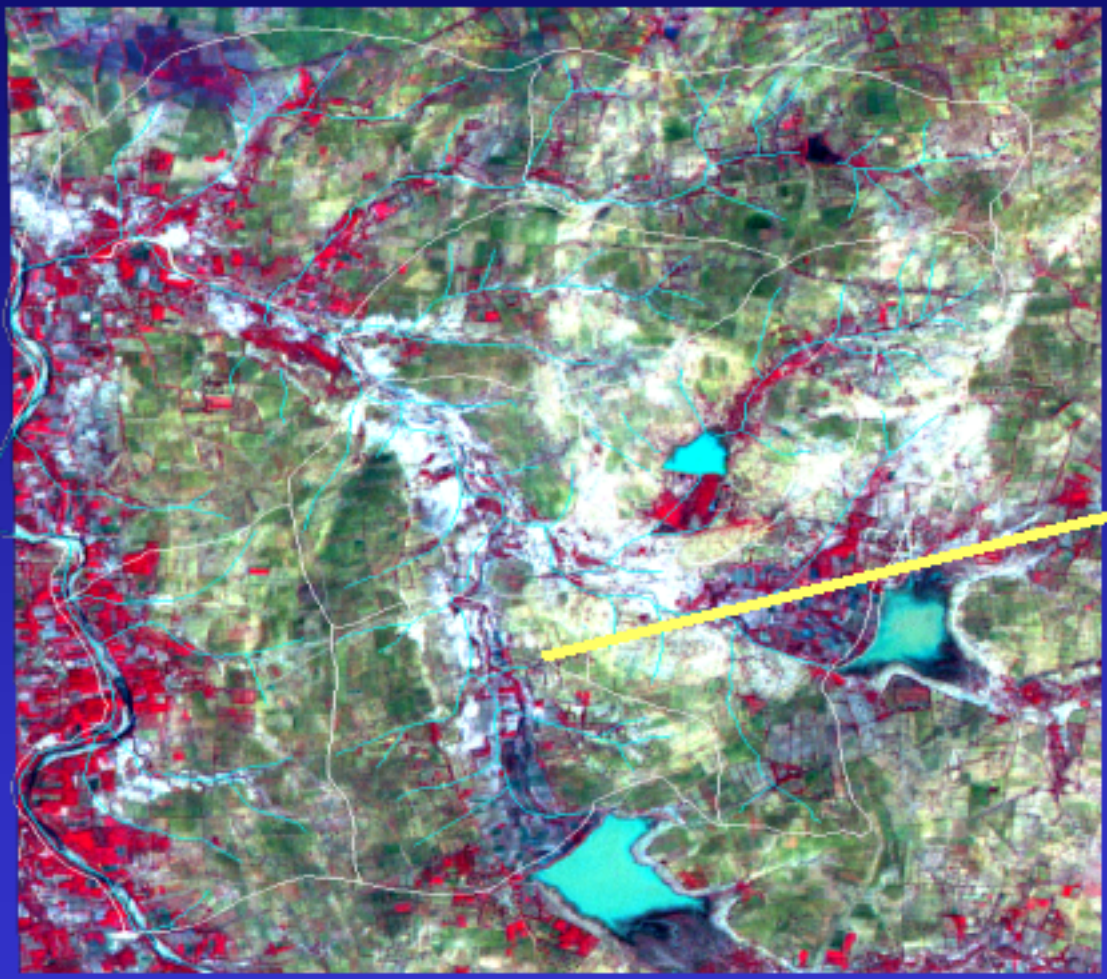


Processes Adopted for Watershed Development

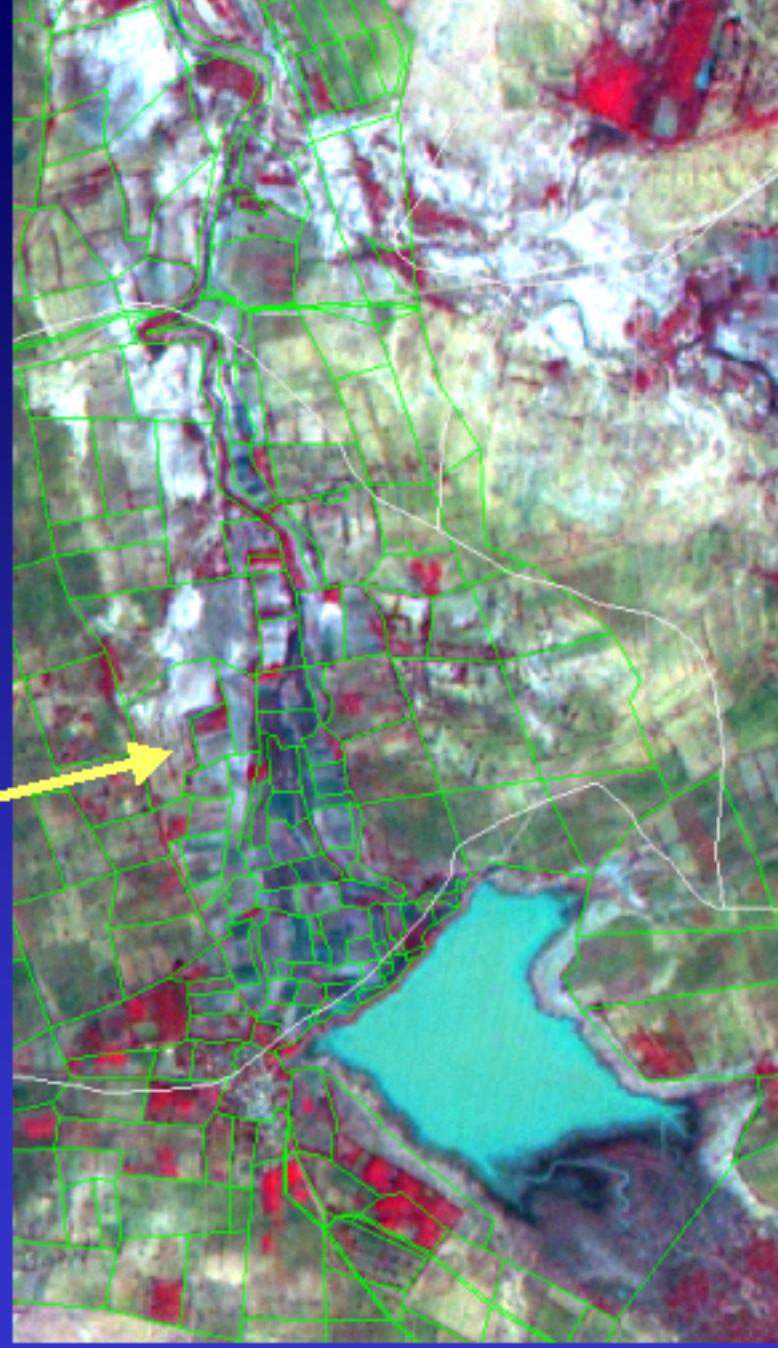


High Resolution IRS Image with Watershed boundary overlaid

- A typical example showing degraded lands



Area: 5560 ha

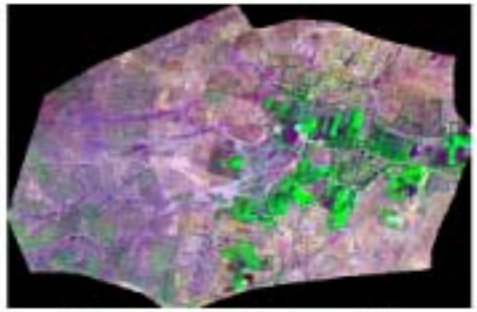


Microwatershed with cadastral overlay

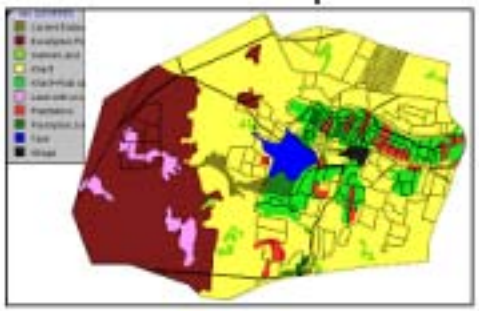
Value Added IRS data products in True color

Empowers People for better Resource Mapping

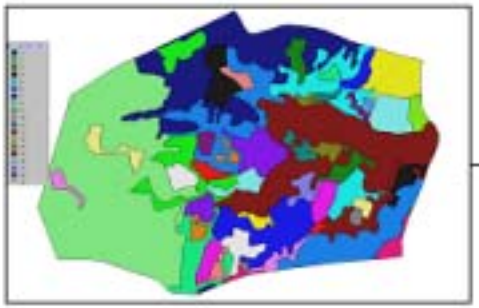
Satellite & GIS Inputs for Planning with community



