

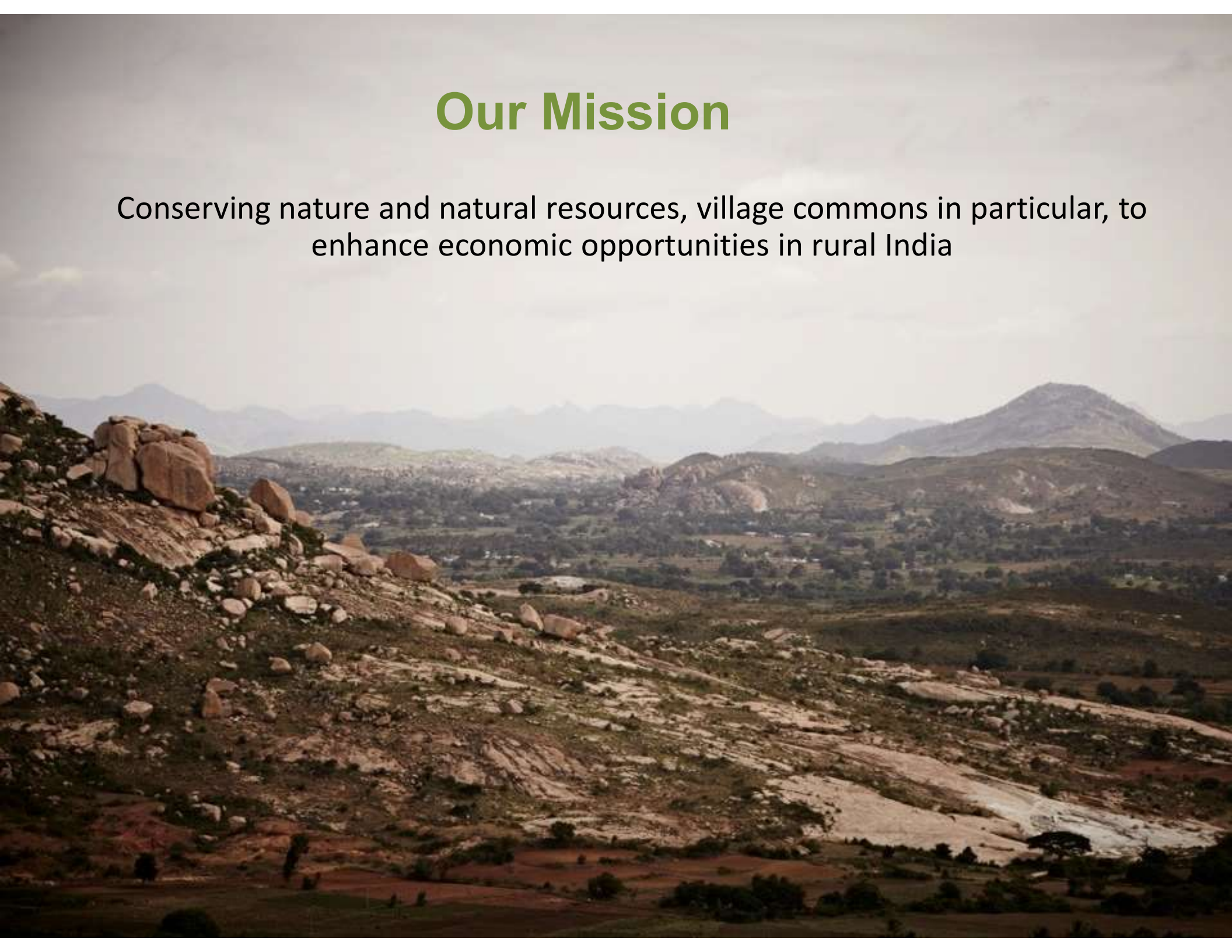
Geospatial tools for Natural Resource Management and Informed Decision Making by Village Community

Foundation for Ecological Security



Our Mission

Conserving nature and natural resources, village commons in particular, to enhance economic opportunities in rural India



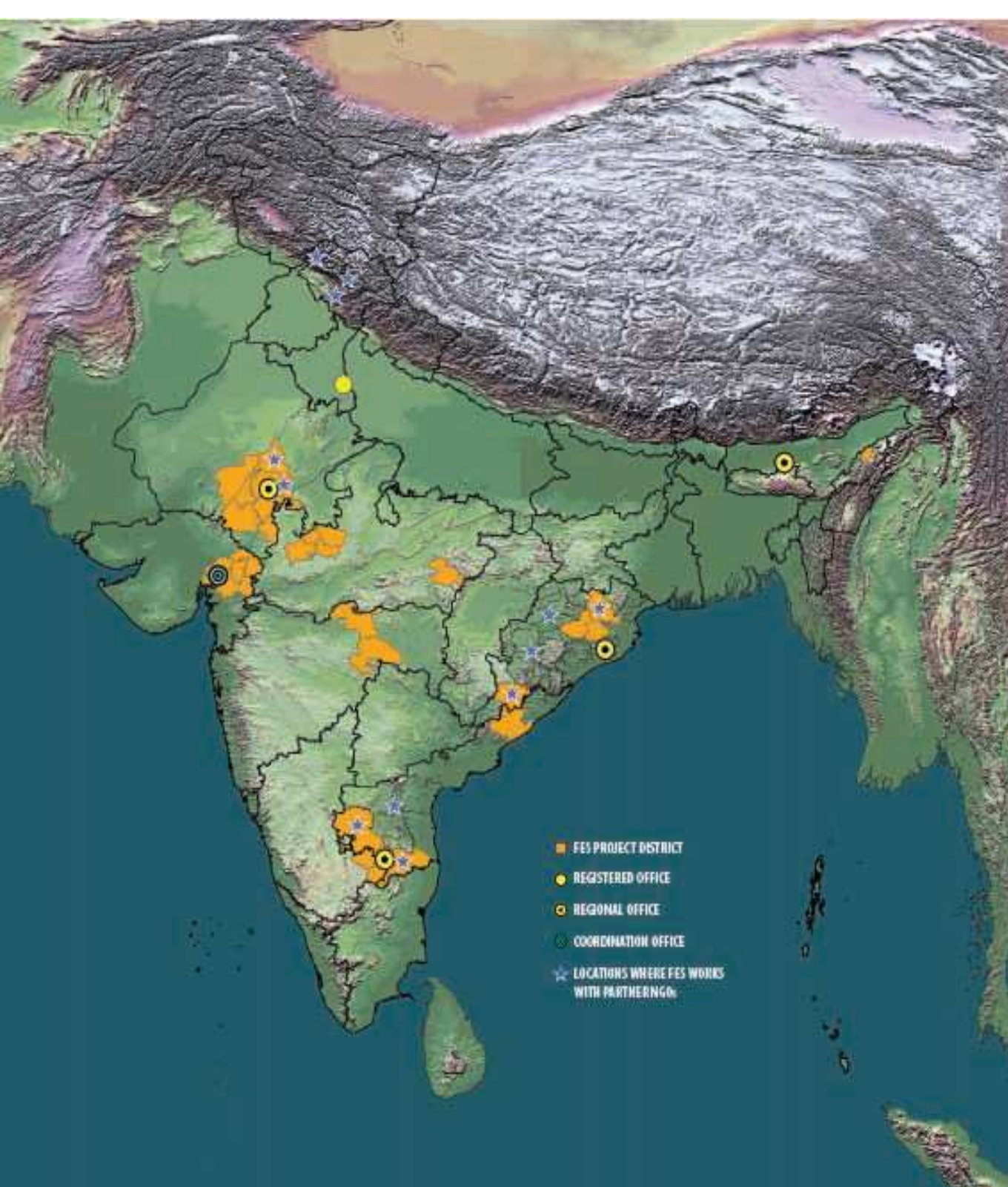
Our Presence

FES activities are spread across **110** districts in **11** states of India, covering 11 agro-ecological zones of the country.

