



Resource Management and Sustainable Rural Livelihood in Post-Pandemic Era – An IGIF Driven Approach

Soumya K Ghosh, Pulak Mishra, Sayak Roychowdhury

skg@cse.iitkgp.ac.in, pmishra@hss.iitkgp.ac.in, sroychowdhury@iem.iitkgp.ac.in

Indian Institute of Technology Kharagpur, India



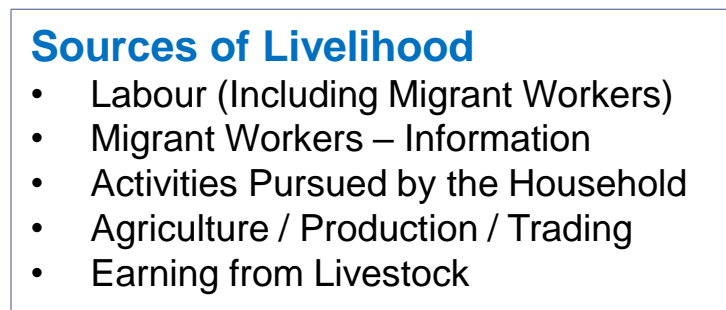
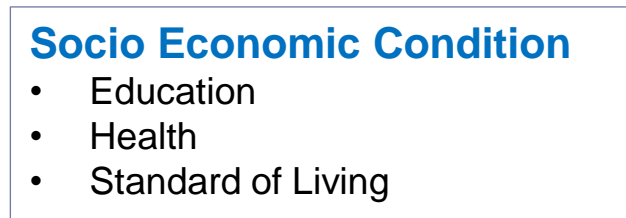
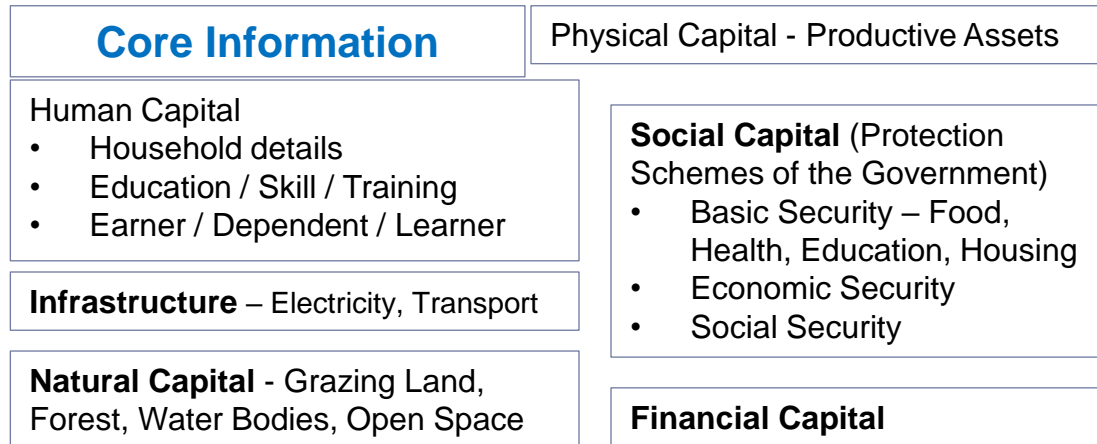
Preamble

- ▶ Major challenge in the Post-Pandemic period (particularly in Rural India) - To bring in. *socioeconomic stability and rejuvenate the development process with adequate emphasis on conservation and judicious use of the critical natural resources*
- ▶ While addressing these aspects requires interventions through appropriate policies and institutional arrangements, designing and successful implementation need detailed analysis using diverse datasets (from both primary and secondary sources) that are harvested and analyzed at various levels.
- ▶ Integrated Geospatial Information Framework (IGIF) backend Spatial Data Infrastructure (SDI) and Geo-Analytics module may be an ideal platform

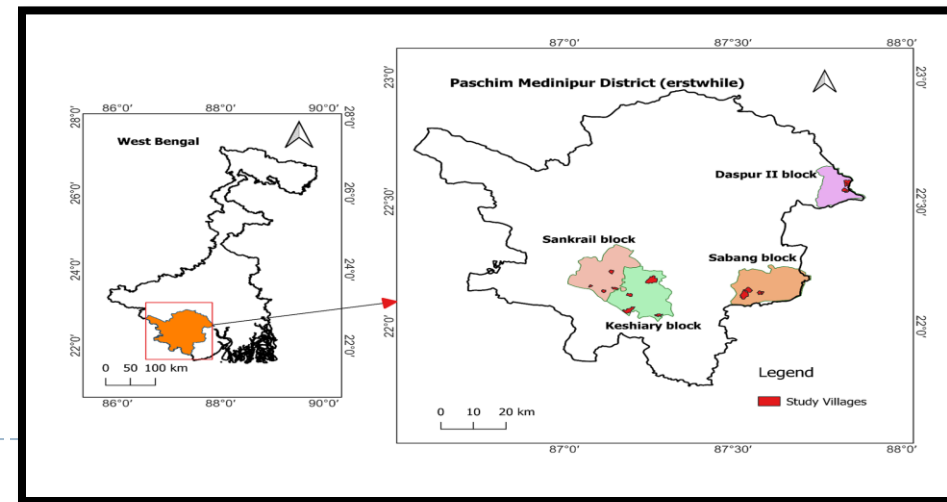
Household Level Survey (Primary data)

Study Area: Paschim Medinipur district of West Bengal state (India)

Blocks: 4 Villages: 16 Households: 400



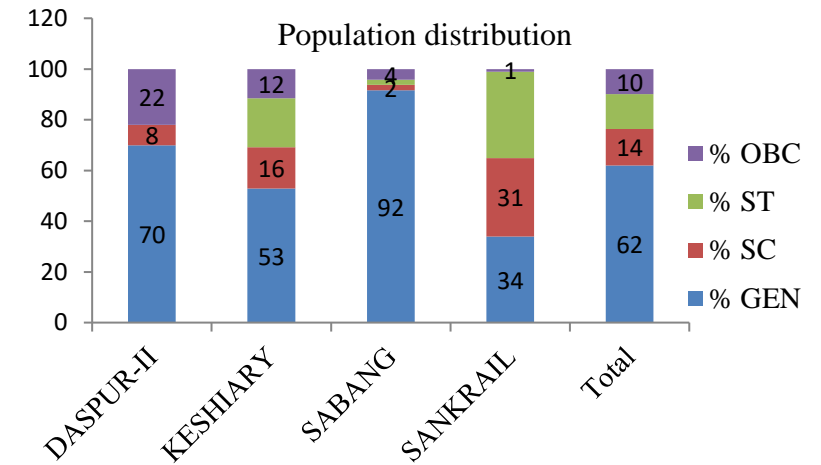
HOUSEHOLD CAPITAL/ASSET	RURAL LIVELIHOOD		GOVERNMENT SCHEMES	SOCIO-ECONOMIC CONDITION
Human capital Social Capital Physical Capital Financial Capital Natural Capital	Nature of Employment and Earnings Production Based Activities Use of Common Property Resources (CPR) Livelihood Shock	Migration Duration Causes Emoluments Reverse Migration and its Consequence	PDS MGNREGA NRLM SGSY and SHGs Others (BRGF, JFM)	Education Healthcare Standard of Living Status of Food Security and Poverty Consumption Savings



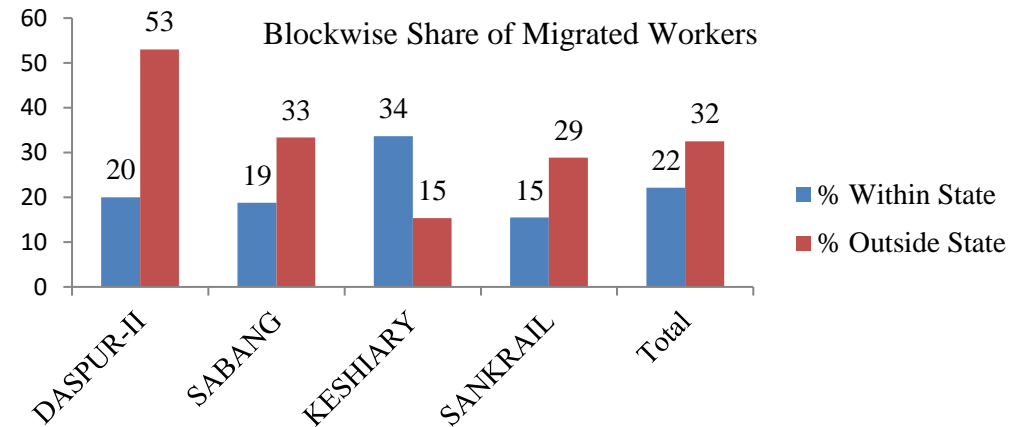
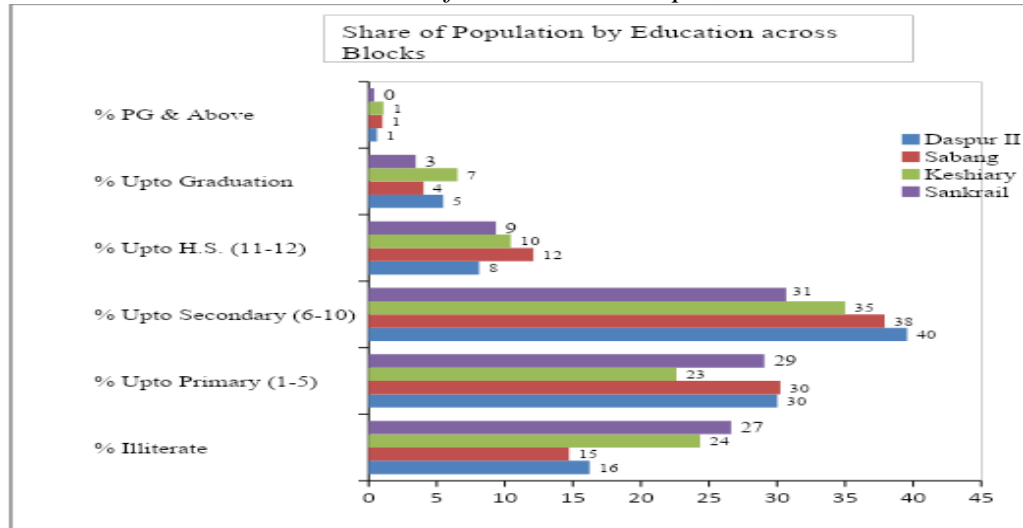
Few Facts and Figures

