

HYDRO/METEORO/CLIMATO-LOGICAL
HAZARDS

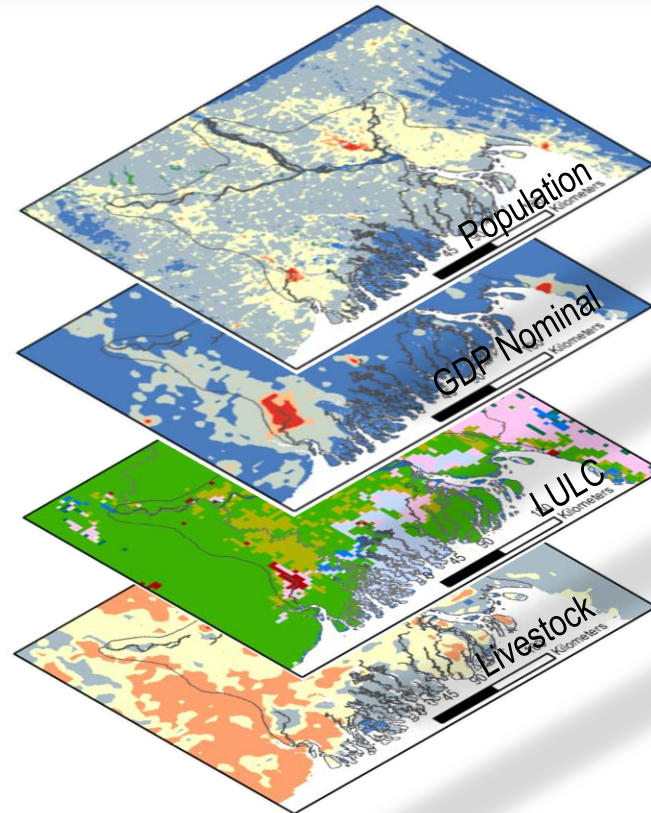
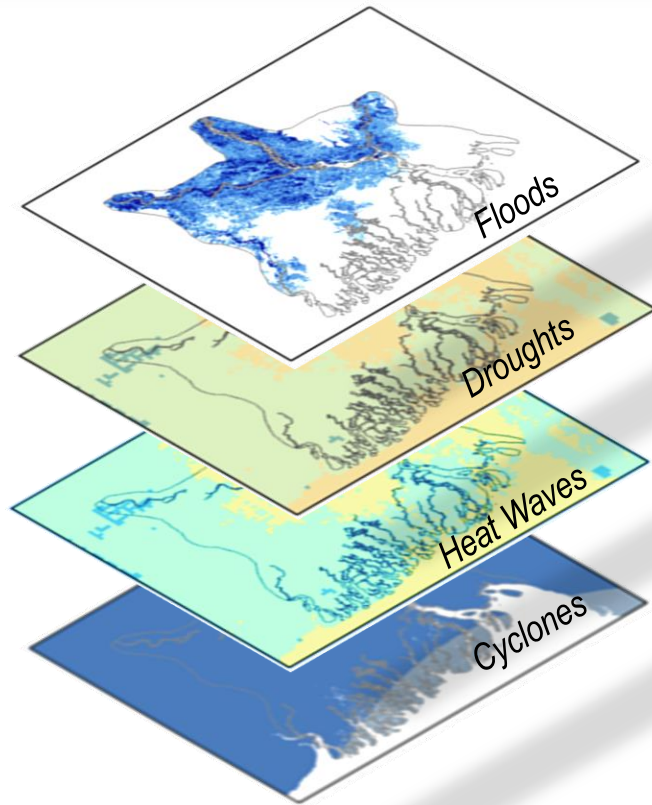


VULNERABILITY



RESILIENCE

Multi-dimensional Disaster Risk Assessment



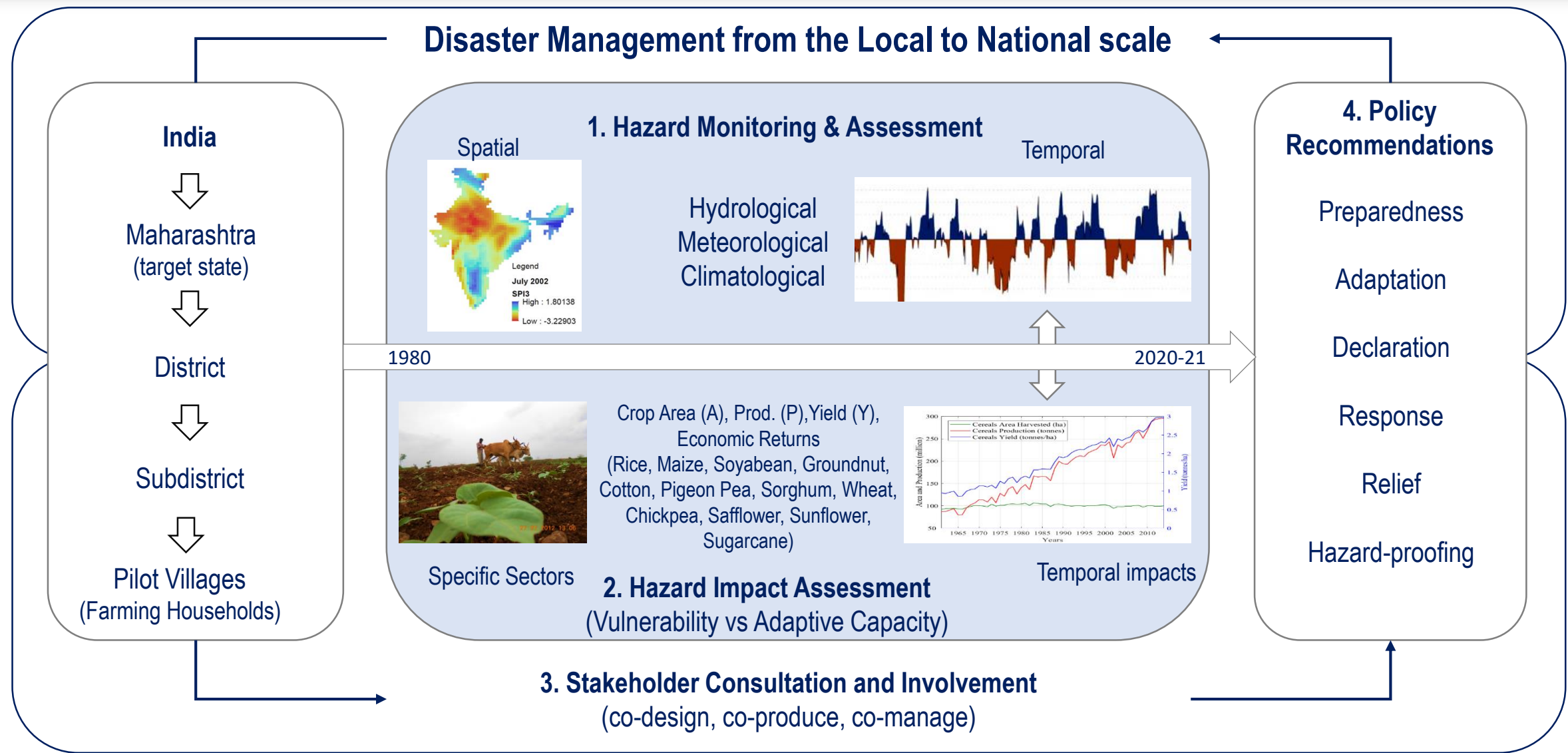
Parmeshwar D. Udmale
Assistant Professor
Centre for Technology Alternatives
For Rural Areas (CTARA)