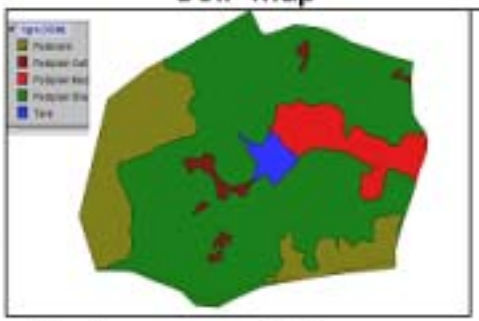
True Color Composite



Land use / land cover map

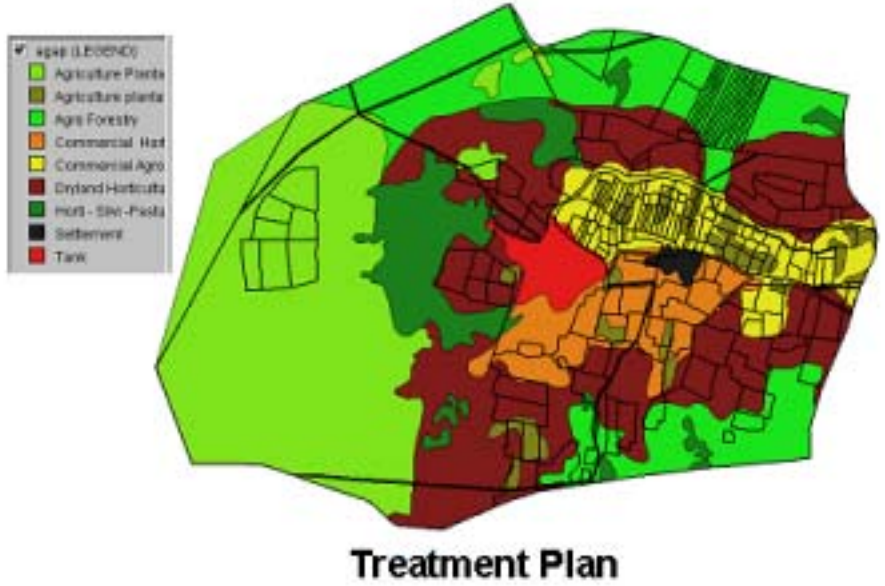


Soil map

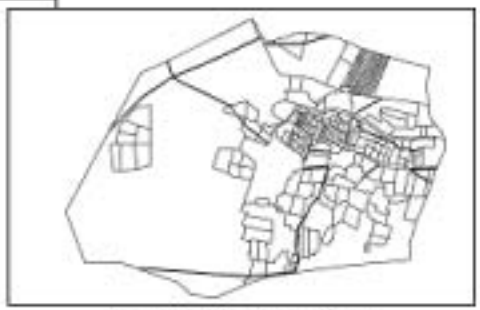


Hydro geomorphology map

Participatory Planning



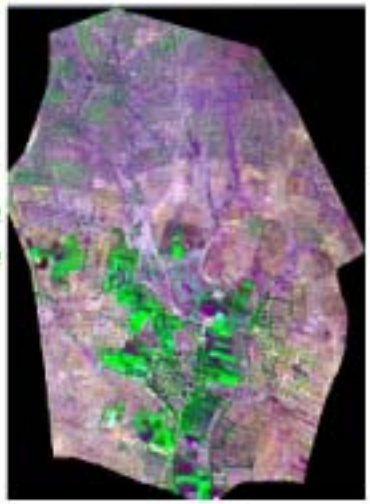
Treatment Plan



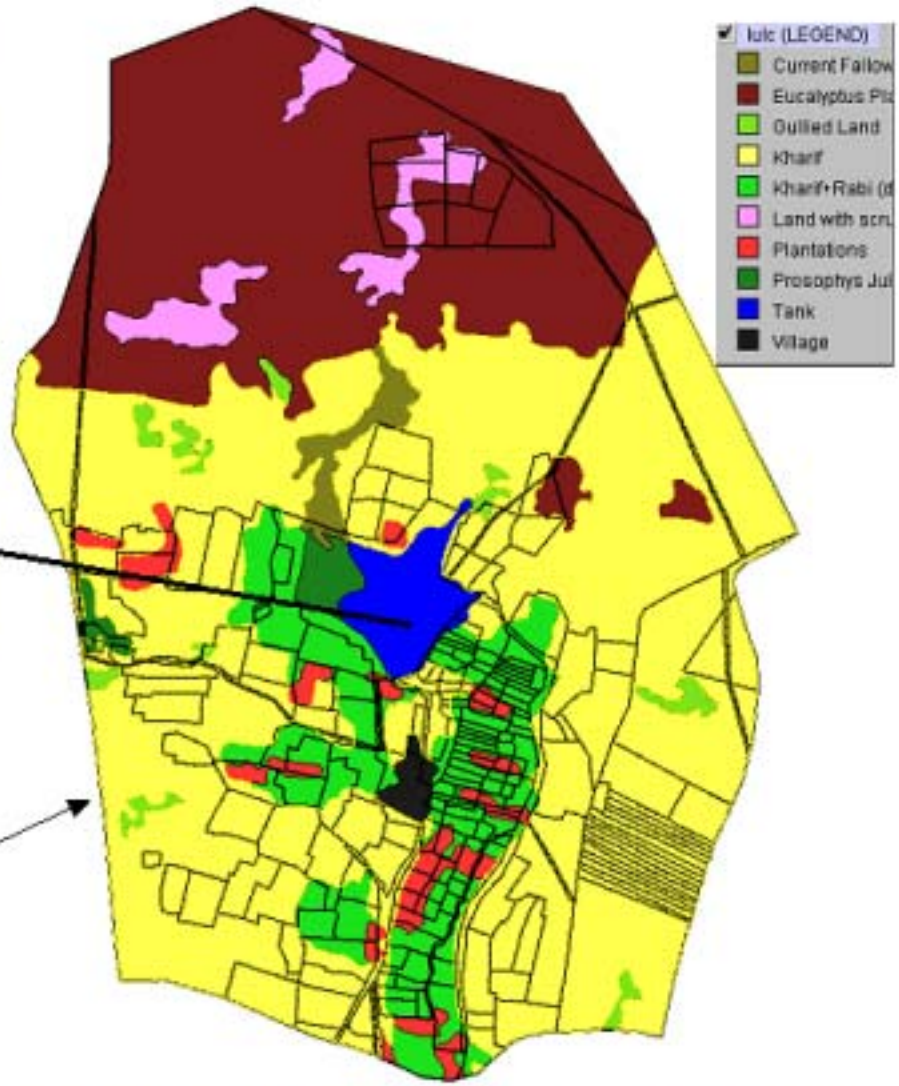
Land Parcel map

Drainage map

Participatory planning by the local community through PRA



Satellite Image
True Color Composite



Satellite derived Land use \ Land cover Map

- facilitates resource mapping through PRA.

Jodibisalahalli Micro-watershed, Kolar District, Karnataka, India

Spatial Query for Locale Specific Alternative Practices

GeoVIS ::: -> Tamil Nadu -> Thanjavur -> Thiruvaiyaru

File View Tools Help

Help Exit

Themes

- Cadastral
- Landuse/landcover
- Cadastral

LEGEND

Cadastral

Cadastral

Landuse/landcover :: nu

Suggestion.....