12.52 million acres of common land brought under community management

41,880 habitations assisted in restoring and managing their Commons

24.8 million people impacted





Secure
Land Rights

+



Empower
Local Governance

+



Restore Degraded
Ecosystems

=



Ecological
Health

+



Resilient
Livelihoods

Sarnal, Gujarat

July, 1986



July, 2016

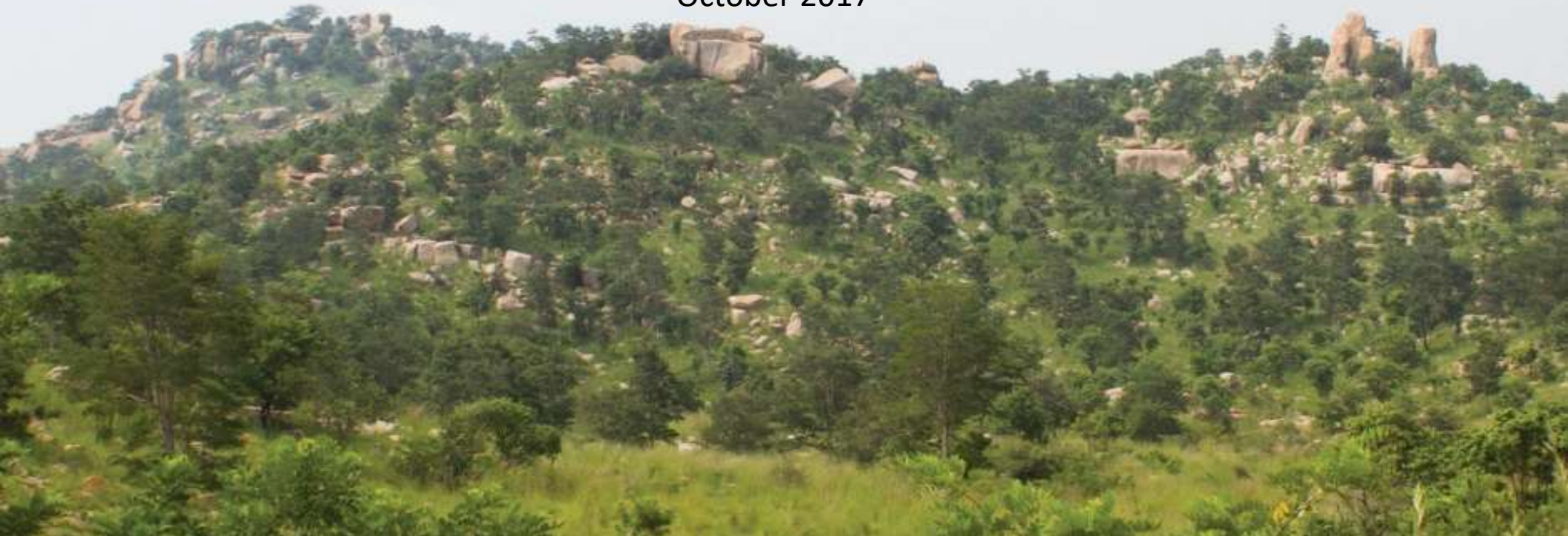


Sajjupalli, Karnataka

August 2004



October 2017





Gaps addressed by IO in Current Developmental Practices

- Most of the data initiatives disregard nature and natural processes, *IO could position itself to advance the mission of Ecological Security and Livelihood Security*
- While there are several data sets, analytics and algorithms available, the 'last mile' gap in access and application is missing, *IO bridges this last mile gap.*
- Much of the development practice is sectorial, inter-disciplinary integration is missing, resulting in subpar outcomes and sometimes working at cross purposes. *IO encourages interdisciplinary thought process.*

IO is intended to **deliver data, knowledge, analytics, insights and advisories** to the village communities drawing from numerous sources including primary data collected through the app

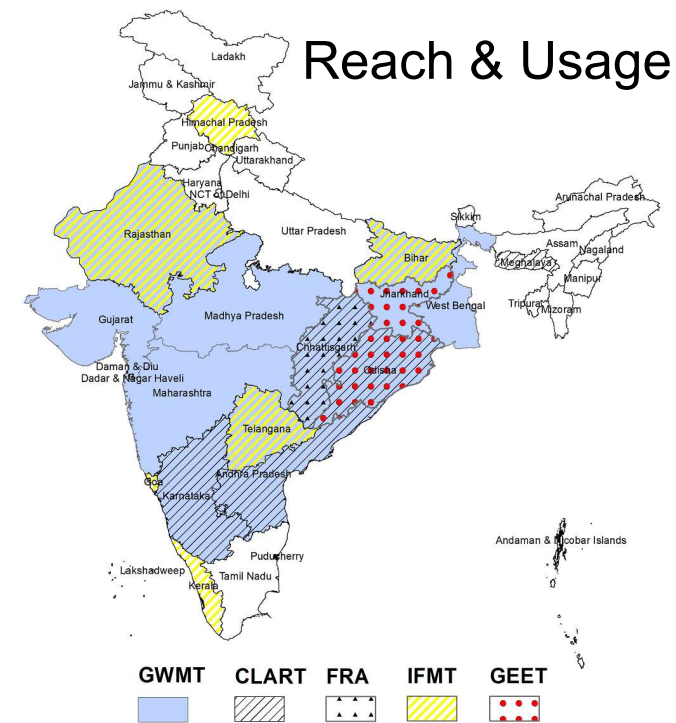
India Observatory components

Data Platform

Indian Biodiversity Information System

Tools/Applications

Tools	Planning	Implementation	Monitoring	Evaluation
Composite Landscape Assessment and Restoration Tool (CLART)	✓	✓		
Crop Water Budgeting (CWB)	✓			
Experimental Game (EG)	✓			
Ground Water monitoring Tool	✓	✓	✓	
Common Land Mapping Tool	✓	✓	✓	✓
Integrated Forest Management Toolbox (IFMT)	✓	✓	✓	✓
Forest Right Act Tool (FRA)	✓	✓	✓	
GIS Enabled Entitlement Tracking (GEET)	✓	✓	✓	✓
Primary data collection tool (Household surveys, MIS etc.)	✓	✓	✓	✓
Data platform (Socio economic, ecological and environmental data from different sources)	✓	✓	✓	✓



India Observatory Database

Socio-Economic

Spatial data:

Administrative Divisions (state, district, tehsil, village), 1991, 2001 & 2011

Digital chart of the world

- River basins, Bio-geographic regions
- ASTER, SRTM & Gtopo30 (Digital Elevation)
- Agro-eco regions
- Protected areas (IUCN 2012)
- Forest cover (1990-2011)
- Wasteland (1995, 2005 & 2010)
- CGWB Watershed Atlas

Non-spatial data:

- Census data 1991 & 2001 (around 300+ attributes)
- Time series data for Project States (1951-2007)
- Market potential Areas (2001 & 2008)
- Groundwater data (2004)
- Forest cover from 1990 – 2011

Ecological

Remote Sensing:

- Vegetation Indices NDVI/EVI From 2000 onwards
 - Leaf Area Index
 - Gross Primary Productivity
 - Thermal Anomalies & Fire
 - Land Cover Type Yearly
 - Vegetation Continuous Fields
 - GRACE TELLUS Landmass Dataset
 - Climatology Data (CRU TS 3.20, 1901 to 2011, Monthly Average of Temperature (Min, Max, Mean), PET, WET Days etc.

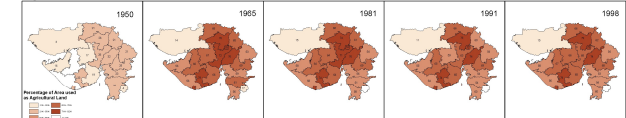
Other Datasets

- Other Census like Agriculture, Livestock, Irrigation etc.
- Harmonized World Soil Database
- Global Aridity and PET Database
- Bio-geographic & Agro-ecological regions
- Expert Range Maps

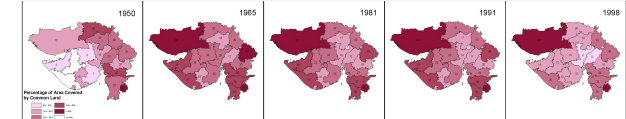
Biodiversity

- Approximate 30,000 Taxa of Birds, Mammals, Reptiles, Amphibians, Spiders and Angiosperm Flora
- Diverse Database
 - Bibliography
 - Books
 - Images and Multimedia
 - Museum Collection
 - Sighting Database
- GIS Based distribution and sighting maps