Disaster Risk Management: Phases

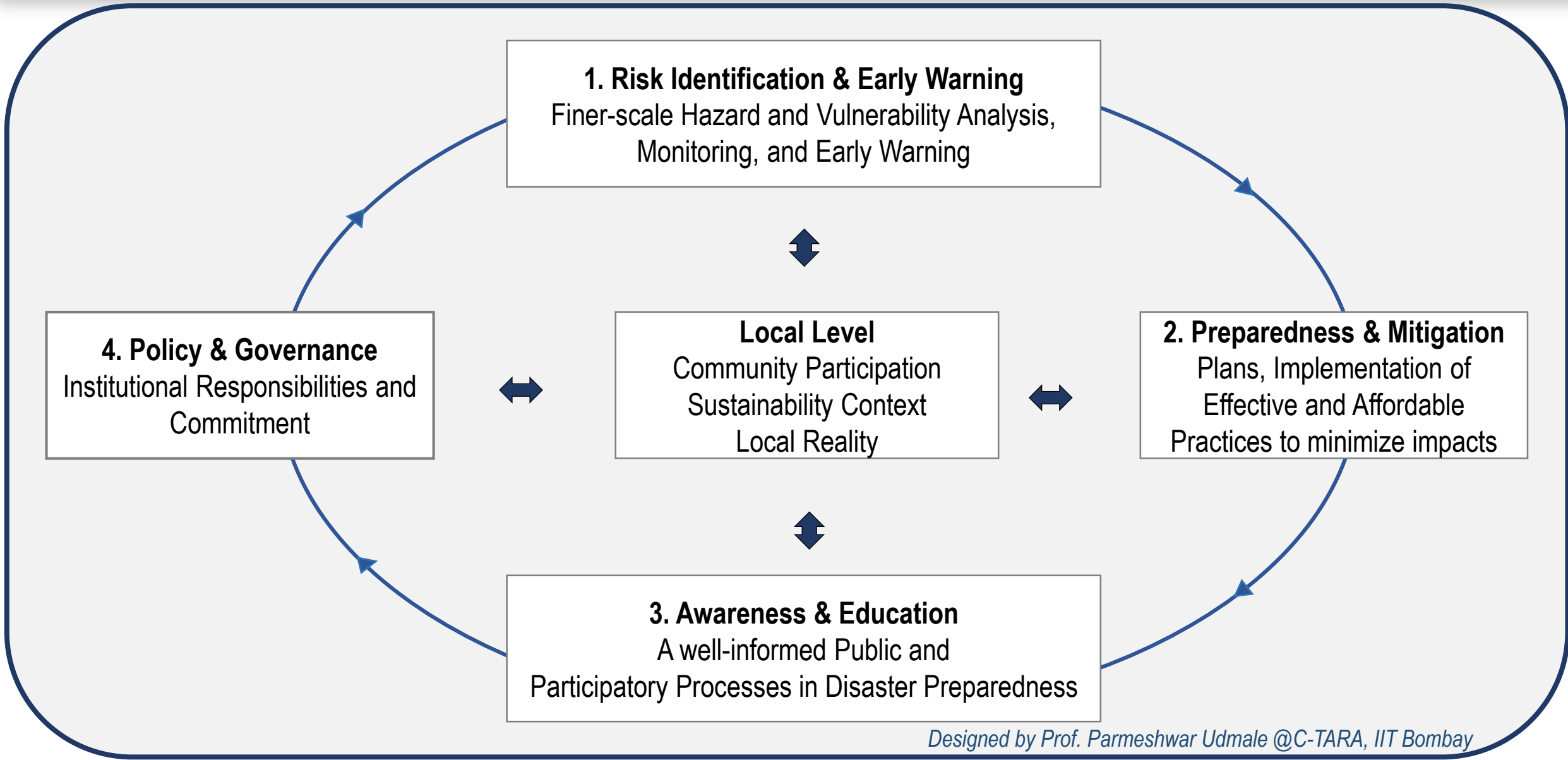


Disaster : Science, Management And Policy (D-SciMAP)



Designed by Prof. Parmeshwar Udmale @C-TARA, IIT Bombay

Risk Assessment & Preparedness: Pre-disaster Phases



Designed by Prof. Parmeshwar Udmale @C-TARA, IIT Bombay

Steps in Disaster Risk Assessment



Step 1: Conceptualization

- Identification of linkages between Hazards, Exposure and Vulnerability of Socio-Ecological Systems
- Stakeholders including Experts Mapping and Selection



Step 2: Literature Review

- Review of Existing Approaches, Data, Reports, Management Strategies
- Identification & Categorization of Indicators
- Preliminary Indicator Selection



Step 3: Expert Inputs

- Discussion on Preliminary list of Indicators
- Expert Inputs & Selection of Appropriate Indicators
- Identification of Measurement Units, Scale.



Step 4: Toolkit Development

- Data Library in Excel Sheet
- Statistical Analysis
- Geospatial Programming for Scenario-based Risk Analysis



Step 5: Stakeholder Inputs

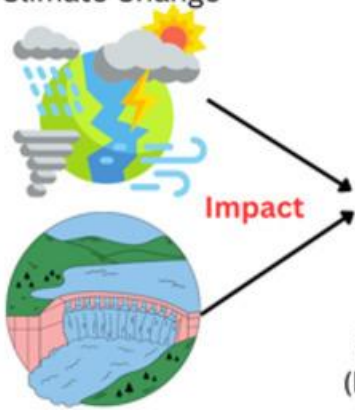
- Feedback on Framework and Indicators
- Feedback on Tool and User Interface
- Weightages for Dimensions and Indicators of Risk Assessment



Step 6: Knowledge Dissemination

- Tools for Risk Assessment
- User Manuals
- Capacity Building Workshops/ Trainings

Natural hazards & Climate Change



Impact

Farming activities (livelihood systems)

Reduced



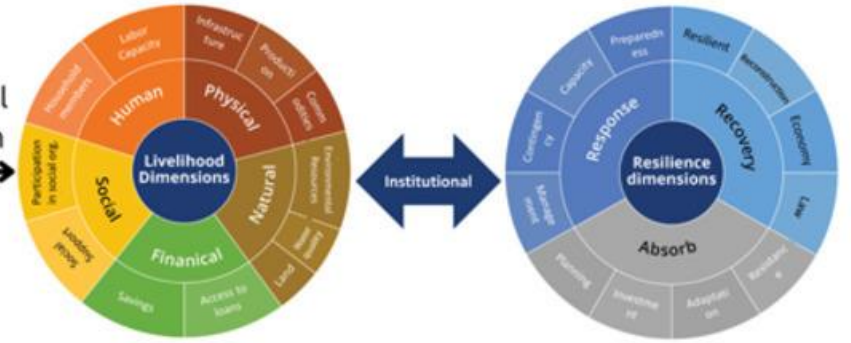
LIVELIHOOD SECURITY

Enhanced



RESILIENCE

Conceptual Integration



Livelihood Security and Resilience Assessment (LiSeRA) Framework

Generation of assessment algorithm

Expert consultation and stakeholder workshops



Development and risk management planning



Resilience Index (% of ideal value)



Quantitative assessment outputs

Data input and analysis



Dimension	Code	Sub-dimension	Measurement Index	Type of Indicator	Effect on Livelihood Resilience	Signif. Value
Human	H101	Non-employment	Percentage of non-employed persons in the community of the target	Resilience	-	1
	H102	Physical and mental health	Percentage of population with physical or mental health issues (disabilities)	Resilience	-	1
	H103	Non-employment	Percentage of the non-employed population in the community of the target	Resilience	-	1
	H104	Level of education and skills	Percentage of population with secondary or higher education	Resilience	+	1
	H105	Skills and health of labor	Percentage of working population with secondary or higher education	Resilience	+	1
	H106	Income inequality	Percentage of income inequality (Gini coefficient) in the community	Resilience	-	1
	H107	Gender inequality	Percentage of gender inequality (Gender Inequality Index) in the community	Resilience	-	1
	H108	Population growth rate	Percentage of population growth rate in the community	Resilience	-	1
	H109	Level of literacy and numeracy skills	Percentage of population with literacy and numeracy skills	Resilience	+	1
	H110	Income	Average household income	Resilience	+	1
	H111	Access to basic services	Percentage of population with access to basic services (water, electricity, internet, etc.)	Resilience	+	1
	H112	Quality of services	Percentage of population with access to quality services	Resilience	+	1
Natural	N101	Availability and quality of natural resources	Percentage of population with access to natural resources (water, land, forests, etc.)	Resilience	+	1
	N102	Level of natural resources	Percentage of natural resources in the community	Resilience	+	1
	N103	Population pressure on natural resources	Percentage of population pressure on natural resources (deforestation, etc.)	Resilience	-	1
	N104	Population pressure on natural resources	Percentage of population pressure on natural resources (deforestation, etc.)	Resilience	-	1
	N105	Population pressure on natural resources	Percentage of population pressure on natural resources (deforestation, etc.)	Resilience	-	1
	N106	Population pressure on natural resources	Percentage of population pressure on natural resources (deforestation, etc.)	Resilience	-	1
	N107	Population pressure on natural resources	Percentage of population pressure on natural resources (deforestation, etc.)	Resilience	-	1
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	N111	Population pressure on natural resources	Percentage of population pressure on natural resources (deforestation, etc.)	Resilience	-	1
	N112	Population pressure on natural resources	Percentage of population pressure on natural resources (deforestation, etc.)	Resilience	-	1

Index-based Livelihood Security and Resilience Assessment (LiSeRA) Toolkit in Excel and 'R' Programming

Livelihood Security & Resilience Assessment (LiSeRA)

Pal, Baskota, Dhungana, Udmale, ... (2023)

<https://doi.org/10.1016/j.mex.2023.102301>

Heat Wave Risk Assessment using an indicator-Based approach: Subdistrict levels analysis of Maharashtra State

