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Government of Meghalaya

Workshop
on
Geo-Spatial Applications for Natural Resource Management in Meghalaya: Review and Way Forward

Moreau Institute of Integral Training (MIIT) Near
RBI, Brookdene, Shillong
18th November, 2022

Organised by

GIS Lab, MBDA/ MBMA

GIS LAB MBDA/MBMA

Centre of Excellence for NRM and Sustainable Livelihood

MBMA Meghalaya Basin Management Agency

THE WORLD BANK

MBDA MEGHALAYA

Workshop on

"Geo-Spatial Applications for Natural Resource Management in Meghalaya: Review and Way Forward"

Date: 18th November, 2022

Venue: Moreau Institute of Integral Training (MIIT), Near RBI, Brookdene, Shillong

Background Note

Environment is the interplay of diverse biotic and abiotic constituents which are intricately linked to each other through various natural cycles and therefore it is a multidisciplinary subject. Its understanding requires information on many themes like land use land cover, forests, geology, soil, terrain, weather, quality of air and water and many others. Environment at any place to a great extent depends on how the natural resources have been managed and treated in that region in the past.

Geographic information system (GIS) is based on the concept of arranging information in many geo-referenced spatial layers along with all textual and tabular data tagged to different features. It also provides powerful tools of analysis and map creation taking into account inter-linkages of data on various themes stored in the database. Remote sensing data allows us to map and assess bio-physical features on the earth in a cost and time efficient manner. Remote sensing and GIS, thus is the most optimum tool for natural resource management wherein one has to essentially deal with a data set of many bio-physical layers.

Over a period of time GIS Lab of MBDA has created a vast spatial database on natural resource of the State, considering the needs of natural resource management for different missions, climate change actions and implementation of various projects including externally aided projects. This has led to creation of a spatial database comprising more than 30 spatial layers relevant to the natural resource management. Creation of spatial database is an ongoing exercise wherein spatial layers from different sources which are in public domain (mostly from government agencies), primary data generated by the GIS team of MBDA and its functionaries and regular update and analysis of the existing layers have been undertaken. The database continues to grow.

It is intended that the above workshop would create wide awareness in the Departments and individuals associated with the natural resource management, environment, conservation and developmental activities about the use of spatial data in the State. It is proposed that the data from the database would be shared with others in soft and hard copies with a sharing framework in place.

The main objective of this workshop organised by the GIS Lab, MBDA are to create an awareness about different geo-spatial applications for NRM being done by different departments and how we all as a community of the stake holders can complement and supplement each other for the larger benefits to the State. The workshop also aims to provide a platform for interaction between the GIS analysts within the MBDA family particularly at the District units and also with experts from other departments and institutions.

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Time: 1030 – 1700 hrs

Programme

Time	Topics	Speaker
9:30-10:30 am	Registration	
10:30-10:45 am	Welcome and Overview of the Geo-Spatial Applications on NRM in Meghalaya	**Dr. S. Ashutosh, Retd. IFS** Co-Chairman & Director CoE, MBDA/MBMA
10:45-11:00 am	Speech	**Prof. O. P. Singh** Dept. of Environment, NEHU
11:00-11:15 am	Speech	**Dr. M Stalin** Director Survey of India
11:15-11:20 am	Vote of Thanks for the Inaugural Session	**Shri Gunanka DB, IFS** Executive Director MBDA, & Addl. Project Director-CLLMP/MegLIFE
11:20-11:30 am	Inaugural Tea	
11:30-11:45 am	Village Level Land Use Land Cover Mapping for Khasi & Jaintia Hills Region	**Dr. Jenita Nongkynrih** Scientist NESAC
11:45-12:00 pm	Land Use Change in Mining Areas of Jaintia Hills, Meghalaya	**Prof. O. P. Singh** Dept. of Environment, NEHU
12:00-12:15 pm	Identification of Their Recurrence: A Remote Sensing Approach	**Prof. Hiambok Syiemlieh** Dept. of Geography, NEHU
12:15-12:30 pm	Geo-Spatial Applications for Preparation of Forest Management Plans	**Shri Stebanshon Mylliemngap,** Asst. Manager GIS MBDA/MBMA
12:30-12:45 pm	Village boundary mapping for NRM in Meghalaya	**Shri Fettleman Dohling,** Manager GIS MBDA/MBMA
12:45-01:00 pm	Land Use Land Cover Change Analysis in Garo Hills: Grid Based Sampling Approach	**Smt. Norita Sohlang** Asst. Manager GIS MBDA/MBMA
01:00-01:15 pm	ESRI Solutions on Natural Resource Management	**ESRI Team**
01:15-01:30 pm	Geo-spatial Applications for Payment for Eco-system Service	**Smt. Suhsiengmon Lating** Asst. Manager GIS MBDA/MBMA
01:30-02:15 pm	Lunch	

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Programme Cont.

Time	Topics	Speaker (Tentative)
02:30-02:40 pm	Geo-Spatial Applications in the State Forest Department	**Forest Department of Meghalaya**
02:15-02:30 pm	Geo-Spatial Applications in the State Soil & Water Conservation Department	**Soil & Water Conservation Department of Meghalaya**
02:40-02:50 pm	Geo-Spatial Applications in the State Water Resource Department	**Water Resource Department of Meghalaya**
02:50-03:00 pm	Geo-Spatial Database on NRM For Meghalaya Created by GIS Lab, MBDA	**Smt. Aibiang Meka Kharsahnoh** PA GIS MBDA/MBMA
03:00-03:15 pm	Springshed Mapping	**Dr. Wansah Pyrbot** Manager Water Resources CLLMP-MBMA
03:15-03:30 pm	Training on Uses of Remote Sensing, GIS & GPS Tools and Technologies	**Smt. Silgamchiy Shira** PA GIS MBDA/MBMA
03:30-03:45 pm	Drone Applications in NRM	**Shri Kishore Kumar Y.** Technical Specialist UAV-RS, MBDA
03:45-04:00 pm	Light Refreshment	
04:00-04:40 pm	Panel Discussion & Way Forward	
04:30-05:00 pm	Vote of Thanks	

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Geo-Spatial Applications for Natural Resource Management in Meghalaya: Review and Way Forward

VILLAGE LEVEL MAPPING

FOR

MEGHALAYA

USING

HIGH RESOLUTION GEOSPATIAL DATA

18th November, 2022

Funded By -

Meghalaya Basin Development Authority

Executed By -

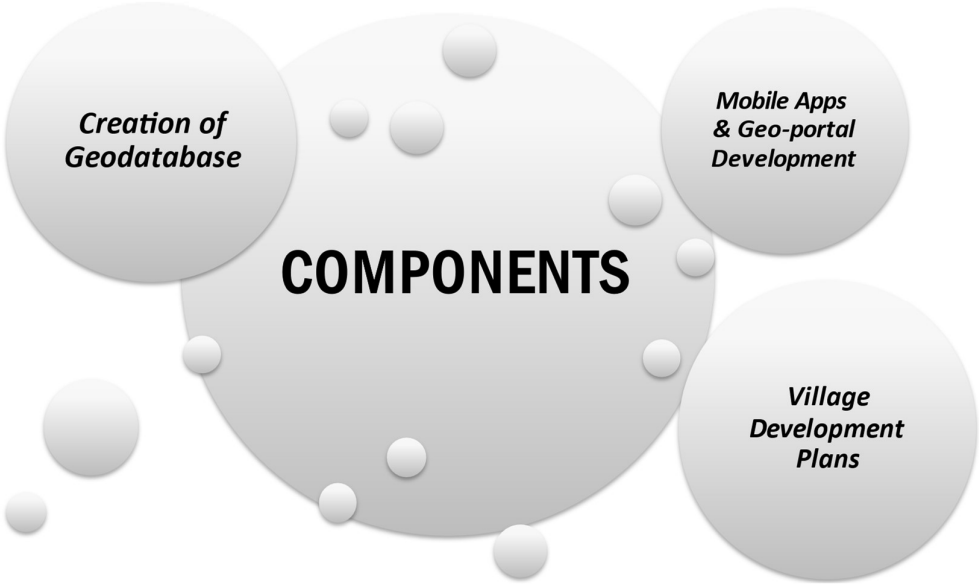
NESAC NORTH EASTERN SPACE APPLICATIONS CENTRE

Dr. Jenita Mary Nongkynrih
Scientist SF,
Head, Urban & Regional Planning Division
jnongkynrih@nesac.gov.in
Mob:9436164699

VILLAGE LEVEL MAPPING

OBJECTIVES & COMPONENTS

TO GENERATE A GEOSPATIAL DATABASE FOR MEGHALAYA USING HIGH RESOLUTION GEOSPATIAL DATA



VILLAGE LEVEL MAPPING

DESIGN & STANDARDS

ELEMENTS OF STANDARDS

- Remote Sensing Image Standards.
- Spatial Reference Standards.
- Geo-spatial Data Content and GIS Database Standards.
- Quality Assurance/Quality Check.

OUTCOME / DELIVERABLES

- Final maps in the form of user-friendly spatial products at the functional scale of **1:4000** having defined layers such as Administrative Boundary, Landuse / land cover map, Landmarks.

- Development of Mobile application to be deployed at NESAC/MBDA.

VILLAGE LEVEL MAPPING

GEO-SPATIAL DATA CONTENT

Sl No.	Spatial Layers
I	**Base layers**
	1. Road
	2. Rail
	3. Bridges
	4. Flyovers
	5.Water bodies
II	**Land Use/Land cover**
III	**Utilities***
	Water Supply Network
	Power Supply Network
IV	**Hypsography**
	Digital Elevation Model
	Contour

Land Use / Land Cover -- Classes

- Agricultural Land
- Central Govt. Property
- Commercial
- Communication
- Eco-Sensitive Areas
- Educational
- Green Areas
- Health Services
- Heritage
- Industrial
- Mixed
- Others
- Public Utilities
- Public Semipublic
- Railway
- Recreational
- Religious
- Residential
- Rural
- Shifting Cultivation
- Slum
- Solid Waste Management
- Specific Land Use
- State Govt. Property
- Traffic related
- Transportation
- Unclassified
- Vacant Land
- Wastelands
- WaterBodies
- Wetlands

Sub-Classes

- River
- Stream
- Canal
- Drain
- Ponds
- Lake
- Tank
- Island(River/Lake)
- Reservoir
- Back Water
- Sea
- Well
- Bank Erosion Protection Wall
- Other Water Bodies

SPATIAL

Class	Sub-Class	Geometry	Symbol
Road	*National Highway*	Polygon / Line	
	State Highway	Polygon / Line	
	Major District Road	Polygon / Line	
	Other District Road	Polygon / Line	
	Expressway	Polygon / Line	
	Bypass	Polygon / Line	
	Ring Road	Polygon / Line	
	Service Road	Polygon / Line	
	*Major City Road**	Polygon / Line	
	*Minor City Road**	Polygon / Line	
	Other Public Road	Polygon / Line	
	Other Private Road	Polygon / Line	
	BRTS	Polygon / Line	
	Cycle Track	Polygon / Line	
	Village road	Polygon / Line	
	Foot path	Line	
	Cart track	Line	
	Ropeway	Line	
	*Carriageway**	Line	
	*Right of way**	Line	

NON-SPATIAL

Attribute Name
Road Id
Code
Sub-Class
Length in km.
Ward Number
Road Name
Road Construction Material
Carriage Width (in mt.)
Right of Way Width (in mt.)
Maintained By
Foot Path
Foot path width(in mt.in case Yes)
Foot Path Construction material

CLASSES ----------71

SUB-CLASSES ----------503

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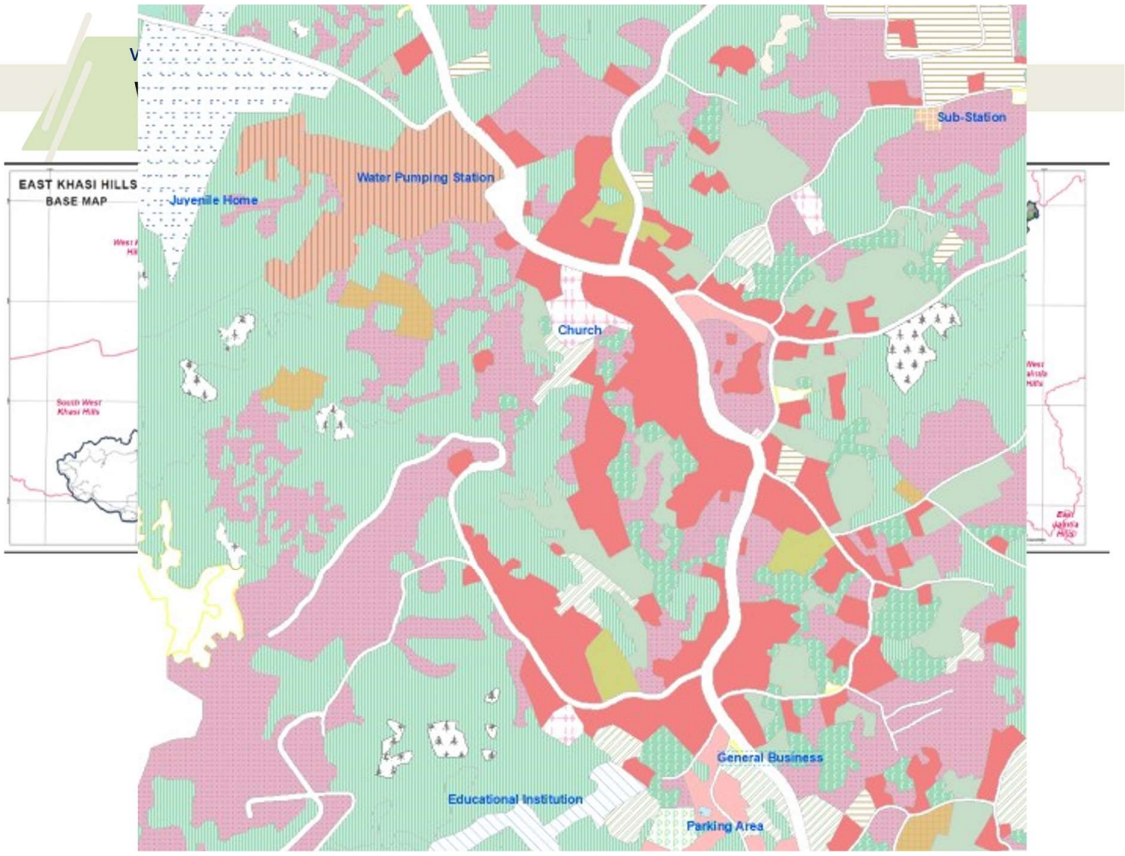
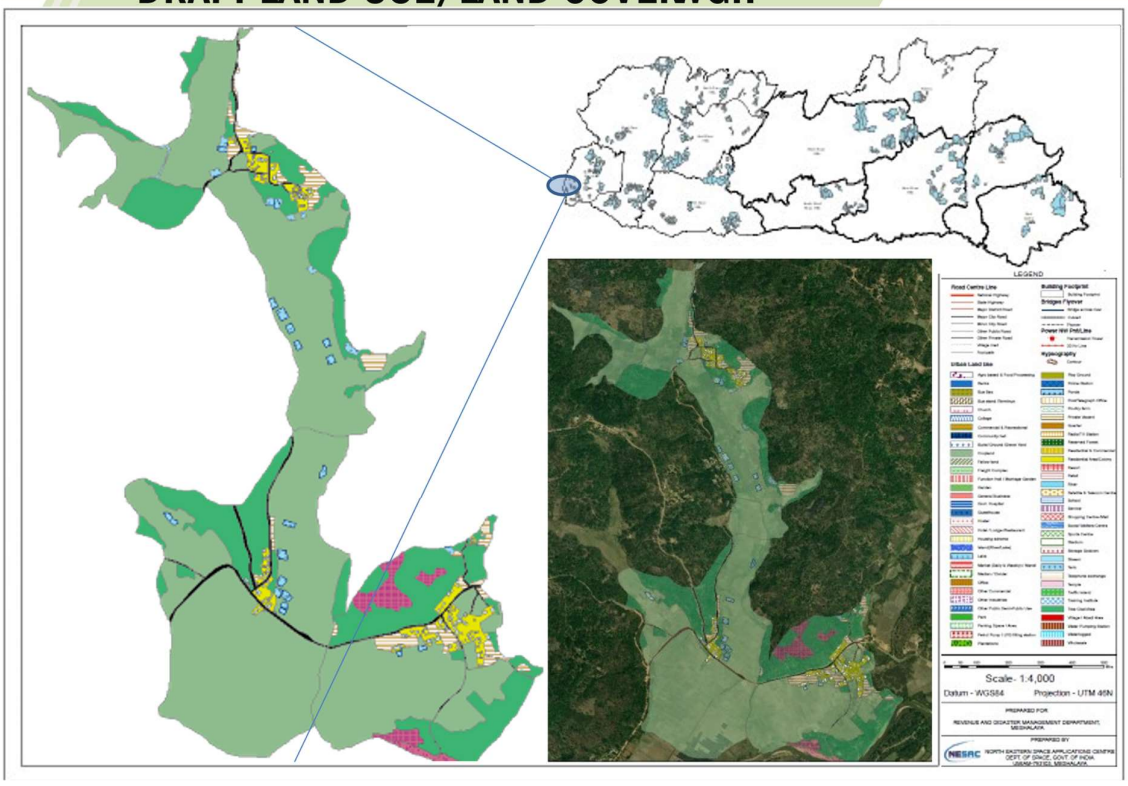


VILLAGE LEVEL MAPPING

DRAFT LAND USE/LAND COVER-WGH



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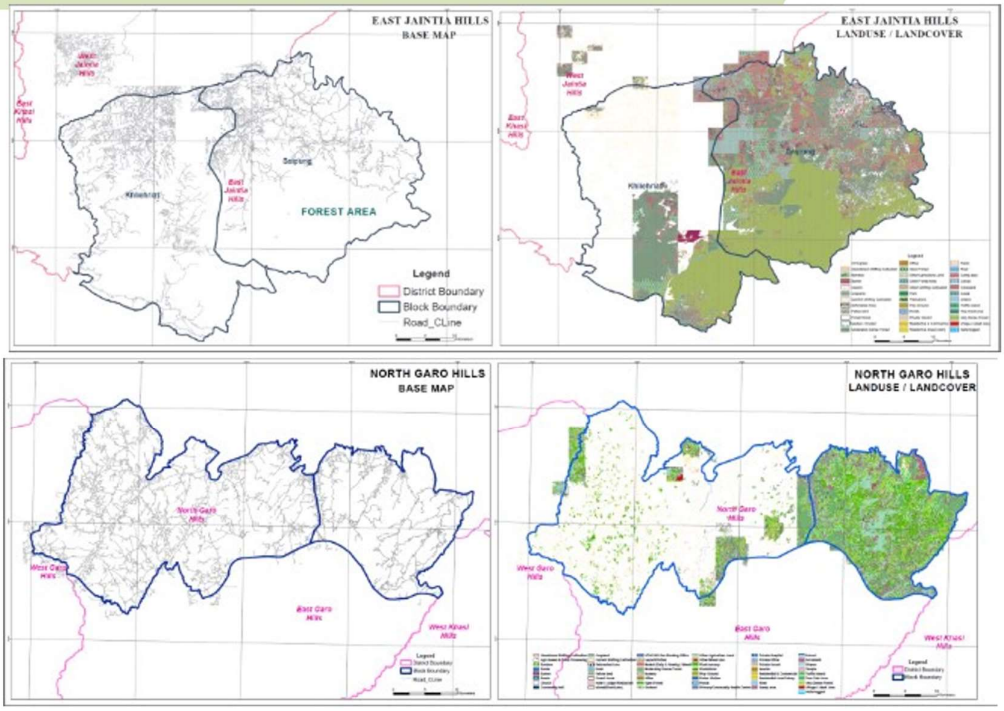
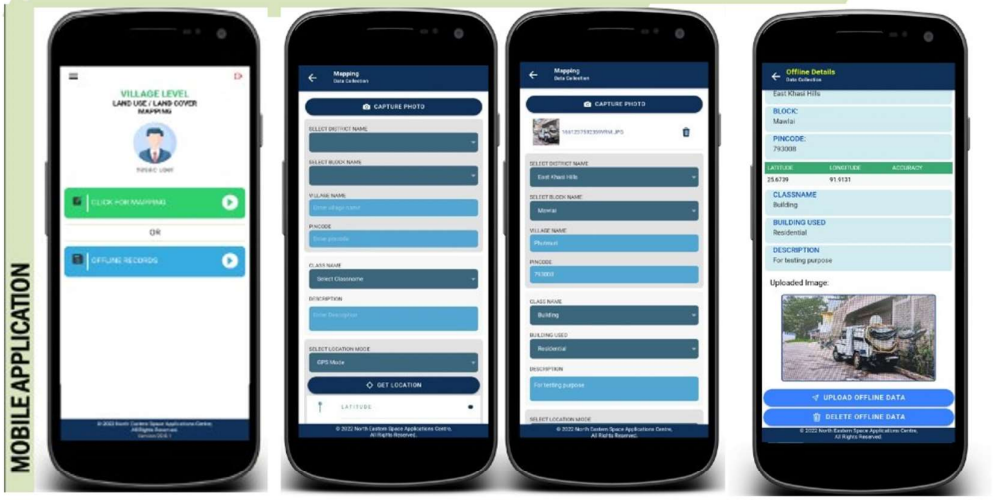
VILLAGE LEVEL MAPPING

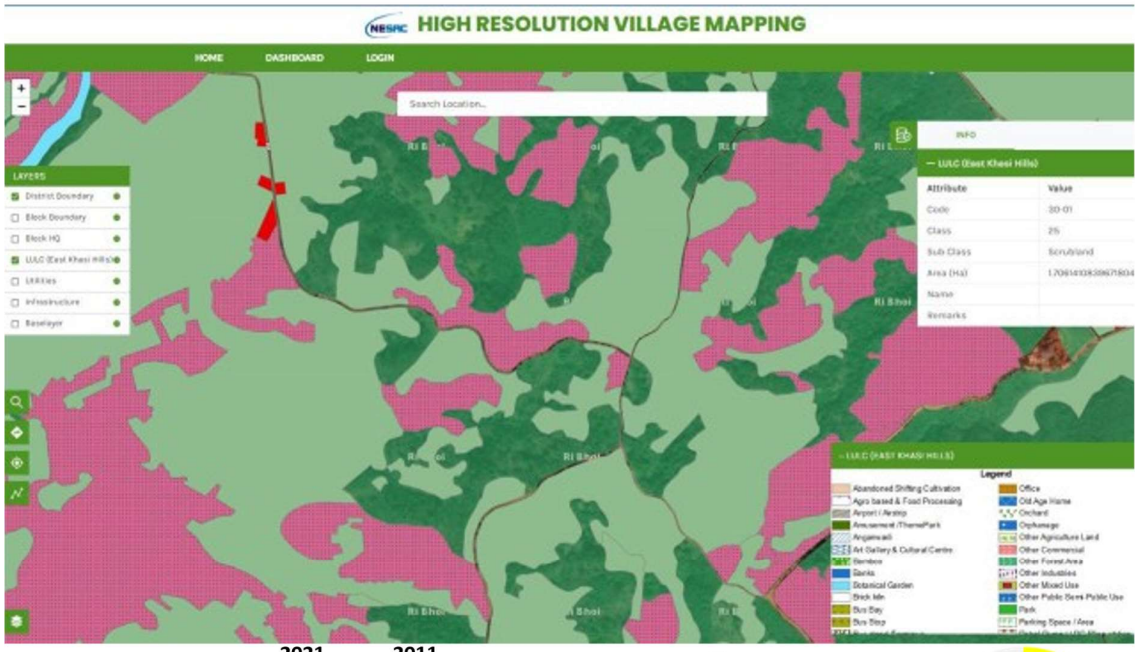
WORK PROGRESS



VILLAGE LEVEL MAPPING

POINT LOCATIONS WITH FIELD PHOTOS





Key Map

Distance from Near by Towns

Census Data

2021
Popln- Total –
Male-
Female–
Households–
Popln Growth –
Literates– Total
Male-
Female-
Sex ratio-
Area(km2)-
Density/km2-

2011
Popln- Total –
Male-
Female–
Households–
Popln Growth –
Literates– Total
Male-
Female-
Sex ratio-
Area(km2)-
Density/km2-

SocialInfra

Education Facilities–Total #
School –
College–
Training Institute-
Health Facilities- Total #
Recreational Facilities-

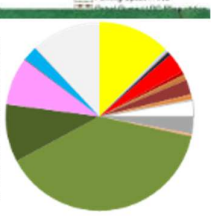
PhysicalInfra

Road Length(km2)-
Fuelling Station-
# of HT Tower –
Training Institute-
Health Facilities- Total #
Waste Collection Points-

Blue Infra

# of Ponds/ Tank– Area (km2)
Length of stream in km2

Area Statistics



THANK YOU

Land use land cover (LULC) changes in mining areas of Jaintia Hills, Meghalaya

Dr. O. P. Singh
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Main objectives of the study

-to understand thespatio-temporal LULC changes in Jaintia Hills for 26 years (during 1987-2013) and

-to know the probable causes of such changes.

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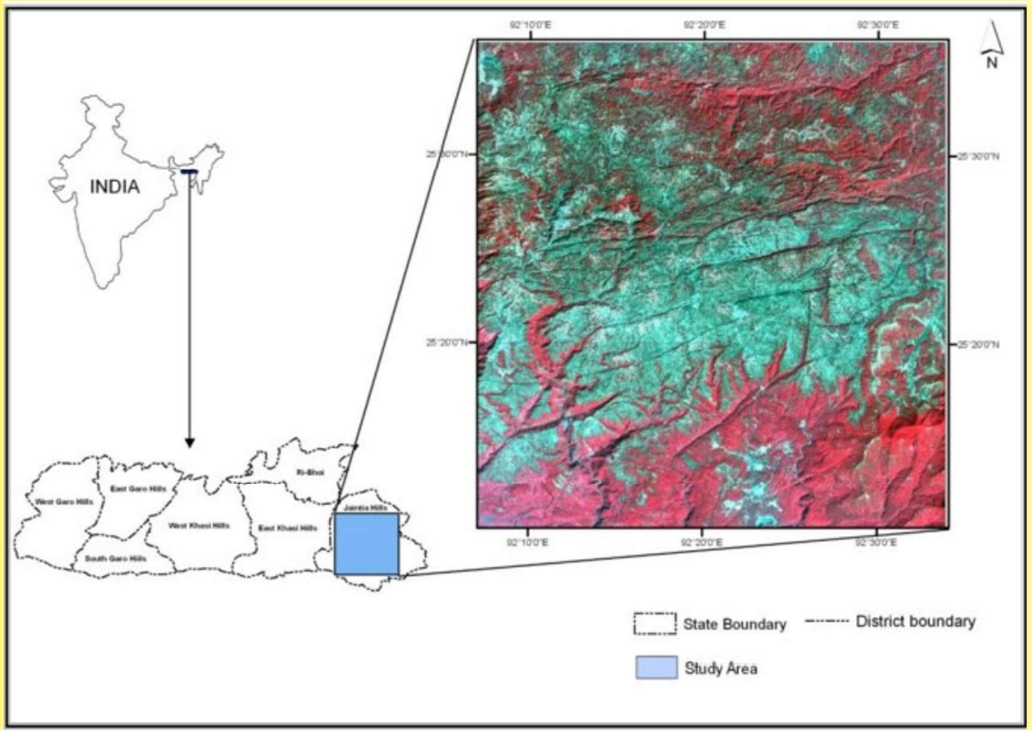
Study Area

- The study area is situated at approximately 92°06'83"E and 25°36'03"N longitude, and 92°34'27"E and 25°09'24"N latitude of Jaintia Hills.
- The study area covers an area of approximately 2023.60 km^2.
- The selected study area comprises of disturbed areas in Jaintia Hills, which has been subjected to various types of human interventions including mining activities (coal and limestone), industrial expansion, urbanization and commercial activity, agricultural expansion, plantation, shifting cultivation etc.

Study Area



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Satellite Data used:

The study was conducted by using Landsat series satellite data comprising TM (1987), ETM+ (1999), and OLI (2013).

Land use land cover (LULC) categories:

A total of 7 categories of LULC were identified and analyzed representing

2 forest cover categories (dense and open forest) and

5 non-forest cover categories (shrub/grassland, cropland, barren land, built-up, and water body).

Methodology (1)

Three time series LULC maps were classified by combining two hybrid supervised-unsupervised classification methods called 'guided clustering' and 'cluster busting' from TM (1987), ETM+ (1999) and OLI (2013).

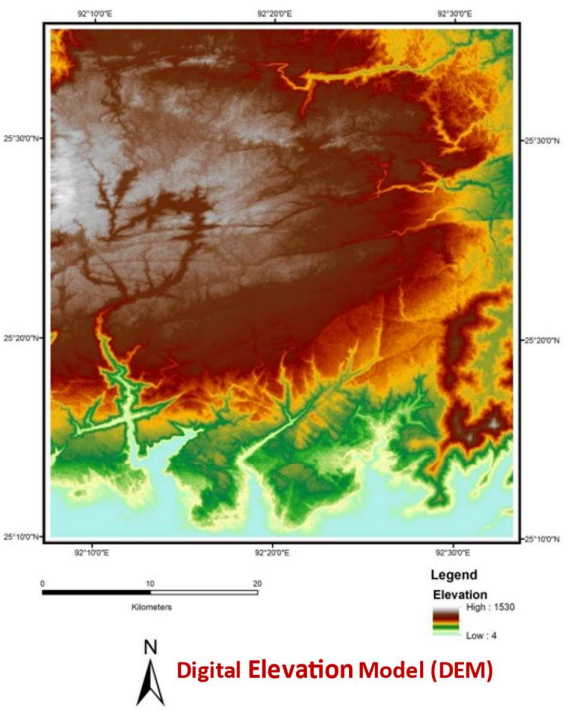
The resulted classified maps was subjected to post-classification editing and filtering process to remove the salt and pepper effects as well as to improve accuracy. The 3*3 majority filtering was selected and used as the post classification filtering mode for generating the final output LULC maps.

Methodology (2)

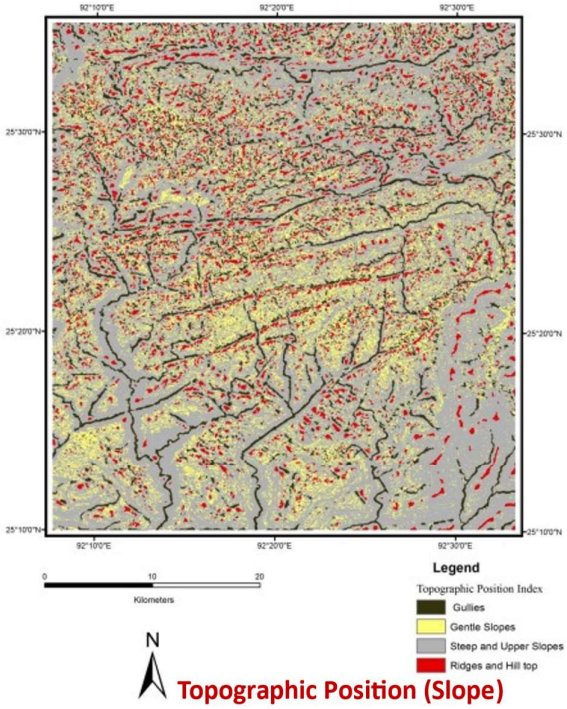
The accuracy of the final output LULC maps for 1987, 1999, and 2013 were evaluated by means of user's accuracy, producer's accuracy, overall accuracy, and kappa coefficients. This was done by using a confusion matri embedded in 'Erdas Imagine".

For determining the accuracy both the reference data and th classified image (final output LULC map) were taken into account for each LULC maps separately.

For each LULC map, a total of 520 stratified random points (pixel) were set up and then compared with the reference data.



Digital Elevation Model (DEM)



Topographic Position (Slope)

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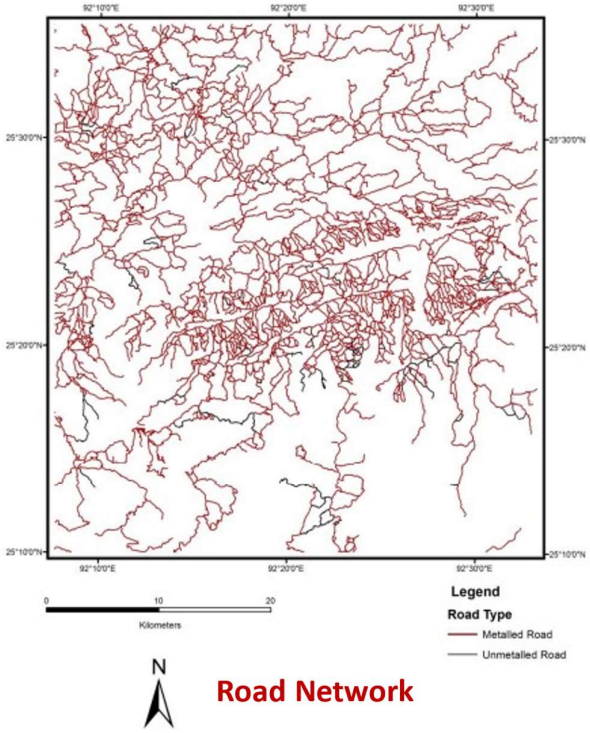
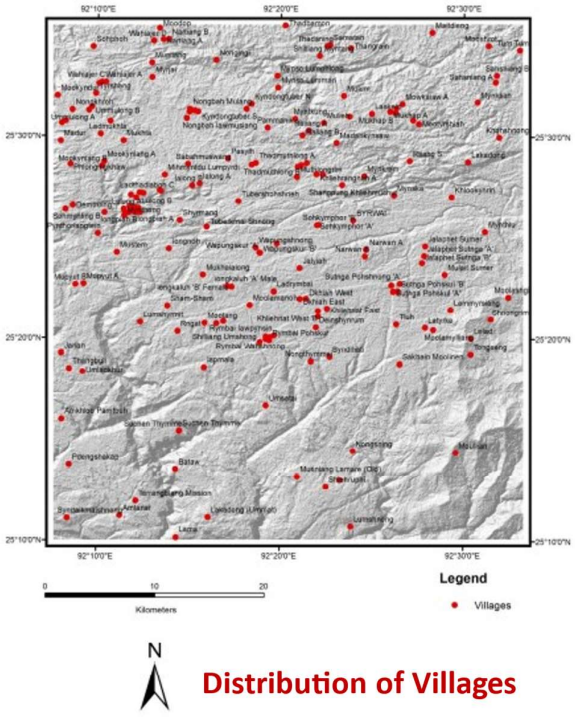
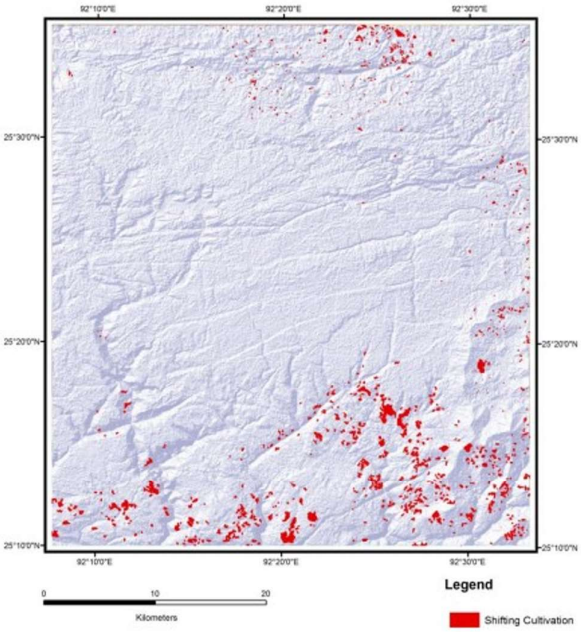


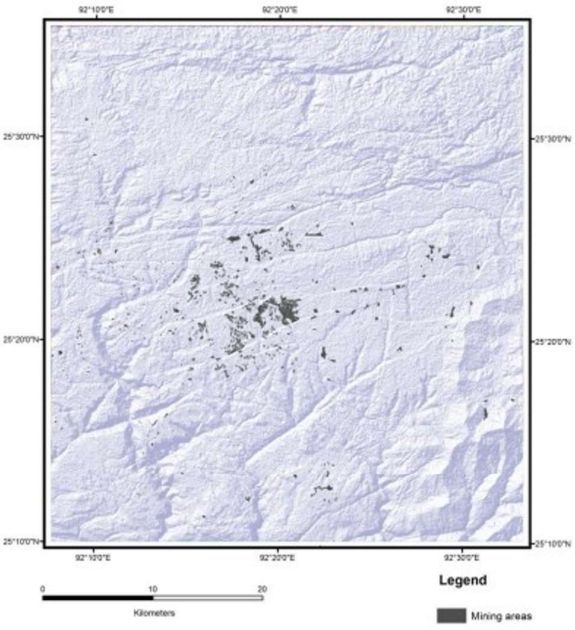
Road Network



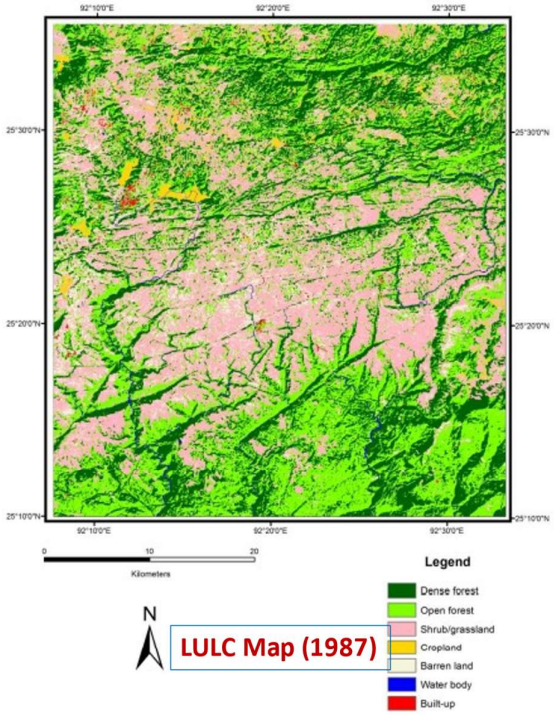
Distribution of Villages



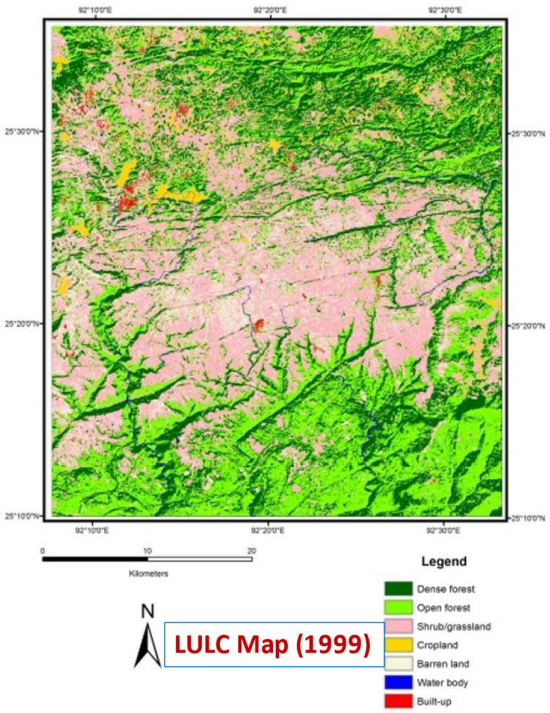
Shifting Cultivation Areas



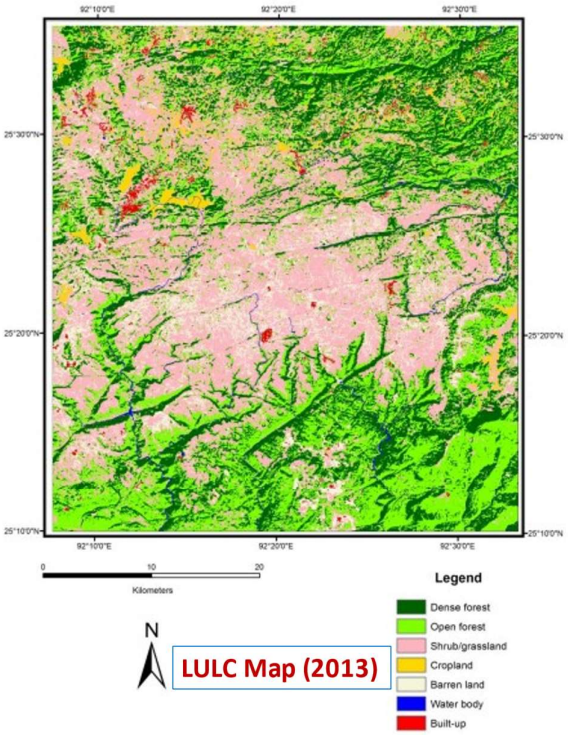
Mining Areas



LULC Map (1987)



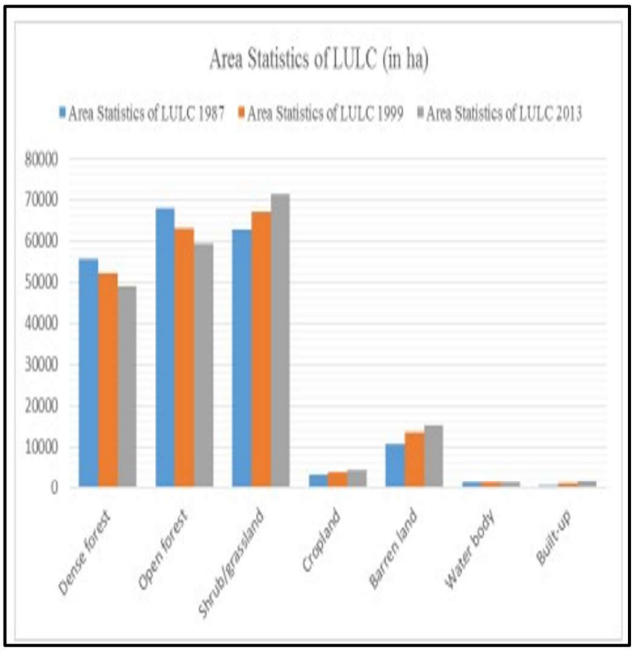
LULC Map (1999)



LULC Map (2013)

LULC class	Area Statistics of LULC (in ha)		
	1987	1999	2013
Dense forest	55825.11	52305.39	48995.01
Open forest	67879.53	63209.52	59331.6
Shrub/grassland	62832.6	67050.54	71321.31
Cropland	3322.8	4050.54	4440.51
Barren land	10674.99	13508.91	15256.8
Water body	1221.03	1221.03	1247.49
Built-up	610.02	1020.15	1773.36

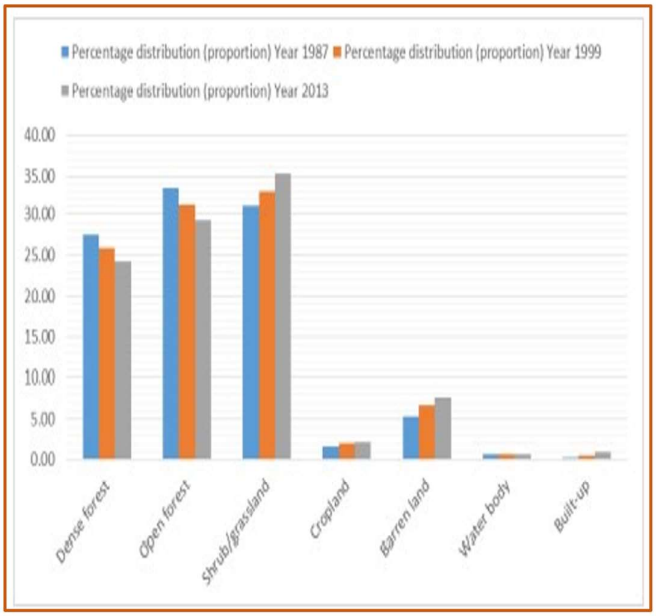
LULC Area Statistics for 1987, 1999 and 2013



Graphical Representation of LULC Area Statistics for 1987, 1999 and 2013 (in ha)

LULC class	Percentage Distribution or Proportion (in %)		
	Year		
	1987	1999	2013
Dense forest	27.59	25.85	24.21
Open forest	33.54	31.24	29.32
Shrub/grassland	31.05	33.13	35.24
Cropland	1.64	2.00	2.19
Barren land	5.28	6.68	7.54
Water body	0.60	0.60	0.62
Built-up	0.30	0.50	0.88

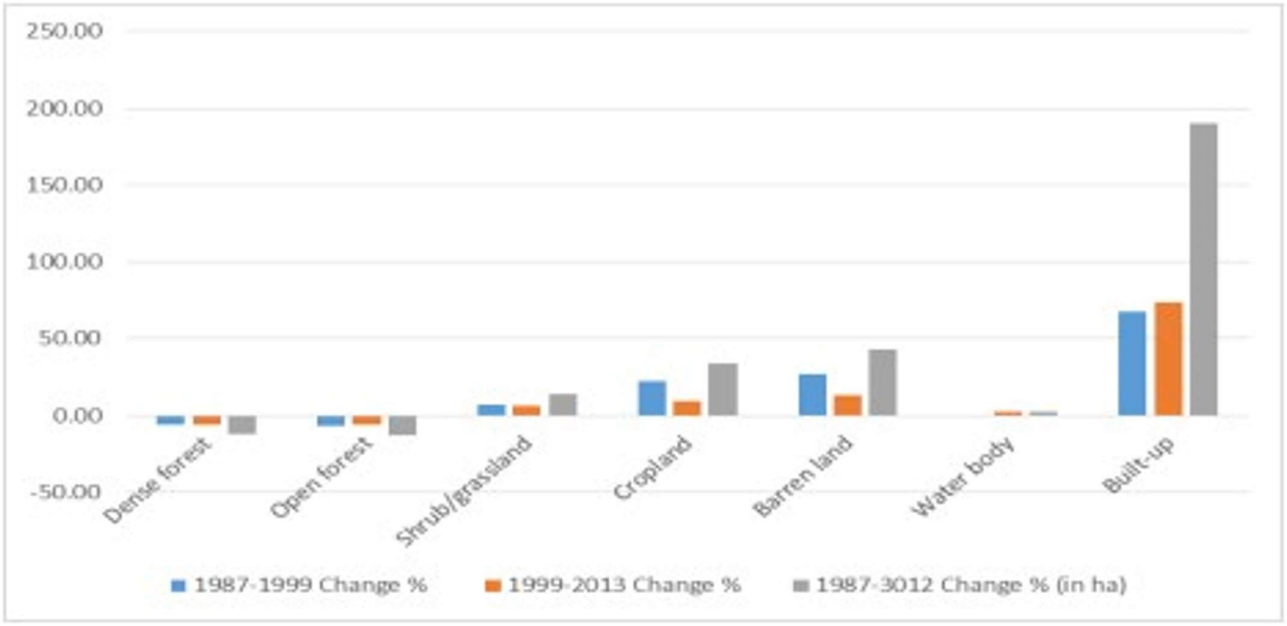
LULC Area Proportion for 1987, 1999 and 2013 (in %)



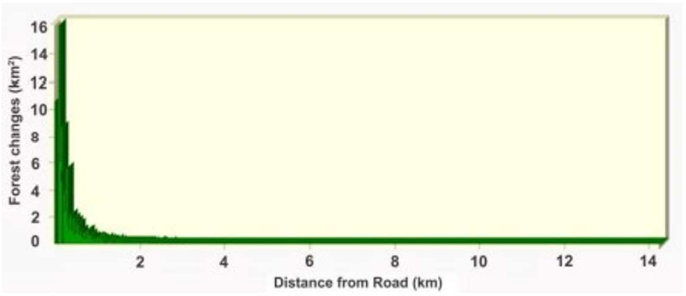
Graphical Representation of LULC Area Proportion for 1987, 1999 and 2013 (in %)

LULC Change Percentage during 1987 -1999, 1999-2013, and 1987- 2013 (in %)

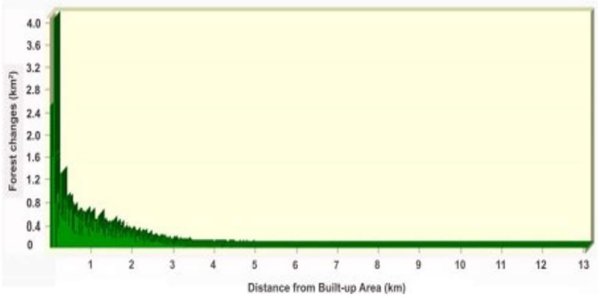
LULC class	1987-1999	1999-2013	1987- 2013
	Change %	Change %	Change % (in ha)
Dense forest	-6.30	-6.33	-12.23
Open forest	-6.88	-6.14	-12.59
Shrub/grassland	+6.71	+6.37	+13.51
Cropland	+21.90	+9.63	+33.64
Barren land	+26.55	+12.94	+42.92
Water body	0.00	+2.17	+2.17
Built-up	+67.23	+73.83	+190.71



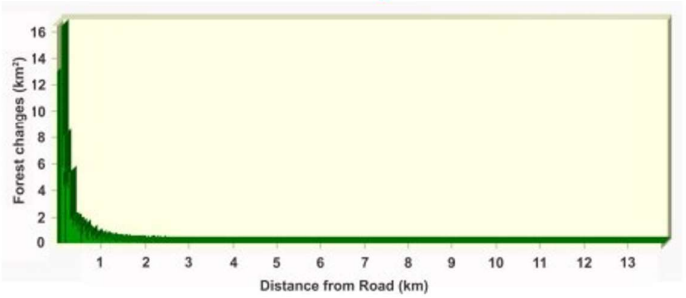
Graphical Representation of LULC Change Percentage during 1987-1999, 1999-2013, and 1987-2013 (in %)



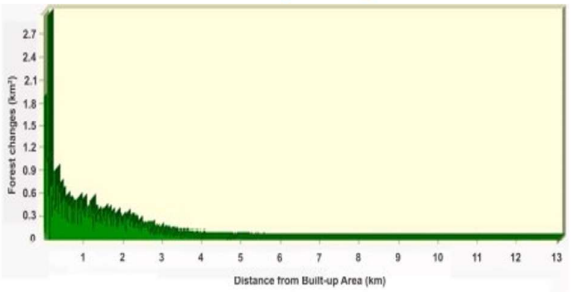
Relationship between Forest Cover Change (loss) and Road network during 1987-1999



Relationship between Forest Cover Change (loss and Built-Up during 1987-1999

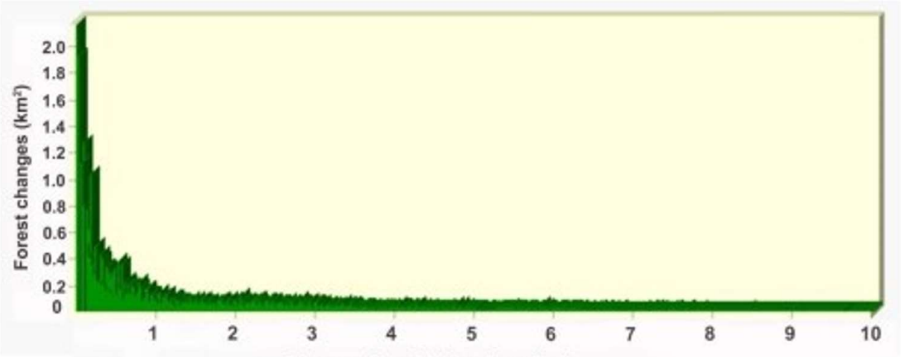


Relationship between Forest Cover Change (loss) and Road network during 1999-2013

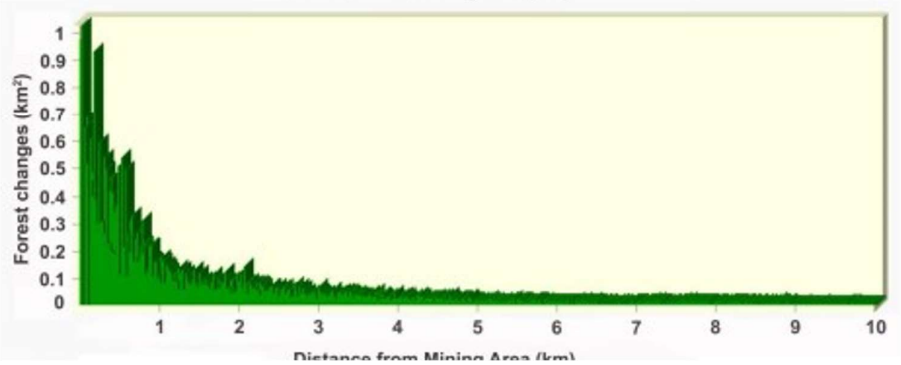


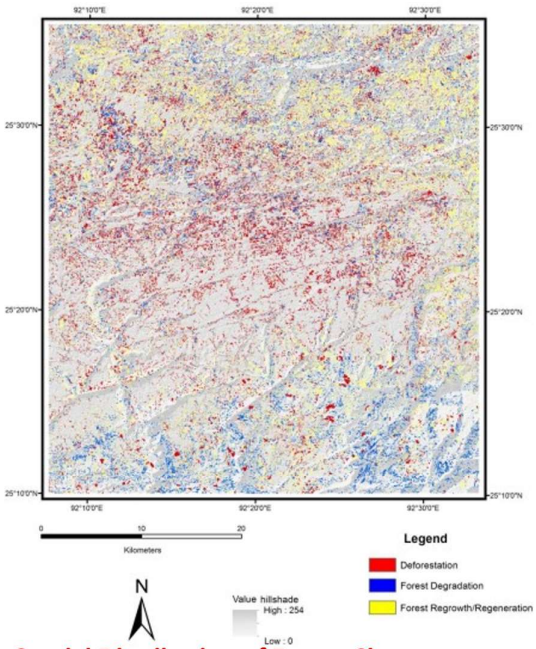
Relationship between Forest Cover Change (loss) and Built-Up during 1999-2013

Relationship between Forest Cover Change (loss) and Mining Area during 1987-1999

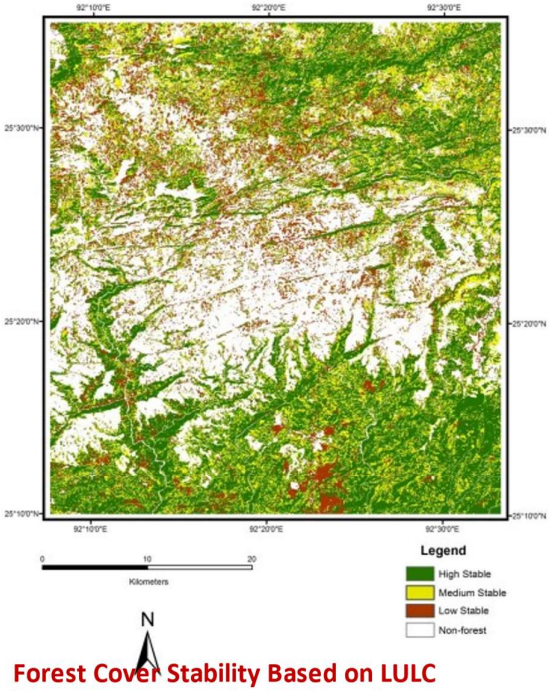


Relationship between Forest Cover Change (loss) and Mining Area during 1999-2013





Spatial Distribution of Forest Change types based on Transition/Conversion during 1987



Forest Cover Stability Based on LULC Transition/Conversion Trajectories

Summary

Significant changes in the proportion and distribution of different LULC classes have taken place during the 26 years (1987-2013).

The open forest area was found to be the dominant LULC class in the study area in 1987 and over the time it was replaced by the shrub/grassland.

Declining trend in the areas of forest classes (dense and open forest) along with an increasing trend in the area under other non-forest classes (i.e. shrub/grassland, cropland, barren land, built-up and water body) was noticed.

The LULC conversion/transformation analysis showed that the LULC dynamics in the study area largely happened mainly due to the interaction among dense forest, open forest and shrub/grassland.

Seven proximate factors of human intervention 'distance to road network', 'distance to shifting cultivation, 'distance to agricultural area', distance to mining area', 'distance to shifting cultivation' were found to be the significant factors that drive the forest landscape changes.

Recommendations

There is need for

- proper land use planning in order to minimize negative changes in LULC.
- imposing regulations and restrictions in order to minimize further degradation of ecologically sensitive areas.
- restoration activities for improvement of forest area and its quality.

Acknowledgement

The presentation was based on the data of Doctoral Thesis of Dr. Thangjam Somendro Singh.

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NRM UNDER CLIMATE UNCERTAINITY

HOW DO WE MOVE FORWARD IN MEGHALAYA?

All lifeforms on earth depend on nature

If all mankind were to disappear,

The world would regenerate back to the rich state of equilibrium

That existed ten thousand years ago.

If insects were to vanish,

The environment would collapse into chaos.

Edward O Wilson

But man has extra demands

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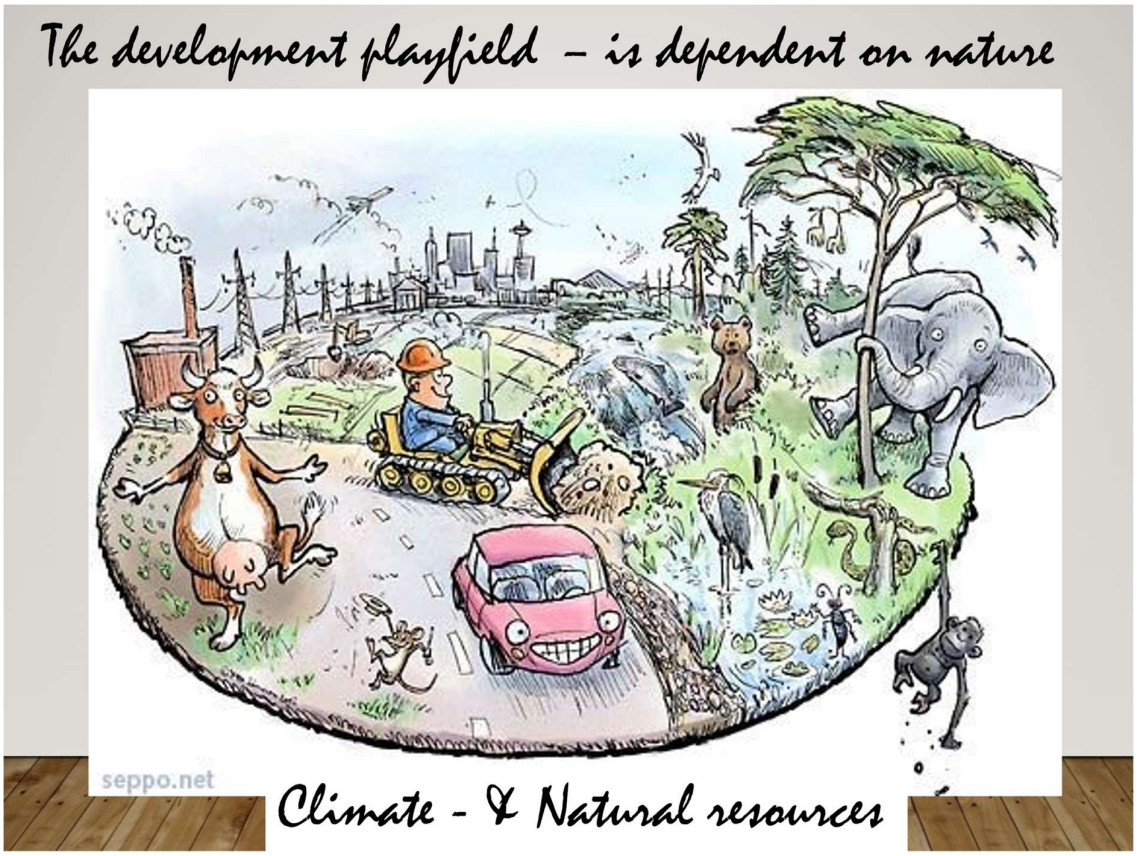

PRESENT UNDERSTANDING OF CLIMATE IN THE REGION

The physical character of N. E. India

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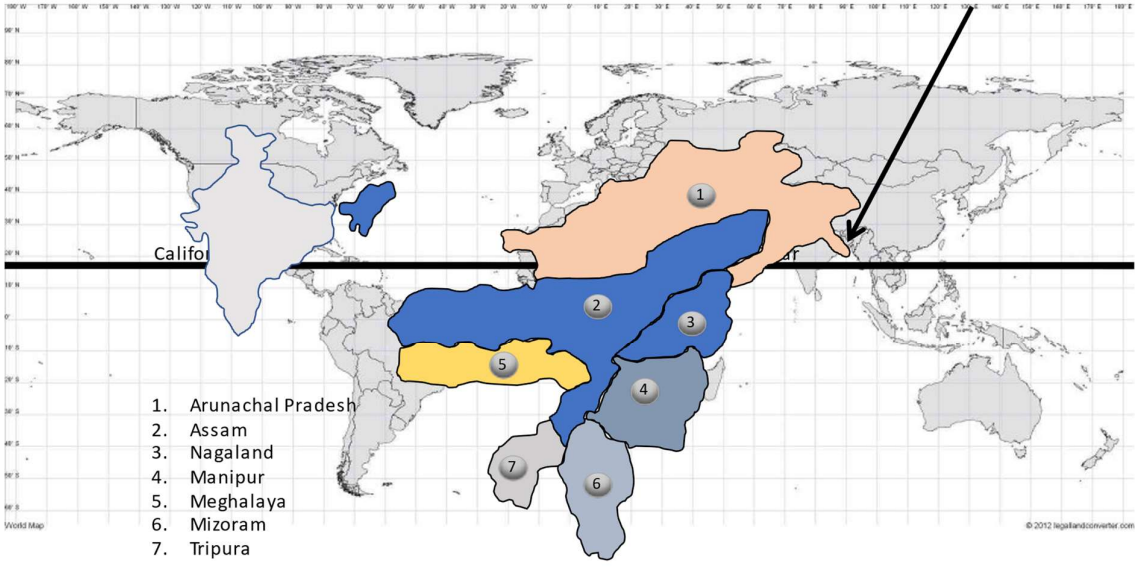
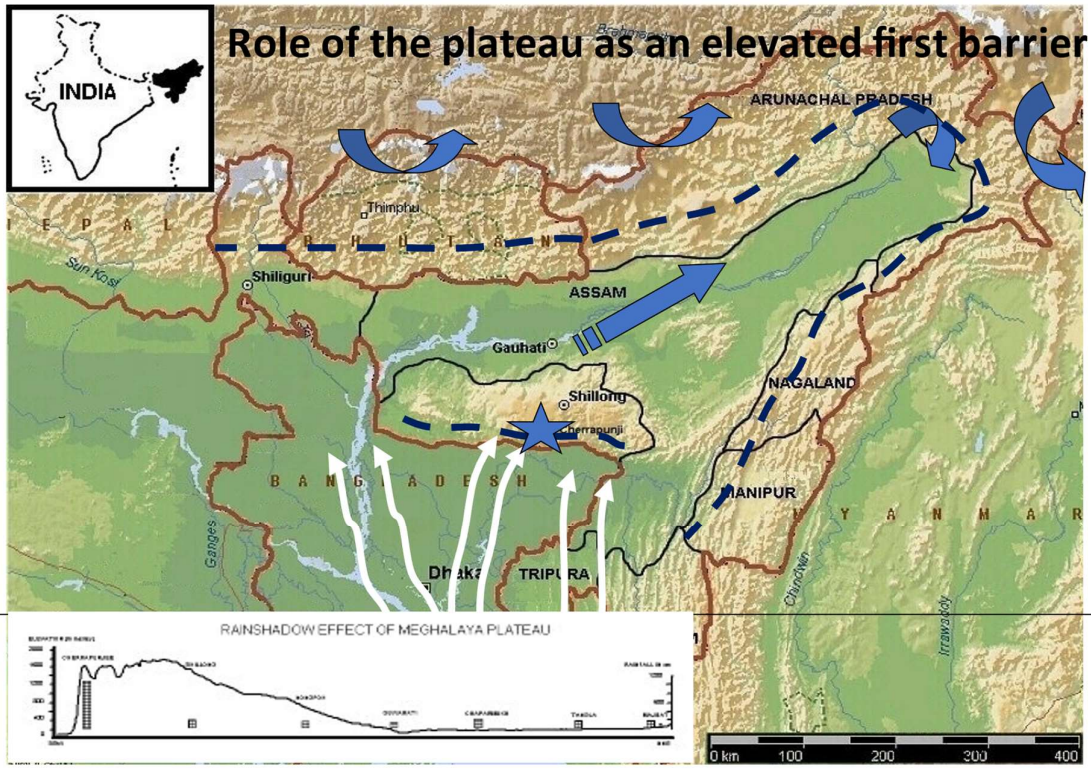
A naturally wet region

- This is the only wet region located along these latitudes;
- The rest of the areas around the globe are deserts, hence it is highly vulnerable to climate events

Heavy Rainfall Recorded at Sohra
1874 – 23,663 mm
1961 – 22,987 mm
1974 – 24,600 mm



1. Arunachal Pradesh
2. Assam
3. Nagaland
4. Manipur
5. Meghalaya
6. Mizoram
7. Tripura



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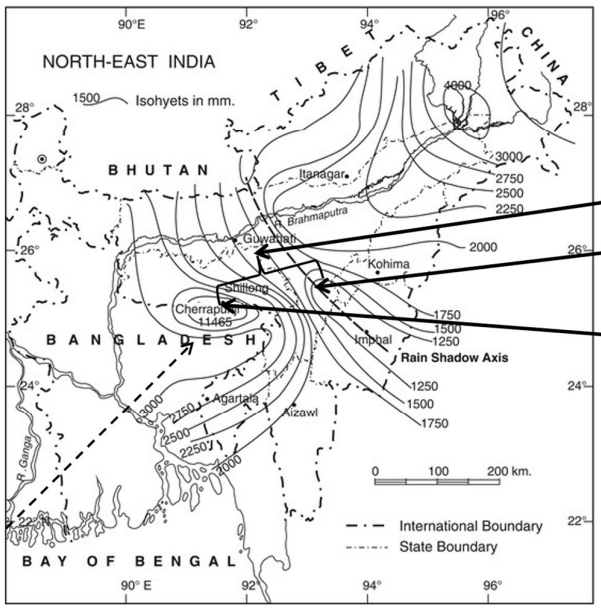
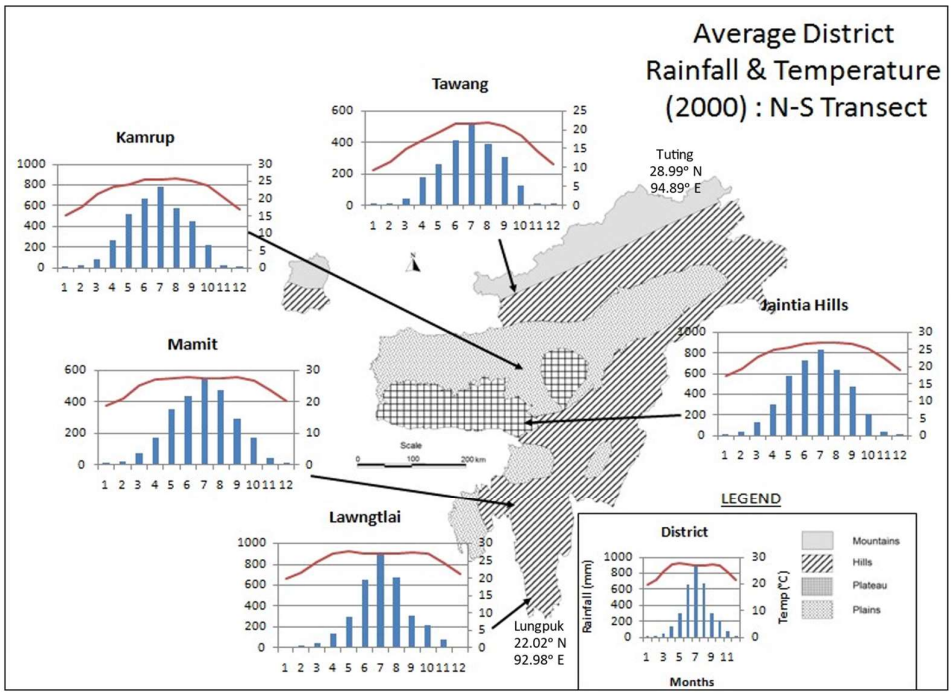
Reduction of rain volume within short distance



Distance (150 km approx)

Lowest rainfall
Lumding(1161 mm)

Heaviest rainfall
Sohra(11131 mm)



Tuting (1240 masl)
Temp : -1° to 25°C

Lungpuk (729 masl)
Temp : 18°- 35°C

Jaintia Hills (1500masl)
Temp : 16° - 28°C

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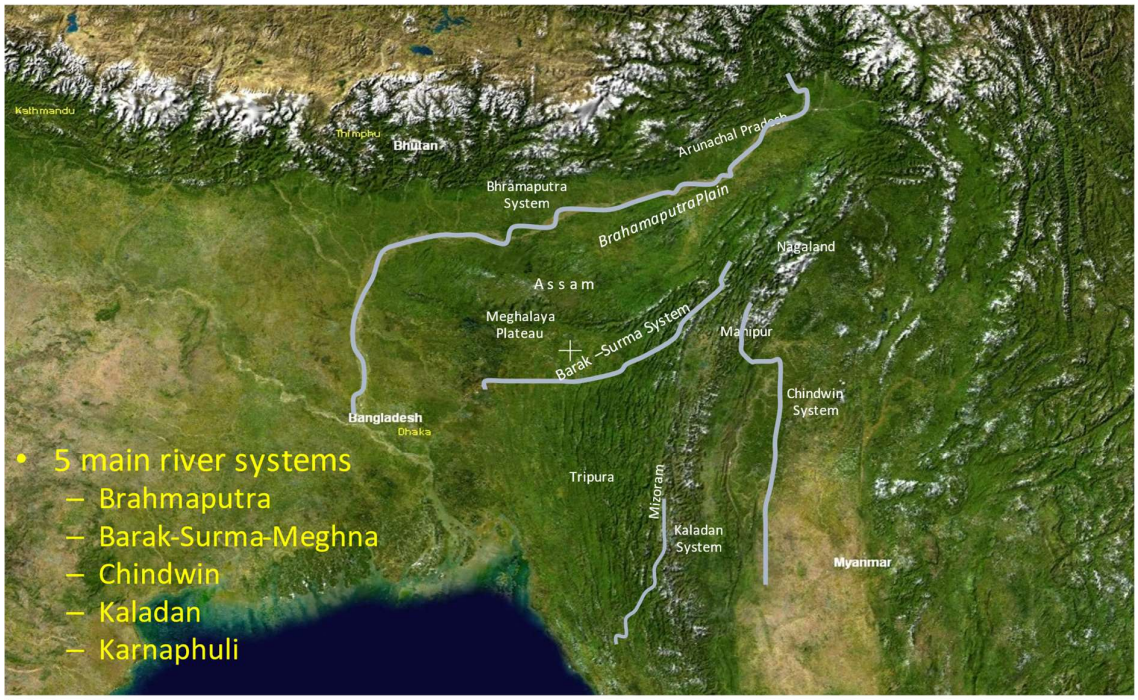
N E India: Major Drainage systems



Flood : A Major Recurring Disaster in different areas

Year	Some information on the floods
1900	Change in river bed level after the 1897 earthquake
1906	Change in river bed level after the 1897 earthquake
1913	Highest flood since 1883 due to continuous rain
1915	Both Cachar & Sylhet under water durin most of May to July due to incessant rain
1916	Cachar & Sylhet under water in October due to rain in Mizo Hills and Manipur
	Nowgong was also under water due to rain in Jaintia Hills & N C Hills
1927	Assam Valley under water
1928	Cachar & Sylhet under water in October due to rain
1929	Cachar & Sylhet under water in May & June due to excessive rain in K & J Hills
1981	3 waves
1984	5 waves in May, June, July (2) & Sept in Brahmaputra Valley
1985	2 waves in June & July in Brahmaputra Valley
1986	4 waves in June, July, August & Sept
1987	Unprecedented intense floods
1988	Most intense maximum area of the Brahmaputra Valley submerged
1997	From June to Sept (Brahmaputra Valley & Barak Valley
1998	From June to Sept (Brahmaputra Valley & Barak Valley
2000	3 waves this time affecting from AP (June to August)
2013	Affecting Assam & northern districts of Bangladesh
2014	Assam & Meghalaya (Garo Hills) flooded due to incessant rains
2017	Assam Valley (Sivsagar to Dhubri, Cachar), AP, Nagaland & Manipur

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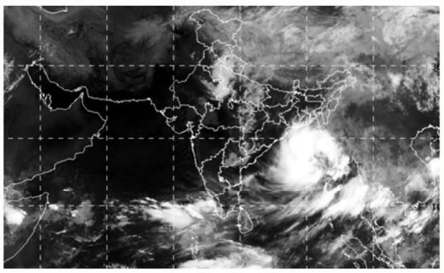
TROPICAL CYCLONES AND THEIR EFFECTS ON N.E.INDIA

- The Indian sub-continent is one of the worst affected by cyclones in the world
- Vulnerability : ~ 8% of area; East Coast & Gujarat coast
- 5-6 tropical cyclones in the BoB & Arabian Se
- More cyclones in BoB ; sometimes severe
- Time : May, June, October & November
  Cyclone Mora : End of May 2017



Satellite image of Cyclone Mora. (Credit: IMD)

According to the Indian Meteorological Department (IMD), it is expected to intensify into a "severe cyclonic storm" in the next 24 hou with wind speeds in the range of 100-150 kilometres per hour.

