SESSION 4

Geo Referenced Exposure Database for Natural Catastrophe Modelling (NatCat Model)

Building Block 3 : Data and Information for Social Protect

Mubushar Hussain, National Disaster Risk Management Fund (NDRMF), Islamabad

NDRMF

NatCat Model Scope

01 Riverine Floods

Major rivers, Indus, Jhelum, Chenab, Ravi, Sutlej, Kabul for return periods of 5, 10, 25, 50, 100, and 200 years.

02 Earthquake

Major seismic Zones for return periods of 95, 475, 975, and 2475 years

03 Drought

Meteorological and Hydrological droughts for Rabi and Kharif Crops under climate scenarios SSP245 and SSP585

04 Tropical Cyclone

Tropical storm up to 1000 years of return periods

05 Urban Flooding

Five major cities in Pakistan, i.e., Lahore, Peshawar, Karachi, Quetta, Islamabad with its twin city Rawalpindi

06 Flash Floods

For Nari river basin return periods, i.e., 5, 10, 25, 50, and 100 years

07 Heatwaves

For the entire country for return periods of 5, 10, 25, 50, 100, 250, and 500 years.

08 Landslides

For Chitral, Neelam, Muzaffarabad, Hunza, Hunza-Nagar, Karakoram Highway (KKH)

09 Tsunami

For Makran Subduction Zone (MSZ)

10 Storm Surge

Storm surge 25, 50, 100, 500, and 1000-year return periods along Pakistan's coast

NatCat Risk Modelling Process

Probabilistic risk modeling is global best practice in DRR, CCA and DRF

Hazard Module

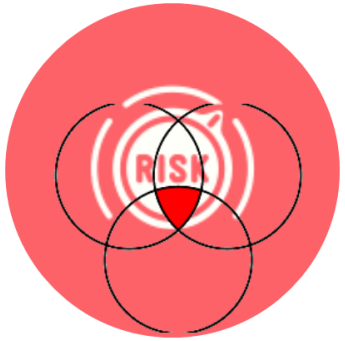
Probability or likelihood of **multiple disaster scenarios** (return period, historical disaster events), and impact with varying frequencies and severities.

Exposure Module

"value" at risk, assets, such as populations, crops, livestock, infrastructure, in areas where a disaster event of a particular return period may occur.

Vulnerability Module

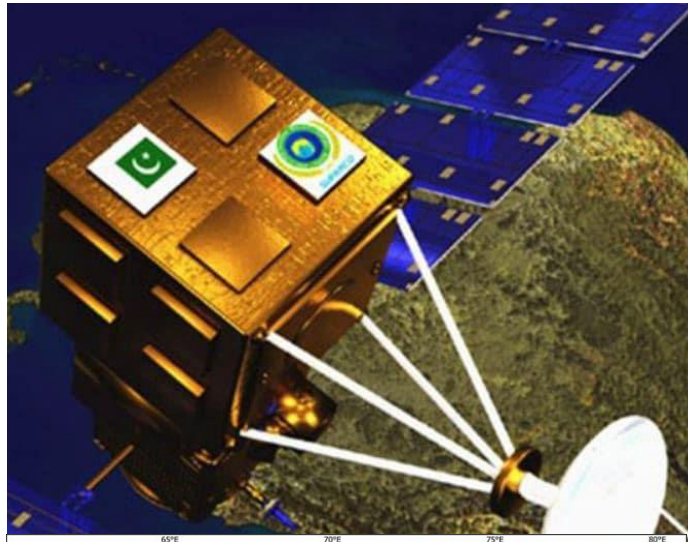
Degree (Susceptibility) to which the **exposed elements** can be affected or damaged during a disaster. Physical vulnerabilities of built-up infrastructure, and Social vulnerabilities of populations