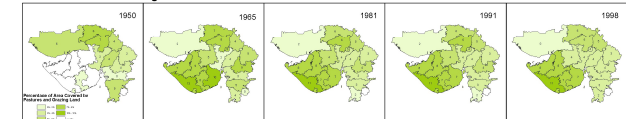
Agricultural Land



Common Land



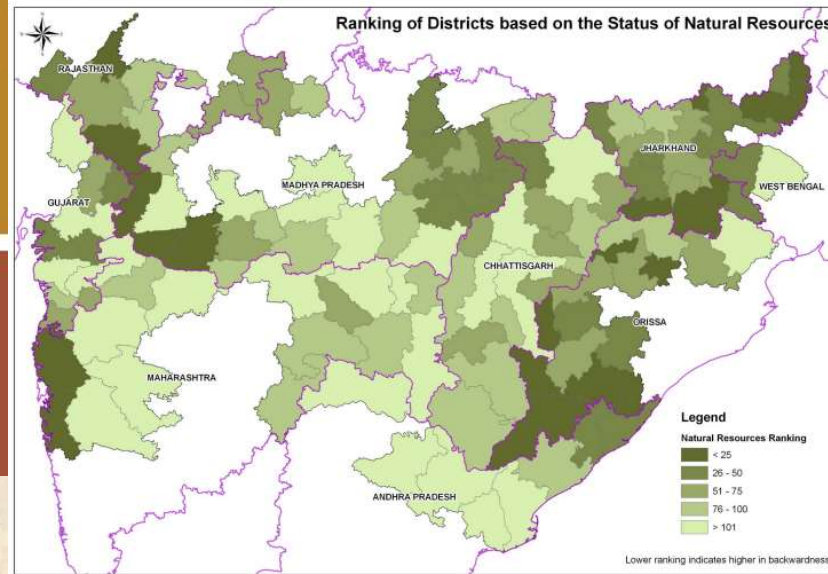
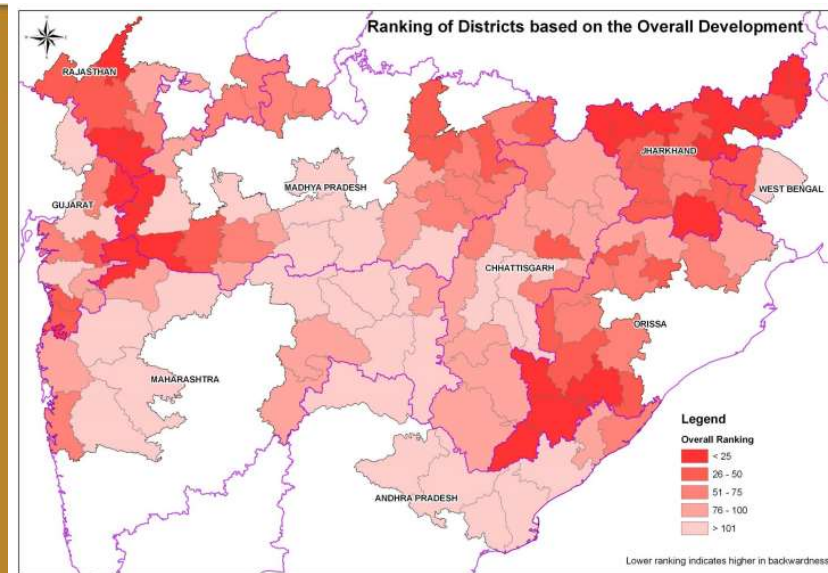
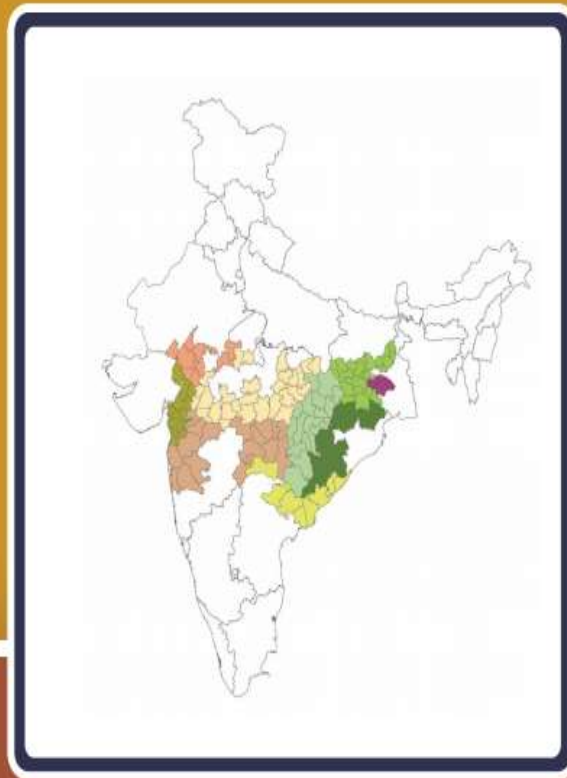
Pastures and Grazing Land



Maps for calculation: Reporting Area For Land Utilization Statistics

MAP: landusel, in_guj_new

ATLAS OF CENTRAL INDIA

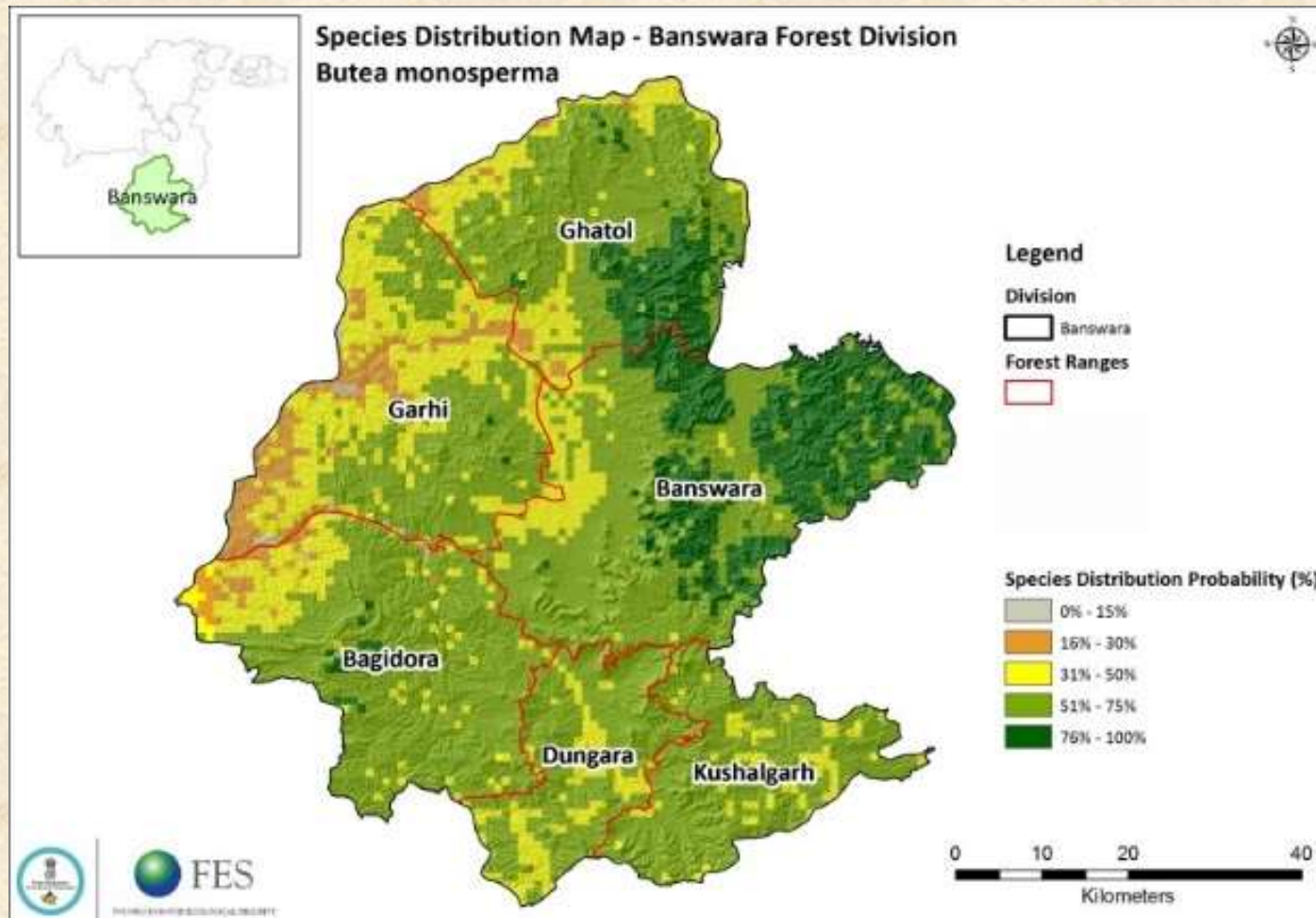


Knowledge Bank for 130 tribal districts of Central India to support with livelihood based projects (supported by **CINI**)

Ranking of districts based on: Ecological profile, Demography, Infrastructure, Education, Health, Agriculture & Livestock, Economic status, Natural resources

Integrated Forest Management Toolkit (IFMT)

Suite of tools built for sustainable forest management and preparation of working plans in accordance with NWPC-2014.