Rainfall on 31 May:84 mm @Sohra

Extremely Severe Cyclonic Storm Hudhud

Extremely severe cyclonic storm (IMD scale)
Category 4 tropical cyclone (SSHWS)

Hudhud nearing landfall at

Winds	3-minute sustained: 185 km/h (115 mph) 1-minute sustained: 215 km/h (130 mph) Gusts: 260 km/h (160 mph)
Pressure	950 hPa (mbar); 28.05 inHg
Fatalities	124 total
Damage	$3.4 billion (2014 USD)
Areas affected	Andaman and Nicobar Islands · Andhra Pradesh, Vishakhapatnam · Odisha · Chhattisgarh · Madhya Pradesh · Uttar Pradesh · Nepal

Oct 812, 2014

Rainfall on 8 Oct: 51 mm @Sohra

Severe cyclonic storm (IMD scale)
Category 1 tropical cyclone (SSHWS)

Cyclone Laila on May 19

Formed	May 17, 2010
Dissipated	May 21, 2010
Highest winds	3-minute sustained: 100 km/h (65 mph) 1-minute sustained: 120 km/h (75 mph)
Lowest pressure	986 hPa (mbar); 29.12 inHg
Fatalities	65 total
Damage	$117.49 million (2010 USD)
Areas affected	Sri Lanka, India

Rainfall on 19-22 May 486.5mm @Sohra

SIDR : POST MONSOON CYCLONE (15-16 NOV,2007)

RESEARCH ARTICLES : CURRENT SCIENCE, VOL. 100, NO. 10, 25 MAY 2011 1522

Singh, S., Hayashi, T.,Syiemlieh, H.J., Cajee, L., & Terao , T.: Weather variability and rainfall pattern of Sidr, the post-monsoon cyclonic storm of 15 November 2007 in the Meghalaya Plateau, India

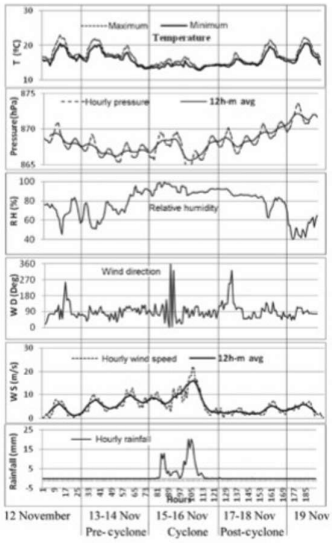


Figure 5. Weather conditions of 8-days duration of pre-cyclone, cyclone and post-cyclone stages starting from 00 h 12 November to 2300 h 19 November 2007 at Cherrapunji. 12 h m avg, Twelve hours moving average.

Table 3. Hourly weather conditions for 16 h (21 h 15 November to 12 h 16 November 2007) of most disturbed weather at Cherrapunji

Date	Time (h)	Air temperature (°C)	Relative humidity (%)	Wind speed (m/s)	Wind direction	Hourly rainfall (mm)	Barometeric pressure (hPa)	Psychrometric index (hPa/°C)	Saturation vapour pressure (hPa)	Vapour pressure (hPa/°C)
Starting phase										
15 November	21:00	14.33	89.78	13.05	NNE	3.6	869.6	0.57855	16.32270	1.139058
15 November	22:00	14.88	89.19	13.35	NE	4.0	869.0	0.57815	16.91270	1.136606
15 November	23:00	15.33	88.21	6.60	NNE	1.8	868.7	0.57795	17.40929	1.135635
16 November	0:00	14.61	95.13	7.65	NNE	0.2	868.1	0.57755	16.62076	1.137629
16 November	1:00	15.81	95.86	11.55	SEE	0.8	866.6	0.57655	17.95306	1.135551
16 November	2:00	16.07	94.17	8.10	SEE	3.2	866.3	0.57635	18.25378	1.135892
16 November	3:00	15.97	85.65	15.00	E	8.8	864.5	0.57515	18.13760	1.135730
16 November	4:00	14.76	95.86	17.85	SE	7.2	864.8	0.57535	16.78240	1.137019
Heavy rainfall phase										
16 November	5:00	14.70	96.94	17.85	SSE	10.8	864.8	0.57535	16.71758	1.137250
16 November	6:00	14.61	97.85	22.05	SEE	20.2	864.5	0.57515	16.62076	1.137629
16 November	7:00	14.51	97.57	21.30	E	15.6	865.1	0.57555	16.51377	1.138096
16 November	8:00	13.86	98.27	14.40	SSE	20.2	866.0	0.57615	15.83292	1.142347
16 November	9:00	13.38	98.08	16.35	SE	18.0	866.9	0.57675	15.34611	1.146944
16 November	10:00	13.22	96.16	11.40	SE	10.8	866.9	0.57675	15.18679	1.148774
16 November	11:00	12.96	95.78	12.60	SE	6.6	866.6	0.57655	14.93100	1.152083
16 November	12:00	13.07	94.40	8.85	NEE	5.0	866.0	0.57615	15.03875	1.150631

Table 5. Rainstorm pattern during cyclone *Sidr* (48 hours from 00 h 15 November 2007)

Station	Duration (h) and amount of rainfall (mm)	Intensity (mm/h)	Hourly maximum rainfall (mm)	Hourly minimum rainfall (mm)	Hourly mean rainfall (mm)	Skewness (coefficient)	Kurtosis (coefficient)	SD (mm)	CV (%)	Active level of rainfall (mean + SD) (mm)
Cherrapunji	40 (204.6)	5.115	20.20	0.20	4.26	1.5663	1.5815	5.65	110.67	9.91
Thangkarang	34 (137.0)	4.030	21.00	0.50	2.85	1.6503	2.0904	3.93	97.65	6.78
Mawsynram	44 (157.5)	3.591	16.50	0.50	3.28	1.5304	2.2941	3.77	105.42	7.05
Pynursla	34 (220.5)	6.485	16.50	0.50	4.59	1.4592	1.5553	5.58	86.74	10.17
Amlarem	33 (113.0)	3.424	12.00	0.50	2.35	1.6190	2.7774	2.93	85.67	5.28
Nongpoh	26 (38.6)	1.484	6.00	0.20	0.81	2.2592	4.1643	1.52	102.86	2.33
Byrnihat	11 (7.5)	0.682	2.40	0.20	0.16	3.9185	17.5391	0.49	314.24	0.65

Rainfall intensity for the effective period was calculated dividing total amount of rainfall by duration of rainfall during the cyclonic period (as given in column 2); SD, Standard deviation; CV, Coefficient of variation.

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NORTH EAST INDIA

- The inhabitants

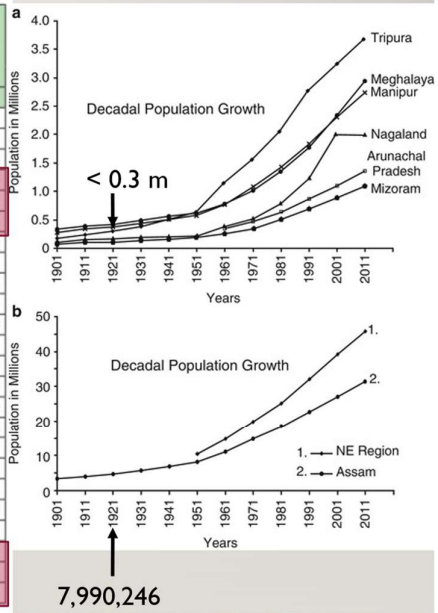
North East India is a land of many tribes – *Cul de sac*

Population of each tribe is not large – some are small groups

North East India : Population

States	Area	Area in Sq.Km	Population			Sex Ratio	Population Density	No. of Household	Household Size
			Persons	Males	Females				
1	2	3	4	5	6	7	8	9	10
Arunachal Pradesh	Total	83,743.00	1,383,727	713,912	669,815	938	17	270,577	5.1
	Rural	N.A.	1,066,358	546,011	520,347	953	-	200,210	5.3
	Urban	N.A.	317,369	167,901	149,468	890	-	70,367	4.5
Assam	Total	78438.00	31,205,576	15,939,443	15,266,133	958	398	6,406,471	4.9
	Rural	77,178.12	26,807,034	13,678,989	13,128,045	960	347	5,420,877	4.9
	Urban	1,259.88	4,398,542	2,260,454	2,138,088	946	3,491	985,594	4.5
Manipur	Total	22,327.00	2,570,390	1,290,171	1,280,219	992	115	510,448	5.0
	Rural	22,147.50	1,736,236	878,469	857,767	976	78	338,109	5.1
	Urban	179.50	834,154	411,702	422,452	1,026	4,647	172,339	4.8
Meghalaya	Total	22,429.00	2,966,889	1,491,832	1,475,057	989	132	548,059	5.4
	Rural	22,146.11	2,371,439	1,194,260	1,177,179	986	107	430,573	5.5
	Urban	282.89	595,450	297,572	297,878	1,001	2,105	117,486	5.1
Mizoram	Total	21,081.00	1,097,206	555,339	541,867	976	52	222,853	4.9
	Rural	20,494.00	525,435	269,135	256,300	952	26	105,812	5.0
	Urban	587.00	571,771	286,204	285,567	998	974	117,041	4.9
Nagaland	Total	16,579.00	1,978,502	1,024,649	953,853	931	119	396,002	5.0
	Rural	16,335.52	1,407,536	725,472	682,064	940	86	277,491	5.1
	Urban	243.48	570,966	299,177	271,789	908	2,345	118,511	4.8
Sikkim	Total	7,096.00	610,577	323,070	287,507	890	86	129,006	4.7
	Rural	7,057.75	456,999	242,797	214,202	882	65	93,288	4.9
	Urban	38.25	153,578	80,273	73,305	913	4,015	35,718	4.3
Tripura	Total	10,486.00	3,673,917	1,874,376	1,799,541	960	350	855,556	4.3
	Rural	10,094.12	2,712,464	1,387,173	1,325,291	955	269	616,582	4.4
	Urban	391.88	961,453	487,203	474,250	973	2,453	238,974	4.0

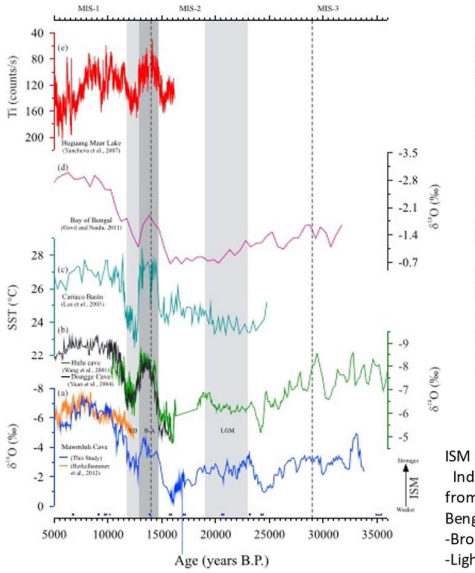
Source: Census 2011, RGI.

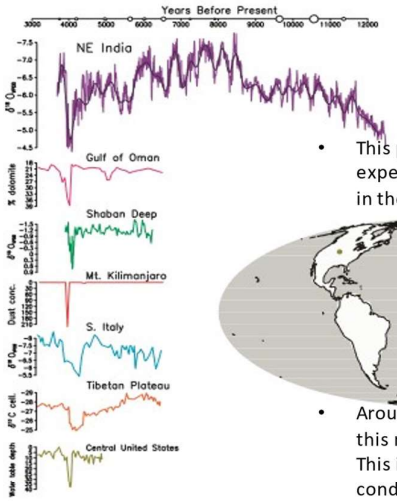


UNDERSTANDING PAST CLIMATE

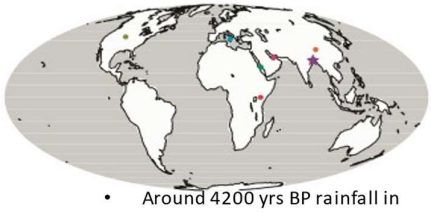
NATURE OF RAIN IN THE PAST 35,000 YEARS

Geophysical Research Letters 10.1002/2015GL06





- This part of the world had experienced a turbulent climate in the past Berkelhammer, 2012);



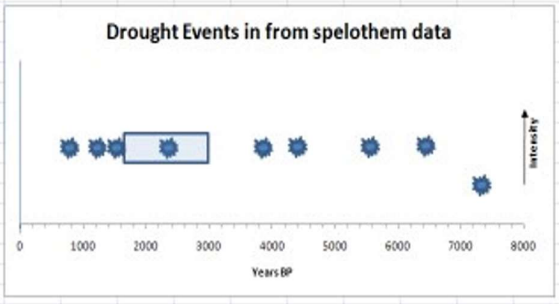
- Around 4200 yrs BP rainfall in this region dropped to its lowest This indicated global drought conditions for about 200 years which was clearly indicated in the spelothemdata;
- This determined the **Meghalayan age**

ISM proxy record from Mawmluh Cave, Sohra, India, compared with cave and lake Records from China, and marine records from the Bay of Bengal and Cariaco Basin (Dutt, et.,al ., 2015)
-Broken veritcal black lines mark the boundaries between marine isotropic stages
-Light grey bars mark the Younger Dryas and Last Glacial Maximum
-Dark grey bar indicates the Bølling – Allerad period

Humid & Arid in S. Asia conditions till around 8000 years

Source : Clift, P.D & Plumb, A. (2008) : The Monsoon Asia: Causes History & Effects

Drought Years (BP)	Years of Drought
400-500	100
900-1000	100
1200-1300	100
1400-2800	1400
3500-3700	200
4100-4300	200
5350-5525	175
6225-6410	190
7130-7300	170



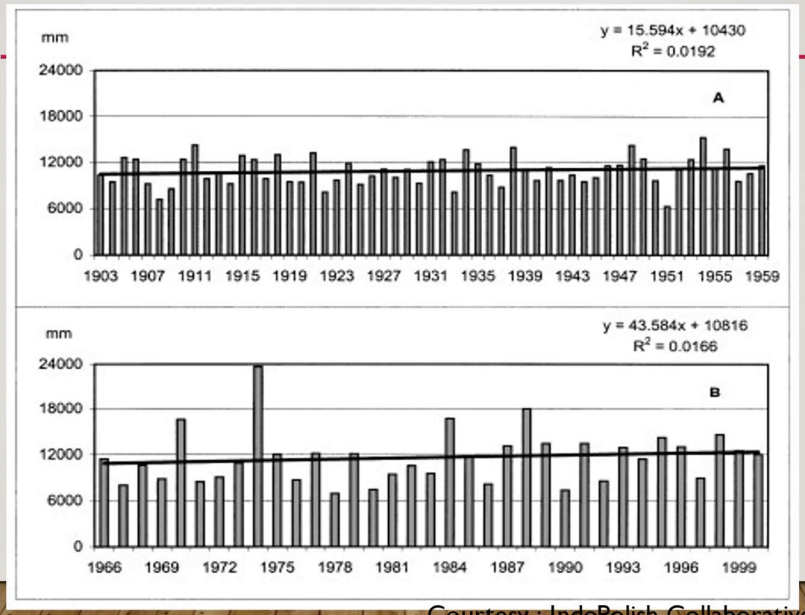
Years Dry	Years Wet	
100		ndations of Mughal empire
	400	n in S. Asia
100		s take Baghdad
	200	
100		n of Mohammed
	100	
1400		
	700	apse of empires in India
200		n of Buddha
	400	
200		ic culture in India
	1050	
175		
	700	erian collapse
190		Babylon
	720	t-urban Harappan
170		

Sumerian wars
Urban Harappan
Sumerian zenith @ Ur
Birth of Hinduism
Anarta Civilization (India)
Uruk Civilization
Loteshwar culture (India)
Farming in Mesopotamia
Ubaid Civilization

Asian history is highly linked to climate

Increase of sedimentation in the Bengal delta between 7-9 ky corroborates with intense rainfall and with continuous seismic activity. **Several intense droughts amidst periods of active monsoonshave been deciphered from spelothem data, the latest three being within 1500 years from today.**
(Clift & Plumb, 2009)

PATTERN OF RAINFALL (CHERRAPUNJEE) 1901-2000



Courtesy : IndoPolish Collaborative Research

https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1029/2018JD029625

r's site Page 1 / 11

JGR Atmospheres

RESEARCH ARTICLE
10.1029/2018JD029625

Key Points:
- Rapid drying of Northeast India in the last three decades is found
- The estimated recycled rainfall is rather small, which suggests a minimum contribution of local feedback on the observed drying trend
- This drying is found to be a part of interdecadal natural variability associated with the Pacific decadal oscillation

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mkonwar@tropmet.res.in

Citation:
Choudhury, B. A., Saha, S. K., Konwar, M., Sujith, K., & Deshamukhya, A. (2019). Rapid drying of Northeast India in the last three decades: Climate change

Rapid Drying of Northeast India in the Last Three Decades: Climate Change or Natural Variability?

B. Abida Choudhury[1], Subodh Kumar Saha[2], Mahen Konwar[2], K. Sujith[2], and Atri Deshamukhya[1]

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Abstract Northeast India (NEI), the wettest place on the Earth, has experienced a rapid decrease in summer monsoon rainfall (about 355 mm) in the last 36 years (1979–2014), which has serious implications on the ecosystem and the livelihood of the people of this region. However, it is not clear whether the observed drying is due to anthropogenic activities or it is linked with the global natural variability. A diagnostic model is employed to estimate the amount of recycled rainfall, which suggests that about 7% of the total rainfall is contributed by the local moisture recycling and decrease in recycled rainfall is about 30–50 mm. Using gridded observed rainfall and sea surface temperature data of the last 114 years (1901–2014), here we show that the recent decreasing trend of NEI summer monsoon rainfall is rather associated with the strong interdecadal variability of the subtropical Pacific Ocean. The strong interdecadal variability over NEI suggests a possibility of skillful decadal prediction of the monsoon rainfall, which may have important implications in terms of long-term planning and mitigation.

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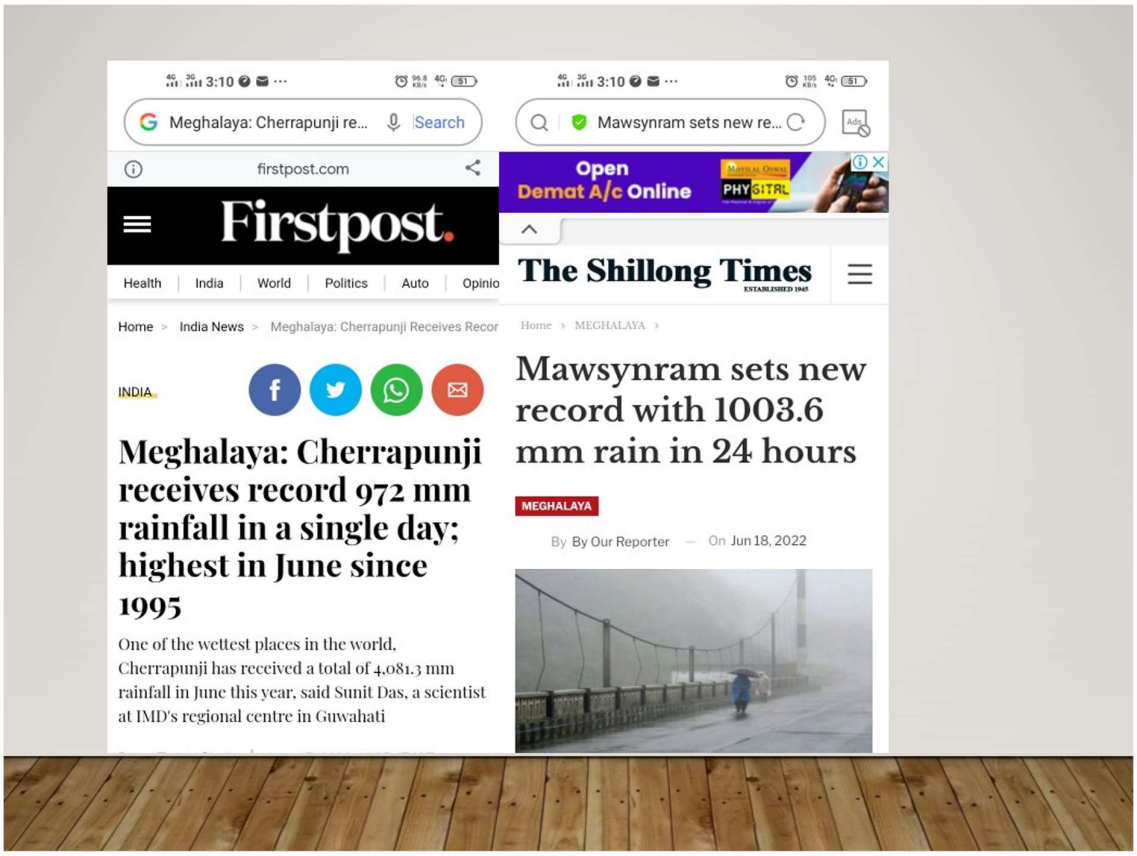

CURRENT SCIENCE, VOL. 101, NO. 3, 10 AUGUST 2011 SPECIAL SECTION:

Climate change vulnerability profiles for North East India

N. H. Ravindranath[1,*], Sandhya Rao[2], Nitasha Sharma[1], Malini Nair[1], Ranjith Gopalakrishnan[1], Ananya S. Rao[1], Sumedha Malaviya[1], Rakesh Tiwari[1], Anitha Sagadevan[1], Madhushree Munsi[1], Niharika Krishna[1] and Govindasamy Bala[3]

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[3]Department of Civil Engineering, Indian Institute of Technology Delhi, New Delhi 110 016, India

WATER VULNERABILITY

Aimed at providing a quantitative Approach to assess vulnerability of three key sectors to climate change.

Water Vulnerability Index
High vulnerability :Goalpara, Dhubri, Bongaigaon, Kamrup, Sonitpur, Kamrup, Nalbari (Assam)
W.Garo Hills, E.Garo Hills, RI Bhoi (Meghalaya)
Low vulnerability :Dibang Valley, Lower Dibang Valley, Anjaw (Arunachal Pr)
Karimganj, Cachar, N.C. Hills (Assam), Ukhrul (Manipur), Tawang (Arunachal Pr)

Forest Vulnerability Index
Most Vulnerable in Bisnupur (Manipur); Tirap (Arunnachal Pr.)
In future scenario : Several mixed changes are seen

Agriculture Vulnerability Index
Overall vulnerability decreased in future scenario
High vulnerabilty: Tirap, W. Siang, Changlang (Arunachal Pr.)
Dibrugarh (Upper Assam), Nalbari (Lower Assam)

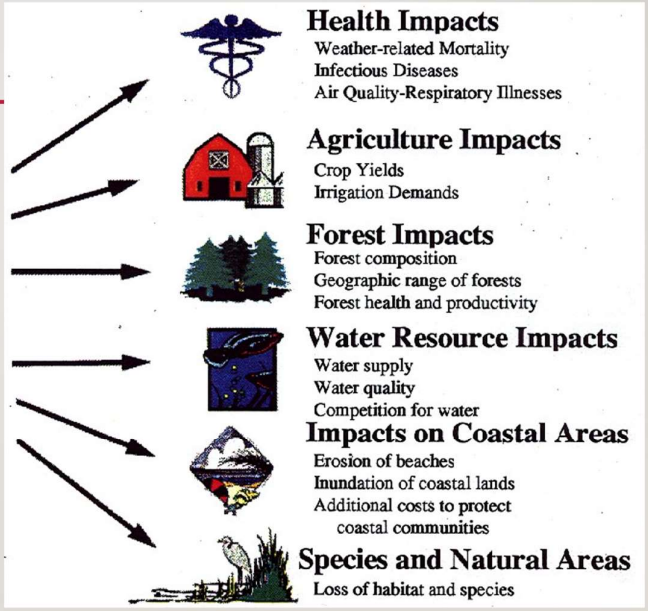
Water vulnerability is not only for the areas indicated above but also for the whole state of Meghalaya with specific mention to the southern region

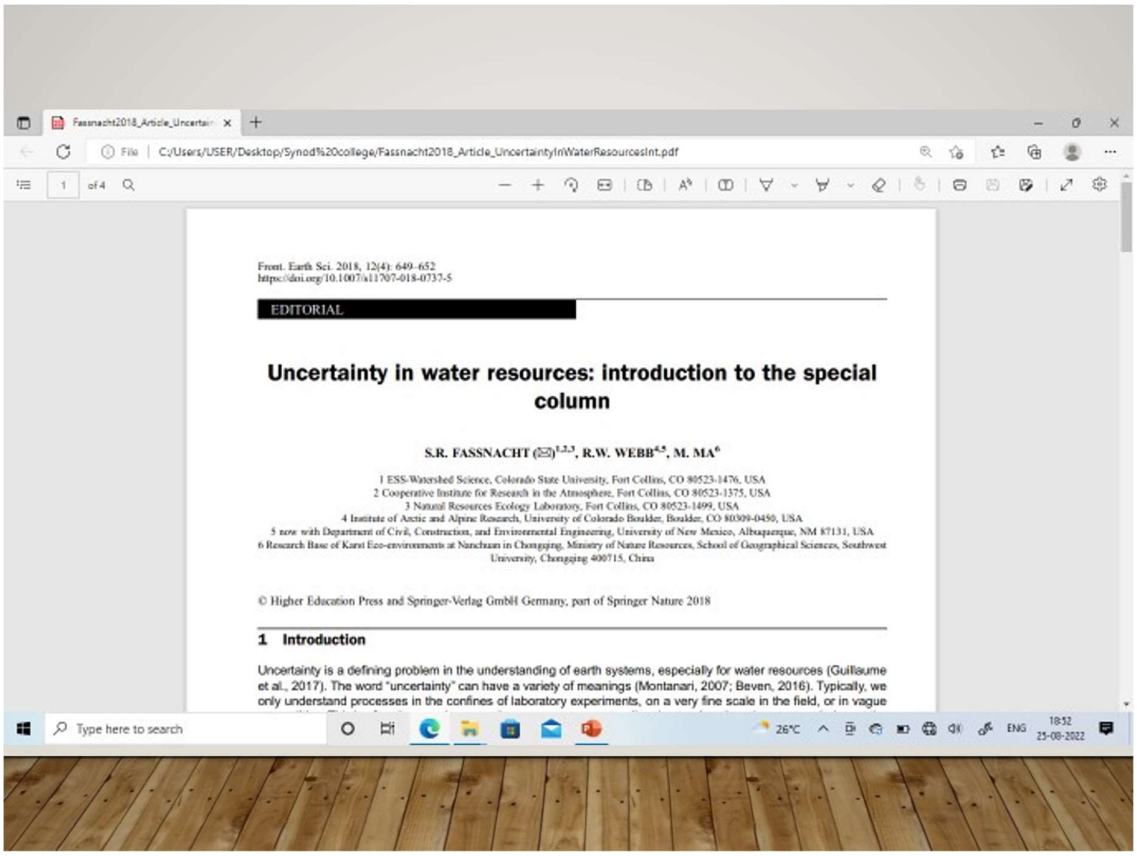
THE MOST IMPORTANT FACTOR THAT WOULD ATTRACT CHANGE IS CLIMATE

POTENTIAL CLIMATE CHANGE IMPACTS

EXPECTED IMPACT OF CHANGE IN TEMP & RAIN

Trends–
- Rain is variable
- Temperature increasing





Front. Earth Sci. 2018, 12(4): 649–652
https://doi.org/10.1007/s11707-018-0737-5

EDITORIAL

Uncertainty in water resources: introduction to the special column

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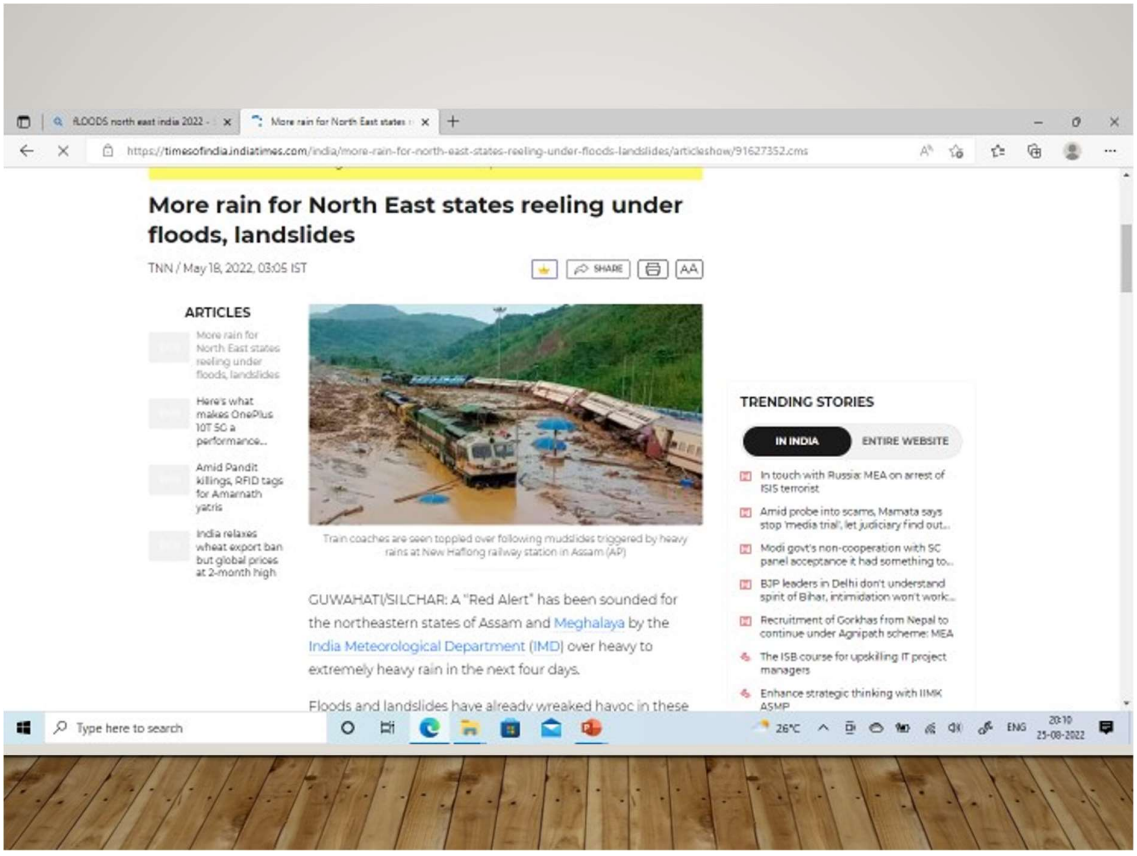
1 Introduction

Uncertainty is a defining problem in the understanding of earth systems, especially for water resources (Guillaume et al., 2017). The word "uncertainty" can have a variety of meanings (Montanari, 2007; Beven, 2016). Typically, we only understand processes in the confines of laboratory experiments, on a very fine scale in the field, or in vague



More rain for North East states reeling under floods, landslides

TNN / May 18, 2022, 03:05 IST

ARTICLES

- More rain for North East states reeling under floods, landslides
- Here's what makes OnePlus 10T 5G a performance...
- Amid Pandit killings, RFID tags for Amarnath yatris
- India relaxes wheat export ban but global prices at 2-month high

Train coaches are seen toppled over following mudslides triggered by heavy rains at New Haflong railway station in Assam (AP)

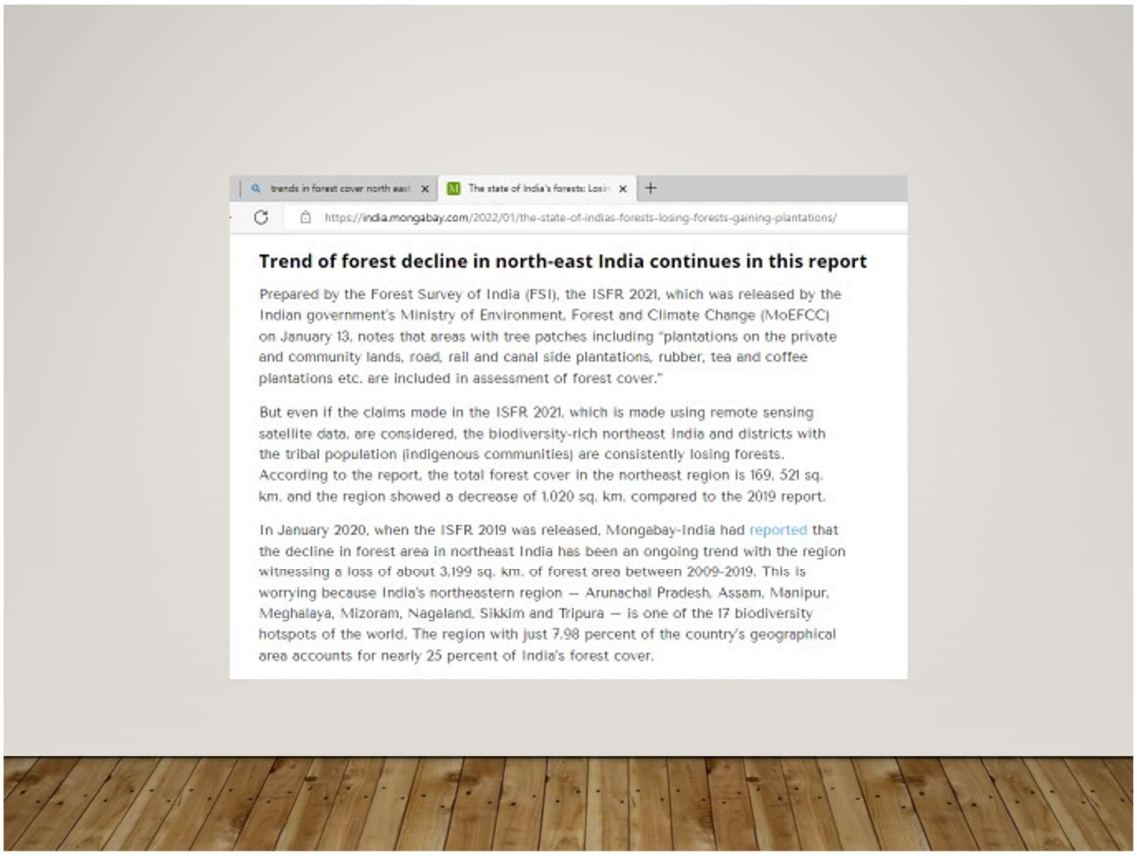
GUWAHATI/SILCHAR: A "Red Alert" has been sounded for the northeastern states of Assam and Meghalaya by the India Meteorological Department (IMD) over heavy to extremely heavy rain in the next four days.

Floods and landslides have already wreaked havoc in these

TRENDING STORIES

IN INDIA | ENTIRE WEBSITE

- In touch with Russia: MEA on arrest of ISIS terrorist
- Amid probe into scams, Mamata says stop 'media trial', let judiciary find out...
- Modi govt's non-cooperation with SC panel acceptance it had something to...
- BJP leaders in Delhi don't understand spirit of Bihar, intimidation won't work...
- Recruitment of Gorkhas from Nepal to continue under Agnipath scheme: MEA
- The ISB course for upskilling IT project managers
- Enhance strategic thinking with IIMK ASMP



trends in forest cover north east | The state of India's forests: Losi

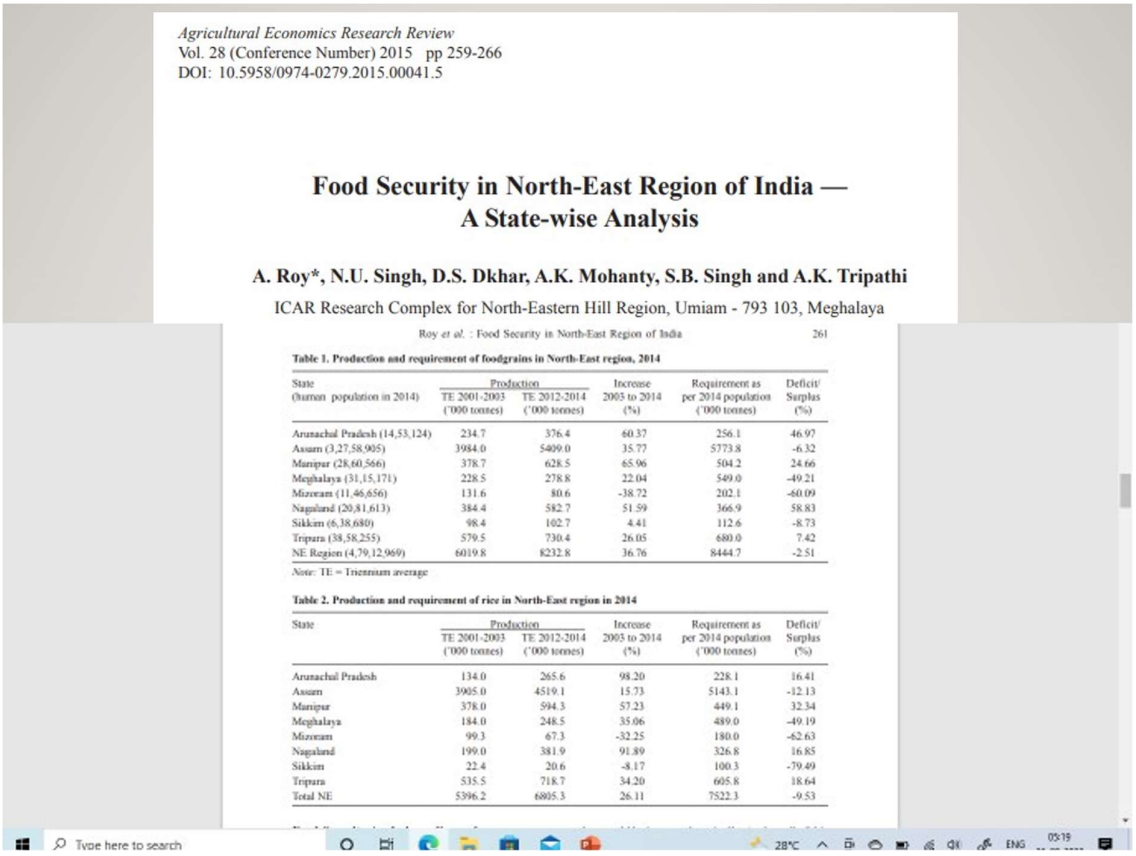
https://india.mongabay.com/2022/01/the-state-of-indias-forests-losing-forests-gaining-plantations/

Trend of forest decline in north-east India continues in this report

Prepared by the Forest Survey of India (FSI), the ISFR 2021, which was released by the Indian government's Ministry of Environment, Forest and Climate Change (MoEFCC) on January 13, notes that areas with tree patches including "plantations on the private and community lands, road, rail and canal side plantations, rubber, tea and coffee plantations etc. are included in assessment of forest cover."

But even if the claims made in the ISFR 2021, which is made using remote sensing satellite data, are considered, the biodiversity-rich northeast India and districts with the tribal population (indigenous communities) are consistently losing forests. According to the report, the total forest cover in the northeast region is 169, 521 sq. km. and the region showed a decrease of 1,020 sq. km. compared to the 2019 report.

In January 2020, when the ISFR 2019 was released, Mongabay-India had reported that the decline in forest area in northeast India has been an ongoing trend with the region witnessing a loss of about 3,199 sq. km. of forest area between 2009-2019. This is worrying because India's northeastern region — Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura — is one of the 17 biodiversity hotspots of the world. The region with just 7.98 percent of the country's geographical area accounts for nearly 25 percent of India's forest cover.



Agricultural Economics Research Review
Vol. 28 (Conference Number) 2015 pp 259-266
DOI: 10.5958/0974-0279.2015.00041.5

Food Security in North-East Region of India — A State-wise Analysis

A. Roy*, N.U. Singh, D.S. Dkhar, A.K. Mohanty, S.B. Singh and A.K. Tripathi

ICAR Research Complex for North-Eastern Hill Region, Umiam - 793 103, Meghalaya

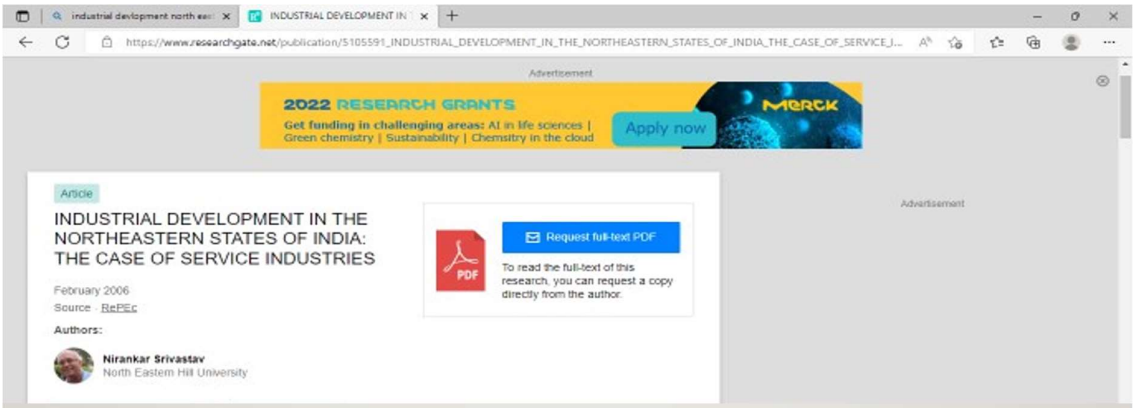
Table 1. Production and requirement of foodgrains in North-East region, 2014

State (human population in 2014)	Production TE 2001-2003 ('000 tonnes)	Production TE 2012-2014 ('000 tonnes)	Increase 2003 to 2014 (%)	Requirement as per 2014 population ('000 tonnes)	Deficit/ Surplus (%)
Arunachal Pradesh (14,53,124)	234.7	376.4	60.37	256.1	46.97
Assam (3,27,58,905)	3984.0	5409.0	35.77	5773.8	-6.32
Manipur (28,60,566)	378.7	628.5	65.96	504.2	24.66
Meghalaya (31,15,171)	228.5	278.8	22.04	549.0	-49.21
Mizoram (11,46,656)	131.6	80.6	-38.72	202.1	-60.09
Nagaland (20,81,613)	384.4	582.7	51.59	366.9	58.83
Sikkim (6,38,680)	98.4	102.7	4.41	112.6	-8.73
Tripura (38,58,255)	579.5	730.4	26.05	680.0	7.42
NE Region (4,79,12,969)	6019.8	8232.8	36.76	8444.7	-2.51

Note: TE = Triennium average

Table 2. Production and requirement of rice in North-East region in 2014

State	Production TE 2001-2003 ('000 tonnes)	Production TE 2012-2014 ('000 tonnes)	Increase 2003 to 2014 (%)	Requirement as per 2014 population ('000 tonnes)	Deficit/ Surplus (%)
Arunachal Pradesh	134.0	265.6	98.20	228.1	16.41
Assam	3905.0	4519.1	15.73	5143.1	-12.13
Manipur	378.0	594.3	57.23	449.1	32.34
Meghalaya	184.0	248.5	35.06	489.0	-49.19
Mizoram	99.3	67.3	-32.25	180.0	-62.63
Nagaland	199.0	381.9	91.89	326.8	16.85
Sikkim	22.4	20.6	-8.17	100.3	-79.49
Tripura	535.5	718.7	34.20	605.8	18.64
Total NE	5396.2	6805.3	26.11	7522.3	-9.53



It is revealed that there has been a growing trend of 'tertiarization' of the structures of production. The emergence of the service sector in a big way draws the attention to examine further the possibility of its 'catalytic' role in the economic development of the region.

The inter-state comparative analysis suggests that the states adopting a more focused approach towards economic growth by implementing state level economic reforms policies forge ahead in future to provide better employment and income generating opportunities, and thus, improve the standard of living of their people.

For balanced and sustainable economic development, NE States have to adopt and implement a more focused growth oriented policy measure.

Population in N. E. India (2022)

State	Population	Density/km^2
Arunachal Pradesh	13,83,727	17
Assam	3,12,05,576	397
Manipur	25,70,390	122
Meghalaya	29,66,889	132
Mizoram	10,97,206	52
Nagaland	19,78,502	119
Sikkim	6,10,577	86
Tripura	36,73,917	350
	45,486,784	

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Rainfall variations in short distances

Mawsynram

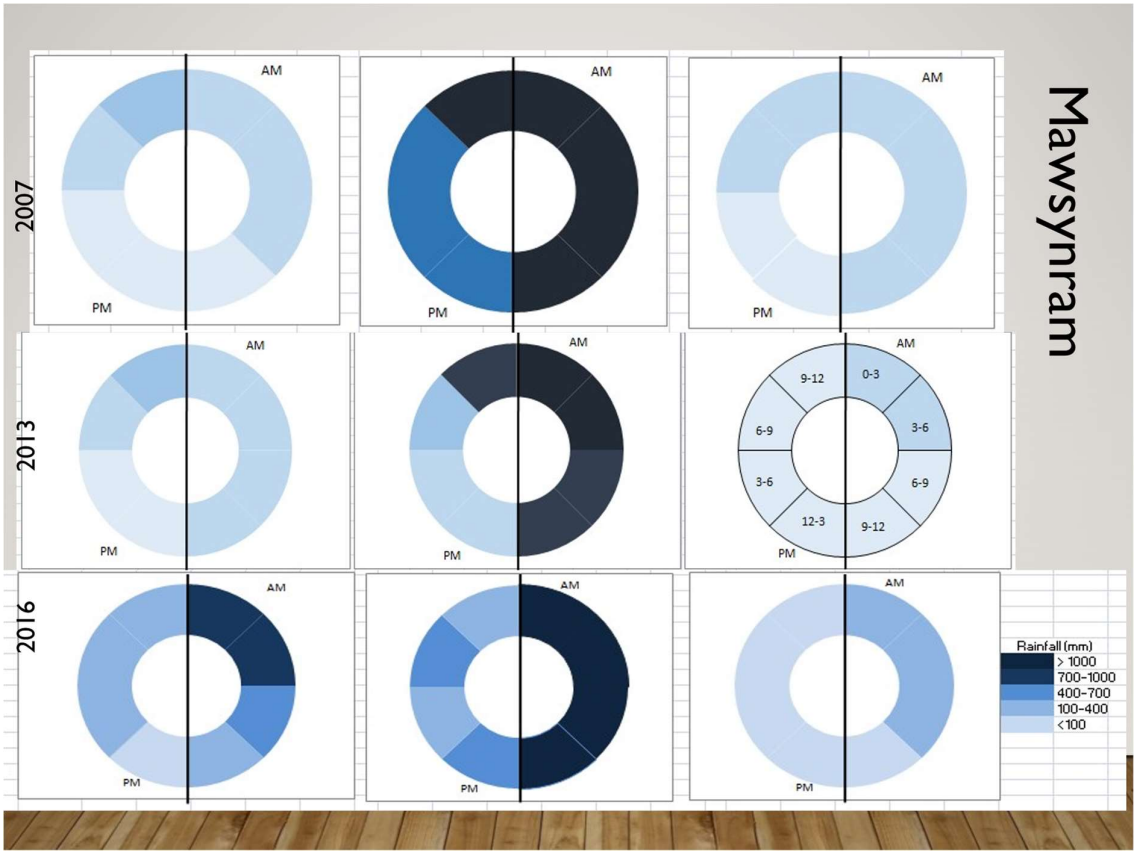
Year	Pre– Monsoon Precipitation (mm)	Monsoon Precipitation (mm)	Post– Monsoon Precipitation (mm)	Max. Precipitation Month (mm)	Max Precipitation hour (mm)
2007	1579	10670 (80%)	1003.5	5030 (July)-37%	285.0 (July7-8:00 hrs)
2013	1637	6124 (74%)	458	2000 (July)-24%	244.0 (June3-4:00 hrs)
2016	2322.5	6908.5 (70%)	582	4363 (July)-44%	351.0 (July4-5:00 hrs)

Sohra

Year	Pre– Monsoon Precipitation (mm)	Monsoon Precipitation (mm)	Post– Monsoon Precipitation (mm)	Max. Precipitation Month (mm)	Max Precipitation hour (mm)
2007	1911	10028 (78%)	920	4585.5 (July)-35%	319.5(8:009:00 hrs)
2013	1942.5	5198.5 (68%)	518.5	1933 (July)-25%	182 (July4-5:00 hrs)
2016	2339.5	6189.5 (68%)	573	3711 (July)-40%	295.5 (4:005:00 hrs)

Pynursla

Year	Pre– Monsoon Precipitation (mm)	Monsoon Precipitation (mm)	Post– Monsoon Precipitation (mm)	Max. Precipitation Month (mm)	Max Precipitation hour (mm)
2007	1046.5	8154 (80%)	841.5	3242.5 (July)-32%	202.5 (July 78:00 hrs)
2013	1583	5080 (68%)	0	1772 (July)-22%	271 (July5-6:00 hrs)
2016	3269.5	5425.5 (58%)	574.5	3276.5 (July)-35%	213 (July 56:00 hrs)



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WHAT CAN CAUSE FLASH FLOOD AT AN ELEVATION OF 1800MASL – RECENT EXTREME EVENTS ???

MAY 2011

JUNE 2018

Intense Rainfall events

	2007				2016				Other storms			
	Date	Time	Intensity (mm/hr)	Daily Max (mm)	Date	Time	Intensity (mm/hr)	Daily Max (mm)	Date	Time	Intensity (mm/hr)	Daily Max (mm)
Mawsynram	18/07	1-2 AM	85.5	761	19/07	4-5 AM	87	449	20/04/07	10-11 PM	102	160
Sohra	18/07	3-4 PM	78.5	625	19/07	4-5 AM	87	448.5	16/06/07	1-2 PM	69	478.5
Pynursla	25/07	3-4 PM	52.5	515.5	20/07	9-10 AM	44.5	334	23/04/16	10-11 PM	130	301

Some large volume precipitation @Sohra	
16 June 1995	1563 mm
14 June 1876	1036 mm
July 1861 (31 days)	9300 mm
June & July 1861 (2 months)	12767 mm
May - July 1861 (3 months)	16369 mm
June – Sept 1974 (4 months)	18876 mm

Source : Starkel, L., et.,al. (2004): Rainfall, Runoff and Soil Erosion in the globally humid areaCherrapunjiregion, India, IGIPZ, PAN, Warsaw

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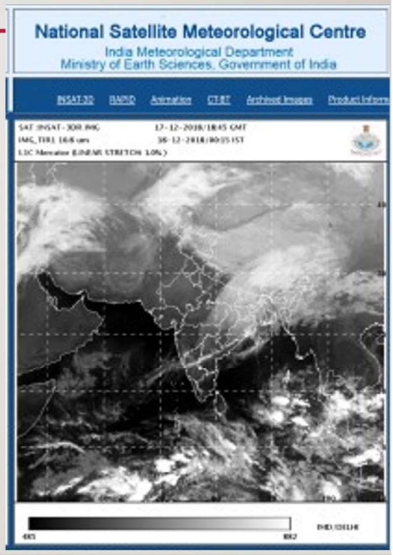
WHAT WE CAN UNDERSTAND TODAY ??