Land use pattern in the selected blocks

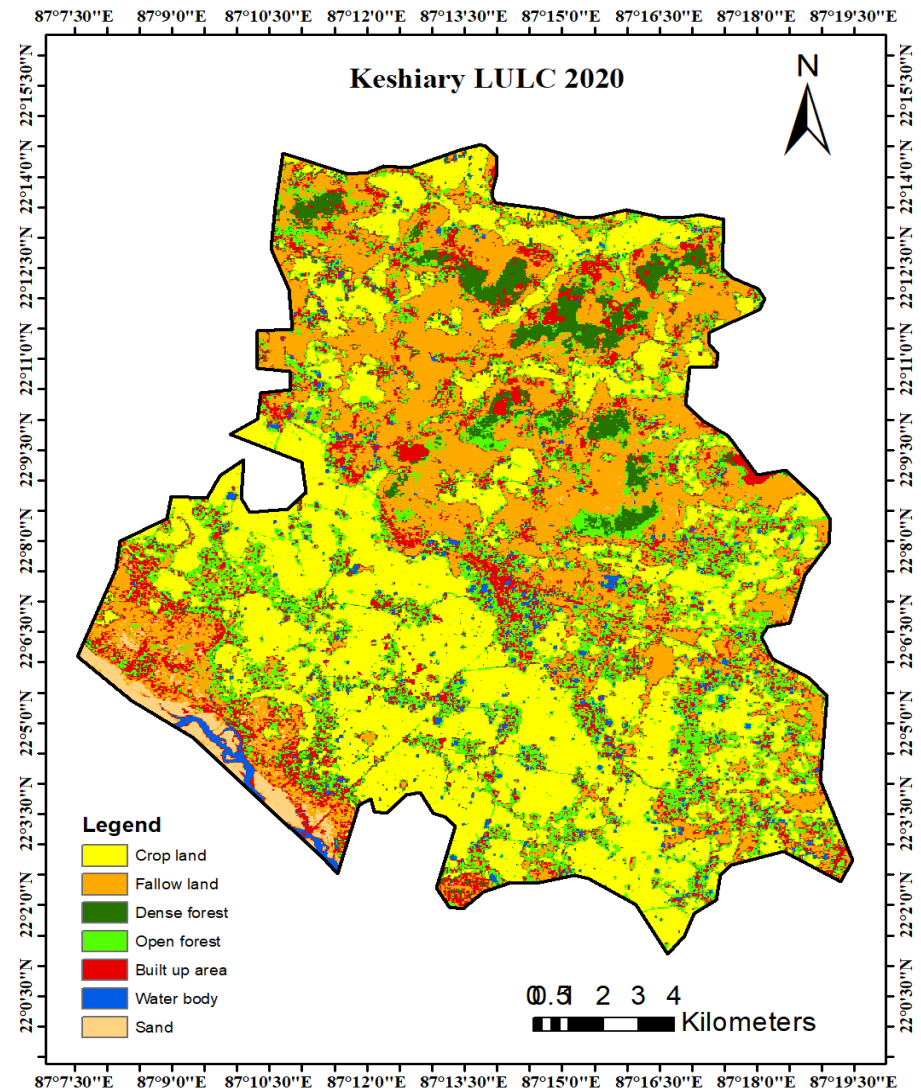
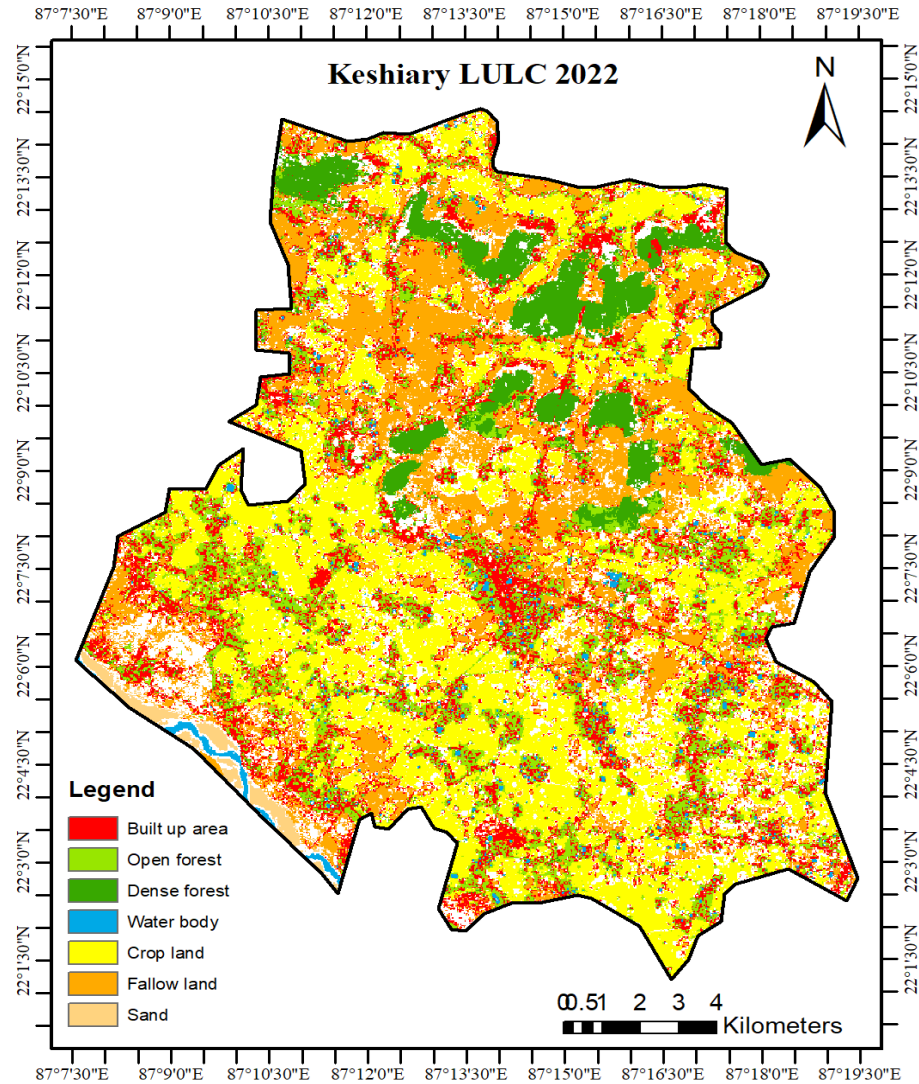
Block	Net Cropped Area	Area under Pasture & Orchard	Current Fallow Land	Forest land	Area under More than Once	Gross Cropped area	Cropping Intensity (%)	Geographical Area (in hectare)
Sankrail	21153	446	420	1620	11275	32428	153	27610
Keshiary	20720	585	400	2314	11827	32547	157	29352
Sabang	21083	372	-	-	20526	41609	197	30075
Daspur-II	13000	462	-	-	12127	25127	193	16614



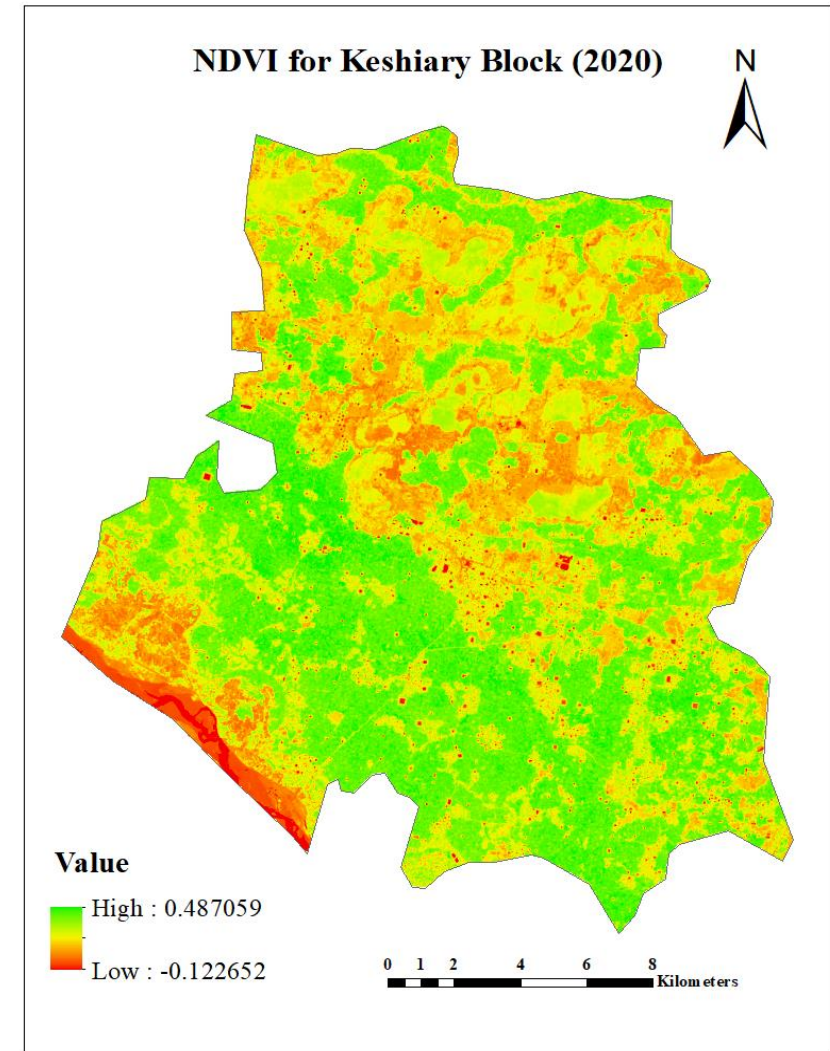
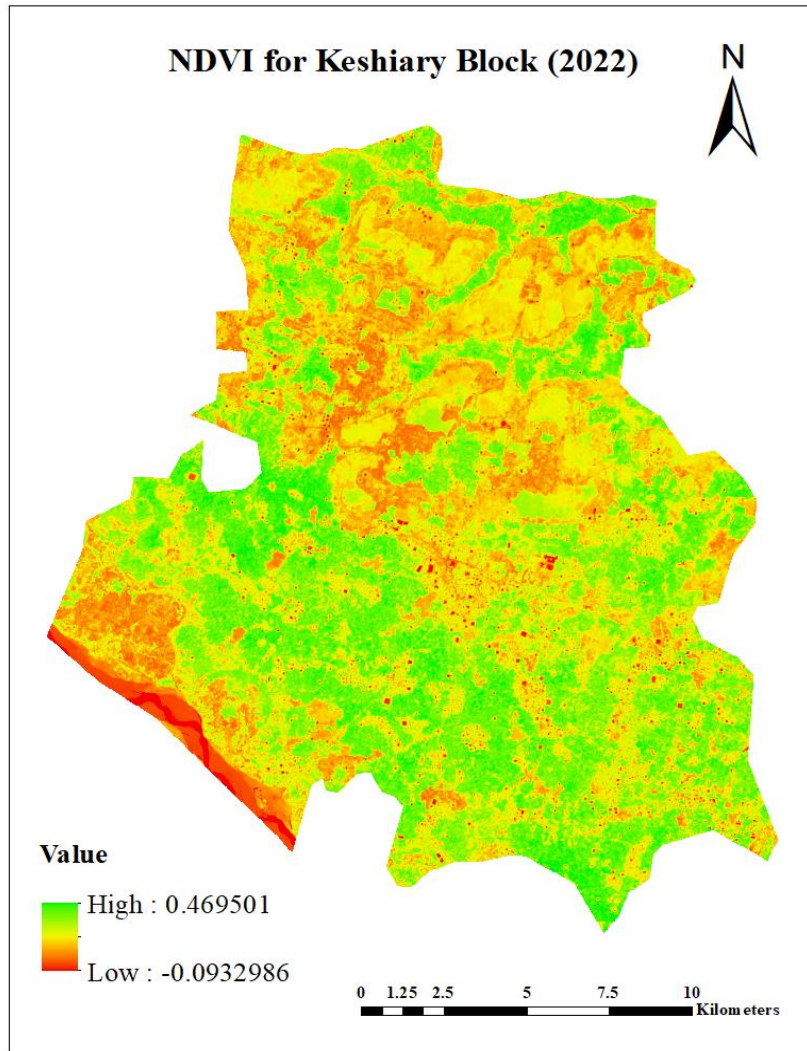
Source: District Census Handbook of Paschim Medinipur, 2011