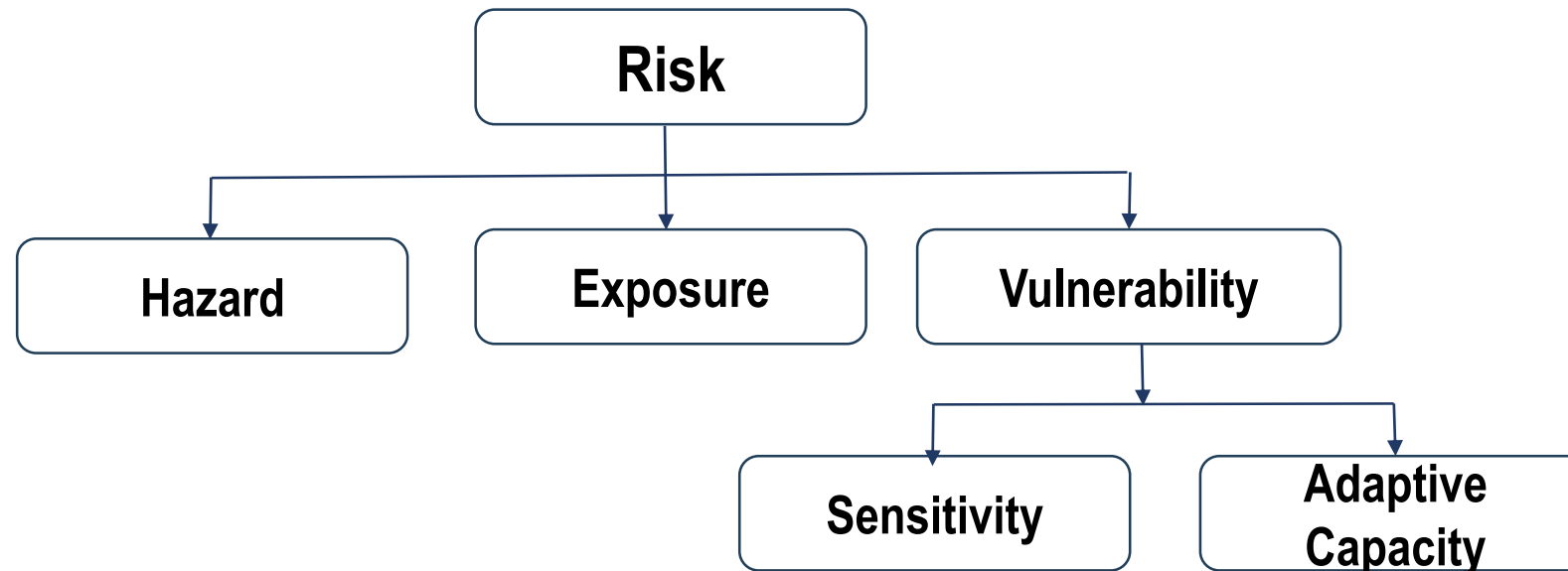
Heat Wave Risk: (IPCC, 2014)

$$\text{Risk (R)} = f(\text{H, E, V})$$

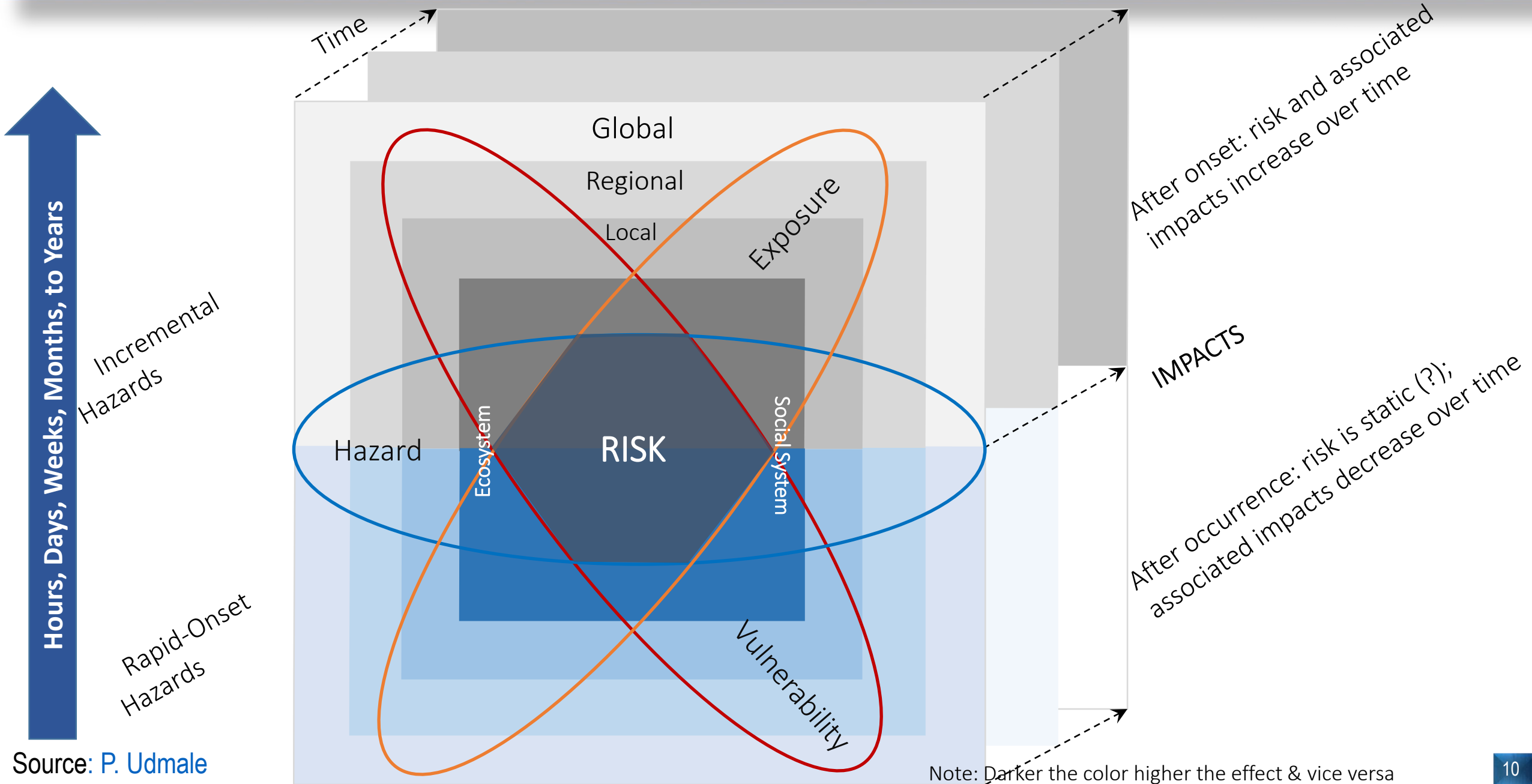
Where, R= Risk, H= Hazard, E= Exposure, and V= Vulnerability

$$\text{Vulnerability} = f(\text{S, AC})$$

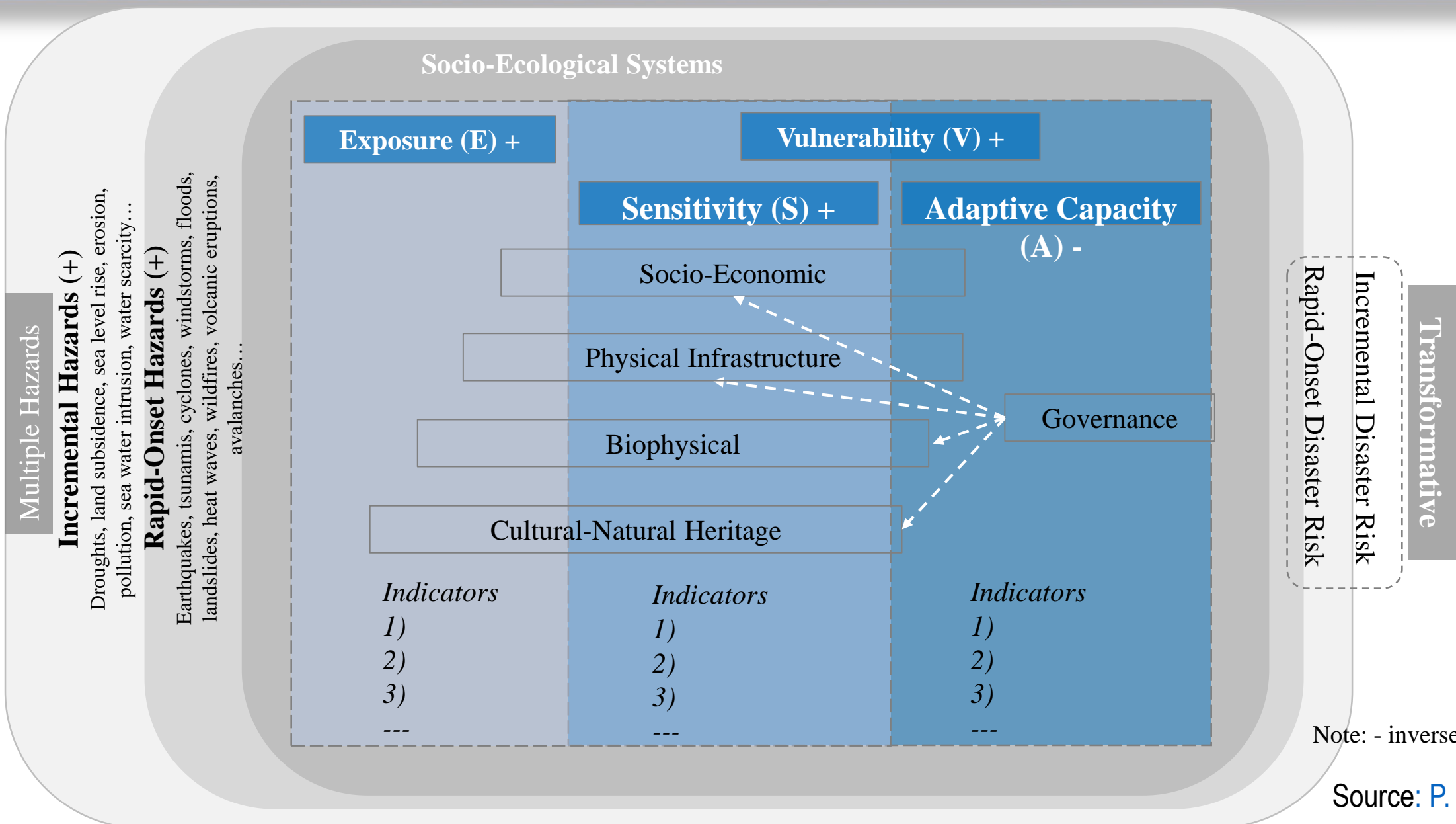
Where, S= Sensitivity, and AC= Adaptive Capacity