- The economy of the state is **highly climate dependent** which needs a serious thought;
- Atmospheric disturbances in the Bay of Bengal & Arabian Sea, directly or indirectly affects the state depending largely on the character & season;
- The occurrence of extreme events calls for a much more refined data collection and impact of such events;
- Shifts in the distribution of rain and increasing temperature are disturbing points to be noted
- Good tree canopy cover in available areas need to be strengthened to reduce vulnerability as well as generate income



Thank You

Acknowlegements:
Indo-Polish collaboration
Indo-Japan Collaborative Research
Contributions of PhD Scholars
North Eastern Hill University

FOREST MANAGEMENT PLAN

Application of RS/GIS in Forest Management Plan
On 18th November, 2022

Presented by:

Stebanshon Mylliemngap
Assistant Manager GIS

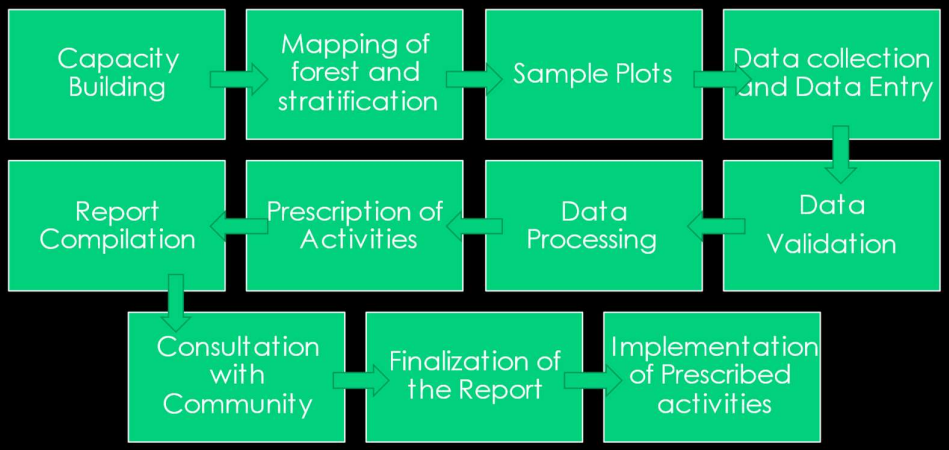
INTRODUCTION

- Forest Management Plan(FMP) is an important and unique initiative under the Community Led Landscape Management Project (CLLMP)
- FMP is one of the objectives of CLLMP
- Centre of Excellence (CoE) has taken up the task for preparation of FMPs in all the 400 villages selected under CLLMP
- Release of FMP Reports for 51 villages by Hon'ble CM of Meghalaya on Environment Week of 2022

OBJECTIVES

- Sustainable management of the forest and natural resources within the forest
  - Through generation of quantified estimates such as growing stocks, carbon yield, trees of different girth classes etc
- Conservation of forest and biodiversity
  - By developing a suitable prescription of practices
  - Sustained yield
- Base document which later can be developed as a approved "Working Scheme"

METHODS



METHOD-CAPACITY BUILDING

- Capacity building of the Master Trainers (75 Nos.)
- Master Trainer in-turn trained 1200 VCFs in the state
- Capacity Building of the CoE Staffs on Data Processing
  - In house by Director ofCoE

Sl. No.	Organisation	No. of MTs
1	CLLMP	33
2	MBDA GIS	6
3	JICA	6
4	KHADC	5
5	JHADC	5
6	GHADC	20

METHOD-CAPACITY BUILDING

- Capacity Building of the Village Community Facilitators (VCFs)
- Capacity building of the Data Entry Operators
  - 11 DEOs have been trained

Sl No	District	VNRMCs	No. of VCFs Trained
1	EGH	30	90
2	EJH	30	90
3	EKH	93	279
4	NGH	20	60
5	RB	30	90
6	SGH	23	69
7	SWGH	49	147
8	SWKH	40	120
9	WGH	40	120
10	WKH	25	75
11	WJH	20	60
	Total	400	1200

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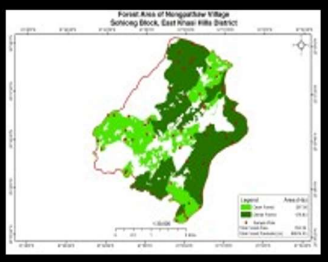
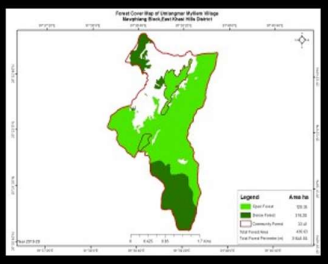
TOPICS OF TRAINING RELATED TO GIS

- Map Reading
- GPS demarcation of Sample plots
- Reaching to the sample plots (goto)

METHOD-GIS

- Role of GIS in FMP
  - Training of the Master trainers and VCFs
  - Generation of Village Boundary maps
  - Stratification of Forest
  - Generation of Forest Cover Maps demarcating the community forests
  - Generation of Sample plots
  - Analysis of forest carbon and Estimation of forest carbon for each village
  - Generation of Forest Types for each village as per the Champion and Seth Classification (1968)





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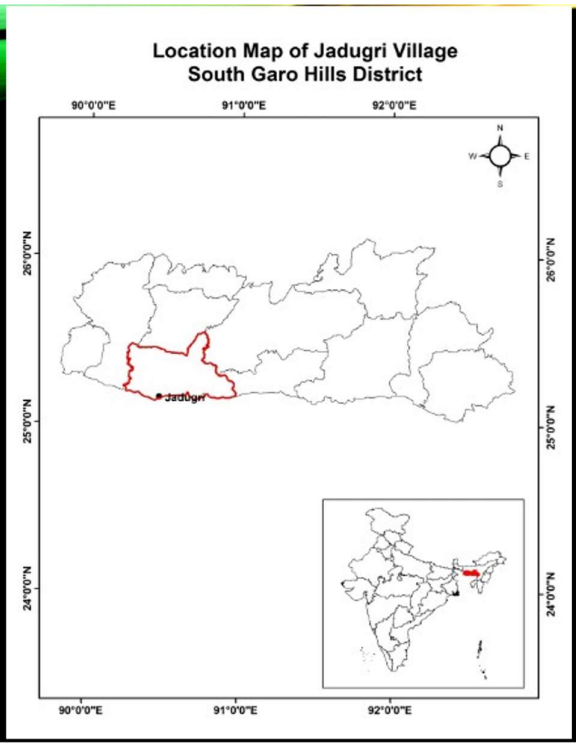
GIS SUPPORT FOR FMP

- Location Map
- Boundary Map
- LULC Map
- Forest cover overlay with Sample Plots and Community Forest Map
- Statistics:
  - Area of Boundary, Area of Forest, Forest Type
  - Determining detected forest fire points in each village using FSI data
  - Average Altitude
  - Forest Blanks
  - Average Slope
  - Culturablewaste Land outside Forest Area
  - Distance from nearest road from District HQ, District Road, State Highway and National Highway



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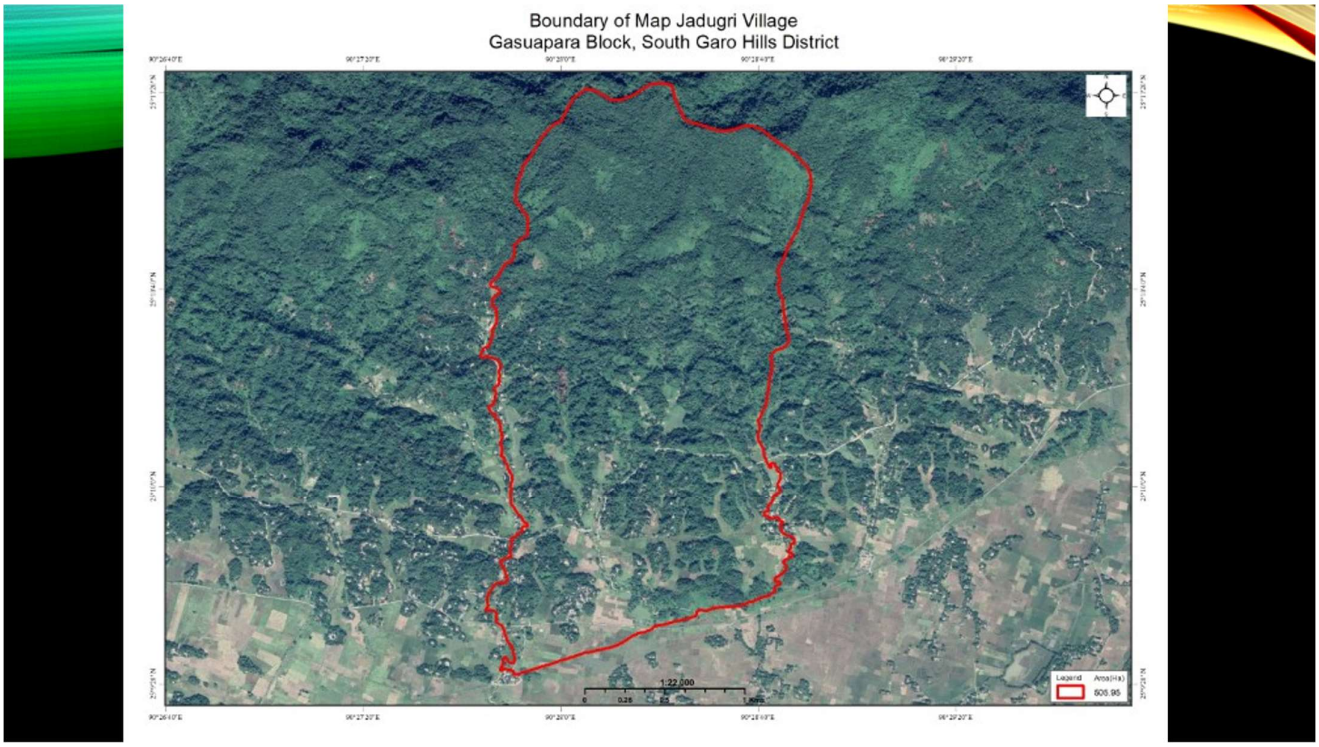

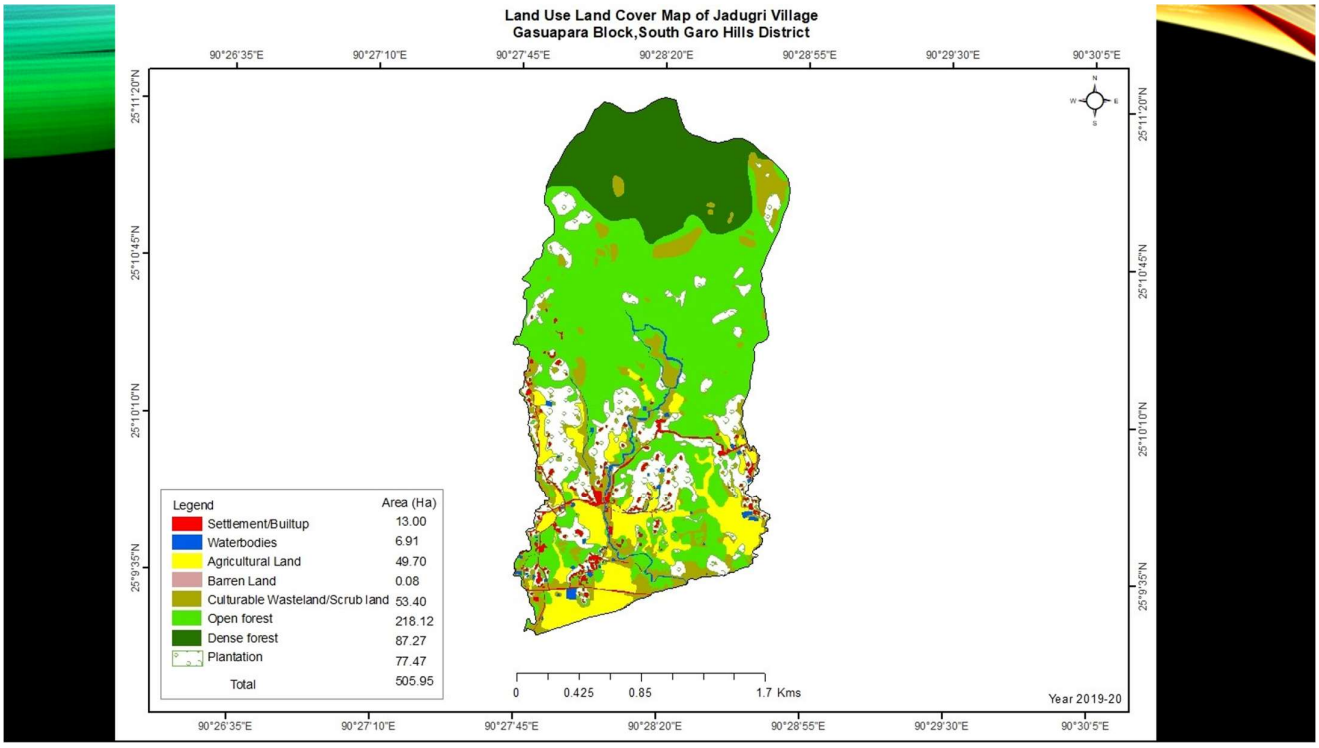

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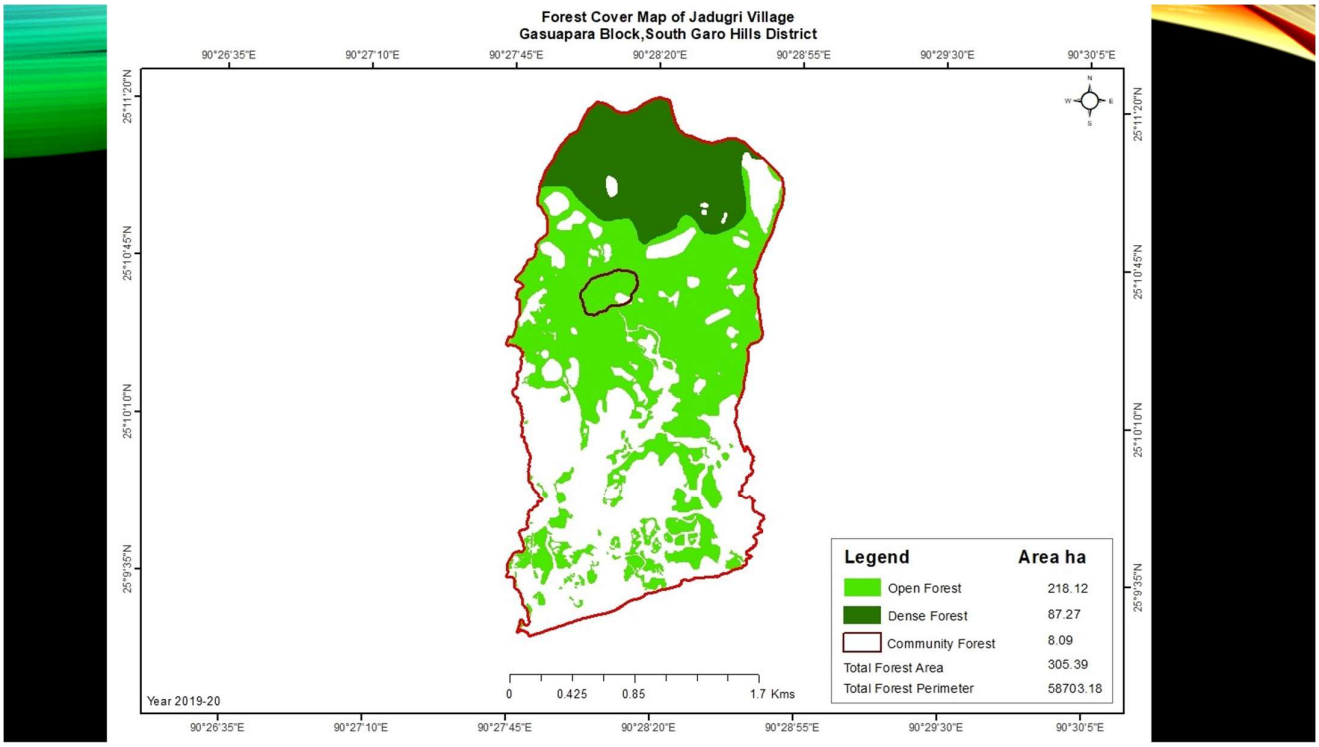

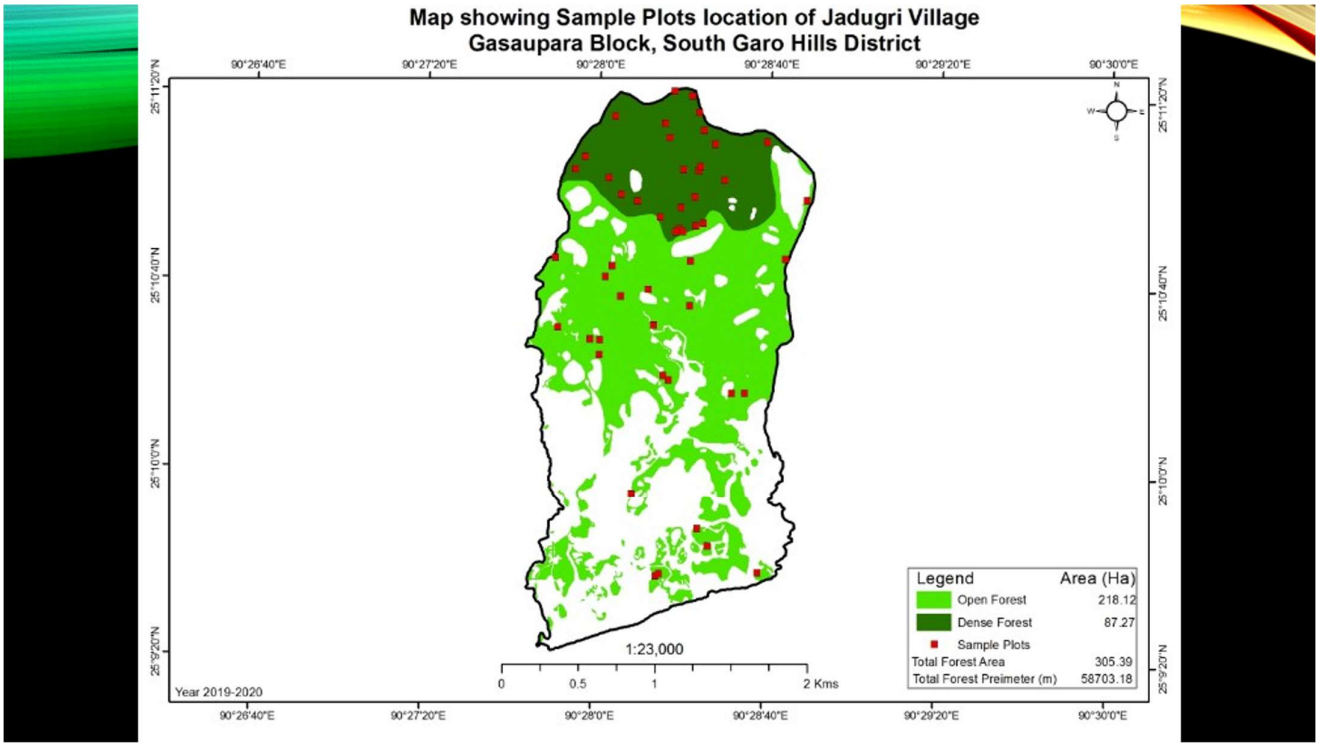

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GIS Statistics for FMP

Block	Village	Latitude	Longitude	Boundary Area	Average Altitude (m)	Average Slope (°)
Saipung	Mynthlu	25.41834	92.512588	1174.46	972.43	7.6

Open Forest (Ha)	Dense Forest (Ha)	Tot Forest (Ha)	Perimeter of Total Forest (m)	Forest Blank (ha)	Culturable Wasteland outside Forest (ha)	Area under Waterbodies (ha)
237.57	106.03	343.6	285613.62	450.68	618.25	10.75

Forest Fire Points (nos.)						Forest Type (FSI)	Distance (Kms) from			
2016	2017	2018	2019	2021	Total	Assam Sub Tropical Pine Forest	District HQ	Nearest District Road	Nearest State Highway	Nearest National Highway
0	2	0	4	0	6	Cachar Tropical evergreen forest	24.09	0.54	15.61	6.23

District	Village	Dominant Forest Type (FSI)	DF Carbon	OF Carbon	Village DF	Village OF	Forest Carbon in Tonnes	Total Forest Area (Ha)	Forest Carbon Per Ha (C tonnes/ha)
EGH	Danal Attewakgre	Semi Evergreen Forest	136	75.9	36.7	252.43	24153.74	289.1	83.54816697

METHOD-INVENTORY

- Procurements of Equipment for the conducting field works for FMP (105 Sets)
- Sample plots maps generated by GIS were shared with the respective villages
- VCFs were instructed to reach the plots with the help of GPS
- Plots were set as per the FMP guidelines
- Measurement of Girth, clear bole height and total height of the trees were carried out using the equipment as per the guidelines in the FMP manuals
- Data were recorded in the given format
- Submission of the data at the DPMUs
- Time to time review of the progress both through online and physical

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METHOD-DATA COLLECTION & DATA VALIDATION

- Collection of Inventory data and validation at district level
- Collection of data at CoE
- Data entry into the prepared format
- Data validation based on the set criteria
- Errors were notified to the respective DPMUs for correction and resubmission of rectified data
- Re-entering of rectified data

METHOD-DATA PROCESSING

- Finding out of dominant species
- Volume of the each trees (using the quarter girth formula)
- Rotation of the dominant species
- Sustainable and prescribed yield of the dominant species
- Re checking of the processed data

METHOD – REPORT WRITING

- Drafting of the report
- Proof reading of the draft report
- Framing of the prescription of activities village wise and Inclusion of the same in the report for all the villages
- Consultation with VNRMCs on the FMP prepared by SPMU
- Finalization of the FMPs on the basis of the inputs and suggestions given by the communities
- Printing of the FMPs
- Distribution of the FMPs to the VNRMCs
- Allocation of funds for prescribed activities under FMP
- Regular monitoring of activities as prescribed in the FMP by
- the DPMU

IMPLEMENTATION OF PRESCRIBED ACTIVITIES

- Sustainable Yield from forest
- Regeneration of the existing forest
  - Assisted Natural Regeneration(ANR)
  - Filling up of the Forest Blanks
- Afforestation of the Degraded Lands
- Establishment of Community Nursery
- Bamboo Management
- Forest Fire management and control
- NTFP Management
- Eradication of Invasive Species
- Pest & Disease Management
- Wildlife Management
- Soil & Water Conservation
- Registration of Forest & Plantations with Forest Department

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OUTCOME

- Sustainable yield for each village
- Prescribed yield for each village
- Density of forest (in terms of number of trees)
- Prescription of activities to conserve and protect forest
- Base document to develop an approved "Working Scheme"
- Current Target (Under CLLMP)= 400 villages
  - Inventory completed = 400
  - Data entry completed = 400
  - Data processing completed = 400
  - Report writing completed = 370

CHALLENGES

- **Human Resources**
  - Capacity building in terms of technicality (Data accuracy)
- **Ownership of the forest**
  - (Private Owners not allowing to carry out inventory work at their forests)
- **Misunderstanding**
  - Community had misunderstanding with regards to FMP, as they thought if they allow to do inventory work, Government will take over their forest.
- **Handling of equipment**
  - Even after training, it was found that VCFs were not confident in using the equipment

Creating Boundaries of all the Villages in Meghalaya with the help of GPS and Google Earth Images for Natural Resource Management

Presented by Fettleman Dohling
Manager GIS
MBDA/MBMA

THE WORLD BANK

Content

Introduction

- There are over 6500+ villages in the State boundaries of the villages do not exist and cadastral survey has not been done.
- Natural Resource Management planning and interventions, boundaries of the villages are essentially required.
- GIS lab of MBDA has undertaken the exercise of capturing the boundaries of the villages with the help of local people and VCFs who has knowledge about the village boundaries.
- Training to VCFs from the villages for capturing village boundaries using GPS and Google Earth images has been imparted and they are asked to traverse the boundary and capture the same on GPS. The GPS data is then downloaded and processed by overlaying the same on Google Earth images at MBDA GIS lab for finalizing the village boundaries.

Contd...

Introduction

- Such boundaries of villages may not serve the purpose for administrative or legal matters but they are good enough for the purpose of Natural Resource Management.
- In this manner, MBDA/MBMA GIS lab had been collecting NRM village boundaries under CLLMP - 400, MLAMP - 1350 and JICA - 450. Thus, 2200 total number of villages has been captured by MBDA/MBMA GIS Lab for NRM boundaries. Still about 4785 villages boundaries (approx.) are yet to be collected from the ground following the above methodology.
- These boundaries will be useful not only in the externally aided projects but also all villages resource management planning and implementation of different activities being executed by different Departments.
- It is therefore proposed to create boundaries of the remaining 4785 villages (approximately). The budget estimate for the same is proposed for sanction.
- Issuing of Log book for fieldwork/boundary collection record and Letter.

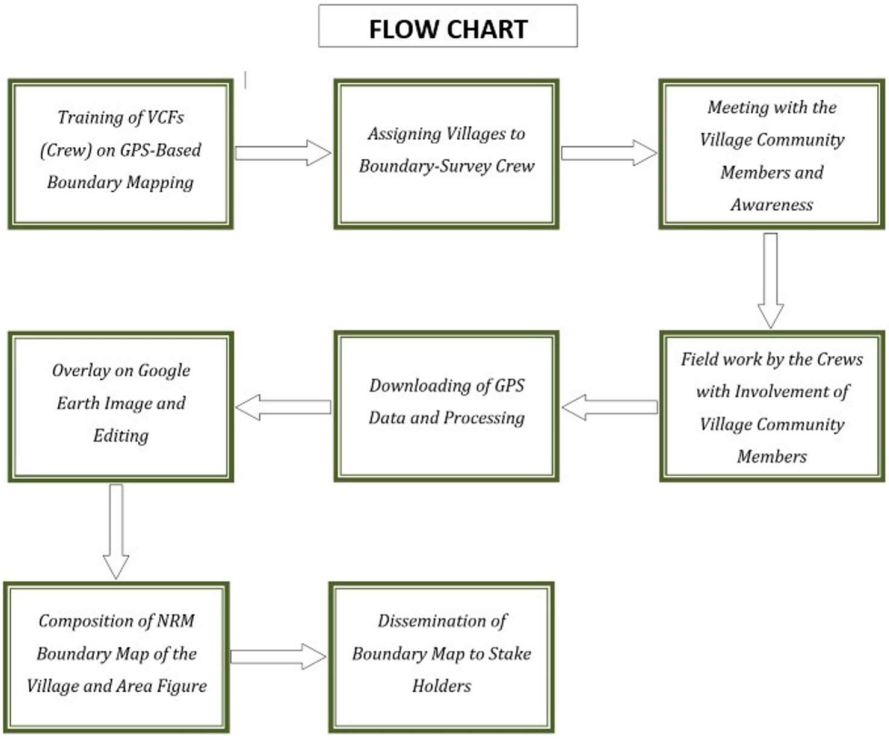
Objectives

1. Capturing Village boundaries of Meghalaya with the help of GPS and Google Earth Images for Natural Resource Management
2. Impart training to VCFs for capturing the boundaries using GPS and Google Earth images.

Methodology

The above-mentioned objective can be achieved through the following steps and procedures:

1. Providing participatory training programme for the VCFs in using GPS.
2. Following this, the 4785 (approx) village NRM boundaries will be captured by the VCFs along with the village locals who have knowledge about the village boundary.
3. Lastly, the GPS data will be shared by the VCFs and later can be downloaded and processed by GIS lab, MBDA/MBMA. Village boundary maps that have been composed will be recycled back to the village communities which then can be used for any natural resource management planning and implementation projects.
4. Superimpose on Google Earth image to create satellite imagery map of the village.



Budget

Sl. No	Items	Year I	Remarks
1	One Day Refresher Training for VCF (in batches of 40 will be conducted Training Programmes @ 30,000 per programme	150,000	200 VCFs who have good skills in using GPS will be selected for this exercise.
2	Boundary Survey of Villages (VNRM Boundaries). Average 2 days for on village involving 6 mdays of work for each village, @ 500 per person dayi.e.INR3000 per village (average 4,785 villages in 3 Years i.e. 1,595 villages per year.	4,785,000	200 selected and trained VCFs will form and lead 200 crews. Each crew will comprise 1 VCF and 2 local youth from the village under survey. There are approximately 6986 Villages in the State out of which boundaries of 2,200 Villages have been created by MBDA. Thus boundaries of remaining 4,785 needs to be created.
3	Articles to facilitate Field Survey w for each crew	360,000	The expenditure provides the set of articles for all the 200 crews
	Back pack 1 no @ 400		
	Water Bottle 2nos @ 300		
	Measuring tape @ 400		
	Dao @ 400		
	First Aid Med @ 300		
	Total 1,800 for each crew		
4	Travel Expenses of VCFs and Officia L.S.	400,000	-
5	Miscellaneous	200,000	-
	Total	5,895,000	

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Wages of VCFs and Village personnel for each District based on No. of villages					
Sl.no	District	No. of VCFs	No. of Villages to be selected by each District	Daily Wages Rate Per Vill Bnd Mapping: 1VCF + 2 Vill personnel (Total 3 people) @ Rs 500 each * 2 days (avg)	Amount to be disbursed to each District on Daily Wages for Village Bnd Mapping (Year 1)
1	WKH	13	104	3000	312000
2	WJH	10	80	3000	240000
3	WGH	20	160	3000	480000
4	SWKH	20	160	3000	480000
5	SWGH	24	192	3000	576000
6	SGH	11	88	3000	264000
7	RB	15	120	3000	360000
8	NGH	10	80	3000	240000
9	EJH	15	120	3000	360000
10	EGH	15	120	3000	360000
11	EKH	47	371	3000	1113000
	Total	200	1595	3000	4785000

Travel Expenses per District based on No. of VCFs				
Sl.no	District	No. of VCFs	Percentage of total VCFs (%)	Amount to be disbursed to each District on Travel Expenses for VCFs for the activity from 4 lakhs Travel Expenses (Year 1)
1	WKH	13	6.5	26000
2	WJH	10	5	20000
3	WGH	20	10	40000
4	SWKH	20	10	40000
5	SWGH	24	12	48000
6	SGH	11	5.5	22000
7	RB	15	7.5	30000
8	NGH	10	5	20000
9	EJH	15	7.5	30000
10	EGH	15	7.5	30000
11	EKH	47	23.5	94000
	Total	200	100	400000

Total Amount to be disbursed to each District (Wages + TE) Year 1				
Sl.no	District	Amount to be disbursed to each District for Daily Wages of Village Bnd Mapping	Amount to be disbursed to each District For Travel expenses for VCFs for the activity	Total Amount to be Disbursed to District
1	WKH	312000	26000	338000
2	WJH	240000	20000	260000
3	WGH	480000	40000	520000
4	SWKH	480000	40000	520000
5	SWGH	576000	48000	624000
6	SGH	264000	22000	286000
7	RB	360000	30000	390000
8	NGH	240000	20000	260000
9	EJH	360000	30000	390000
10	EGH	360000	30000	390000
11	EKH	1113000	94000	1207000
	Total	4785000	400000	5185000

Achievement

Target till Dec 2022: 400nos

Boundaries Collected Till Nov 19th 332nos

Currently Verifying and reverting back to Districts for corrections

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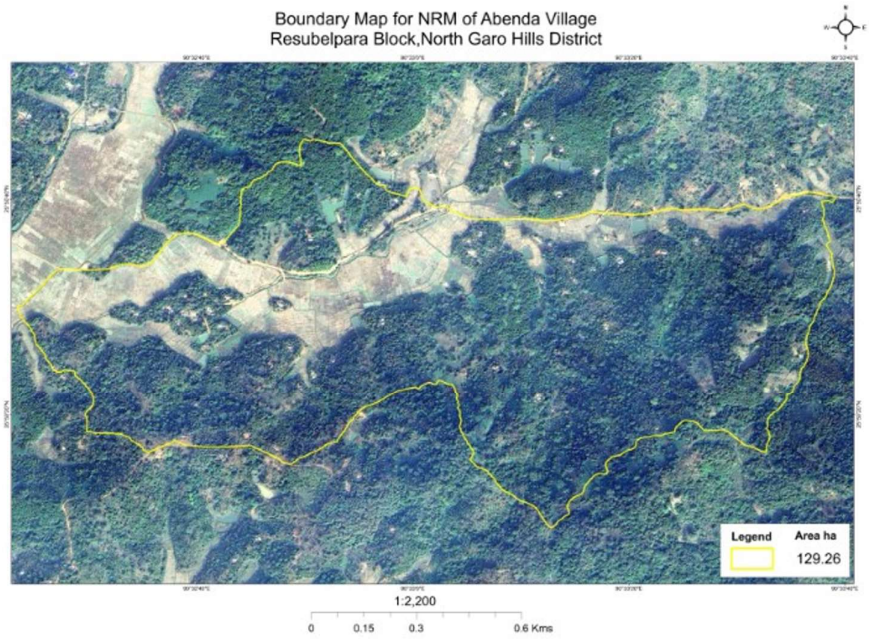
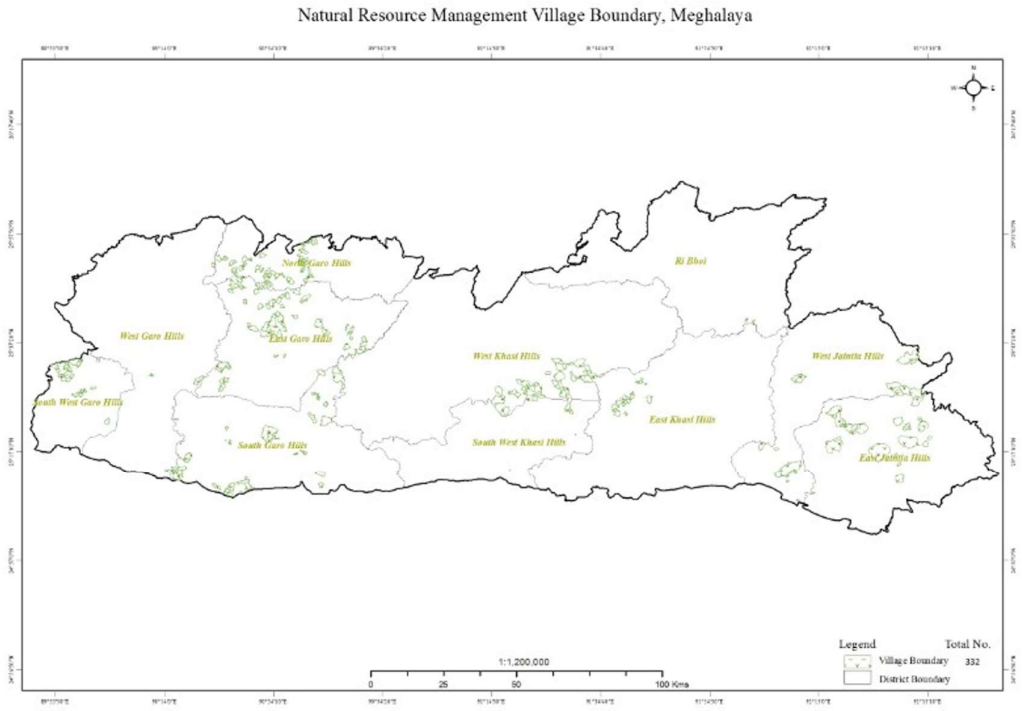
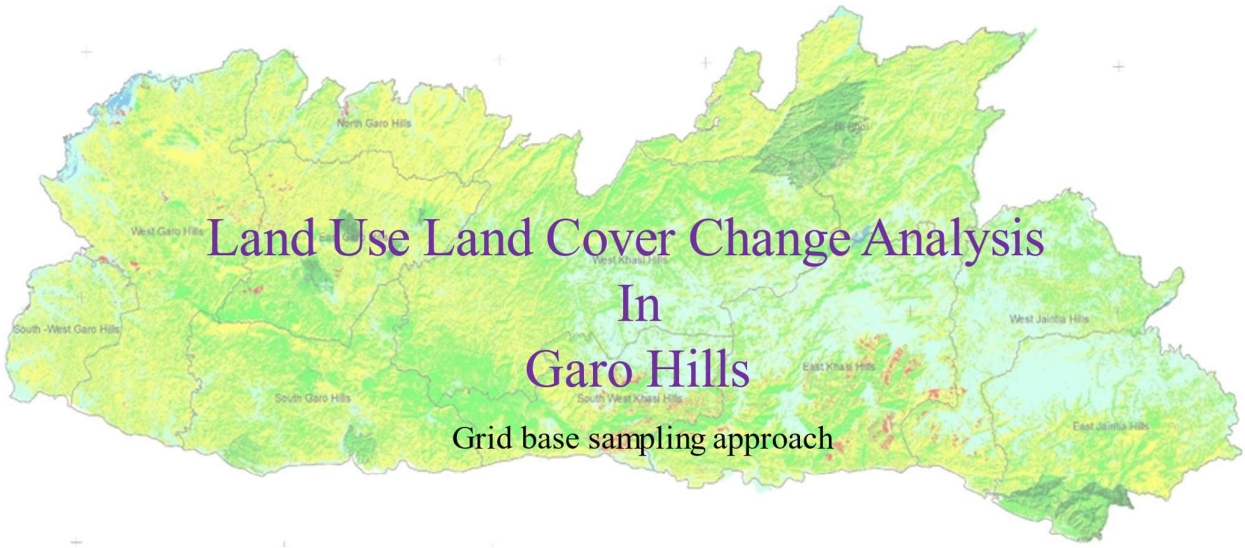
Sample Boundary Map





Conclusion

- By this exercise, a highly important data need of the State i.e. village boundary of natural resource management is being fulfilled.
- Since the boundary mapping is being done by the village youths (VCFs), the exercise is leading to large scale capacity building.
- After completion of the project, the natural resource management boundary of the village can be shared to the users under data sharing protocol.



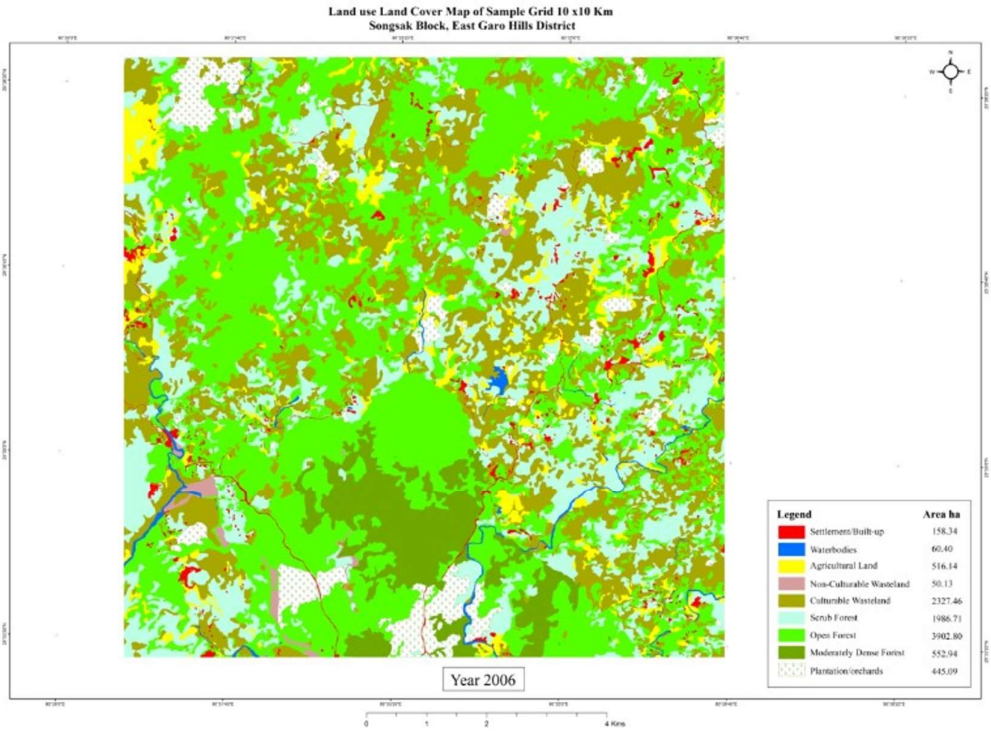
Land Use Land Cover Change Analysis In Garo Hills

Grid base sampling approach

Presented by: Norita Nongbet Sohlang
Assistant Manager (GIS)

- Land use/ Land cover is an important component in understanding the interactions of the human activities with the environment and thus it is necessary to monitor and detect the changes to maintain a sustainable environment.
- Land use/Land cover (LULC) changes are major issues of global environment change.
- The satellite remote sensing data with their repetitive nature have proved to be quite useful in mapping land use/land cover patterns and changes with time.
- Quantification of such changes is possible through GIS techniques even if the resultant spatial datasets are of different scales/ resolutions (Sarma et al., 2001).
- Such studies have helped in understanding the dynamics of human activities in space and time.

- The study was carried out through Remote Sensing and GIS approach using Google earth imagery of and IRS -P6-LISS-IV of 2006 and 2017.
- A 10x10 km grid is created in the three districts of Garo hills region for the purpose of studying the change in the past ten years.
- Ten year time period of 2006 -2017 was selected for change analysis.



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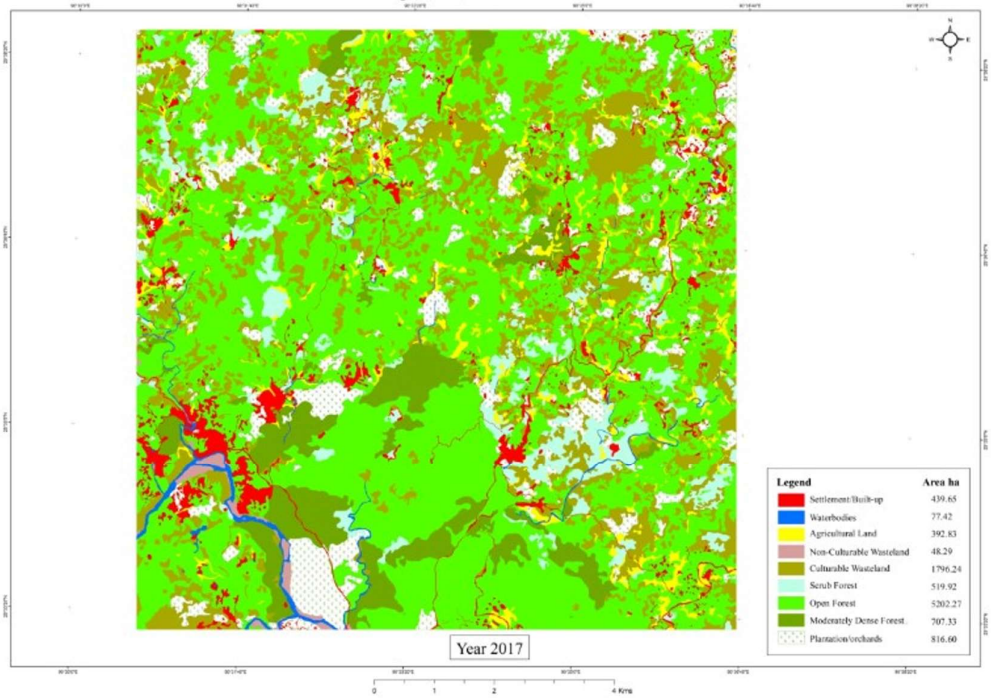
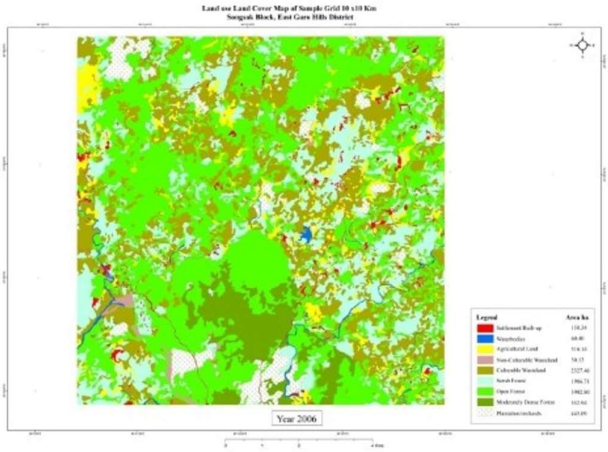
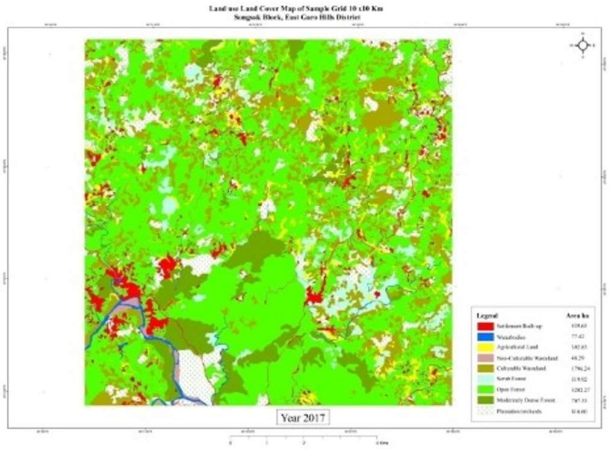
Land use Land Cover Map of Sample Grid 10 x10 Km
Songsak Block, East Garo Hills District







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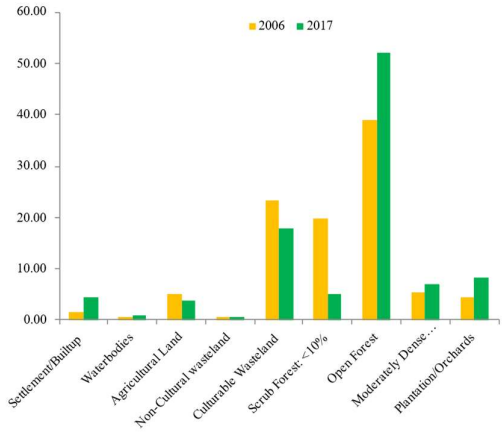
10x10 km Grid Songsak Block, East Garo Hills 2006			
LULC_CLASS	**Area in ha**	**Area in sq km**	**Percentage %**
Settlement/Built up	158.34	1.58	1.58
Water bodies	60.40	0.60	0.60
Agricultural Land	516.14	5.16	5.16
Non-Cultural wasteland	50.13	0.50	0.50
Culturable Wasteland	2327.46	23.27	23.27
Scrub Forest: <10%	1986.71	19.87	19.87
Open Forest	3902.80	39.03	39.03
Moderately Dense Forest	552.94	5.53	5.53
Plantation/Orchards	445.09	4.45	4.45
Total	10000.00	100.00	100.00

10x10 km Grid Songsak Block, East Garo Hills 2017			
LULC_CLASS	**Area in ha**	**Area in sq km**	**Percentage %**
Settlement/Built up	439.65	4.40	4.40
Water bodies	77.42	0.77	0.77
Agricultural Land	392.83	3.93	3.93
Non-Cultural wasteland	48.29	0.48	0.48
Culturable Wasteland	1796.24	17.96	17.96
Scrub Forest: <10%	519.92	5.20	5.20
Open Forest	5202.27	52.02	52.02
Moderately Dense Forest	707.33	7.07	7.07
Plantation/Orchards	816.06	8.16	8.16
Total	10000.00	100.00	100.00

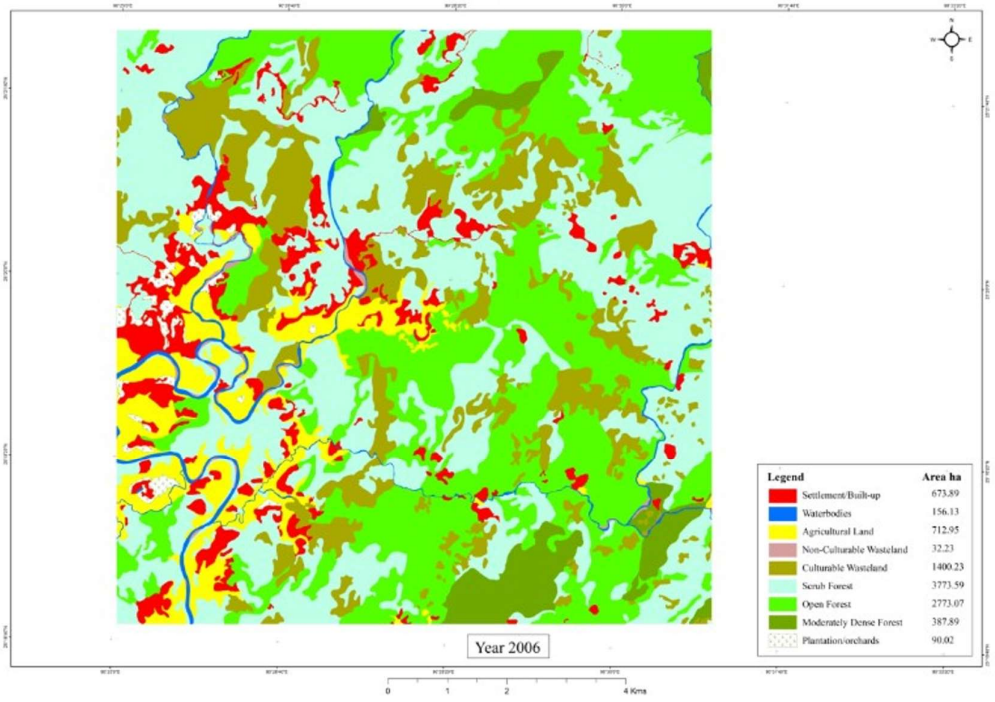


Change in LULC in 10x10 km Sample Grid Songsak Block, East Garo Hills (Area in ha)

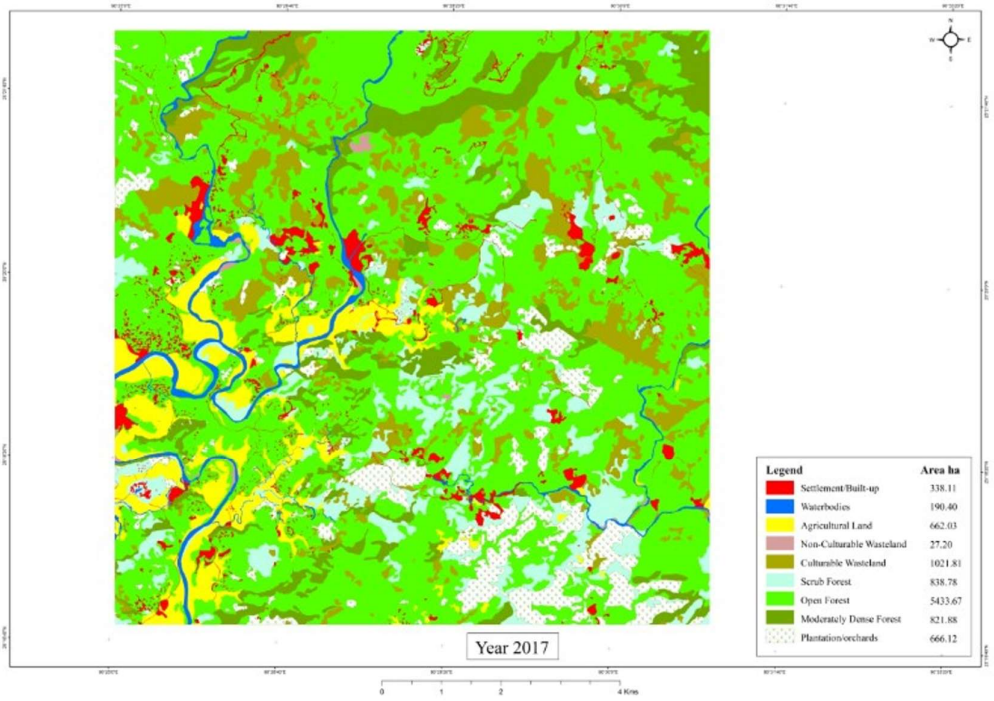
LULC CLASS	2006	2017	Change inha	Changein Percentage %
Settlement/Built up	158.34	439.65	281.31	177.67
Water bodies	60.40	77.42	17.03	28.19
Agricultural Land	516.14	392.83	-123.31	-23.89
Non-Cultural wasteland	50.13	48.29	-1.84	-3.67
Culturable Wasteland	2327.46	1796.24	-531.22	-22.82
Scrub Forest: <10%	1986.71	519.92	-1466.79	-73.83
Open Forest	3902.80	5202.27	1299.47	33.30
Moderately Dense Forest	552.94	707.33	154.39	27.92
Plantation/Orchards	445.09	816.06	370.98	83.35
Total	10000.00	10000.00	0.00	

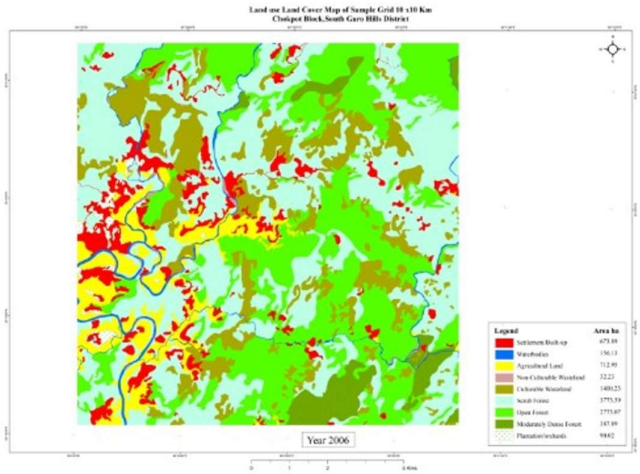
- Settlement increased by 177.67 %
- Plantation/orchards increased by 83.35%
- Agricultural land decreased by -23.89%
- Open Forest increased by 33.30%
- Moderately Dense Forests increased by 27.92%
- Area of Water Bodies increased by 28.19%

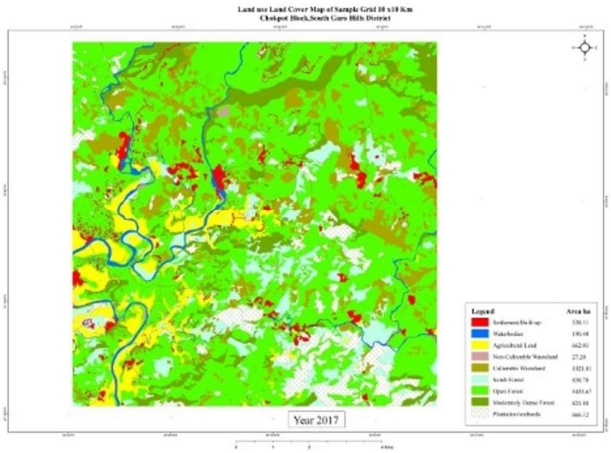
Land use Land Cover Map of Sample Grid 10 x10 Km
Chokpot Block,South Garo Hills District



Land use Land Cover Map of Sample Grid 10 x10 Km
Chokpot Block,South Garo Hills District

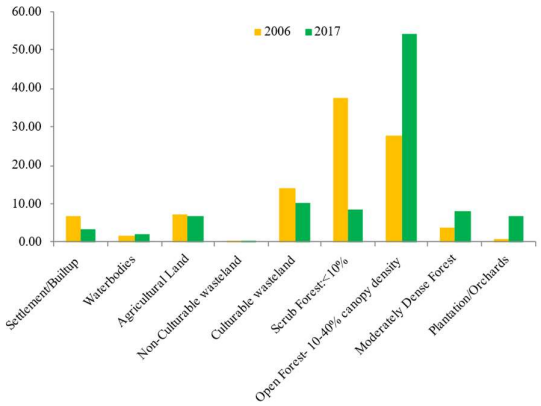






10x10 km Grid ChokpotBlock,South Garo Hills 2006			
LULC CLASS	**Area Ha**	**Area in sq km**	**Percentage %**
Settlement/Builtup	673.89	6.74	6.74
Water bodies	156.13	1.56	1.56
Agricultural Land	712.95	7.13	7.13
Non-Culturable wasteland	32.23	0.32	0.32
Culturable wasteland	1400.23	14.00	14.00
Scrub Forest:<10%	3773.59	37.74	37.74
Open Forest- 10-40% canopy density	2773.07	27.73	27.73
Moderately Dense Forest	387.89	3.88	3.88
Plantation/Orchards	90.02	0.90	0.90
TOTAL	10000.00	100.00	100.00

10x10 km Grid Chokpot Block,South Garo Hills 2017			
LULC CLASS	**Area Ha**	**Area in sq km**	**Percentage %**
Settlement/Builtup	338.11	3.38	3.38
Water bodies	190.40	1.90	1.90
Agricultural Land	662.03	6.62	6.62
Non-Culturable wasteland	27.20	0.27	0.27
Culturable wasteland	1021.81	10.22	10.22
Scrub Forest:<10%	838.78	8.39	8.39
Open Forest- 10-40% canopy density	5433.67	54.34	54.34
Moderately Dense Forest	821.88	8.22	8.22
Plantation/Orchards	666.12	6.66	6.66
TOTAL	10000.00	100.00	100.00



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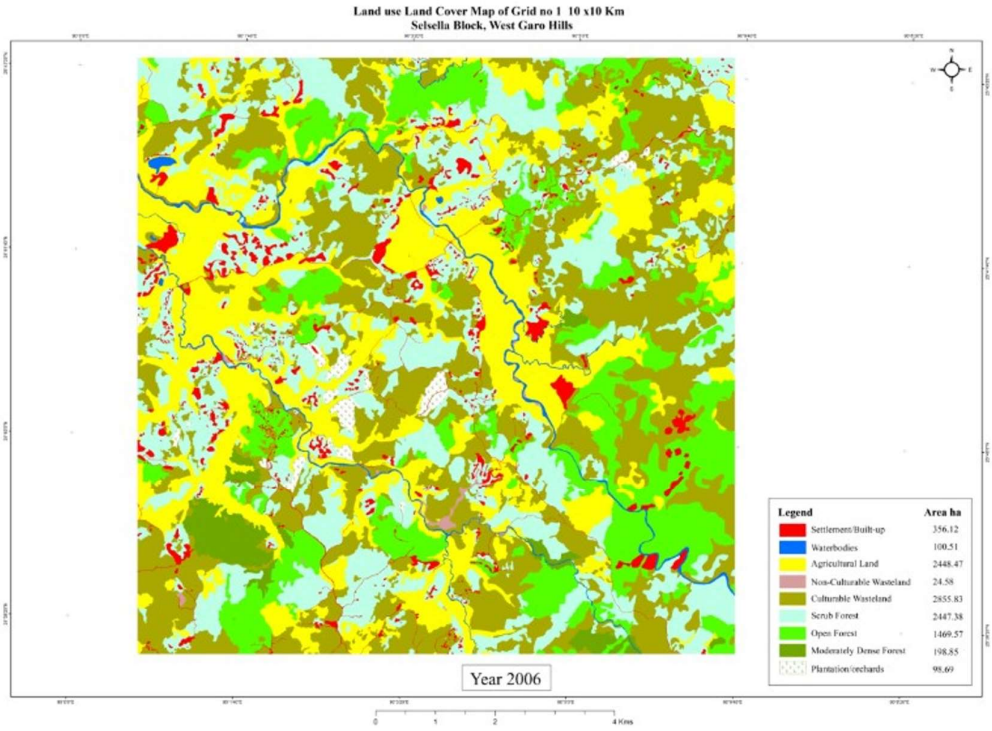
Change in LULC in 10x10 km Sampl&Grid Chokpot Block, South Garo Hills (Area in ha)				
LULC CLASS	**2006**	**2017**	**Change in ha**	**Change in Percentage%**
Settlement/Built up	673.89	338.11	-335.77	-49.83
Water bodies	156.13	190.40	34.27	21.95
Agricultural Land	712.95	662.03	-50.93	-7.14
Non-Culturable wasteland	32.23	27.20	-5.02	-15.59
Culturable wasteland	1400.23	1021.81	-378.42	-27.03
Scrub Forest:<10%	3773.59	838.78	-2934.81	-77.77
Open Forest 10-40% canopy density	2773.07	5433.67	2660.60	95.94
Moderately Dense Forest	387.89	821.88	433.99	111.88
Plantation/Orchards	90.02	666.12	576.09	639.93
TOTAL	10000.00	10000.00	0.00	

- Plantation increased by 639.93%
- Agricultural land decreased by -7.14%

- Moderately Dense Forest increase by 111.88%
- Open Forest increased by 95.94%
- Area of Water bodies increased by 21.95%



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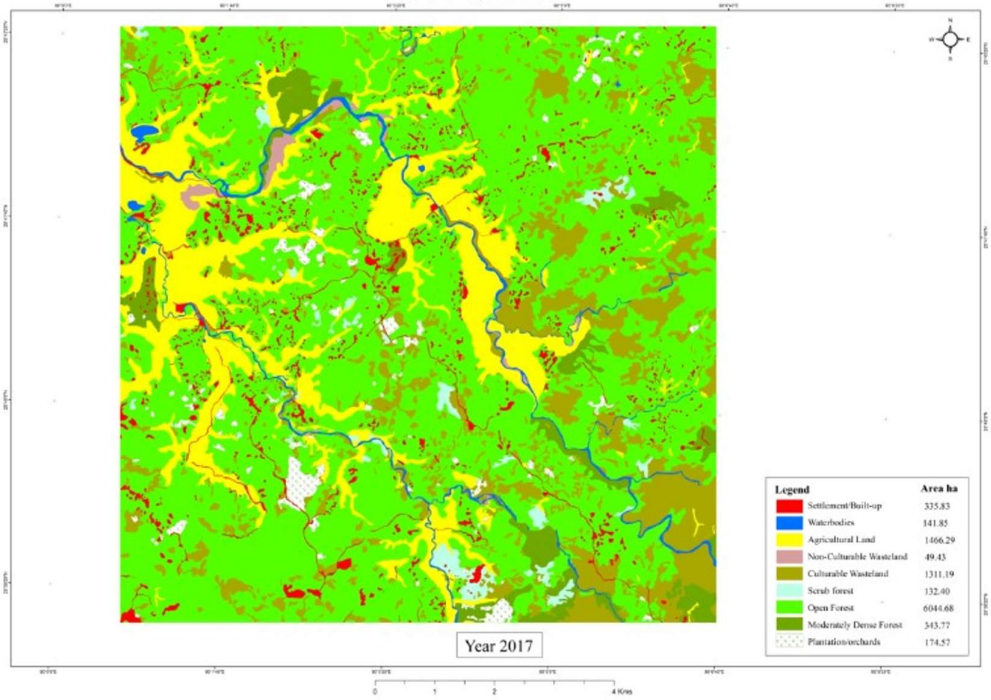
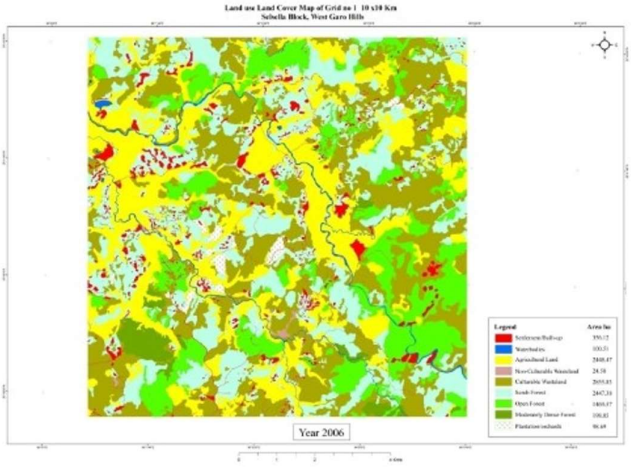
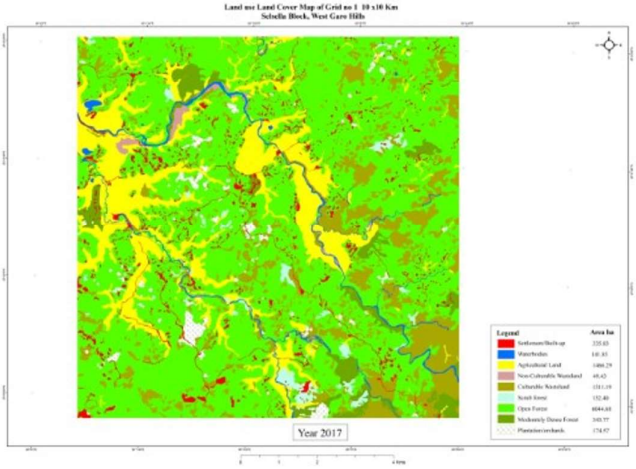
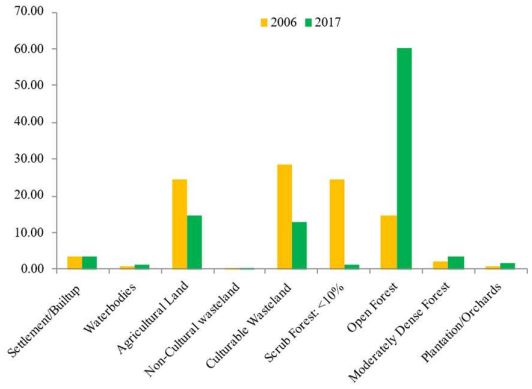
Land use Land Cover Map of Grid no 1 10 x10 Km
Selsella Block, West Garo Hills







10x10 km Grid 1 Selsella Block,West Garo Hills 2006			
LULC_CLASS	**Area ha**	**Area in sq km**	**Percentage %**
Settlement/Builtup	356.12	3.56	3.56
Water bodies	100.51	1.01	1.01
Agricultural Land	2448.47	24.48	24.48
Non-Cultural wasteland	24.58	0.25	0.25
Culturable Wasteland	2855.83	28.56	28.56
Scrub Forest: <10%	2447.38	24.47	24.47
Open Forest	1469.57	14.70	14.70
Moderately Dense Forest	198.85	1.99	1.99
Plantation/Orchards	98.69	0.99	0.99
Total	**10000.00**	**100.00**	**100.00**



10x10 km Grid 1Selsella Block, West Garo Hills 2017			
LULC_CLASS	**Area ha**	**Area in sq km**	**Percentage %**
Settlement/Builtup	335.83	3.36	3.36
Water bodies	141.85	1.42	1.42
Agricultural Land	1466.29	14.66	14.66
Non-Cultural wasteland	49.43	0.49	0.49
Culturable Wasteland	1311.19	13.11	13.11
Scrub Forest: <10%	132.40	1.32	1.32
Open Forest	6044.68	60.45	60.45
Moderately Dense Forest	343.77	3.44	3.44
Plantation/Orchards	174.57	1.75	1.75
Total	**10000.00**	**100.00**	**100.00**

Change in LULC in 10x10 km Sample Grid 1 Selsella Block, West Garo Hills (Area in ha)				
LULC CLASS	**2006**	**2017**	**Change inha**	**Changein Percentage%**
Settlement/Built up	356.12	335.83	-20.29	-5.70
Water bodies	100.51	141.85	41.34	41.13
Agricultural Land	2448.47	1466.29	-982.18	-40.11
Non-Cultural wasteland	24.58	49.43	24.85	101.09
Culturable Wasteland	2855.83	1311.19	-1544.65	-54.09
Scrub Forest: <10%	2447.38	132.40	-2314.98	-94.59
Open Forest	1469.57	6044.68	4575.11	311.32
Moderately Dense Forest	198.85	343.77	144.92	72.88
Plantation/Orchards	98.69	174.57	75.88	76.89
Total	**10000.00**	**10000.00**		

- Plantation/Orchards increased by 76.89 %
- Agricultural land decreased by - 40.11%

- Open Forest increased by 311.32%
- Moderately Dense Forest increased by 72.88%
- Area of Water bodies increased by 41.13%

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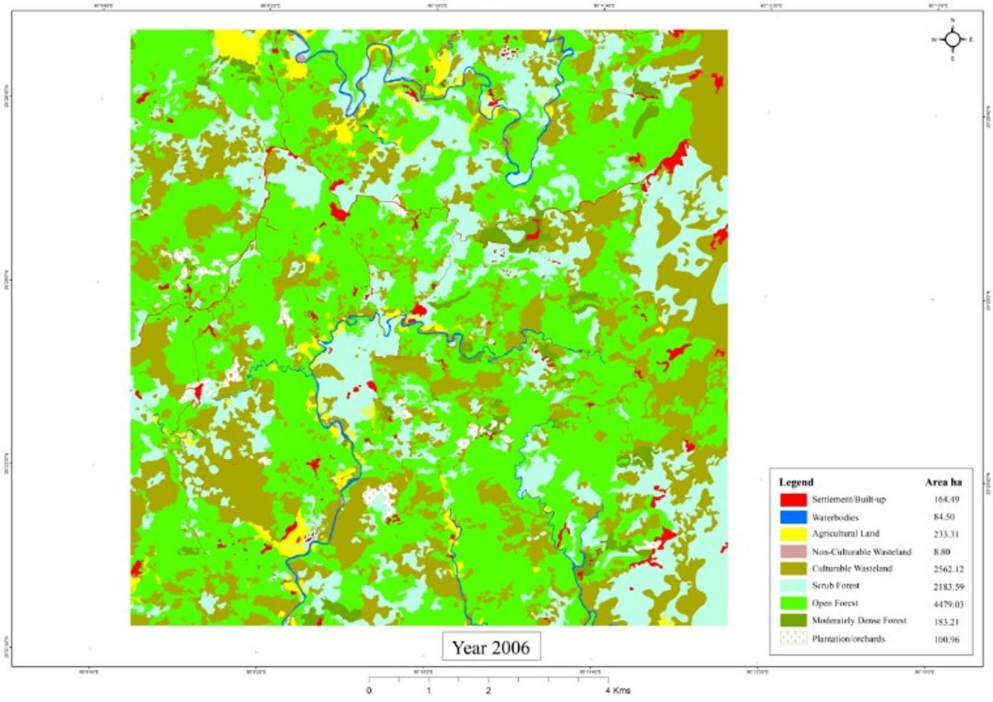
Land use Land Cover Map of Sample Grid no 2 10 x10 Km
Gambegre Block ,West Garo Hills District



Land use Land Cover Map of Sample Grid no 2 10 x10 Km
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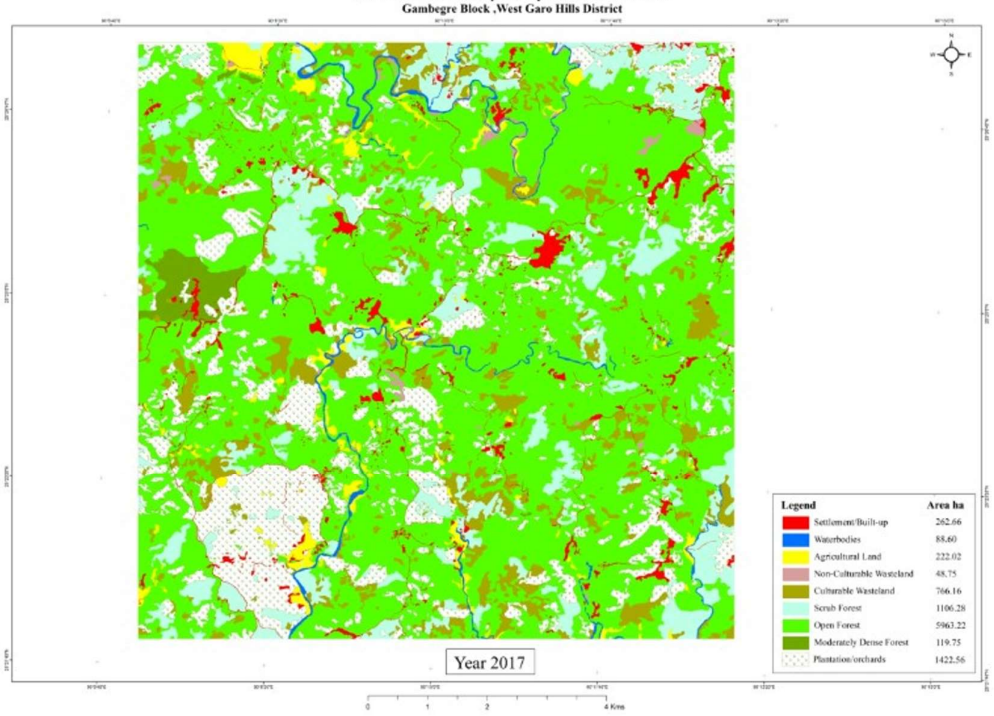
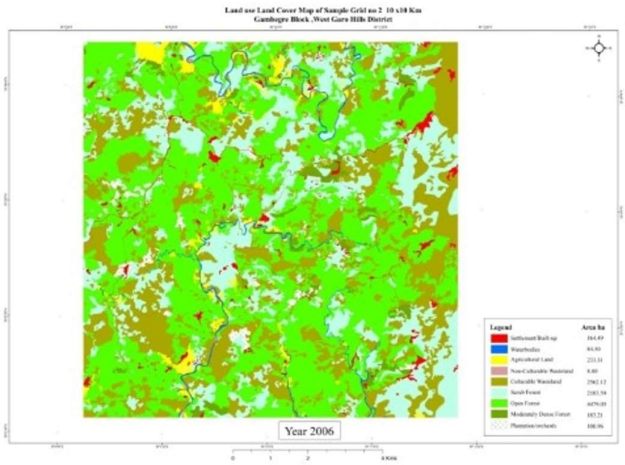
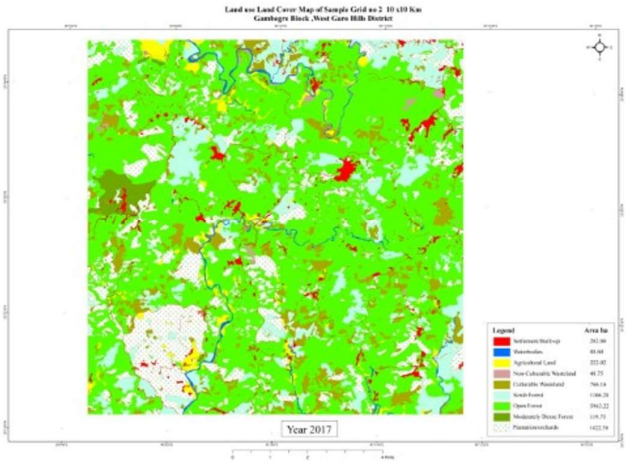
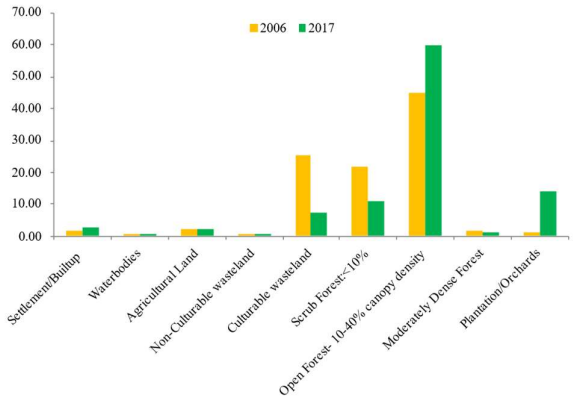






10x10 km Grid2 Gambegre Block,West Garo Hills 2006			
LULC CLASS	**Area ha**	**Area in sq km**	**Percentage %**
Settlement/Builtup	164.49	1.64	1.64
Water bodies	84.50	0.84	0.84
Agricultural Land	233.31	2.33	2.33
Non-Culturable wasteland	8.80	0.09	0.09
Culturable wasteland	2562.12	25.62	25.62
Scrub Forest:<10%	2183.59	21.84	21.84
Open Forest 10-40% canopy density	4479.03	44.79	44.79
Moderately Dense Forest	183.21	1.83	1.83
Plantation/Orchards	100.96	1.01	1.01
TOTAL	10000.00	100.00	100.00



10x10 km Grid 2Gambegre Block, WestGaro Hills 2017			
LULC CLASS	**Area ha**	**Area in sq km**	**Percentage %**
Settlement/Builtup	262.66	2.63	2.63
Water bodies	88.60	0.89	0.89
Agricultural Land	222.02	2.22	2.22
Non-Culturable wasteland	48.75	0.49	0.49
Culturable wasteland	766.16	7.66	7.66
Scrub Forest:<10%	1106.28	11.06	11.06
Open Forest 10-40% canopy density	5963.22	59.63	59.63
Moderately Dense Forest	119.75	1.20	1.20
Plantation/Orchards	1422.56	14.23	14.23
TOTAL	10000.00	100.00	100.00

Change in LULC in 10x10 km Sample Grid 2 Gambegre Block, West Garo Hills (Area in ha)				
LULC CLASS	**2006**	**2017**	**Change inha**	**Changein Percentage%**
Settlement/Built up	164.49	262.66	98.17	59.68
Water bodies	84.50	88.60	4.10	4.85
Agricultural Land	233.31	222.02	-11.29	-4.84
Non-Culturable wasteland	8.80	48.75	39.95	453.68
Culturable wasteland	2562.12	766.16	-1795.96	-70.10
Scrub Forest:<10%	2183.59	1106.28	-1077.30	-49.34
Open Forest 10-40% canopy density	4479.03	5963.22	1484.19	33.14
Moderately Dense Forest	183.21	119.75	-63.46	-34.64
Plantation/Orchards	100.96	1422.56	1321.60	1309.06
TOTAL	10000.00	10000.00		

- Plantation/orchards increased by 1309.06%
- Moderately Dense Forest decreased by -34.64%
- Settlement increased by 59.68%
- Agricultural land decreased by -4.85

- Open Forest increased by 33.14%
- Area of Water bodies increased by 4.85%

Results

- The result of this study shows that there has been an increased in Plantation/Orchards mainly of Areca nut in all the sample grid (76.89% - 1309.06%).Similarly, Settlement/Built up area have increased. The study also shows that there has been a decreased in the agricultural land. However, Moderately Dense Forest and Open Forest have increased in the ten years time periods.