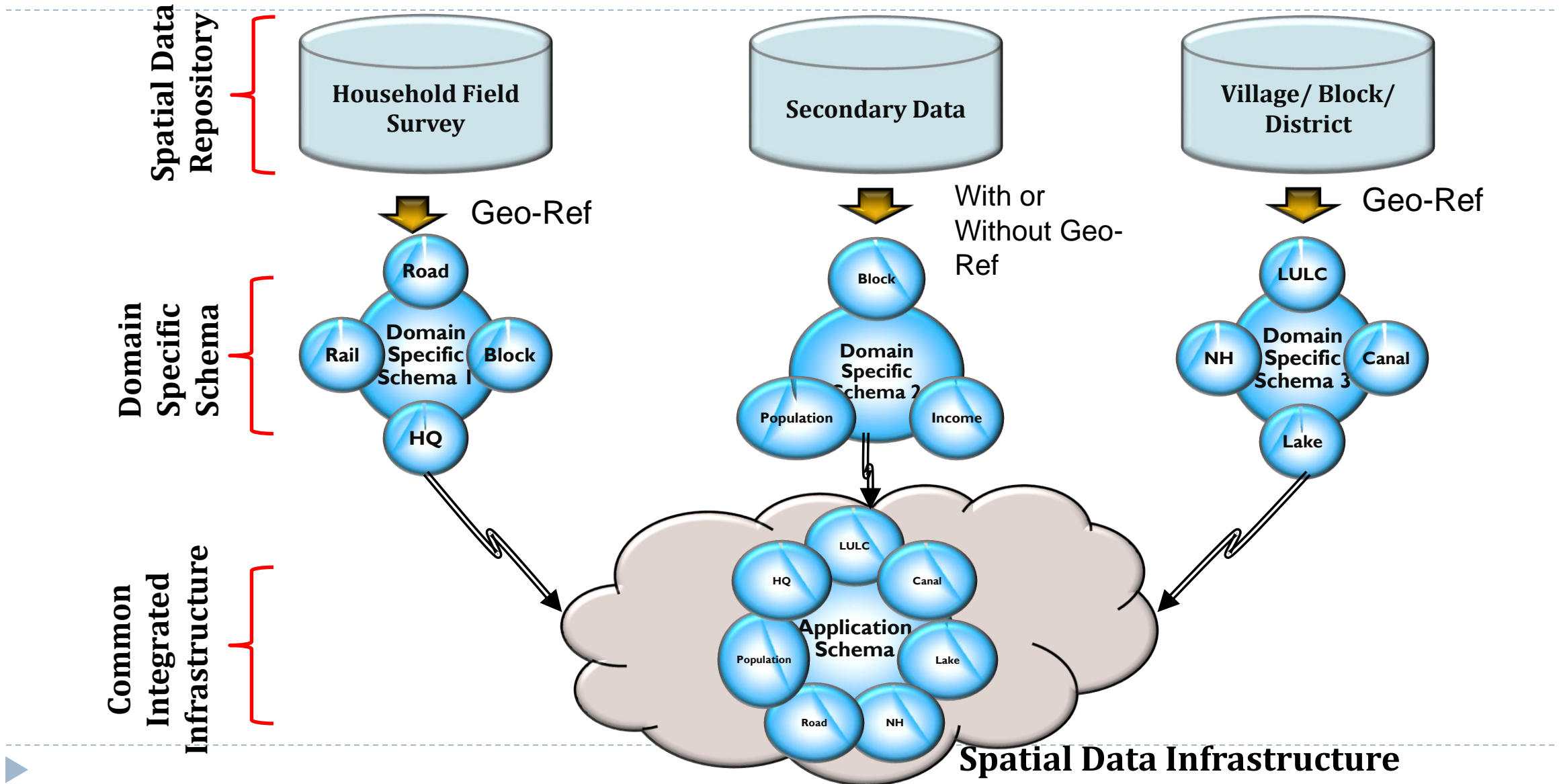
LULC Maps of a Keshiary Block (2022 vs 2020)



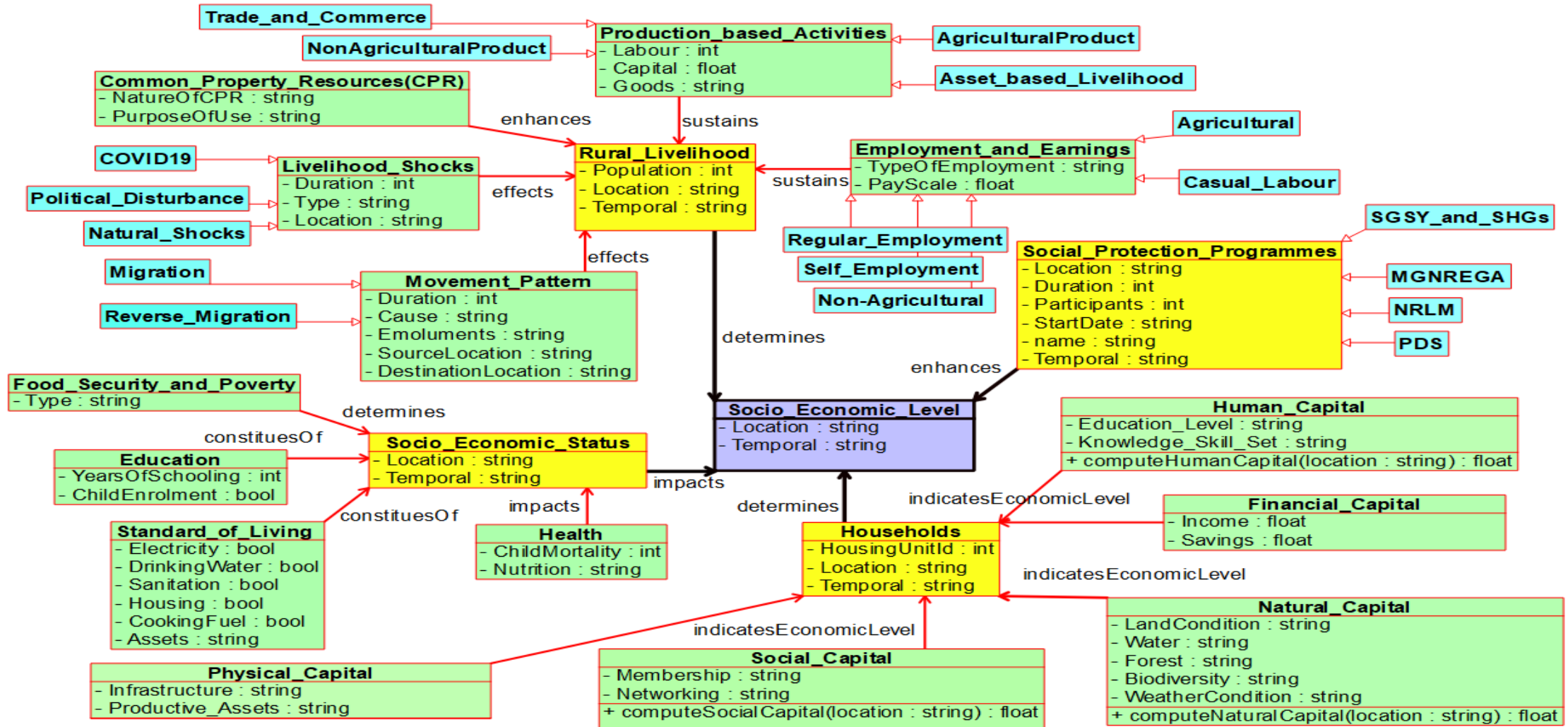
NDVI Maps of a Keshiary Block (2022 vs 2020)



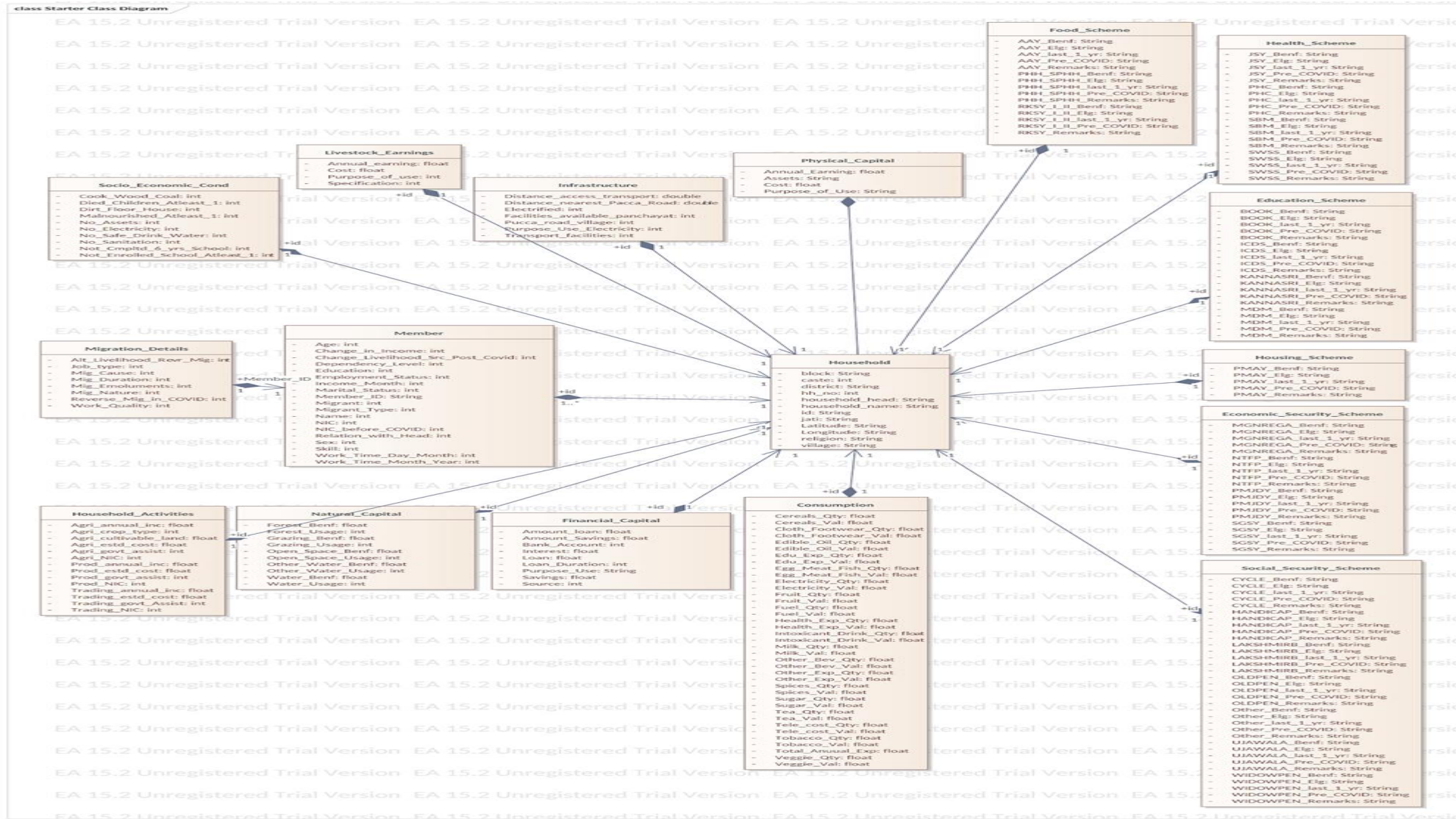
Enabling Interoperability - Schema Integration [SDI to IGIF]



GeoSpatial Data Model



GeoSpatial Data Model

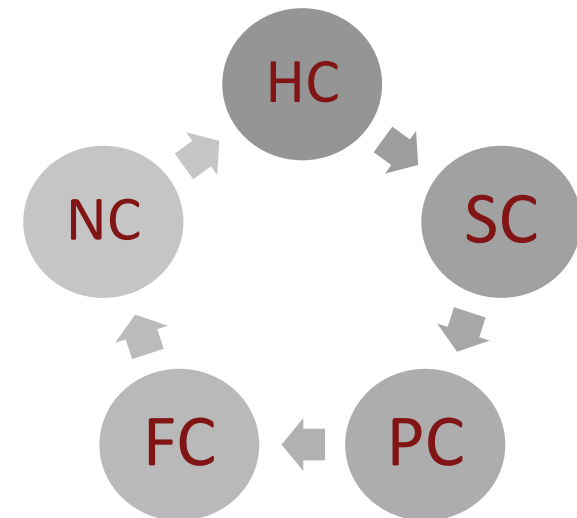


Sustainable Livelihoods Framework (SLF)