Risk in space & time



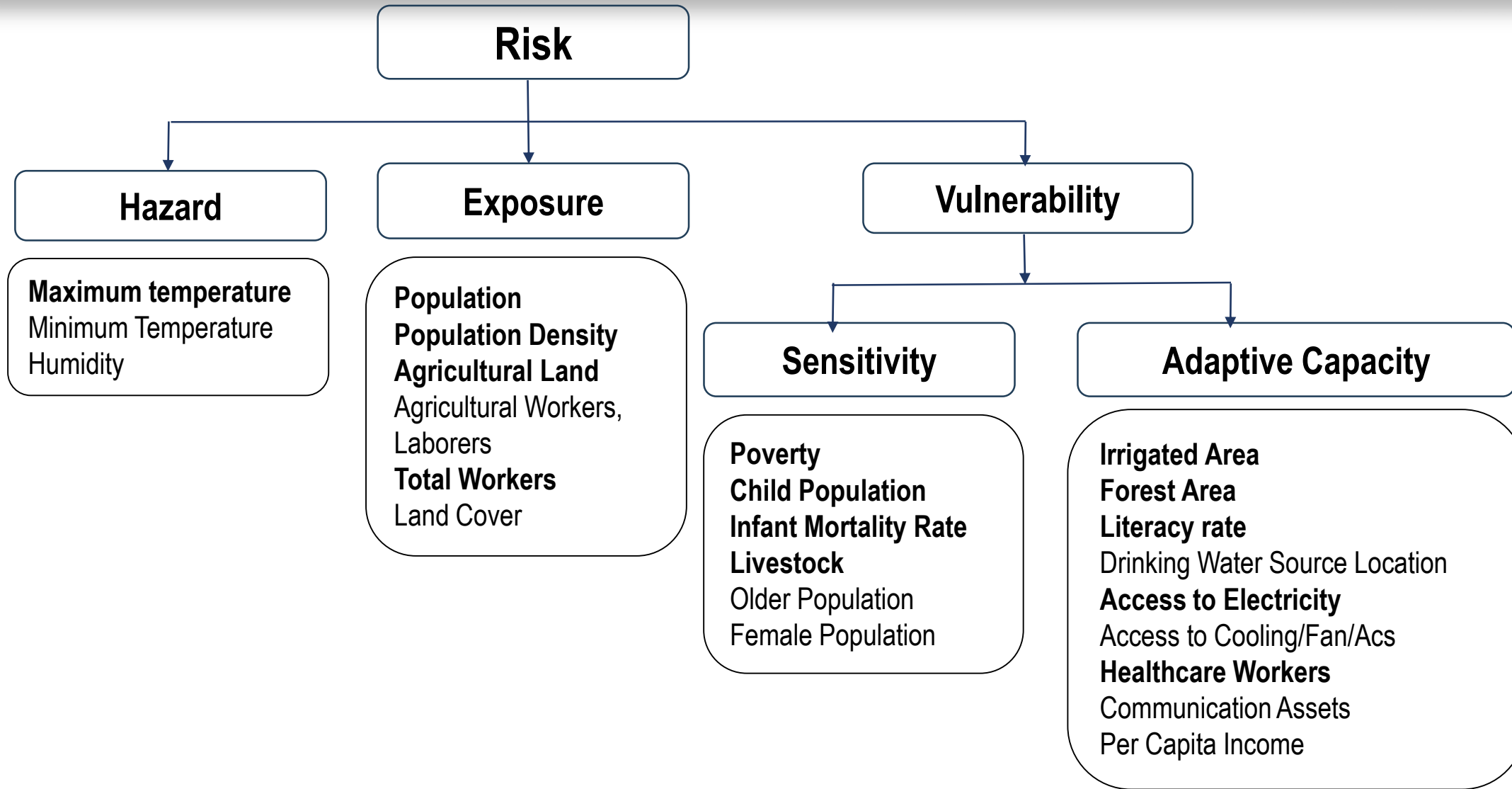
Risk Conceptualization



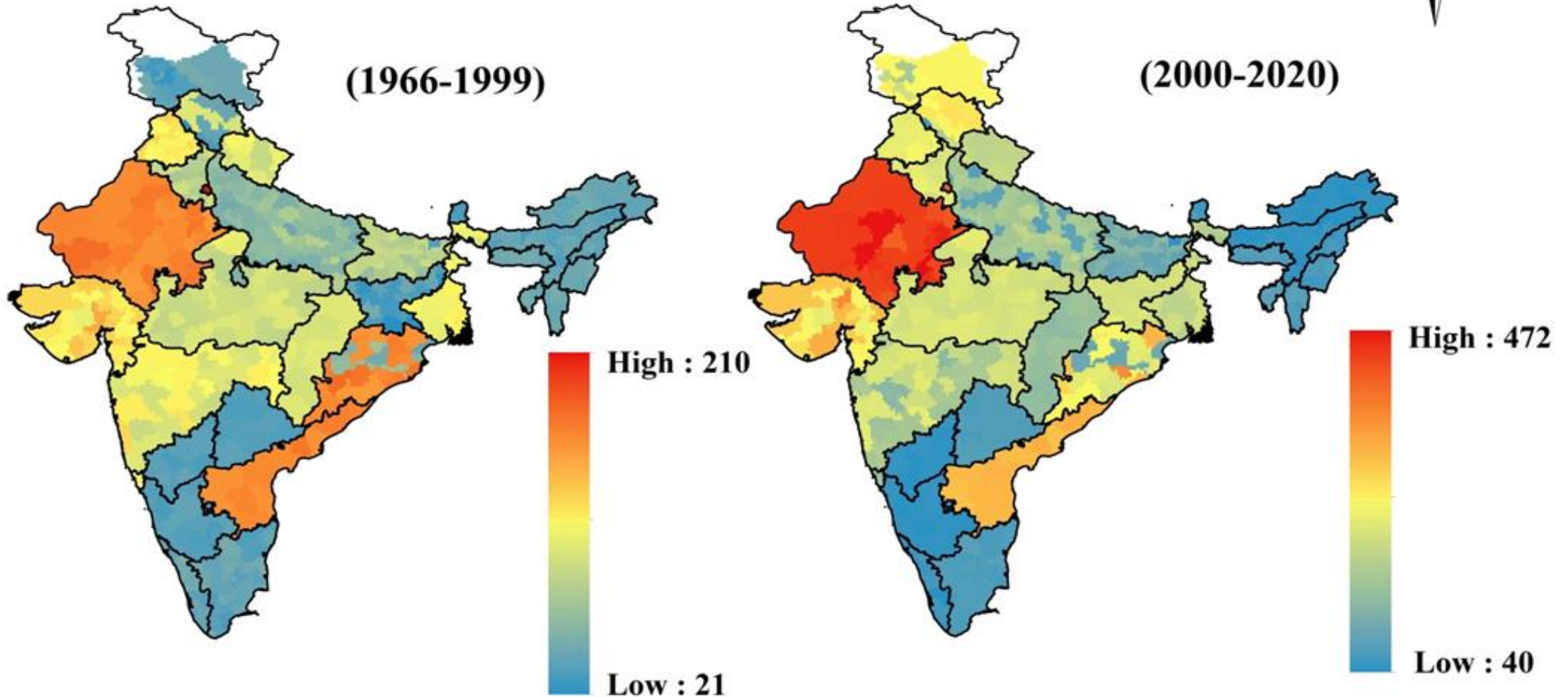
Note: - inverse relation

Source: P. Udmale

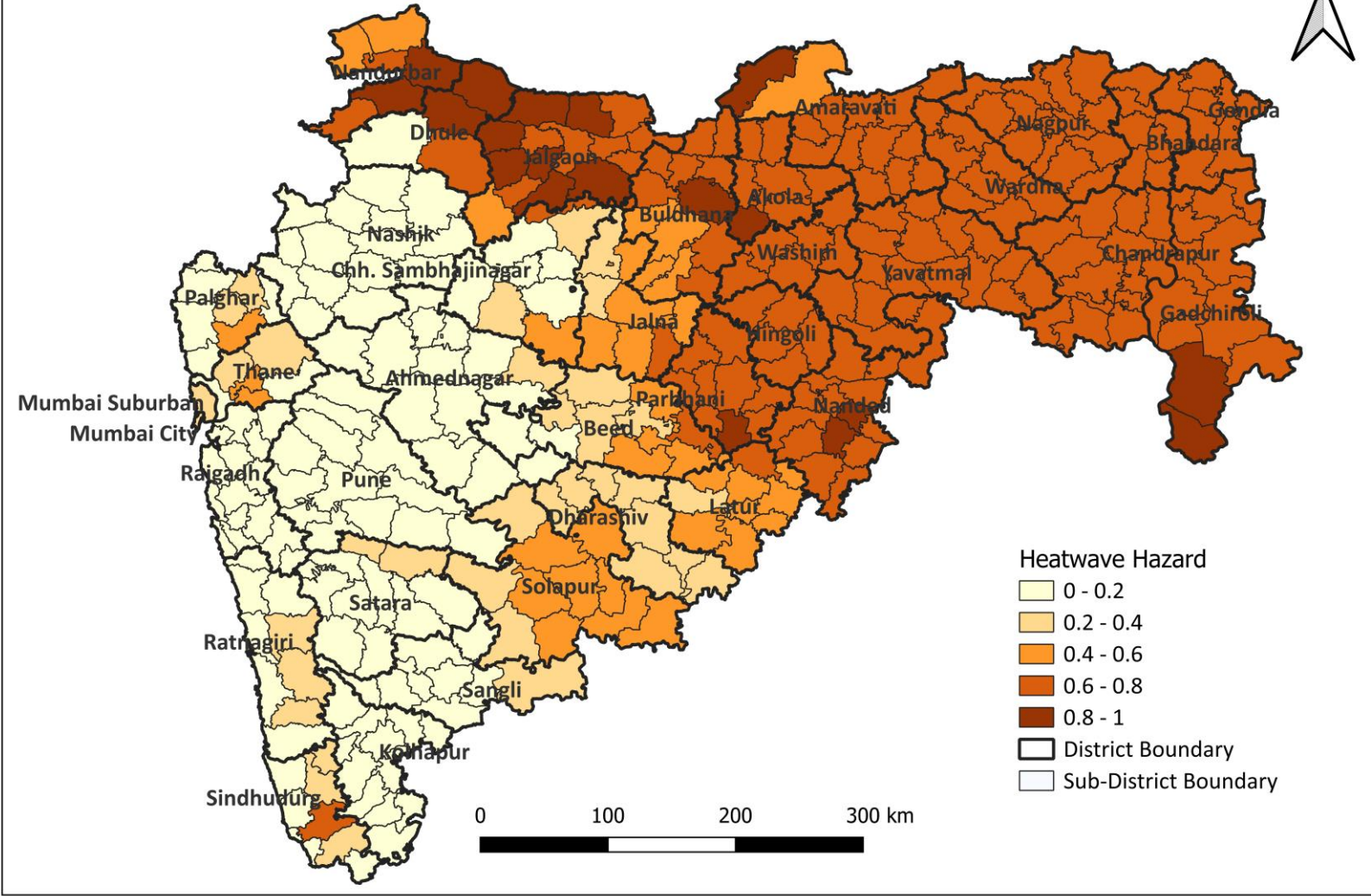
Risk Components and Indicators



Total Heat Wave spells