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UC GIS Enabling Transformation

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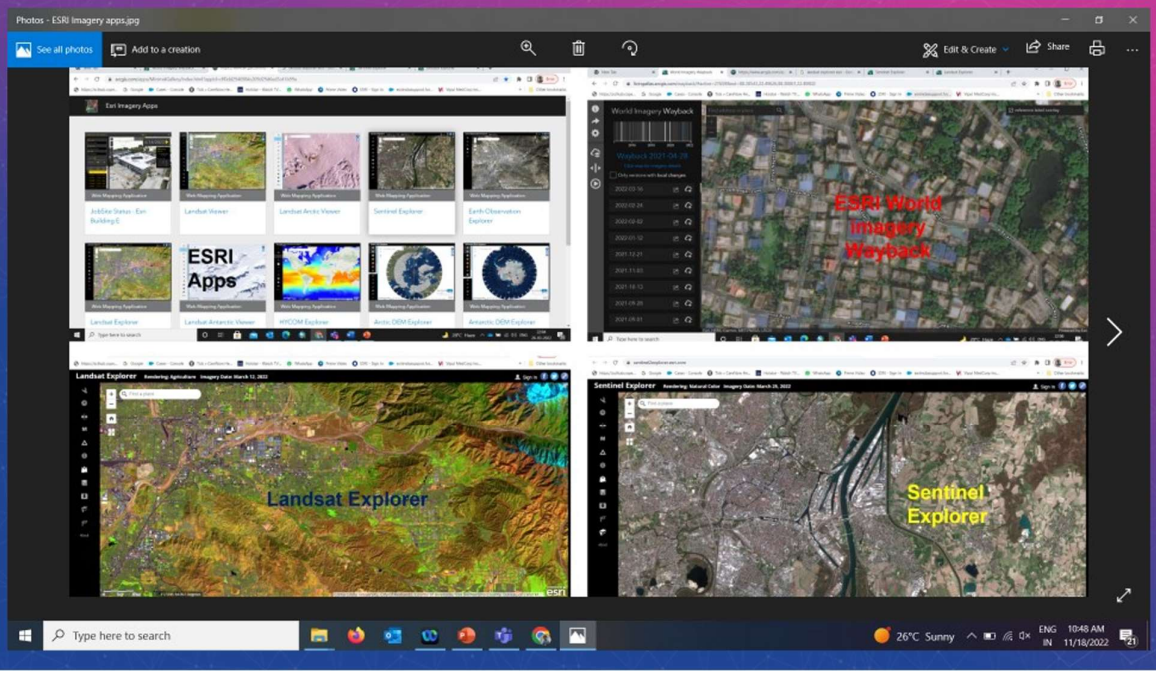
ESRI Solution for natural resources Management

Surya Deb Chakraborty (ESRI India)

M.Sc , PG Diploma, M.Tech(IIRS,ISRO), PhD, (Submitted)

Young scientist Fellow (KIIT Germany, 2015)

ESRI Apps



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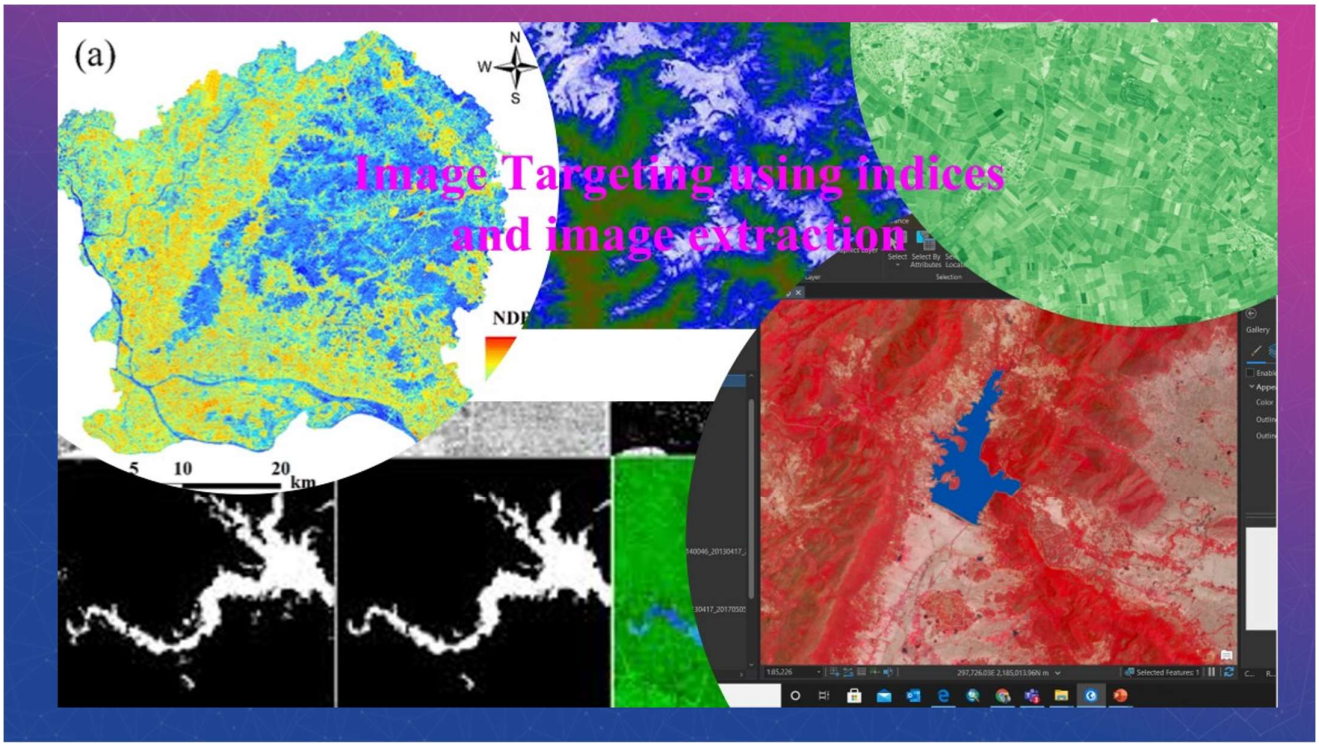

Story Map Generation

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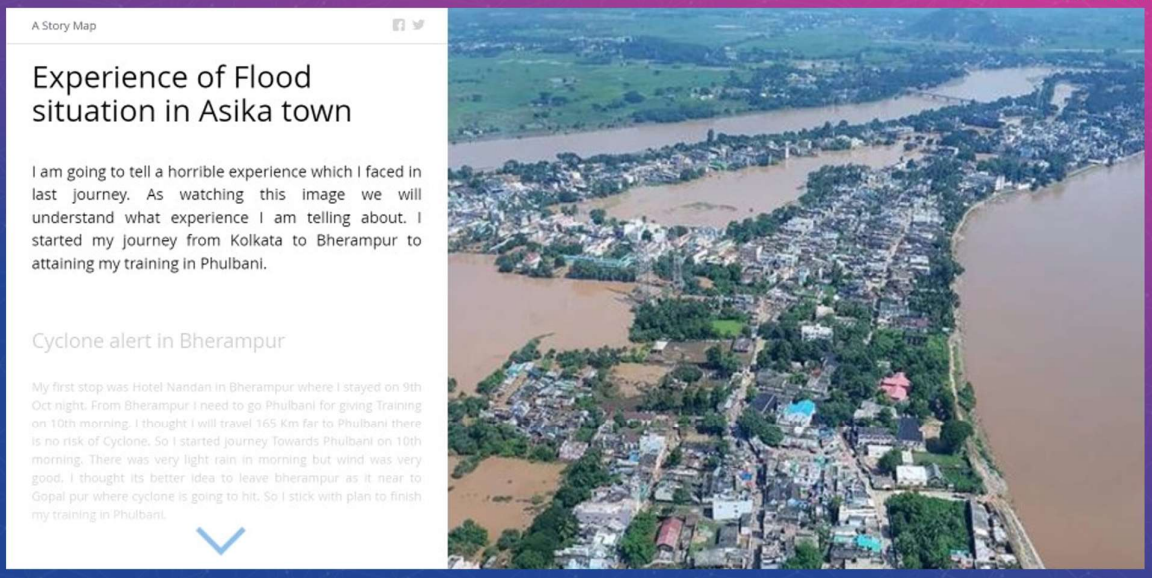

https://esriindia.maps.arcgis.com/apps/MapJournal/index.html?appid=4ef132b8a5ad4546a92add085ae67834

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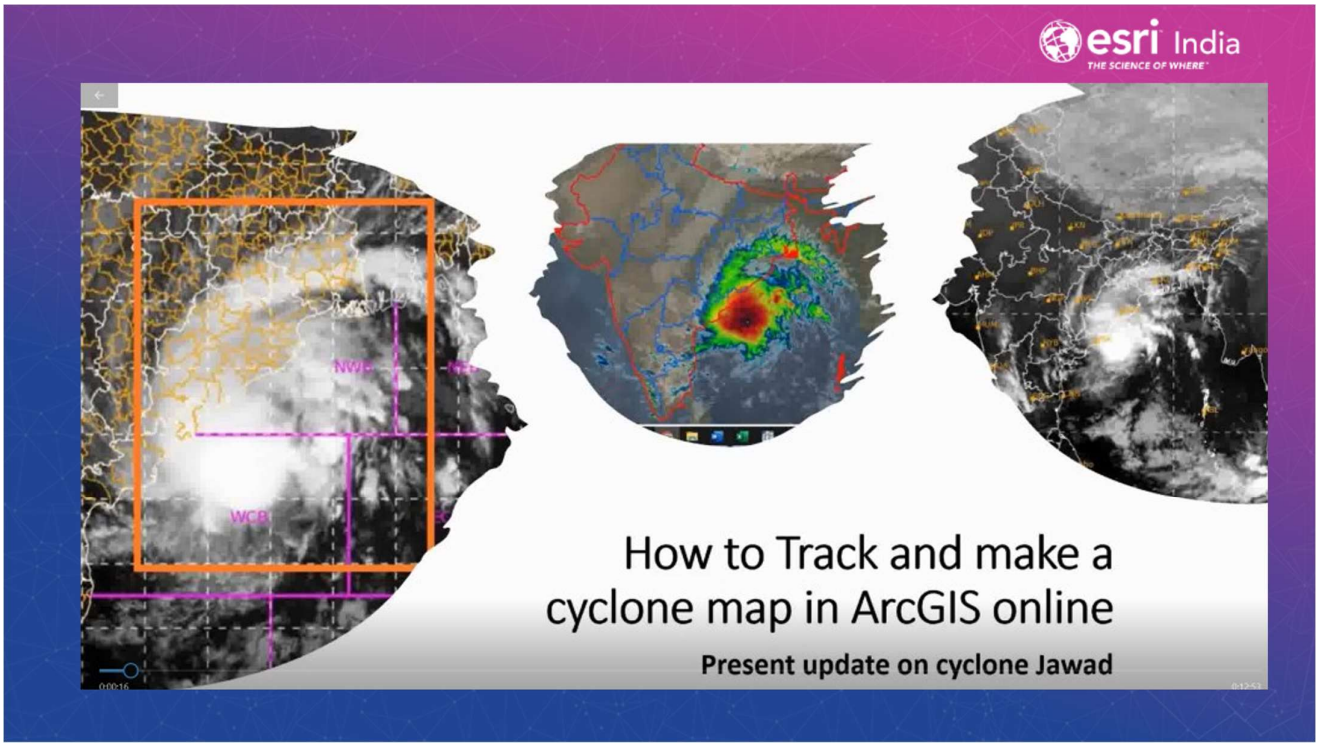

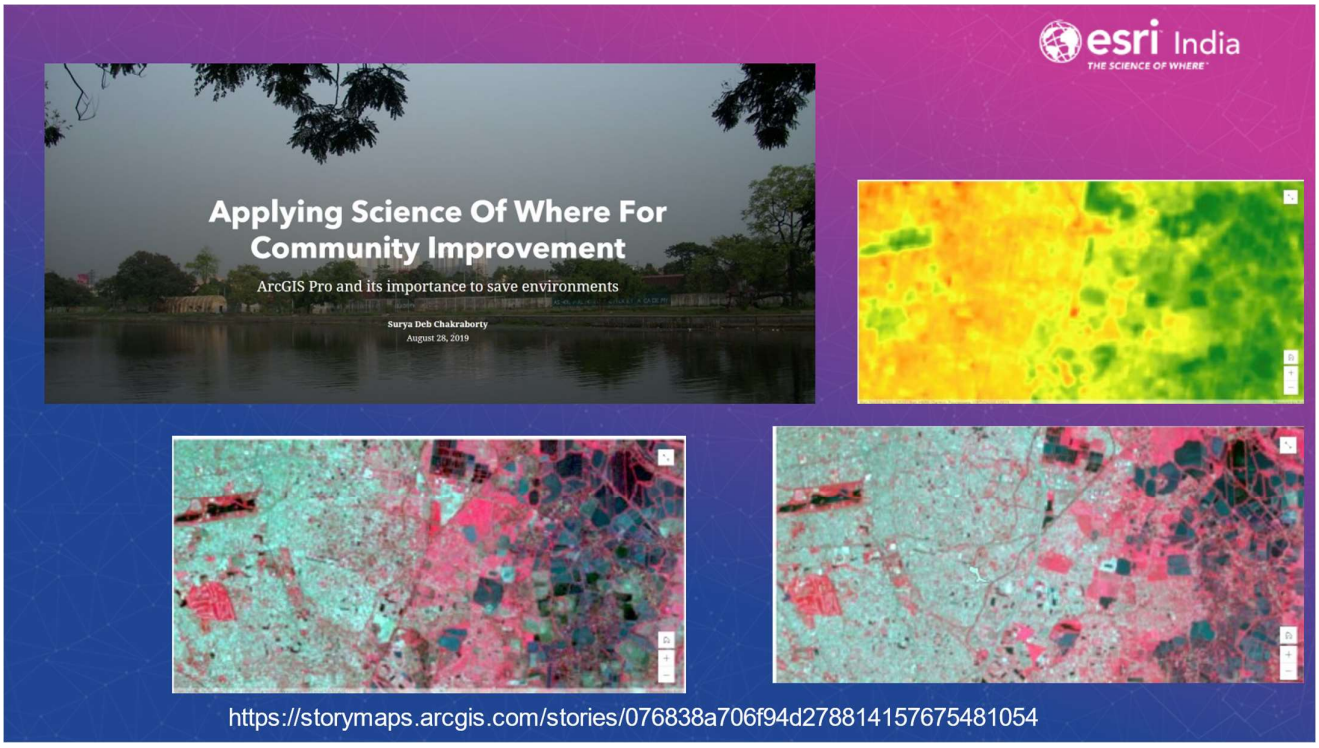

Deep learning Tool in ArcGIS Pro

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Conclusion

- The technologies discussed above are just a few of the many promising areas of remote sensing research .
- Over the next two decades, we look forward for a revolutionary change in private industry, academia, other government organizations, and the general public to promote and advance this exciting and rapidly changing field.
- Advances in remote sensing will enable quicker and more focused emergency response, more accurate map products, improved navigation, and better geospatial information and derived products for the general public and professionals in a wide variety of fields.

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Meghalaya Basin Development Authority | Government of Meghalaya

GEO-SPATIAL APPLICATIONS OF

Green MEGHALAYA

Grassroot Level Response towards Ecosystem Enhancement and Nurturing

Payment for Ecosystem services

Presented By
Suhsiengmon Lating, Assistant Manager – GIS & RS
DPMU– WGH, MBMA/MBDA

An efficient mechanism for improving natural systems under stress and at the same time helps communities by providing them remunerative incentives in lieu of following prescribed set of practices for the protection and sustainable management of ecosystems, leading to enhanced ecosystem services

An effective strategy for motivating the people to adopt sustainable land use practices as desired by the society at large for which they are provided monetary incentives based on their adherence to the land management prescriptions and performance-based ecosystem improvement works, which are duly verified.

Introduction of **Green** MEGHALAYA

Specifically suited to the socio-economic conditions, culture and land holding system prevalent in the State may lead to the desired ecosystem development on sustainable basis and also provide an income generating opportunity to the poor people in the villages.

An ecological benefits which is provided by the ecologically sound land management activities which include forest conservation, soil & water conservation measures, control of forest fires, afforestation& reforestation

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About Green MEGHALAYA

Grassroot Level Response towards Ecosystem Enhancement and Nurturing

This scheme is a transparent system for the additional provision of environmental services through conditional payments to voluntary providers.

- financial support to villages, communities, clans or individuals that commit to conserve and protect Natural Forests under the **Payment for Ecosystem Services** Model for a minimum period of 30 years.
- Villages, communities, clans or individuals that have a minimum of 2 or 5 Hectares of Natural Forest are eligible under this scheme
- Those with land smaller than 5 Hectare can group their lands with other natural forest land owners so that the total size becomes 2 or 5 Hectares or more, provided that these forest lands are close by.

Benefits of Green MEGHALAYA

Benefits through incentives

Financial support up to Rs. 15000/- per hectare per year for 5 years for conserving the forest.

Rs. 8000/-

- The plot of land should have 5 ha area and above
- The area should have a Natural vegetation cover

Rs. 5000/-

- If the Forest is notified as community reserve with Forest Department
  If the forest is not yet notified, the applicant can apply for notification with State Forest Dep
  (Wildlife Division) and submit a copy of the application receipt while submitting the applic
- If forest is covered under Working Scheme
  If the forest is not yet covered under working scheme, the applicant can apply for Working S
  with the relevant Autonomous District Councils and submit a copy of the application receipt
  submitting the application

Rs. 2000/-

- If Forest is very dense forest or traditionally recognised Sacred Grove or has Living Root Bridge or is located in eco-sensitive zones around protected areas* (National Parks and Wildlife Sanctuar wildlife corridors**.
- *Eco-sensitive zone as defined by Forest Department
  ** Wildlife corridor as identified by Forest Department

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Pilot Project of Green MEGHALAYA

Launch on the 2nd April 2022 at West Garo Hills District

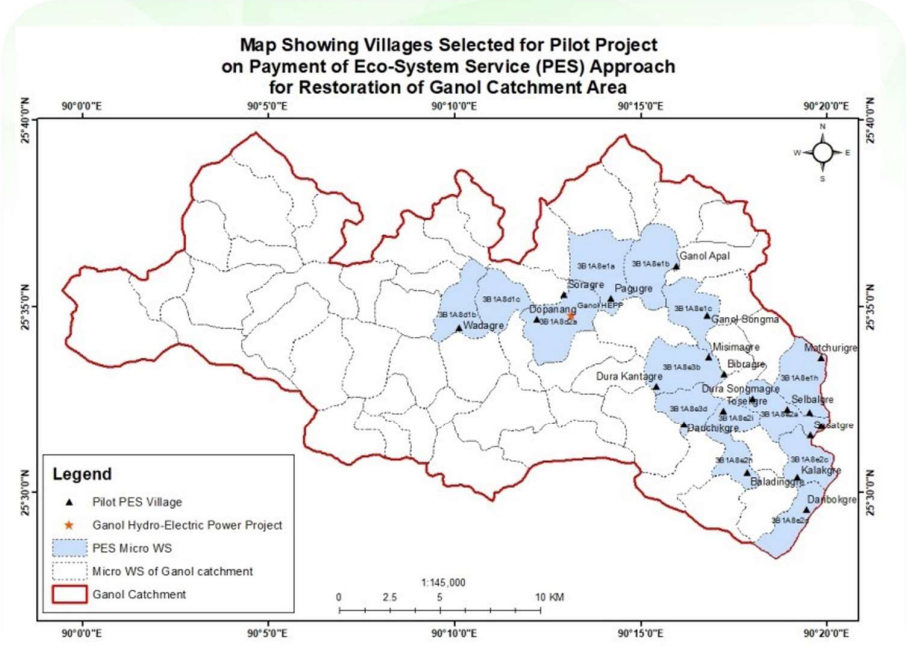
- Implemented in the 20 villages of Ganol Catchment area
- Located in 12 critical micro-watershed area.
- CLLMP – WGH, S&WC Department and GHADC will be closely involved

Restoration of catchment area and improving the water discharge of springs and streams
Study its potential and effectiveness for evoking the communities participation in environmental safeguard

5 Field Associates (VCFs) are engaged for this pilot Project

- Proposed to run for 3 years though the feedback will be from the first year itself.
- Expected to restore 200 ha of ecosystem, generating income to the involving village people

Pilot Project of Green MEGHALAYA



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Activities for the Pilot Project of Green MEGHALAYA

Sl. No.	PES Activity	Verifiable Parameter/Indicator	Remarks
1	Transition from Jhum to Improved Agriculture Practices	-Area (in ha) based on GPS -score based on periodic transect observations to verify adherence to prescribed practices - observation based on high resolution satellite data/drone image - soil organic carbon	A methodology of the transect observations and scoring would be separately given and PFAs will be trained in the methodologies.
2	Conservation of existing natural forests	-forest area (in ha) based on GPS - change in Basal Area/ha - change in canopy density as assessed with the help of satellite image/drone image - change in number of forest fire incidences -area affected by forest fire - number of trees felled (if any) - score based on transect observations	Change in basal area will be assessed using measurement data from the sample plots Methodology for the measurements and observations will be separately given.

Activities for the Pilot Project of Green MEGHALAYA

Sl. No.	PES Activity	Verifiable Parameter/Indicator	Remarks
3	Reforestation (this activity will have two sub components, Creation and Maintenance, the later will be operational from the second year after creation)	Reforestation - area reforested - change in stocking (number of trees/ha) in annual cycle based on sample plots Transect observations on - forest fire incidences - effectiveness in controlling grazing -survival percentage of enrichment planting - regeneration	Methodology for the measurements and observations will be separately given
4	Afforestation (this activity will have two sub components, Creation and Maintenance, the later will be operational from the second year after creation)	- number of seedlings planted - survival % after six months in the first year -area brought under afforestation (in ha) Maintenance (to be assessed through transect observations) -survival % after 1st yr -survival % after 2nd yr -survival % after 3rd yr - intensity of weeds - transect observations for forest fires, grazing, weed growth	Quantum of payment for Afforestation will be determined based on survival percentage and score based on other transect observations Methodology for the measurements and observations will be separately given

Activities for the Pilot Project of Green MEGHALAYA

Sl. No.	PES Activity	Verifiable Parameter/Indicator	Remarks
5	Soil & Water Conservation Measures	Contour Trenches Length/Area of contour trenches - creation - maintenance Area of water conservation pond or reservoir -creation -maintenance physical dimensions of structures	Quantum of incentive will be determined based on the physical dimensions of structures/works created and maintained. Scores will be assigned based on the physical inspection of works by PFAs. Methodology for the measurements and observations will be separately developed.

Workflow of Green MEGHALAYA

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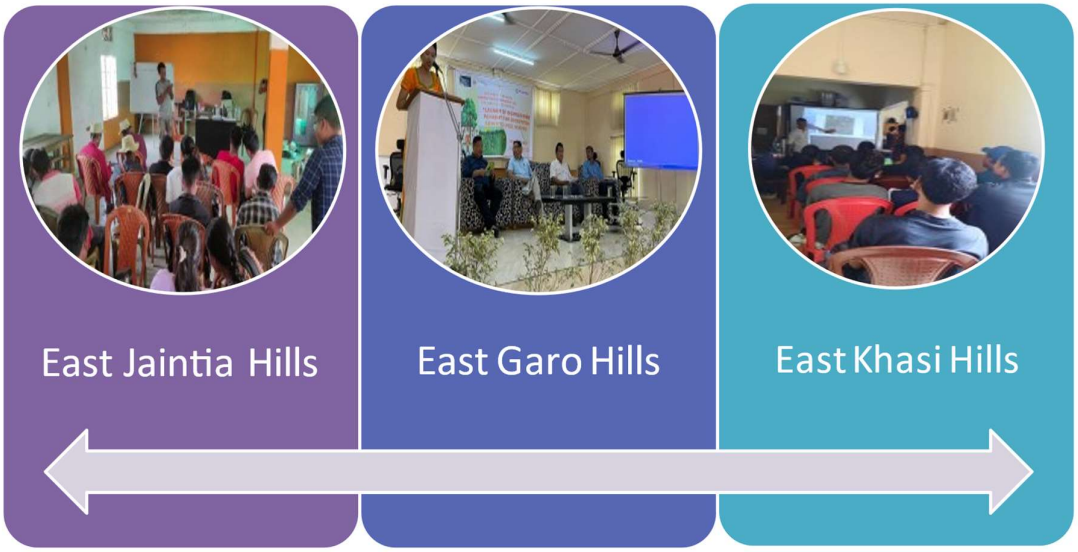
Awareness of Green MEGHALAYA



Awareness of Green MEGHALAYA

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Awareness of Green MEGHALAYA

GIS support for Green MEGHALAYA

- Trained theVcf and PFAs for collection of data through GPS
- Collection and compilation of data which consist of primary and secondary data.
- Creation of spatial database of all the forest cover in the Green MEGHALAYA schemes
- Processing and analyzing the GIS data for the Map Output

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GIS support for Green MEGHALAYA

Training

- 1. GPS training to the VCFs, staff and PFAs for delineating the forest boundary
- 2. Training to the Coe staff for collecting the GPS data
- Field training to the VCFs and PFAs

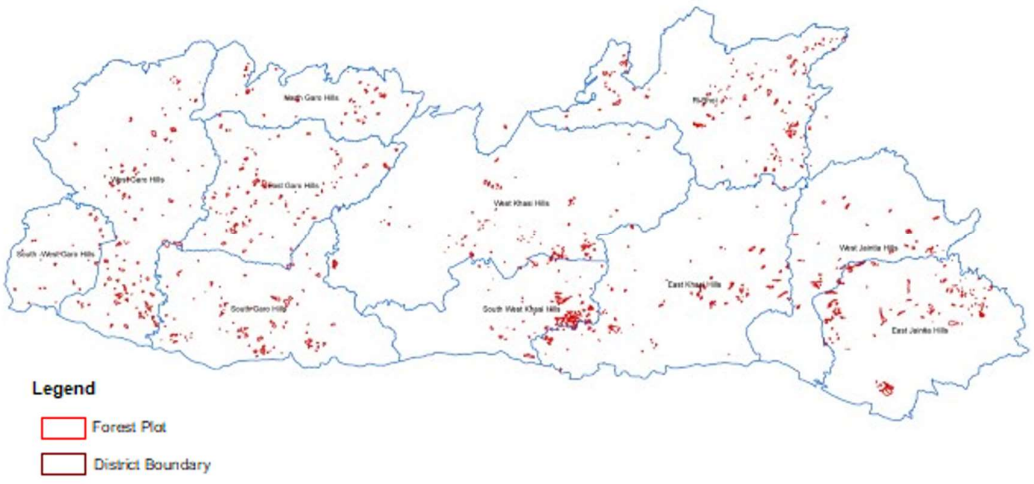
Mapping

- 1. Import the forest boundary from GPS
  2. Layering the forest boundary in the Arc Gis for area calculation
  3. Overlaying the forest plot with FSI data
  4. Overlaying of forest plot with the Sacred Grove areas , Living Root Bridge , eco-sensitive zones, Reserved Forest, Protected Forest, National Parks and Wildlife Sanctuary
- 5. Processing andAnalysingof each forest plot for initiating the payment

GIS support for Green MEGHALAYA

District Boundary Data (MBMA/MBDA)

Extracting the forest plots from GPS device and import the shapefile/KML on the map to calculate the forest plots areas which should be 5 ha and above



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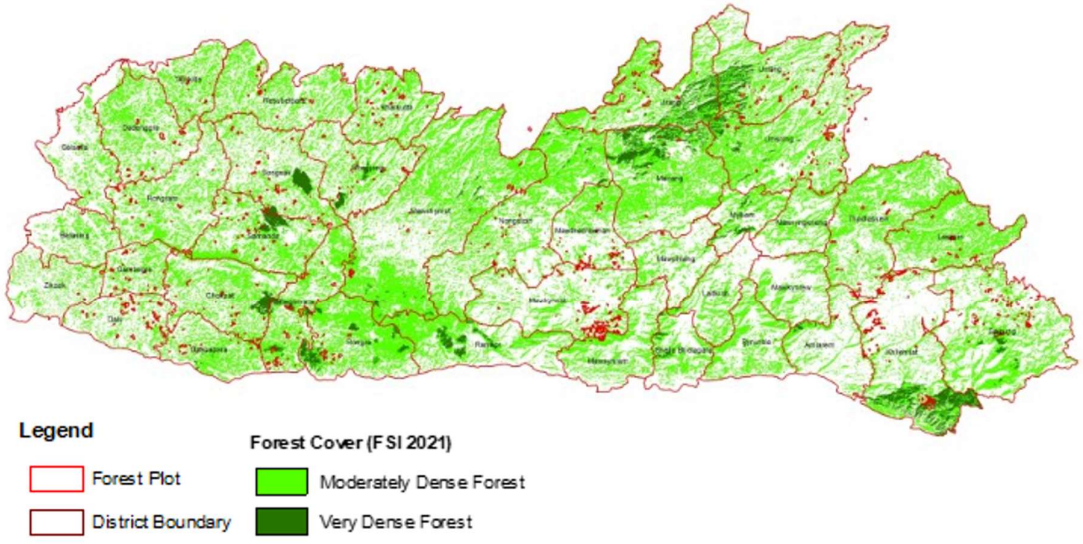
Map data of FSI 2021 with MDF & VDF Clusters

Overlay the forest plot on the map to identify the forest plot under moderately dense forest cover and Very dense forest cover



Legend

Forest Plot

District Boundary

Forest Cover (FSI 2021)

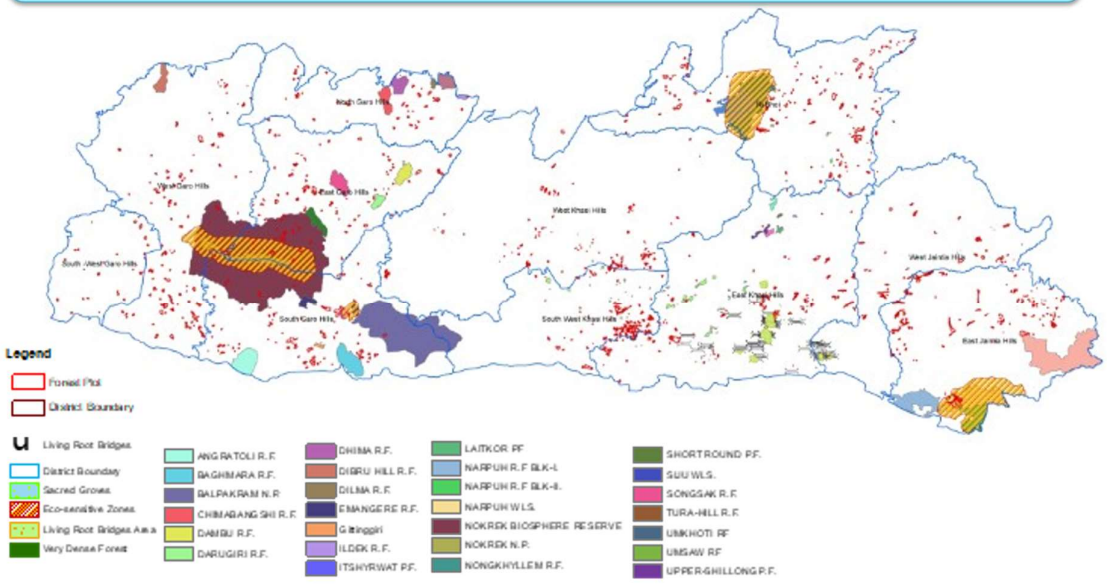
Moderately Dense Forest

Very Dense Forest

GIS support for Green MEGHALAYA

Map of MBMA/MBDA/Forest Department Data

Overlaying the forest plots with the Sacred Grove areas , Living Root Bridges, Eco-sensitive zones, Reserved Forest, Protected Forest, National Parks and Wildlife Sanctuary.



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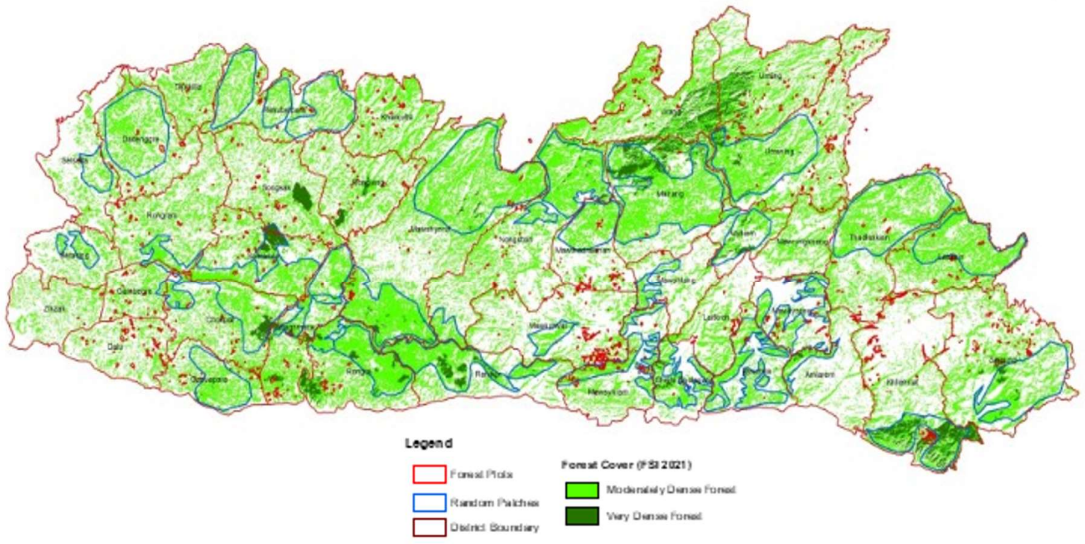
GIS support for Green MEGHALAYA

FSI 2021 with MDF & VDF Clusters

Overlay the forest plot on the map with areas under moderately dense forest cover and Very dense forest cover to select the random patches to reach these areas in the second phase of the projects



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Statistics of overlayingforest Plots with other layers

The overlaying of different layers of GIS maps helps in generating the forest plots areas which fa under forest cover FSI 2021, Eco sensitive Zones, Sacred Grove areas , Living Root Bridge areas , Reserved Forest, Protected Forest, National Parks and Wildlife Sanctuary.

Reference	Name	Area of PES Plot (Ha)	Forest Cover FSI 2021	Area of Forest FSI 2021 (Ha)	Eco Sensitive Zones	Eco Sensitive Zones Name	Sacred Groves	Sacred Groves Name	RF, NP, WLS, BR	RF, NP, WLS, BR Name	LRB Village	LRB Village Name	LRB Bridge	LRB Bridge Name
EGHSAMDEE	Janggan M Sangma	14.43	Moderately Dense Forest	10.23	YES	NOKREK NP ESZ			YES	NOKREK BIOSPHERE RESERVE				
EJHKHLMOG	TUBER COMMUNITY RESERVE	104.07	Moderately Dense Forest	85.29			YES	Khloo Blai Sien Raij Tuber						
EKHPYNHLG	nongblia3	108.25	Moderately Dense Forest	93.91							YES	Laitshutim		
EKHPYNUXP	Lokaskhongsit	25.99	Moderately Dense Forest	20.28									YES	Banam

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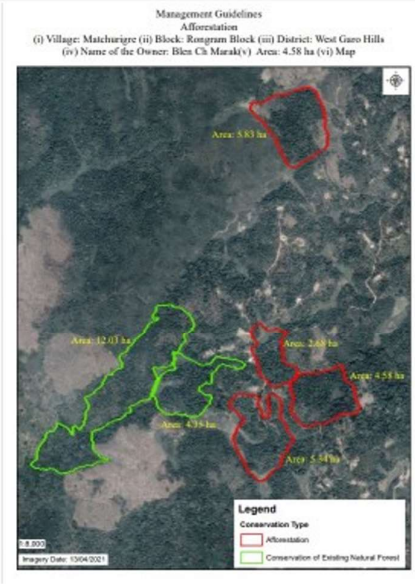
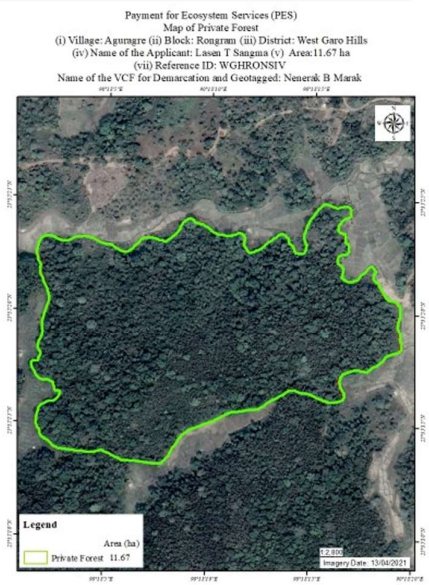
Final Layout

The maps for the Ganol Catchment Pilot project and the Green MEGHALAYA schemes





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Summary of Green MEGHALAYA

- Total Forest Plots: 1145 nos.
- Plot falls in RF, NP, WLS, BR: 52nos
- Plot falls in LRB Site: 1 no
- Plot falls in LRB Village: 1 no
- Plot falls in Eco Sensitive Zones: 33nos
- Plot falls in Sacred Groves: 21nos
- Villages to reach out: 1362 nos.

Summary of Ganol catchment Green MEGHALAYA

Total no. of activities: 107

Transition from Jhum to Improved Agriculture Practices

- 4 numbers of jhum plots

Conservation of existing natural forests

- 32 numbers of forest plots

Reforestation

- 5 numbers of plots

Soil & Water Conservation Measures

- 27 numbers of plots

Afforestation

- 39 numbers of plots

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Way forward to Green MEGHALAYA

Extensive environmental awareness, communities dialogues, sets of NRM activities, attractive necessary funds, and capacity development.

+

Using GIS tools and techniques helps in getting quick result and report for mapping and data generating as compared to the traditional techniques of capturing and processing the data from ground.

=

The Green Meghalaya schemes may prove to be an efficient approach as a functional scheme for restoration of catchment areas and addressing other environmental issues being faced by the State

Geo-Spatial Applications in Meghalaya State Forest Department

Presented by:

Shri. Jerry F Kharkongor,
GIS Technician,
GIS Laboratory,
Forest & Environment Department

Smti. Ibadasukshisha L Mawphlang
Range Forest Officer,
Working Plan Division,
Forest & Environment Department

LIST OF FEW ACTIVITIES UNDER FOREST & ENVIRONMENT DEPARTMENT ENGAGING GIS & REMOTE SENSING TECHNOLOGY

- Mapping of Reserved Forests (RF), Protected Forests (PF), Protected Areas (PA)& Community Reserved Forests (CRF).
- Criteria-Oriented Interpretation of RF, PF & PA.
- Forest Fire Risk Assessment via Grid-Based Zonation.
- Mapping of Distribution of Fauna within National Parks & Wildlife Sanctuaries
- 3D Visualization depicting suitability for Plantation.
- Forest Density Cover of Meghalaya.
- Forest/Vegetation Type Cover of Meghalaya.

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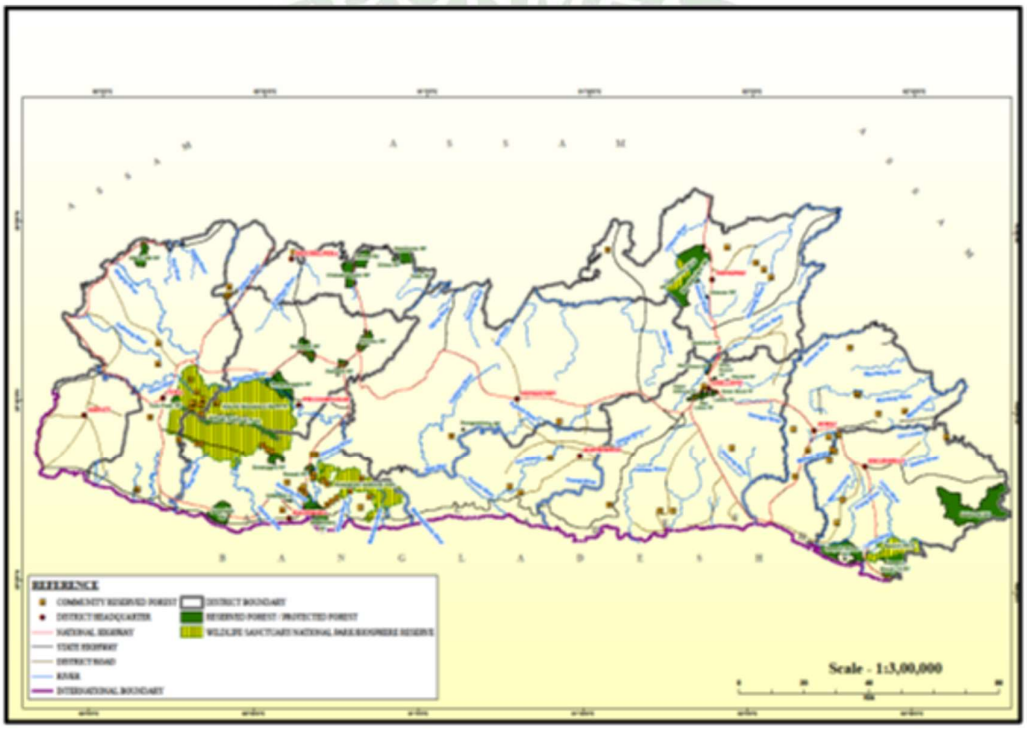
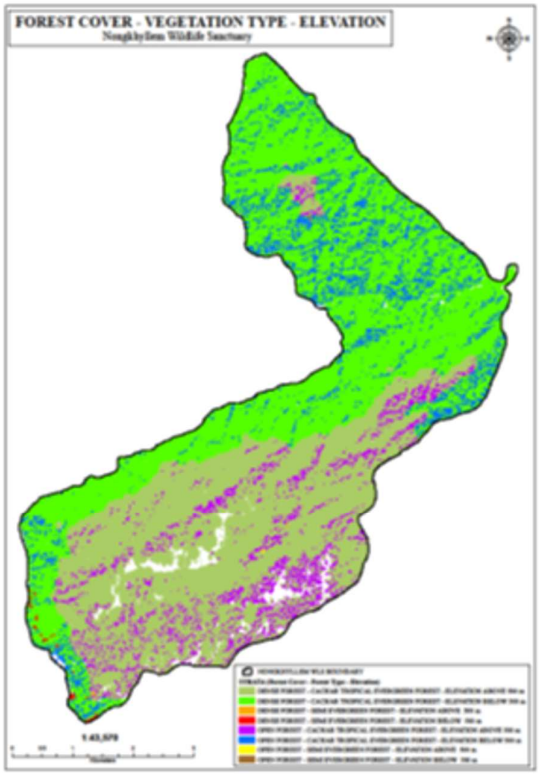
MAPPING OF RESERVED FORESTS (RF), PROTECTED FORESTS (PF), PROTECTED AREAS (PA)& COMMUNITY RESERVED



CRITERIAORIENTED INTERPRETATION OF RF,PF & PA



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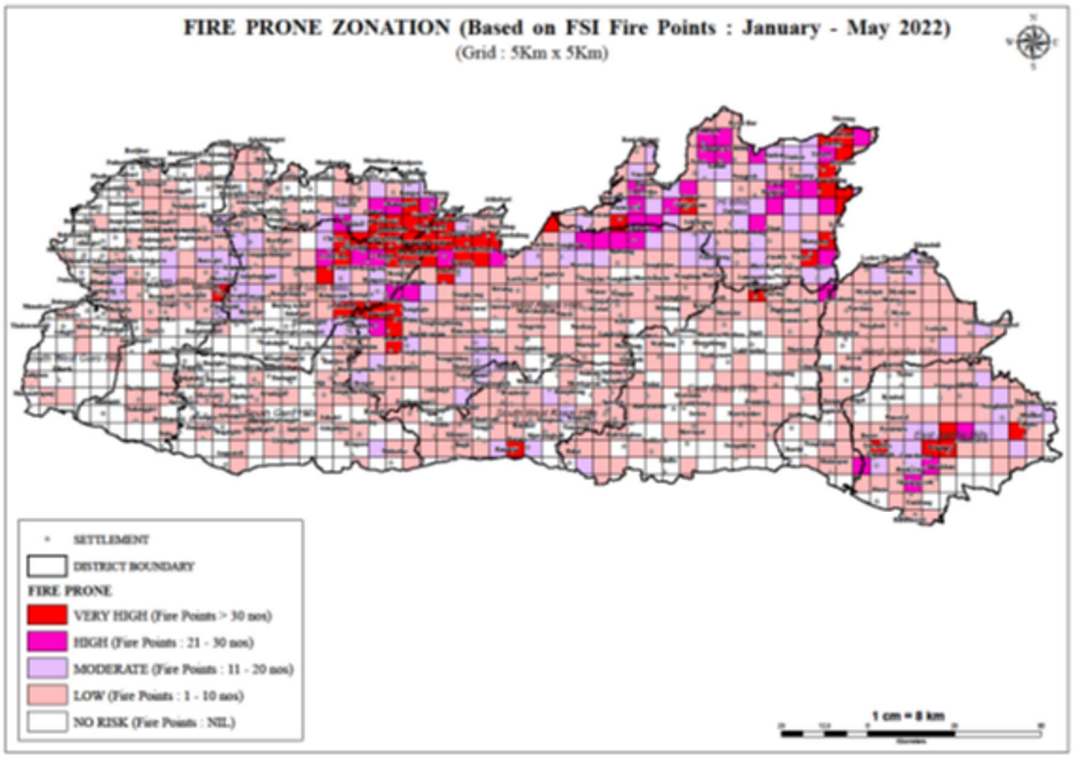
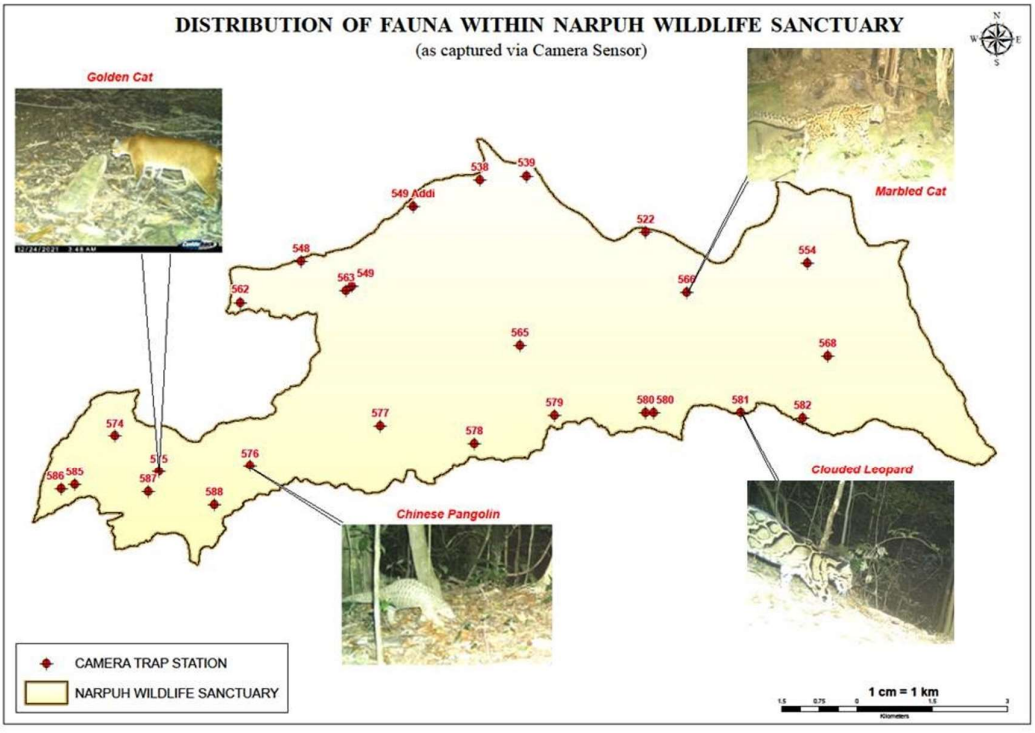
FOREST FIRE RISK ASSESSMENT VIA GRADED ZONATION



MAPPING OF DISTRIBUTION OF FAUNA WITHIN NATIONAL PARKS WILDLIFE SANCTUARIES



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LIST OF FEW SPECIES CAPTURED AT FEW CAMERA STATIONS

588	Himalyan Crestless Porcupine
	Large Indian Civet
	Asiatic Bush-Tailed Porcupine
	Marbled cat
575	Barking deer
	Wild Boar
	Serow
	Kalij Pheasant
	Golden cat
	Himalyan Crestless Porcupine
	Barking deer
577	Leopard cat
	Pallas squirrel
	Rodent
	Peacock Pheasant
	Yellow throated Marten
	Serow
	Marbled cat

566	Marbled cat
	Blue Whistling Thrush
	Pallas squirrel
	Peacock Pheasant
	Kalij Pheasant
	Sambar
	Asiatic Brushtailed Porcupine
	Yellow throated Marten
	Pitta
	Wild boar
	Large Indian Civet
	Himalayan Crestless Poircupine
576	Sambar
	Chinese pangolin
574	Large Indian Civet
	Rhesus Macaque
	Kalij Pheasant
	Himalayan PalmCivet
	Serow
	Marbled cat

PHOTO PLATES OF DIFFERENT SPECIES RECORDED IN NARPUH WILDLIFE SANCTUARY

GOLDEN CAT

LEOPARD CAT

MARBLED CAT

GOLDEN JACKAL

CLOUDED LEOPARD

STRIPED WEASEL

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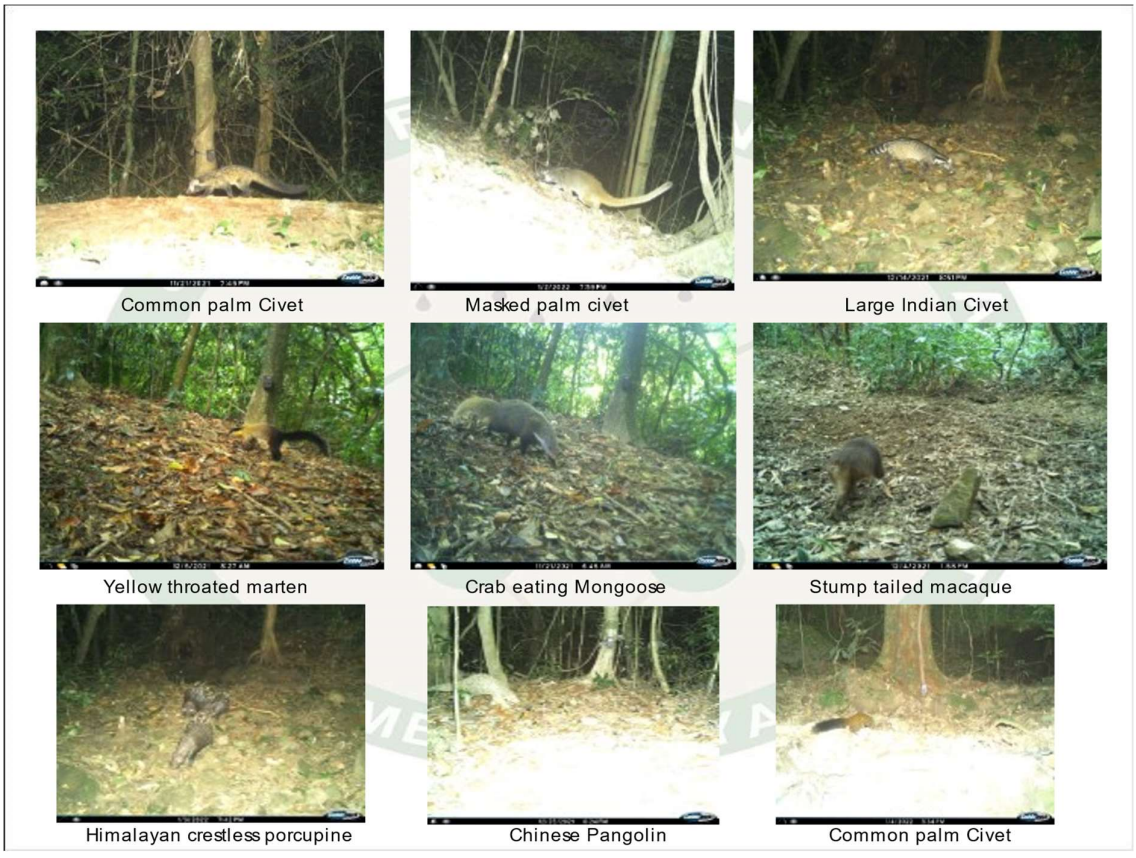

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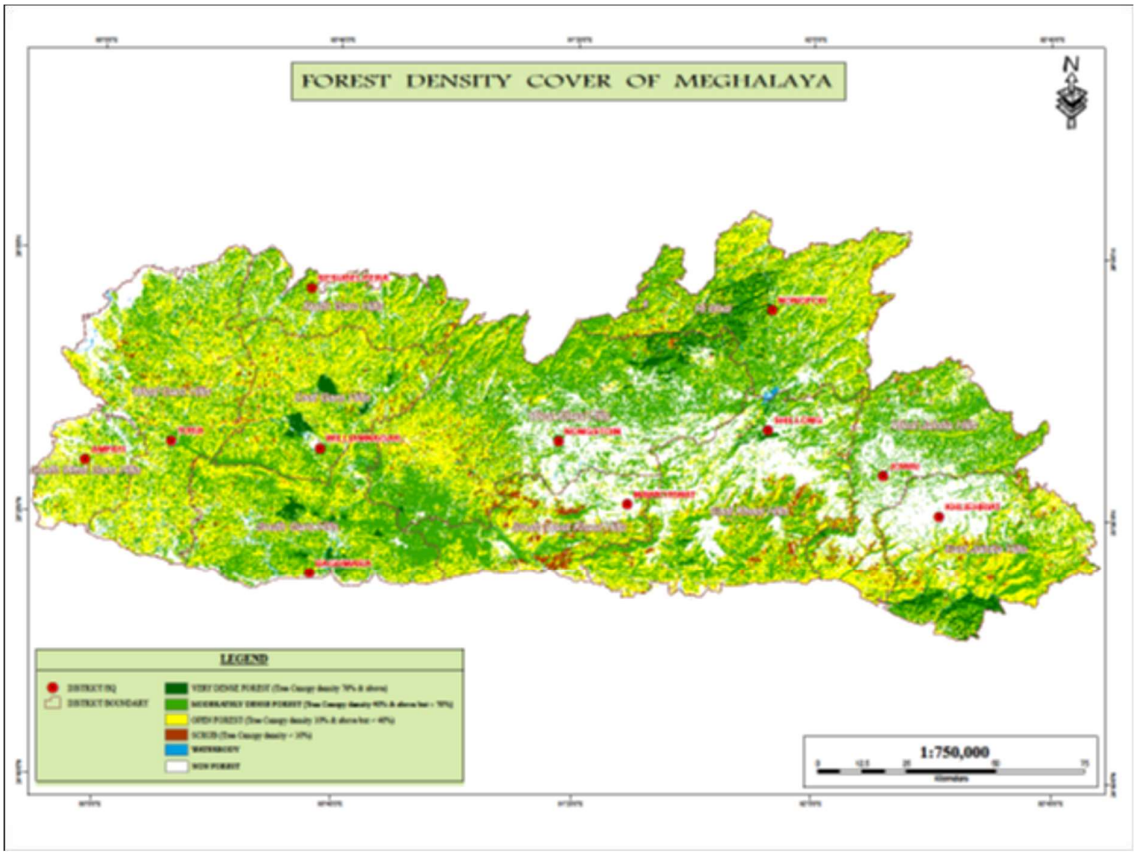
3D VISUALIZATION DEPICTING SUITABILITY FOR PLANTATION



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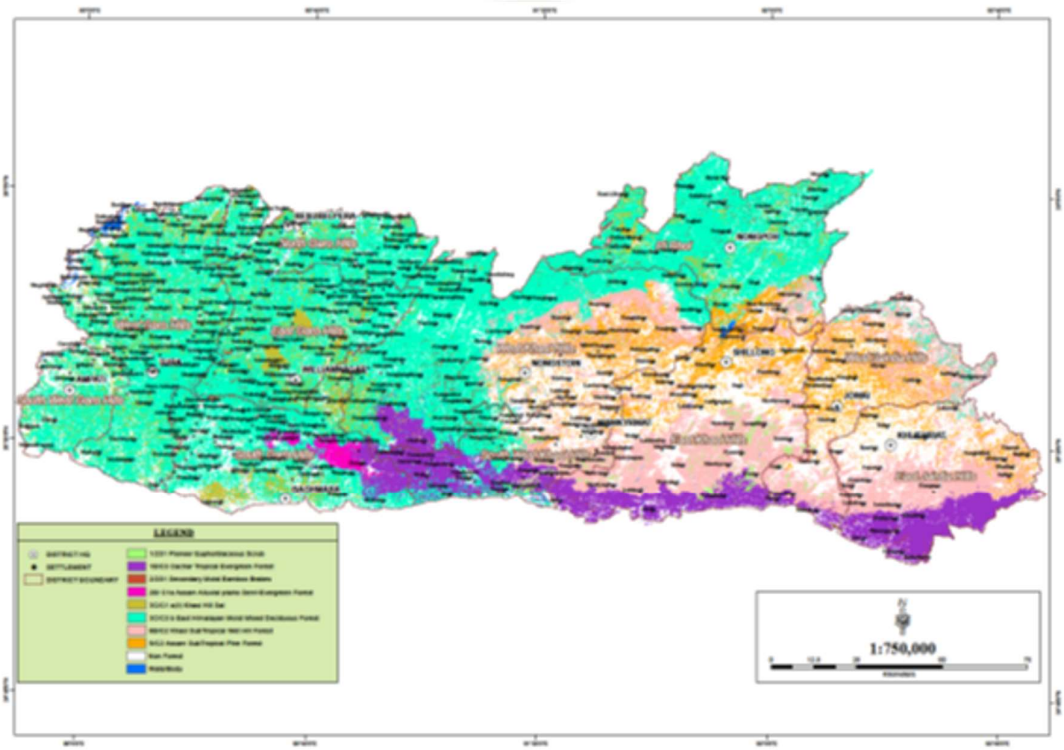
VEGETATION TYPE OF MEGHALAYA



Thank you

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Geo Spatial Applications in Soil and Water Conservation Department

Presented by:
Frinkwell Marboh
S&WCD (Jr-1)

Dated- 18th November, 2022

Mandate

- Natural Resources Management Task (Soil, Water, Vegetative-Resources)
- Adoption & application of appropriate Soil & Water Conservation techniques, measures, practices for perpetual utilization and sustainable development
- Improvement, enhancement and sustaining livelihood system.

AIMS

- To promote sustainable utilization of soil, water and vegetation resources.
- Sustainable food support and water needs.
- To promote social, economic and ecological development

MAJOR PROGRAMMES

- Watershed Development Component of the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY-WDC)
- Pradhan Mantri Krishi Sinchayee Yojana Har Khet Ko Pani (PMKSY-HKKP)
- Rashtriya Krishi Vigyan Yojana (RKVY)
- National Bamboo Mission (NBM)
- Soil and Water Conservation Scheme under Rural Infrastructure Development Fund (RIDF), NABARD Loan. RKVY
- Springshed Development Works for Rejuvenation of Springs for Climate Resilient Development in Water Stressed Areas of Meghalaya.