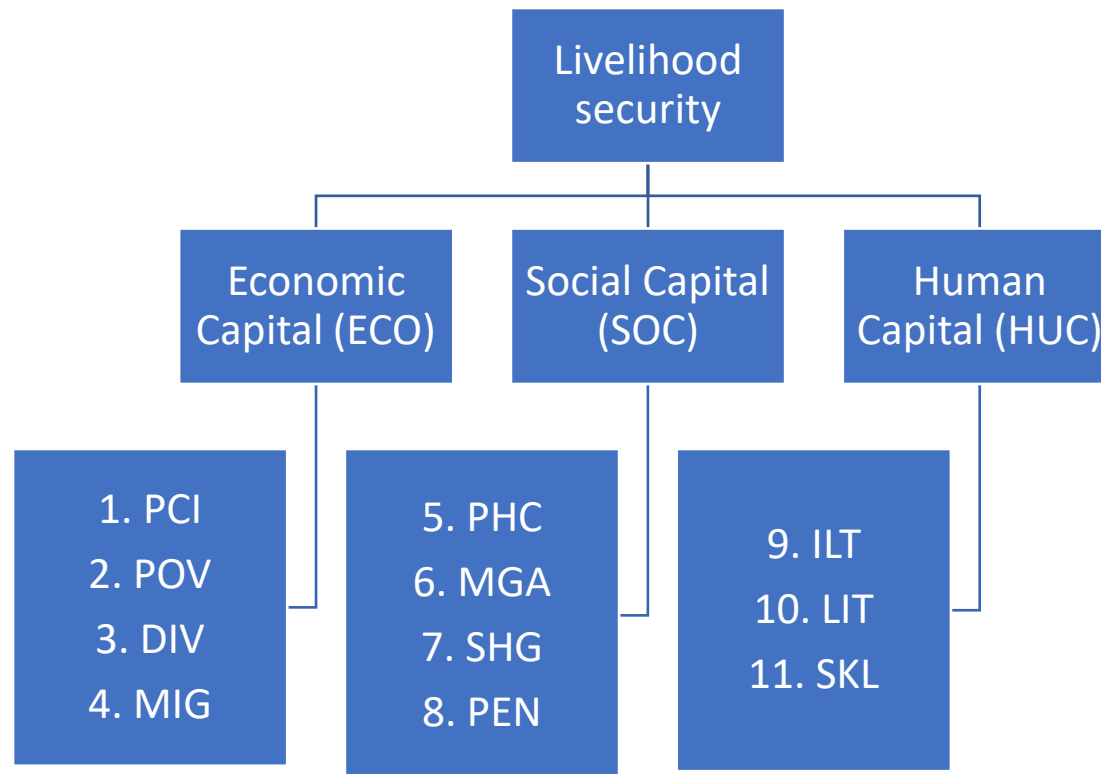
- ▶ **Sustainable livelihoods** can be seen as a way of thinking about the objectives, scope and priorities for development, in order to **enhance progress in poverty elimination** (Roe, 1998).
- ▶ A livelihood comprises various type of assets required for a means of living.
- ▶ A livelihood is sustainable when it will be available for next generation.

The assets that are generally recognized within sustainable livelihoods theory, as summarized by McLeod (2001a) are:

- ▶ **Human Capital:** Education/Skill
- ▶ **Social Capital:** Access/SHGs
- ▶ **Physical Capital:** Equipment of production/ Trade
- ▶ **Financial Capital:** Saving/Credit facility
- ▶ **Natural Capital:** Forest/Water



Livelihood Security - Multi-criteria Decision-Making based Sustainability Analysis



Sl. No.	Variable name	Variable description
1	PCI	Monthly Per Capita Income(PCI)
2	POV	%BPL people
3	DIV	%Diversification
4	MIG	%Migration
5	PHC	%Benefited Primary Health Care
6	MGA	%Benefited MGNREGA
7	SHG	%Benefited Self Help Group
8	PEN	%Benefited Old age pension
9	ILT	%Illiterate
10	LIT	%Literate
11	SKL	%Skill (excluding learner)

Towards IGIF

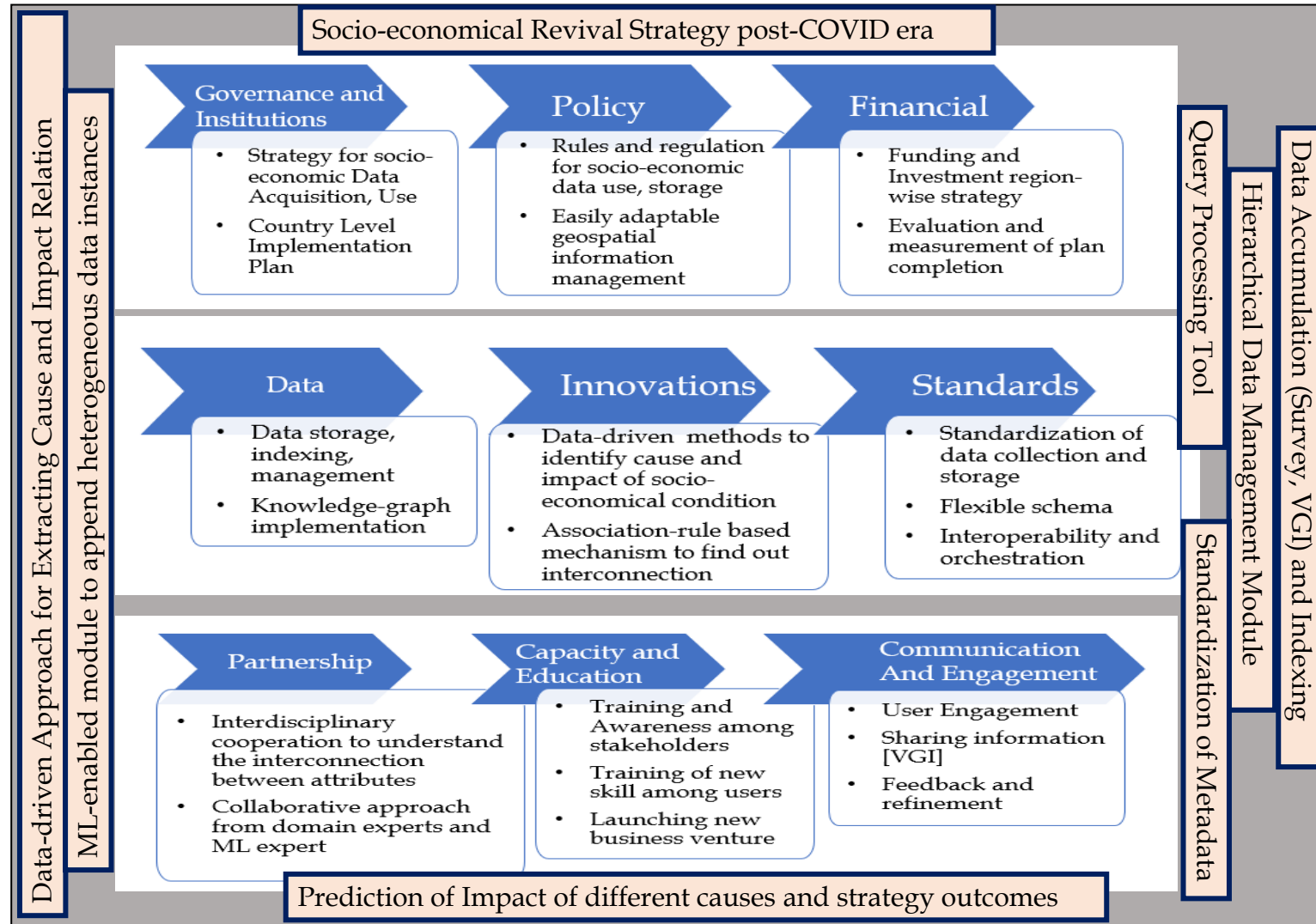
Governance



Technology

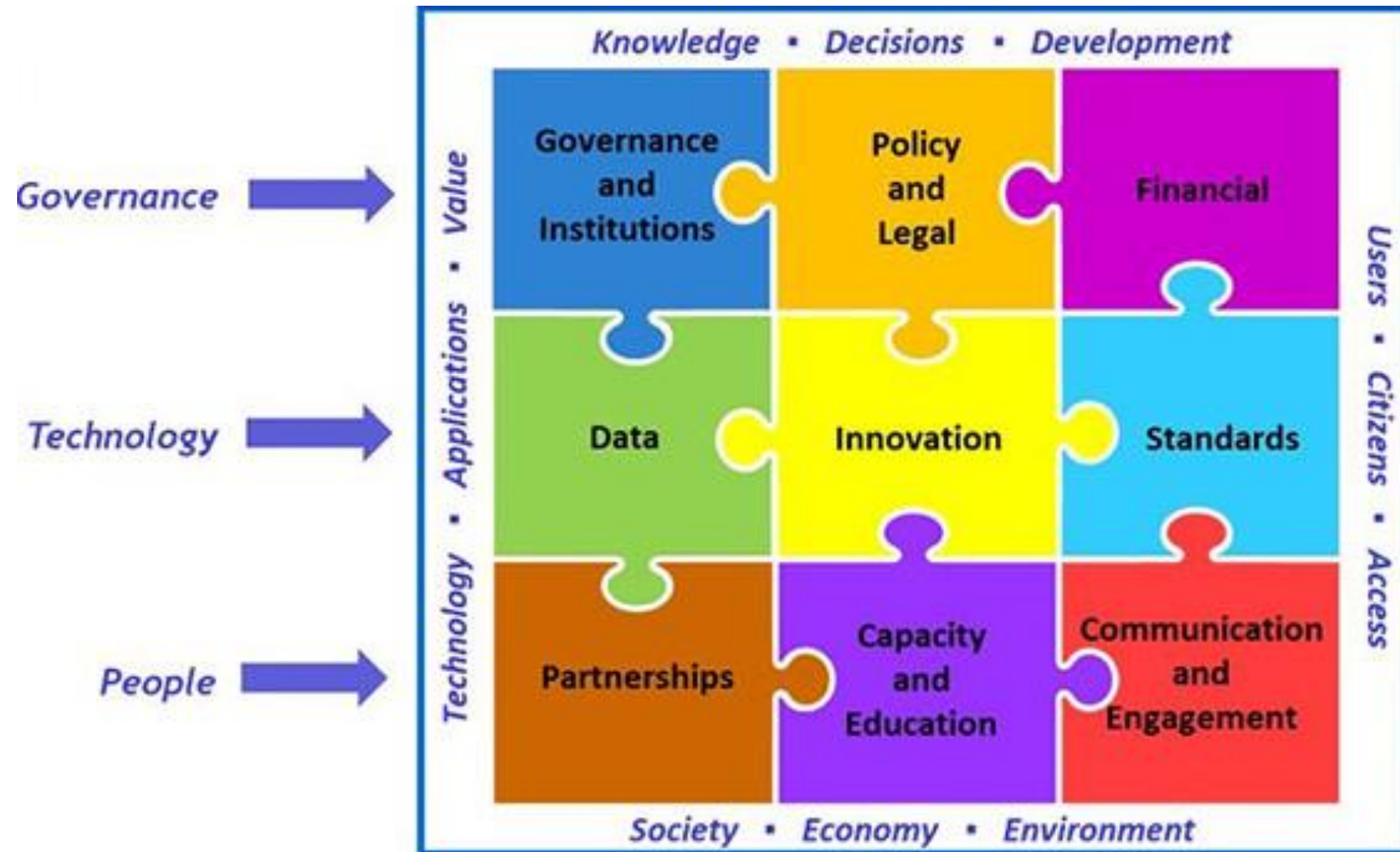


People



Integrated Geospatial Information Framework (IGIF)

Integrated Geospatial Information Framework (IGIF)



Realizing IGIF (1 of 3)



Data:

- Primary data of 400 households of 16 villages from 4 blocks.
 - Secondary sources - Government report , Satellite data etc.
 - Create interlinkage between the secondary and primary data sources.
 - Data curation is done by using various statistical tools .
-

Innovation

- Developing SDI for harvesting Spatial and Socio-economic data
 - Developing models (Statistical/ AI/ ML) to analyze the geo-spatial and socio-economic data
 - SDI / IGIF framework may help in minimize the digital divide
-

Standards

- SDI is developed based on OGC compliant services
 - Promotes interoperability of Data and Services
-

Realizing IGIF (2 of 3)



Partnerships

- Community participation in every village has been encouraged during survey.
 - Village level qualitative data (e.g. health infrastructure) is collected through community participation method.
 - Local government bodies of the villages and blocks have participated and cooperated with us to get proper information of the villages.
-

Capacity and Education

- During the field survey the investigators tried to develop the awareness of the households about the relevant government schemes.
 - Tried to create awareness about market, modern machines and loan availability.
-

Communication and Engagement

- Block level planning and stake holder identification are very important to improve the livelihood of the households.
 - Integrated engagement strategies of various stakeholders with continuous monitoring and evaluation of the villages are required for better resource management and sustainable livelihood..
-

Realizing IGIF (3 of 3)



