



Threats and diversity-based solutions hotspot mapping for sustainable food production

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Objectives

1. To identify places where **agricultural landscapes** are facing **one or multiple socio-ecological threats** to sustainable food production and rank the **threat levels** to highlight the areas where urgent actions are needed [spatial data analysis]
2. To characterize **diversity-based interventions** according to their ability to help alleviate specific threats [meta-analyses and local expert knowledge]



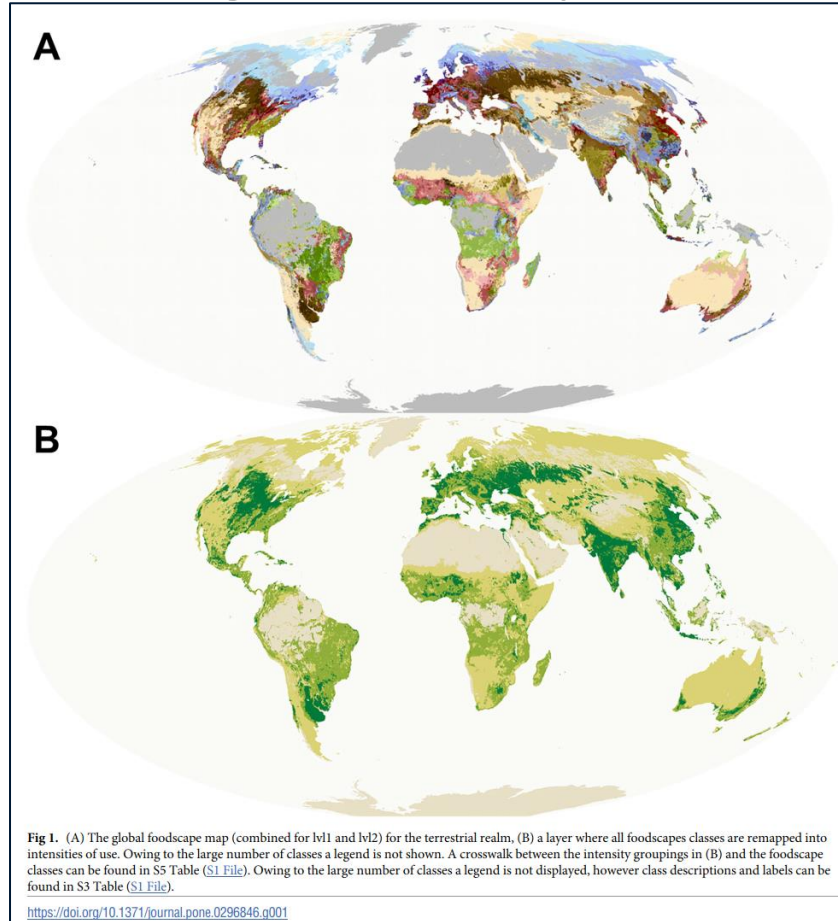
Rice transplanting by women farmers in Mandi District, Himachal Pradesh, India

Foodscapes mapping and their exposure to threats

RESEARCH ARTICLE
A global clustering of terrestrial food production systems

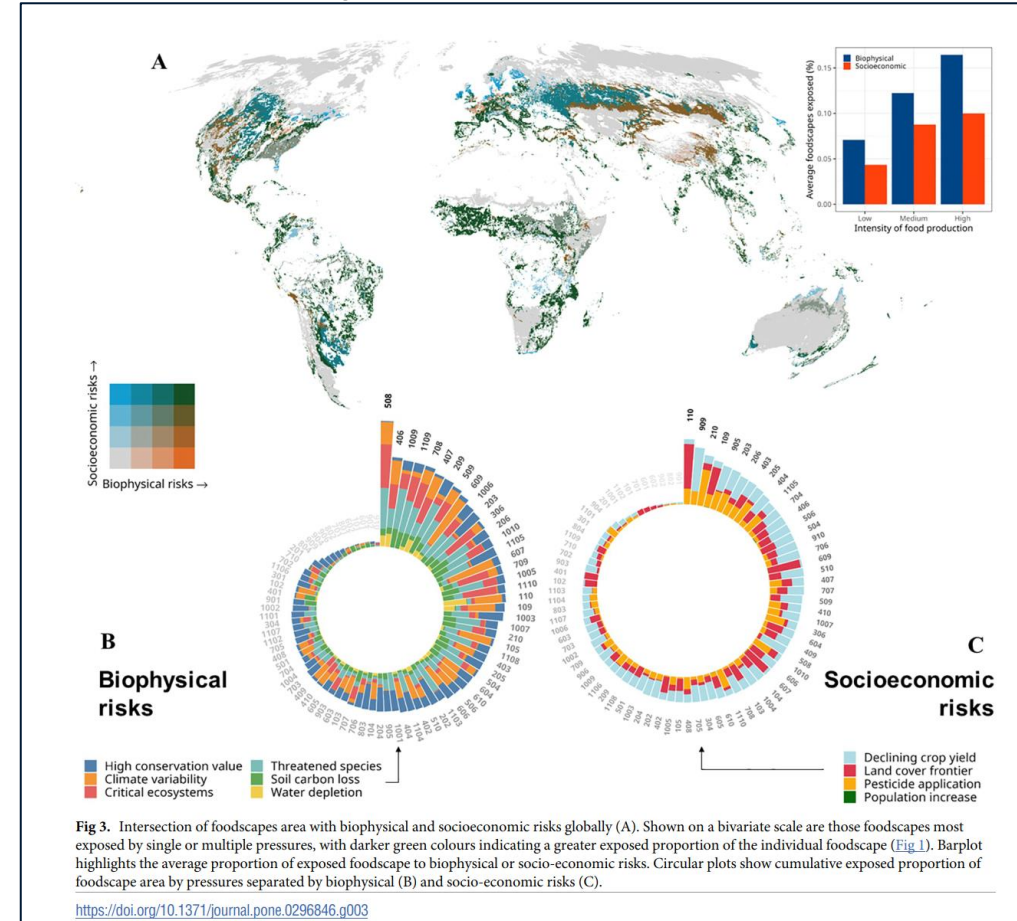
Martin Jung^{1*}, Timothy M. Boucher², Stephen A. Wood^{2,3}, Christian Folberth¹, Michael Wironen², Philip Thornton⁴, Deborah Bossio², Michael Obersteiner^{1,5}