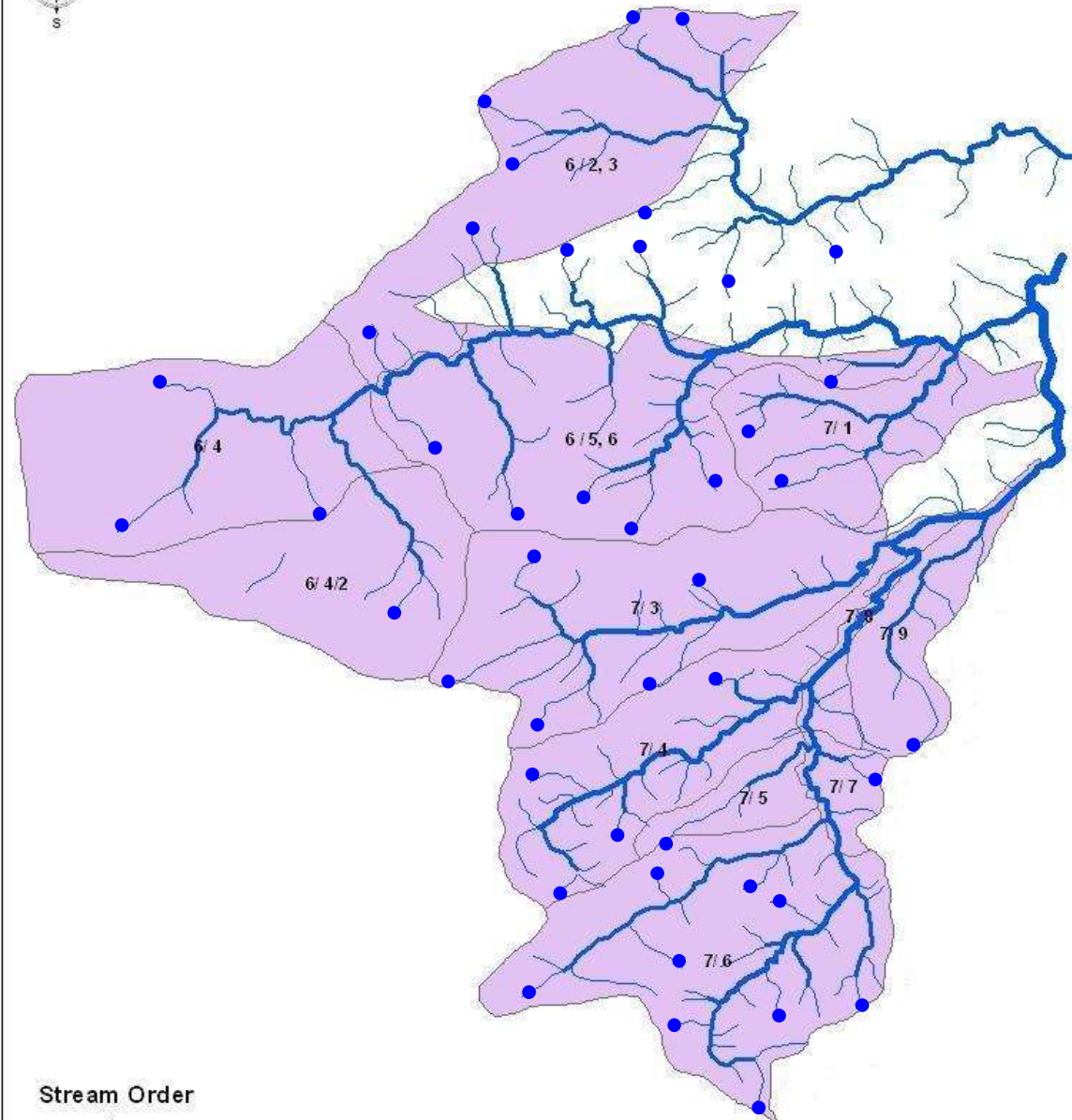
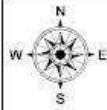
- Adopted by 13 Forest Divisions in five states (Himachal Pradesh, Rajasthan, Telangana, Kerala and Bihar)
- To be expanded to 10 divisions in Kerala and entire state of Telangana. MoEF & CC planning for countrywide adoption
- New features on landscape level planning including non forest areas/ farmlands in the anvil

Composite Landscape Assessment & Restoration Tool (CLART)