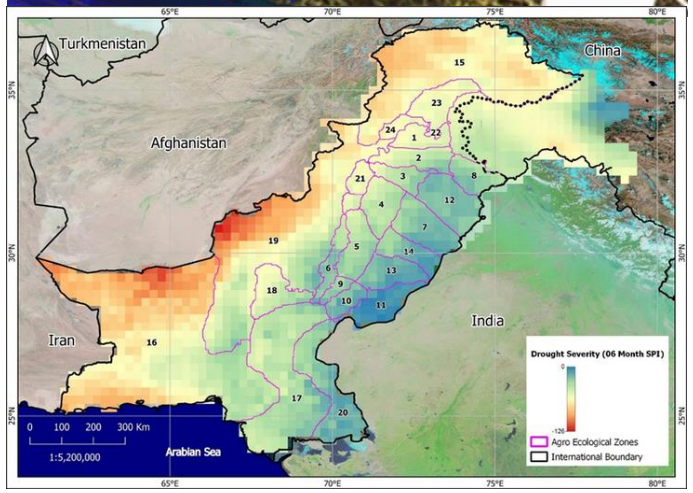


Risk & Loss Estimation

Risk(x,y) = Hazard(x,y) × Exposure(x,y) × Vulnerability(x,y)
, and Probabilities of loss (e.g., 1-in-100-year events, annual expected monetary loss)

Development of The NatCat Geo-database





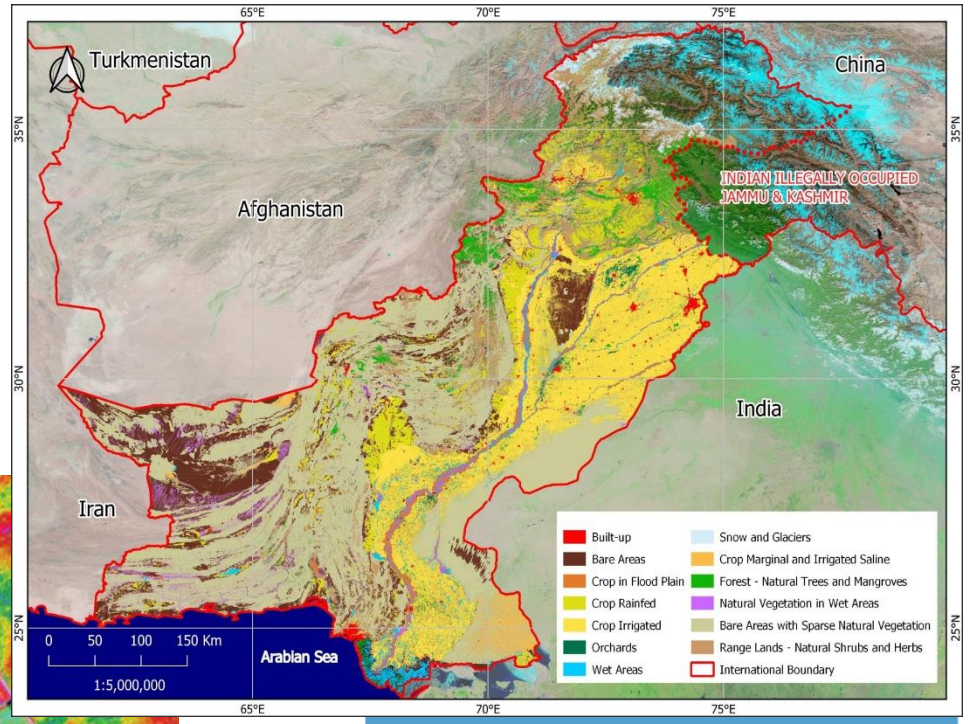
01 Multi / High-resolution Satellite Imagery

- High-Resolution SPOT Imagery (1.5m)
- Sentinel-2 Imagery (10m)
- WorldDEM DSM (12m)
- SRTM DEM (30m)