Homologous foodscapes



Granularity
No social component

Pressure exposure



HUMAN WELL-BEING

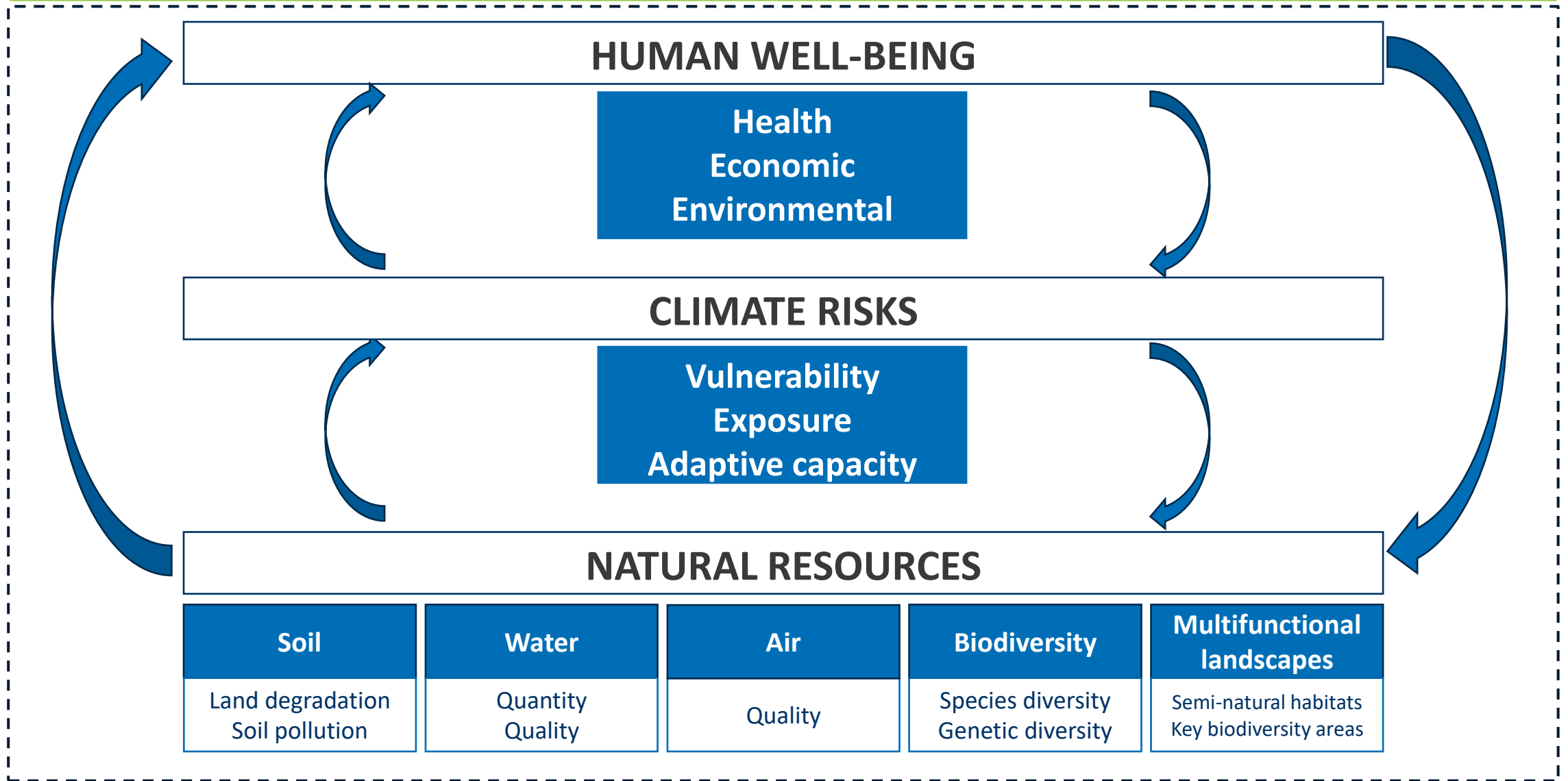
Health
Economic
Environmental

CLIMATE RISKS

Vulnerability
Exposure
Adaptive capacity

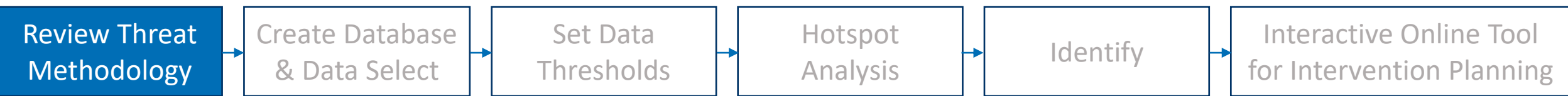
NATURAL RESOURCES

Soil	Water	Air	Biodiversity	Multifunctional landscapes
Land degradation Soil pollution	Quantity Quality	Quality	Species diversity Genetic diversity	Semi-natural habitats Key biodiversity areas