Governance and Institutions

- Each of the four blocks have different characteristics in terms of geo-spatial and socio-economic characters.
 - Need a proper governance model to promote proper resource management techniques and to ensure sustainable rural livelihood.
 - To promote government schemes more accurately at the ground level and to make village resources sustainable we have to define leadership properly.
-

Legal and Policy

- The backend SDI harvest vast dataset related to study villages.
 - Legal protection policy of primary data should be framed to protect the data privacy.
 - Legal policies are also required for better implementation and also to increase the accountability.
-

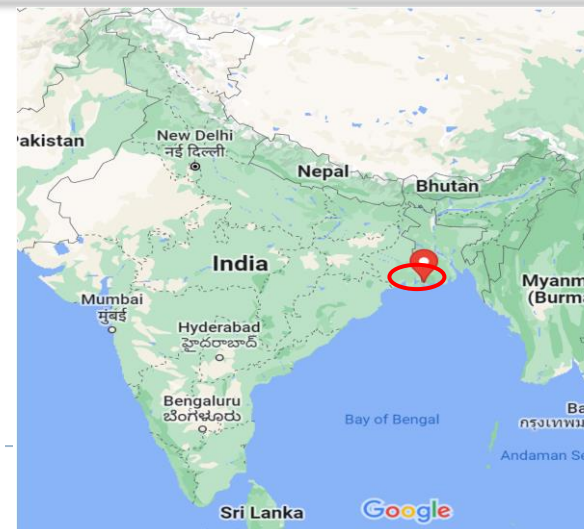
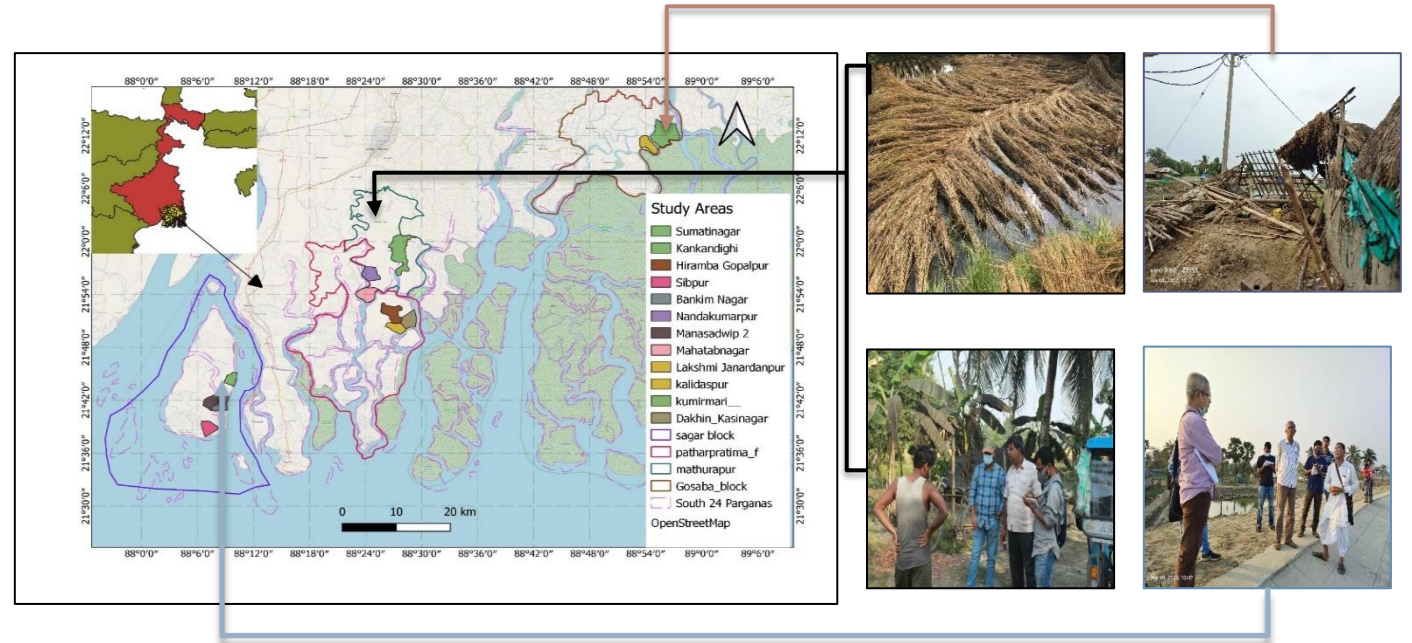
Financial

- Proper financial model may help to increase the livelihood status of the households of the blocks.
 - There are partnership opportunities of the *small entrepreneurs* with other established organizations for better financial returns.
-

Socio-economic Impact of Migration during COVID-19 Crisis in the Sundarbans Region: A Study of Sustainable Solutions using Geo-spatial Analytics

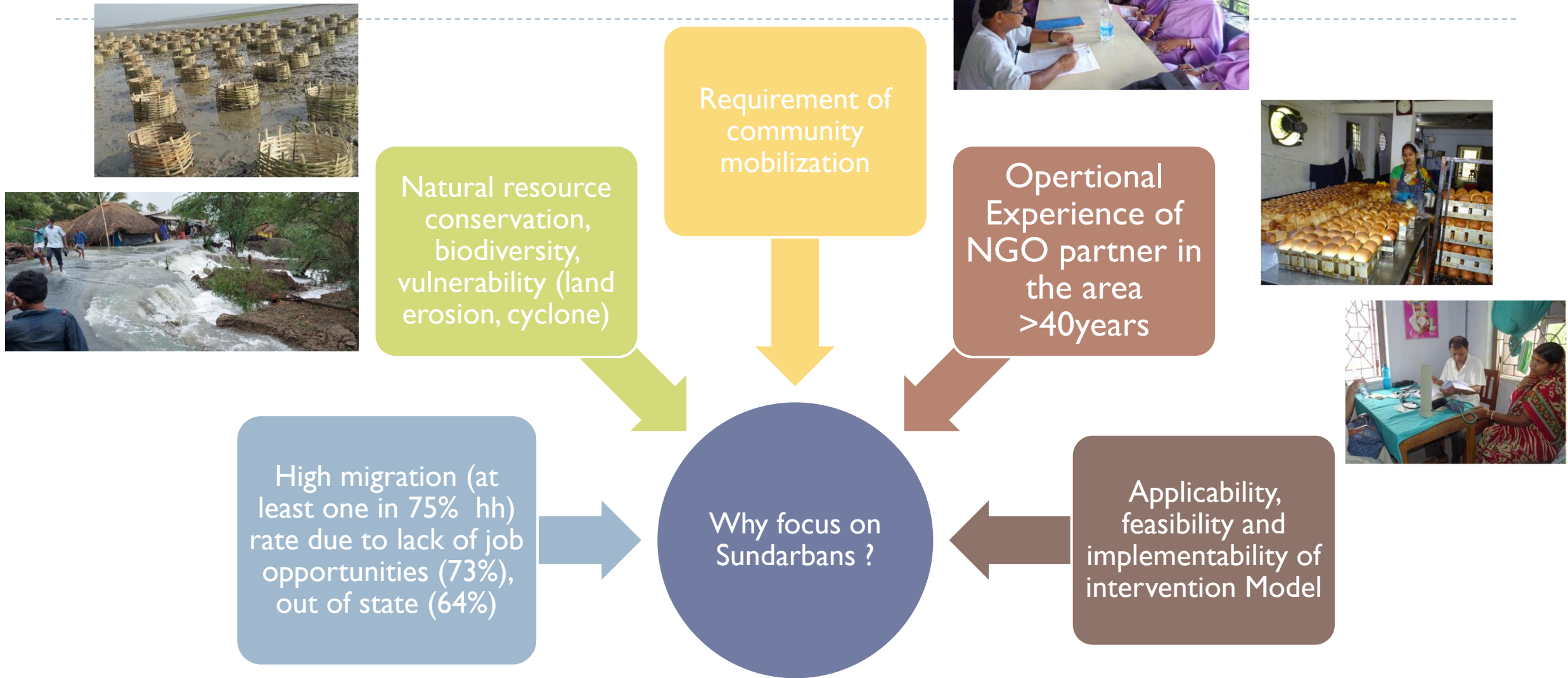
Objective of the Project :

- I. To create a knowledge base on socio-economic status of local people and impact of migration due to COVID 19 pandemic in selected areas of Sundarbans region;
- II. To understand the underlying dynamics and influence of different factors on migration of workforce following COVID 19 pandemic and its socio-economic-ecological implications;
- III. To create of an interactive resource map from the survey data, satellite images and interviews, and secondary data sources;
- IV. To carry out hotspot analysis and develop multi-hazard cascade model for the areas affected by the pandemic and natural disasters; and
- V. To design intervention strategies for creating sustainable livelihood opportunities at local level