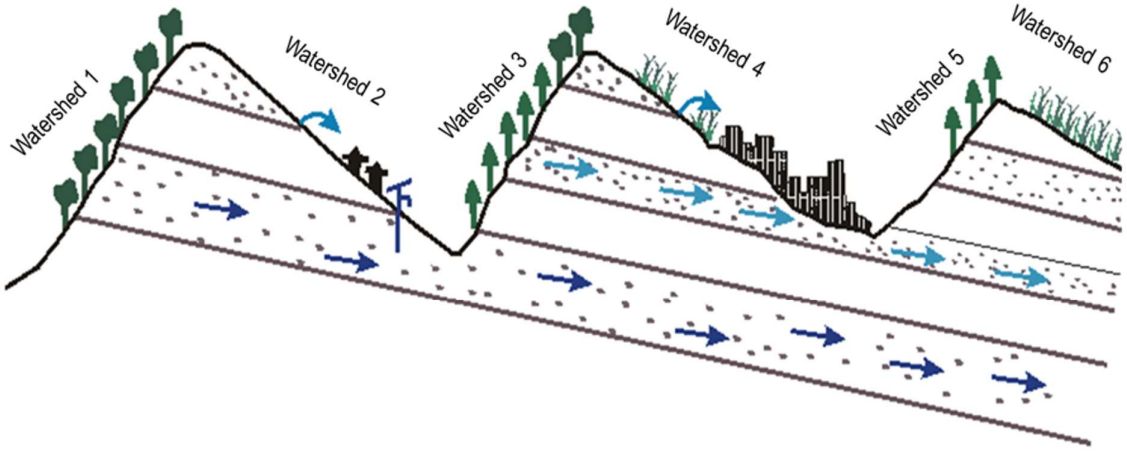
Important concepts in Soil & Water Conservation

- **Watershed concept -** Area from which all the water flows out through a **common outlet**. (Surface)

- **Springshed Concept -** The area from which the water flows out through a **SPRING**. (Sub Surface)

(Springs are areas on the ground that show groundwater outflow from the aquifers below)

Continuity of Watershed and Springshed



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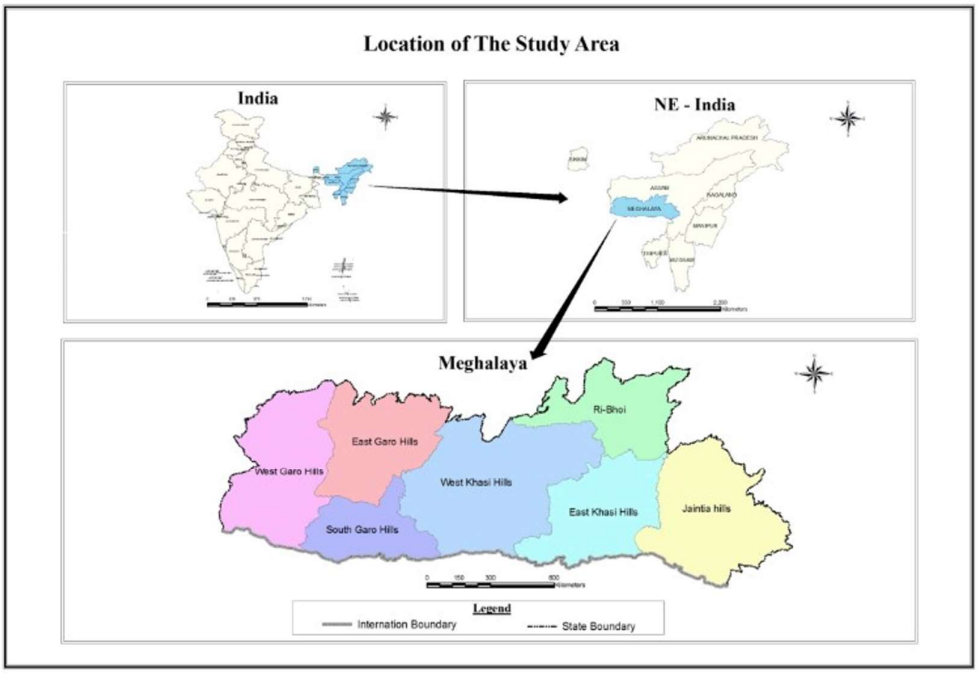
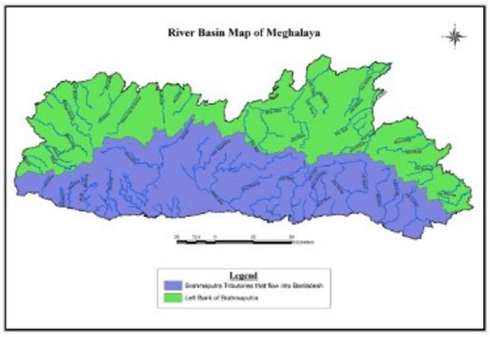
Geo-spatial Applications in Watershed Management (Ridge to Valley Approach)

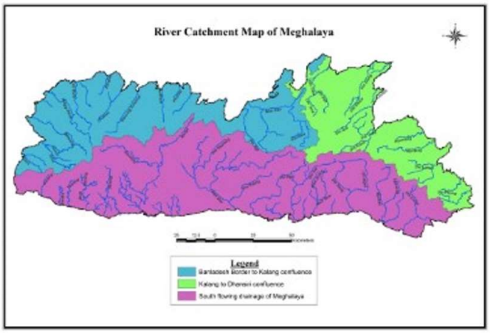
- Delineation of Watershed Boundary Across the State up to Micro - watershed Level.
- Publication of Watershed Atlas of Meghalaya in collaboration with NeSAC
- Selection of Project Area based on Priority
- Preparation of Resource Maps (LULC/Soil/Drainage/ etc)
- Preparation of Planned Activities Maps
- Monitoring, Evaluation & Documentation

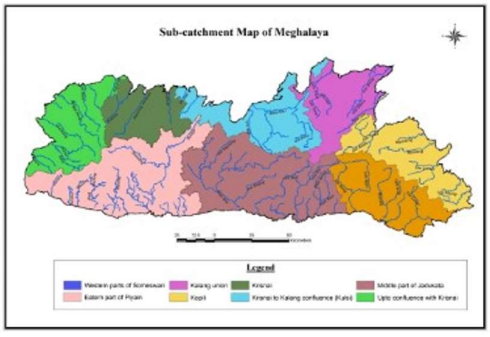
An Overview of Watershed Atlas of Meghalaya

Class	Average Size (Lakh Ha)	Size Range (Lakh Ha)	Nos.
REGION	550	270-1130	1 North East India
BASIN	95	30-300	2
CATCHMENT	30	10-50	3
SUB CATCHMENT	7	2-10	8
WATERSHED	1	0.2-3.0	35
SUB WATERSHED	0.15	0.1-0.2	179
MINI WATERSHED	0.05	0.02-0.1	595
MICRO WATERSHED	0.005	0.001-0.02	2776

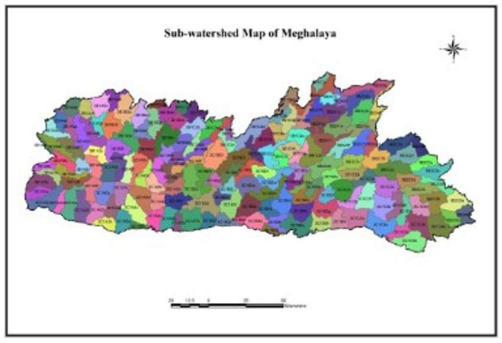

Location of The Study Area
India
NE - India
Meghalaya
Ri-Bhoi
East Garo Hills
West Garo Hills
West Khasi Hills
East Khasi Hills
Jaintia hills
South Garo Hills
Legend
Internation Boundary
State Boundary

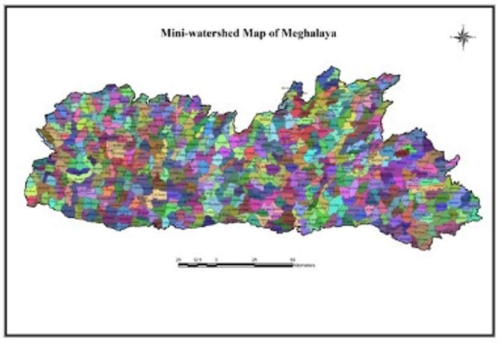

River Basin Map of Meghalaya
Legend

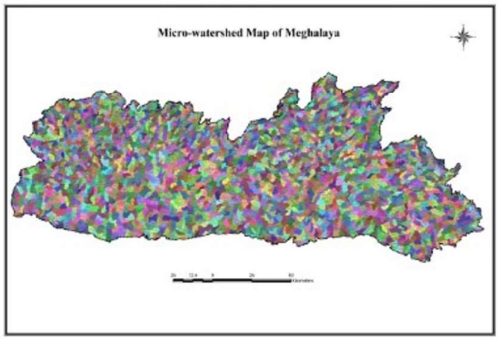

River Catchment Map of Meghalaya
Legend


Sub-catchment Map of Meghalaya
Legend

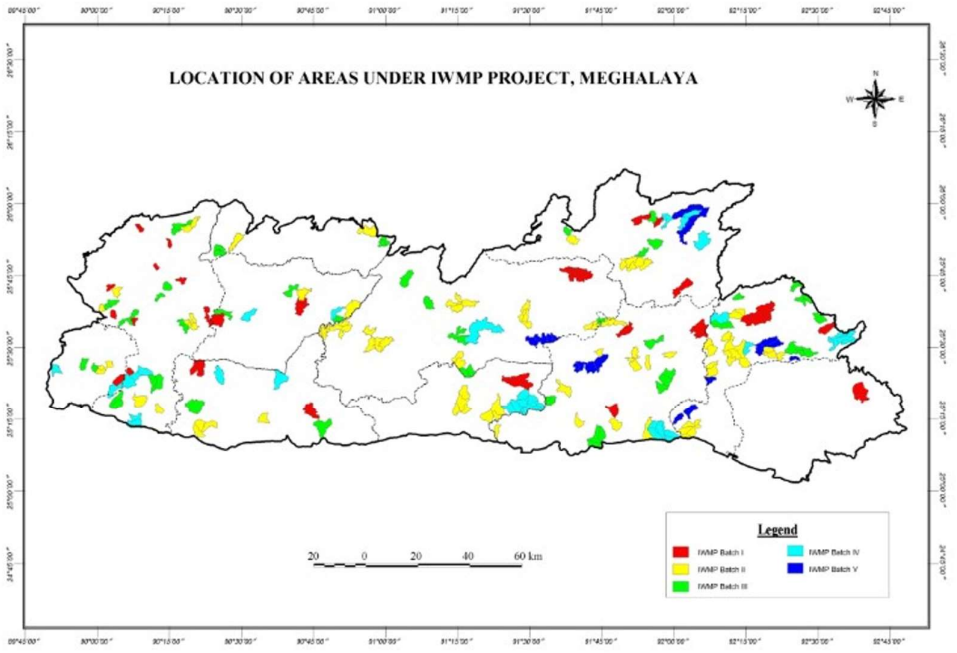

Watershed Map of Meghalaya
Legend
Watershed Names







IWMP Project Status



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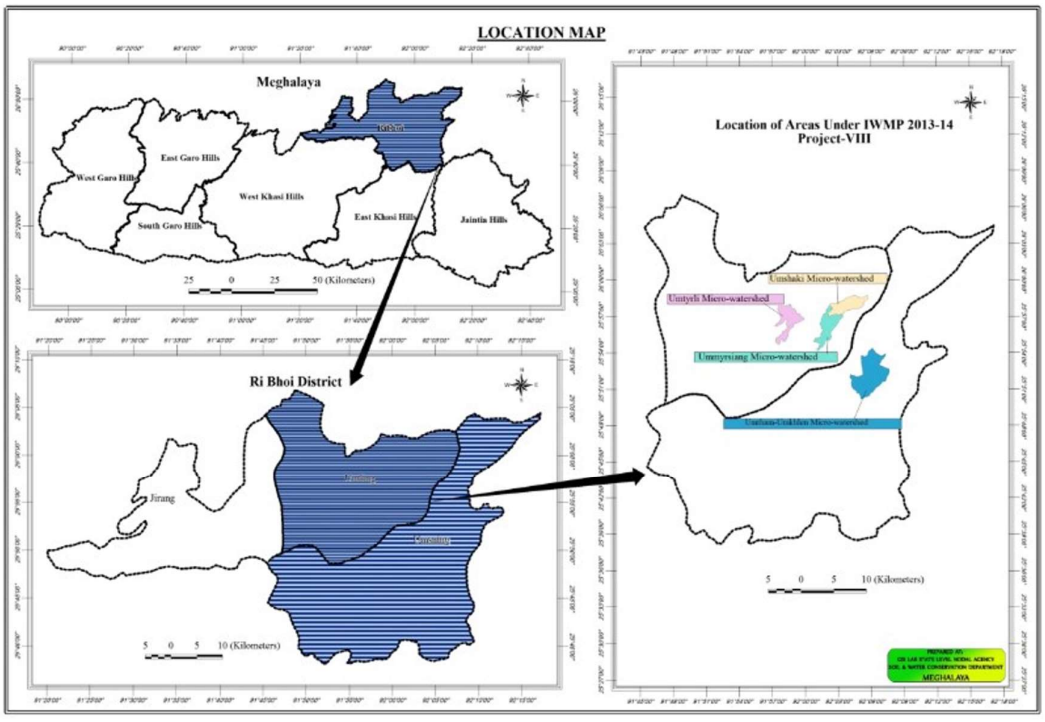
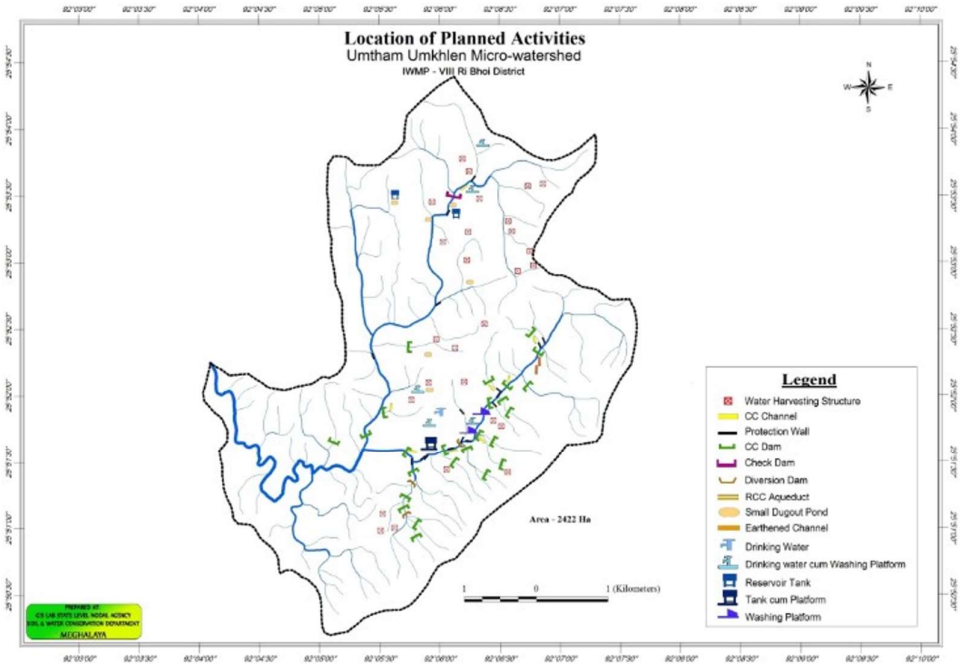
Mapping Exercises for Watershed Management Projects



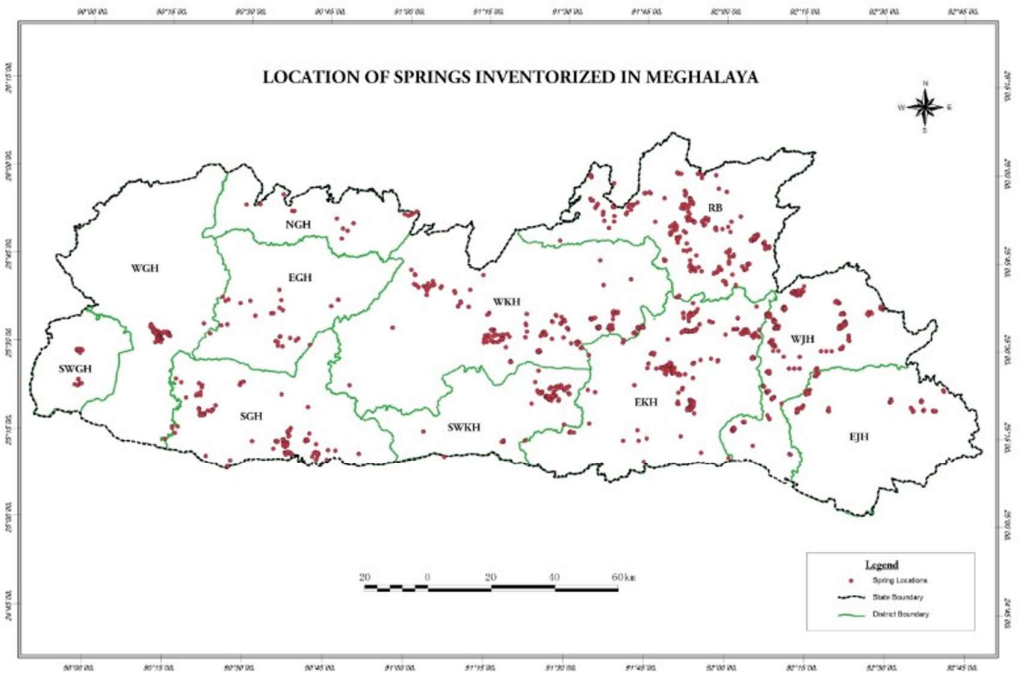


Geo-spatial Applications in Springshed Management (Valley to Valley Approach)

- Inventorization of Springs across the state
- Springshed Development by Cluster approach
- Classification of Vulnerability class of Springs based on Field survey
- Delineation of Springshed Boundary
- Identification of Recharge Areas based on Geological Features(Dip and Strike, Fractures, Parent Materials)
- Preparation of Resource Maps (LULC/Soil/Drainage/ etc)
- Preparation of Planned Activities Maps
- Monitoring, Evaluation & Documentation

District Wise Spring Inventorization

Sl No	Districts	Numbers of Springs mapped
1	East Khasi Hills District	247
2	West Khasi Hills District	469
3	South West khasi Hills District	96
4	East Jaintia Hills District	222
5	West Jaintia Hills District	301
6	Ribhoi District	264
7	East Garo Hills District	453
8	South Garo Hills District	104
9	South West Garo Hills District	301
10	West Garo Hills District	250
11	North Garo Hills District	155
	Total	**2862**



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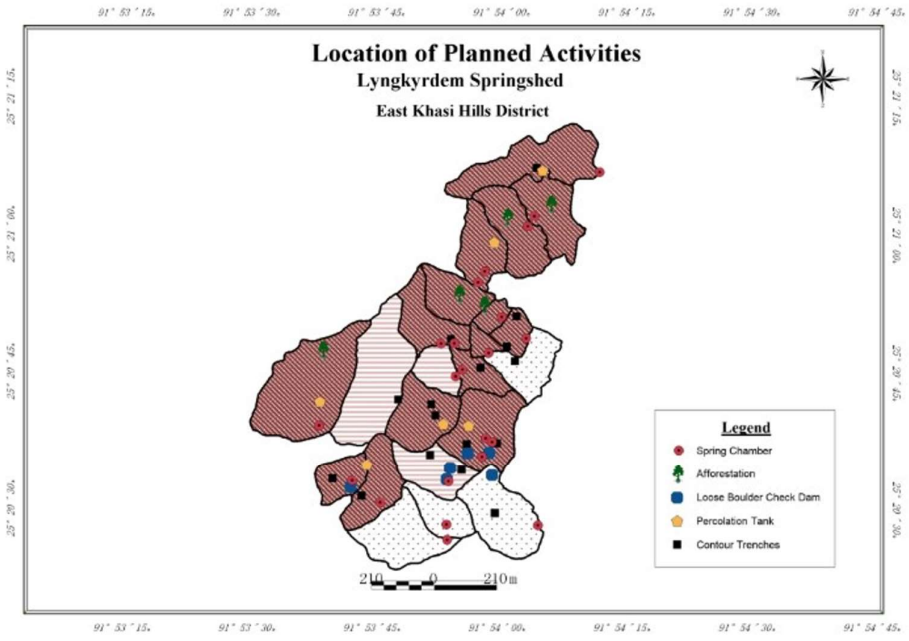
Mapping Exercises for Springshed Development Projects



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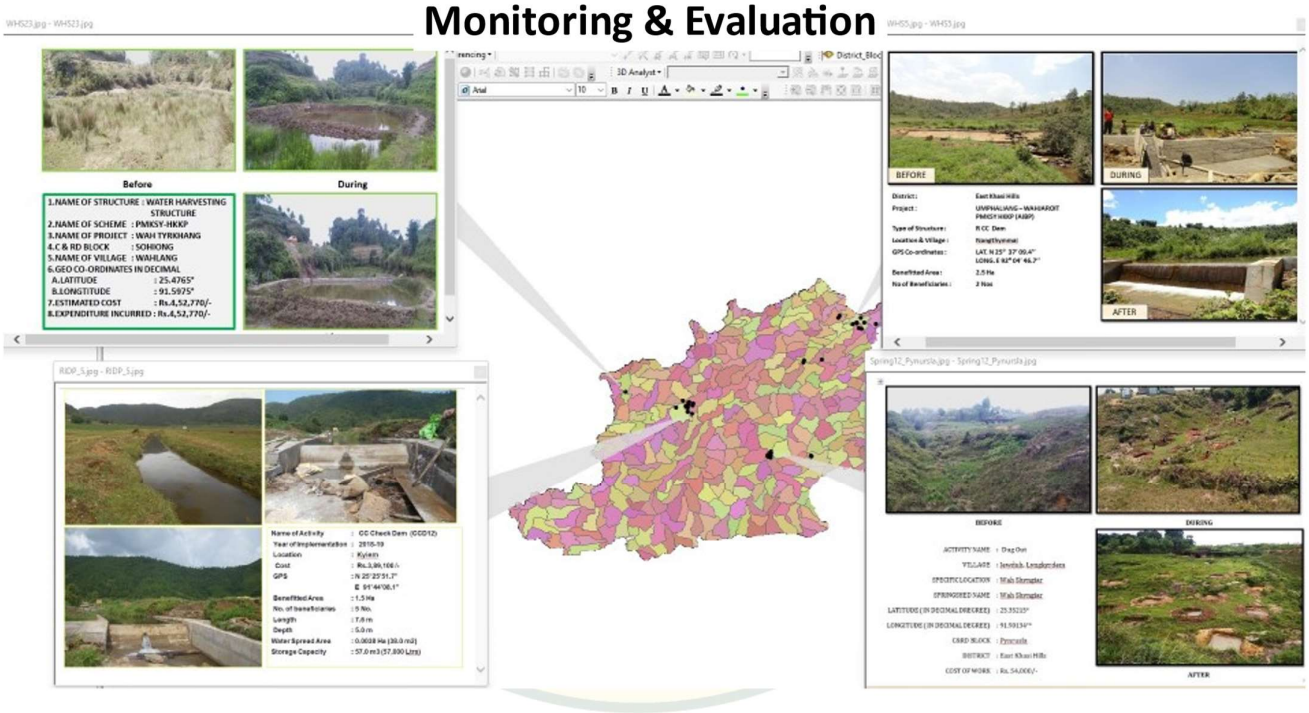
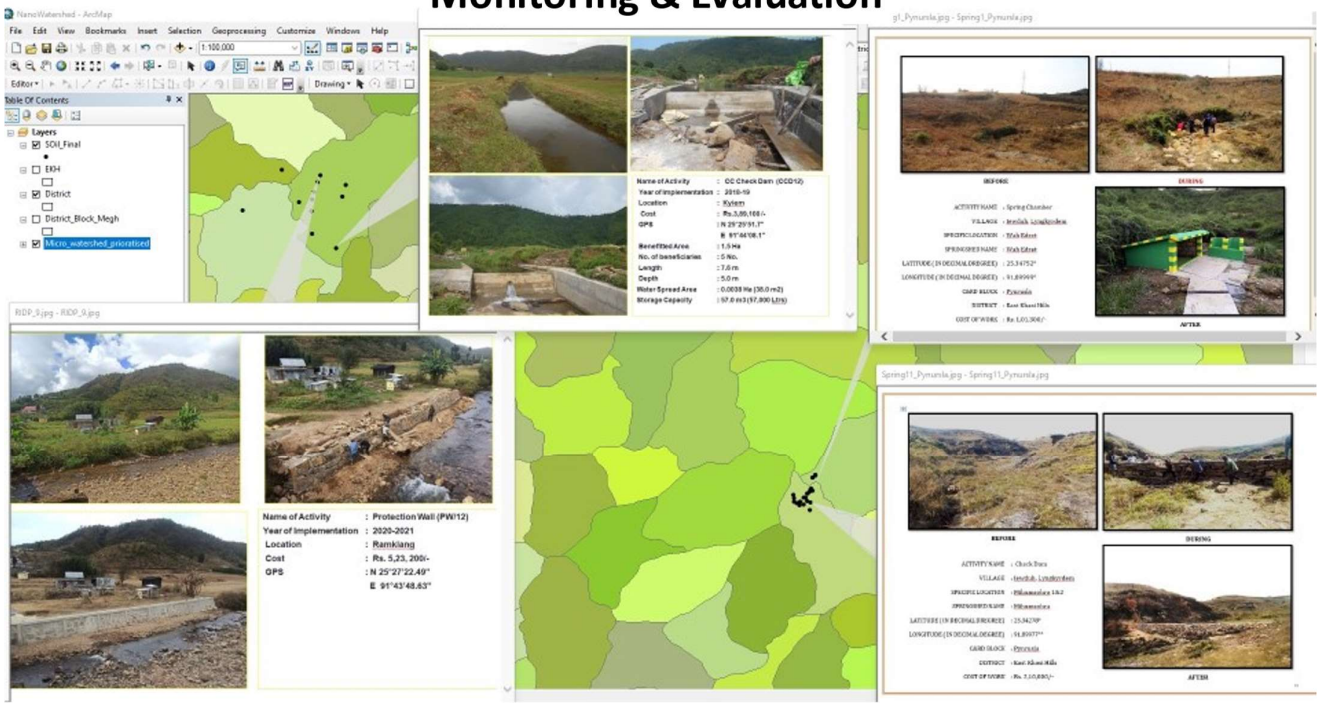
Monitoring & Evaluation



Monitoring & Evaluation



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Government of Meghalaya
DEPARTMENT OF WATER RESOURCES

TOPIC – GEO-SPATIAL APPLICATIONS IN STATE WATER RESOURCES DEPARTMENT

INTRODUCTION

WRD Using Geospatial technology **to collect(by D-GPS/H-GPS/Total Station & Mobile App), analyse the result in GIS software** [Paid Software (ArcGIS Pro) & Open Source (QGIS)] **and store geographic information in the Cloud databae (Online / GEE/ GitHub).**

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GEO-SPATIAL APPLICATION

WRD have divided the application of GIS into two Parts

- 1- BASIC APPLICATION
- 2-ADVANCE APPLICATION

BASIC APPLICATION OF GIS

- ALL THE TECHNICAL STAFFS(ASST-ENGINEER & JUNIOR ENGINEER) OF 11 DIVISIONS KNOW ALL THE SIMPLE GIS APPLICATION IN LOCATING THE CHECK DAM , HEADWORK ,CANAL LINE ,PIPE LINE, etc IN GOOGLE EARTH PRO BY SAVING THE FILE IN KML/KMZ FORMAT ,THEN DIGITIZE AND ANALYSE TO GENERATE THE SHAPEFILE AND MAP IN GIS SOFTWARE IN PREPARING THE DPR.
- FOR QUICK SUBMISSION/INFORMATION WRD GIS EXPERTS HAS DEVELOPED THE ONLINE-GIS WEB-MAPPING APPLICATION EDITING TOOLS THROUGH ONLINE FOR INFORMATION IF THE PROJECT DEAL ONLY WITH SIMPLE SHAPEFILES (POINT ,LINE & POLYGON)

TO CALIBRATE AND VALIDATE THE GROUND TRUTH –

1. FINAL SURVEY BY DGPS &T-STATION
2. PRELIMINARY SURVEY BY MOBILE APP OR H-GPS .

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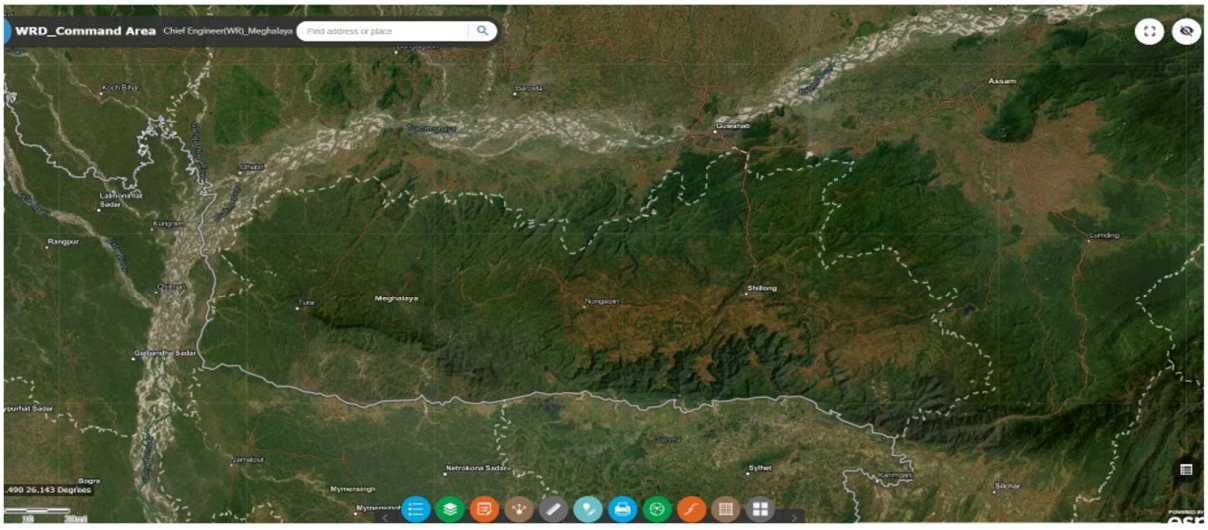
ADVANCE APPLICATION

- WE HAVE ENGINEERS IN THE OFFICE OF CHIEF ENGINEER ,SHILLONG & FEW EXPERT ENGINEERS IN THE DIVISION OFFICE TO HANDLE THE MODELLING SECTION LIKE HOW TO WRITE SCRIPT IN GEE PLATFORM , PERFORM AND SIMULATE THE MODEL IN SOFTWARE LIKE HEC(Hydrologic Engineering Centre) i.e HecHMS(Hydrologic Modelling System) & HecRAS(River Analysis System) & CREATING PYTHON SCRIPT FOR MODELLING IN ArcGIS PRO.

WEB-MAPPING APPLICATION EDITING WITH TOOLS



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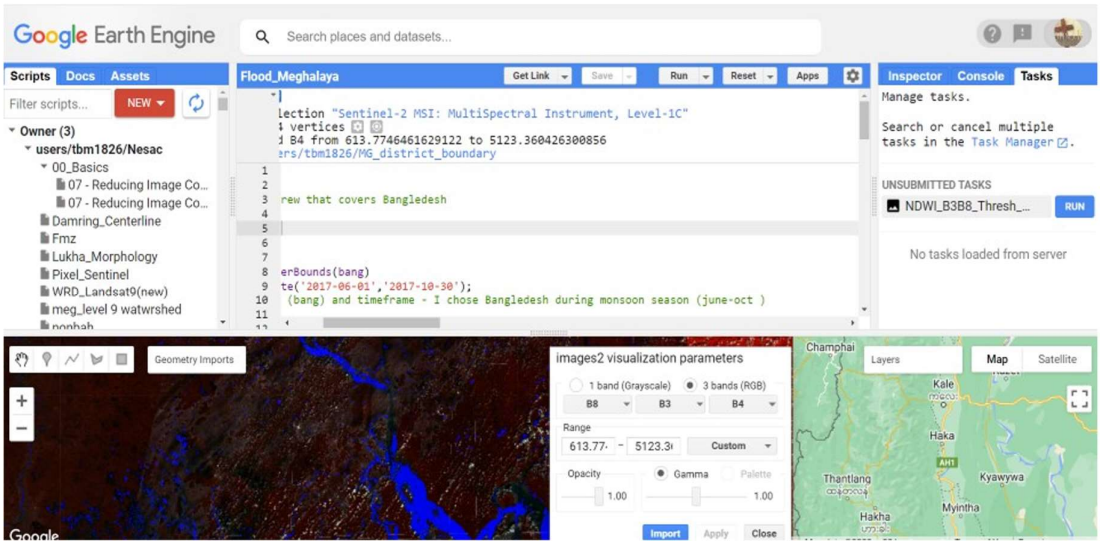
DEPT OF WATER RESOURCES WORKING APPLICATION IN THE GS TECHNOLGY

- GEE SCRIPT
- GIS APPLICATION
- CLOUD DATABASE
- MODELLING

GEE SCRIPT



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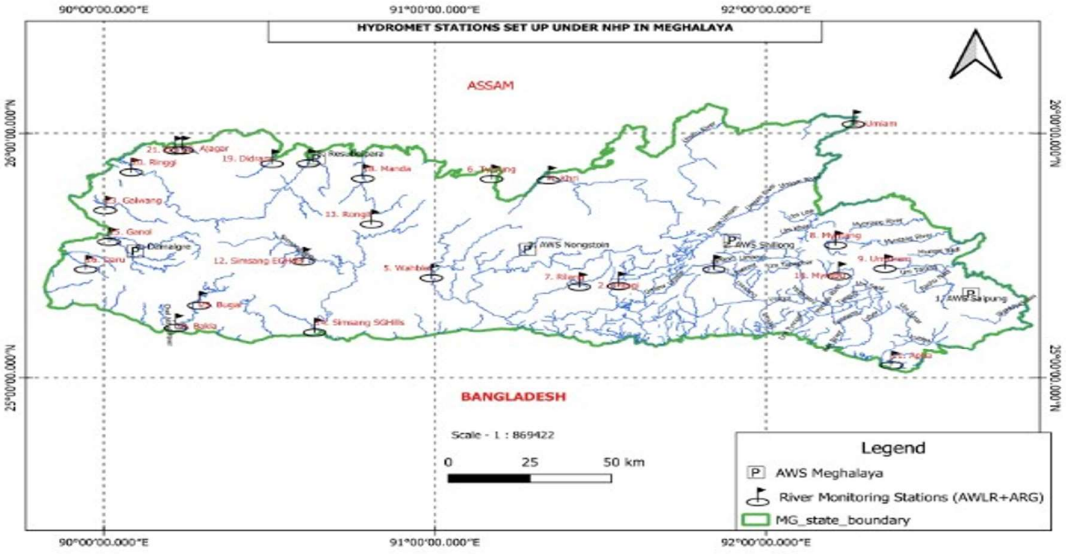
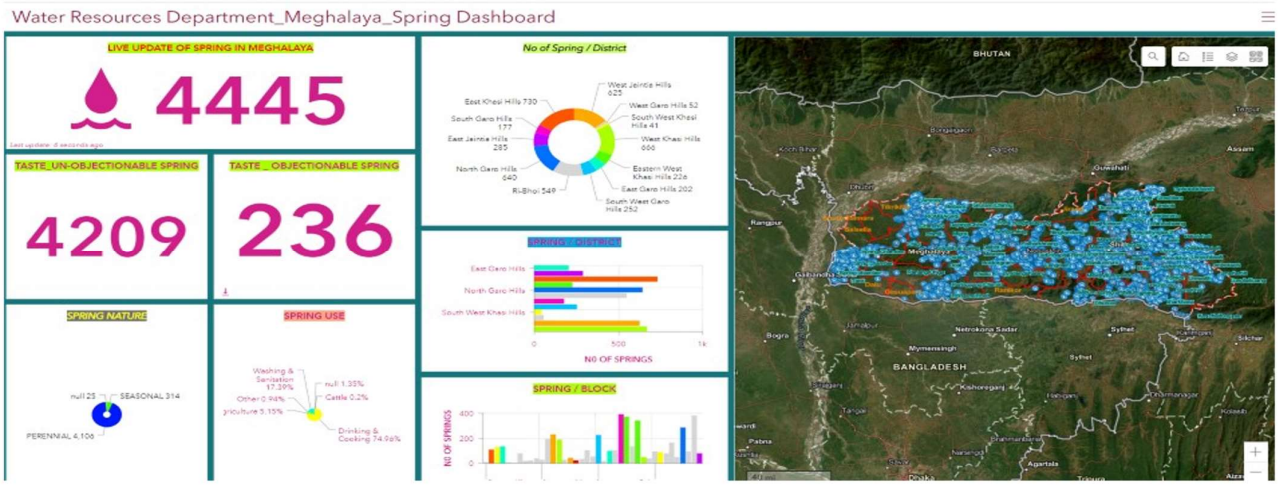
GIS APPLICATION With Hydomet Stations Map



CLOUD DATABASE WITH LIVE SPRING DASHBOARD DEVELOPED IN THE ONLINE PORTAL UPDATED LIVE BY MOBILE APP

UPDATED DATE – 17/11/2022 AT 7:00 PM



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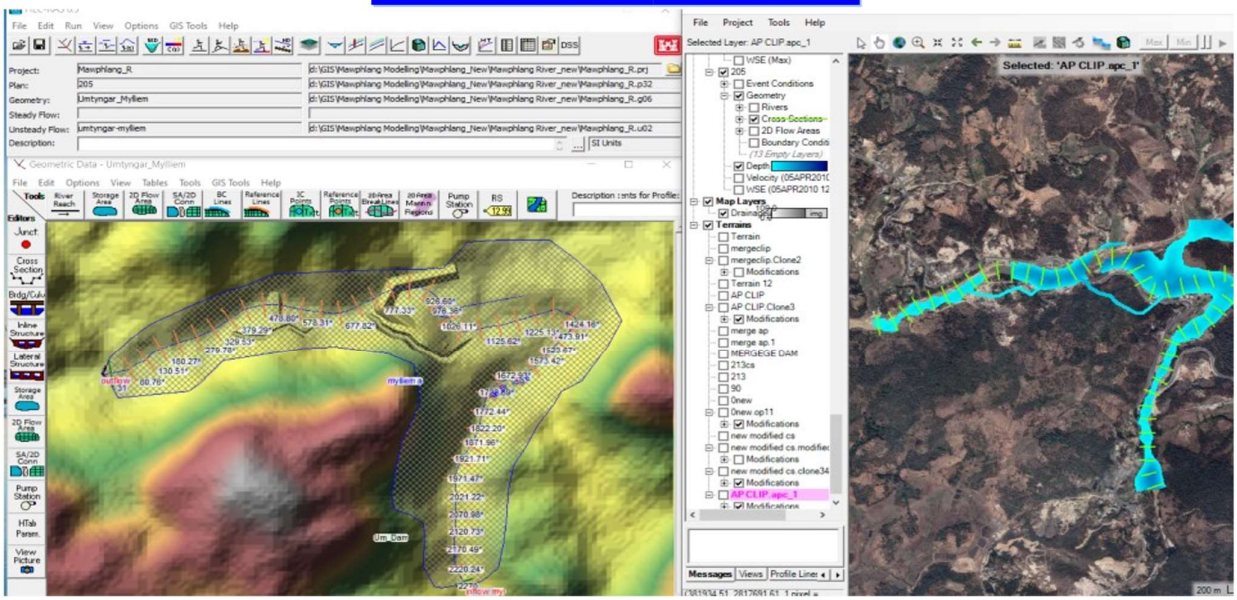
MODELLING OF RIVER C/S , CHANNEL & DAM DESIGN BY HECRAS



THANK YOU

WATER RESOURCES DEPARTMENT MEGHALAYA

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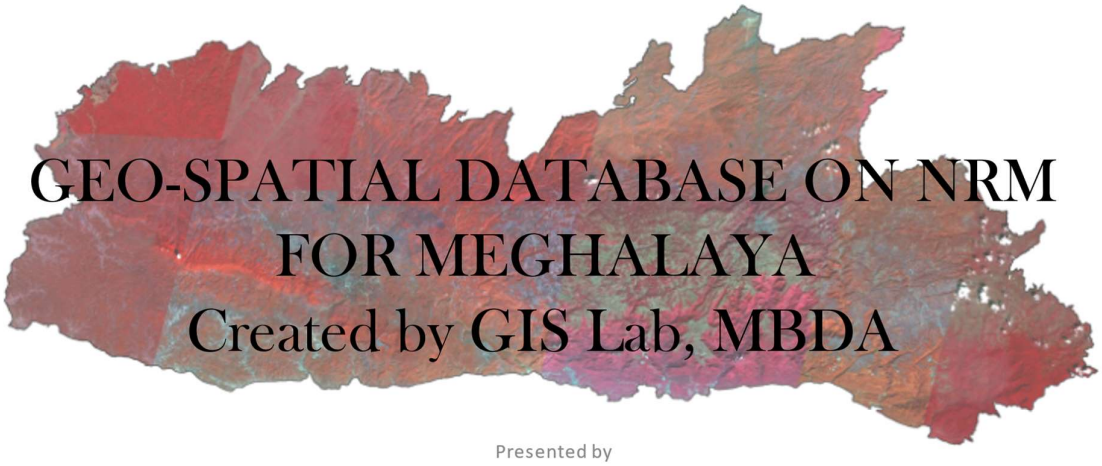

GEO-SPATIAL DATABASE ON NRM FOR MEGHALAYA
Created by GIS Lab, MBDA

Presented by
AibiangMeka Kharsahnoh
GIS Lab, MBDA/MBMA

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THE WORLD BANK

LIST OF LAYERS:

1. Administrative Boundaries
2. Land Use Land Cover
3. Forest Cover
4. Forest Type
5. Reserved Forests & Protected Areas
6. Sacred Grooves
7. Forest Fire Points
8. Drainage Network
9. Soil
10. Geology
11. Road Network
12. Village Locations
13. Digital Terrain Model
14. Slope
15. Aspect
16. Watershed
17. Sub Watershed
18. Micro Watershed
19. Agro-Ecological Regions
20. Temperature
21. Rainfall
22. Community Nurseries
23. Automatic Weather Stations
24. Water Quality at Monitoring Locations
25. Mosaicof IRS LISS IV
26. Mosaic of Merged IRS LISS IV and Cartosat1
27. MosaicToposheet, 1:25,00 &1: 50,000
28. Umiew and Ganol Catchment Area
29. Springs Locations
30. CLLMP Village Boundary
31. NRM Boundary
32. Green (PES) Boundary
33. PES Plots
34. CLLMP Land use Land Cover 2012-2013; 2016-2017
35. NDVI
36. Carbon Stock
37. Agro-Climatic Zone
38. Intervention points
39. FMP (Boundary, LULC, Sample Plots, Forest Cover with Community Forest)
40. LRB Locations

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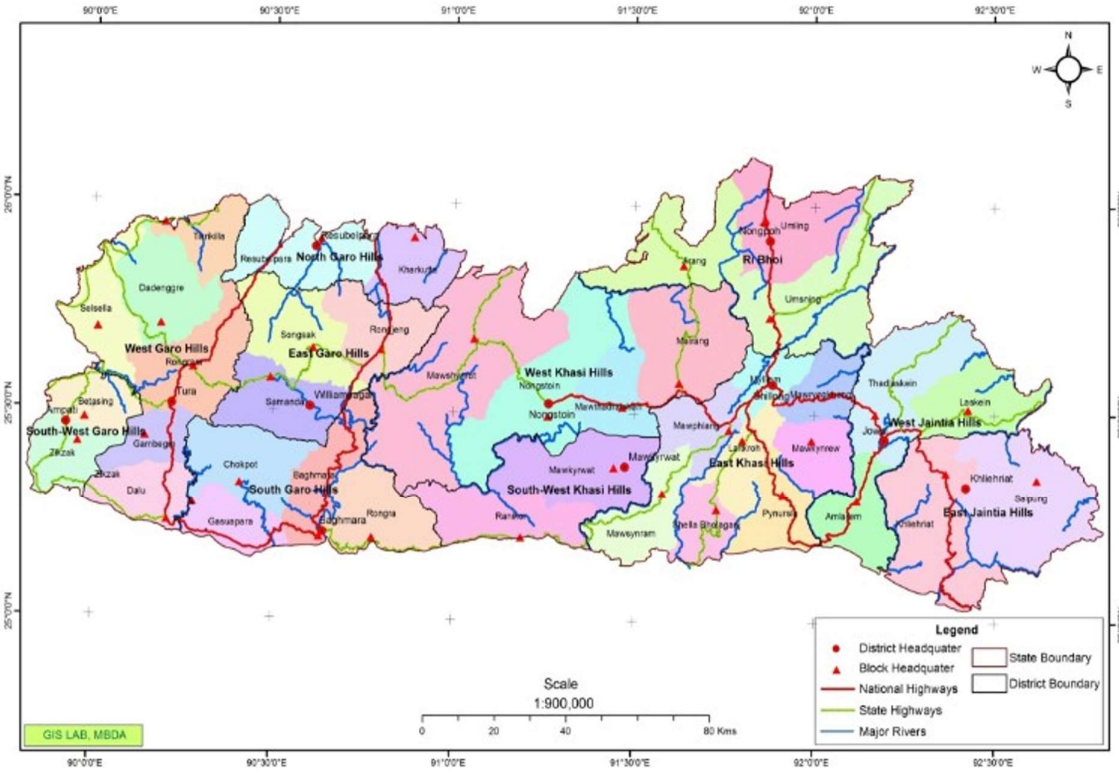
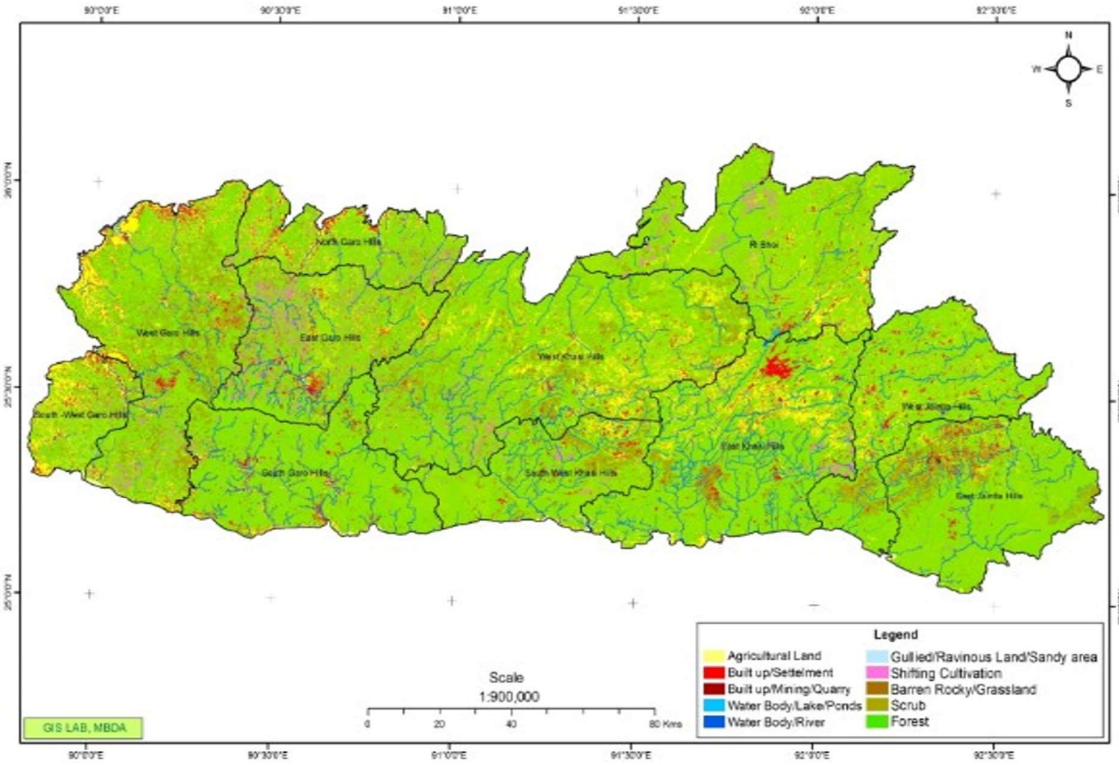
Administrative Map of Meghalaya



Land Use & Land Cover Map of Meghalaya



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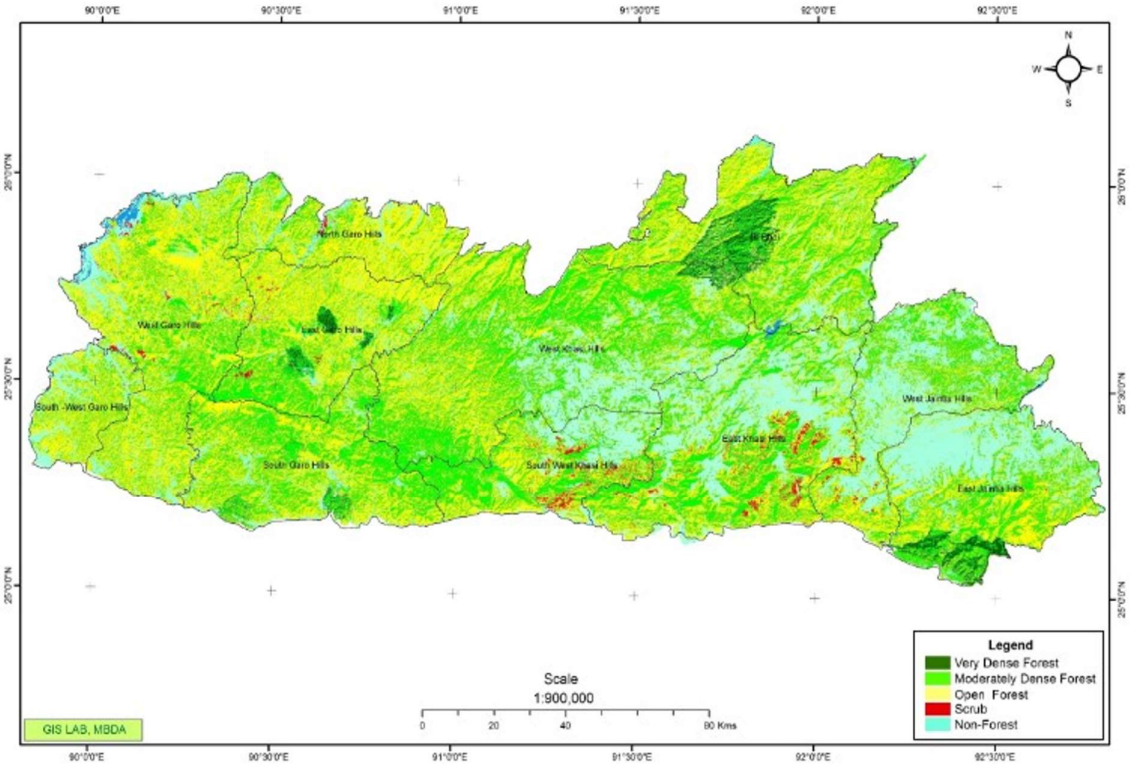
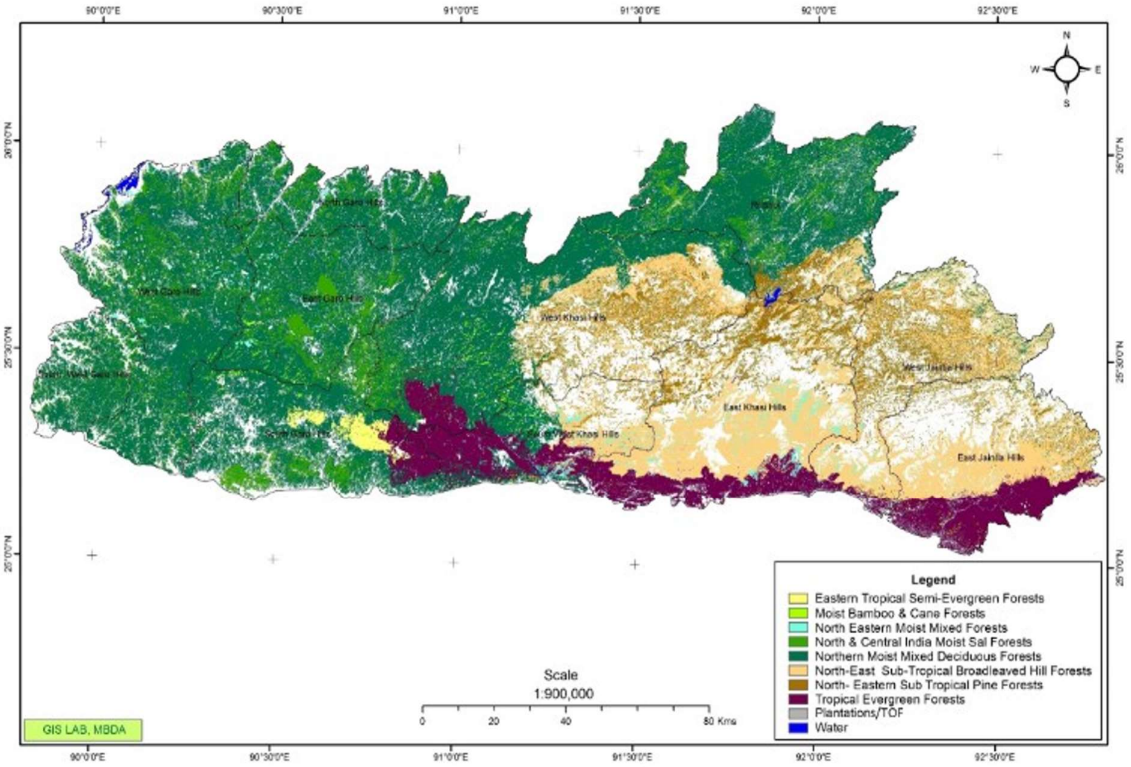
Forest Cover Map of Meghalaya



Forest Type Map of Meghalaya



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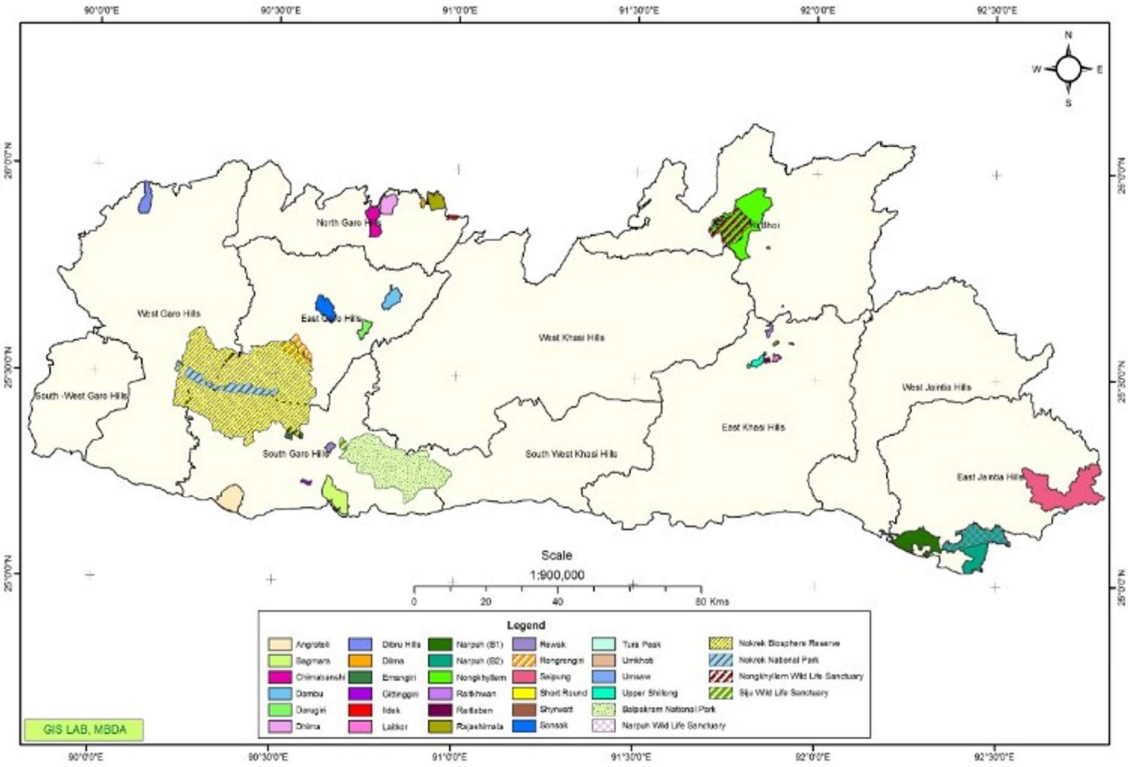
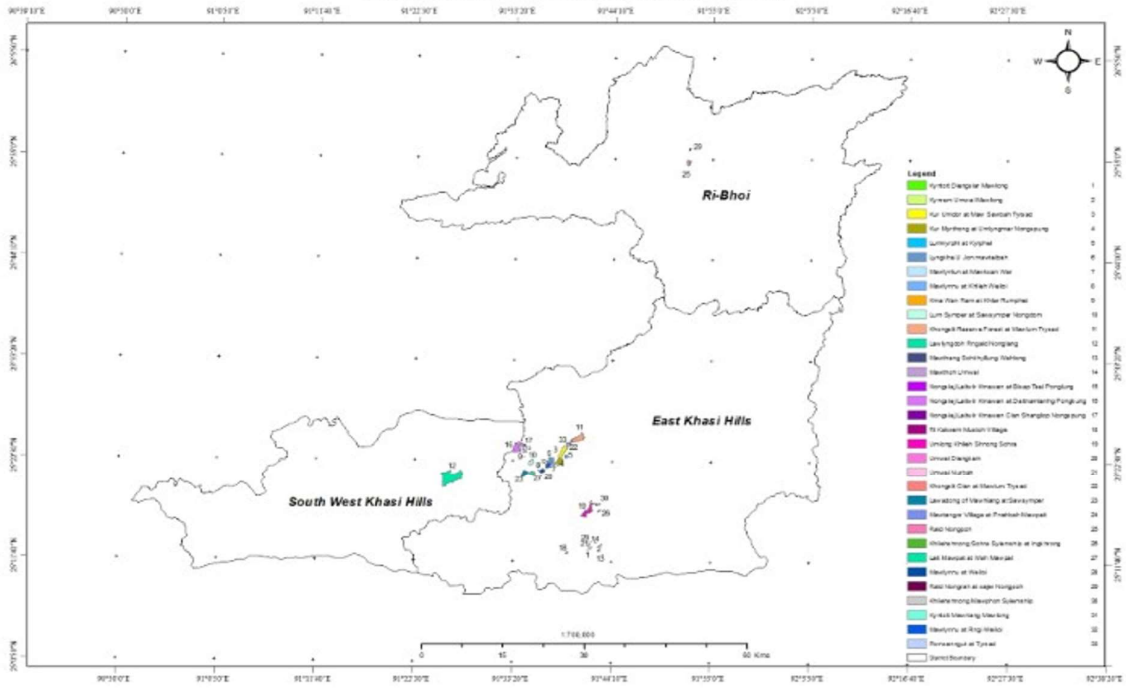
Reserved Forests & Protected Areas (National Parks & Sanctuaries) Map of Meghalaya



Map Showing Sacred Grove in and around East Khasi Hills, South West Khasi Hills and Ri-Bhoi District, Meghalaya



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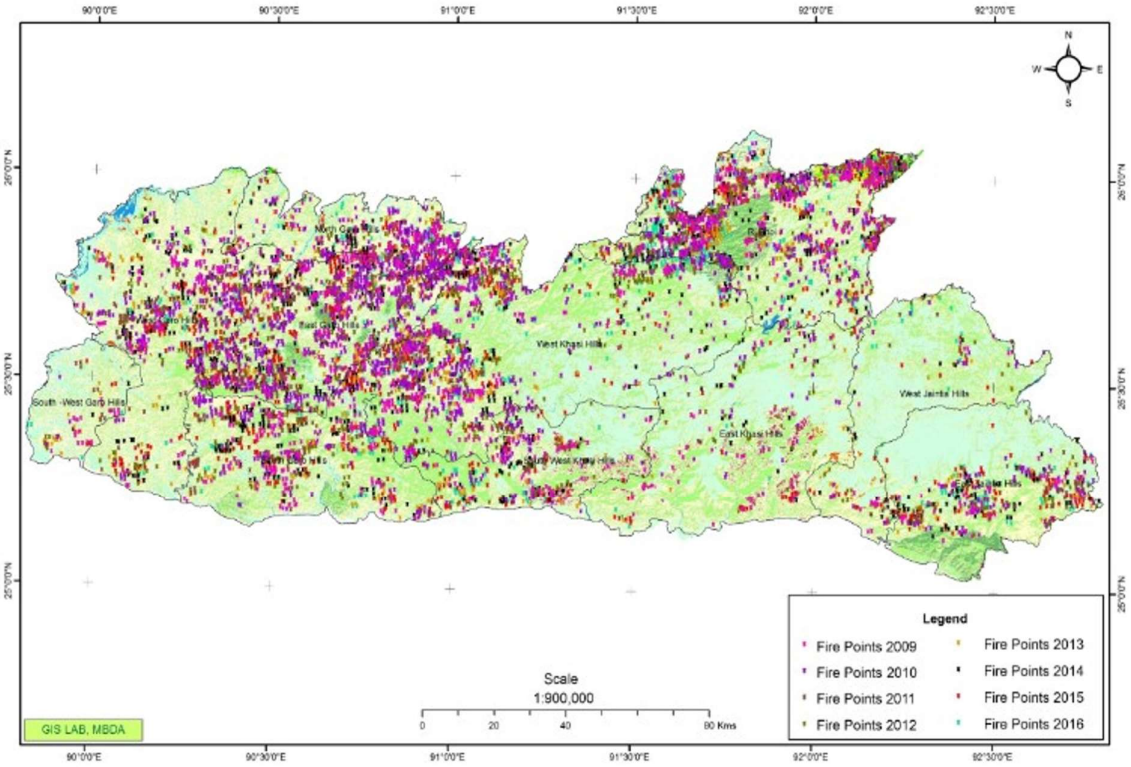
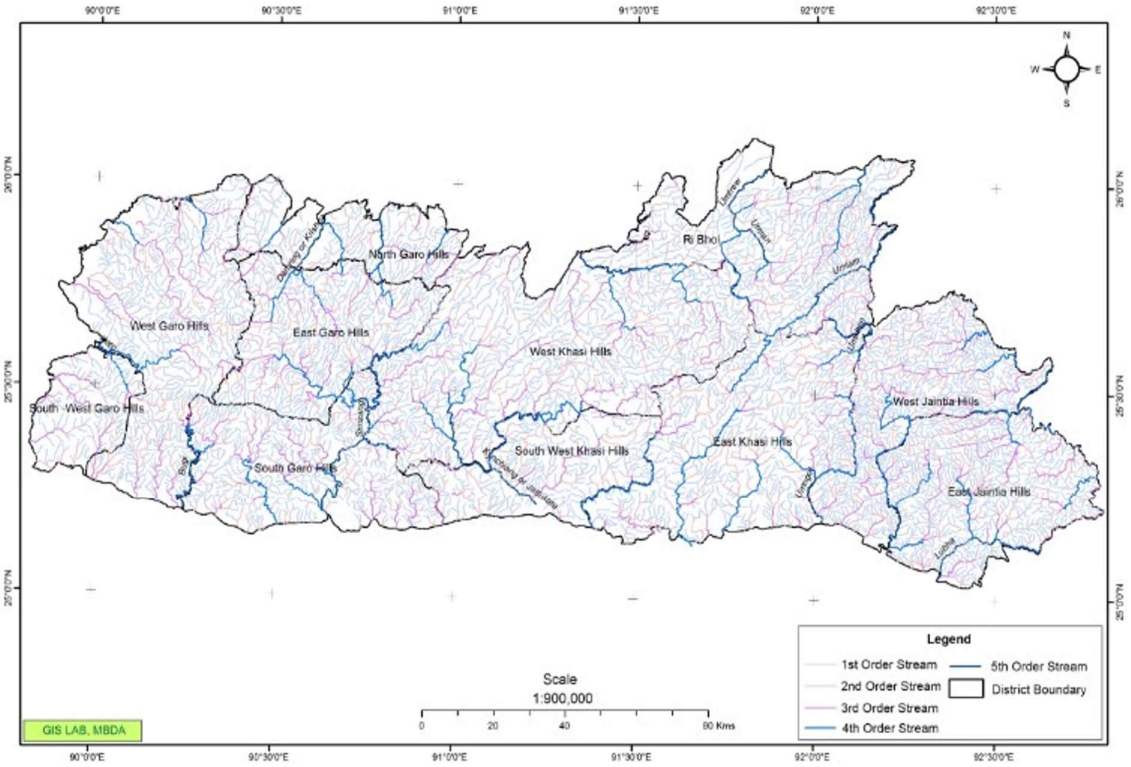
Map Showing Forest Fire Points in Meghalaya (2009 to 2016)



Map Showing Rivers and Streams in Meghalaya (Drainage)



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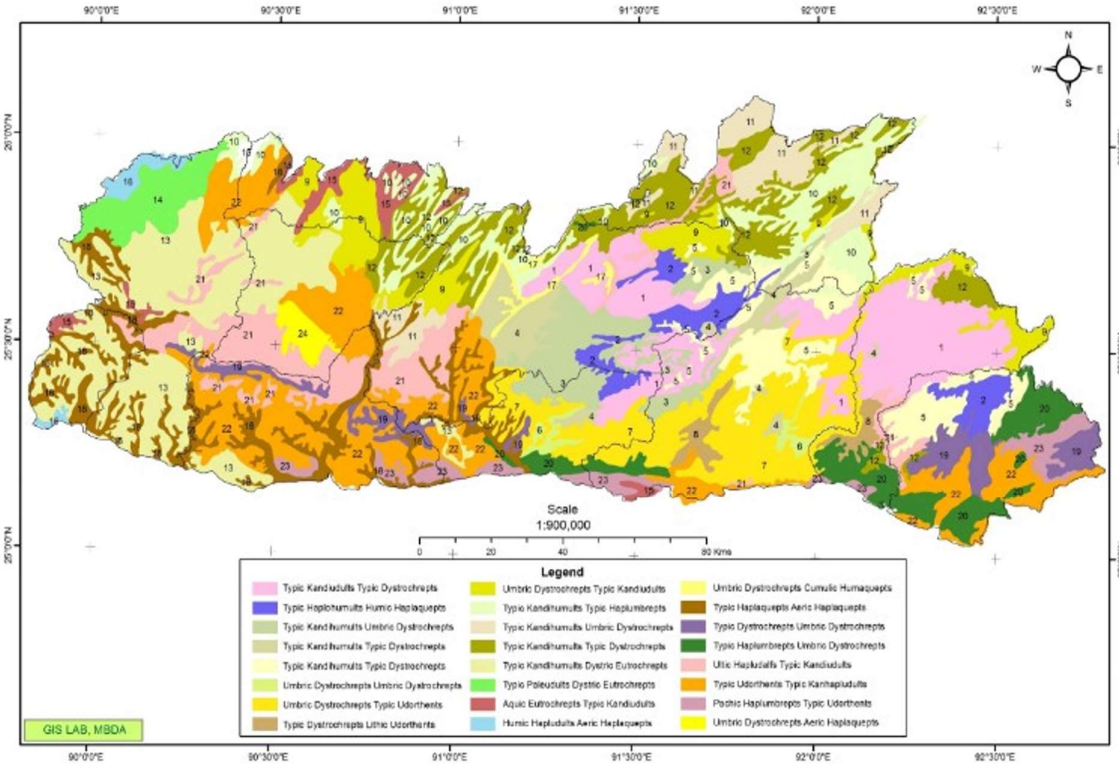
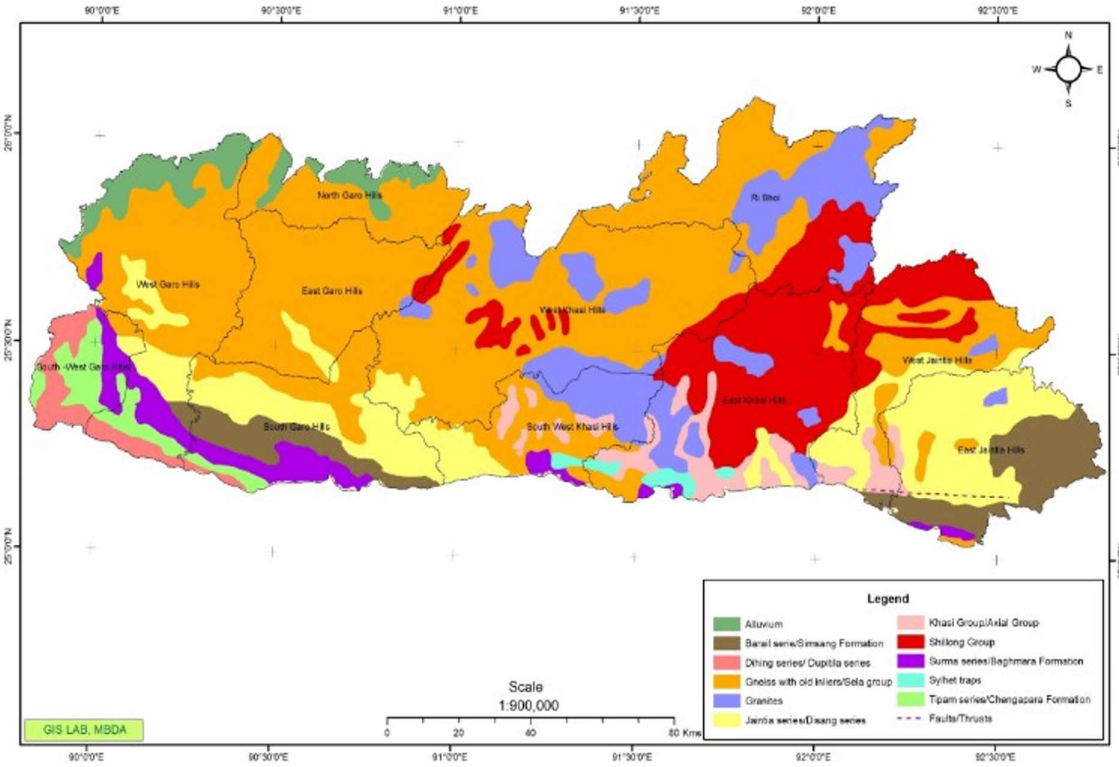
Soil Map of Meghalaya