METHODOLOGY

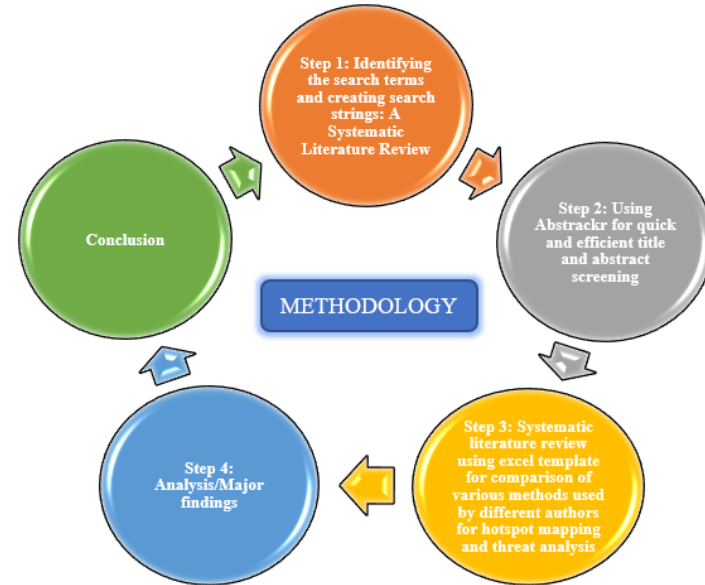




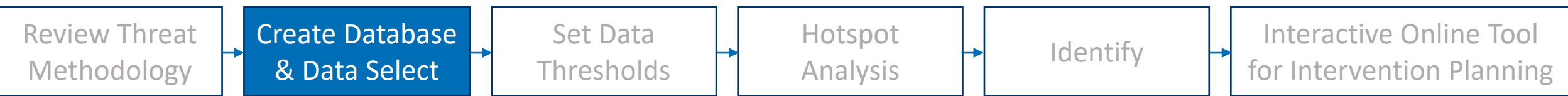
Systematic review of combining spatial layers

Table 1: The search strings to retrieve the total number of publications.

Search string number	Key words searched	Number of articles
1	TS=("remote sensing" OR "GIS" OR "geographic information system*" OR "spatial data") AND TS=("multi*criteria analy*is" OR "integrated assessment*" OR "cluster analysis" OR "hotspot" OR "bundles")	2377
2	TS=("remote sensing" OR "GIS" OR "geographic information system*" OR "spatial data") AND TS=("multi*criteria analy*is" OR "integrated assessment*" OR "cluster analysis" OR "bundles")	1487
3	TS=("remote sensing" OR "GIS" OR "geographic information system*" OR "spatial data") AND TS=("multi*criteria analy*is" OR "integrated assessment*" OR "cluster analy*is" OR "bundles")	1547



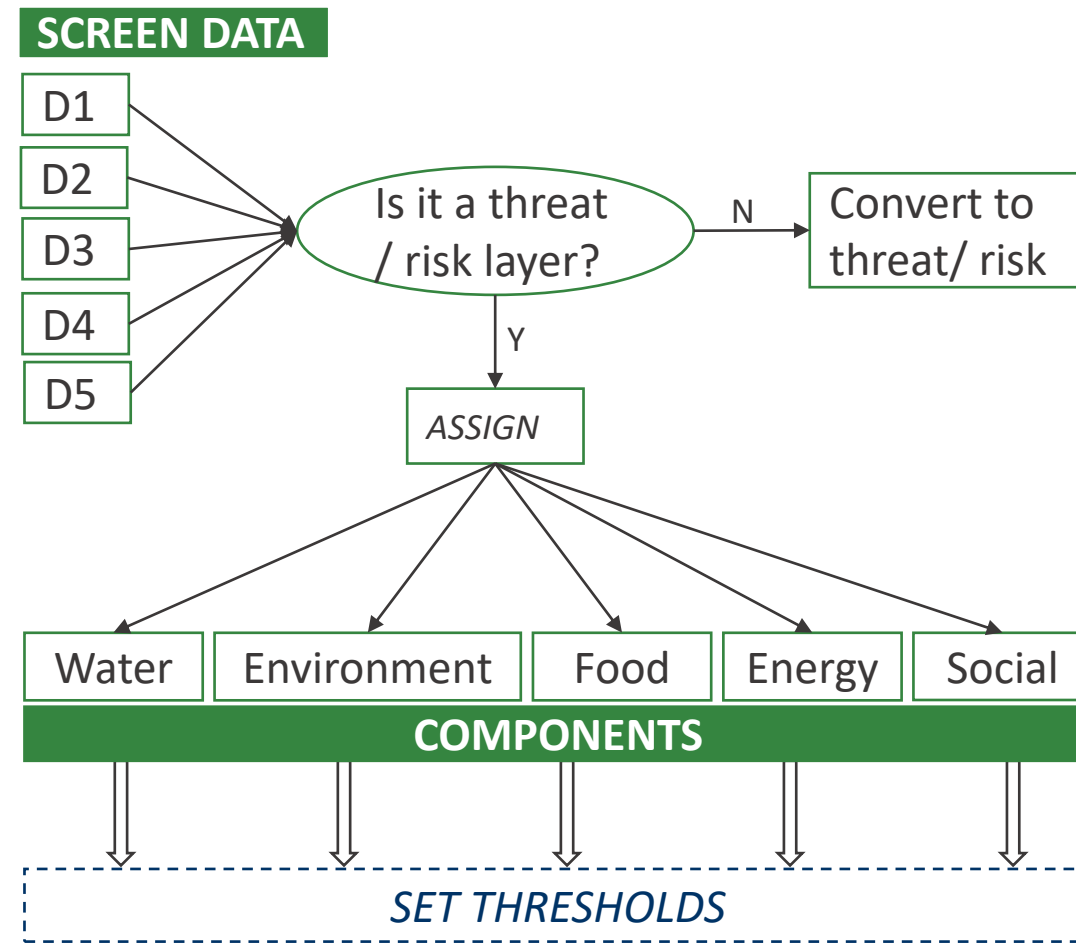
- 1546 peer-reviewed articles identified in Web of Science and screened at the abstract level
- 435 selected as relevant according to our criteria
- 110 fully screened (intro, methods, results, discussion, conclusion)
- 50 extracted information about methods to conduct hotspot analysis, select thresholds, weights, etc