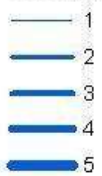


Foundation for Ecological Security

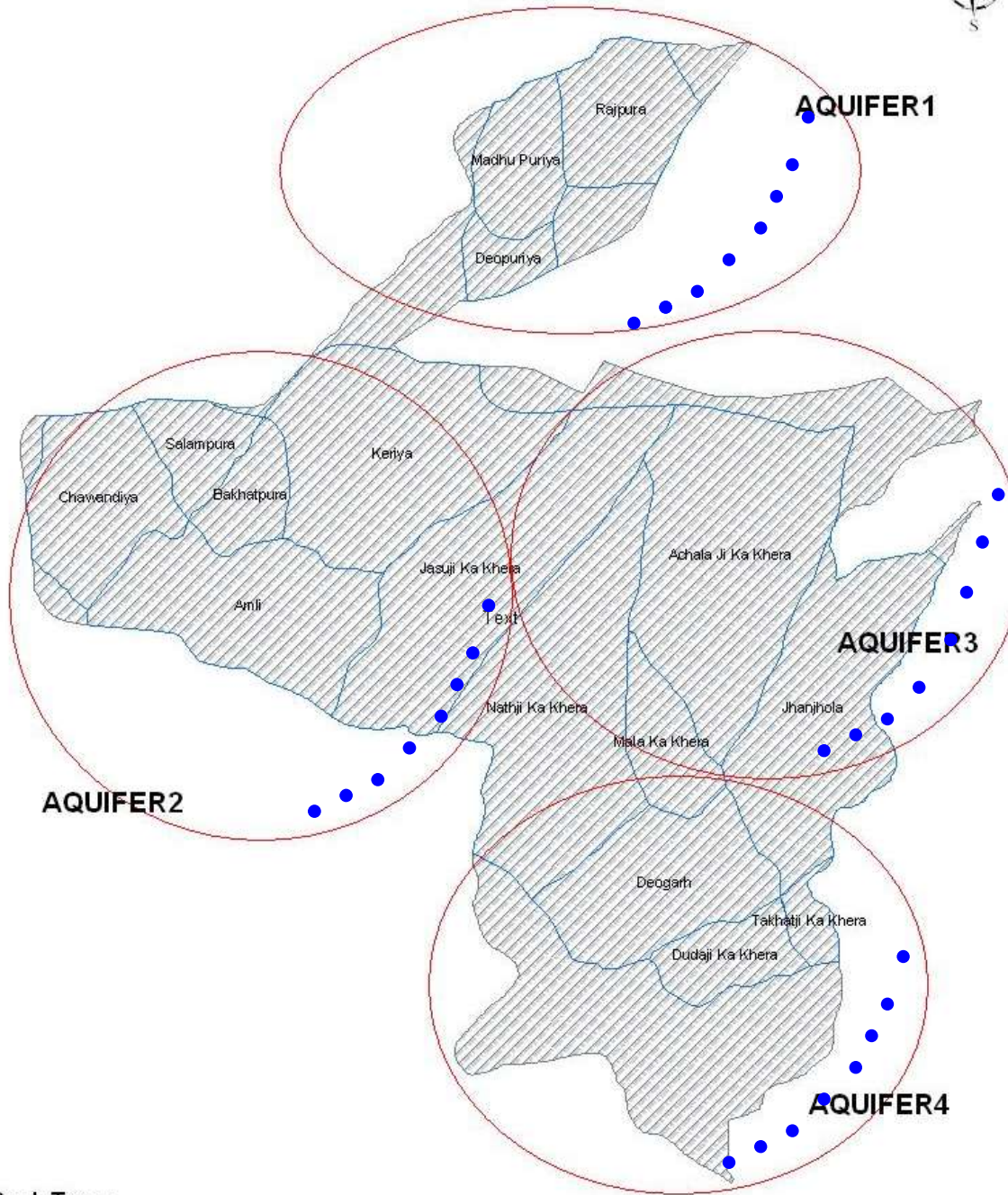
DRAINAGE MAP OF KALYANPURA





Stream Order



LITHOLOGY & AQUIFER MAP OF KALYANPURA WATERSHED

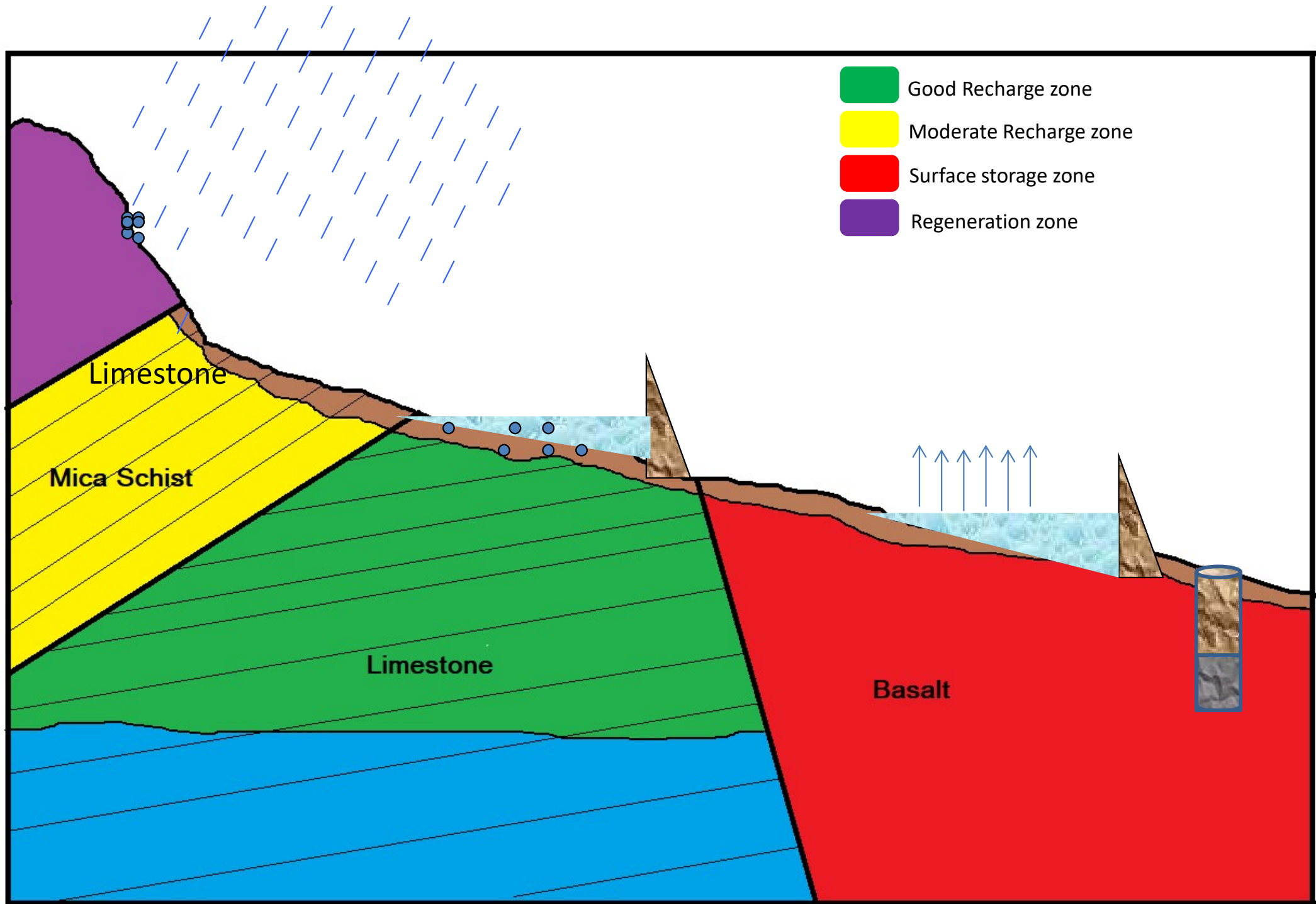


Rock Types

-  Shale, Slate, Phyllite
-  Village Boundary



Schematic process flow of CLART



Composite Landscape Assessment & Restoration Tool (CLART)

Rationale

- Typical water enhancement measures do not consider geohydrology, slope, landuse/land-cover, evapotranspiration.
- Variability in local ecological and climatic conditions impacting water availability is usually not considered.
 - Huge investments (Annually 59% of 69000 crores (2018-19)) are made on on intuitive knowledge leading to injudicious use of public funds
- Access to granular data on soil and water restricts use of data analytics for decision making
 - Limited availability of trained technical staff further adds to planning and implementation gaps.
- Knowledge and insights is not accessible to layman in a user friendly/ demystified manner

Objective

Decision support tool which provides *location specific* information in a *user friendly* manner to *enable village communities* to *plan* and *develop estimates* of the soil and water conservation interventions *without help of Engineers and Internet at field*



Background dataset used in CLART

Layers used in CLART

Drainage

Geology

Recharge potential

Slope

Landuse & Landcover

Geomorphology

Watershed

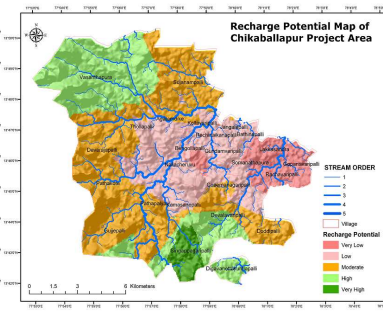
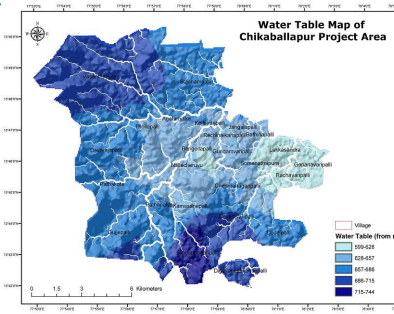
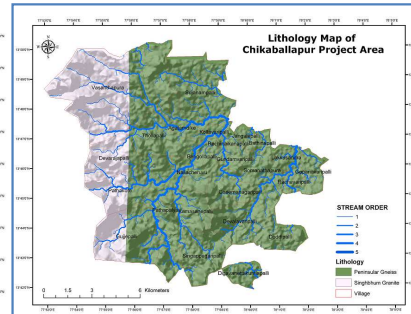
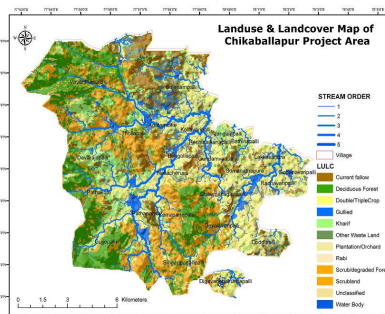
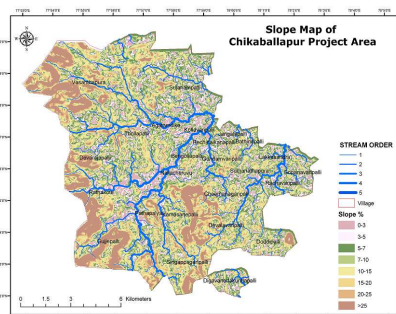
Lineament

Village boundary

Layers	Source	Scale/Resolution
Geology	Bhukosh (Geological Survey of India)	1:50K
Geomorphology	Geological Survey of India-NRSC	1:50K
Drainage	Generated from SRTM/ASTER-DEM	30 meter (approx 1:60K)
Slope	Generated from SRTM/ASTER-DEM	30 meter (approx 1:60K)
Slope	Generated from Cartosat DEM	5 meter (approx 1:10K)
Micro Watershed	Central Ground Water Board & Bhuvan	1:10K
Landuse-Landcover	LISS IV (2018) Bhuvan	5.8 meter (approx 1:11K)
Landuse-Landcover	Sentinel -2 (few places)	10 meter (approx. 1:20K)
Lineament	NRSC-Bhuvan	1:50K
Ground water level	CGWB - WRIS	15,000 wells (approx)
Ground water table	FES GWMT (available for 450 blocks only)	
Village boundary	Survey of India	

Algorithm built on :

1. According to GEC 97 norm
2. REPORT OF THE GROUND WATER RESOURCE ESTIMATION COMMITTEE (Page no 24)
3. www.angelfire.com/nh/cpkumar/publication/Lgwa.pdf



Treatment plan Preparation based on CLART

Recommended Treatment Code	Recommended Treatment Type	Recharge Potentiality	Slope	Land Use/Land Cover
1	Good Recharge structure (Percolation tank, WHS, CCT etc)	Very High (5) High (4)	3-20%	Current fallow (5), Other Waste land (9), Gullied (10), Scrubland (11)
2	Moderate Recharge structure (WAT, GP, LBCD etc)	Moderate (3)	5-25%	Current fallow (5), Other Waste land (9), Gullied (10), Scrubland (11)
3	Surface water Harvesting structure (WHS, FP, FB etc)	Low (2) Very Low (1)	0-20%	Current fallow (5), Other Waste land (9), Gullied (10), Scrubland (11) Agriculture (2,3,4)
4	Regeneration (Plantation, Veg Int, Grass seeding, stone bunding, bench terracing, trenching etc)	Very Low (1), Low (2), Moderate (3)	25 -30%	Current fallow (5), Other Waste land (9), Gullied (10), Scrubland (11), Mixed, degraded forest, Deciduous forest
5	High Runoff zone (Trenching, stone bunding)	Very Low (1), Low (2), Moderate (3) High (4) Very High (5)	Slope >30	Current fallow (5), Other Waste land (9), Gullied (10), Scrubland (11), Mixed, degraded forest, Deciduous forest

Planning for conservation of land & Water (Composite Approach)