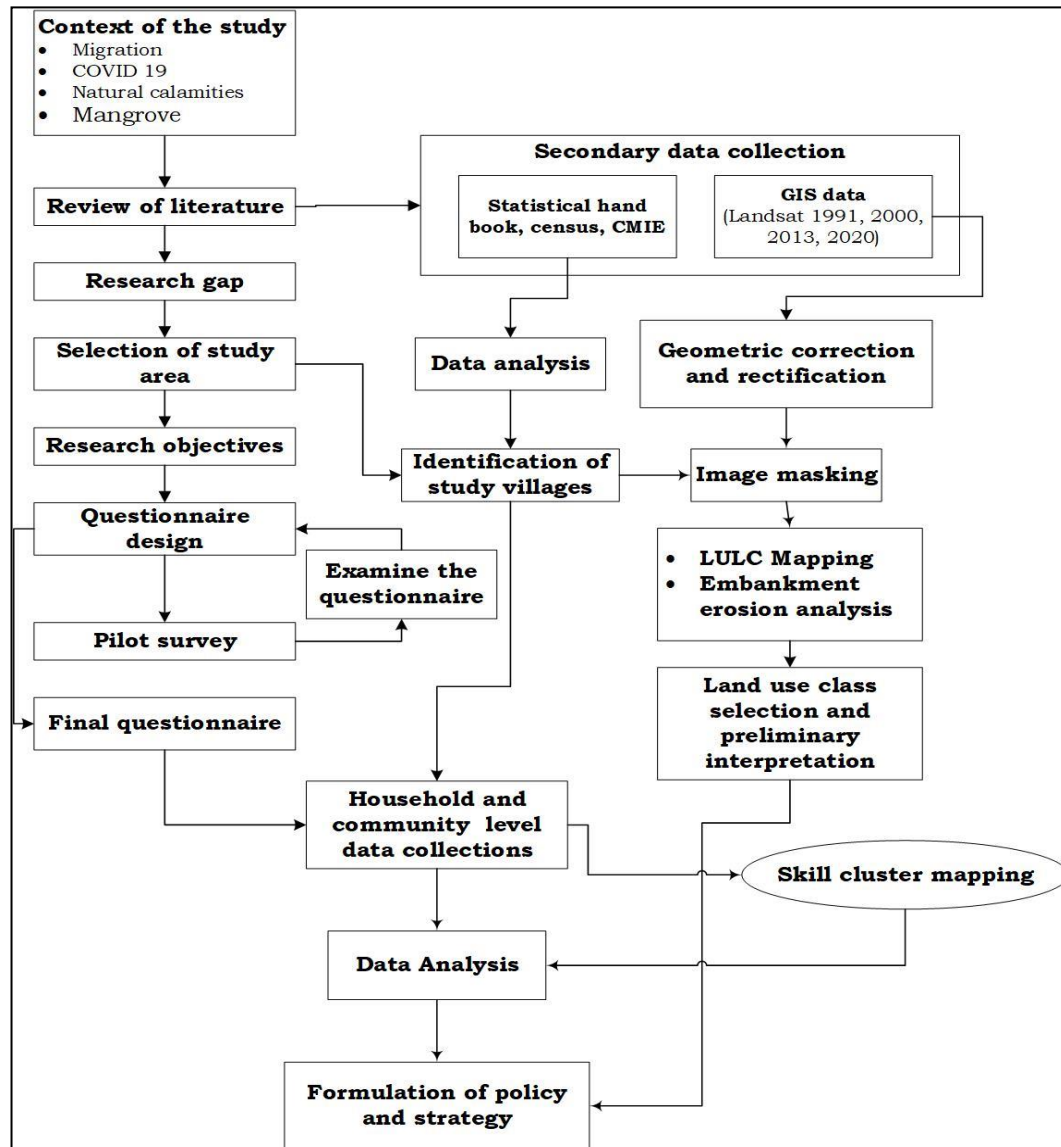


Source: Google Map

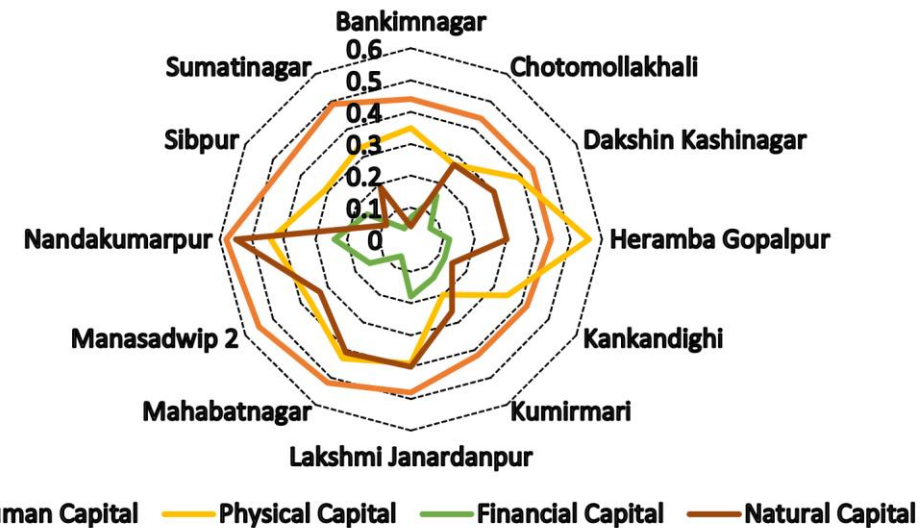
Uniqueness of Our Project



Overall Methodology



Livelihood Asset Index

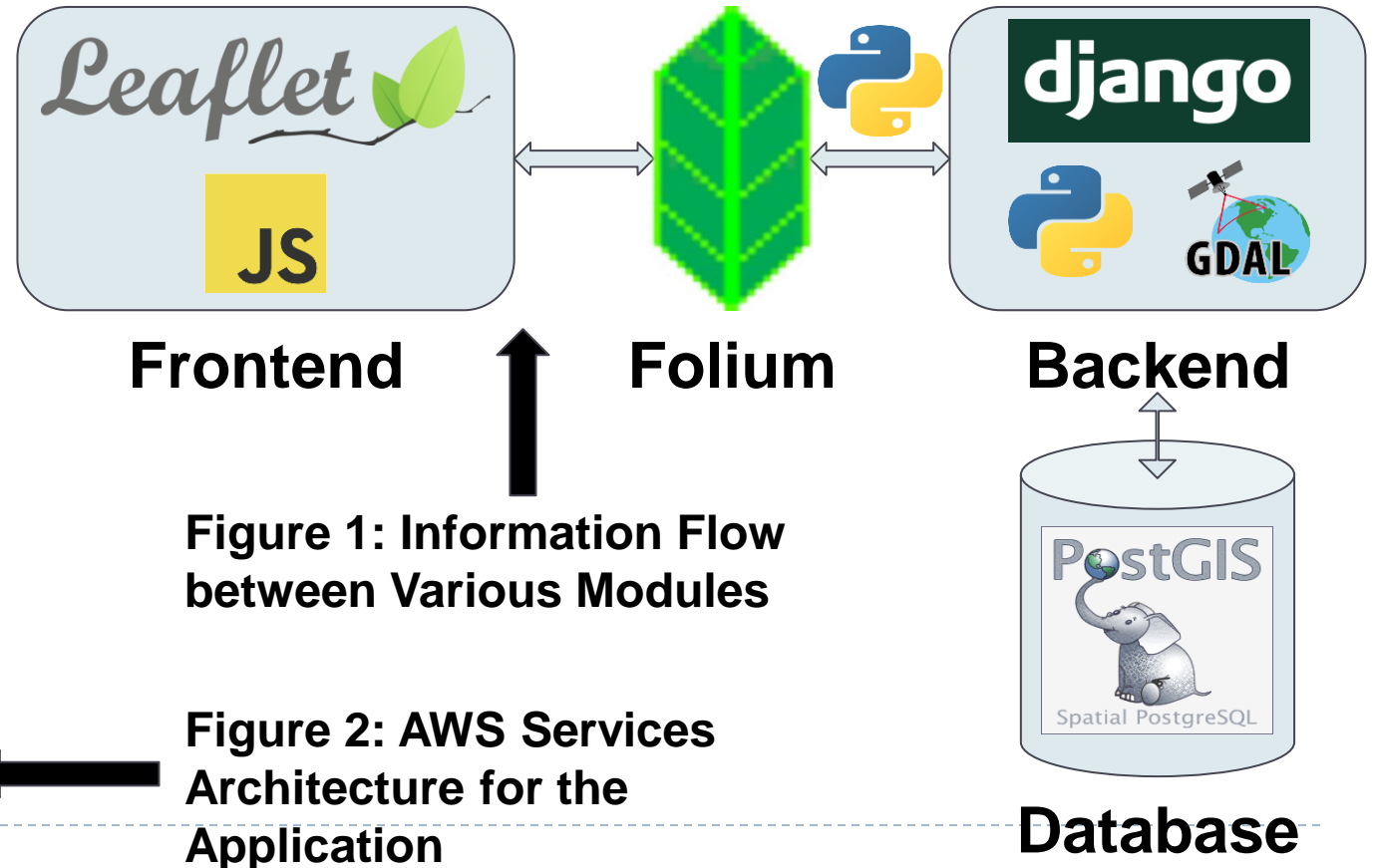
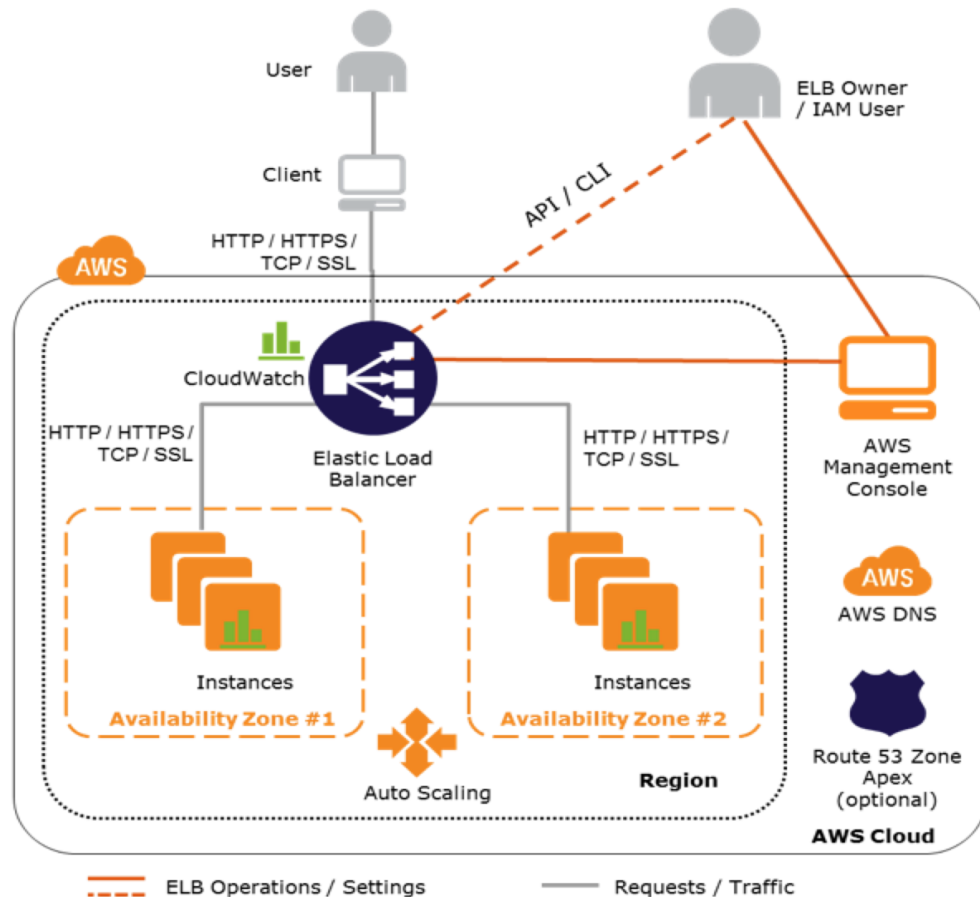


265 households surveyed in 12 villages, situated in 4 blocks of the South 24-Parganas district of West Bengal, viz., Patharpratima, Mathurapur II, Sagar and Gosaba

LAI is a function of working capacity, education, Cultivated land, land holding, physical equipment, Livestock, house type, cash income and access to Loan indices (Yan et al., 2010; Shee and Maiti, 2022)

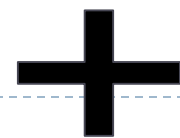
Geospatial Resource Map for Sundarbans Region

- Resource Map helps visualize the demographic and migration data of villages in Sundarbans
- Therefore, one can enter a dataset with geometry fields and assess the data better using the tools
- This would significantly help in analyzing various kinds of information, distributions from the data
- Thus, the tool can be used to cluster villages/households, find optimal locations for resource centers etc.



	NAME_1 text	TRU text	No_HH bigint	geometry geometry
1	Tona	Rural	1316	0103000020847F00000'
2	Uttar Swarup Nagar	Rural	201	0103000020847F00000'
3	Uttar Gazipur	Rural	547	0103000020847F00000'
4	Shyamnagar	Rural	769	0103000020847F00000'
5	Dakshin Swarup Nagar	Rural	294	0103000020847F00000'

Secondary Data - Census 2011



Start typing to filter...	
AUTHENTICATION AND AUTHORIZATION	
Groups	+ Add
Users	+ Add
SITMAP	
Primary survey datas	+ Add

Respondent name:

Education:

Age:

Primary Data - Household Survey 2022

Figure 3: INPUTS Figure 4: OUTPUT - Interactive Resource Map

The following map shows the resources collected from the primary survey data and secondary village-level data for the Sundarbans Region collected from Census 2001, on an interactive map.

Secondary Data - Census 2011

- Choropleth Map Field:
- Village Information 1:
- Village Information 2:
- Village Information 3:
- Village Information 4:
- Village Information 5:

Primary Data - Household Survey 2022

- Household Detail 1:
- Household Detail 2:
- Household Detail 3:
- Household Detail 4:
- Household Detail 5:

Select

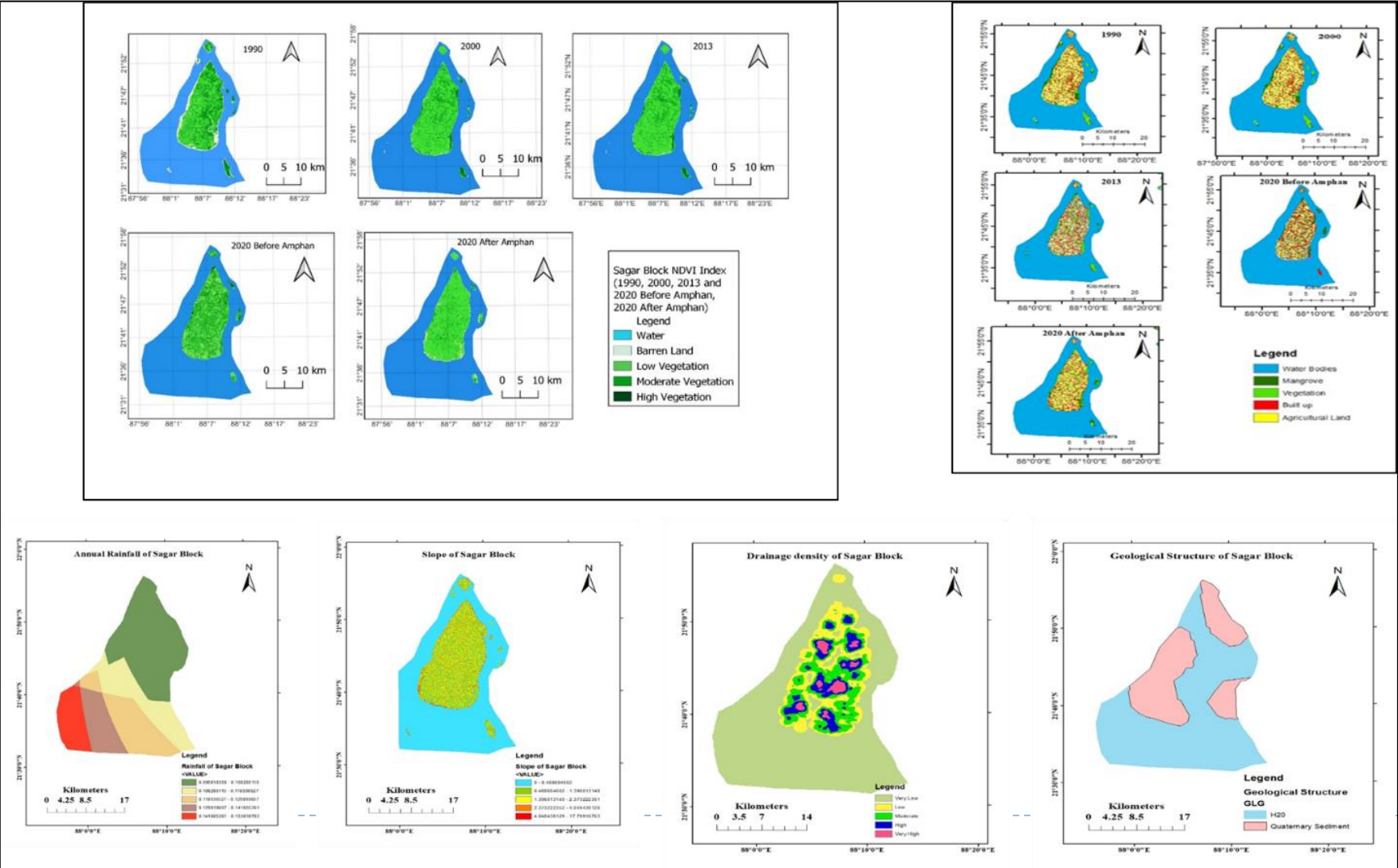


Data Sources

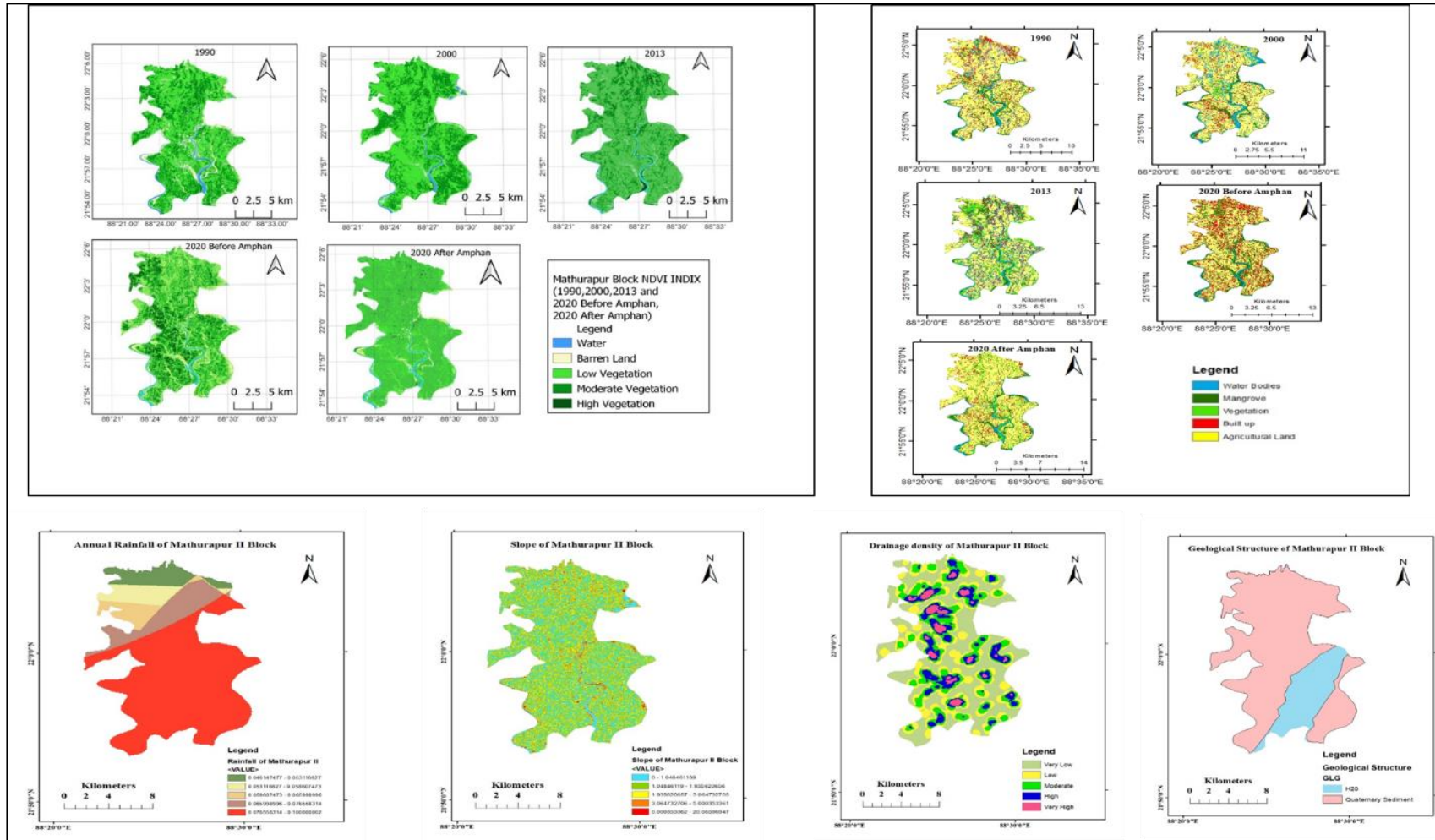
Dataset	Source	Date	Data type	Purpose of uses
Landsat 5,8&9(OLI & TIRS)	USGS earth explorer (https://earthexplorer.usgs.gov)	1990,2000,2013,2020	Raster	Land use classification, extraction of drainage basin
SRTM global digital elevation model (DEM)	USGS earth explorer (https://earthexplorer.usgs.gov)	2014	Raster	Land elevation, slope angle and TWI
Rainfall data	DSMW https://crudata.uea.ac.uk	2000–2020	Vector	Rainfall map
Soil data	DSMW https://data.apps.fao.org	2012–2017	Vector	Content of clay in Soil
River buffers	Google Earth Pro and Landsat 8 image	2020	Vector	For proximity analysis
Base map	The official portal of the Government of west Bengal (http://wbdmd.gov.in)	2011	Raster	Geo-reference based outline map



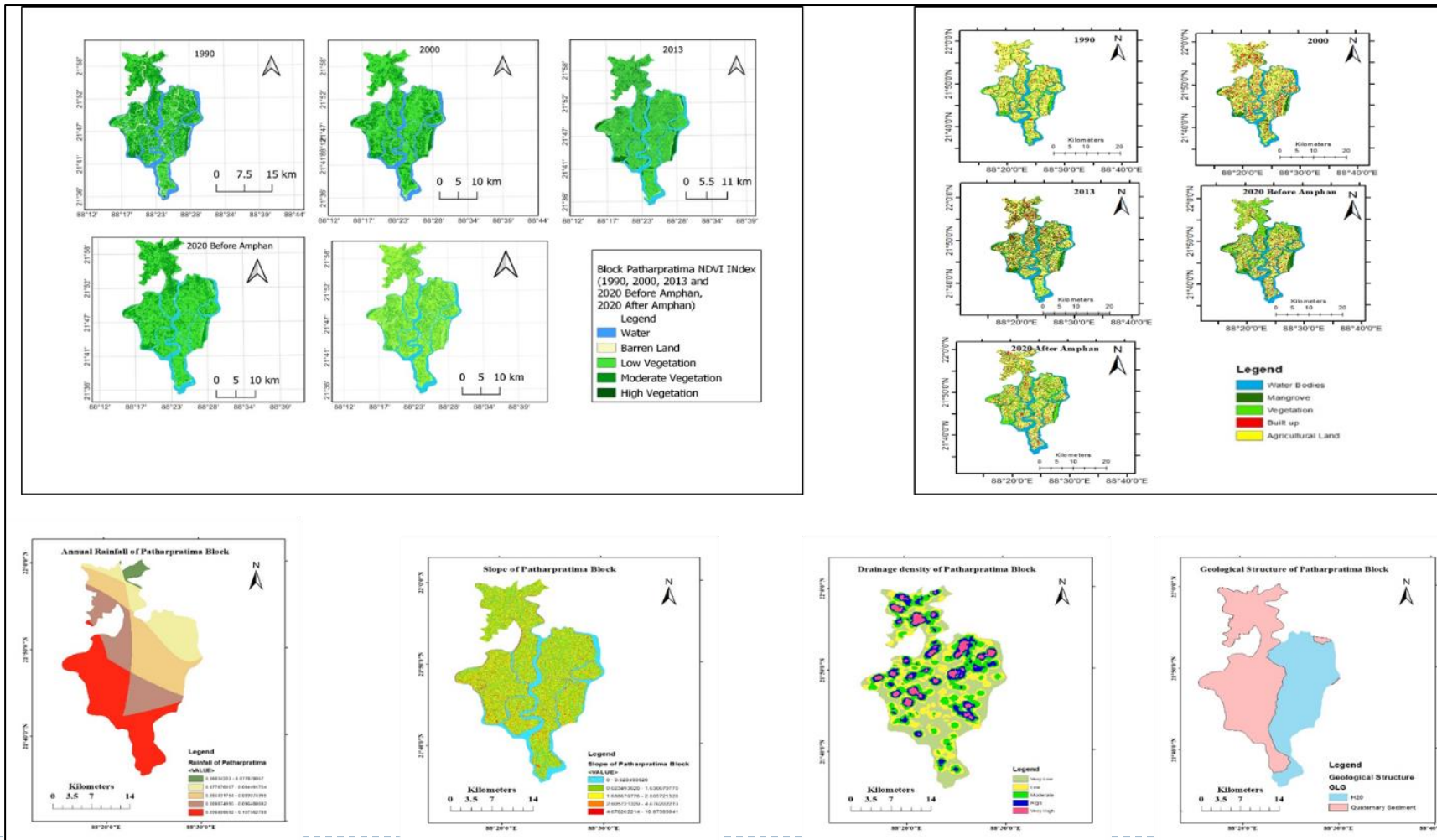
Land Use Land Cover Analysis: Sagar Block