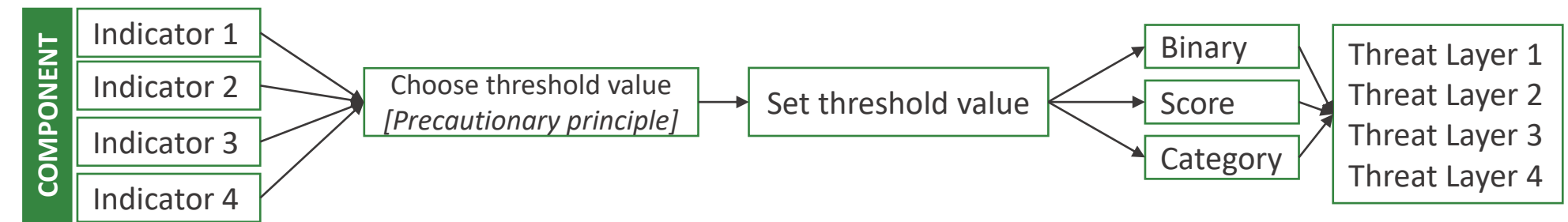


Criteria: Quality and coverage

- Global / national datasets at 1km or finer resolution
- License to use available preferable
- Optimal years: 2016 – 2023

Theme	Sub-theme	Count
Administrative boundaries	National, sub-national boundaries	4
Agriculture	Suitability, irrigated areas, crop production, yield, farm size, livestock, etc.	27
Anthropogenic	Anthromes, conflict, population count, etc.	12
Biodiversity	EII, ecosystem threat, intactness, forest integrity, landscape complexity, etc.	15
Carbon	NEP, NPP, albedo, etc.	4
Climate	Temperature, rainfall, bioclimatic variables, extreme events, etc.	34
Ecological/climate boundaries	Ecological zones, critical areas conservation, etc.	7
Economic	Agricultural subsidies, geographic wealth distribution	2
Energy	Solar atlas, photovoltaic power	1
Land-cover/ land-use	LCLUC, wetland loss, tree cover loss, vegetation cover, etc.	37
Nutrition	Food Insecurity hotspots, etc.	3
Socio-economics	Population census, land holdings, mortality, poverty, etc.	6
Soil	Land degradation, pesticide application, soil properties, soil erosion, etc.	22
Topography	Elevation, slope, eastness, etc.	6
Vegetation	EVI, forest cover, LAI, NDVI, etc.	20
Water	Water stress, water depletion, water extent, seasonality, basin and sub-basin boundaries, water quality monitoring, etc.	30
TOTAL		230