Sub-District Heatwave Hazard in Maharashtra

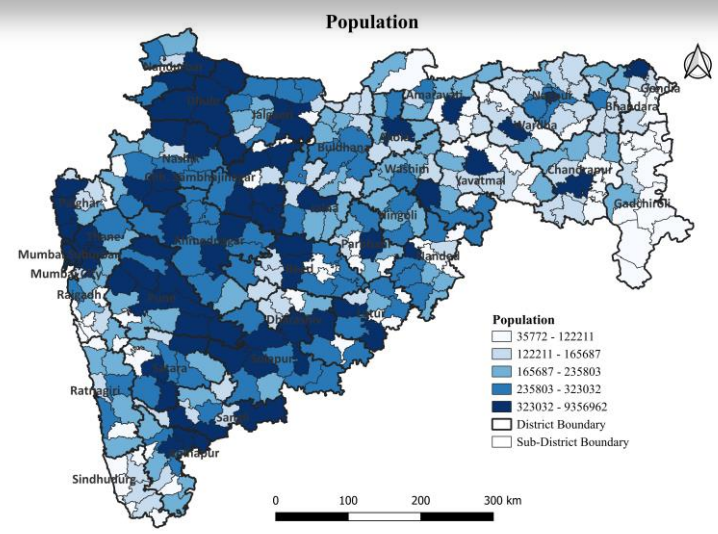


Heatwave Events from year 1980 to 2016

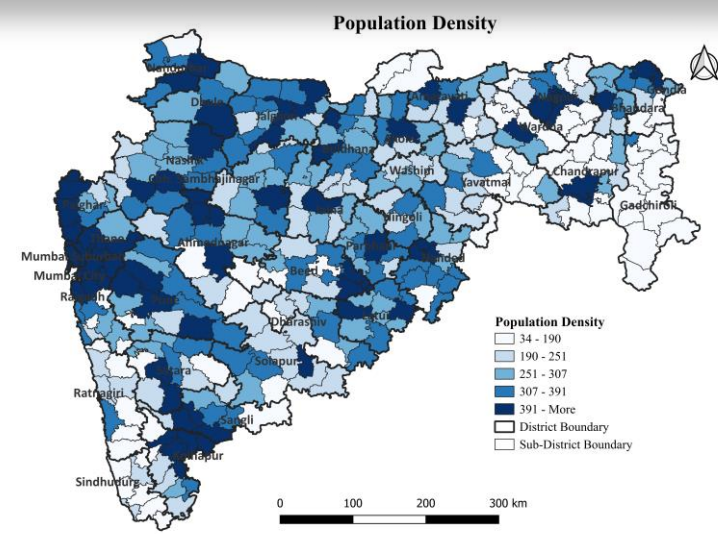
Number of 3 or more consecutive days having temp >40 °C

Data Source: CHIRTSdaily
Data Period: 1980-2016
Resolution = 0.05x0.05
Months (Mar-Jun)