Drainage Line



**VERY GOOD
RECHARGE
STRUCTURE**

Percolation Tanks,
Water Harvesting Structure
For Recharge,
Contour Trench



**MODERATE
RECHARGE
STRUCTURE**

Water Arresting Trench,
Gully Plug, Loose Boulder
Check Dam



**SURFACE
STORAGE
AREA**

Farm Pond,
Surface storage Structure



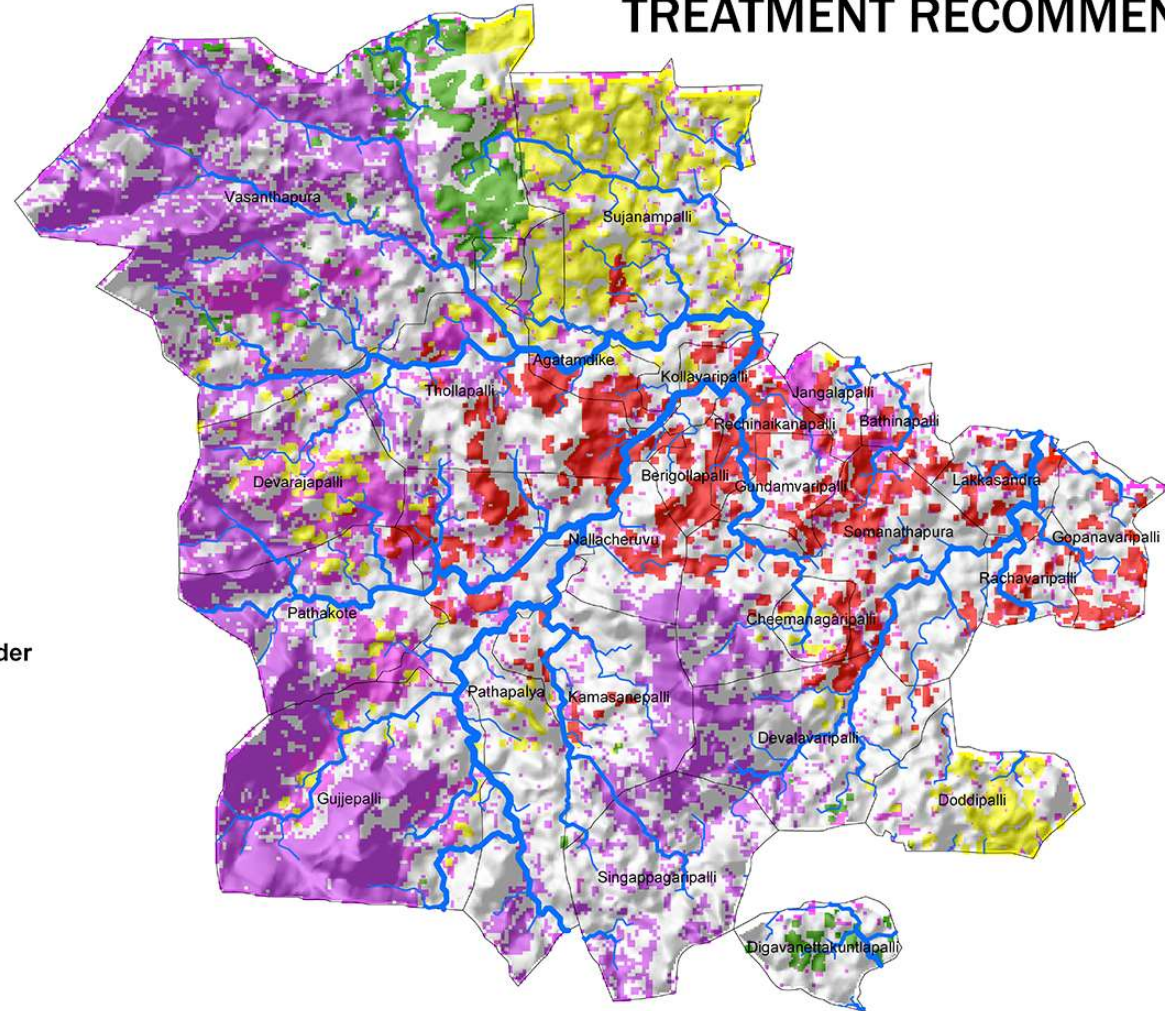
**CATCHMENT
CONSERVATION**

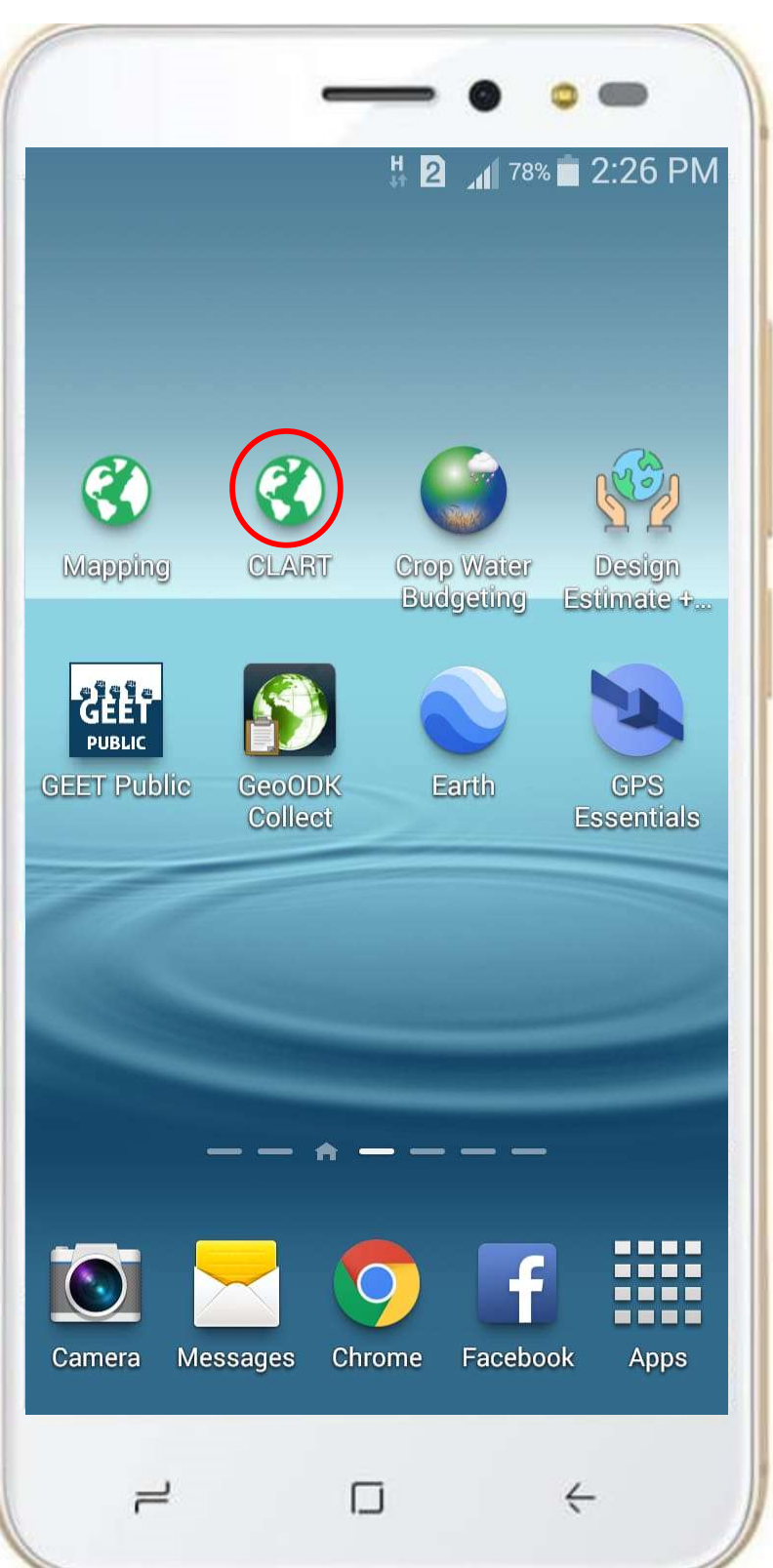
Grass seeding,
Stone Bunding
Bench terracing
Regeneration

Stream Order



TREATMENT RECOMMENDATION





Farm Pond (FP) ⋮

Input Sheet A- Basic Details of the Work
(Filled for each site)

Location Name of the Site *

Agency *

Select Answer

Purpose of structure *

Select Answer

Input sheet B- Filled in the field

Dimension of Farm Pond (Based on field Survey)