CURRENT LANDUSE

FALLOW

SOIL CHARACTERISTICS

Series : PADUGAI

Texture : SANDY CLAY LOAM

Erosion : SLIGHTLY ERODED

ALTERNATIVE CROPS

With Water Available

Vegetables, Flowers

With Less Water Available

Groundnut, Sesame, Sugar Beat, Sweet Sorghum

WATER RESOURCE

Form Ponds

Desilting of Tank

Sub-surface Dyke

Ok

DSS

X : 1050594.2814204546

Y : 1026699.5798863636

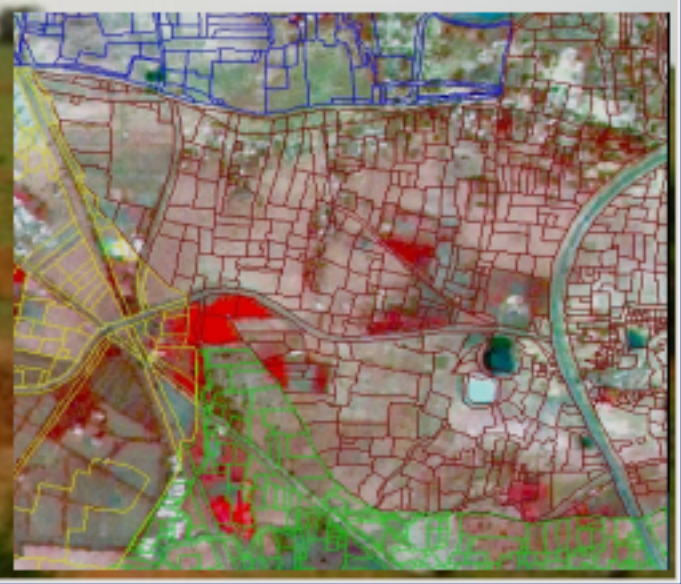
Scale Factor

1 Pix = 7.85 m

ಸುಜಲ ಜಲಾನಯನ ಯೋಜನೆ

ಕ್ರಿಯಾ ಯೋಜನೆ ರಚನೆ

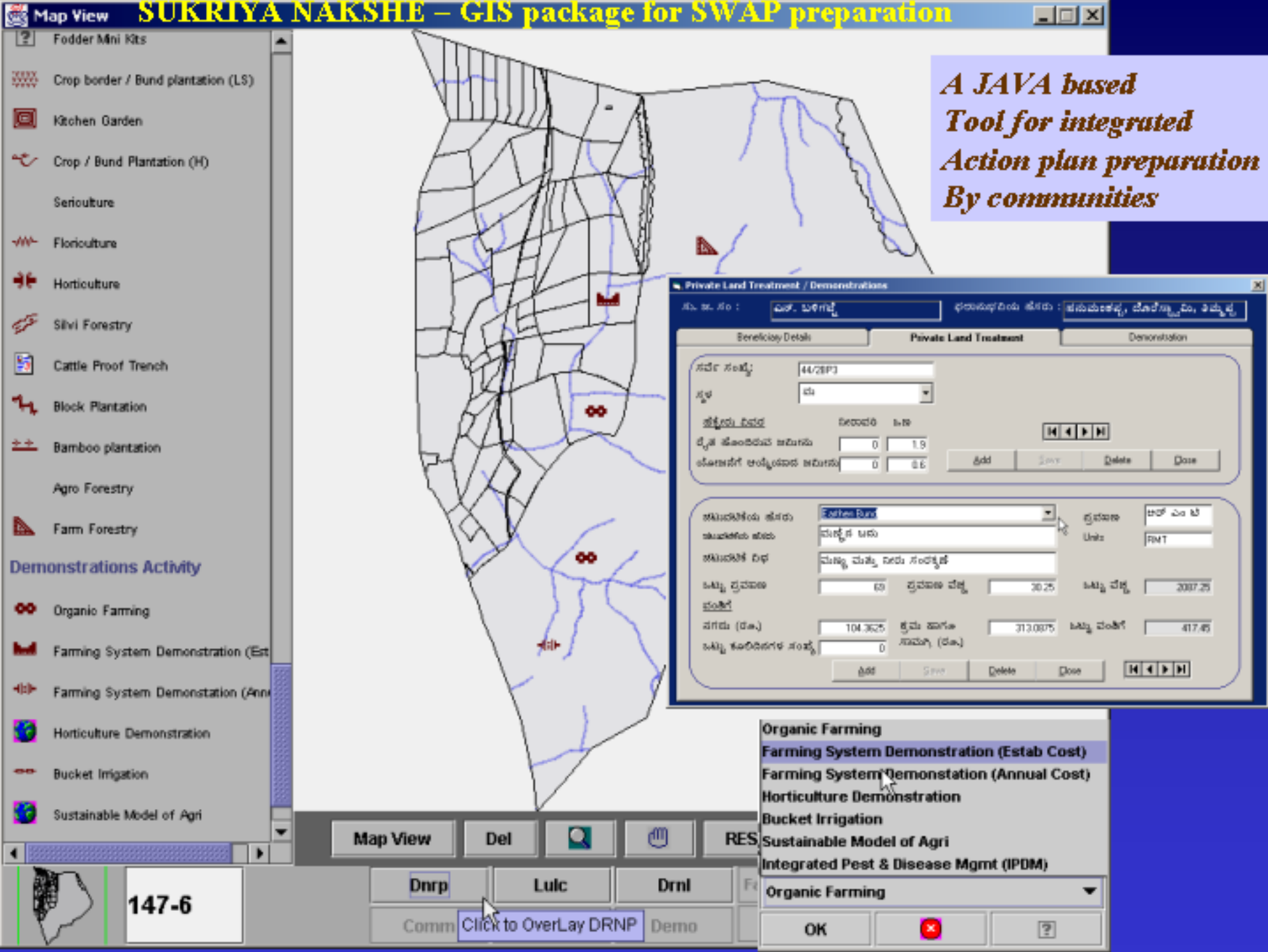
SUKRIYA

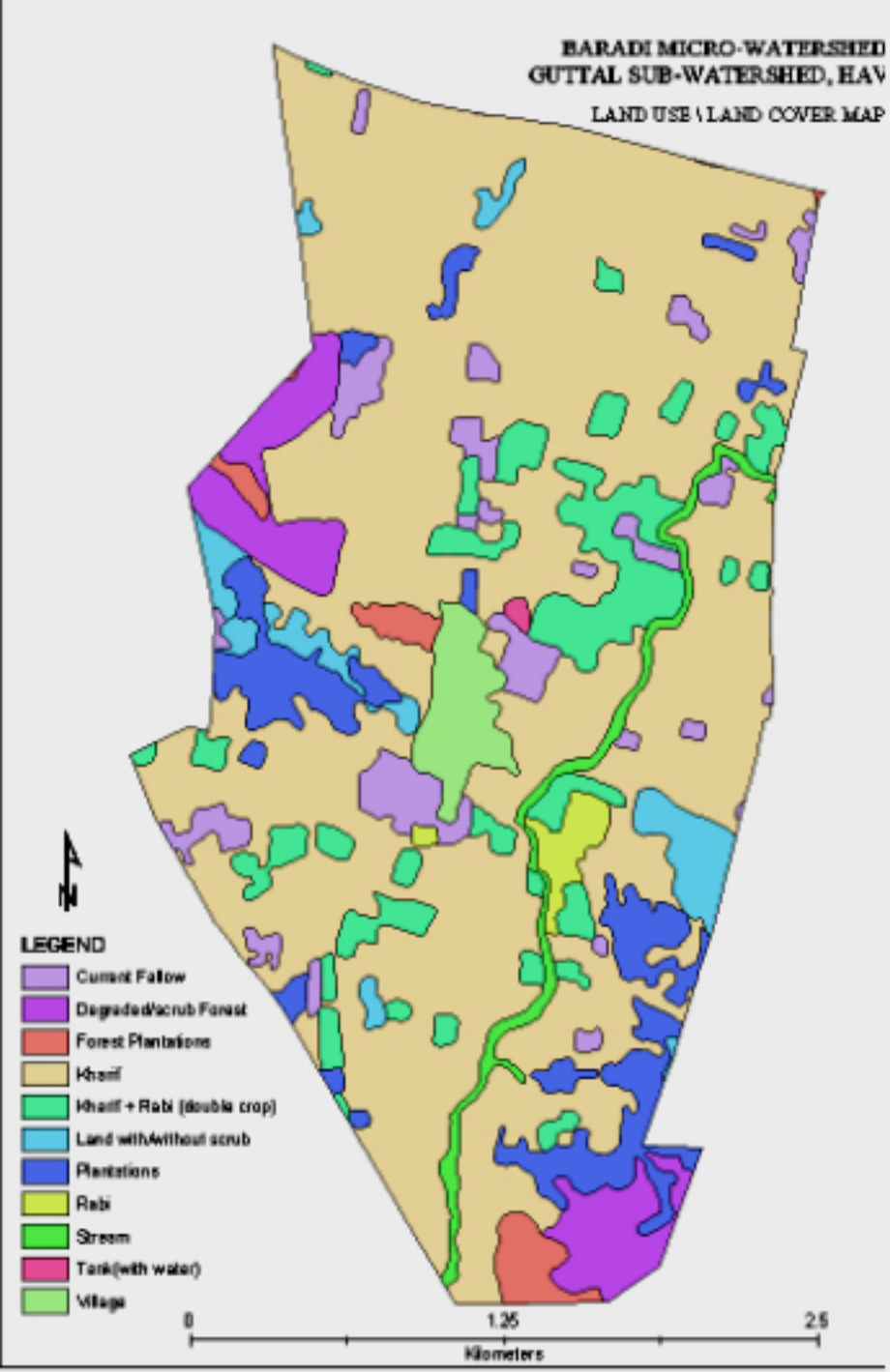