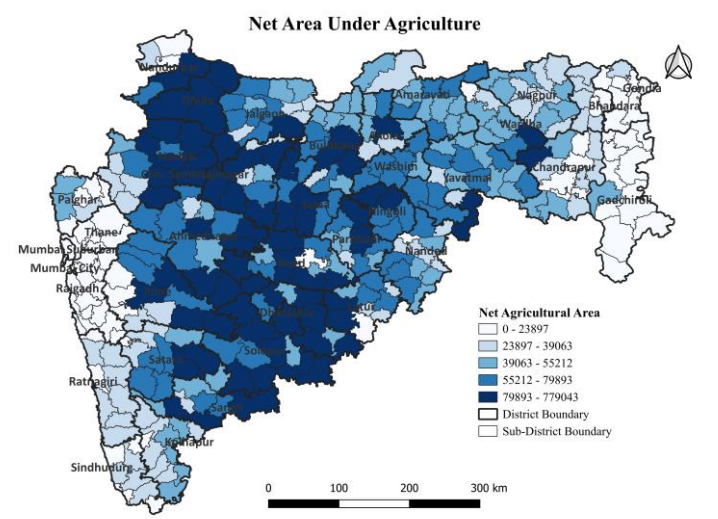
Exposure Indicators



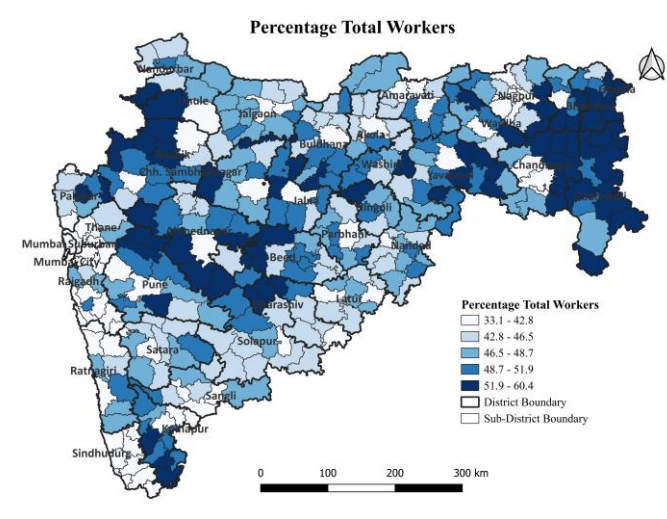
Source: Census 2011



Source: SEDAC, 2020

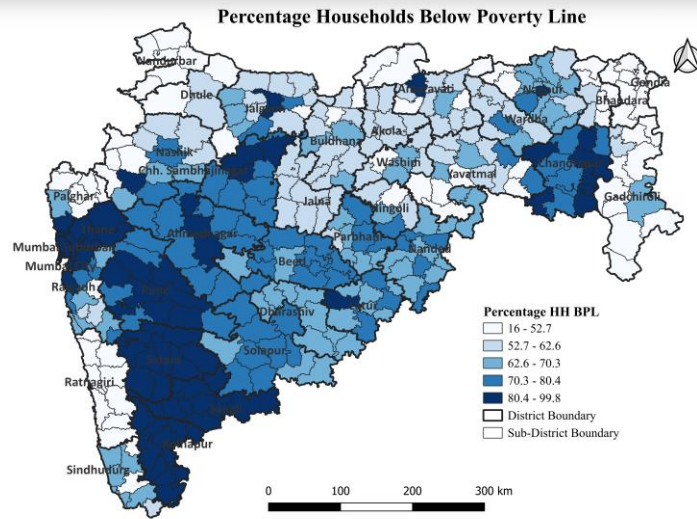


Source: SER, 2022

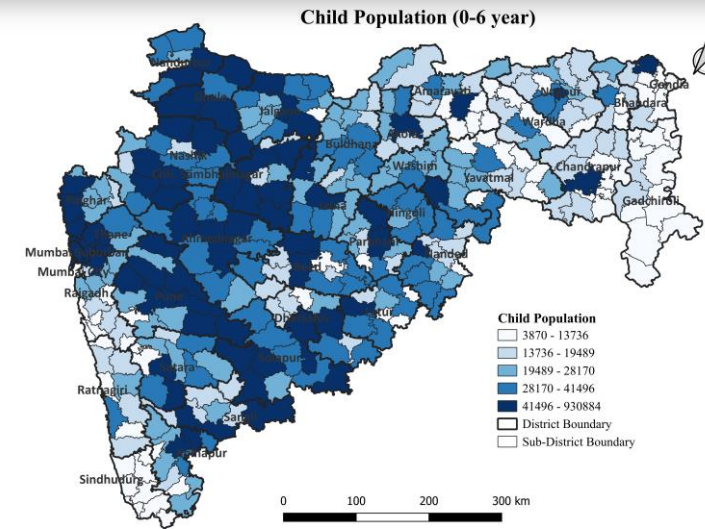


Source: Census 2011

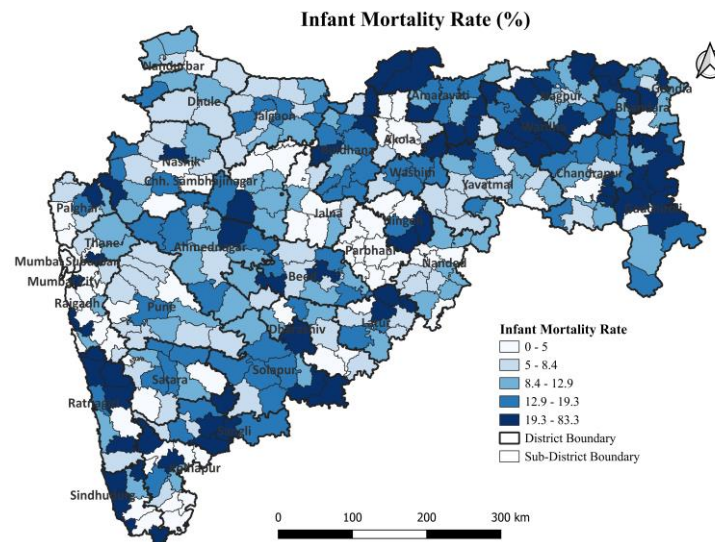
Sensitivity Indicators



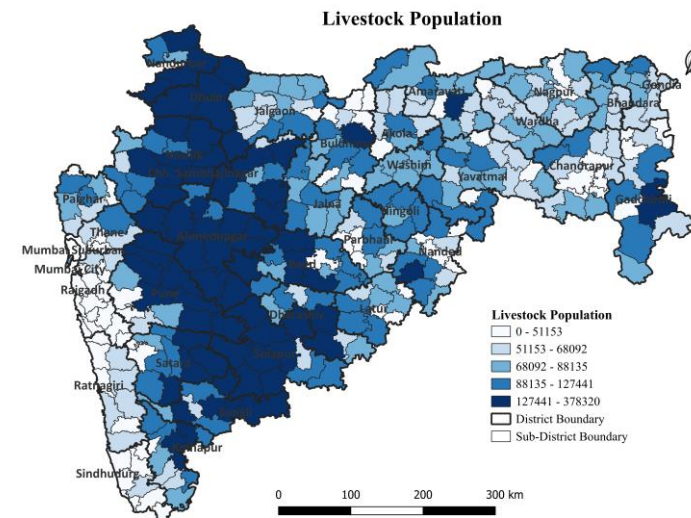
Source: SER, 2002-07



Source: Census 2011



Source: Census 2011

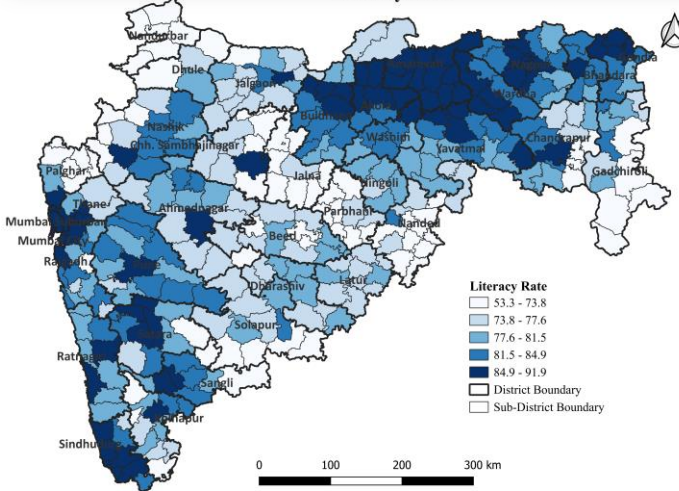


Source: Livestock Census, 2019

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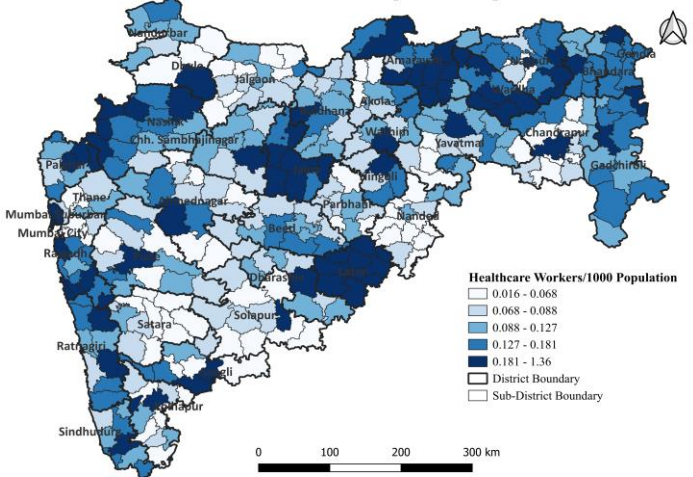
Adaptive Capacity Indicators