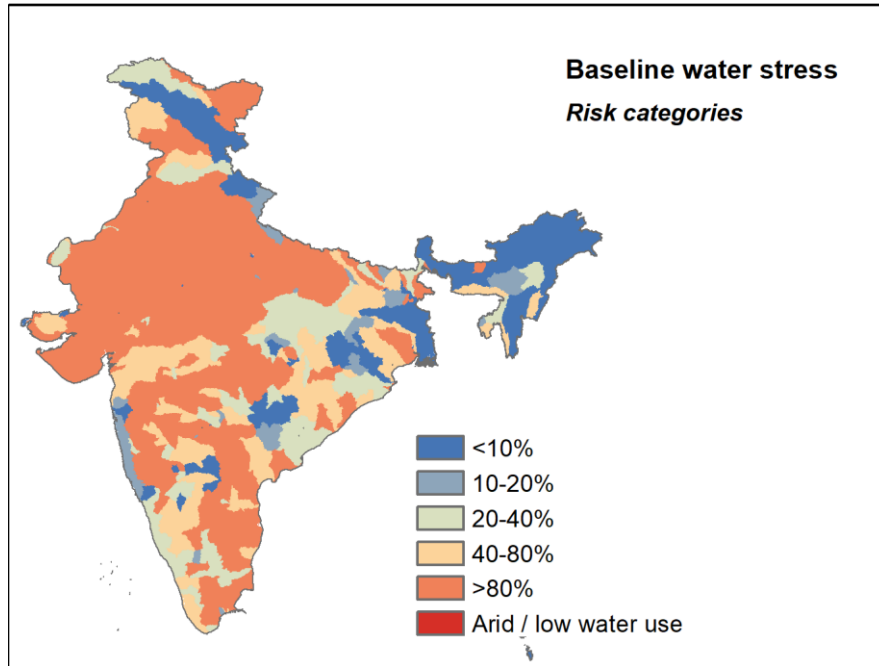


Permissible limits of drinking water quality

Parameters	USEPA	WHO	ISI	ICMR	CPCB
pH (mg/l)	6.5-8.5	6.5-8.5	6.5-8.5	6.5-9.2	6.5-8.5
Turbidity NTU	-	-	10	25	10
Conductivity (mg/l)	-	-	-	-	2000
Alkalinity (mg/l)	-	-	-	-	600
Total hardness (mg/l)	-	500	300	600	600
Iron ^{mg/l}	-	0.1	0.3	1.0	1.0
Chlorides (mg/l)	250	200	250	1000	1000
Nitrate (mg/l)	-	-	45	100	100
Sulfate (mg/l)	-	-	150	400	400
Residual (mg/l) free	-	-	0.2	-	-
Chlorine	-	-	-	-	-
Calcium (mg/l)	-	75	75	200	200

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3482709/>

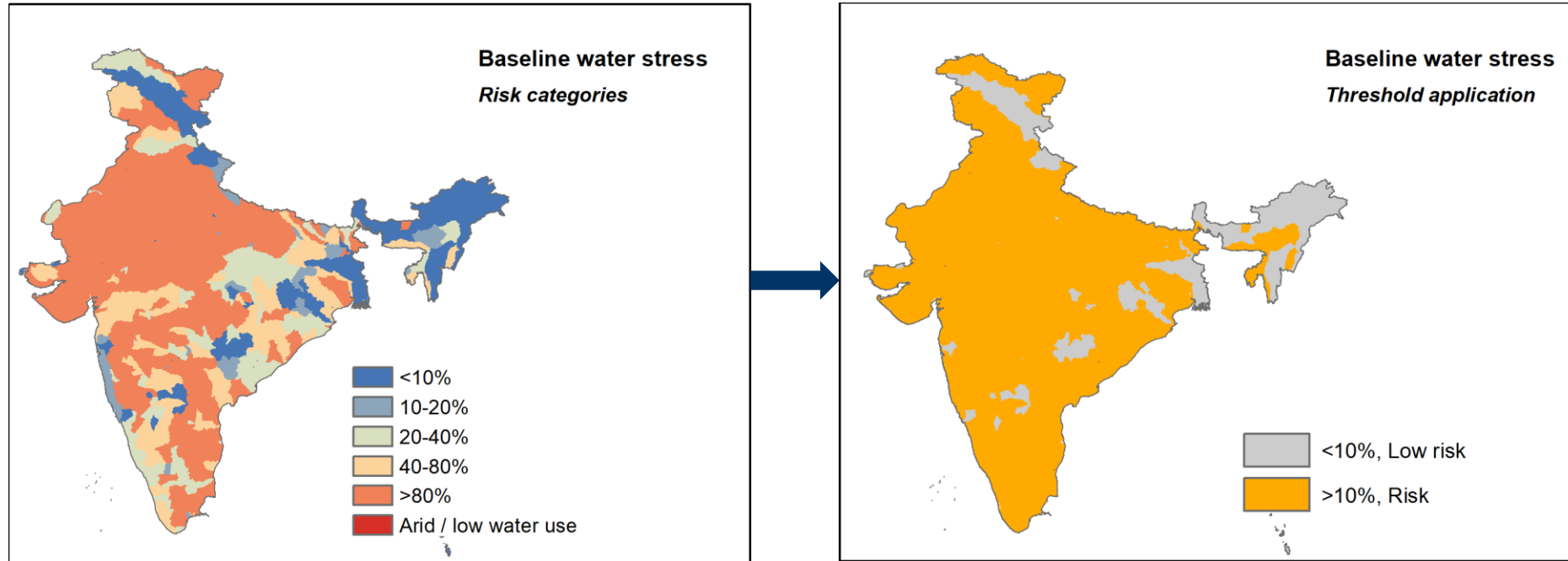
Threat layers and threshold reclassification