Geology Map of Meghalaya



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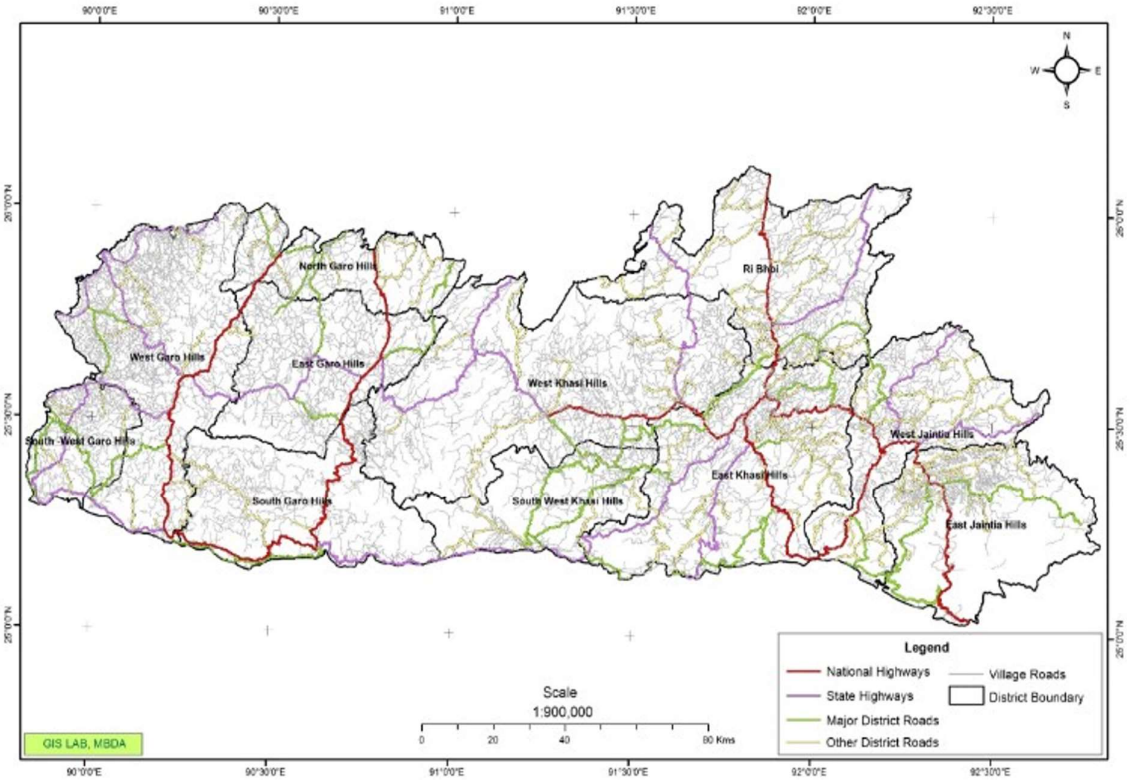
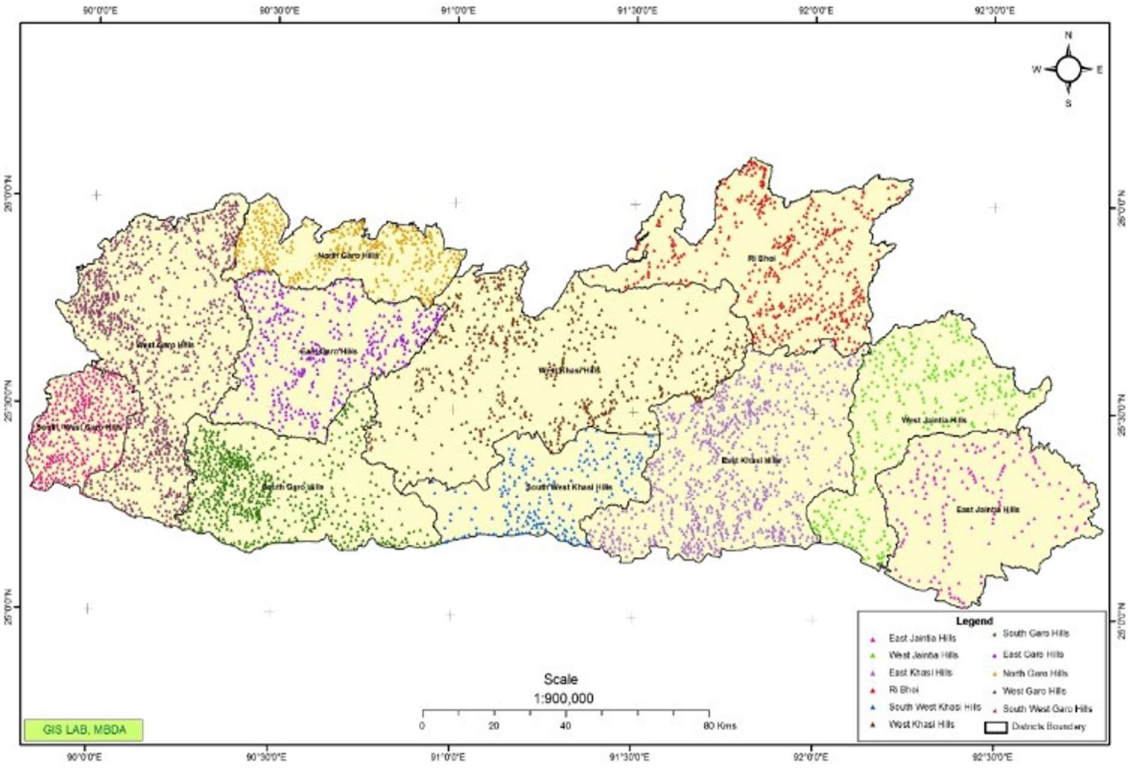
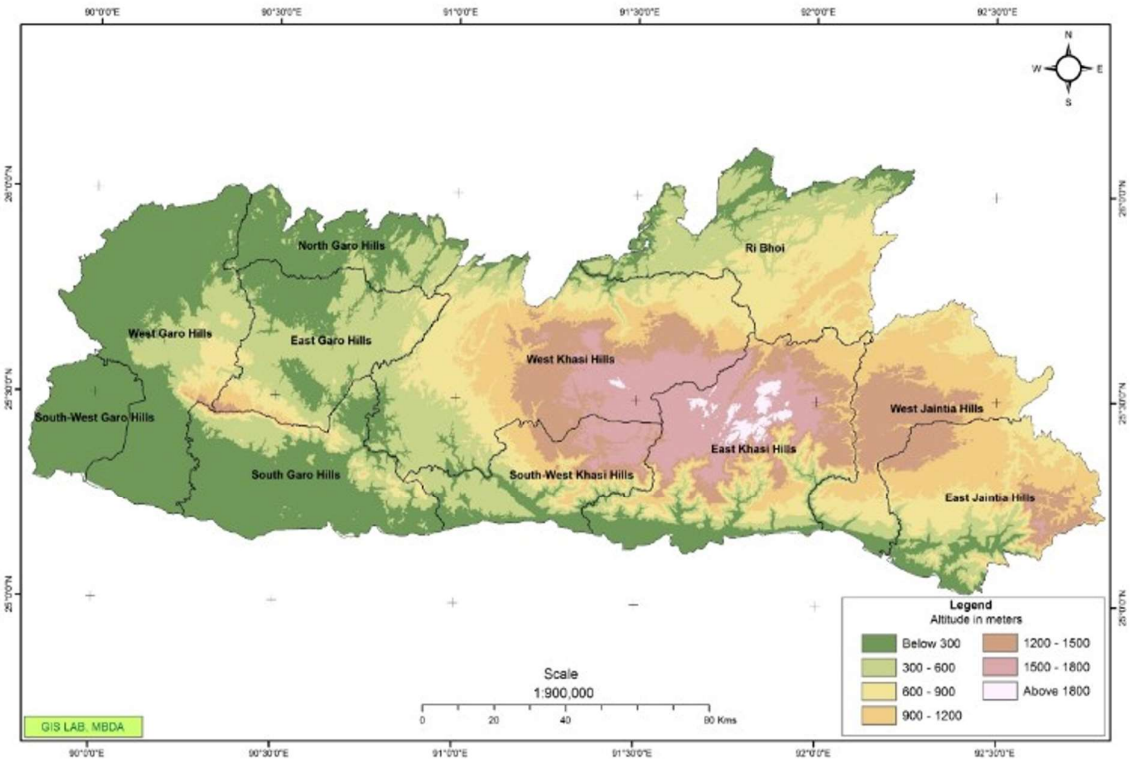
Road Network Map of Meghalaya



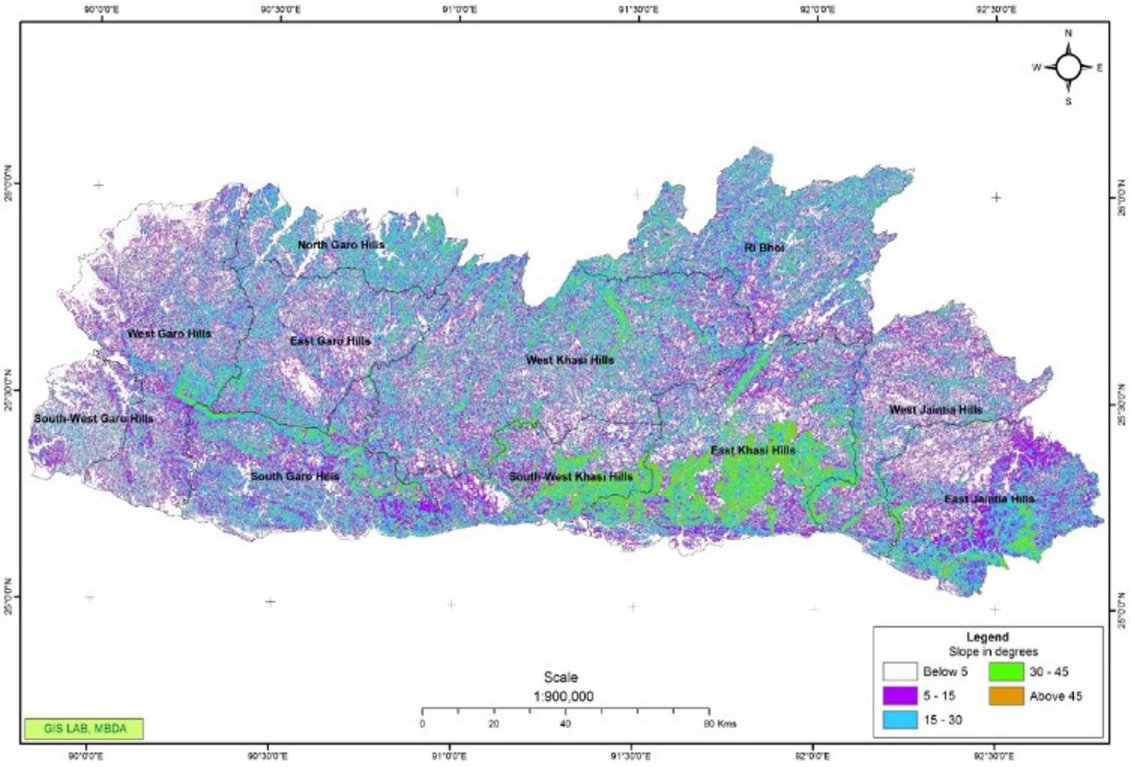
Map Showing Village Locations in Meghalaya

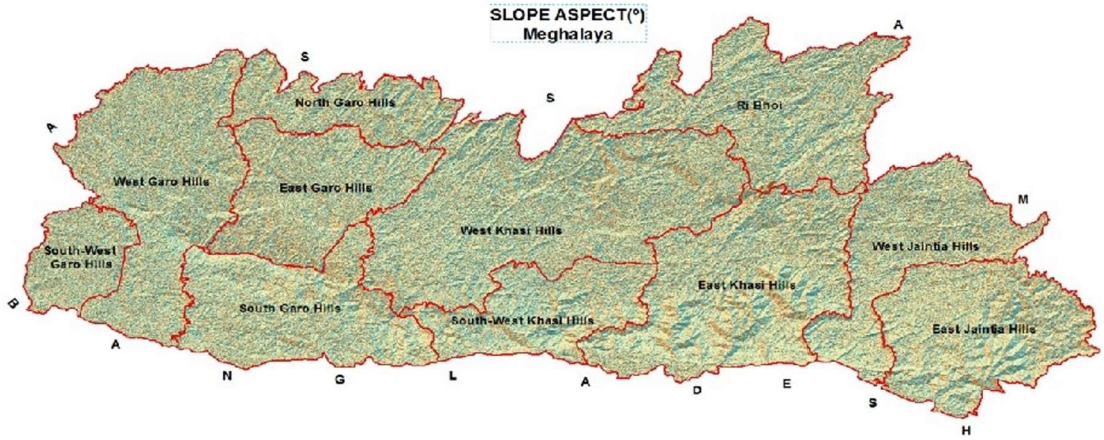


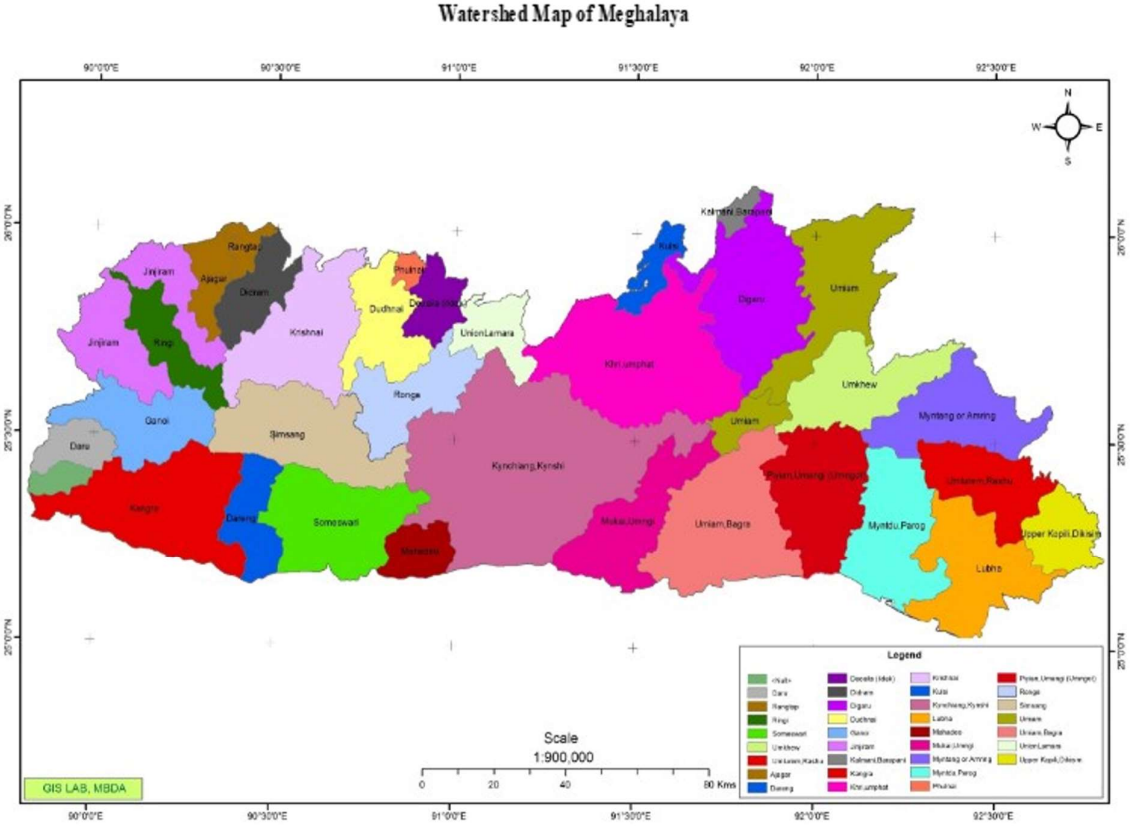
Digital Terrain Model (DTM) of Meghalaya



Slope Map of Meghalaya




SLOPE ASPECT(°)
Meghalaya
North Garo Hills
Ri Bhoi
West Garo Hills
East Garo Hills
West Khasi Hills
West Jaintia Hills
South-West Garo Hills
East Khasi Hills
South Garo Hills
South-West Khasi Hills
East Jaintia Hills


Watershed Map of Meghalaya
Legend
Scale
1:900,000
0 20 40 80 Kms
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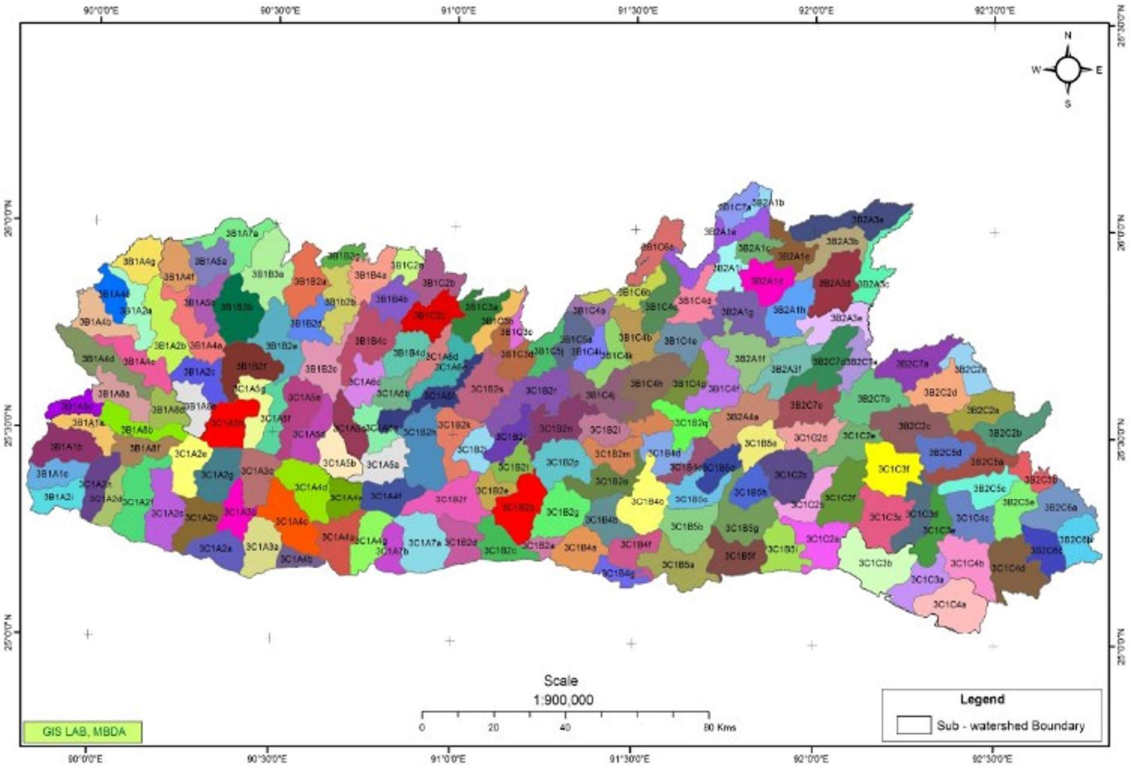
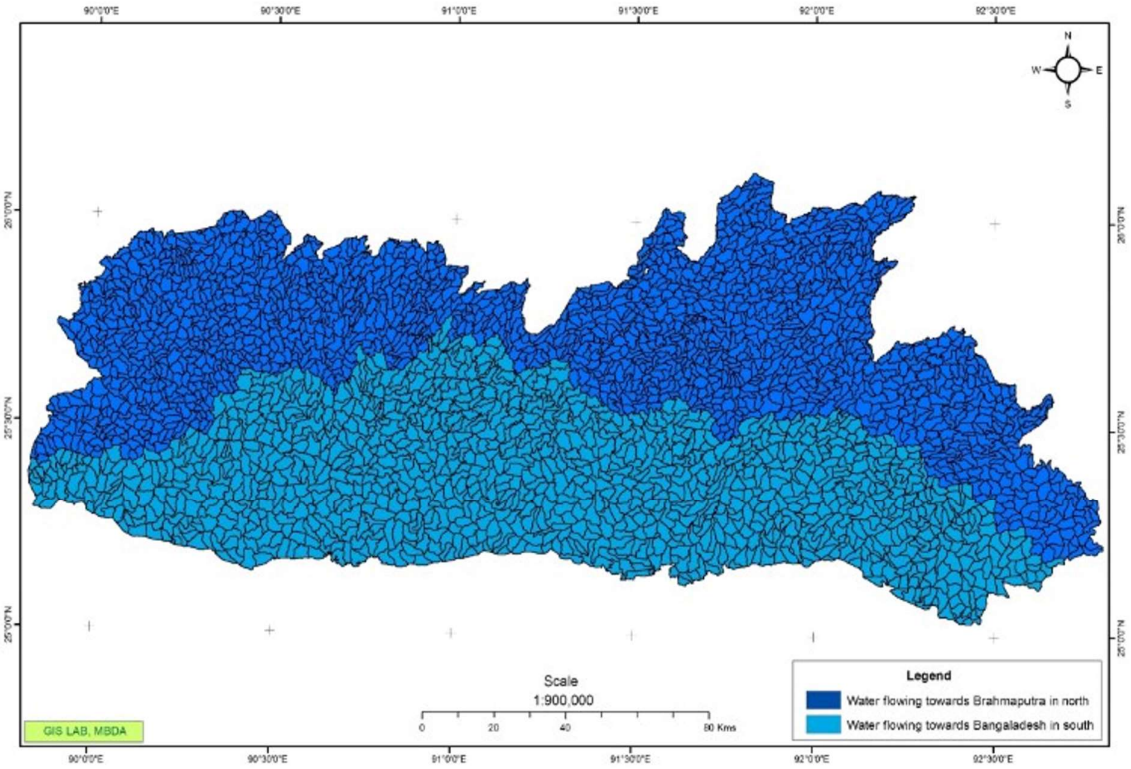
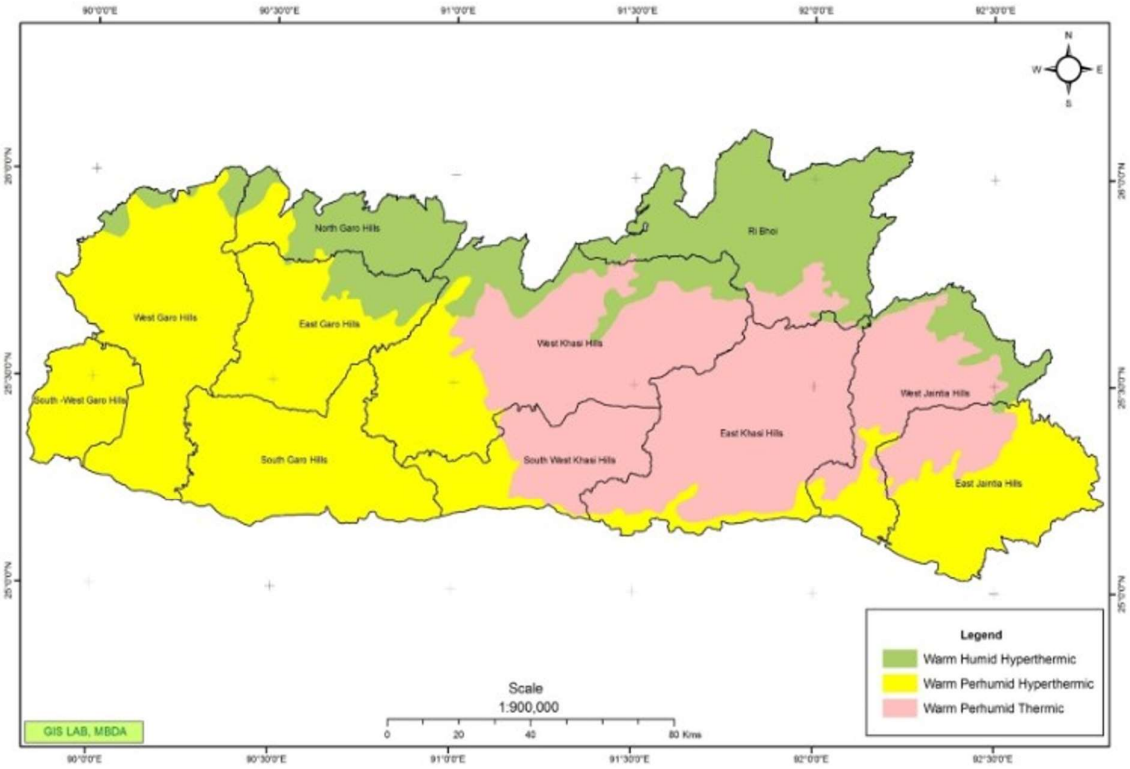
Sub Watershed Map of Meghalaya



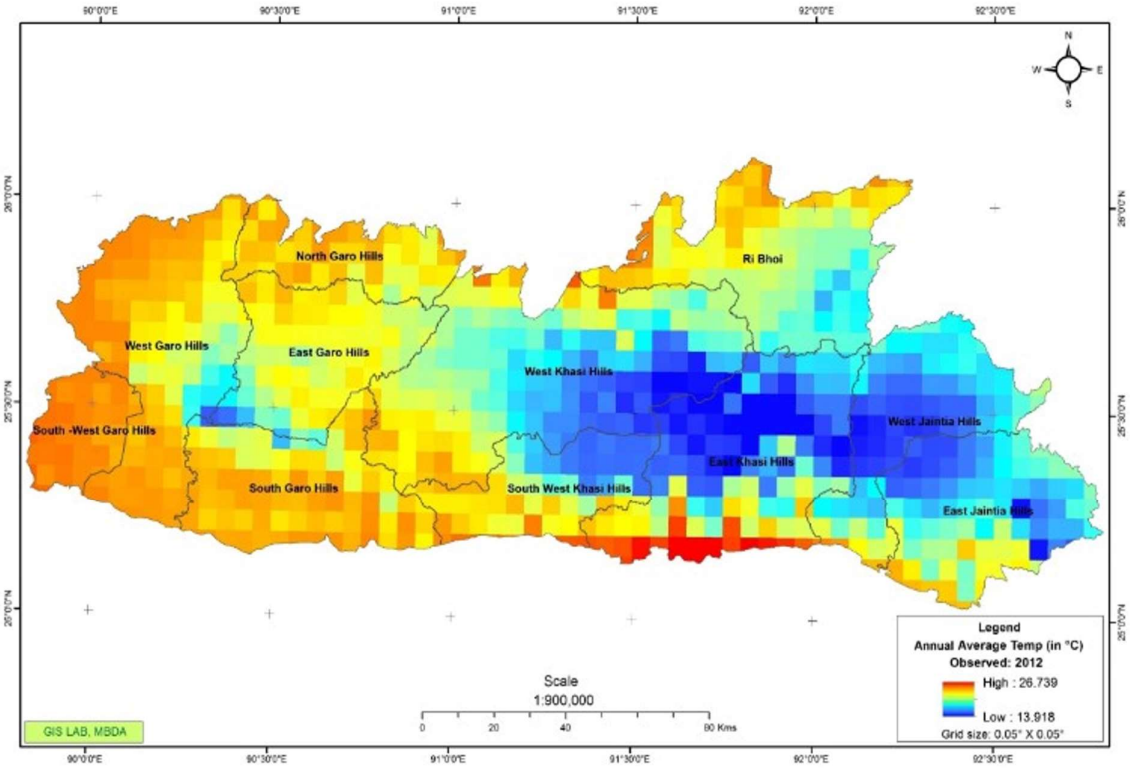
Micro Watershed Map of Meghalaya



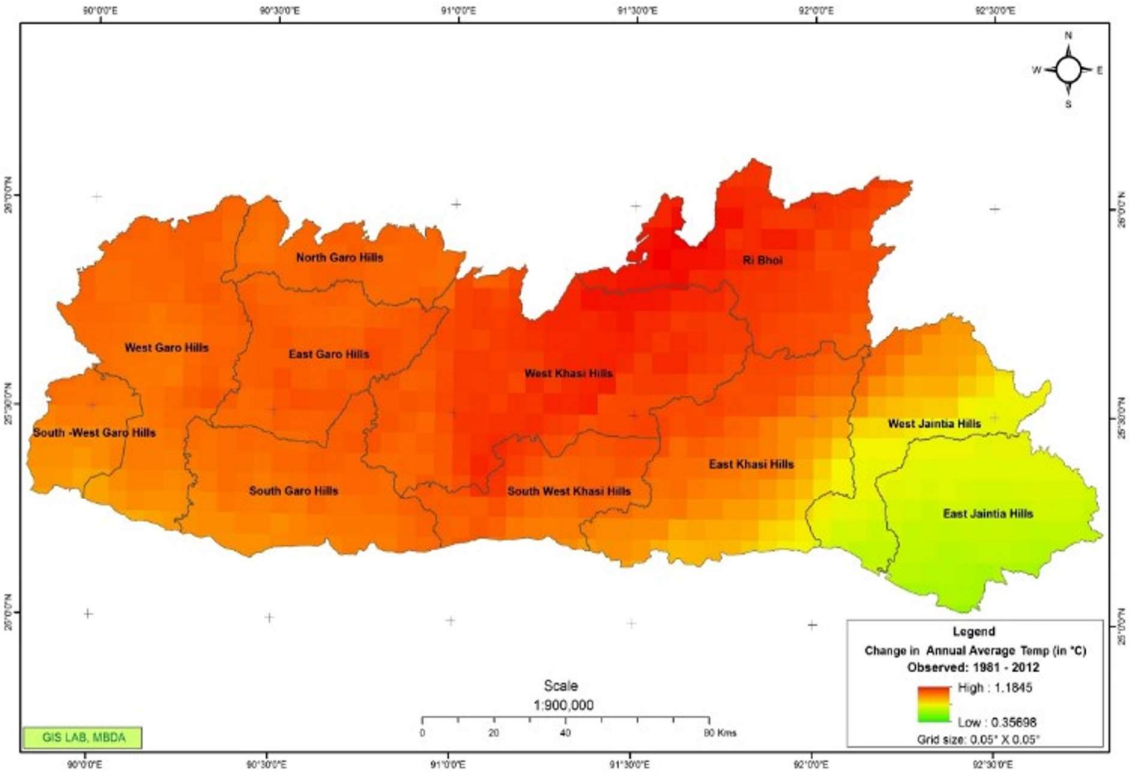
Agro-Ecological , Meghalaya



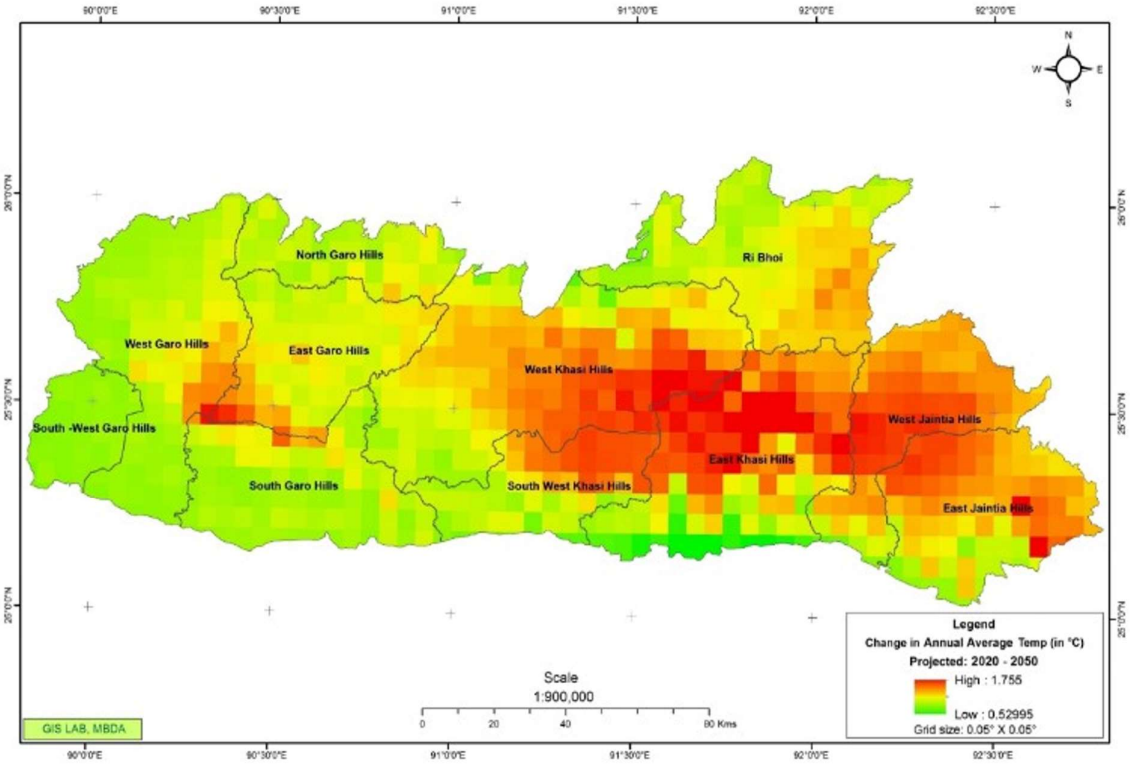
Map Showing Annual Average Temperature in Meghalaya in 2012



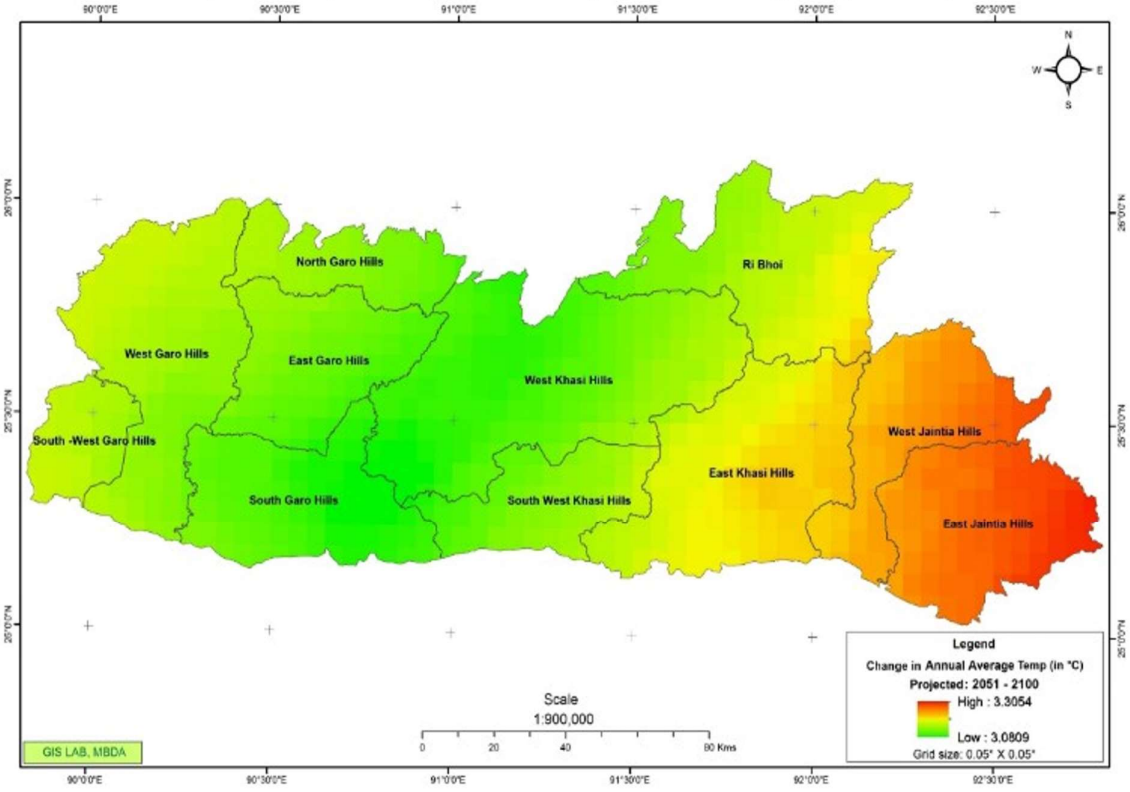
Map Showing Change in Annual Average Temperature in Meghalaya (1981 - 2012)



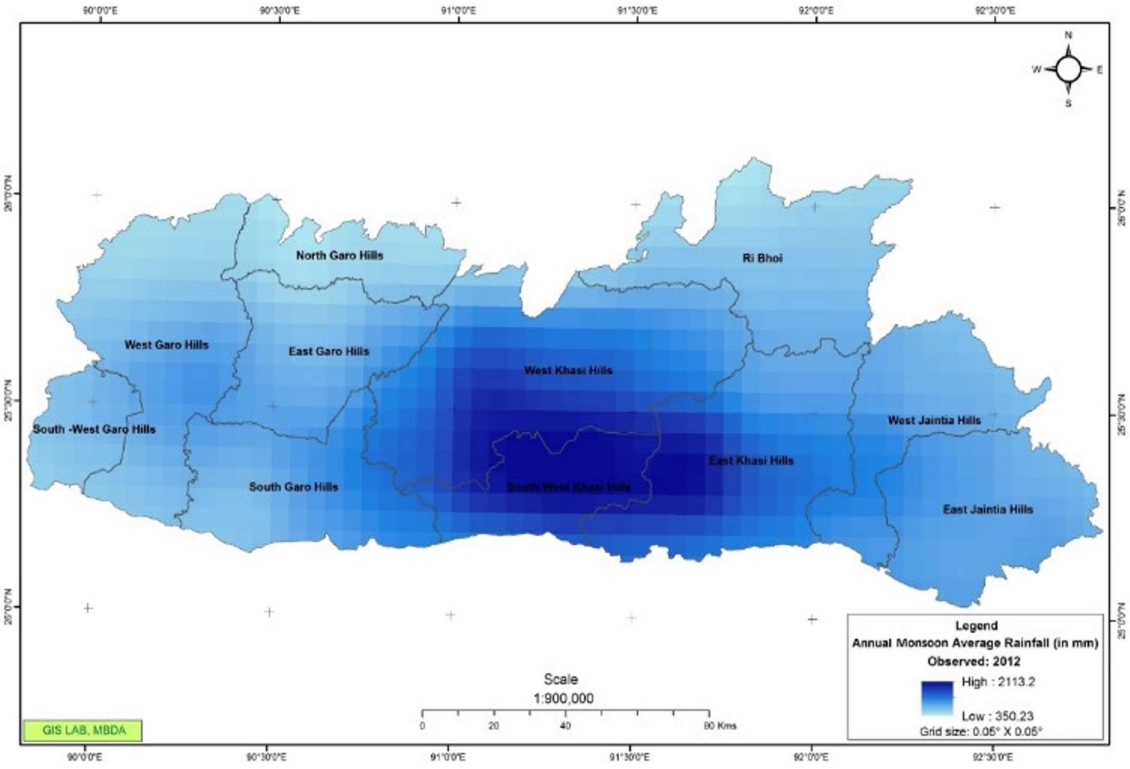
Map Showing Projected Change in Annual Average Temperature in Meghalaya (2020 - 2050)



Map Showing Projected Change in Annual Average Temperature in Meghalaya (2051 - 2100)



Map Showing Annual Average Rainfall in Meghalaya in 2012



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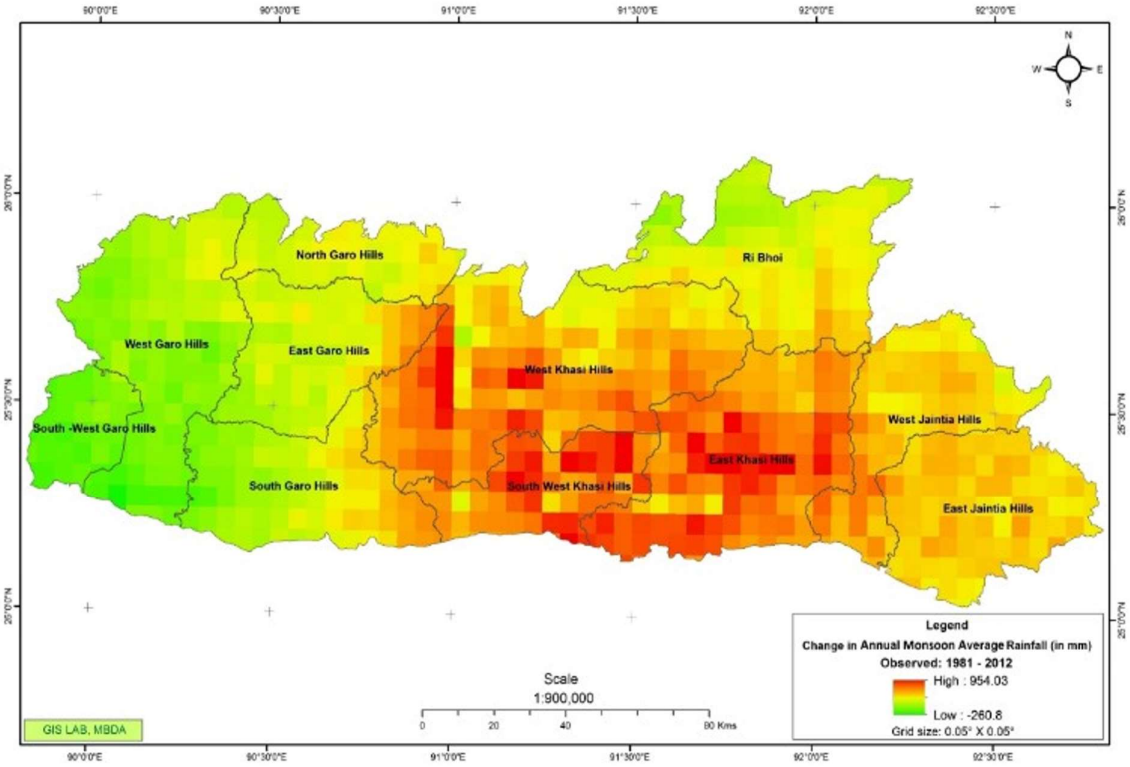
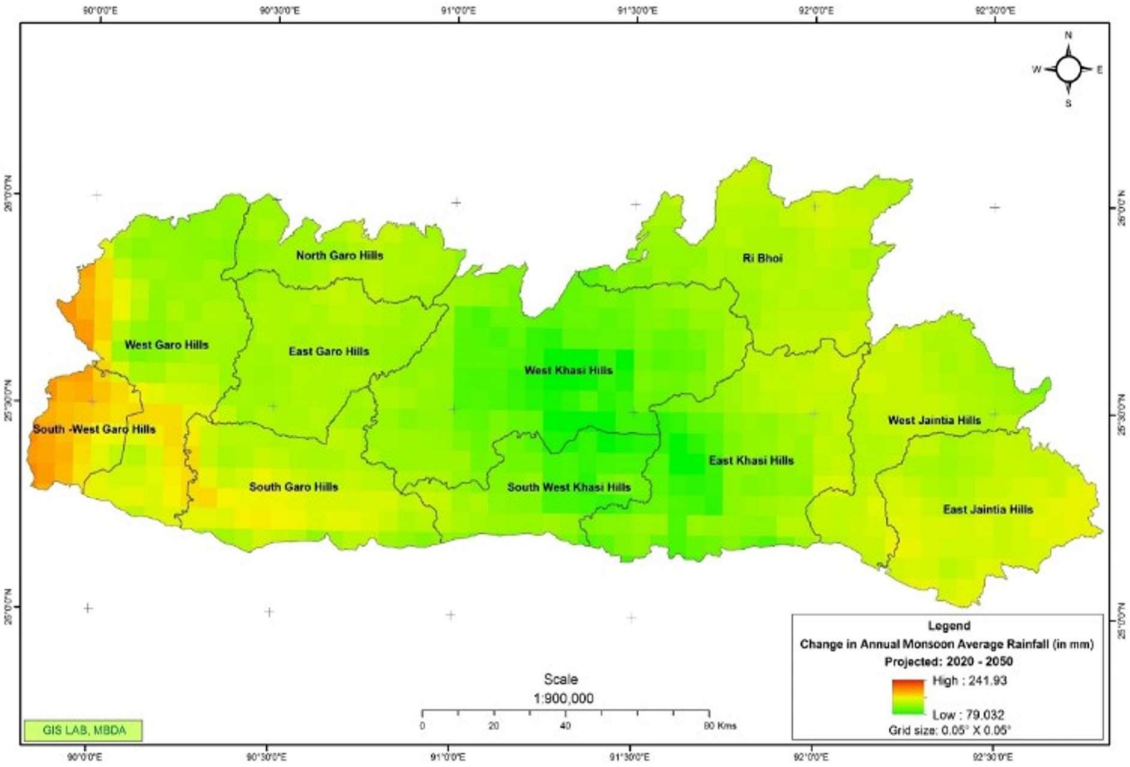
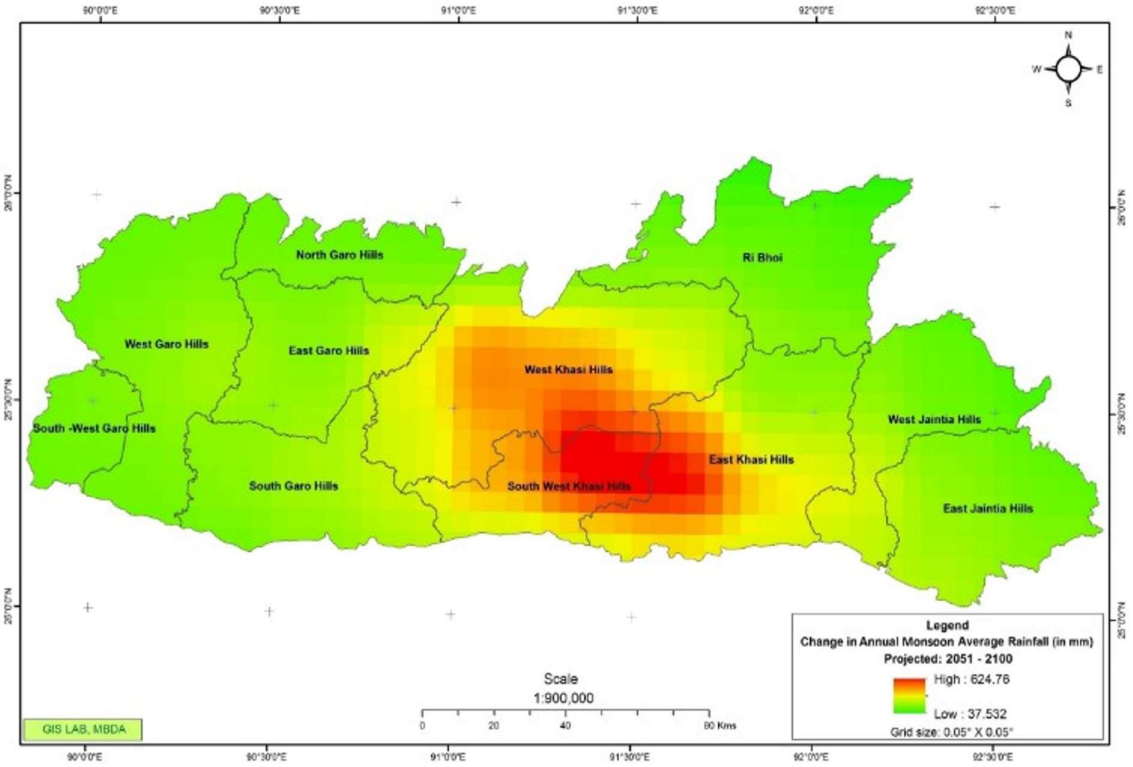
Map Showing Change in Annual Average Rainfall in Meghalaya (1981 - 2012)



Map Showing Projected Change in Annual Average Rainfall in Meghalaya (2020 - 2050)



Map Showing Projected Change in Annual Average Rainfall in Meghalaya (2051 - 2100)



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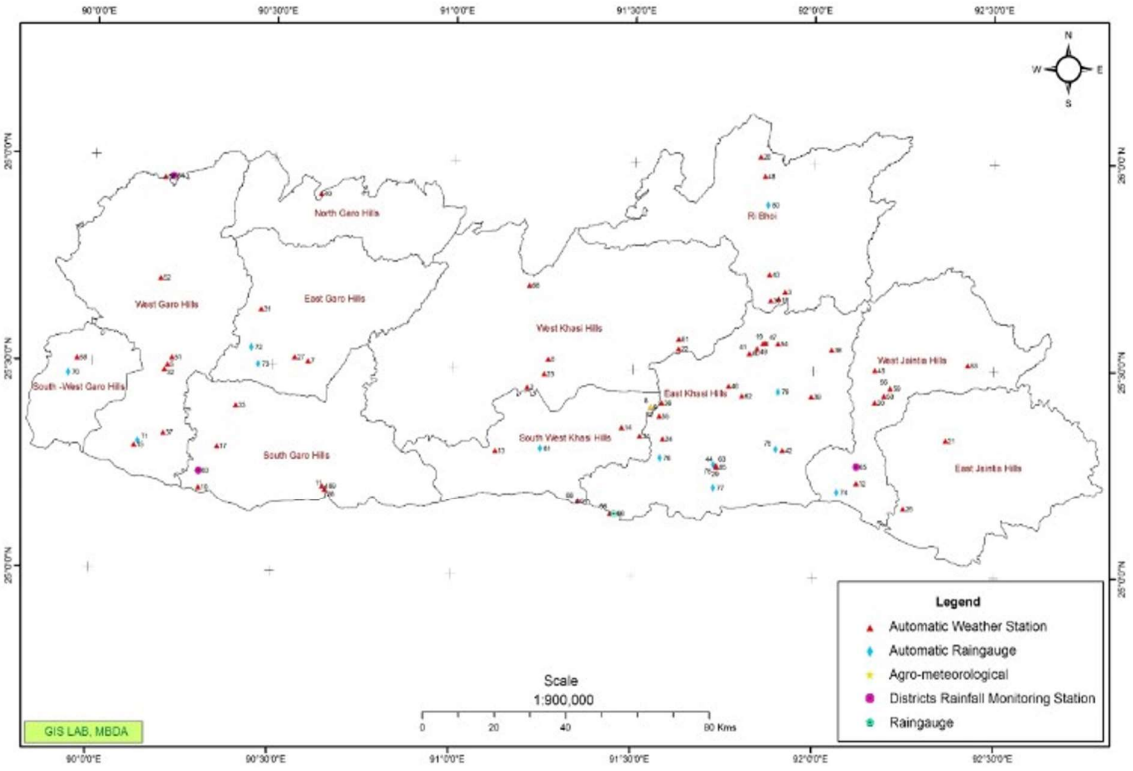
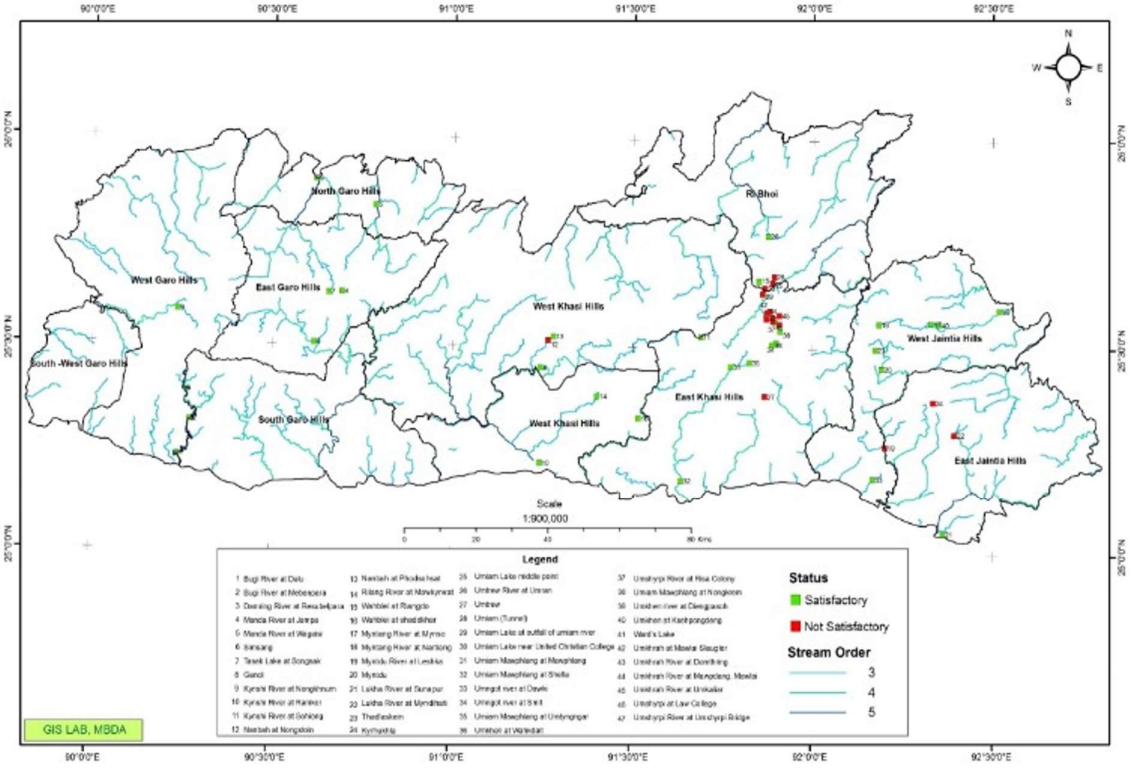
Map Showing Automatic Weather Stations in Meghalaya



Map Showing Water Quality at Monitoring Locations in Meghalaya



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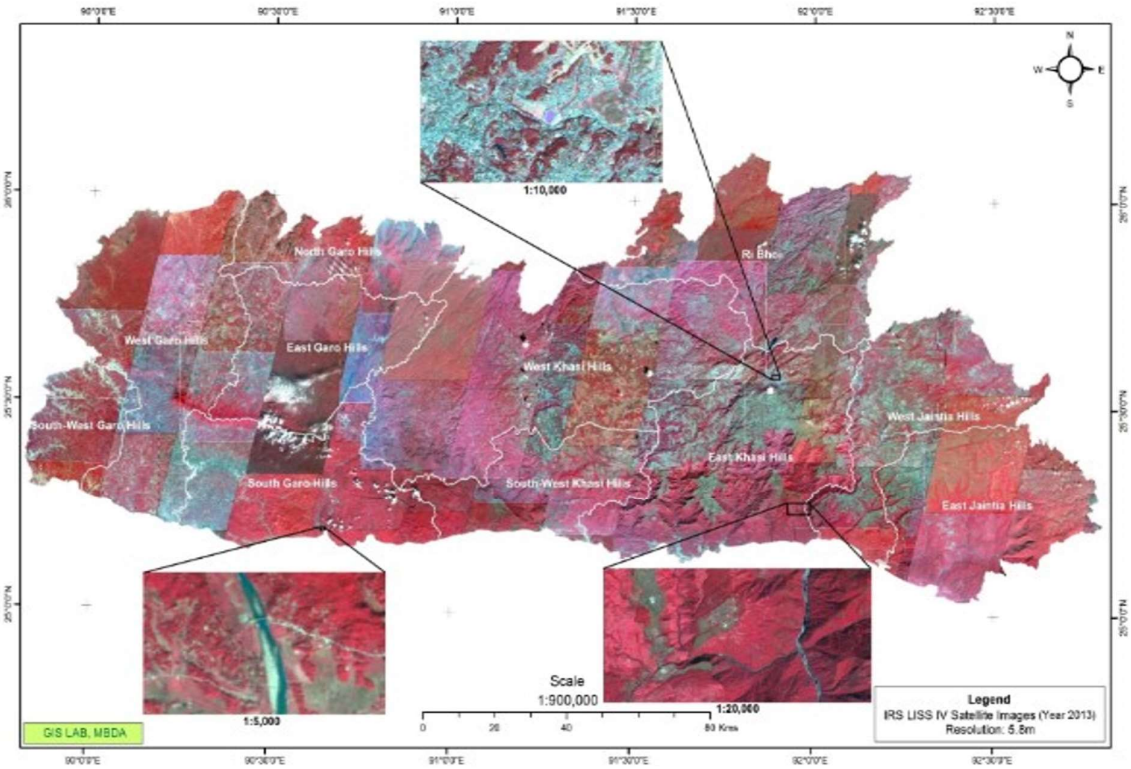
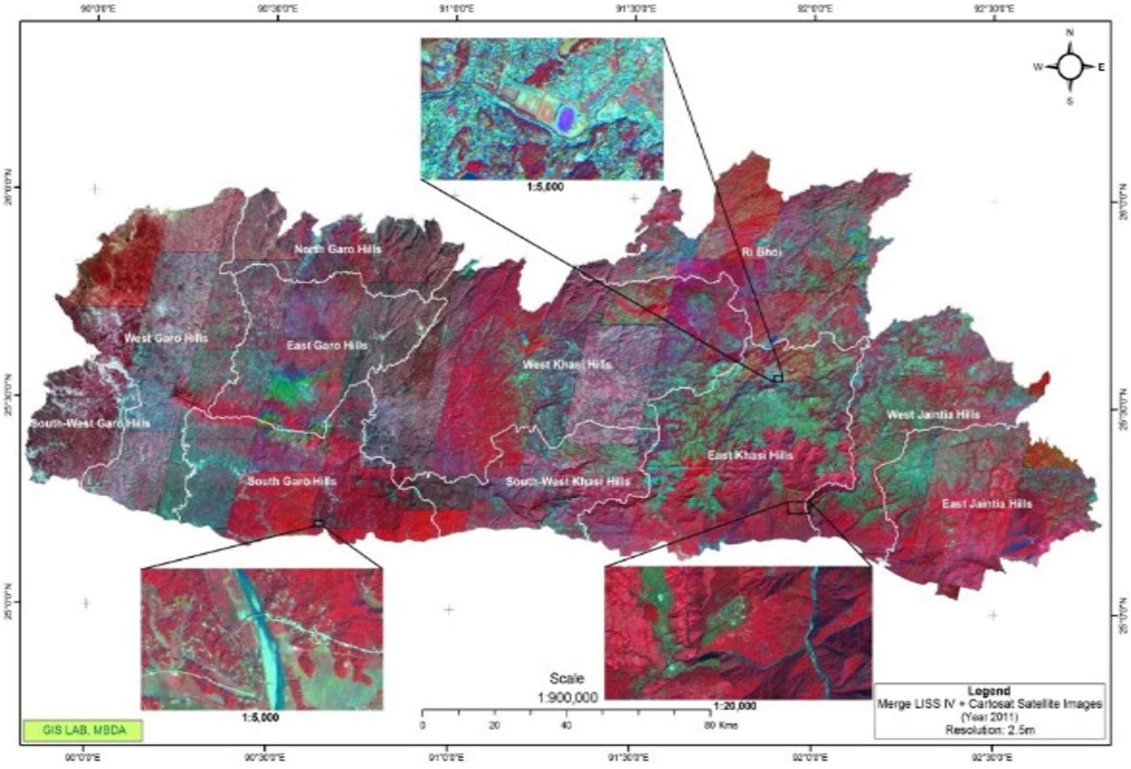
Mosaic of IRS LISS IV Images of Meghalaya



Mosaic of Merged IRS LISS IV & Cartosat 1 Images of Meghalaya



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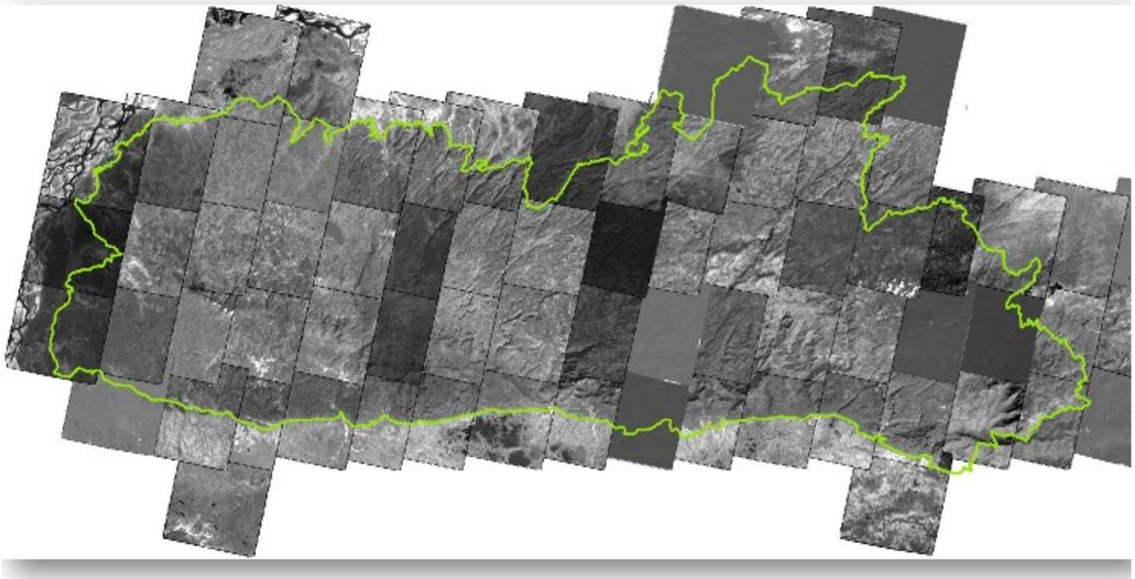
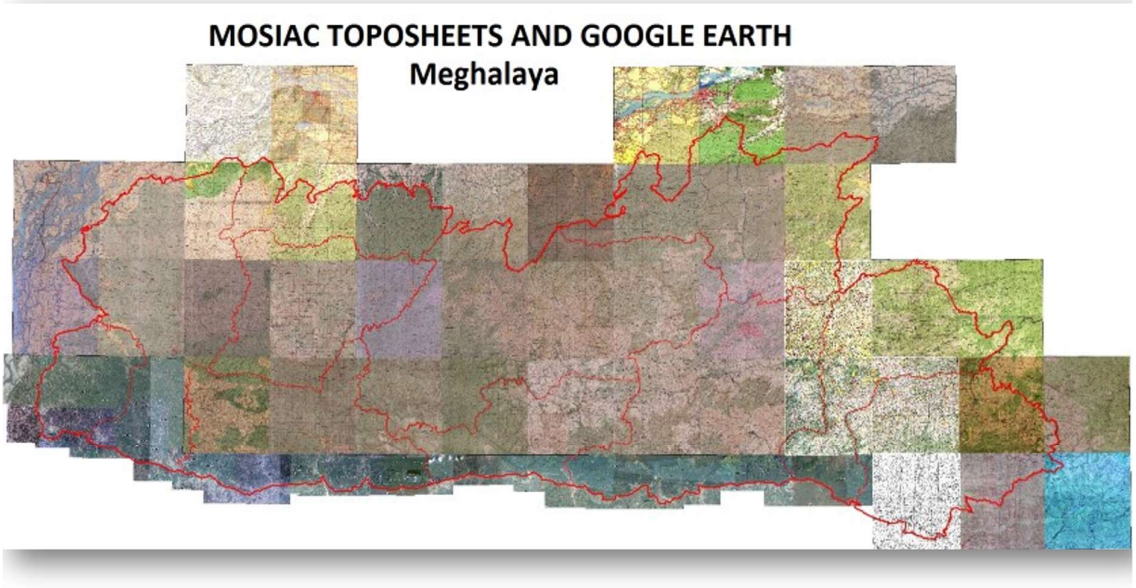
CARTOSAT