Literacy Rate



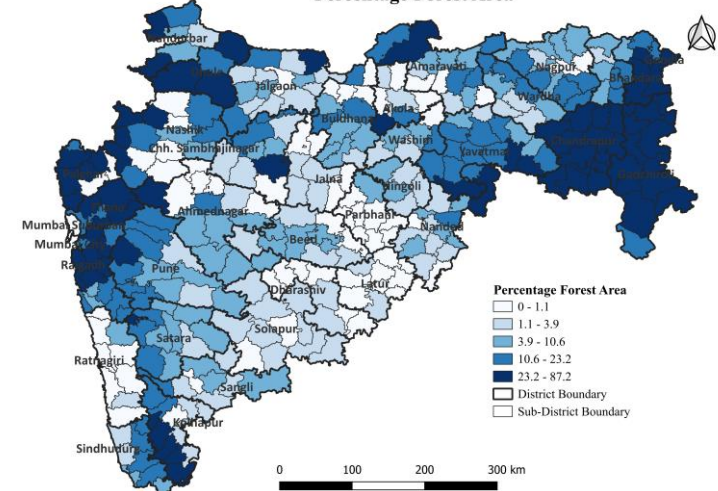
Source: Census 2011

Healthcare Workers per 1000 Population



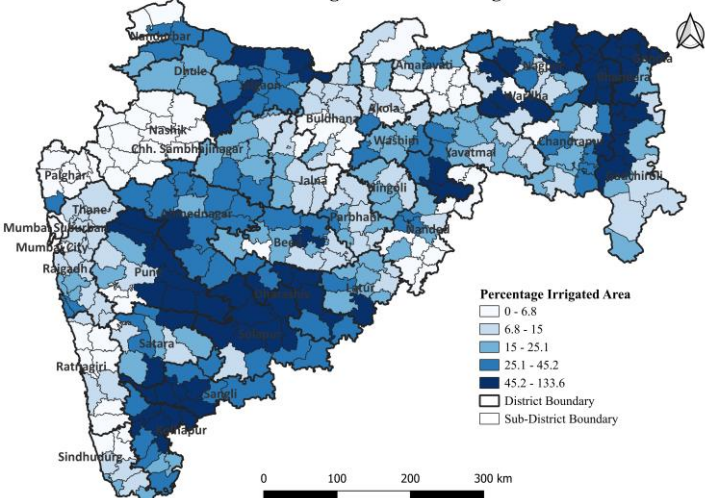
Source: SER, 2022

Percentage Forest Area



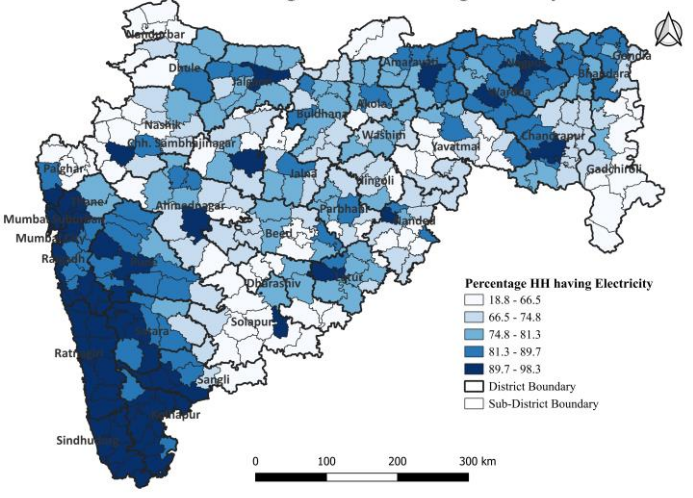
Source: SER, 2022

Percentage Area Under Irrigation



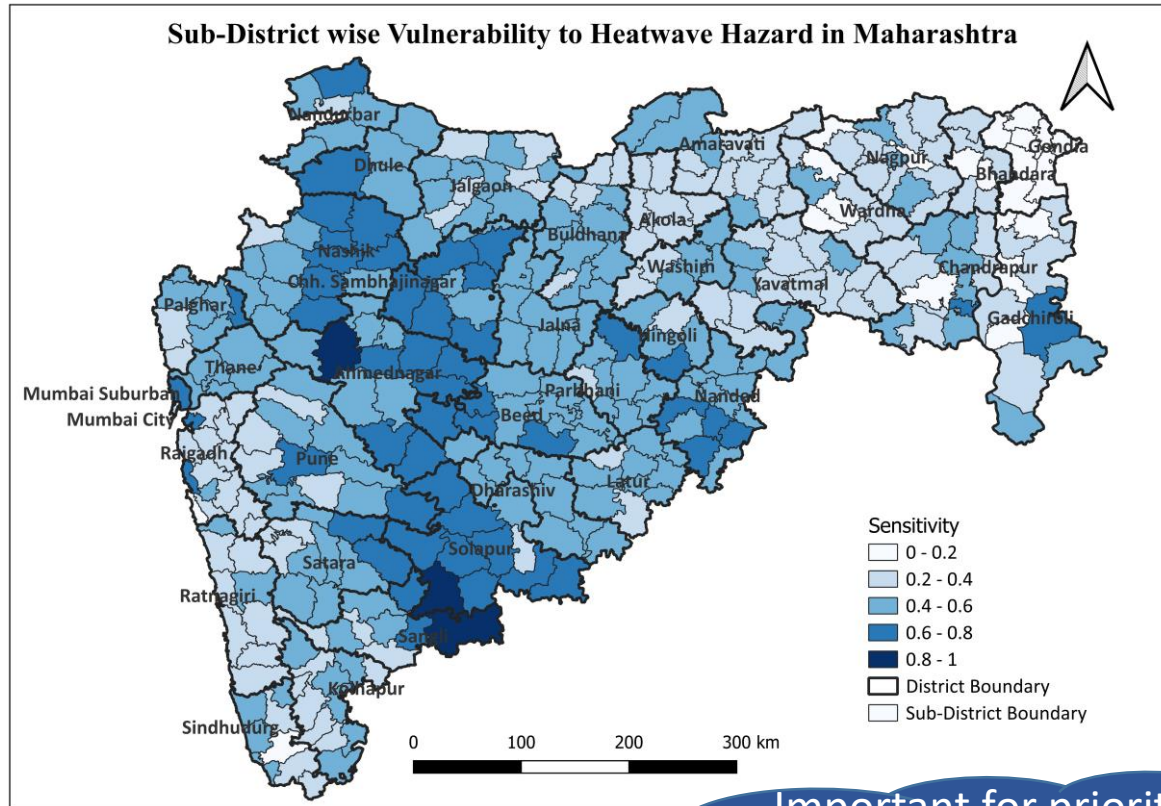
Source: SER, 2022

Percentage Households having Electricity



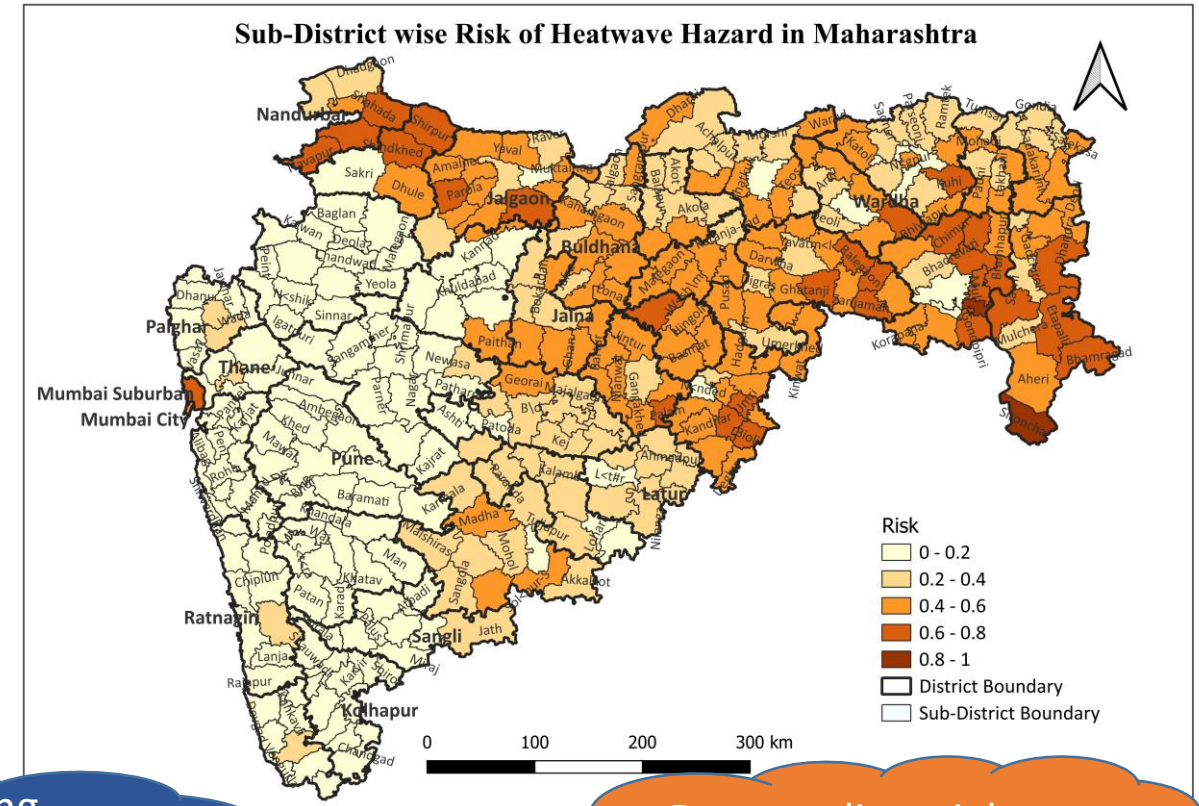
Source: Census 2011

Vulnerability Index



Important for prioritizing mitigation and resources allocation

Risk Index



Data quality might be questionable!

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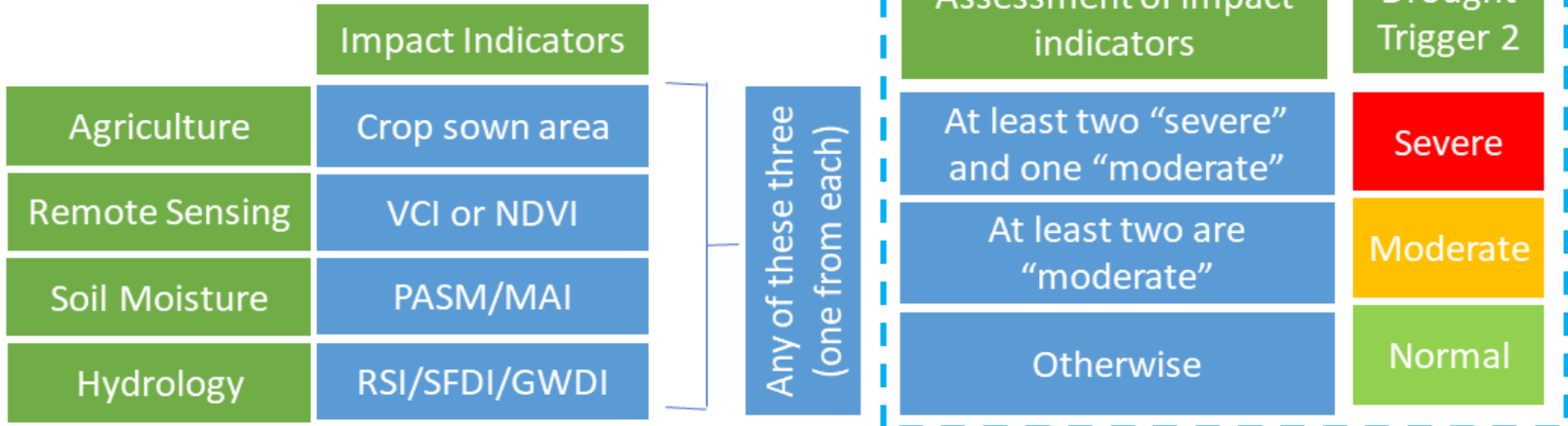
- Dynamic Risk
- Data Limitations
- Spatial Unit of Analysis/Integrated Disaster Management Plans (VDMC?)
- Subjectivity in Methodological Approaches/Common Frameworks
- Transdisciplinary Research/Stakeholders engagement in Research
- Adoption of Advanced Technologies in Disaster Risk Reduction and Management
- Resources?