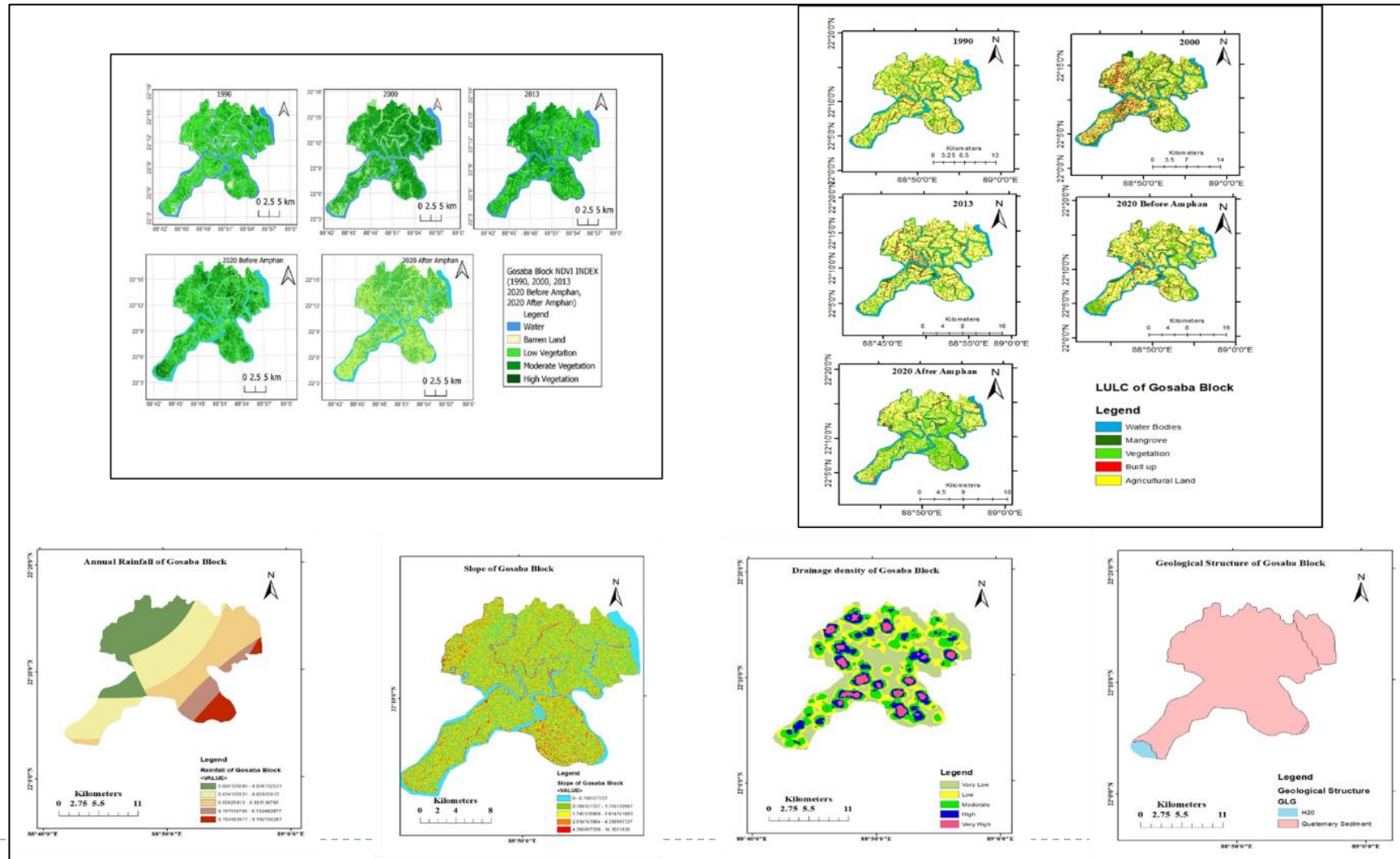
Land Use Land Cover Analysis: Mathurapur II Block



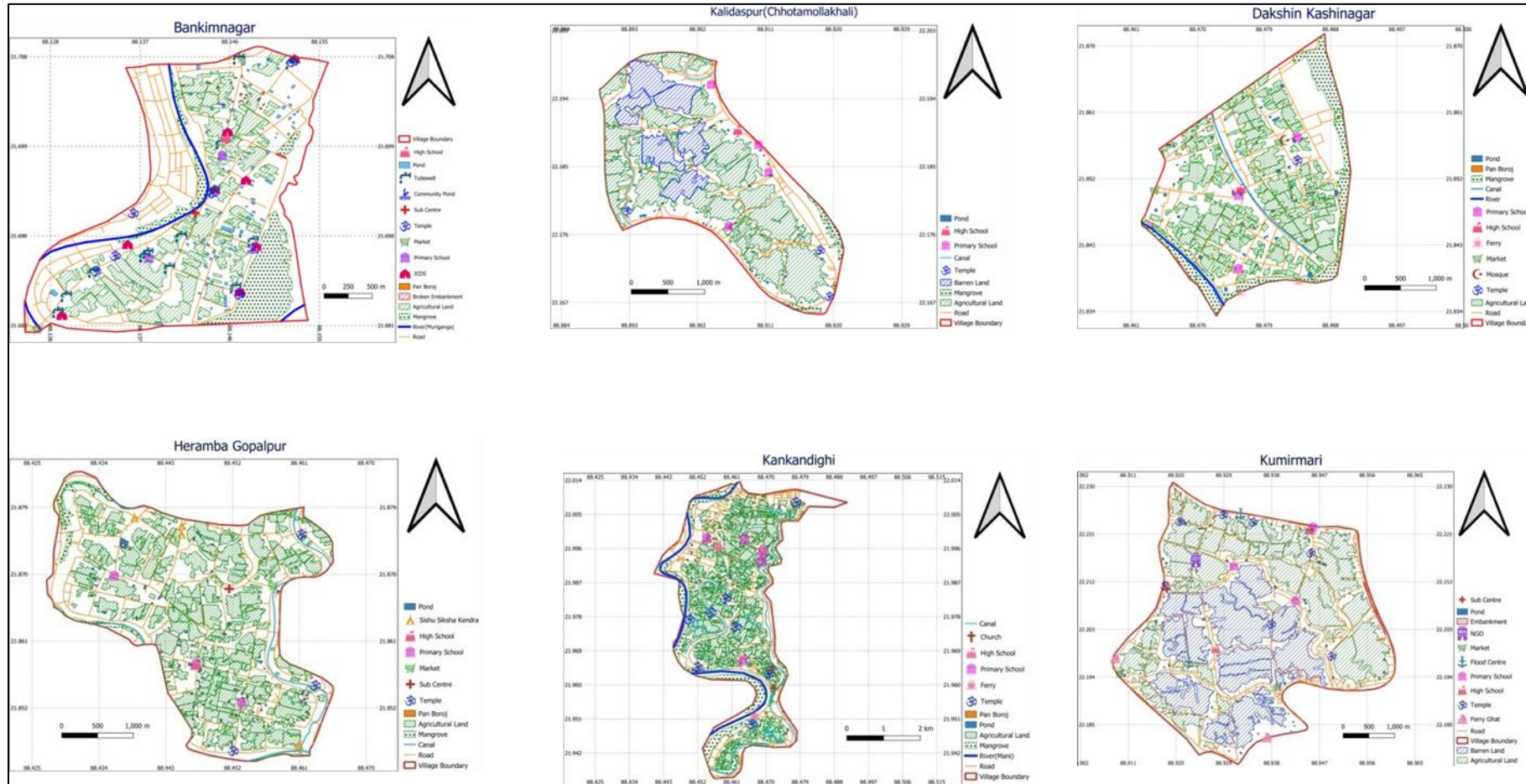
Land Use Land Cover Analysis: Pathar Pratima



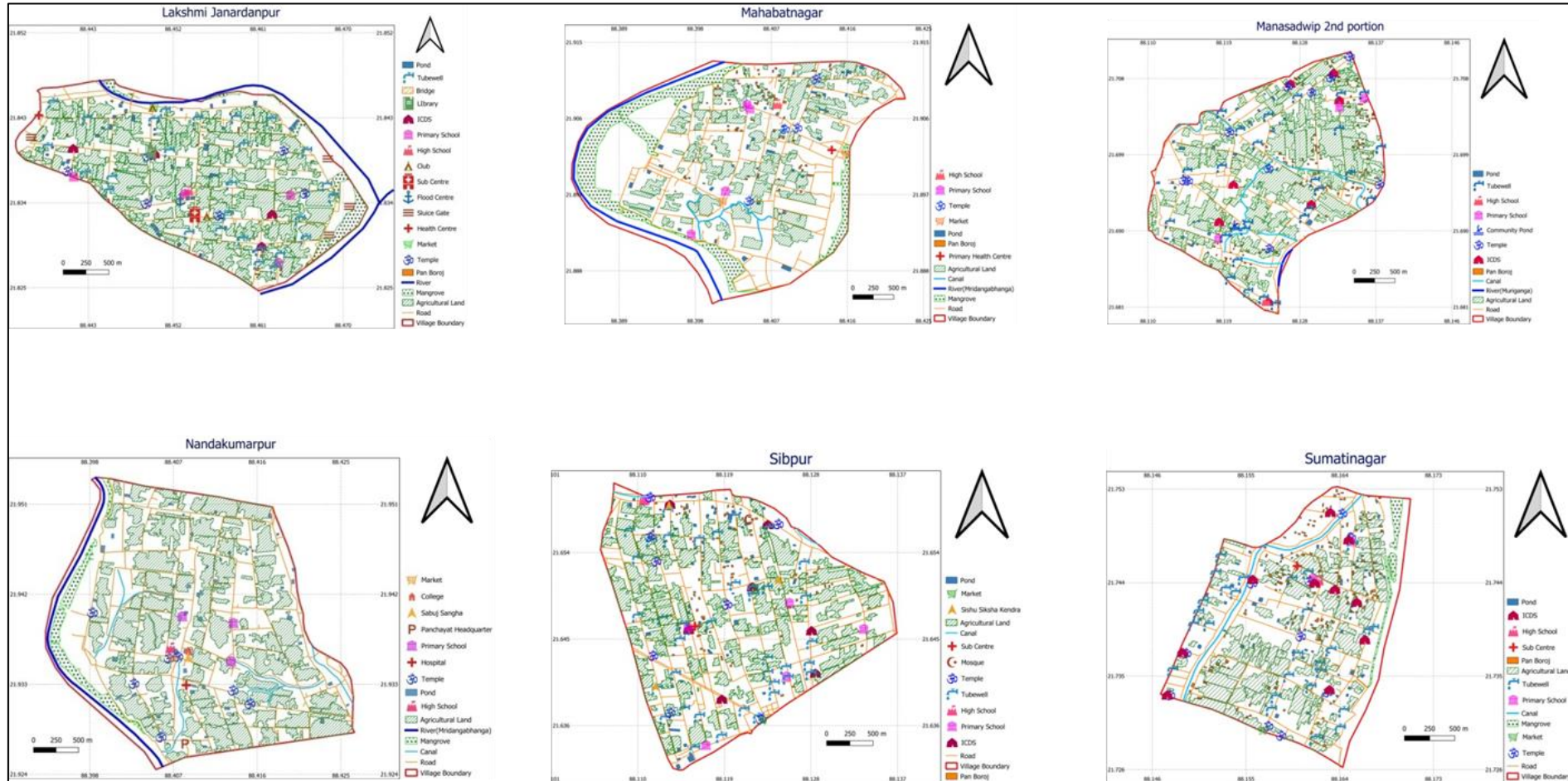
Land Use Land Cover Analysis: Gosaba



Resource Maps



Resource Maps

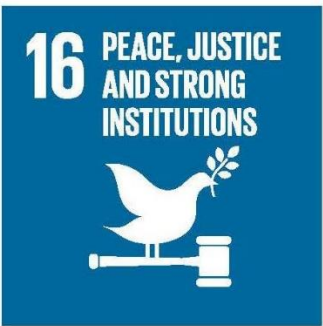
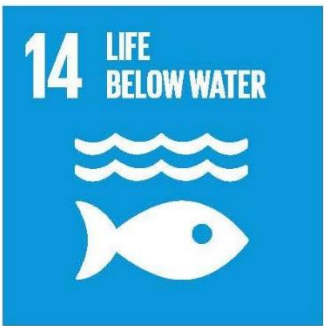


Key Findings

- ▶ Natural calamities causing destruction of property, infrastructure, crop loss, soil and water salinization, drinking water crisis
- ▶ Remoteness
- ▶ Both long-term and seasonal migration
- ▶ Daily wage labourers in informal sectors
- ▶ Better coordination required between government agencies, NGOs, local administration, research institutes and private sectors for :
 - ▶ Sustainable agricultural solutions
 - ▶ Livelihood diversification opportunities



Supporting the SDGs



Conclusion

- ▶ Applications of geospatial information management system at the micro level would play a crucial role in creation of human and social capitals and linking them effectively with the markets, policies and institutions
- ▶ Management of natural, physical and financial capitals for enabling and maintaining a sustainable livelihood framework in the rural areas
- ▶ Adopting *Integrated Geospatial Information Framework (IGIF)* with backend SDI will help in Sustainable and Scalable development

Thank You !

Soumya K. Ghosh
Professor Department of Computer Science and Engineering
IIT Kharagpur, India
skg@cse.iitkgp.ac.in