Aqueduct 4.0, WRI

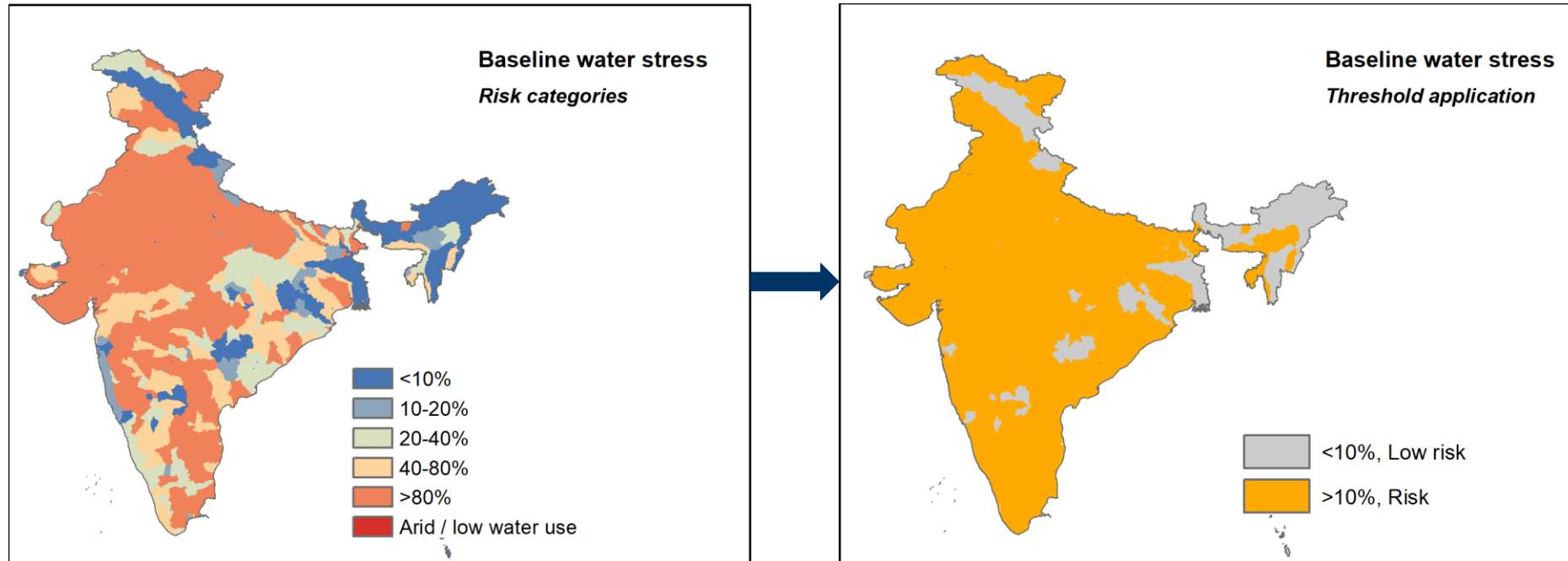
BWS = ratio of total water demand to available renewable surface and groundwater supplies