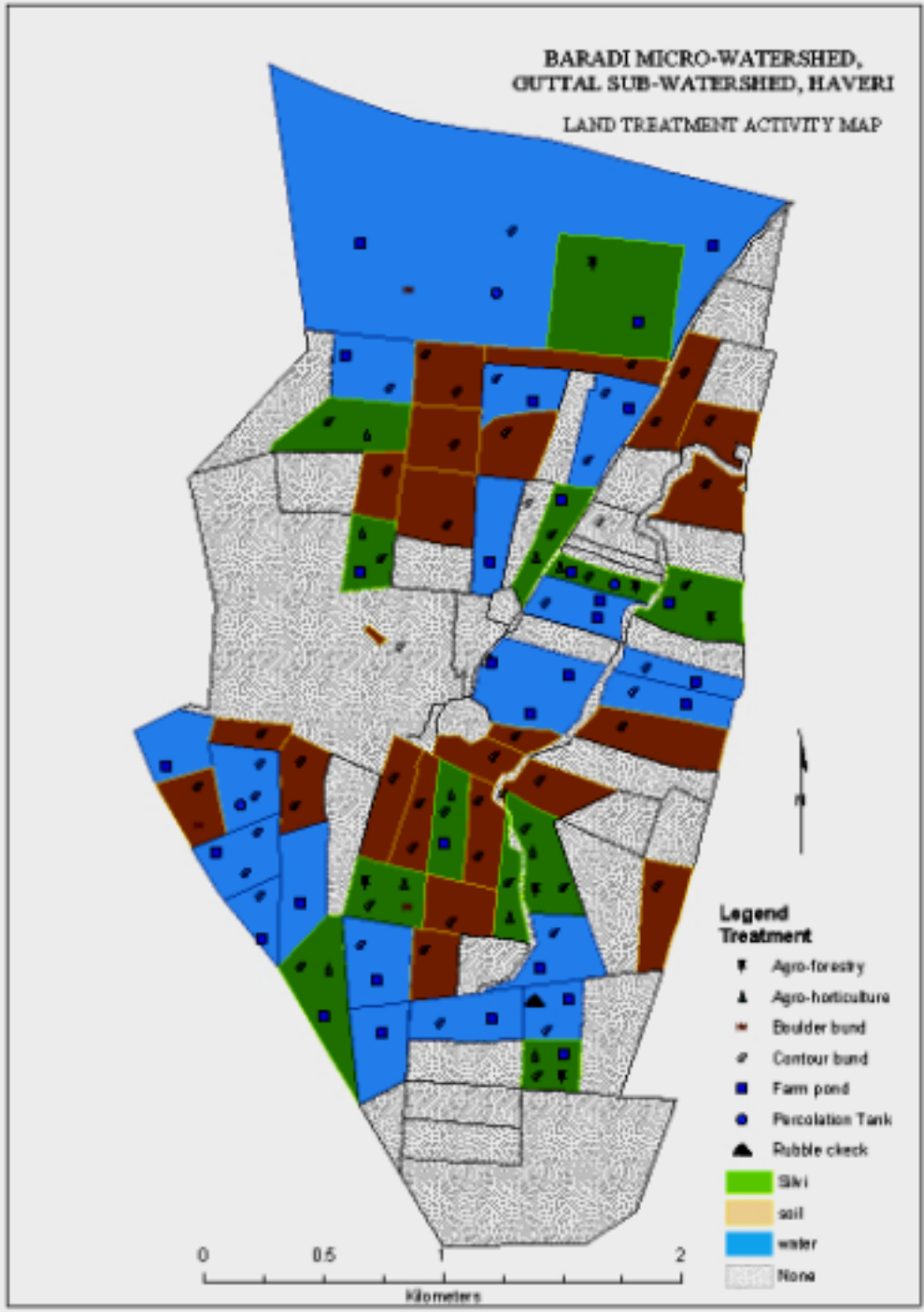
Version 1.0.1

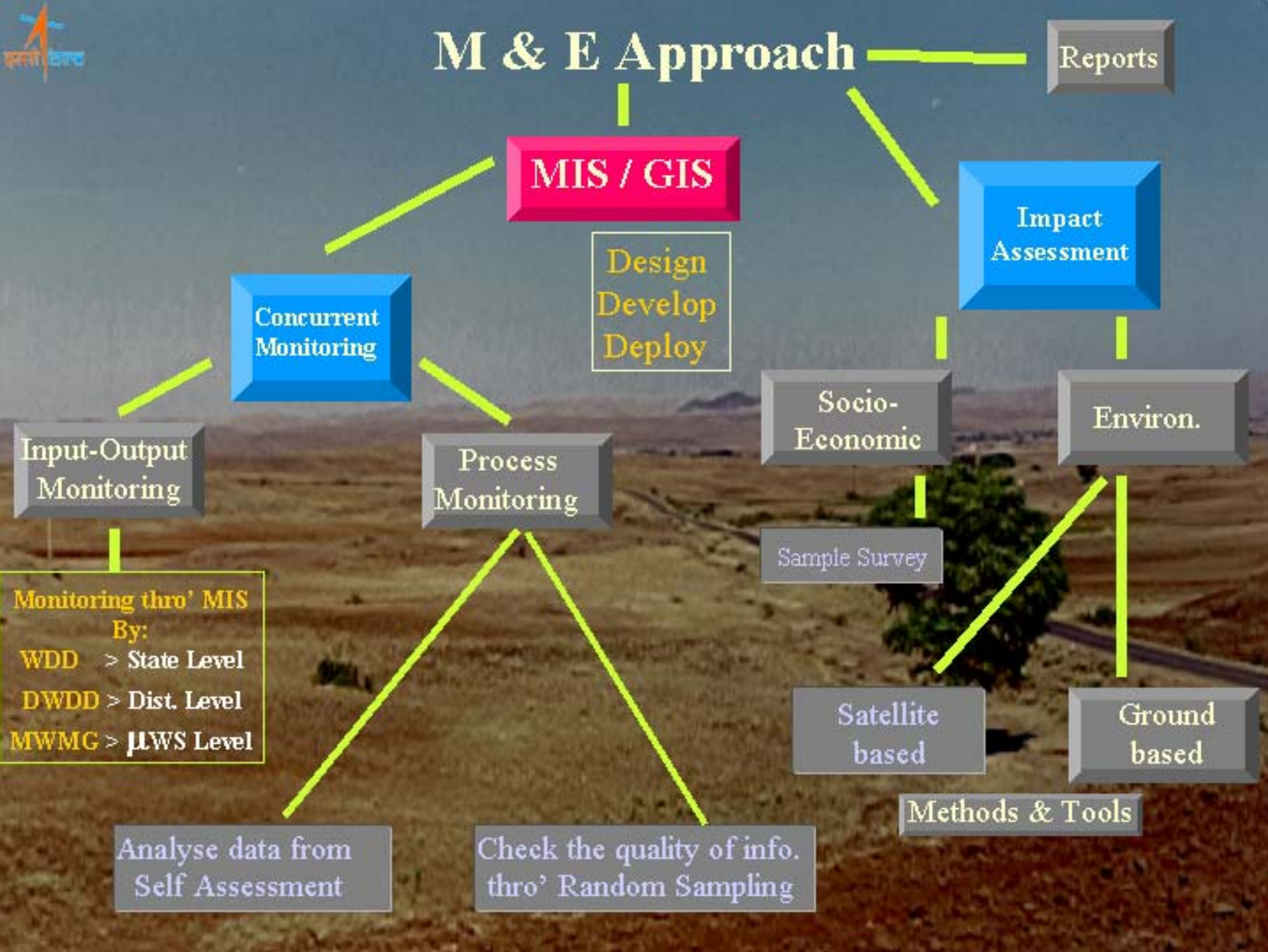
Developed by M, E and L, Antrix Corporation Limited ,ISRO

A Bi-lingual package for communities to prepare Integrated Watershed Development plan at local level