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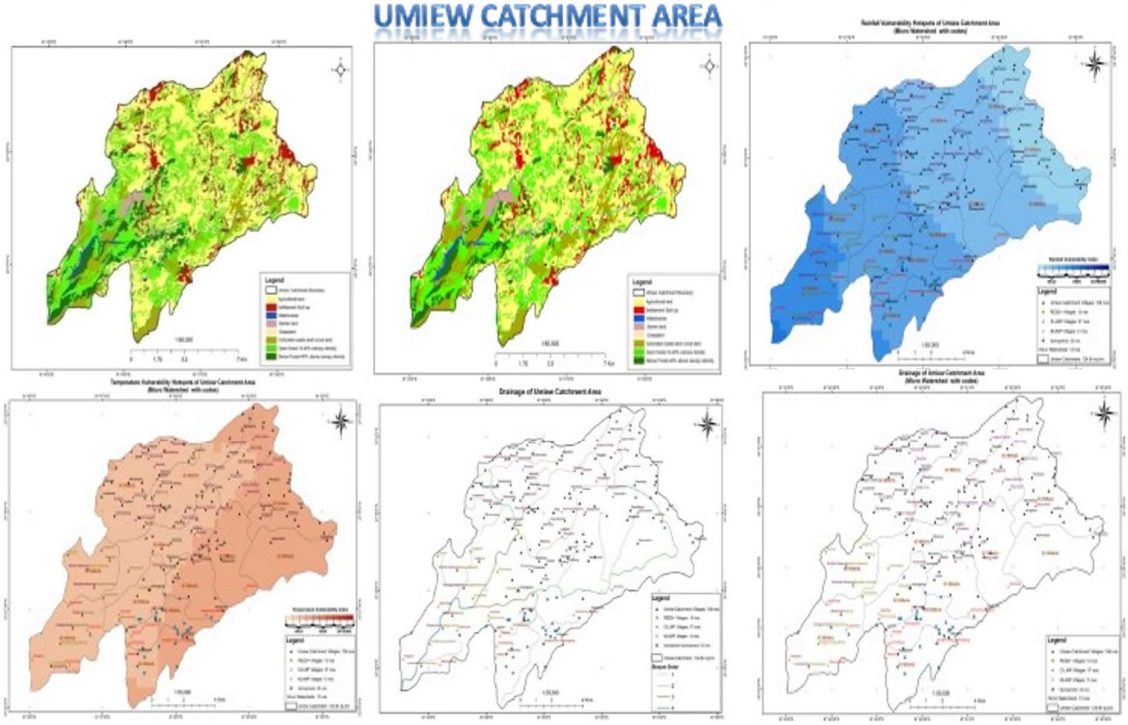
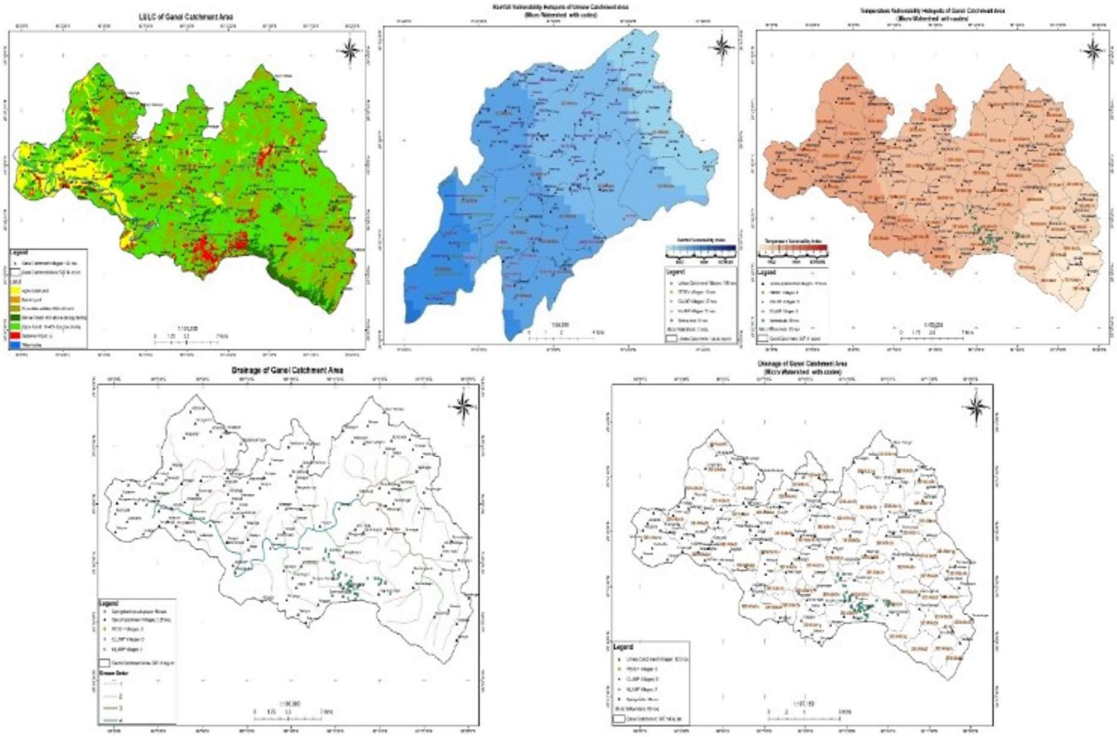
Land Use Land Cover change (2010 & 2018) and Climate Change Vulnerability Assessment ofUmiew Catchment area and providing datasets for preparing of KfW development bank project proposal (MINR & MCCC)

UMIEW CATCHMENT AREA



GANOL CATCHMENT AREA



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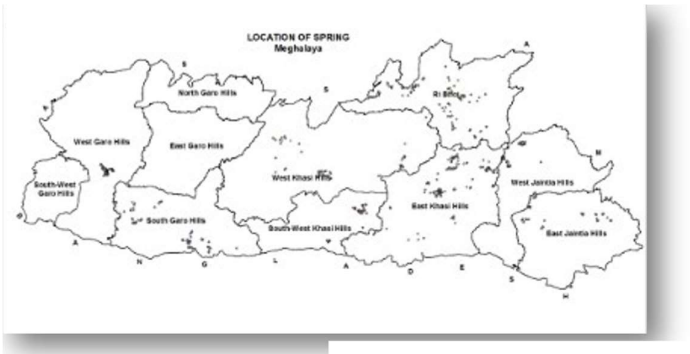
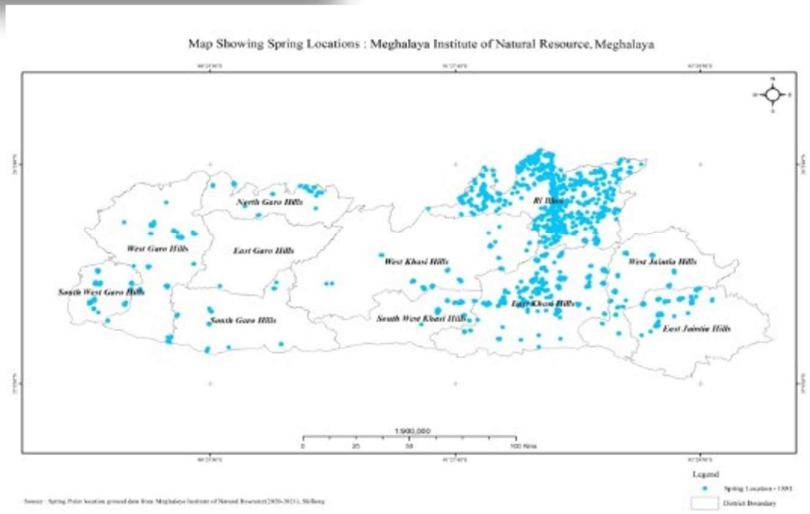
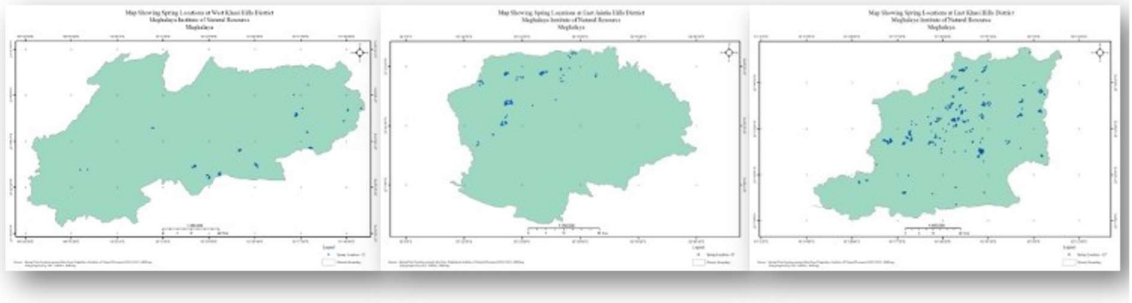
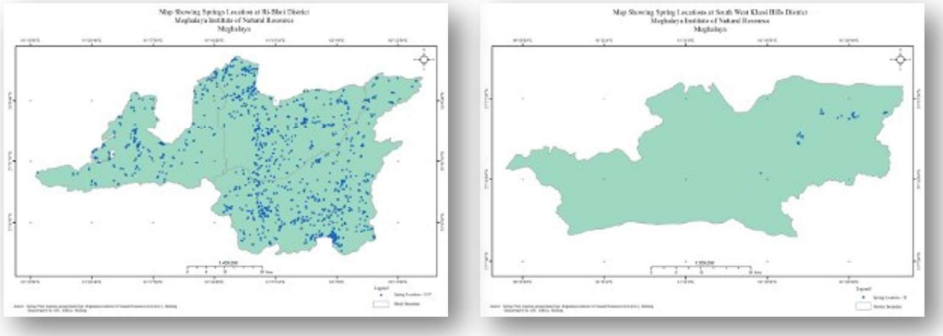


Springs of Meghalaya







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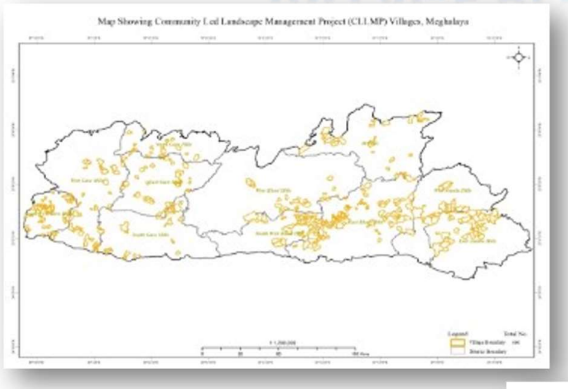
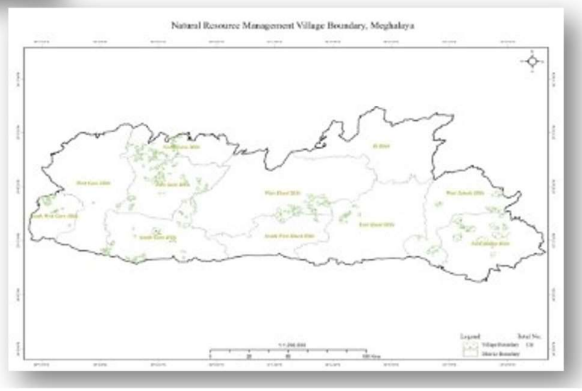
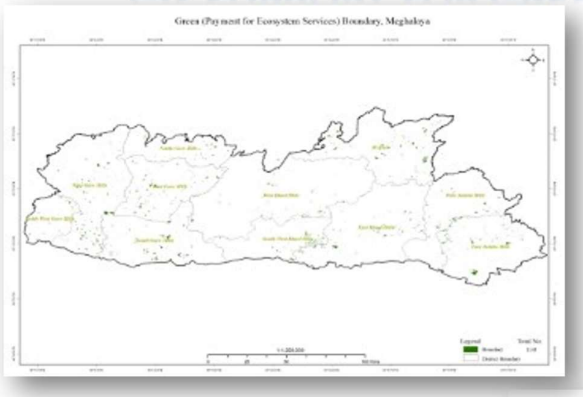
VILLAGE BOUNDARY

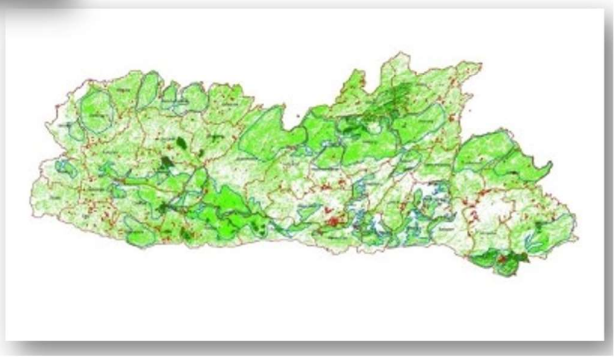




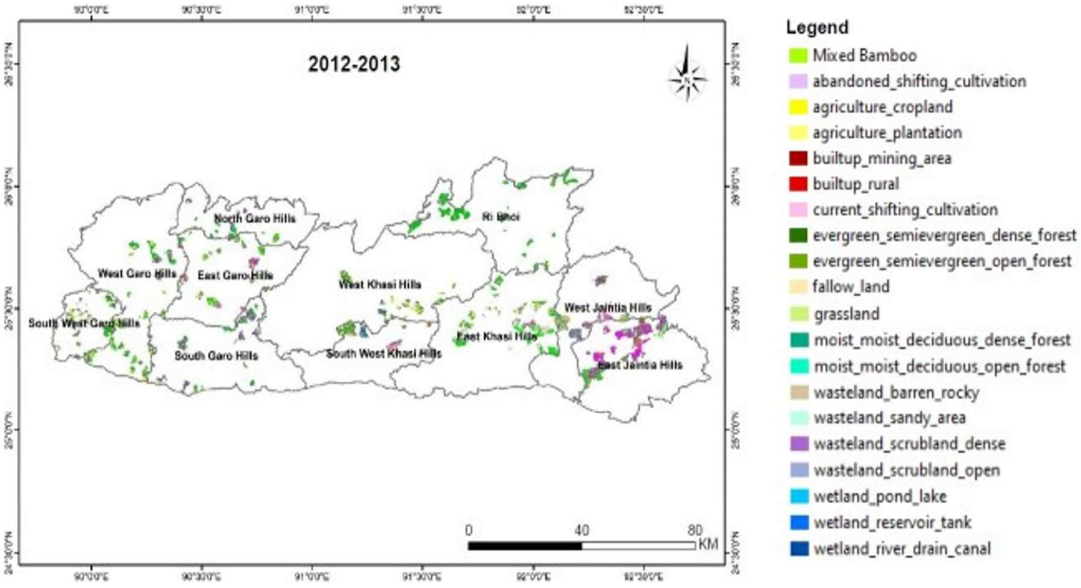
GIS SUPPORT FOR GREEN MEGHALAYA: PES



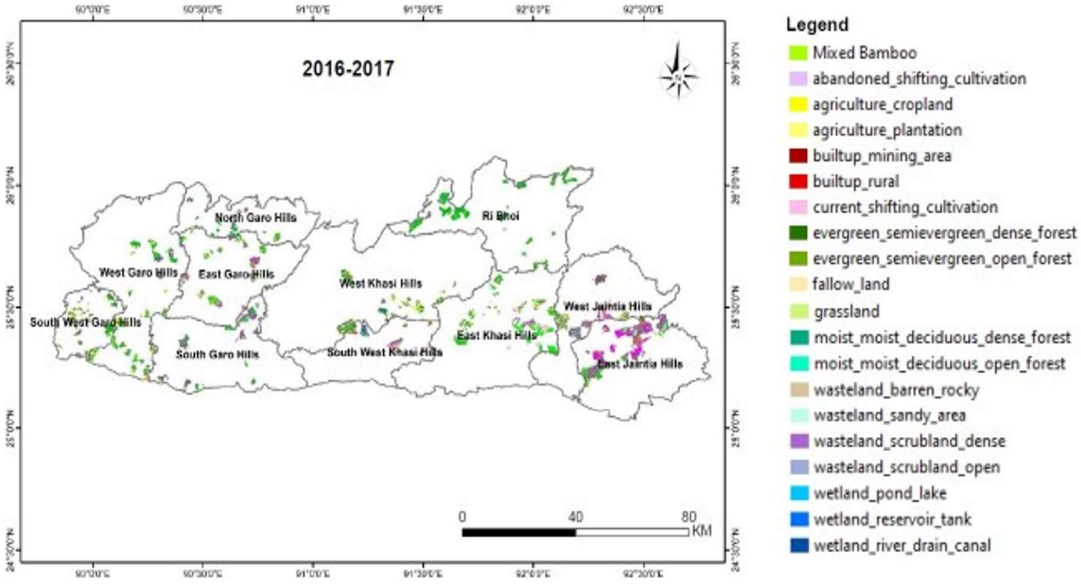
PES Plots overlayed on Forest Cover FSI 2021 with MDF VDF Clusters



CLLMP LULC 2012-13



CLLMP LULC 2016-17



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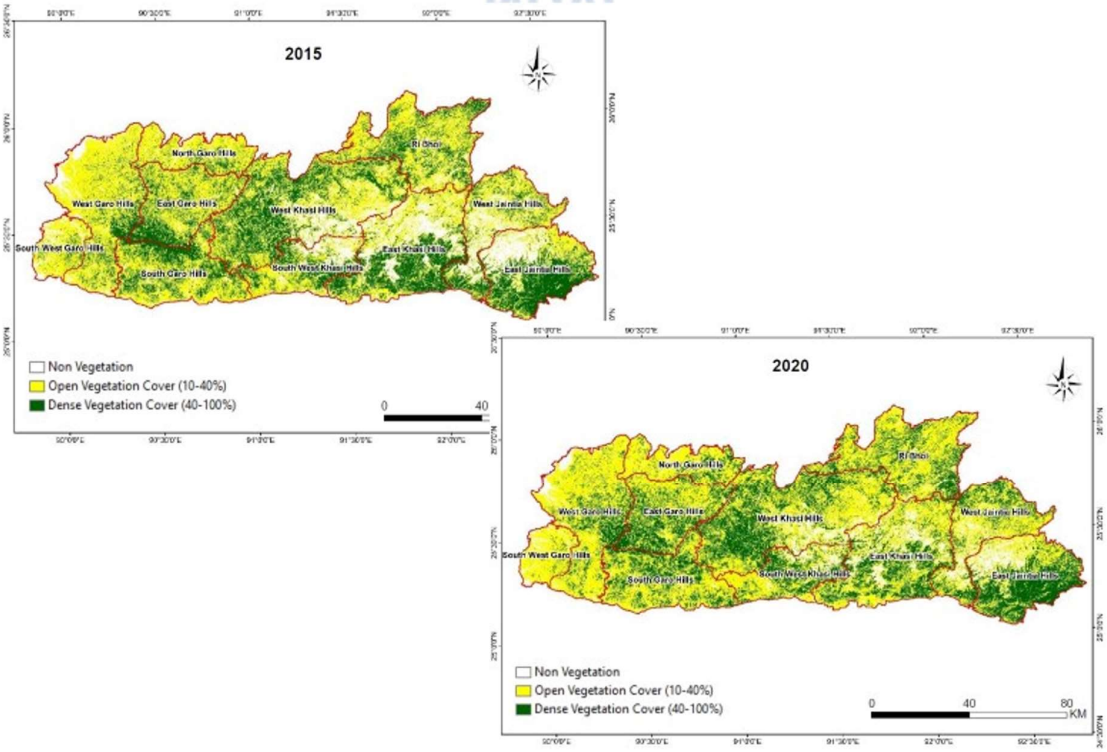
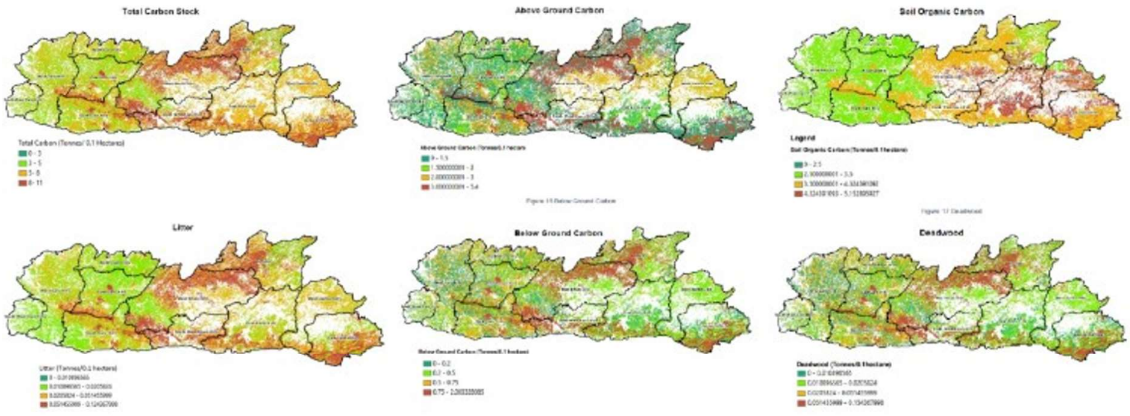
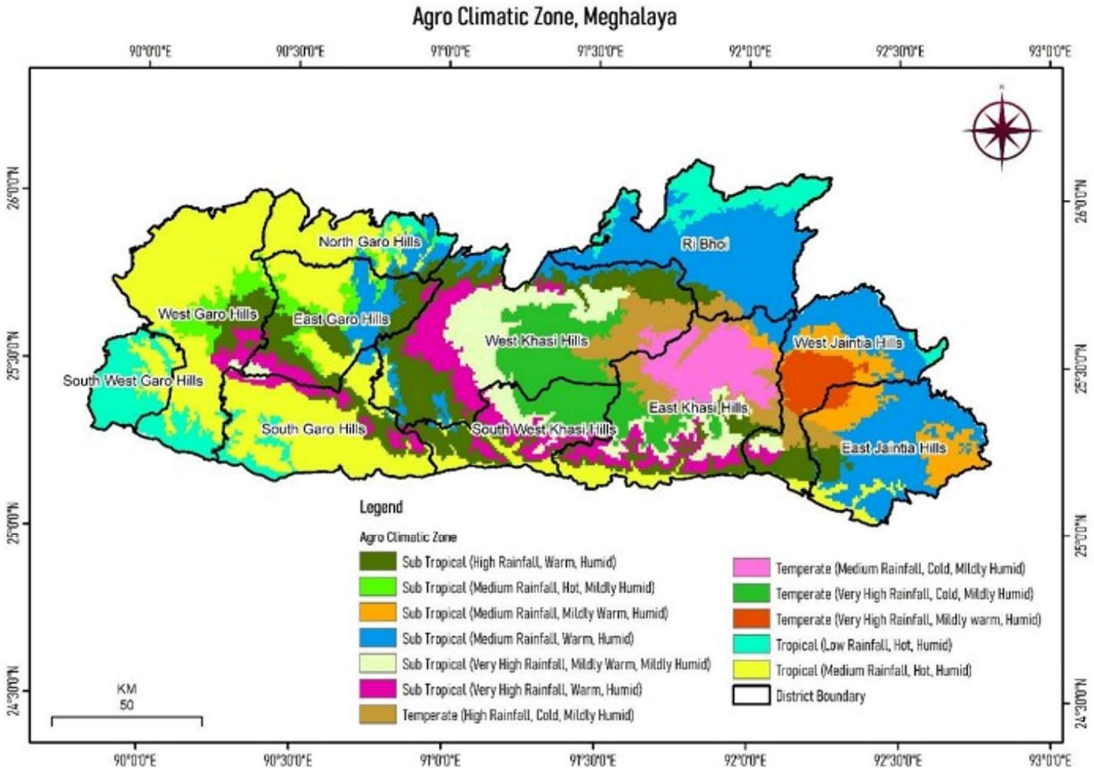
NDVI



CARBON STOCK





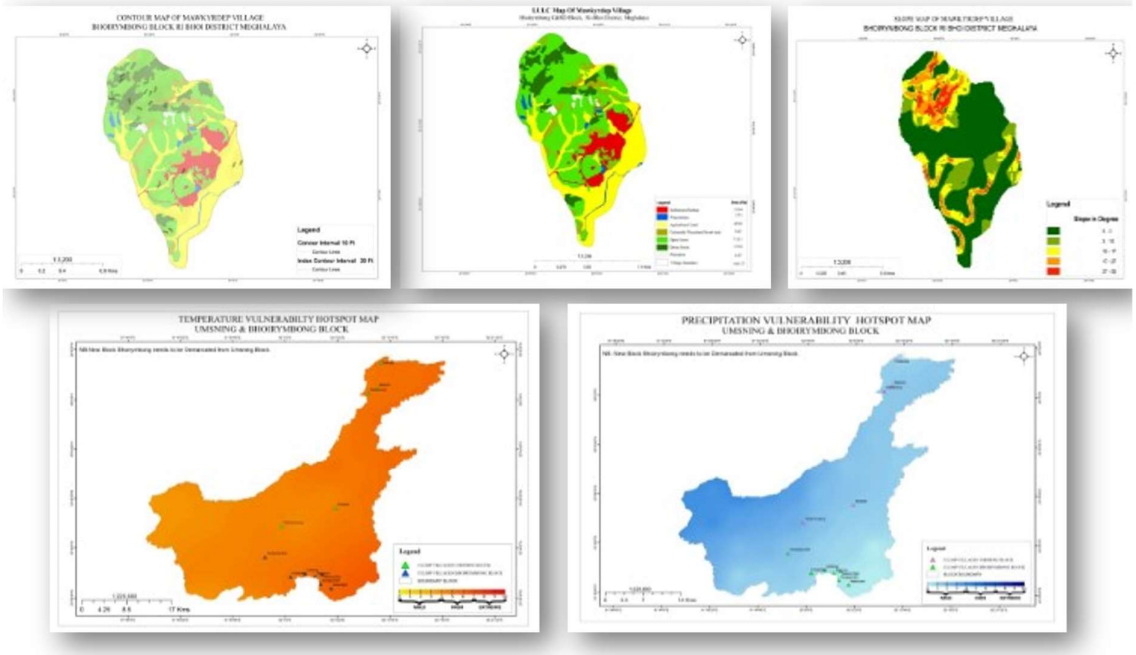
GENERATED MAPS

- Meghalaya Livelihoodsand Access to Markets Project (MLAMP) Villages1350 nos
  Boundary, LULC maps GE + LISS 4 imagery Max no. of classes: 9
- Meghalaya Community Led Landscape Management Project (CLLMP) Villages 400 nos
  Boundary, LULC, Slope, Contour, Intervention Maps; GE + LISS 4 imagery Max no. of classes: 9
- Meghalaya Institute of Natural Resource (MINR)
  Land Use Land Cover change (2010 & 2018) and Climate Change Vulnerability Assessment of Umiew Catchment area and providing datasets for preparing of KfW developmentbank project proposal ; GE+LISS4imageryMax no. of classes: 9
  Spring Mapping, Aroma mission
- Forest Management Project (FMP)
  Location map, Satellite Image, Boundary Map, LULC, Forest Cover, Sampling Points, Average Slope/Height, Forest Blank, Forest Type, Forest Perimeter, Waterbodies, Forest Fire Points., Distance from HQ/ Road, Carbon Stock, Min/Max Temp, Average PCP, Soil Desc, Village Lat/Long.
  Max no. of classes: 9
- Tura Pilot Mapping and Living Root Bridge Mapping using UAV
  Mapping Scale: 1:1000
  Paper Size - Composed: A1 UAV Imagery ,No. of classes: 12+

NEW LAYER UNDER PREPARATION

- NRM boundaries for all the 6500 plus villages of the state.
- Village level LULC maps on the scale of 1:4000 in collaboration with NESAC.
- Overlay analysis for Green Meghalaya: PES(Green)

SAMPLE MAPS UNDER CLLMP



- The maps prepared by respective GIS personnel of the district for CNRMP for visualization and planning purposes

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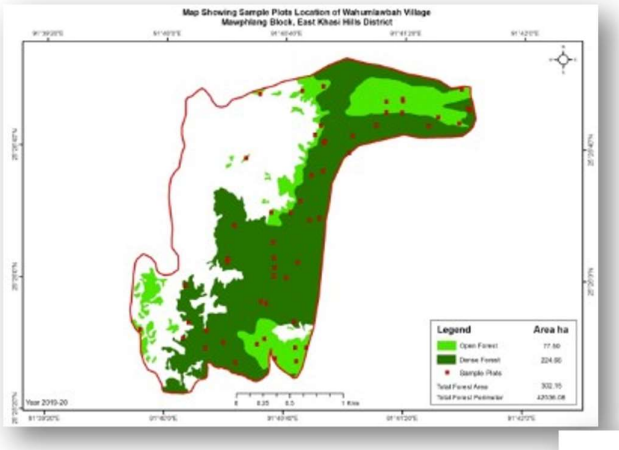
INTERVENTION MAP

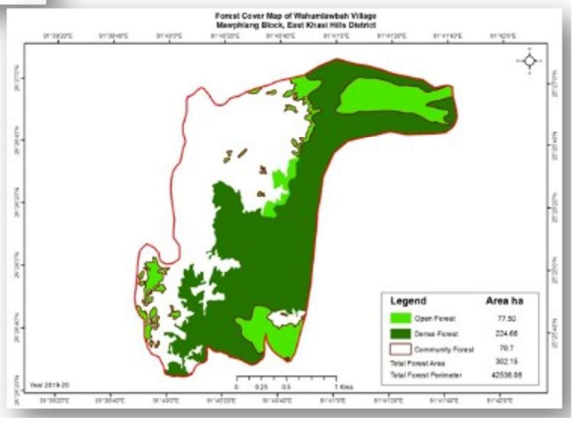
Mawthong Village
South West Khasi Hills District
Meghalaya

Lawblei Village
South West Khasi Hills District
Meghalaya



FMP Sample Plot

FMP Forest Cover



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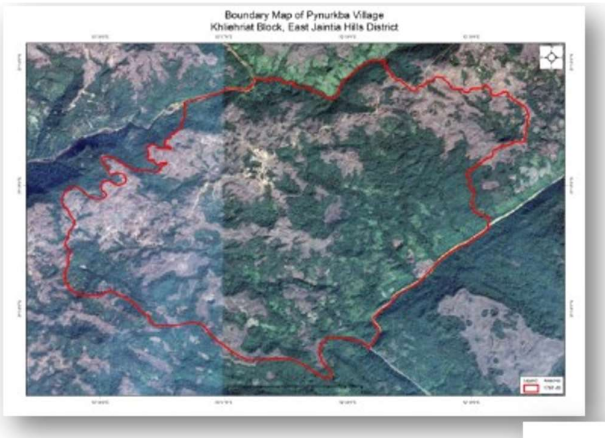
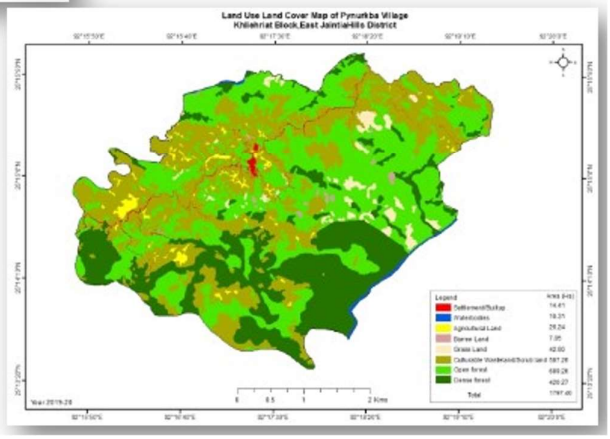
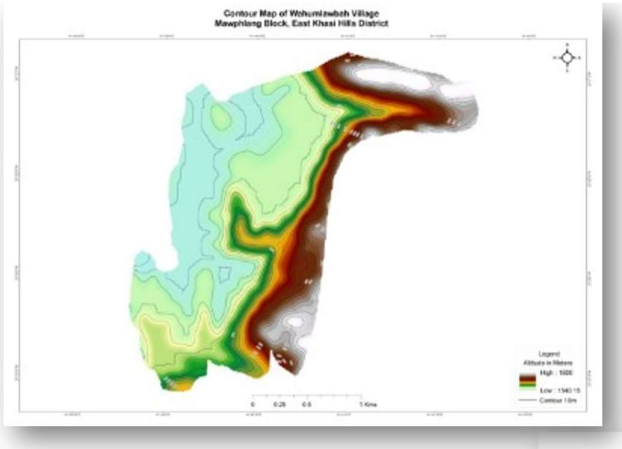


Project Boundary Map

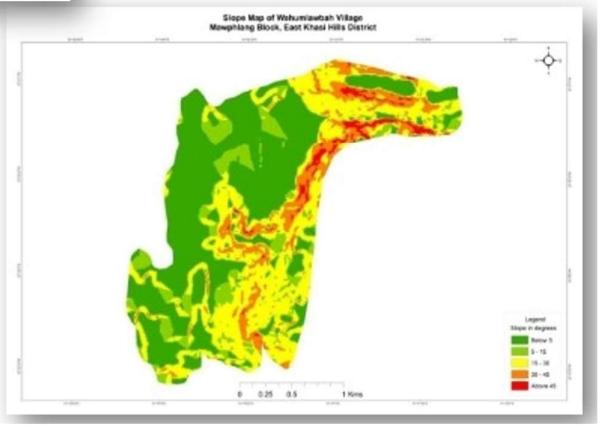
LULC Map





Contour Map

Slope Map



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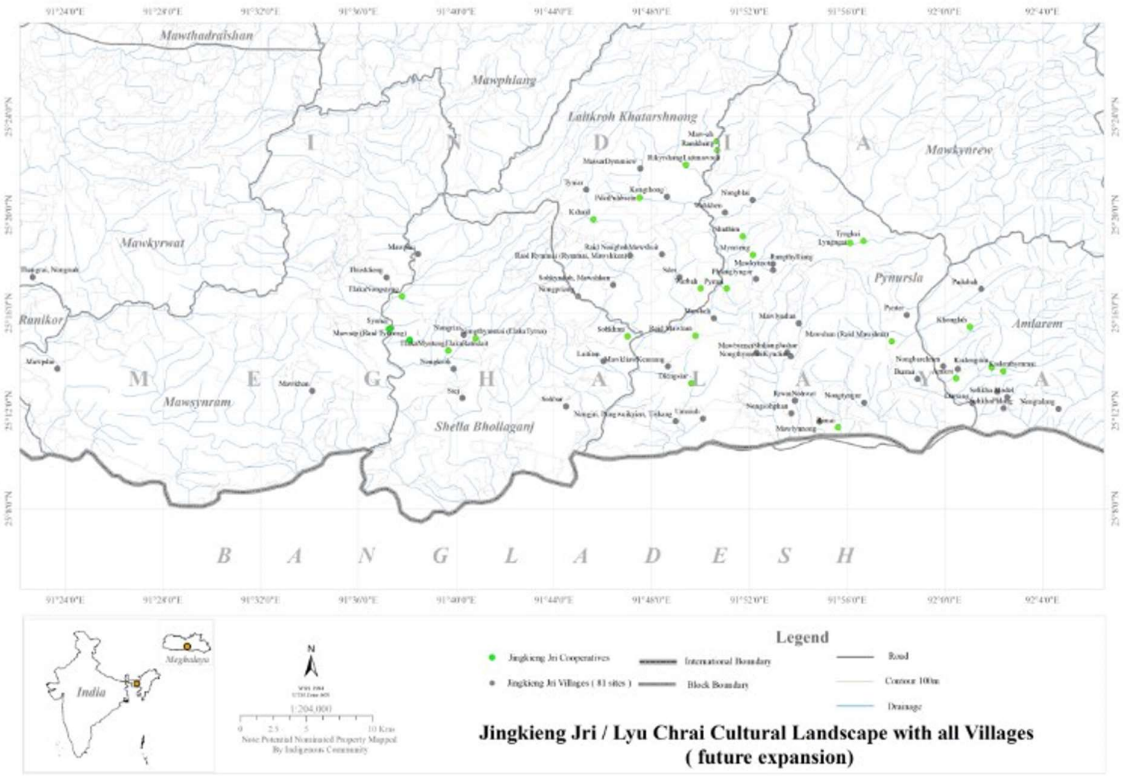

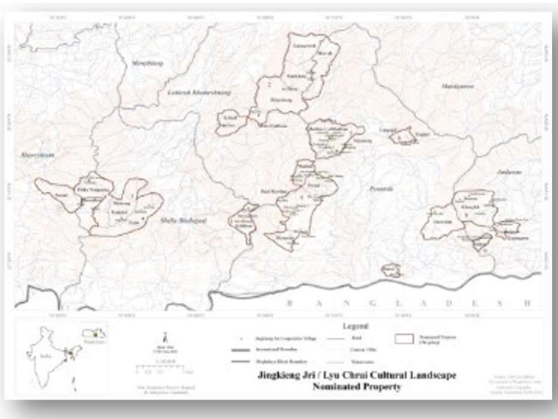

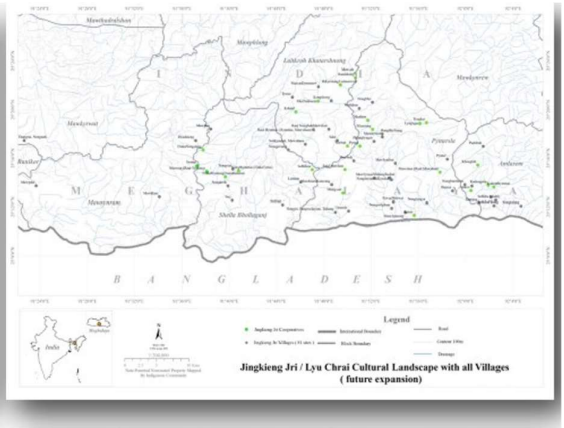

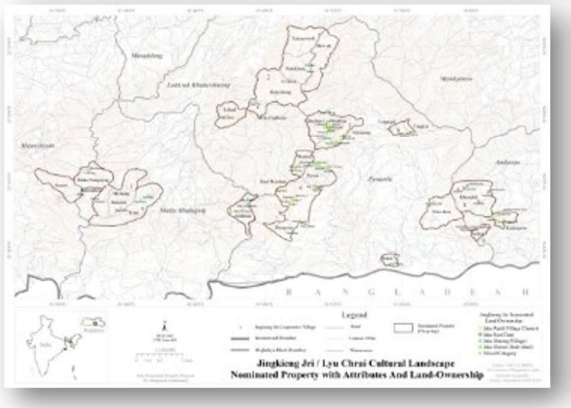

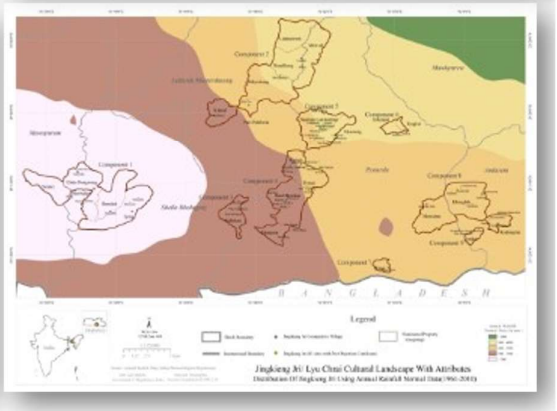

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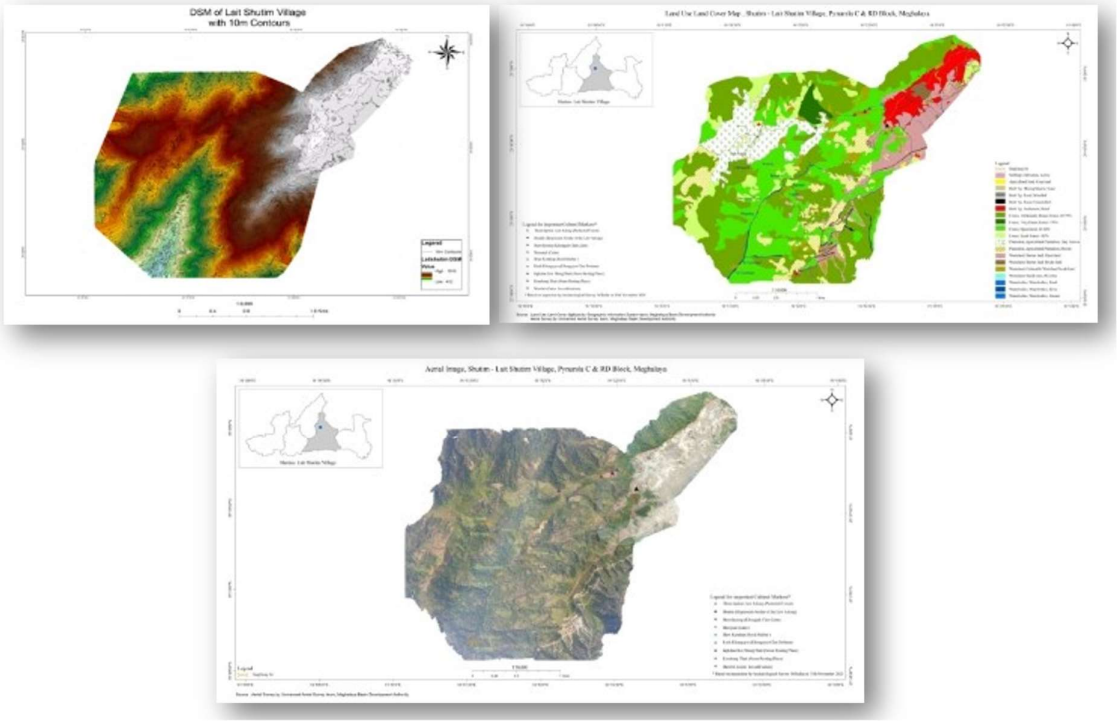
LRB SAMPLE MAPS



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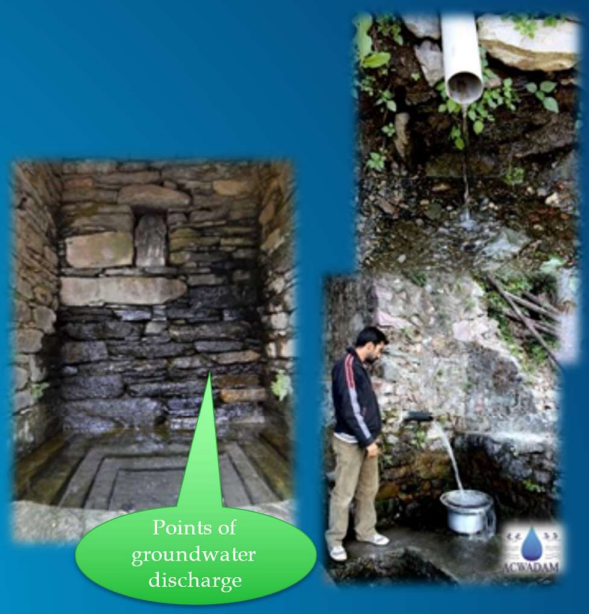
What are Springs?

A spring may be considered as an 'overflowing aquifer'

Springs represent 'natural ground water discharge that feeds streams and rivers, often making such streams and rivers perennial…



IMPACT OF SPRING DISCHARGE DEPLETION

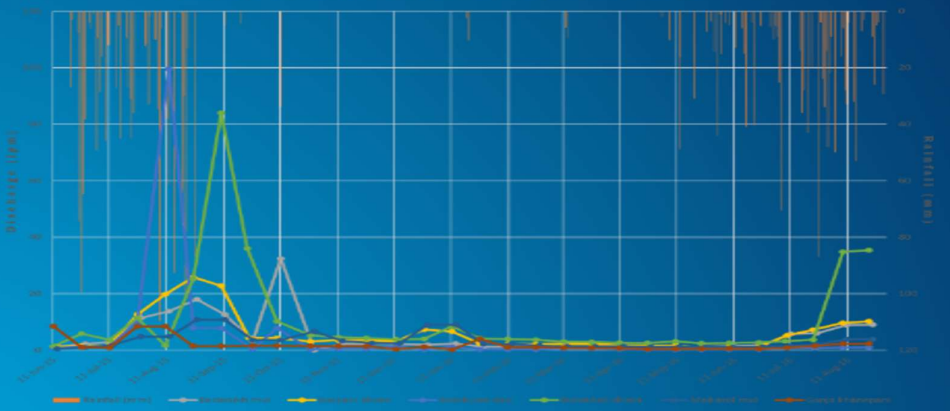


Fig depicted the trend of spring discharge declining according the research study done by Spring Initiatedpartner

In Meghalaya the main indicator of Spring Discharge declining:

1. Human settlement and Encroachment
2. Deforestation and Climatic Condition
3. Mining and other Anthropogenic activity

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ABOUT SPRINGSHED MANAGEMENT

SPRINGSHED MANAGEMENT IS A METHOD OR AN APPROACH

1. IMPROVE SPRING DISCHARGE
2. ENHANCE AVAILABILITY OF SAFE AND CLEAN WATER FOR DOMESTIC AND OTHER PURPOSES
3. TO BUILD THE BASELINE DATA OF QUALITATIVE AND QUANTITATIVE DATA OF SPRINGSHED MANAGEMENT OF THE STATE

ABOUT SPRINGSHED MANAGEMENT

Springshed Management involves creation of artificial rain-water harvesting structures such as:

1. **Recharge Pits or Trenches (Contour Trenches)**
2. **Dug Out Ponds**
3. **Check Dams**
4. **Contour Bunds and**
5. **Afforestation with fruit or forest trees**

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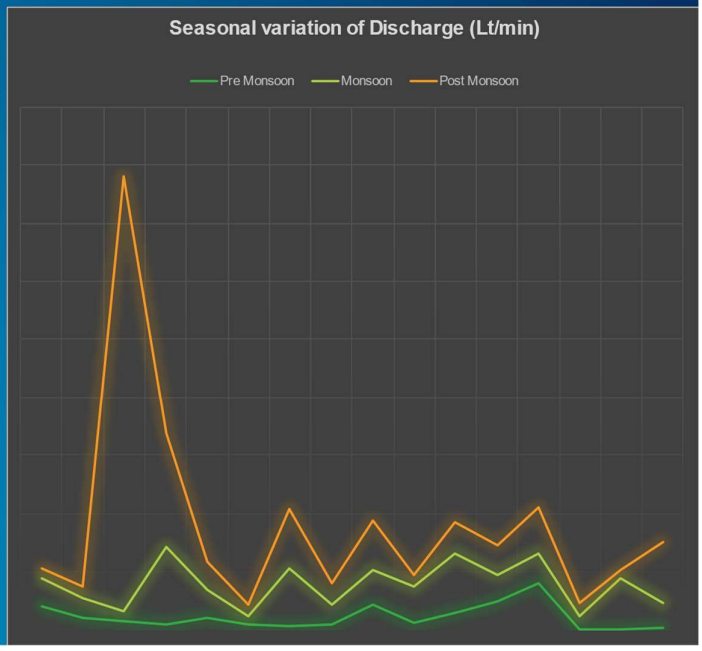
Treatment of the catchment areas springshed measurement, Jarian sutnga, East Jaintia Hills

Seasonal variation of discharge (Litre/minute) of the catchment area treated OF SPRINGS , EAST JAINTIA HILLS

VNRMCs	SPRINGS NAME	Pre Monsoon	Monsoon	Post Monsoon
UMSATAI	WAH LUBER KHLIEH DAM	4.11	4.84	1.57
LUMSKHEN	MANIAJAW	2.2	3.33	1.84
PAMRA KMAI SHNONG	IENGKA	1.53	1.67	75
JARAIN (SUTNGA)	LUM THANGBRU	0.97	13.33	19.35
LELAD	Um khloo Blai	2	5	4.63
	UMRIANG	1	1.33	2
SHNONGRIM	UMDKHAR	0.67	10	10
SAHKAI	KHLIEH MYNKSEH	1.06	3.18	3.67
	LUMHEH	4.29	6	8.56
MYNTHLU	UMTHALONG	1.33	6	2.14
SAMASI	RIMANAR	3	10	5.5
MOOLAIT BRI SUTNGA	KSEH LATYUT	5	4.5	5
	THANGLOOH	8	5	8
KREMMYRSIANG	UM-JOHROI	0.21	2.16	2.16
PALA	UMJAN	0.22	8.70	1.4
	UMSARKAR	0.29	4.41	10.34



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SPRING MAPPING

- pH: is a measure of the basicity or acidity of a solution with a range of 0-14, 7 being Neutral, <7 is acidic >7 basic
- TDS: is a measure of dissolved organic and inorganic substances in water (mg/liter or ppm)
- Salinity : is the amount of salts dissolved in a solution (ppm)
- Electrical Conductivity : is the ability of the solution to allow electric current to flow through (µS/cm)

DESIRABLE LIMITS FOR DRINKING WATER		
	WHO	BIS
pH	6.5 - 8.5	6.5 - 8.5
TDS	300 ppm	500 ppm
EC	400 µS/cm	300 µ S/cm

TRACE METAL ANALYSIS ON ACIDIC SPRING IN COAL MINING AREA

Sl.no	District	Village	Block	Spring Name	Ownership	Household benefit	Zn (ppm)	Cu (ppm)	Cd (ppm)	Fe (ppm)	Pb (ppm)	As (ppm)
1	East Jaintia	Kremmy rsiang	Saipung	Ringpala	Community	40	0.192	0.044	0.001	0.319	0.012	0.034
2	East Jaintia	Jalaphet Bri Sumer	Saipung	Umsning-2	Community	20	0.105	0.044	0	0.484	0.014	0.212
3	East Jaintia	Diensatlang	Khliehriat	Deiniang	Community	14	0.035	0.03	0	0.227	0.001	-0.001
4	East Jaintia	Diensatlang	Khliehriat	Umlum	Community	24	0.039	0.029	0	0.414	0.013	0.338
5	East Jaintia	Umsatai	Khliehriat	Wah Iuber Khlieh Dam	Community	35	0.226	0.029	0	0.36	0.008	-0.008
6	East Jaintia	Deinchy nrum	Khliehriat	Wah Tawiar	Community	40	0.076	0.026	0	0.402	0.006	-0.011
7	East Jaintia	Pamrapaithlu	Khliehriat	Sy nrang Pailiang	Community	45	0.196	0.026	0.001	1.142	0.021	0.379
8	East Jaintia	Jarian Sutnga	Saipung	Umbansati	Community	30	0.054	0.031	0	0.905	0.006	-0.001
9	East Jaintia	Jarian Sutnga	Saipung	Luhiaw	Community	45	0.039	0.023	0	0.251	0.043	-0.007
10	East Jaintia	Sakhain Moolimem	Saipung	Umty rpoh	Community	25	0.162	0.026	0	0.178	0.003	0.009
11	West Jaintia	Khlooky nrien	Laskein	Neinshnong	Community	30	0.034	0.024	0	0.652	0.008	0.007
12	West Jaintia	Thadmuthlong C	Laskein	Ruiong	Community	20	0.025	0.023	0	0.616	0.008	0.112
13	West Jaintia	Khliehrait Nongjngi	Thadlaskein	Khlieh Natsiej	Community	30	0.281	0.03	0	1.158	0.02	-0.007
14	West Jaintia	Iongnoh	Thadlaskein	My ntngam	Community	50	0.015	0.028	0	0.904	0.001	0.193
15	West Jaintia	Muphlang	Thadlaskein	Dong Py rdi	Community	30	0.051	0.024	0	0.066	-0.003	-0.012
16	East Garo Hills	Nengkra Awe	Samanda	Mikgitap	Community	30	0.025	0	0	0.778	0.01	-0.009
17	East Garo Hills	Chimagre Gradekgittim	Samanda	Rerugisim	Community	92	0.038	0.003	0	0.097	0.007	-0.01
18	South Garo Hills	Rongkandi Jongsinggittim	Baghmara	Cotton spring	Community	8	0.176	0.062	0.001	0.982	0.064	0.011
19	South Garo Hills	Dajugittim	Baghmara	Mabilkol	Community	106	0.046	-0.002	0	0.101	0.01	-0.012
20	South Garo Hills	Rongkandi Jongsinggittim	Baghmara	Songma spring	Community	77	0.043	0	0	0.393	0.011	-0.008

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Springshed Management Training

- MBMA impart various training on Springshed management and in cooperated with the external agency like AQWADAM, Chirag, PSI, Parsari and the internal agency like INR , MBDA .
- The MBMA also in cooperated with the line Department of the State like Soil and Water Conservation Department to impart knowledge and hand holding training on Spring shed management.
- The master trainer who enable the benefit of varied training conducted by MBMA are MGNREGA , MLAMP and MINR both in Khasi, Jaintia and Garo region.

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Meghalaya Spring Survey App

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Introduction

ArcGIS **Survey123** is a complete, form-centric solution for creating, sharing and analyzing surveys developed by ESRI(Environmental Systems Research Institute).

Meghalaya Spring Survey Application is configured by ESRI India Technologies Pvt. Ltd. to add and update the springs for the Meghalaya state.

Benefits

- Collect data with smart forms.
- Attach photos to your surveys.
- Work online or offline.
- Submit your work directly into Spring database.
- Use high-accuracy GNSS receivers.

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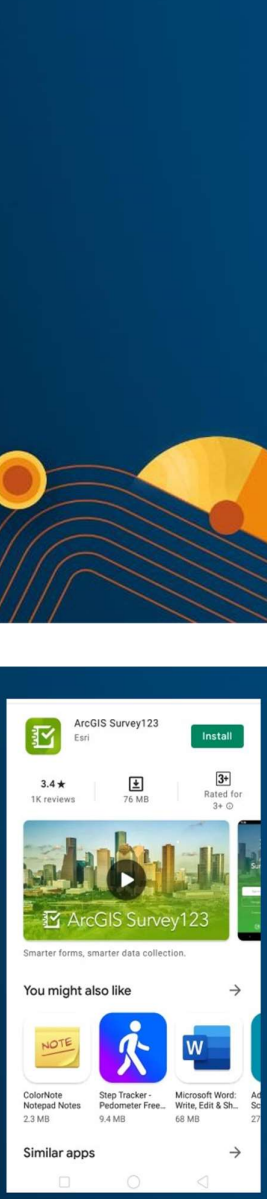
DOWNLOAD & CONFIGURATION



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Download the mobile app "ArcGIS Survey 123" from play store/app store.

Play Store (for android users): https://play.google.com/store/apps/details?id=com.esri.survey123

App Store (for ios users): https://apps.apple.com/us/app/arcgis-survey123/id993015031

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Add connection to the Meghalaya Portal

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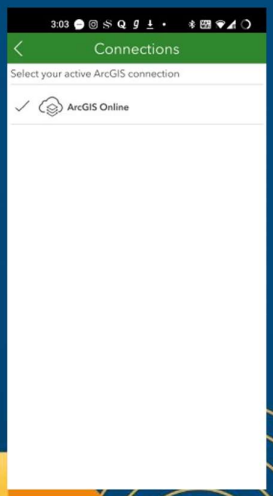
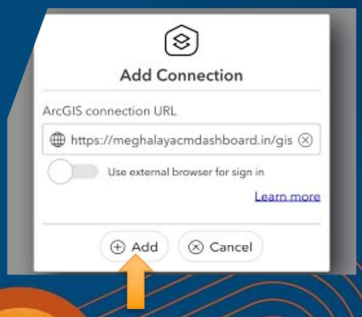
Connection Url : meghalayacmdashboard.in/ gisportal





Register to the Meghalaya portal with district credentials

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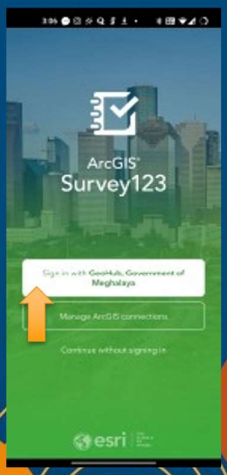
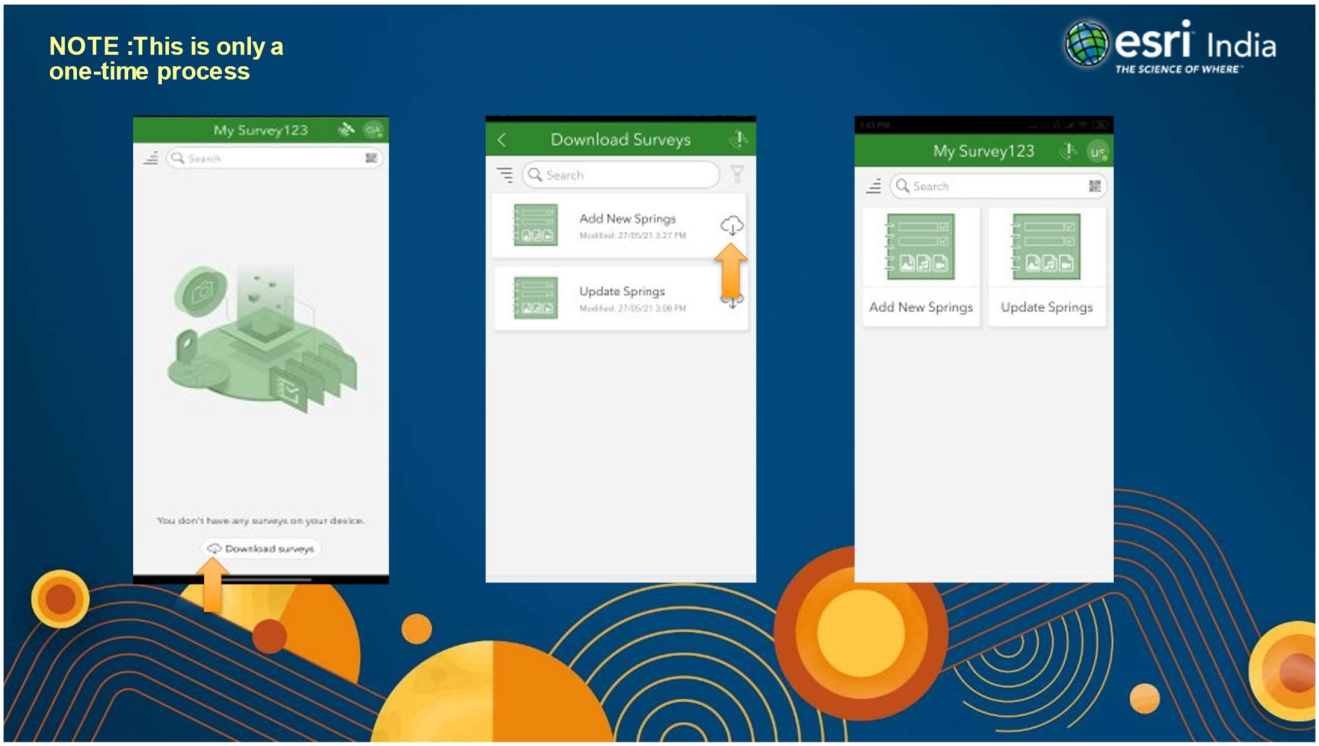
Each district have their particular credentials to sign in into Meghalaya portal.




NOTE :This is only a one-time process
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My Survey123
Search
You don't have any surveys on your device.
Download surveys
Download Surveys
Search
Add New Springs
Update Springs
My Survey123
Search
Add New Springs
Update Springs


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SURVEY FORM

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ADD NEW SPRING SURVEY FORM

The credentials used here is same as used for signing in into Meghalaya portal for each district.