Threat layers and threshold reclassification

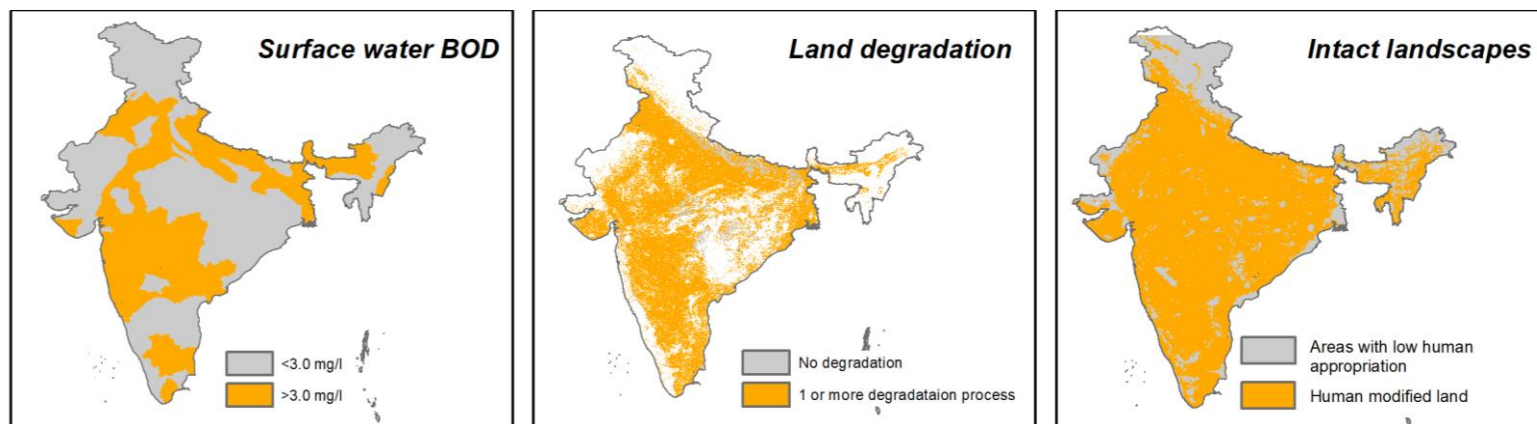


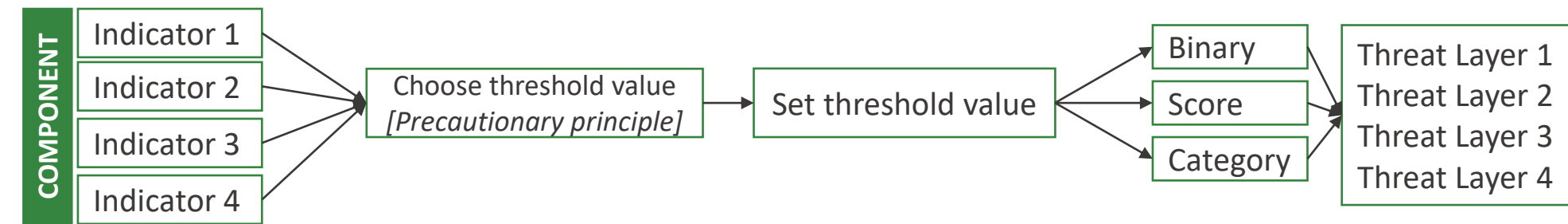
Aqueduct 4.0, WRI

Threat layers and threshold reclassification



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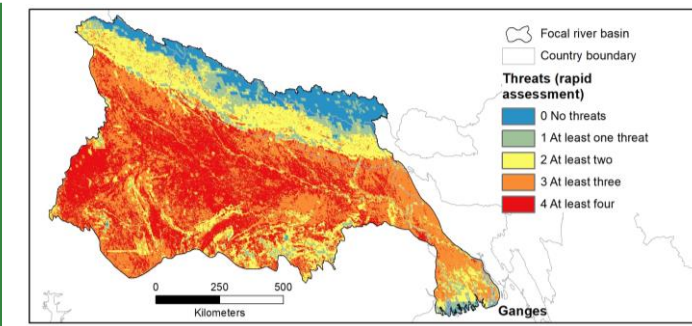
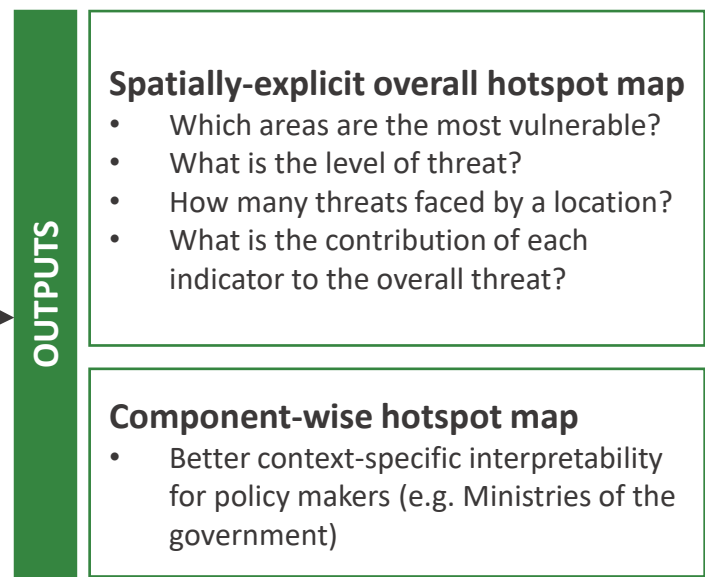
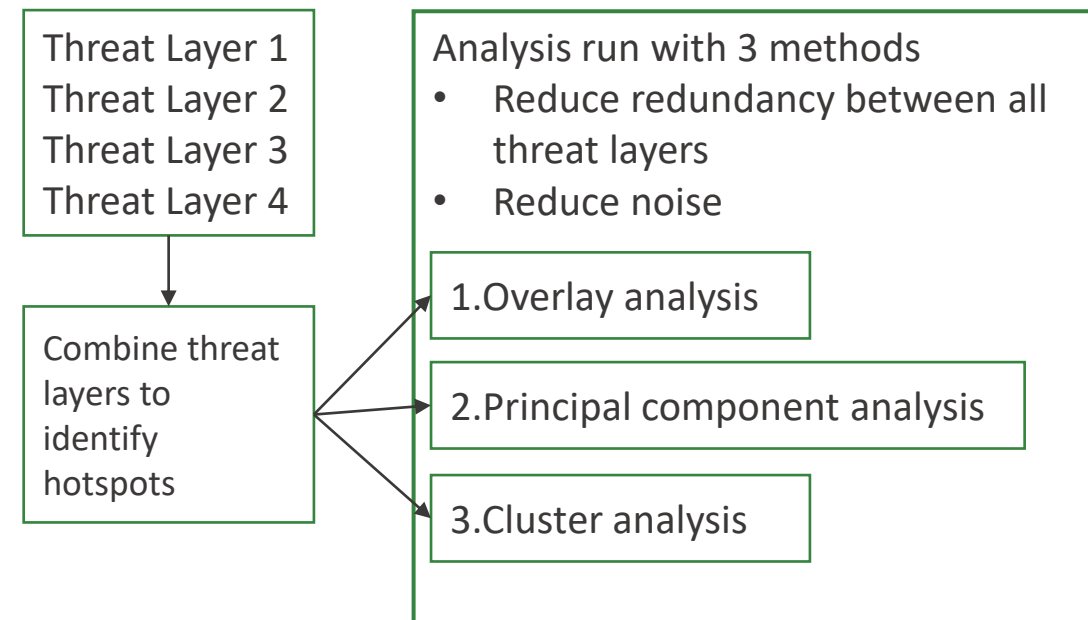