Steps in Drought Declaration

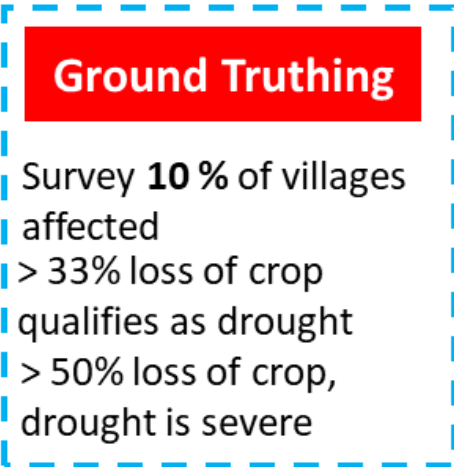
STEP 1



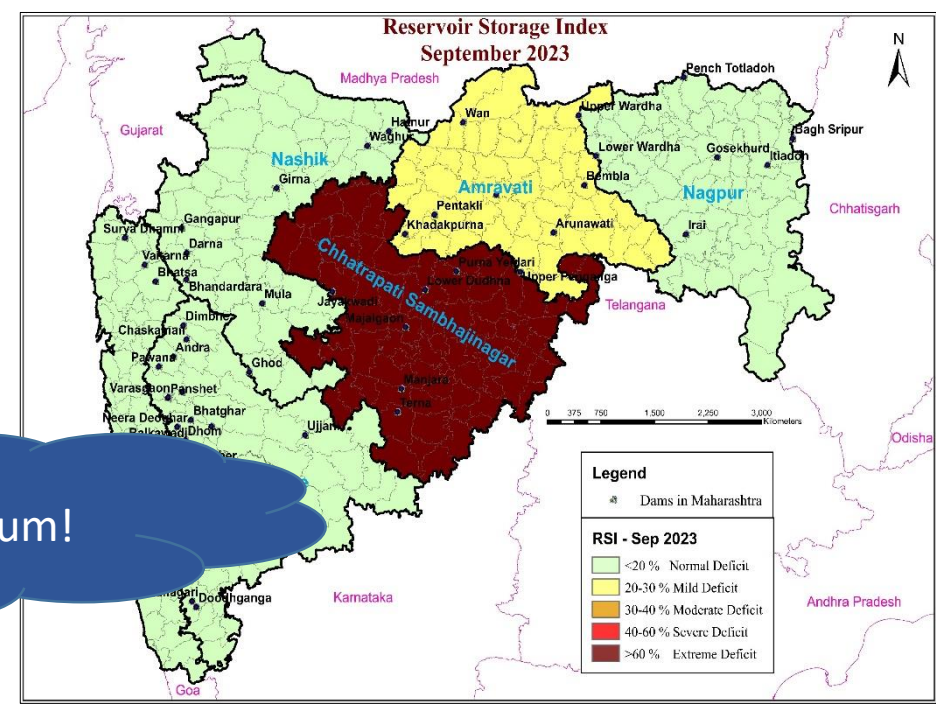
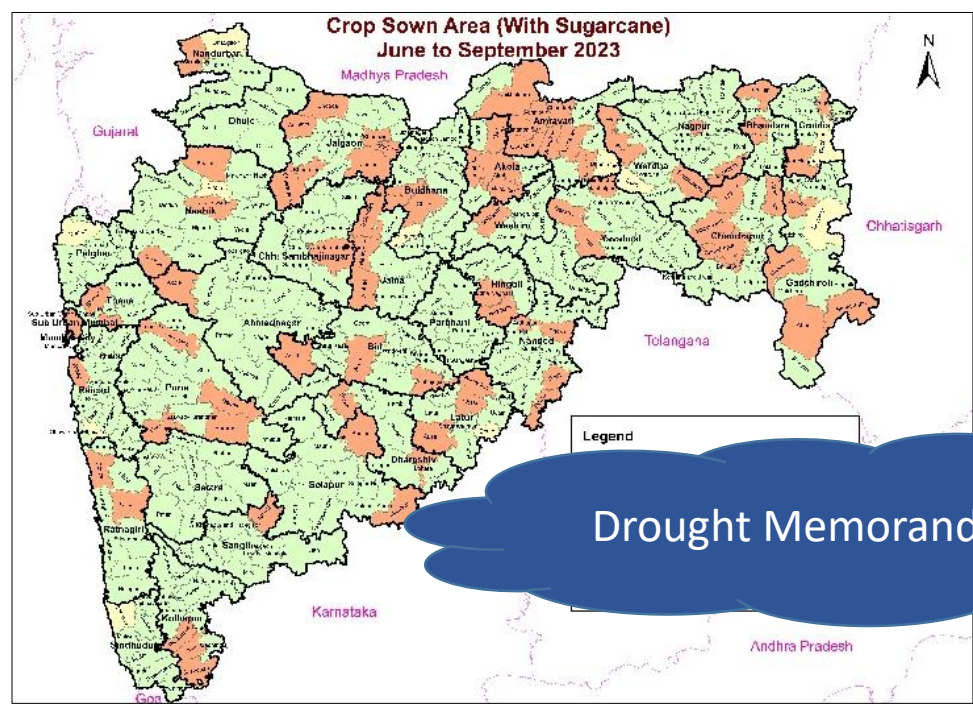
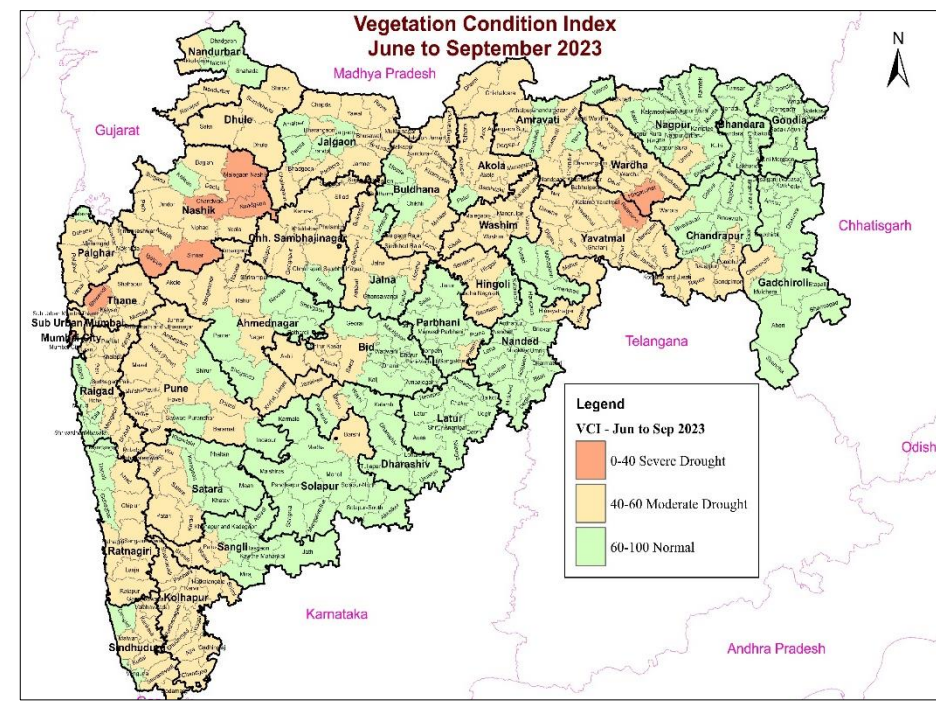
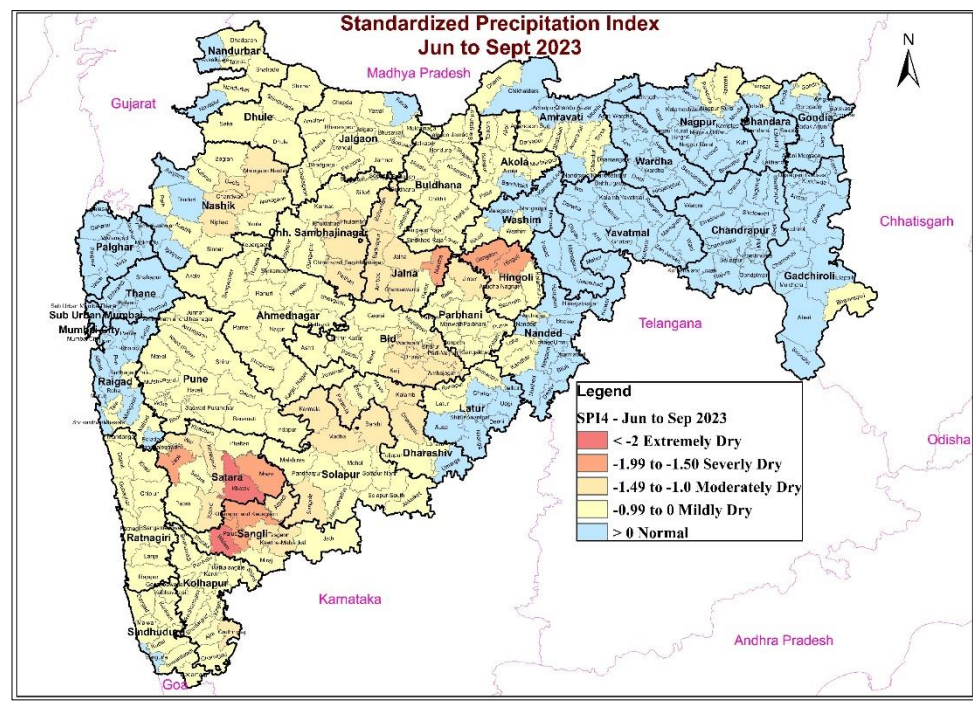
STEP 2



STEP 3



- Step 1 : Know whether or not drought has triggered – Drought Trigger 1
- Step 2 : Impact on crops – Drought Trigger 2
- Step 3 : Ground Truthing



Drought Memorandum!

Thank you!

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(1) IIT Bombay Seed Grant Project: RD/0521-IRCCSH0-017

(2) SERB Start-up Research Grant (SRG)



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