Map View
SUKRIYA NAKSHE – GIS package for SWAP preparation
Fodder Mini Kits
Crop border / Bund plantation (LS)
Kitchen Garden
Crop / Bund Plantation (H)
Sericulture
Floriculture
Horticulture
Silvi Forestry
Cattle Proof Trench
Block Plantation
Bamboo plantation
Agro Forestry
Farm Forestry
Demonstrations Activity
Organic Farming
Farming System Demonstration (Est
Farming System Demonstation (Ann
Horticulture Demonstration
Bucket Irrigation
Sustainable Model of Agri
A JAVA based
Tool for integrated
Action plan preparation
By communities
Private Land Treatment / Demonstrations
Beneficiary Details
Private Land Treatment
Demonstration
Add
Save
Delete
Close
Organic Farming
Farming System Demonstration (Estab Cost)
Farming System Demonstation (Annual Cost)
Horticulture Demonstration
Bucket Irrigation
Sustainable Model of Agri
Integrated Pest & Disease Mgmt (IPDM)
Organic Farming
OK
Map View
Del
Dnrp
Lulc
Drnl
Click to OverLay DRNP
147-6


BARADI MICRO-WATERSHED
GUTTAL SUB-WATERSHED, HAV
LAND USE \ LAND COVER MAP
LEGEND
Current Fallow
Degraded/Acrub Forest
Forest Plantations
Kharif
Kharif + Rabi (double crop)
Land with/Without scrub
Plantations
Rabi
Stream
Tank(with water)
Village
0
1.25
2.5
Kilometers


BARADI MICRO-WATERSHED,
GUTTAL SUB-WATERSHED, HAVERI
LAND TREATMENT ACTIVITY MAP
Legend
Treatment
Agro-forestry
Agro-horticulture
Boulder bund
Contour bund
Farm pond
Percolation Tank
Rubble check
Silvi
soil
water
None
0
0.5
1
2
Kilometers


M & E Approach
Reports
MIS / GIS
Design
Develop
Deploy
Impact Assessment
Concurrent Monitoring
Input-Output Monitoring
Process Monitoring
Socio-Economic
Environ.
Sample Survey
Monitoring thro' MIS By:
WDD > State Level
DWDD > Dist. Level
MWMG > µWS Level
Satellite based
Ground based
Methods & Tools
Analyse data from Self Assessment
Check the quality of info. thro' Random Sampling

PROCESS MONITORING

Broad Indicators

- Awareness creation & sensitization
- PRA & Baseline
- Entry point Activity
- Group activities SHG, AG
- Capacity building for CBO'S (SHG, AG)
- SWS-EC activities & Capacity building
- Action plan preparation
- Environmental and social screening
- Action plan Implementation
- Participatory Impact Assessment
- Withdrawal process & sustainability of assets

Implementation of MIS / GIS Package at local level

- Database creation
- Data Flow
- Data Synthesis
- Monitoring at all levels of project

Database update & Report generation on weekly basis.

Project Head Quarters

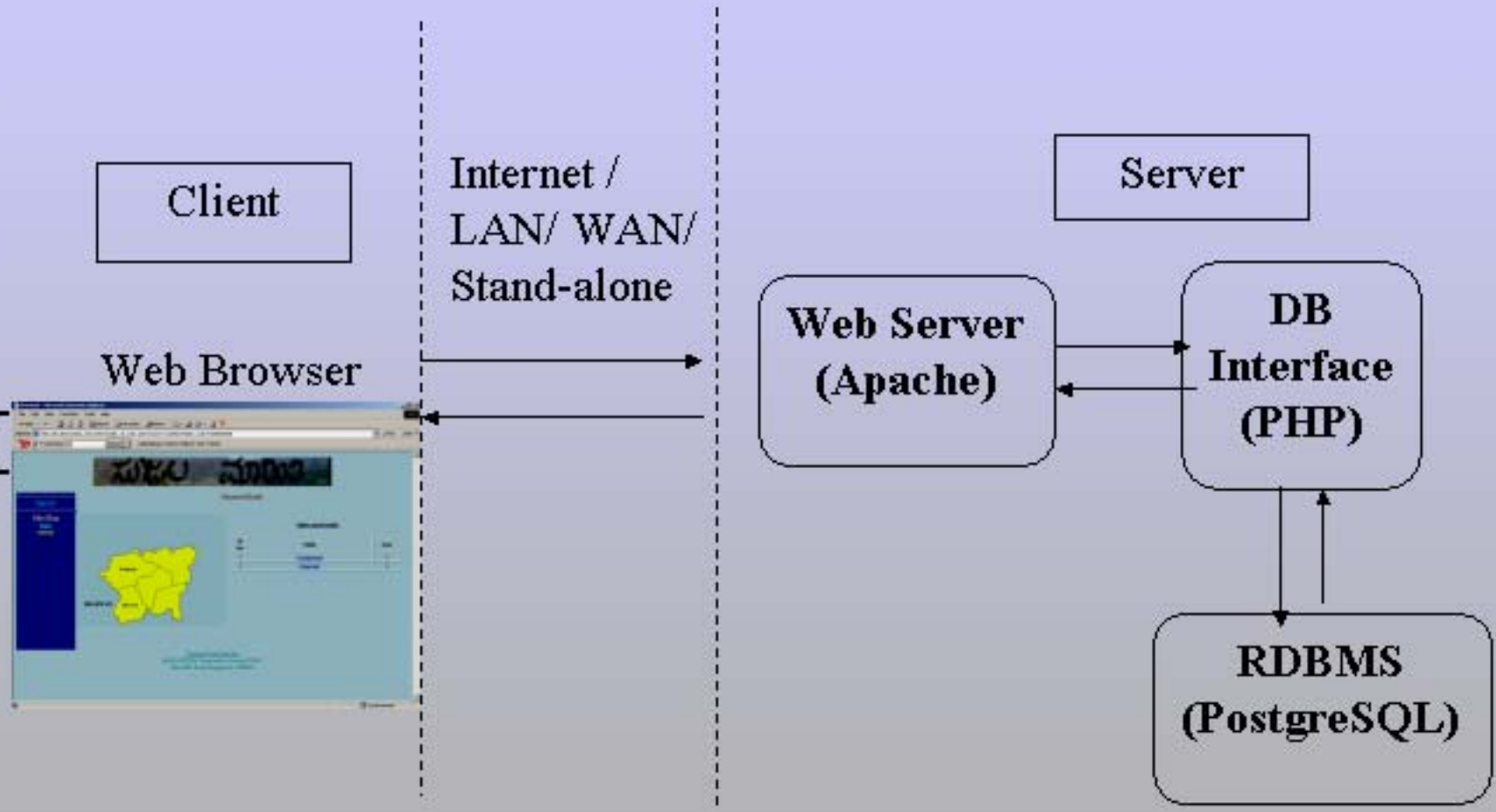
Kolar ***Tumkur*** ***Chitradurga*** ***Haveri*** ***Dharwar***