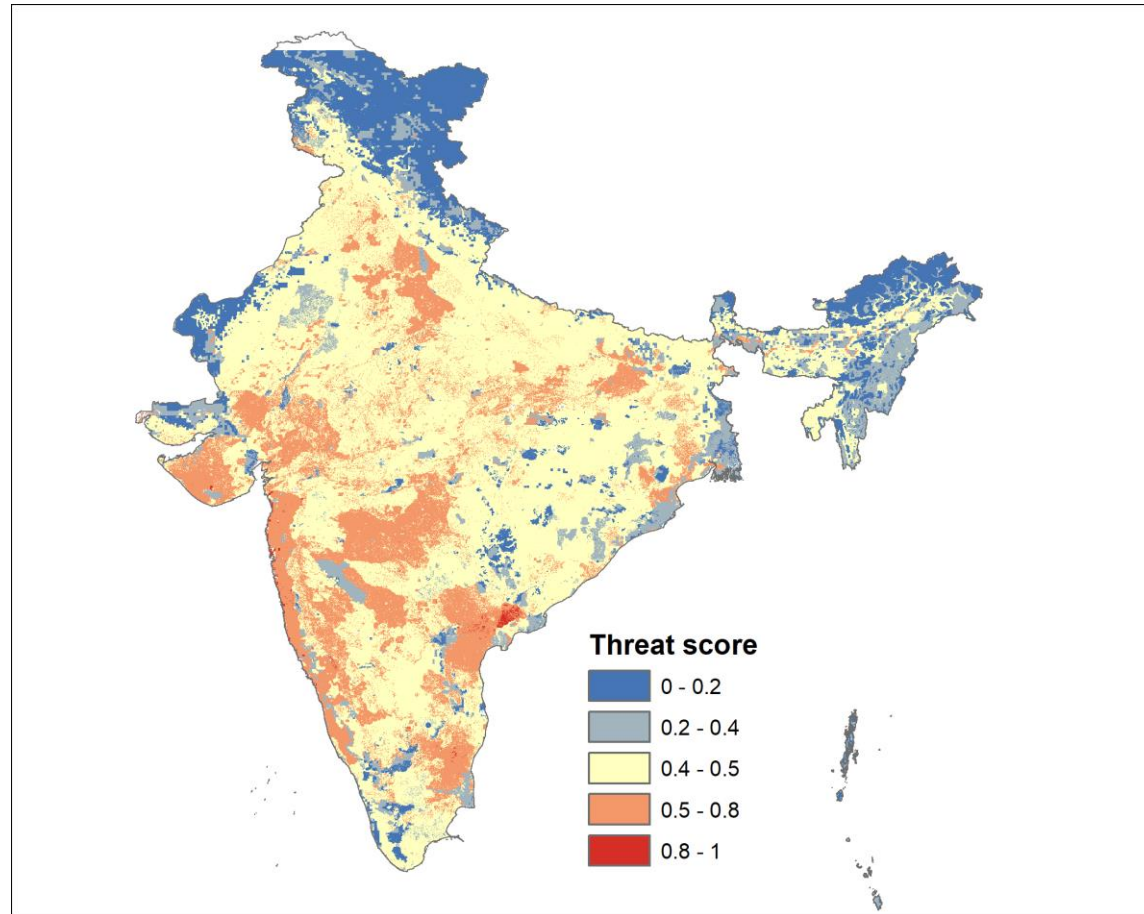
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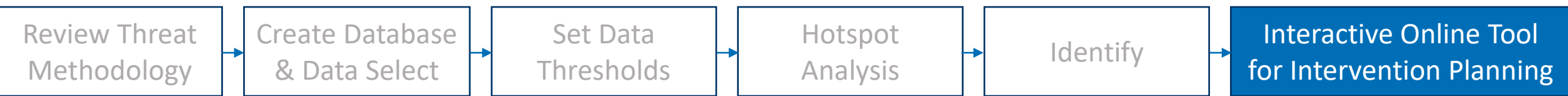


Overlay Analysis Threat Layer



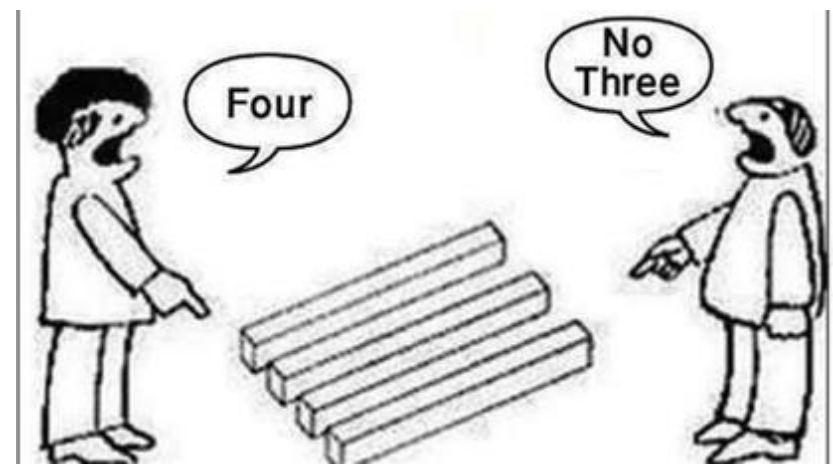
THREAT LAYERS:

- Water stress
- Water quality
- Land degradation
- Livestock diversity
- Intact landscapes
- Climate vulnerability index



Validation and local co-design of solutions

- Context-specific
- Expert input



Interactive tool

Visualization

Where is the threat for indicator 1?

Grey	Grey	Grey
Yellow	Yellow	Yellow
Grey	Grey	Grey

Where is the threat for indicator 1 & 2 combined?

Grey	Grey	Grey
Yellow	Yellow	Yellow
Grey	Yellow	Yellow

Legend: ■ Threat, ■ No threat

Interactive

- For researchers, policymakers, businesses
- User-specific threshold adjustment

1	4	5
3	2	6
7	8	9

Threshold = 8

1	4	5
3	2	6
7	8	9

Threshold = 6

1	4	5
3	2	6
7	8	9

Threshold = 4



Thank you!