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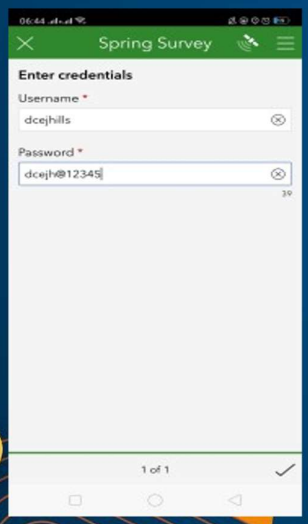

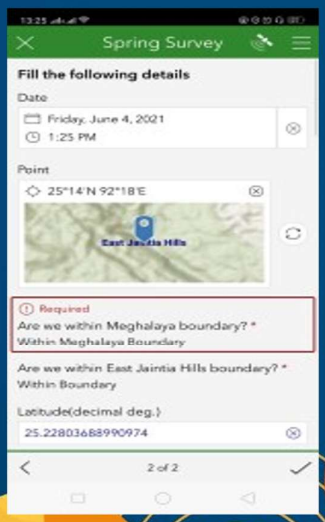

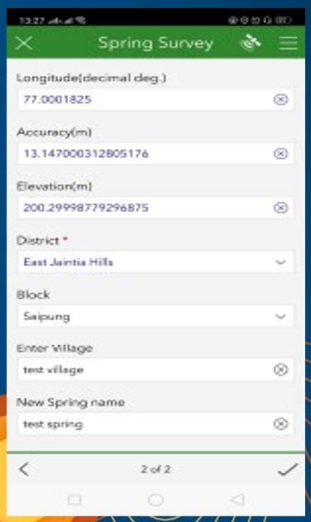

ENTER FOLLOWING DETAILS

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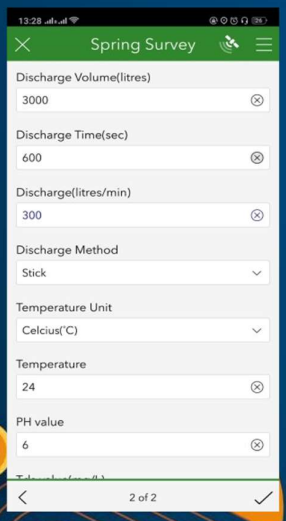

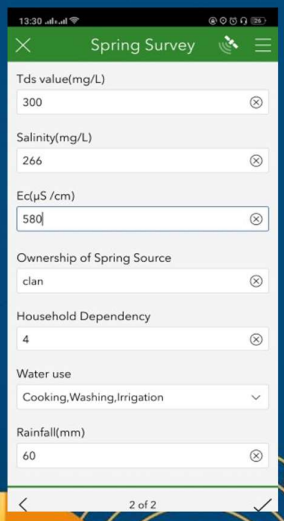

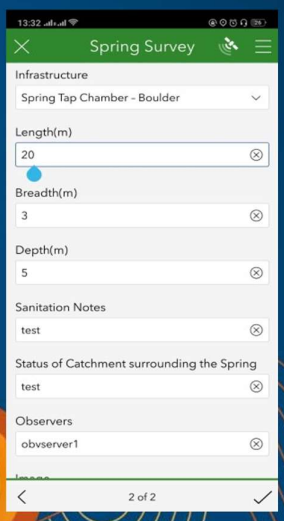

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TAP ON IMAGE ICON

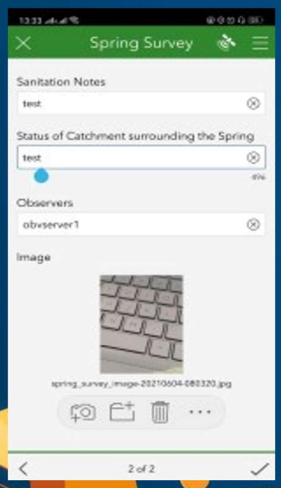
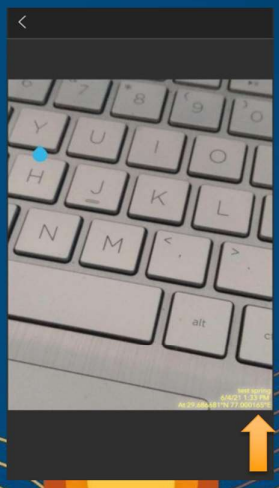


IMAGE WITH WATERMARK



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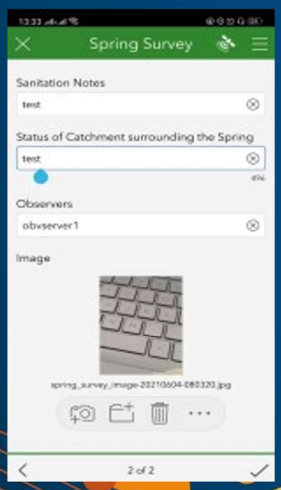
Tap on tick mark after completion of survey



Tap on send now to submit the survey

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INBOX TAB

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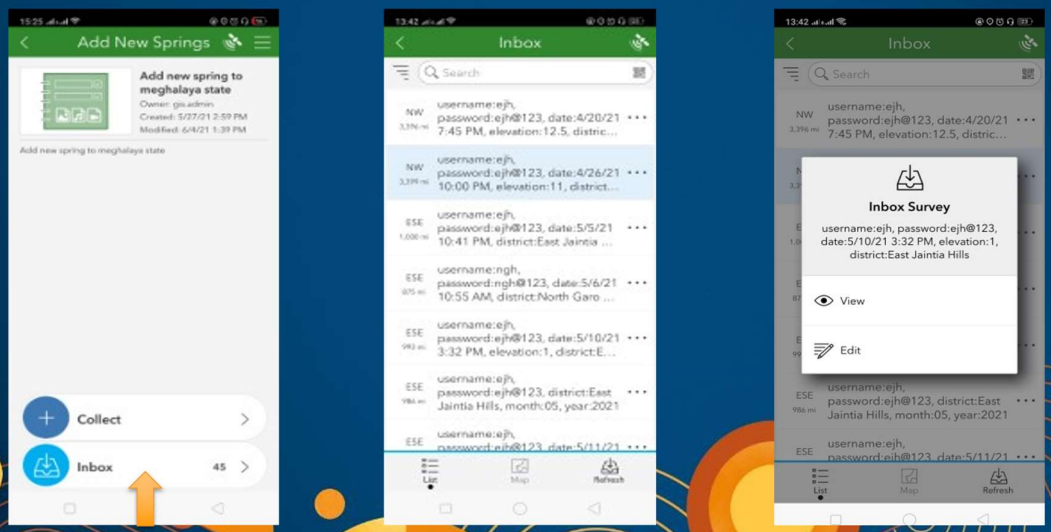

Survey data added in the database

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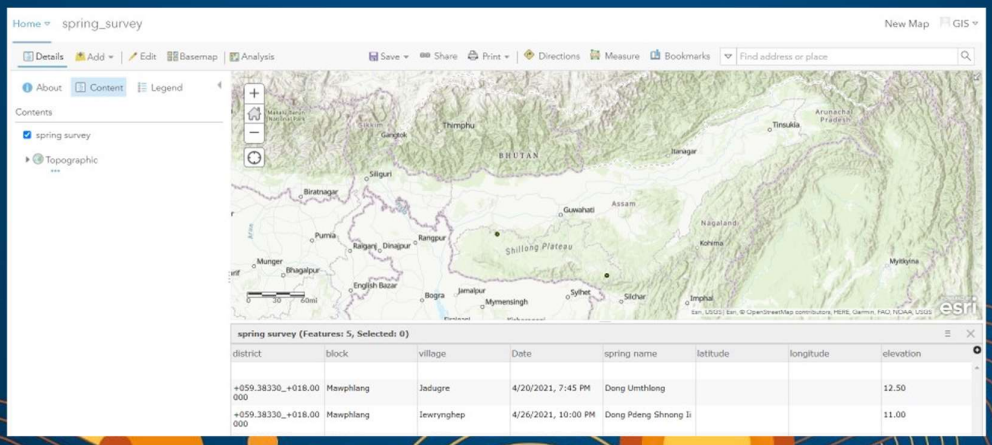

district	block	village	Date	spring name	latitude	longitude	elevation
+059.38330_+018.00000	Mawphlang	Jadugre	4/20/2021, 7:45 PM	Dong Umthlong			12.50
+059.38330_+018.00000	Mawphlang	Iewrynghep	4/26/2021, 10:00 PM	Dong Pdeng Shnong Ii			11.00

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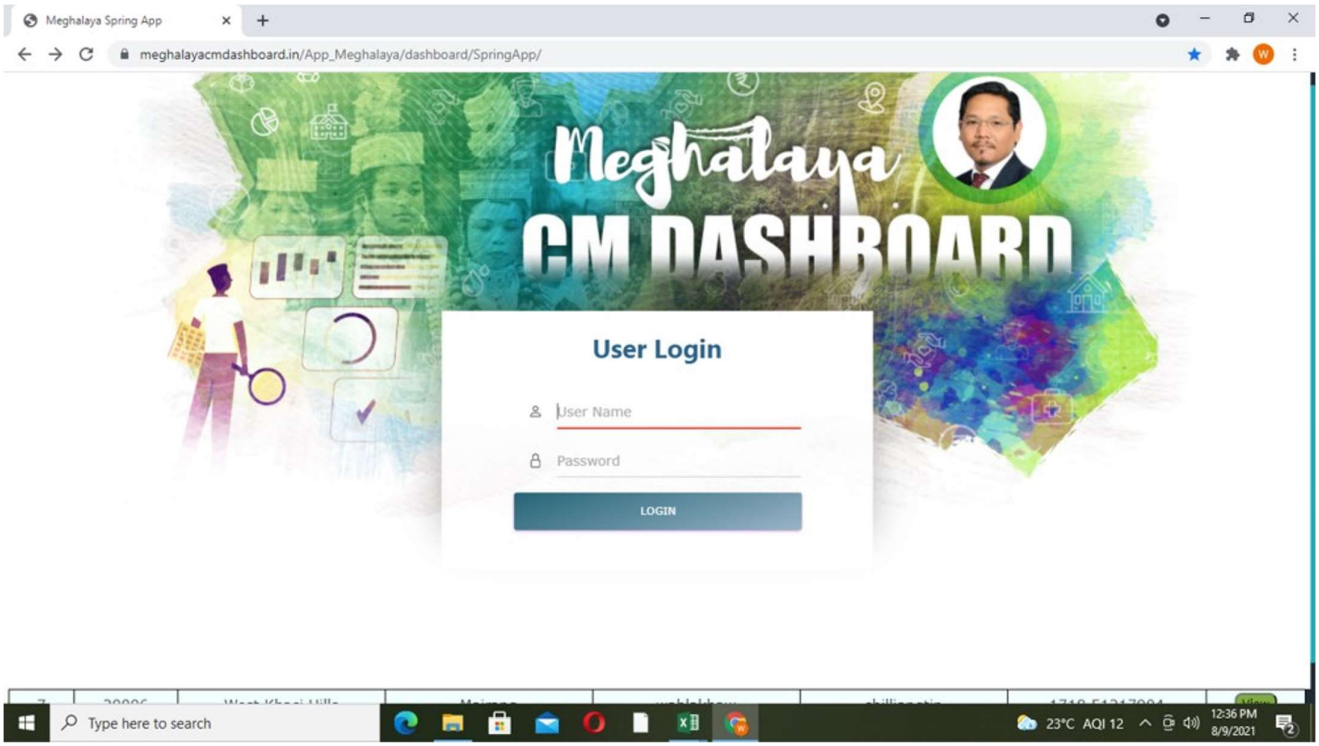

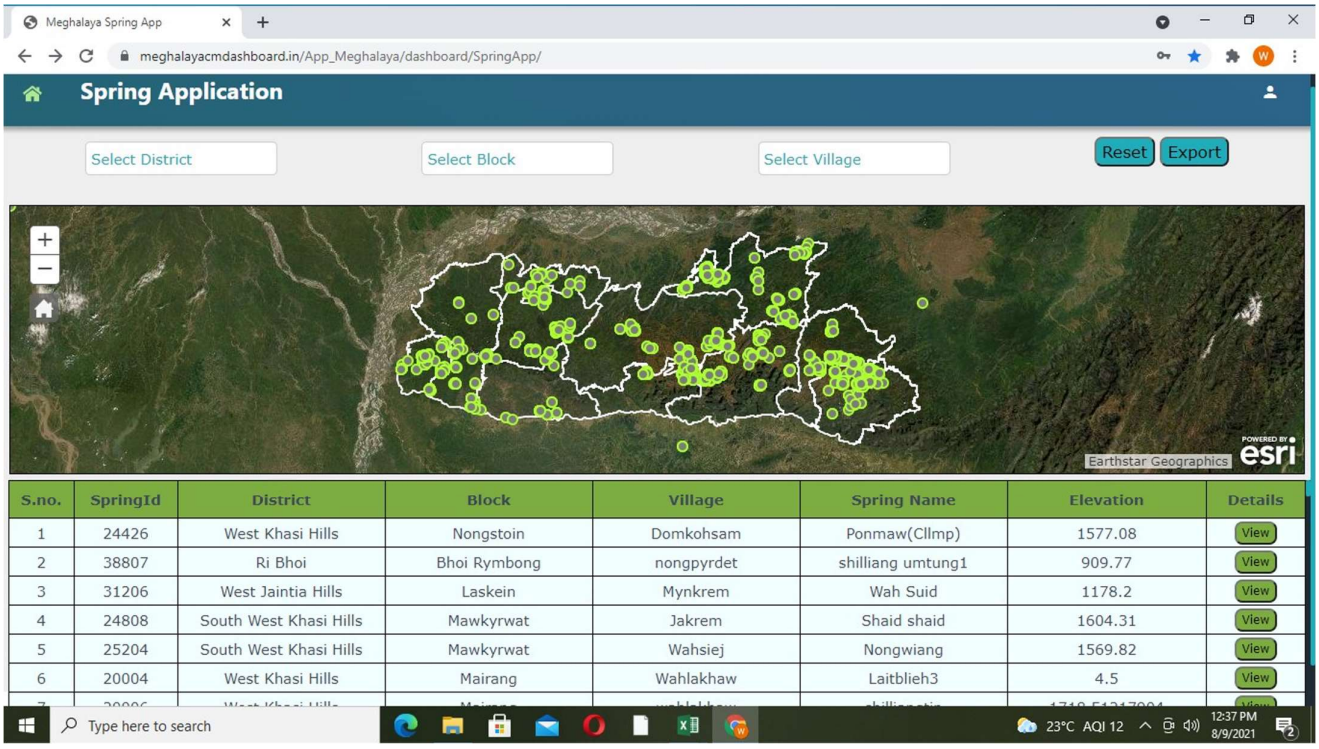

S.no.	SpringId	District	Block	Village	Spring Name	Elevation	Details
1	24426	West Khasi Hills	Nongstoin	Domkohsam	Ponmaw(Cllmp)	1577.08	View
2	38807	Ri Bhoi	Bhoi Rymbong	nongpyrdet	shilliang umtung1	909.77	View
3	31206	West Jaintia Hills	Laskein	Mynkrem	Wah Suid	1178.2	View
4	24808	South West Khasi Hills	Mawkyrwat	Jakrem	Shaid shaid	1604.31	View
5	25204	South West Khasi Hills	Mawkyrwat	Wahsiej	Nongwiang	1569.82	View
6	20004	West Khasi Hills	Mairang	Wahlakhaw	Laitblieh3	4.5	View

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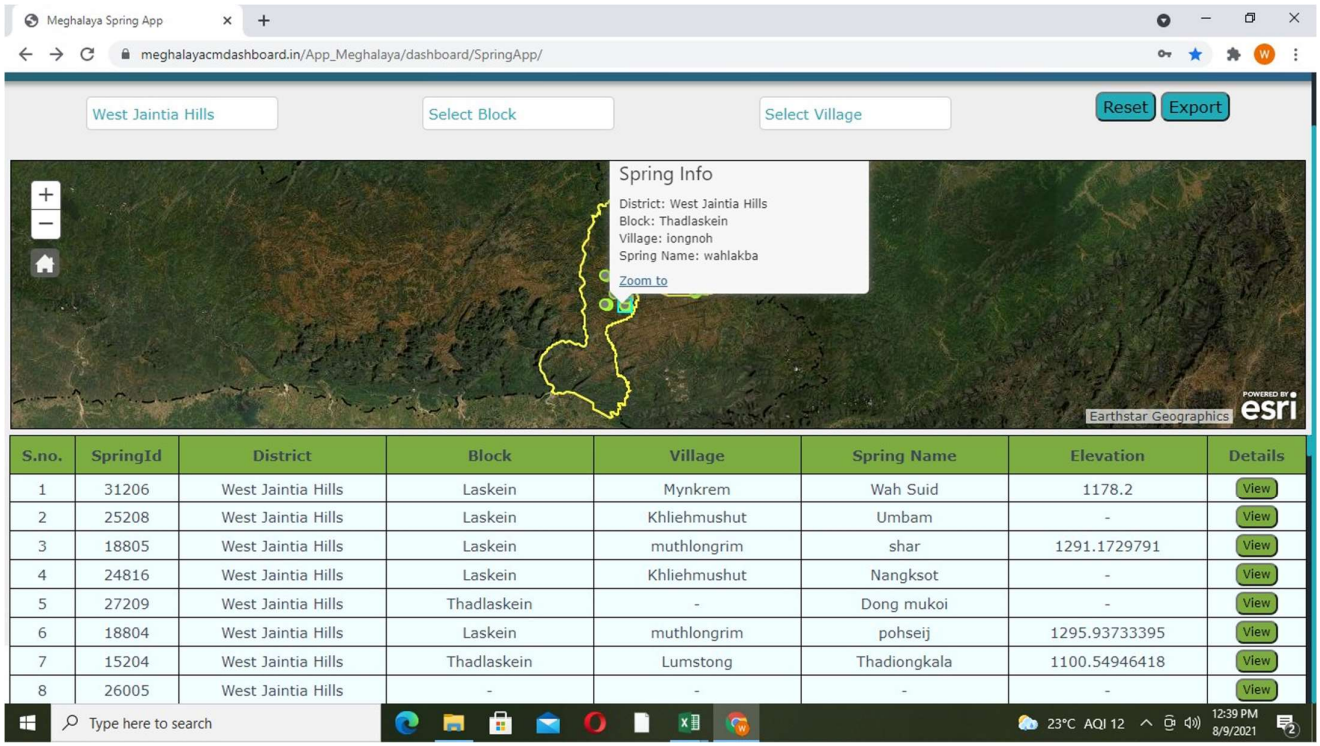
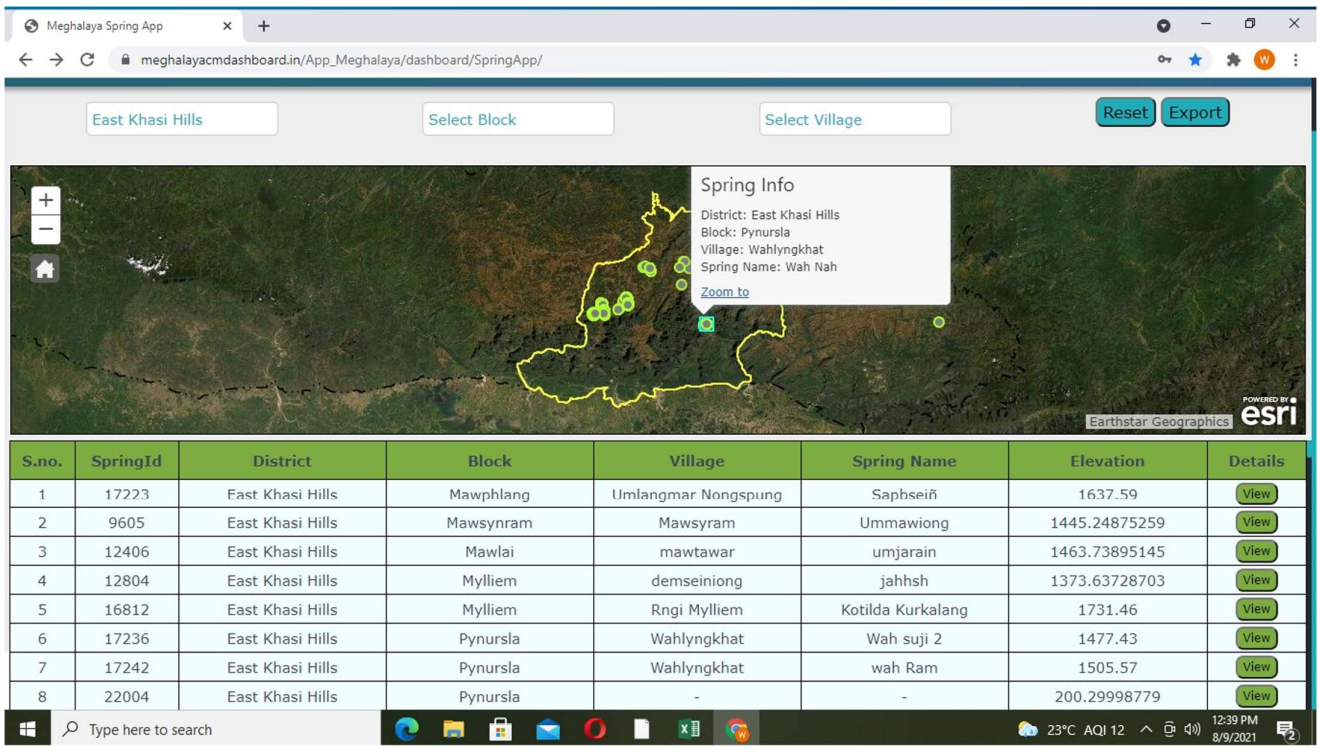


S.no.	SpringId	District	Block	Village	Spring Name	Elevation	Details
1	31206	West Jaintia Hills	Laskein	Mynkrem	Wah Suid	1178.2	View
2	25208	West Jaintia Hills	Laskein	Khliehmushut	Umbam	-	View
3	18805	West Jaintia Hills	Laskein	muthlongrim	shar	1291.1729791	View
4	24816	West Jaintia Hills	Laskein	Khliehmushut	Nangksot	-	View
5	27209	West Jaintia Hills	Thadlaskein	-	Dong mukoi	-	View
6	18804	West Jaintia Hills	Laskein	muthlongrim	pohseij	1295.93733395	View
7	15204	West Jaintia Hills	Thadlaskein	Lumstong	Thadiongkala	1100.54946418	View
8	26005	West Jaintia Hills	-	-	-	-	View



S.no.	SpringId	District	Block	Village	Spring Name	Elevation	Details
1	17223	East Khasi Hills	Mawphlang	Umlangmar Nongspung	Sapbseiñ	1637.59	View
2	9605	East Khasi Hills	Mawsynram	Mawsyram	Ummawiong	1445.24875259	View
3	12406	East Khasi Hills	Mawlai	mawtawar	umjarain	1463.73895145	View
4	12804	East Khasi Hills	Mylliem	demseiniong	jahhsh	1373.63728703	View
5	16812	East Khasi Hills	Mylliem	Rngi Mylliem	Kotilda Kurkalang	1731.46	View
6	17236	East Khasi Hills	Pynursla	Wahlyngkhat	Wah suji 2	1477.43	View
7	17242	East Khasi Hills	Pynursla	Wahlyngkhat	wah Ram	1505.57	View
8	22004	East Khasi Hills	Pynursla	-	-	200.29998779	View

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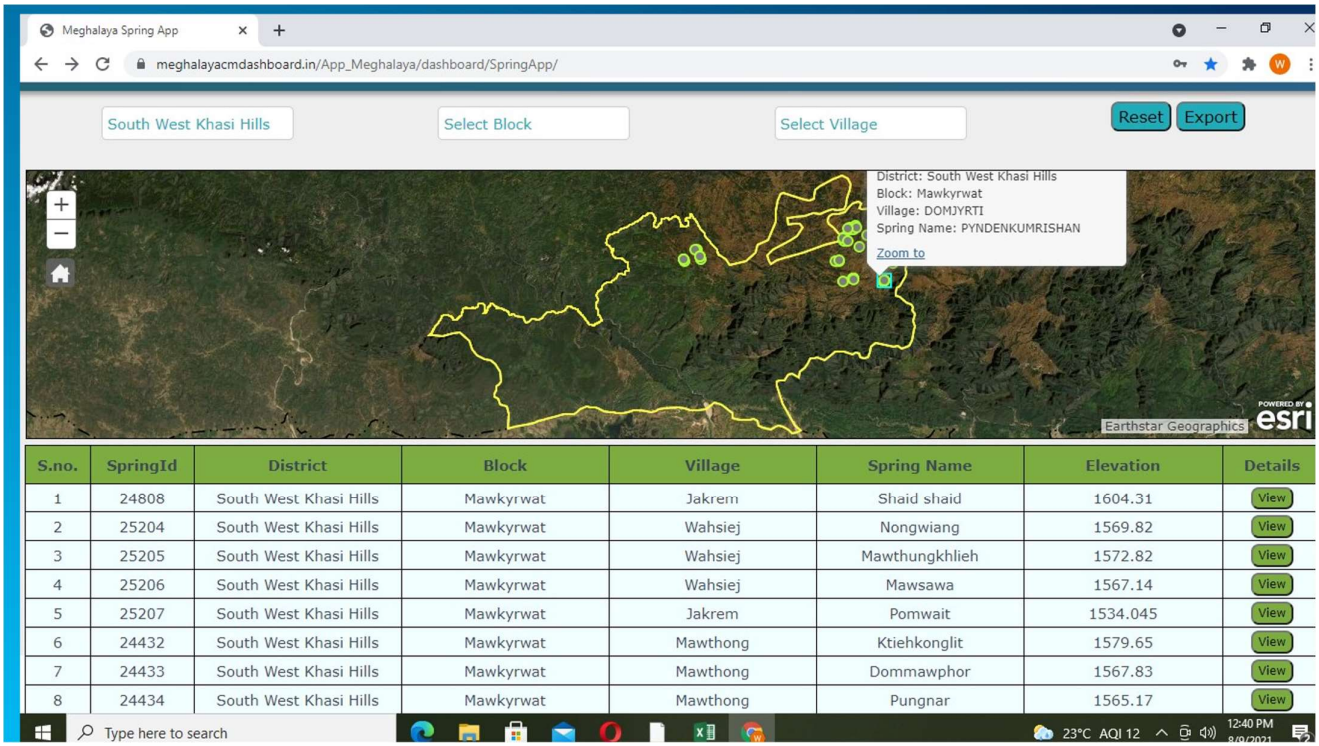
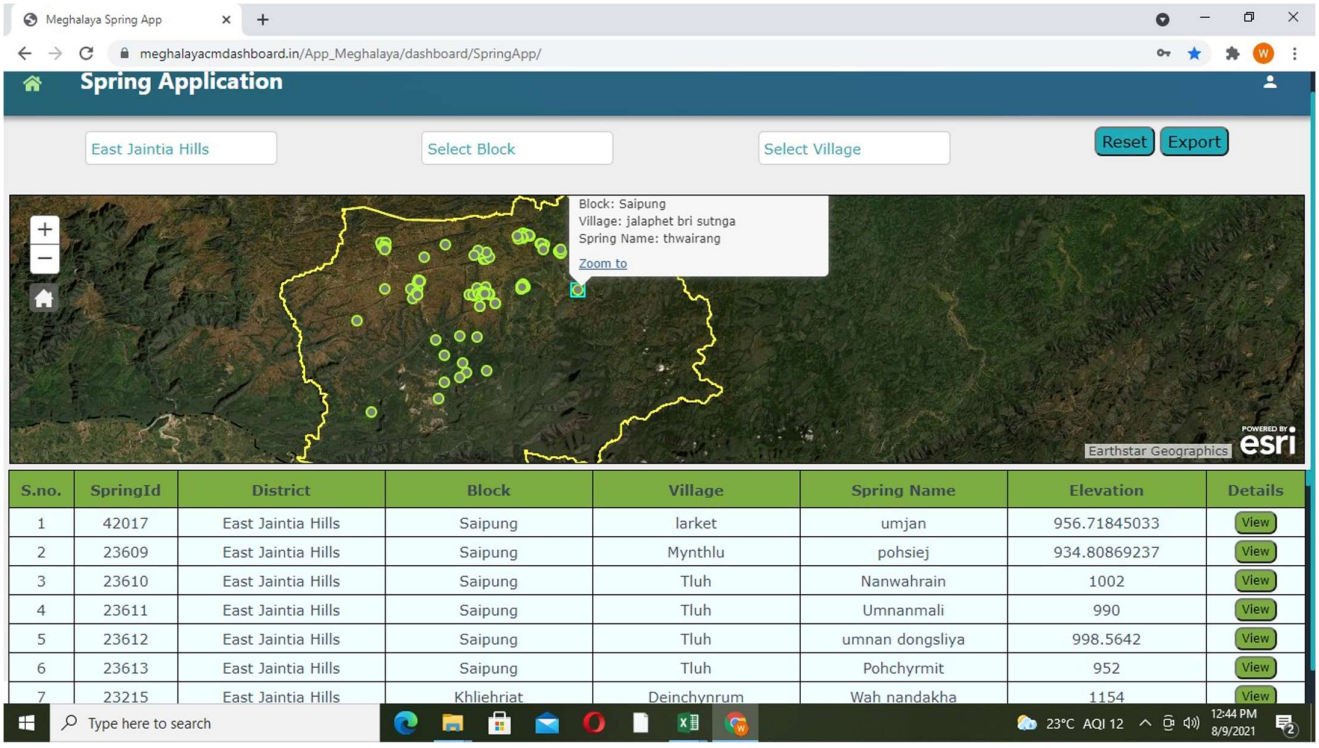
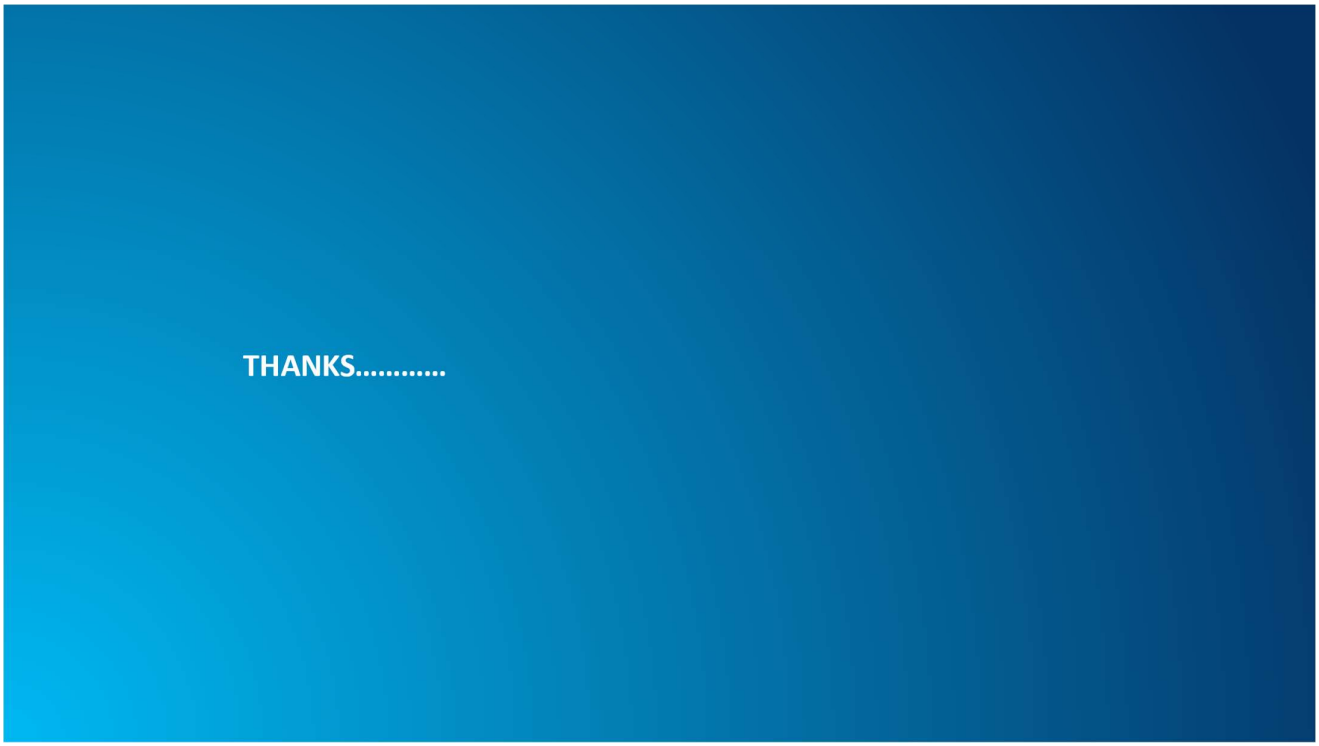


S.no.	SpringId	District	Block	Village	Spring Name	Elevation	Details
1	24808	South West Khasi Hills	Mawkyrwat	Jakrem	Shaid shaid	1604.31	View
2	25204	South West Khasi Hills	Mawkyrwat	Wahsiej	Nongwiang	1569.82	View
3	25205	South West Khasi Hills	Mawkyrwat	Wahsiej	Mawthungkhlieh	1572.82	View
4	25206	South West Khasi Hills	Mawkyrwat	Wahsiej	Mawsawa	1567.14	View
5	25207	South West Khasi Hills	Mawkyrwat	Jakrem	Pomwait	1534.045	View
6	24432	South West Khasi Hills	Mawkyrwat	Mawthong	Ktiehkonglit	1579.65	View
7	24433	South West Khasi Hills	Mawkyrwat	Mawthong	Dommawphor	1567.83	View
8	24434	South West Khasi Hills	Mawkyrwat	Mawthong	Pungnar	1565.17	View



S.no.	SpringId	District	Block	Village	Spring Name	Elevation	Details
1	42017	East Jaintia Hills	Saipung	larket	umjan	956.71845033	View
2	23609	East Jaintia Hills	Saipung	Mynthlu	pohsiej	934.80869237	View
3	23610	East Jaintia Hills	Saipung	Tluh	Nanwahrain	1002	View
4	23611	East Jaintia Hills	Saipung	Tluh	Umnanmali	990	View
5	23612	East Jaintia Hills	Saipung	Tluh	umnan dongsliya	998.5642	View
6	23613	East Jaintia Hills	Saipung	Tluh	Pohchyrmit	952	View
7	23215	East Jaintia Hills	Khliehriat	Deinchynrum	Wah nandakha	1154	View



Institute of Natural Resources, Meghalaya

Hydrological Spring Mapping of village in Meghalaya

Project site target	6605 villages (all over the State)
Project cost estimates	**₹ 1,06,93,800.00**
Project period	One year
Implementation Agency	Green Volunteers from each circle
Project Facilitating Agency	INRM, MBDA
Project Activities	· Selection of the GV etc for carrying out the exercise. · Training and capacity building to the volunteers · Springs mapping (Quantity & Quality) · Preparation of the Village Water Security Plan.

OBJECTIVE

- Generation of Spring Database for future reference.
- To improve the quantity and quality of the water available within the village
- To propagate the importance of spring protection to the community.

Block Level Training for Green Volunteers

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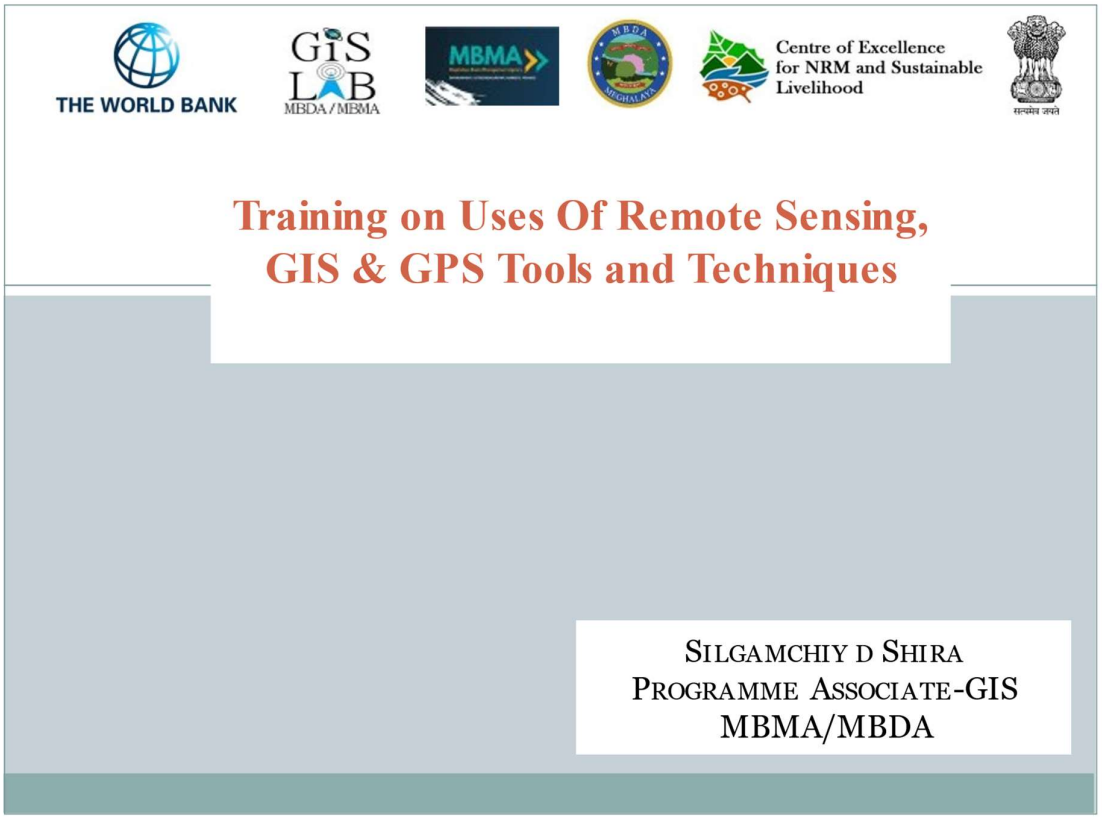
Progress

- ..\H.S.M. Blocks completed (Edited S5).xlsx

THANK YOU



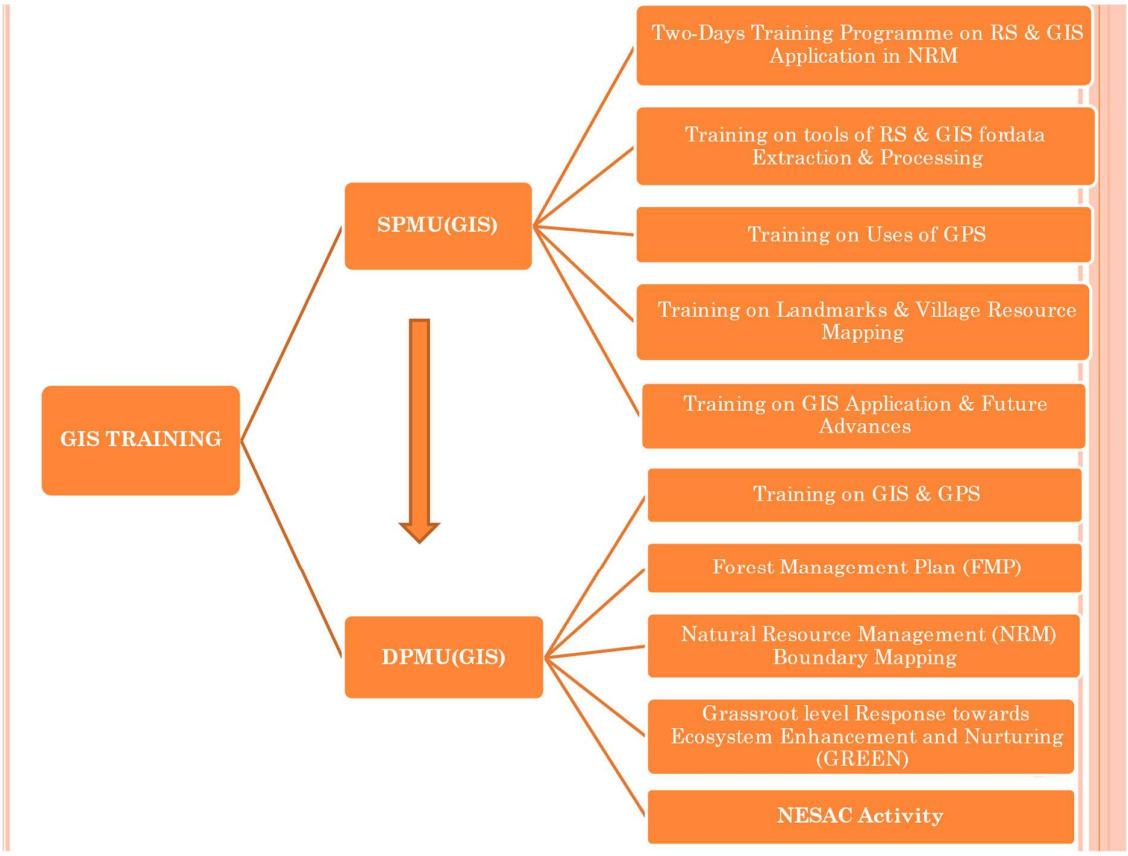
CONTENTS

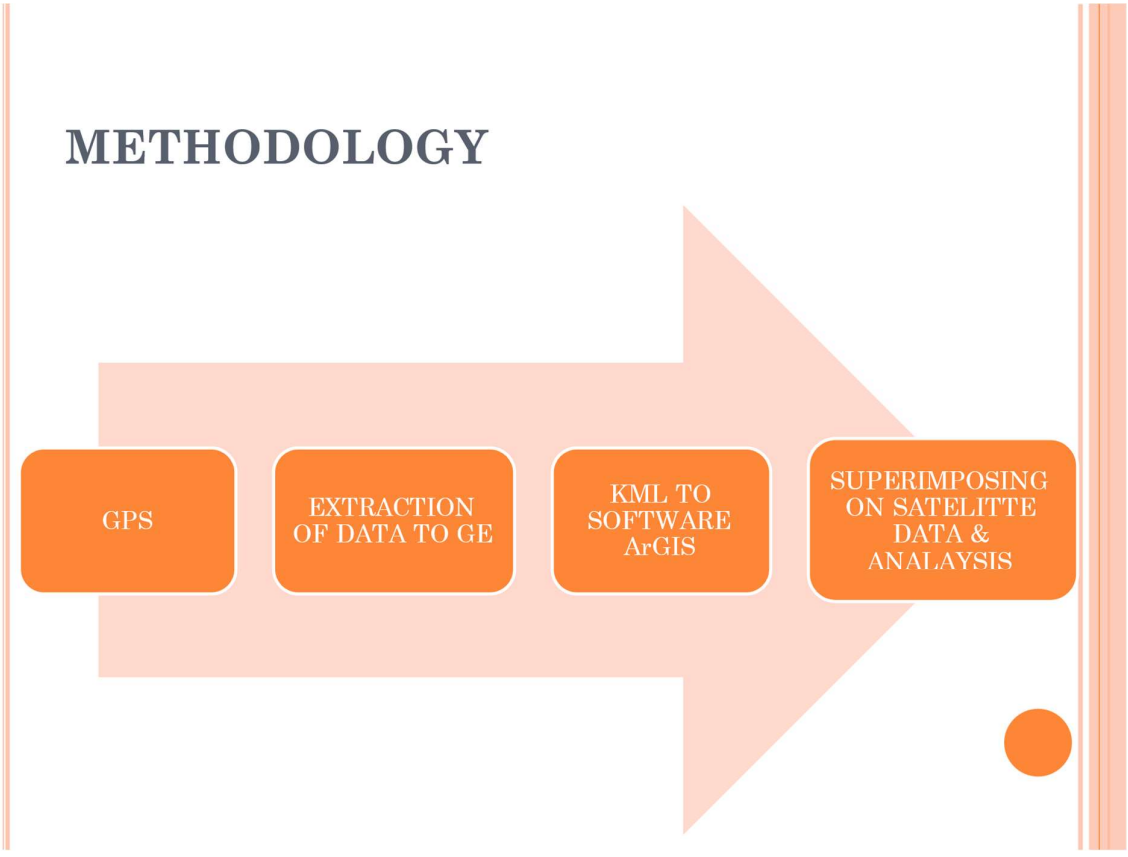
OBJECTIVE

To develop the understanding which can enable trainees to learn the concept, objectives, importance & application of RS,GIS, GPS, GOOGLE EARTH (GE) & Mobile App and Capacity building for planning and management for project purposes.

TARGET GROUP

- Internal SPMU & DPMU Team
- Other Department Functionaries
- Village Communities
- Village Community Facilitator (VCF)
- Apprentices (Students)


GIS TRAINING
SPMU(GIS)
DPMU(GIS)
Two-Days Training Programme on RS & GIS Application in NRM
Training on tools of RS & GIS fordata Extraction & Processing
Training on Uses of GPS
Training on Landmarks & Village Resource Mapping
Training on GIS Application & Future Advances
Training on GIS & GPS
Forest Management Plan (FMP)
Natural Resource Management (NRM) Boundary Mapping
Grassroot level Response towards Ecosystem Enhancement and Nurturing (GREEN)
NESAC Activity


METHODOLOGY
GPS
EXTRACTION OF DATA TO GE
KML TO SOFTWARE ArGIS
SUPERIMPOSING ON SATELITTE DATA & ANALAYSIS

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Two-Days Training Programme on RS & GIS Application in NRM

MBDA Staffs

Training on Tools of RS & GIS for data Extraction & Processing

GOVERNMENT. DEPARTMENTS (DMR AND S&WC)

TRAINING ON USES OF GPS

GREEN VOLUNTEERS

TRAINING ON LANDMARKS & VILLAGE RESOURCE MAPPING

- Marking of Landmarks-with the help of Handheld GPS (Points)
- Collection of Boundary
  - GPS based boundary tracking
  - Onscreen delineation using Google Earth
- Map Reading

Village communities

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3 Months Apprenticeship Training Program
GIS Application & Future Advances

Training on GIS & GPS

- Basic Introduction on GIS and GPS .
- Basic Training to collect field data which are referenced to the earth.
- Using GPS Garmin Handheld available with DPMUs.
- Using openly available apps i.e. GPS Essential & Note Cam Lite.

VCFs & VNRMC Members

FOREST MANAGEMENT PLAN (FMP)

- Map Reading
- GPS demarcation of Sample plots
- Reaching to the sample plots (go to location/navigating app)



VCFs

NATURAL RESOURCE MANAGEMENT (NRM) BOUNDARY MAPPING

- Participatory training programme for the VCFs in using GPS




VCFs

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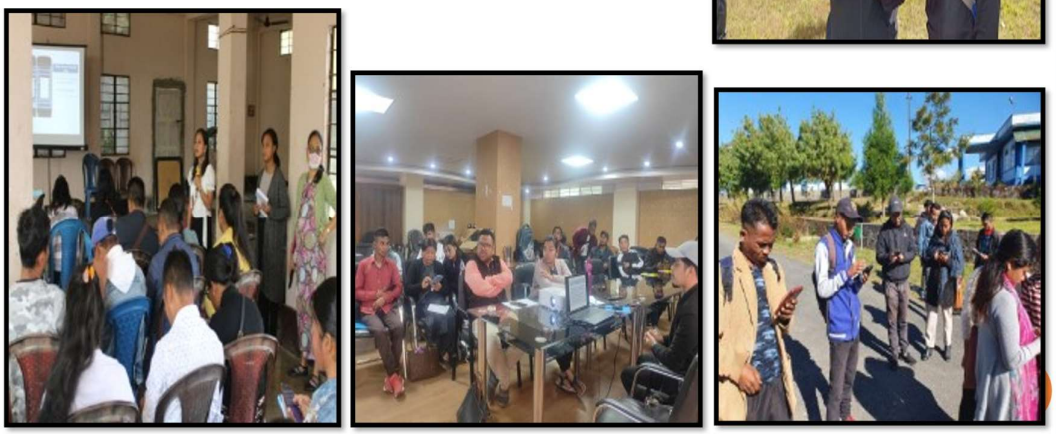
GRASSROOT LEVEL RESPONSE TOWARDS ECOSYSTEM ENHANCEMENT AND NURTURING (GREEN)

- Refresher training on GPS Garmin Handheld
- Sangrah 2.0 (Mobile App)

VCFs

NESAC ACTIVITY

Village Resource Mapping App developed by NESAC to capture landmarks of Villages for the project viz. "Village level Land use/Land cover mapping of Khasi & Jaintia Hills District of Meghalaya using High Resolution Geospatial Data.



VCFs

SUMMARY

Sl. No.	Trainings	No. of Trainees trained
1	Two-Days Training Programme on RS/GIS Application in NRM (MBDA Staffs)	56
2	Training on tools of RS/GIS for data extraction & Processing (Govt. Department)	25
3	Training on Uses of GPS (Green Volunteers)	1000
4	Training on Landmarks & Village Resource Mapping (Village Communities)	800
5	Training on GIS Application & Future Advances (Apprentice)	15
6	Training on GIS/GPS (VCFs & VNRMC Members)	1600
7	FMP (VCFs)	1200
8	NRM Boundary Mapping (VCFs)	200
9	GREEN (VCFs)	350
10	NESAC Activity (VCFs)	275
TOTAL		**5521**

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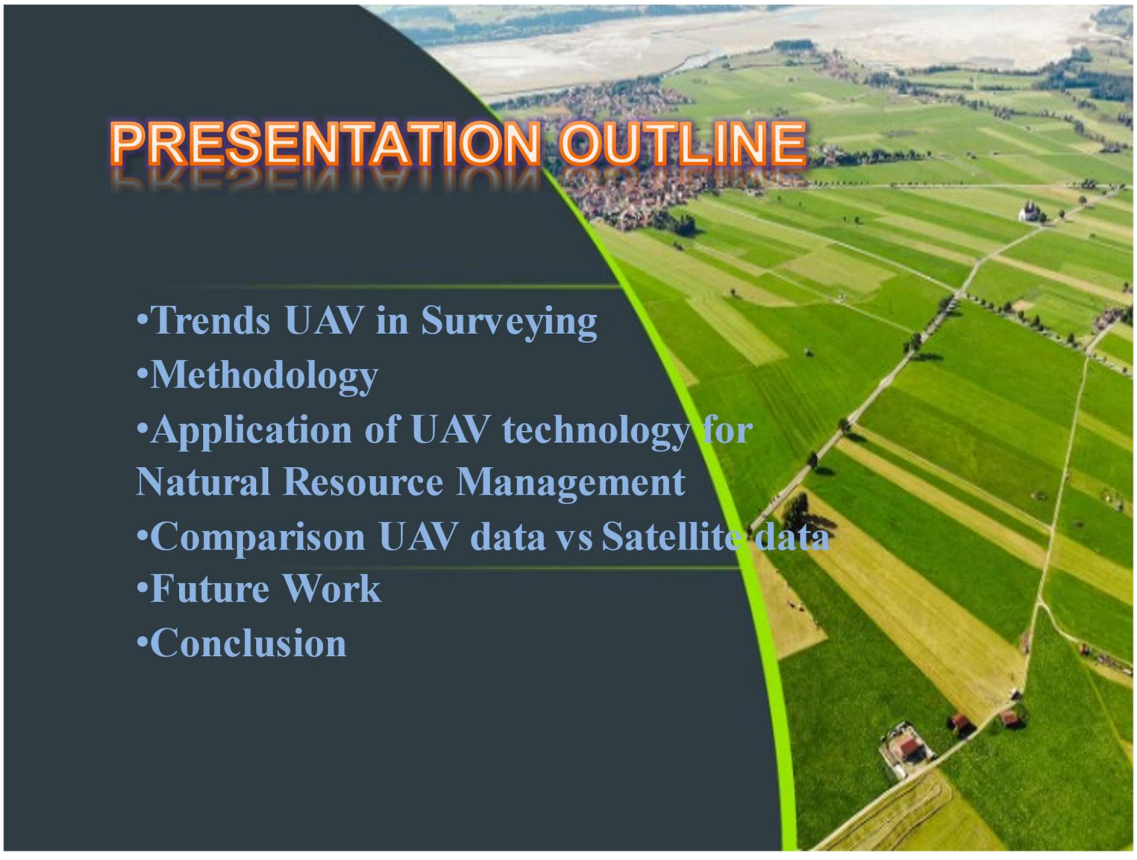
APPLICATION OF UAV TECHNOLOGY FOR NATURAL RESOURCE MANAGEMENT IN MEGHALAYA



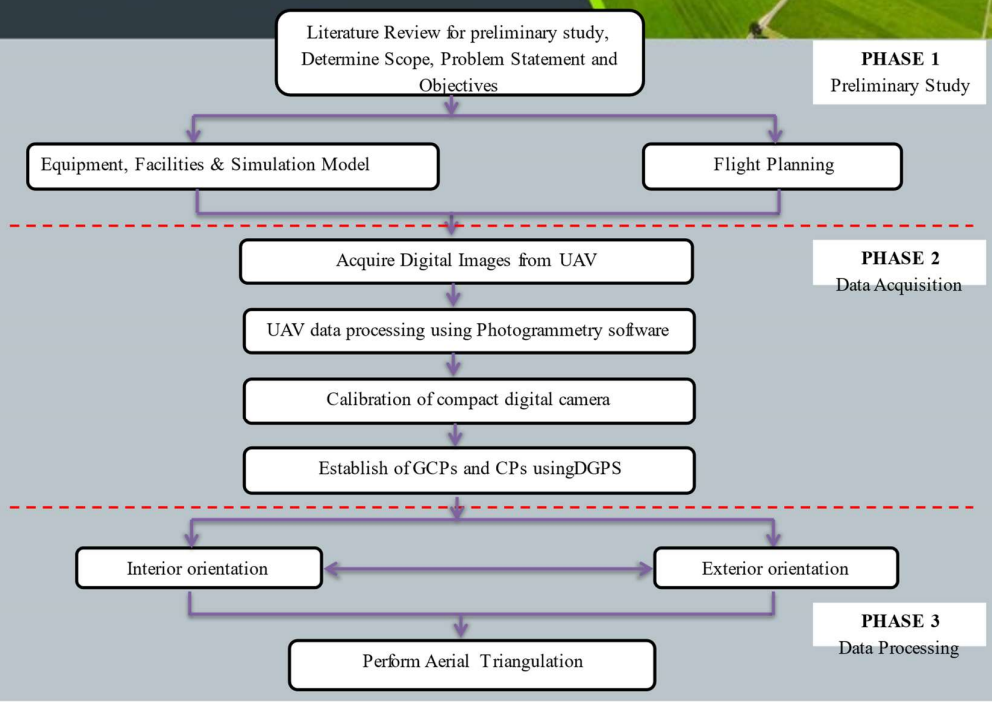
PRESENTATION OUTLINE

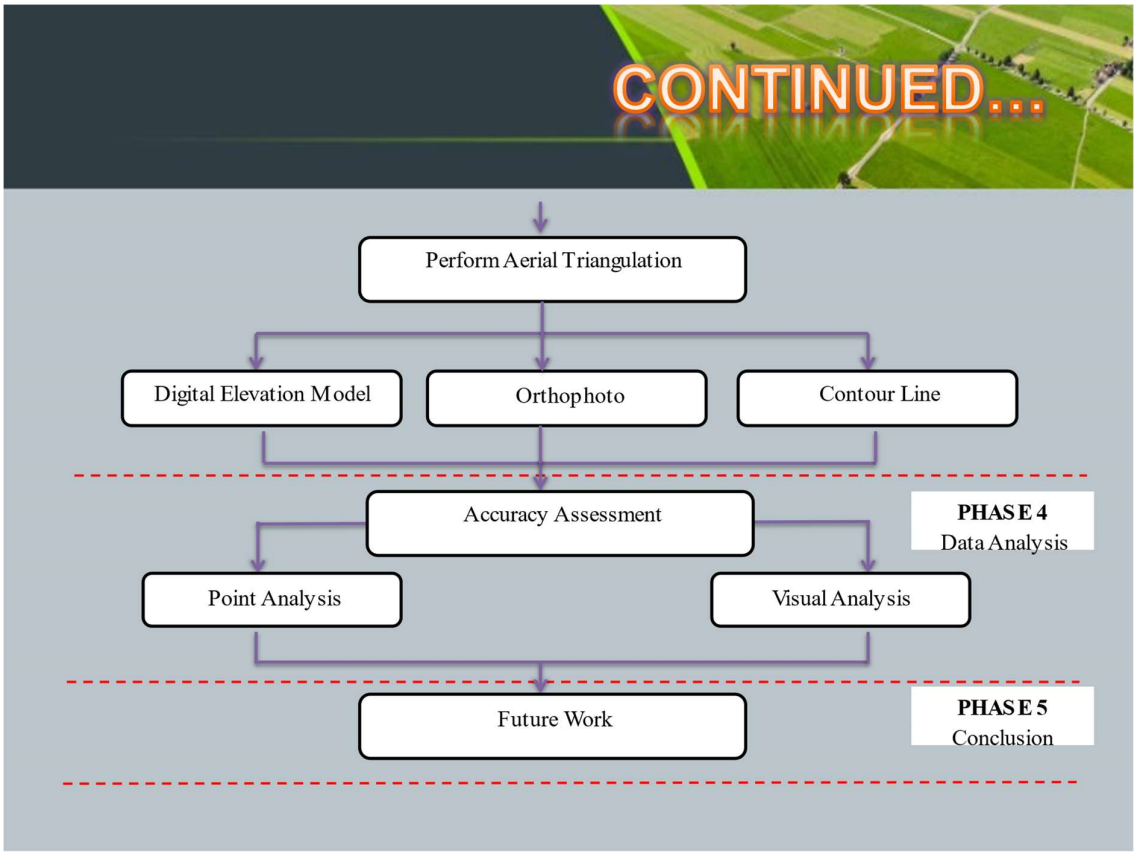
- Trends UAV in Surveying
- Methodology
- Application of UAV technology for Natural Resource Management
- Comparison UAV data vs Satellite data
- Future Work
- Conclusion

TRENDS UAV IN SURVEYING

- This is apparent in comparison to conventional aerial surveying which offer accurate maps, but very expensive and have limited endurance for only a few hours. The UAV systems could be mounted on either high or low altitude platform.
- Low-altitude systems have advantages in conducting photogrammetric surveys under the cloud, providing different views and tilted images of the surveyed objects, low-cost and easy-to-maintain for engineering applications systems such as topographic either large or small scale mapping.
- The development of this technology is very beneficial for monitoring purpose of limited time and budget. It has been reported that UAV has been practiced in many applications such as farming, surveillance, road maintenance, recording and documentation of cultural heritage.

METHODOLOGY




CONTINUED...
Perform Aerial Triangulation
Digital Elevation Model
Orthophoto
Contour Line
Accuracy Assessment
PHASE 4
Data Analysis
Point Analysis
Visual Analysis
Future Work
PHASE 5
Conclusion


APPLICATION OF UAV TECHNOLOGY FOR NATURAL RESOURCE MANAGEMENT IN MEGHALAYA

APPLICATION OF UAV

➢ Agriculture

- Agriculture is the major and fastest growing resource monitoring application of UAV. It has gained popularity in precision agriculture to increase production.
- Monitoring crop health is one of the most important applications of UAV in precision agriculture which includes detection of diseases, dead leaf, water stress, weed cover mapping and herbicide application monitoring
- Mostly small UAV have been used to measure the height of crops, supervise planting pattern of sugarcane weed, pest and disease infestations.
- The rapid growth in the use of UAV for agricultural resource management indicates the potential of UAV for real-time–cost-effective crop monitoring on a smaller scale

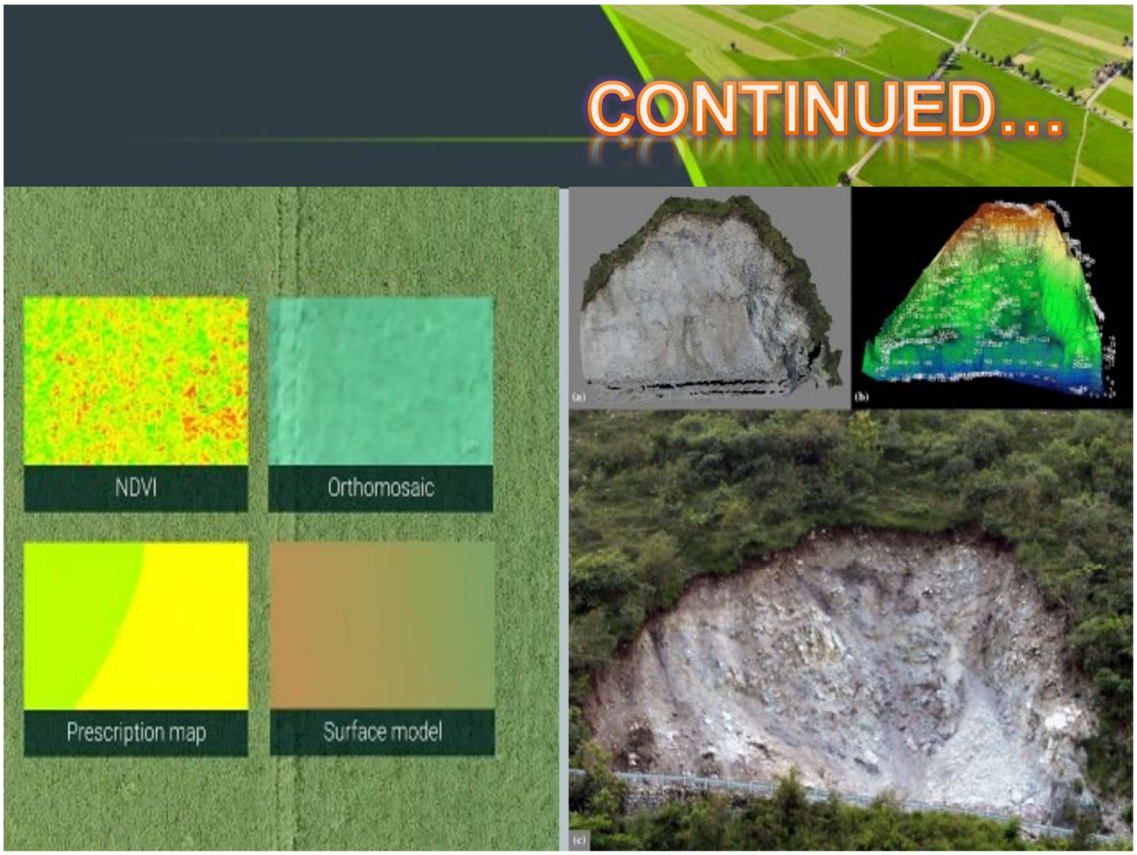
CONTINUED...

➢ Forest and wildlife reserve

- Fine spatial-scale UAV data are used for sustainable management of various forest and wildlife resources where drones play an important role in monitoring inaccessible areas.
- A thermal imager and a hyperspectral sensor in visible–NIR bands have been used with a radio-controlled fixed-wing model for forest fire monitoring.
- Other environmental research applications include biodiversity and habitat monitoring which used small UAV for detecting the density and circulation of various animal species in several forest region.
- It offers a great opportunity for real-time monitoring of endangered and rare species, and this approach has been proved to be cheaper and safer for monitoring a vast area of wildlife habitat than ground-based technique

➢ Water and Land Resource

- The applications of UAV which include the mapping and monitoring of various water and land resources. The applications in water resources include rivers,lakes and wetland mapping
- UAV has also been used for various soil properties and soil erosion-related studies such as multitemporal analysis of hydrological soil surface characteristics, monitoring of gully erosion and assessing the impact of soil surface characteristics on vineyard erosion and landslide evaluation.
- Also used for measuring water level in rivers and lakes from lightweight UAVs.
- Recently, our team has undergone a survey inSiju region where the major landslides and flood occurs and the UAV output data has been used for further studied of the affected area.



COMPARISON OF CONVENTIONAL SATELLITES DATA VS. UAV DATA FOR NATURAL RESOURCE MANAGEMENT

Satellite data Vs UAV data

Specification	Satellite Data	UAV Data
Spatial Resolution	Medium to high	Very High
Temporal Resolution	Fixed	Flexible
Spectral Resolution	Very High	Increase with cost
Scale	Covers larger region	Suitable for small regions
Data Processing Time	Shorts	Long
Data Acquisition	Restricted and fixed	Directly controlled and flexible
Cost	Increased with resolution and area	Cost-effective as compared to satellite data

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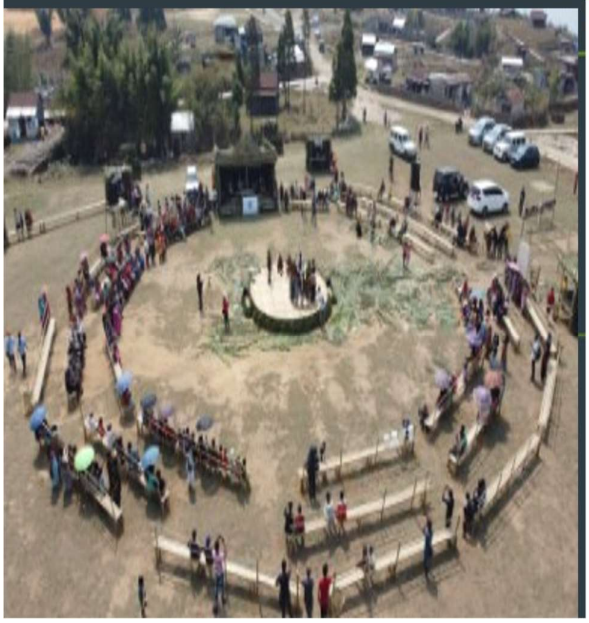
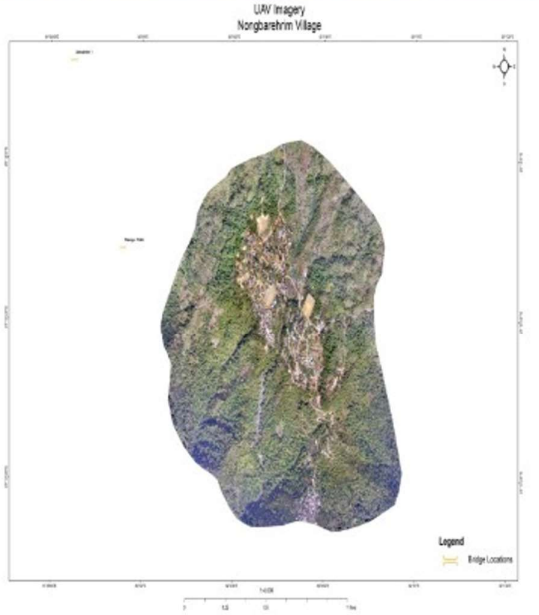
UAV Survey undertaken under MBDA





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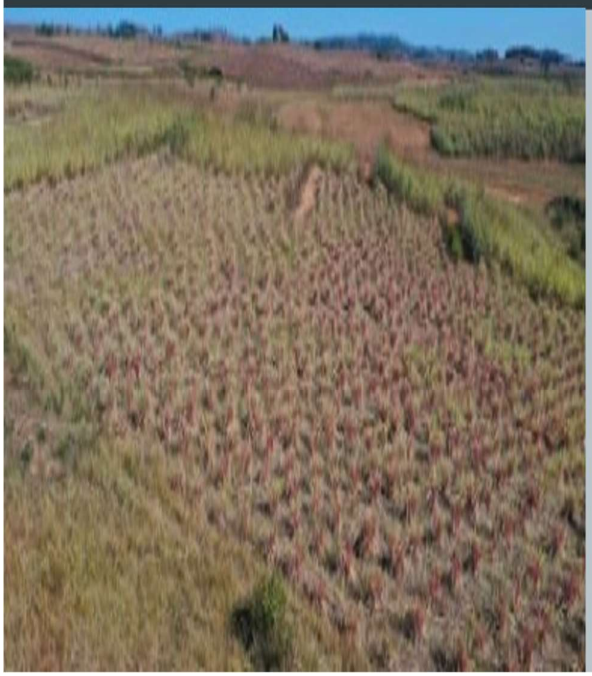


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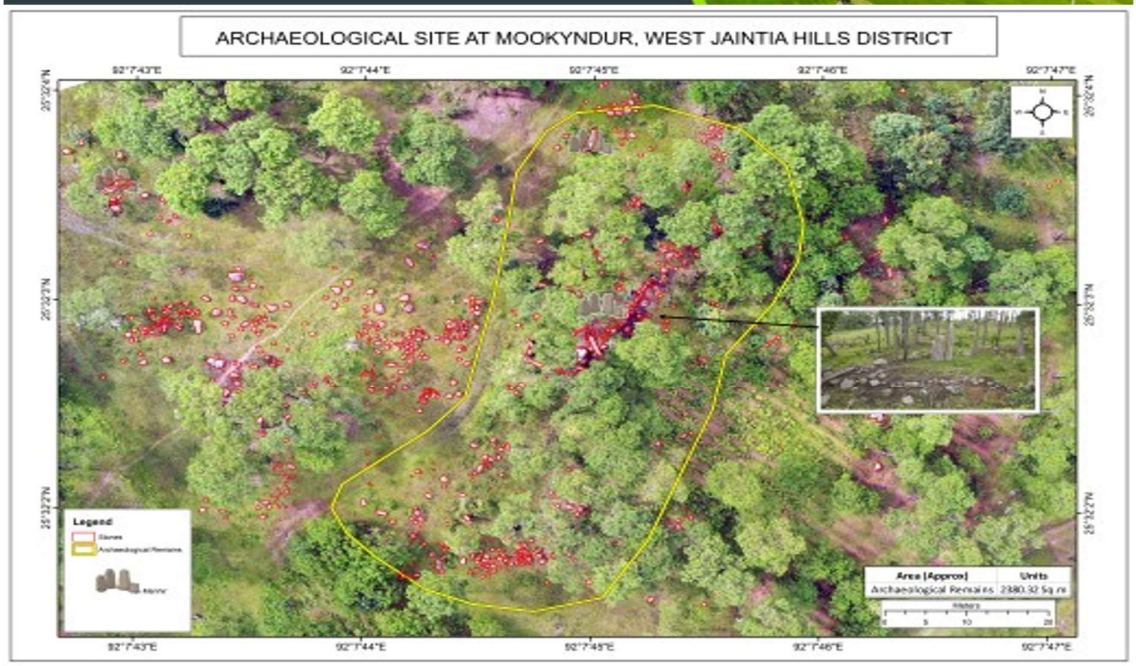
ARCHAEOLOGICAL SITE AT MOOKYNDUR, WEST JAINTIA HILLS DISTRICT
92°7'43"E
92°7'44"E
92°7'45"E
92°7'46"E
92°7'47"E
Legend
Area (Approx)
Units
Archaeological Remains
2380.32 Sq.m


CONTINUED...

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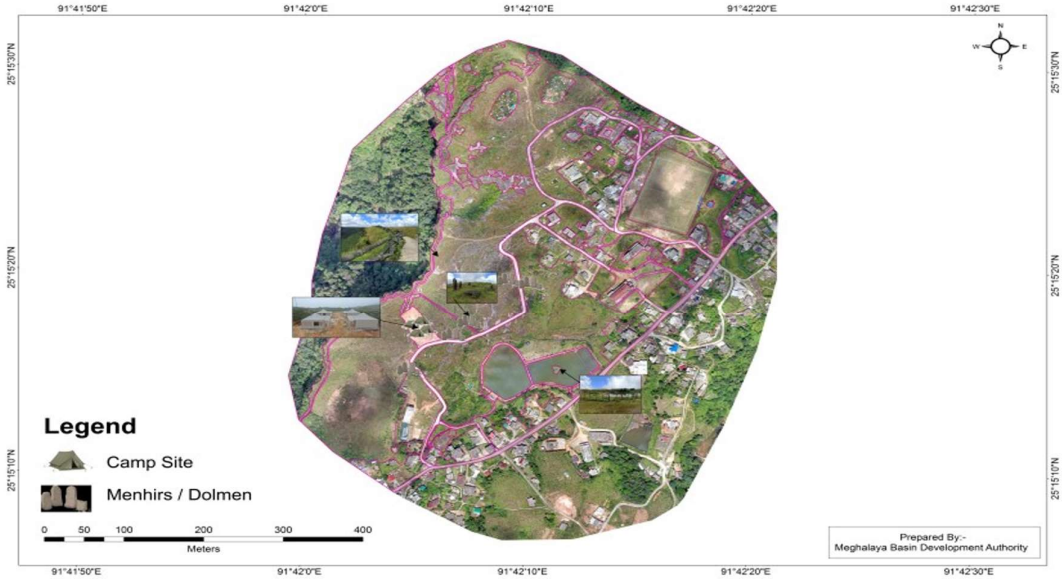
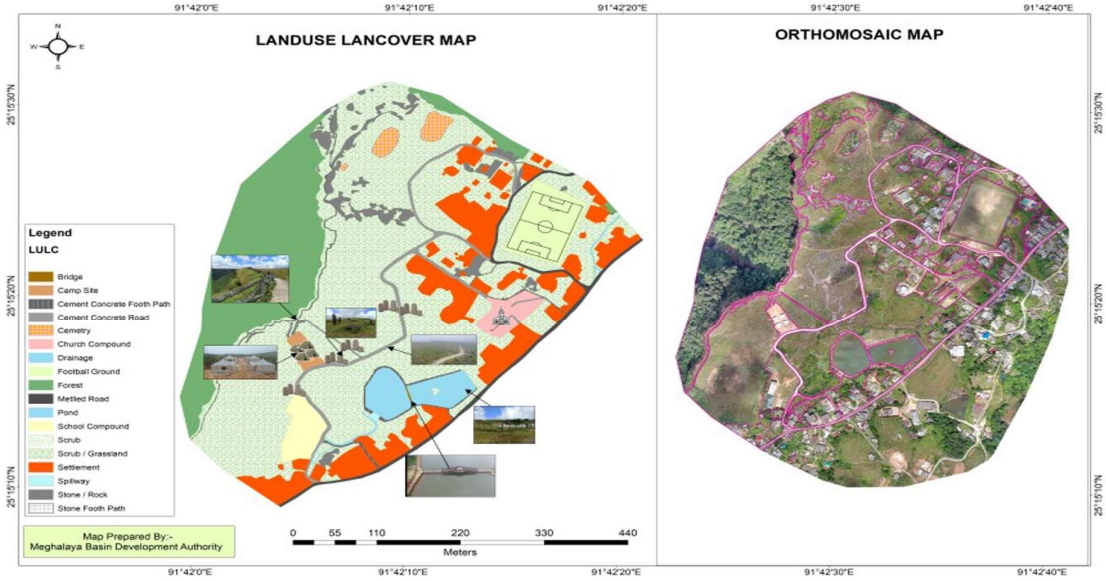
ORTHOMOSAIC IMAGE OF TOURISM SITE AT MAWMLUH VILLAGE



TOURISM SITE AT MAWMLUH VILLAGE



FUTURE WORK

- The use of UAV is still in its early stage for natural resource management but the increasing trend seems to be unstoppable, and there is a rapid advancement in the field because of the low -cost application of specific UAVs.
- The resolution, accuracy, flexibility and spectral range are increasing, also focuses on the engineering part of UAVs to increase its capability.
- However, some of the limitations require more attention and efforts to improve the overall performance of UAVs. These limitations are:

  -Data processing: As the area increases, the number of images also increases and handling large datasets and processing data is one of the biggest limitations of UAV. Apart from this robust, high efficiency, automation and intelligence for data processing are worth more efforts

  -Platform : Due to small size and lightweight, instability of the UAVs causes distortion in data.

  -Sensors: Due to the limitation of payload in small drones, it is impossible to mount highly effective parallel multisensor cameras in the small space

  -Restrictions and regulations : Restrictions on the use of drones in many areas are also a major limitation which prevents researches from testing all possibilities.

CONTINUED...

- It is expected that with the advancement of UAVs technology, all the limitations will be taken care of.

FIXED WING

ROTOR-TYPED

HYBRID VTOL

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