District Level Synthesis

854 microwatersheds information Created by NGOs and Govt. systems

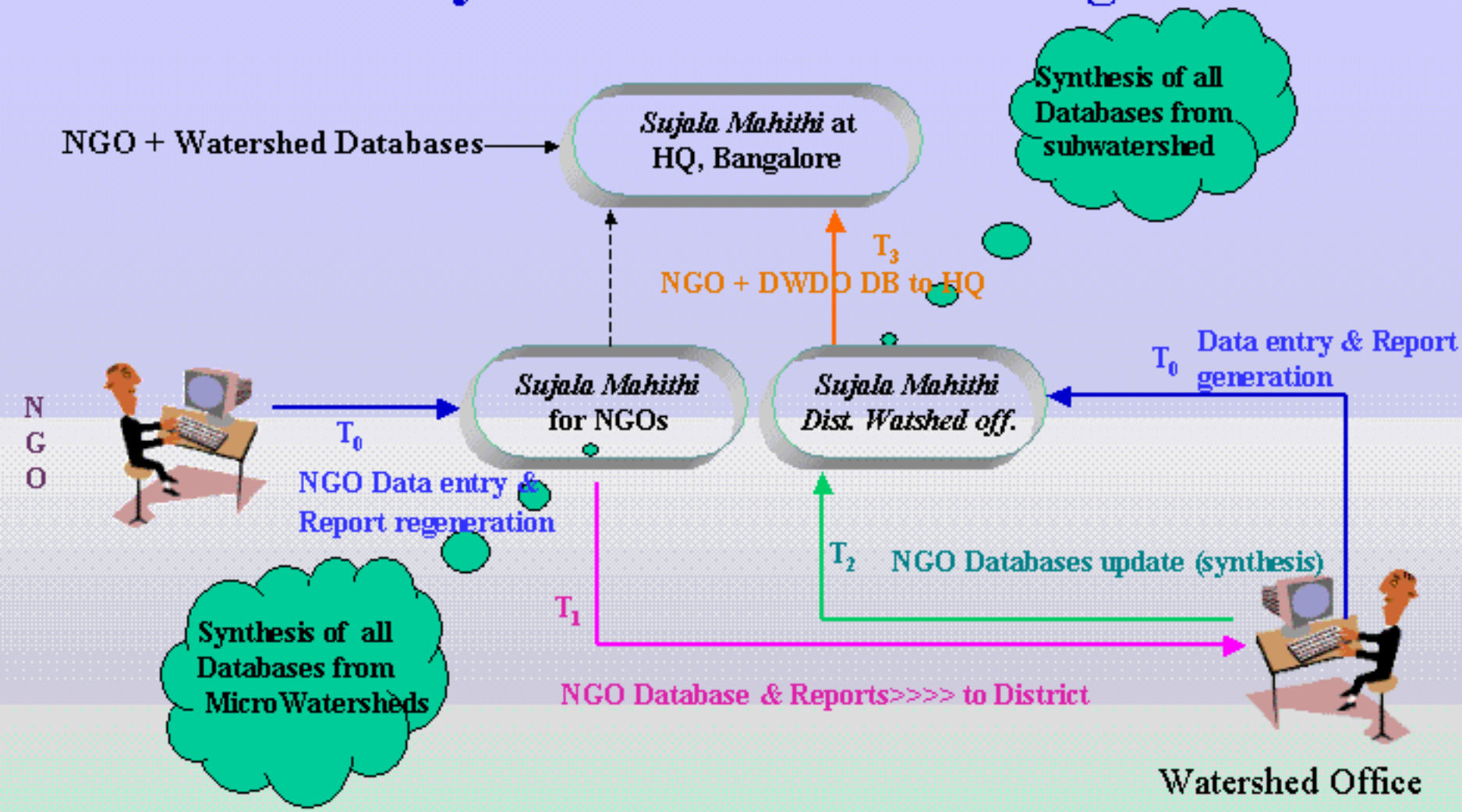
Sujala Mahithi

System Architecture



System components and Information flow within the "Sujala Mahithi" package

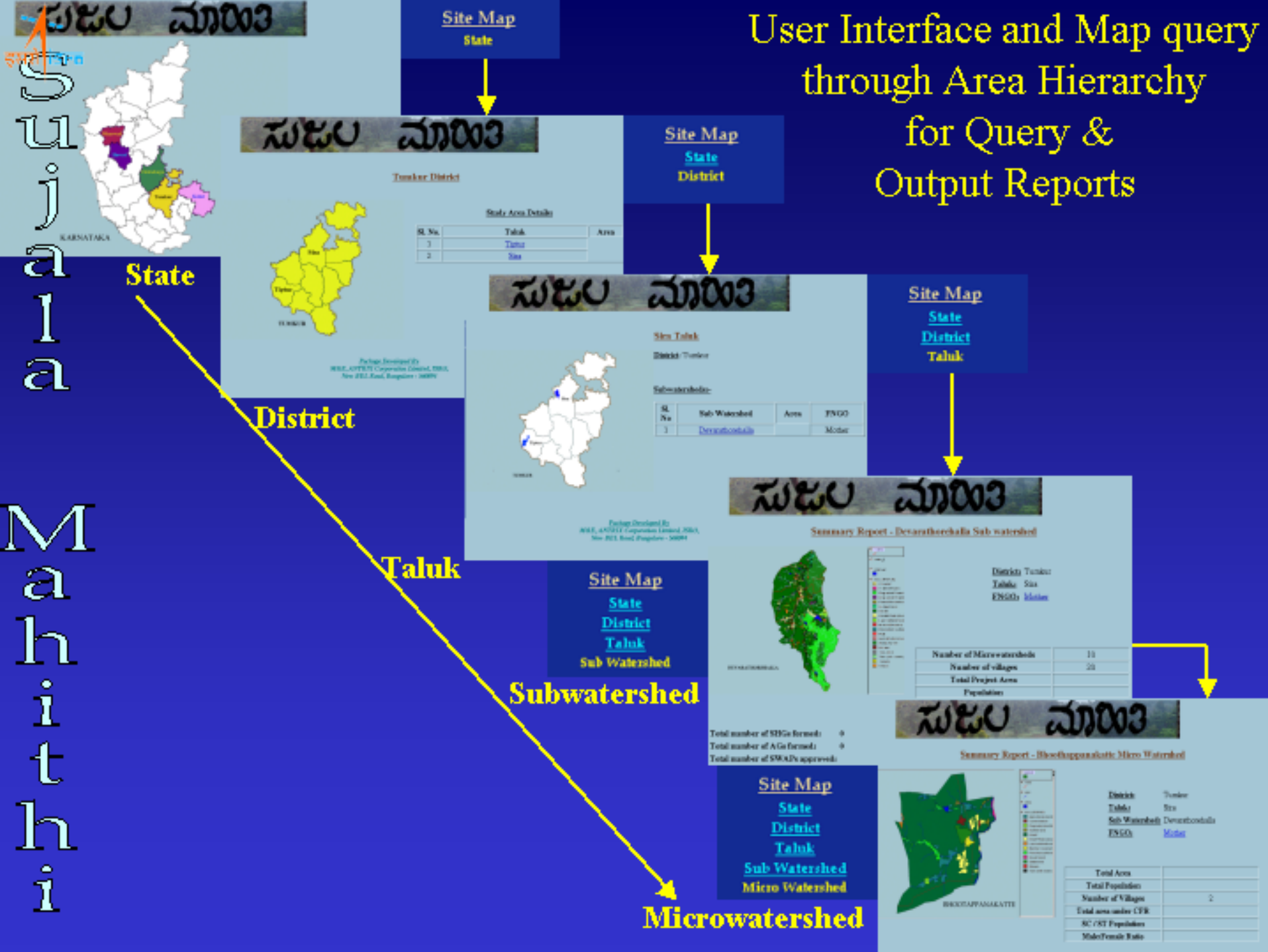
Data Synthesis for monitoring



MIS/GIS for NGOs and Govt. system for monitoring

User Interface and Map query through Area Hierarchy for Query & Output Reports

Sujala Mahithi



IMPACT ASSESSMENT

Social & Environmental

- HOUSEHOLD
- COMMUNITY / VILLAGE
- Micro-Watershed / Sub-Watershed

Macro level

- High Resolution Satellite Images
- GIS database at subwatershed
- Rainfall data

Micro level

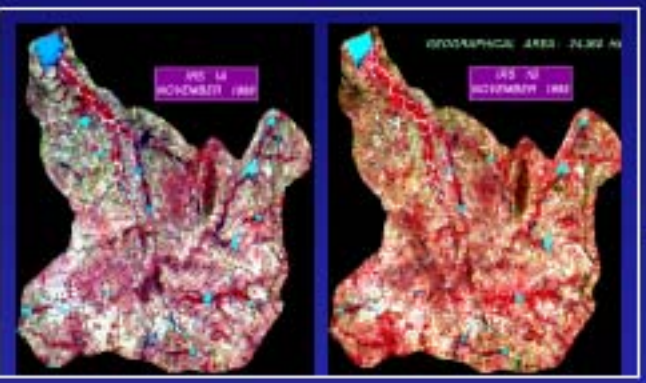
- Water Table – *Dug Wells / Bore Wells*