Top Length of Farm Pond in (meter) *

Top Width of Farm Pond in (meter) *

Depth of Farm Pond in (meter) *

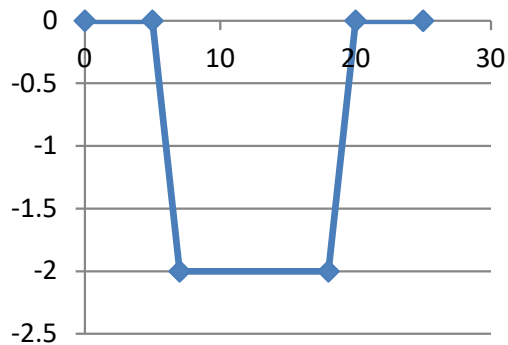
SAVE



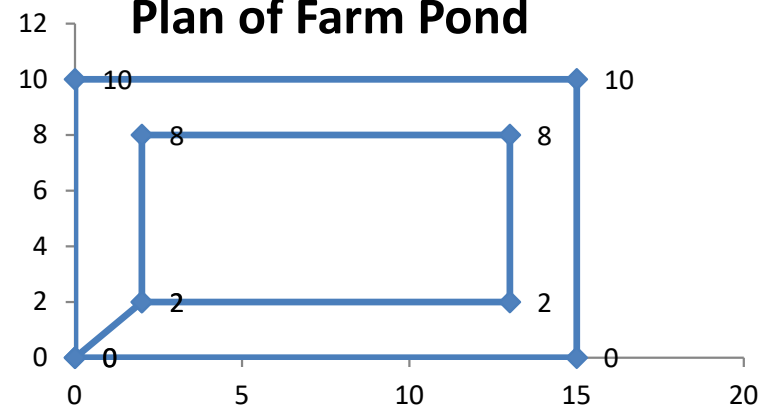
Design Estimate preparation in CLART

Output Sheet B - Cost Estimation Abstract Sheet								
Sr. No.	Item	Quantity of work	Unit	Unskilled Labour Cost	Skilled Labour/ Mate Cost	Material Cost	Total Cost	Total Mandays Generated
1	Layout marking for farm pond	50	Running Meter	50	25	0	75	0.3
2	Dug belling work up to 5 to 7 cm depth for farm pond	50	Running Meter	100	25	0	125	0.6
3	Excavation of farm pond including initial lead and lift	208						
3a	In soft soil/ordinary soil	41.6	Cubic meter	3328	83	0	3411	18.7
3b	In hard soil	83.2	Cubic meter	8320	166	0	8486	46.7
3c	In murrum	20.8	Cubic meter	2496	62	0	2558	14.0
3d	In hard murrum	41.6	Cubic meter	5824	166	0	5990	32.7
3e	In disintegrated rock	20.8	Cubic meter	4160	104	0	4264	23.4
3f	In hard rock	0	Cubic meter	0	0	0	0	0.0
Total Cost of farm pond				24278	632	0	24910	136.4

Cross Section of Farm Pond



Plan of Farm Pond



GIS Enabled Entitlement Tracking System (GEET)

A tool that empowers rural communities to gain access to their entitlements

- Scans eligibility criteria of schemes
- Provides information on entitlements, schemes and their eligibility
- Aids state/mission administrations in tracking claimants and helping them avail benefits
- Assists district/state government officials to monitor claimant applications and status of implementation.

GEET GIS Enabled Entitlement Tracking System

English

HOME SCHEME SEARCH

Search Eligibility Login

Find schemes you are eligible for by entering the following basic details.

State: Select State

Age: Type your age

Caste: Select caste

Gender: Male Female Transgender

BPL: Yes No

Marital status: Select marital status

Disability: Yes No

Search [Advanced Search](#) [Search using entitlement card number](#)

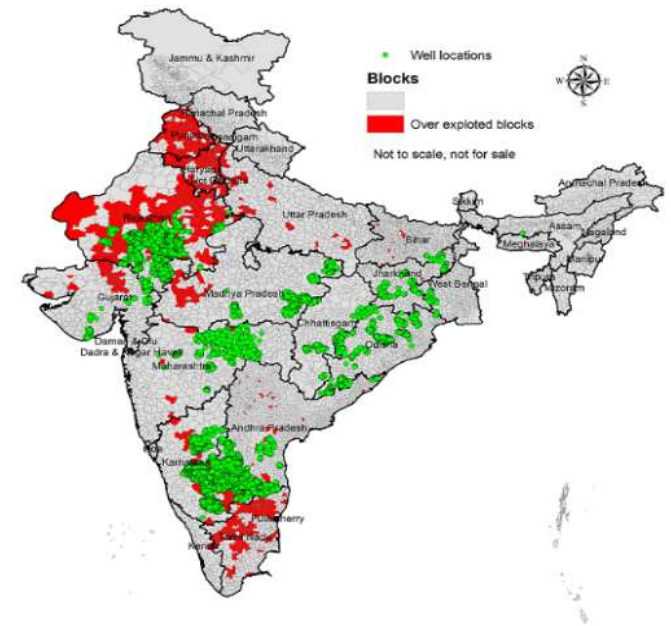
[Download GEET Public app \(android\)](#) [Download GEET Enumerator app \(android\)](#)



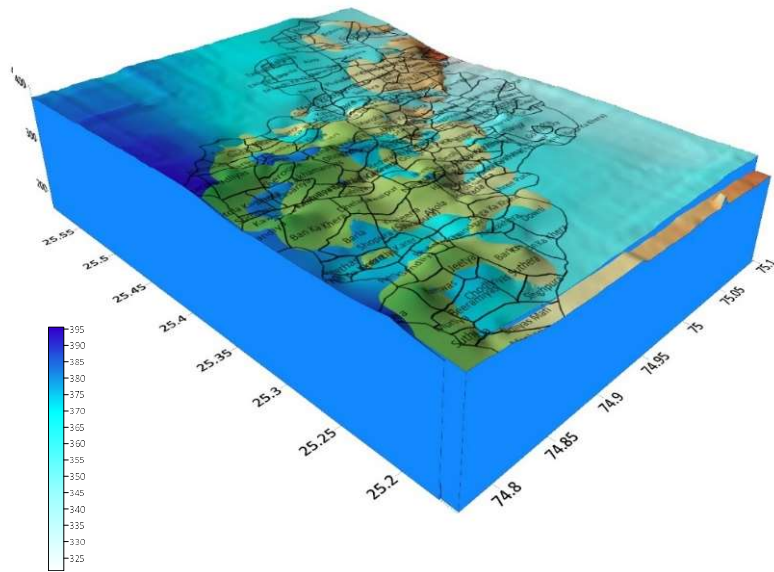
- Actively being used by Odisha and Jharkhand livelihood mission
- Piloted by National Institute of Rural Development (NIRD) in GPDP (Antodaya program)
- Discussions in advanced stages with Azim Premji Philanthropic Initiatives (APPI) across all their partners

Ground water monitoring tool (Napo Jal Bachao Kal)

- Complementing Govt's ground water data for better decision making of soil and water conservation
- In partnership with 140+ organizations
- Nearly 40K wells have been monitored in 10K villages
- Village level analytics



Topography of Maharashtra



Seasons	Wells Monitored	States	Districts	Blocks	Villages
Pre-Monsoon 2020	18,041	12	113	390	5353
Post-Monsoon 2020	20,733	16	141	376	5272
Pre-Monsoon 2021	34,698	12	97	485	9803
Post-Monsoon 2021	32,247	12	87	514	9465
Pre-Monsoon 2022	40,385	12	134	678	10613
Post-Monsoon 2022	32,804	12	149	541	8023
Pre-Monsoon 2023	38,295	12	156	655	9859

Budgeting for water

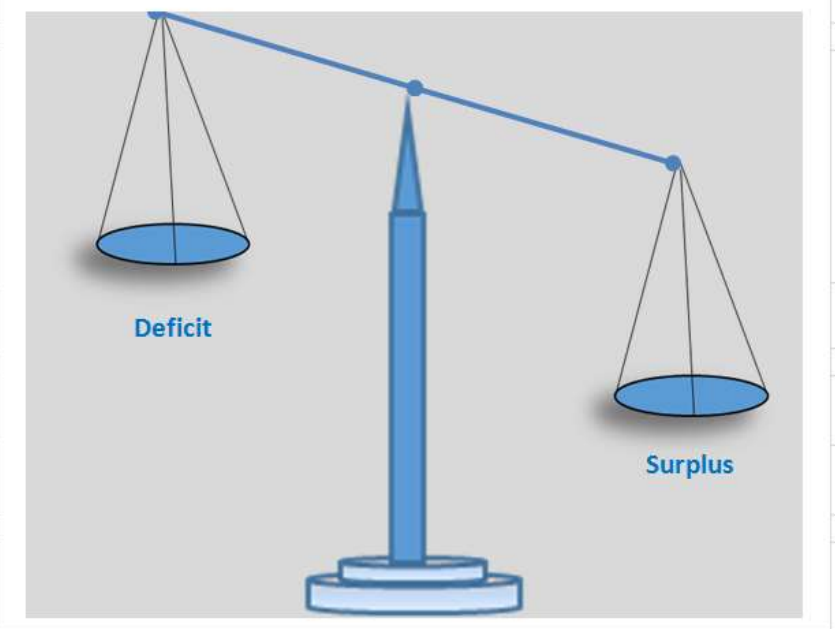


Village Communities accessing information, making Water Resource Estimation using Tablets

Budgeting for water



Crop Water Budgeting (May-Sep)										
Estimation for ground water expenditure for Rabi / Summer crops										
October to May										
S. No.	Name of the crop	Area under Crop (Acre)	Present use of water to irrigate various crops (farmers' practices)				Actual water requirement			
			No. of irrigation/ acre	Pumping hours/ irrigation	Discharge rate of irrigation pump (litres/ hour)	Total water used to irrigate crop in entire cropping season (cum/ acre)	Total water use (cum)	Water requirement in mm (on the basis of FAO reference -ET requirement)	Water requirement (cum/acre)	Total water requirement (cum)
		A	B	C	D	E = (B*C*D)/1000	F = E*A	G	H = (G/1000)*4047	I = H*A
1	Maize									
	Short duration varieties					0	0	500	2024	0
	Long duration varieties					0	0	700	2833	0
2	Wheat									
	Low water demanding varieties	5	2	150	200	60	300	450	1821	9106
	High water demanding varieties	10	4	600	200	480	4800	650	2631	26306
3	Paddy									
	Traditional methods (broadcasting/ transplating)					0	0	800	3238	0



Planning for their crop according to availability of Water

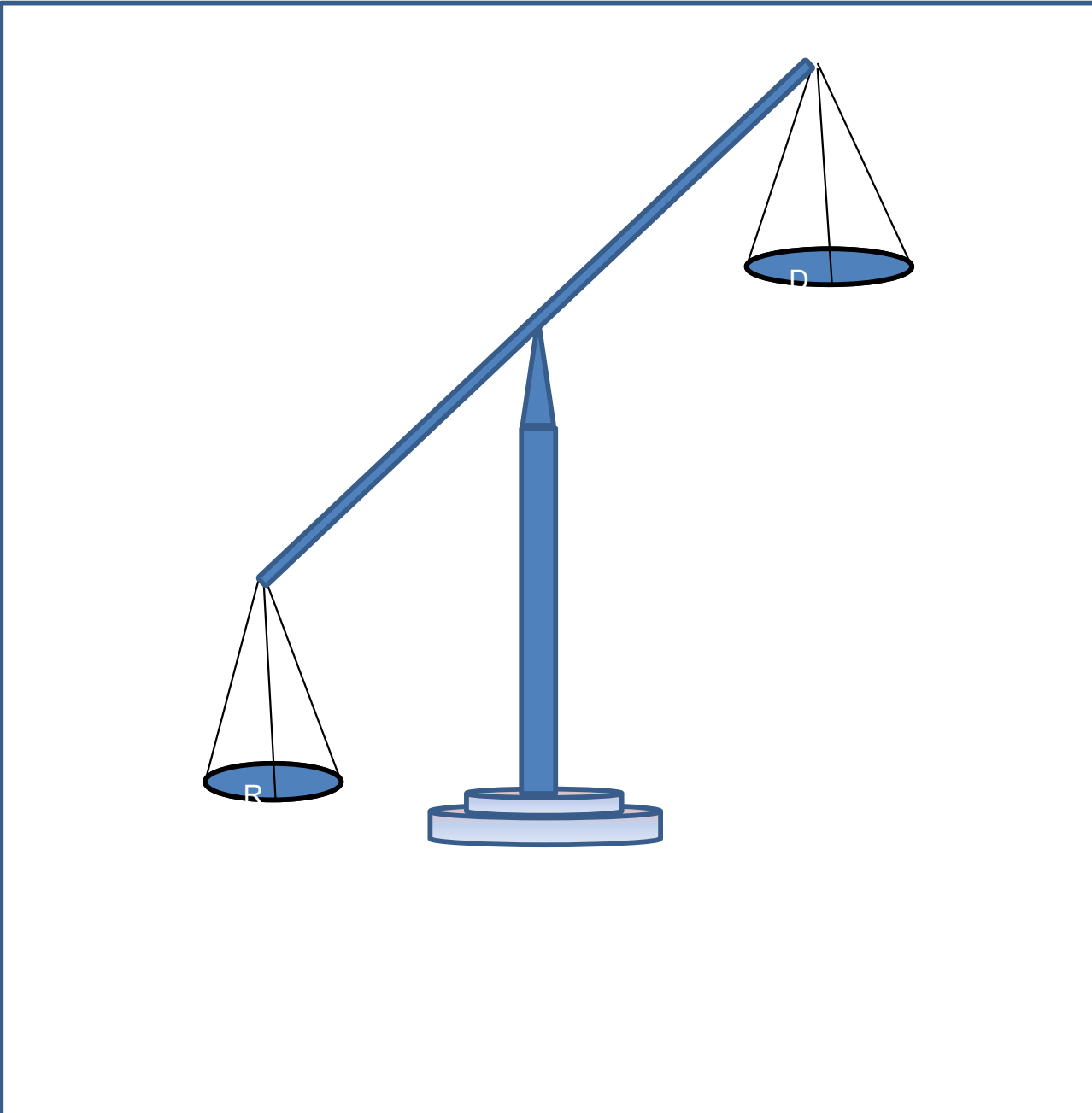
Budgeting for water

Planning for their crop according to availability of


Crop Water Budgeting.xlsx

	B	C	D	E	F
1	Crop Water Budgeting				
2	District		Village		
3	Recharge from Surface wa				
4	Recharge Rate %				
5	Rainfall				
6	Tank, Ponds, Check Dam (Nos)				
7	Area (ha)				
8	No of fillings				
9	Recharge Rate %				
10	Total Recharge to Ground Water				
11	36000				
12	Put the Value in White				
13	RECHARGE				
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					

Recharge_Rainfall Recharge_WHS Discharge



geting (May-Sep)

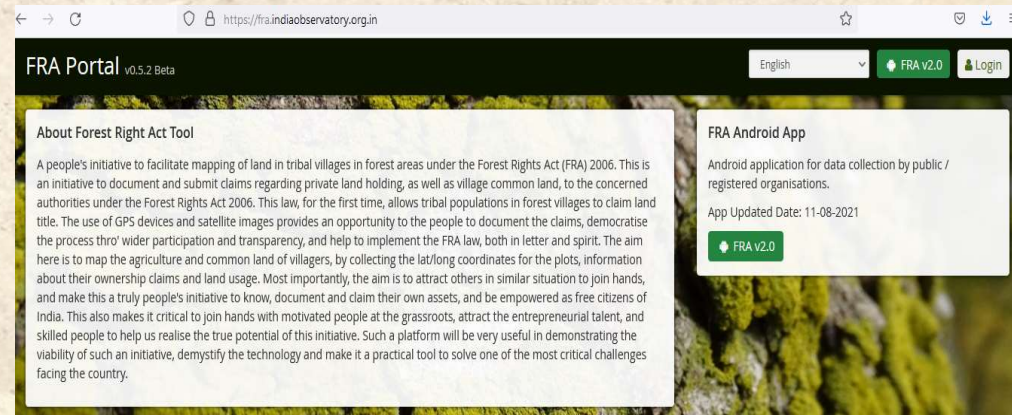
F	G	H	I
Village			
Charge			
Bore Well			
No	75		
			
Discharge Rate (lit/min)			
Daily Usage (hour)			
No of days			
Water Discharge (Lit)			
0			
Water Discharge (cumec)			
7273			
through irrigation return flow			
455			
DISCHARGE			
Discharge	Balance	Recha	

Forest Right Act (FRA) tool

- The tool has been simplified for use at the community level with step wise guidelines
- Enabling observability of the progress of CFR claims (stepwise) at scale
- Implementation at scale in Chhattisgarh in collaboration with Tribal and Forest Department



- Evidence upload facility and use in local language
- The tool is being reviewed by Govt of Chattisgarh for implementation in the field (for CFR)
- For claiming of IFR and survey, the GEET module has been customized and given to Surajpur Forest division of Chhattisgarh and data collection has been initiated



IO Tools usage

Tools	Partners		Reach	
	States Used (Available for use)	NGO-Partners	Villages (used for)	No of Users
CLART	7 (22)	105	24315 (368490+ plans prepared)	41885+
GEET	4 (21)	33	4320 (673K+ screened)	2320+
GWMT	9 (12 states)	111	21969 (39K + wells)	10668
CWB	8 (29)	20	3781	5645
CLM	7 (10)	142	12641 (816K+ ha mapped)	19300+
IFMT & VanApp	6 (29)	0	150 Forest Divisions	691 (ranges)
FRA	1 (5)	2	3900 claims form prepared	1232

To increase effectiveness and efficacy through Geospatial Technology

- Enhance reach of data sets and analytics to the ground in an intelligible manner
- Position village communities/end users at the center of decision making
- Promote evidence based decision making
- Nurture an ecosystem platform that converges
 - Local and external knowledge
 - Initiatives of various NGOs, GOs, Academia and Funders
 - (into a) Grid of data servers
 - and gives expression to thought leadership

Thanks