- Soil sample Analysis – *NPK and organic matter*
- Soil loss & Run off – *Field observations / Empirical*
- Level of Sediment – *Water Sample Analysis*

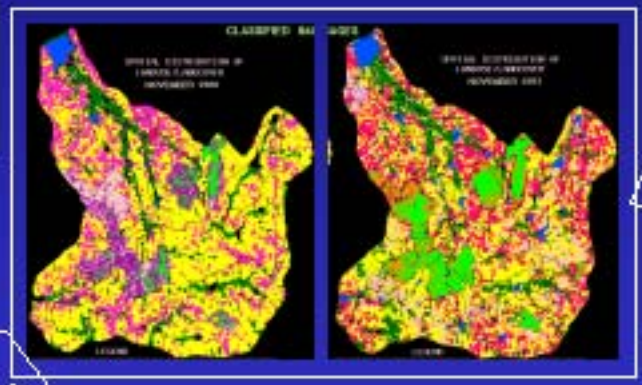
Plot level

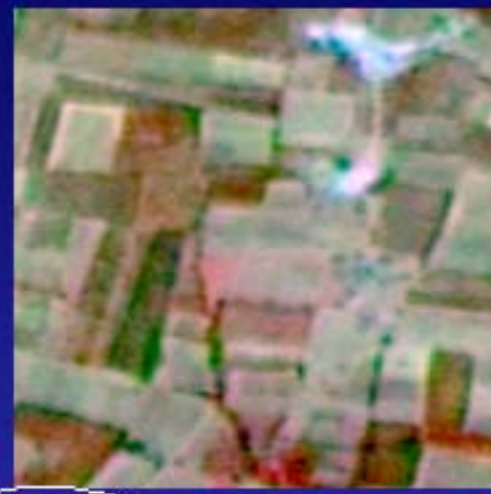
* Cadastral Database (stakeholder information)
* Treatments
* Crop cutting experiments(Yield)

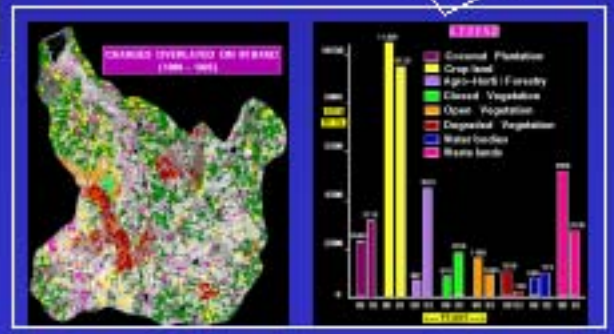
IMPACT ASSESSMENT: using satellite & ground data

A TYPICAL EXAMPLE FROM THE PAST





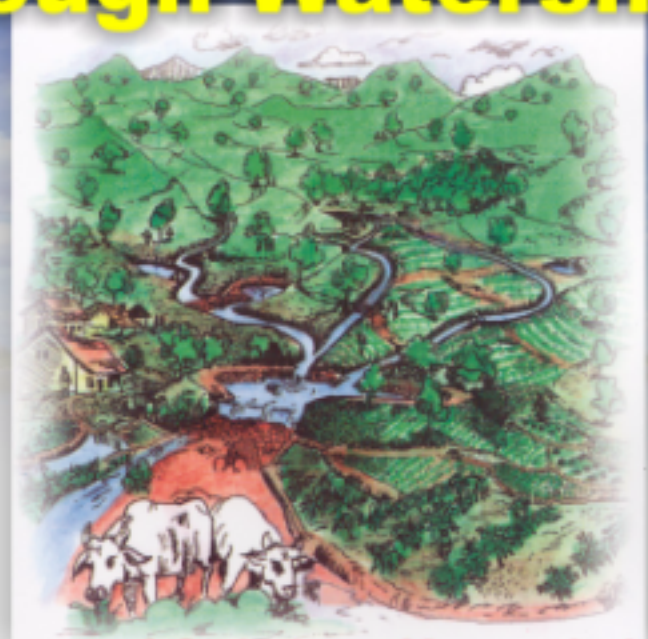




Study Area : Kallambella WS, Tumkur Dist., Karnataka

Geographical Area: 24,300 Ha

Remote Sensing & GIS, An Empowering Tool for Sustainable Local Development through Watersheds



Thank You

An Experience of Sujala - Karnataka (India)