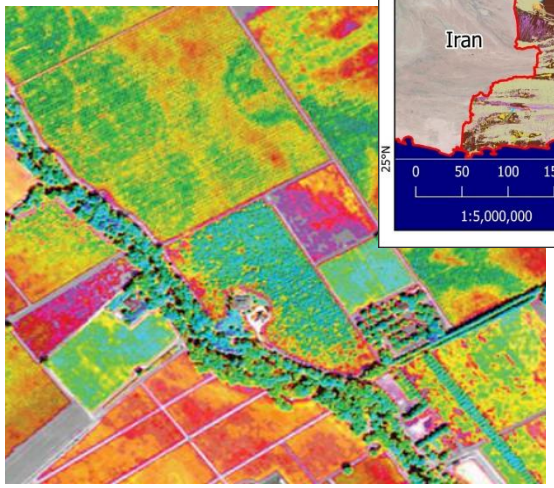
02 Derived and Secondary Data Sets

- Census, building typology
- Major crops, roads, and livestock.
- Educational institutions, health facilities
- Databases: PBS, PARC, PMD, BISP, NHA, IRSA, PIDs, PCRWR

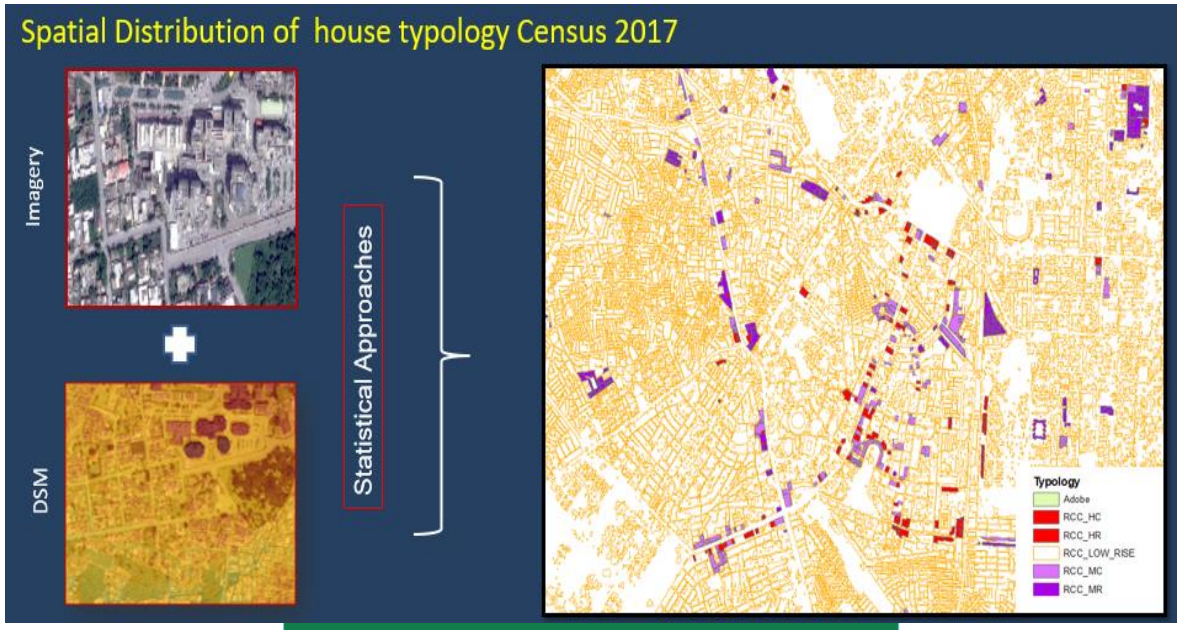
High-resolution Imagery



LAND USE LAND COVER

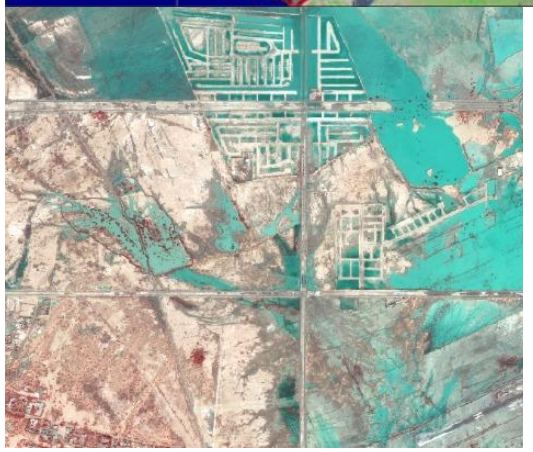


SPECTRAL IMAGERY CROPS

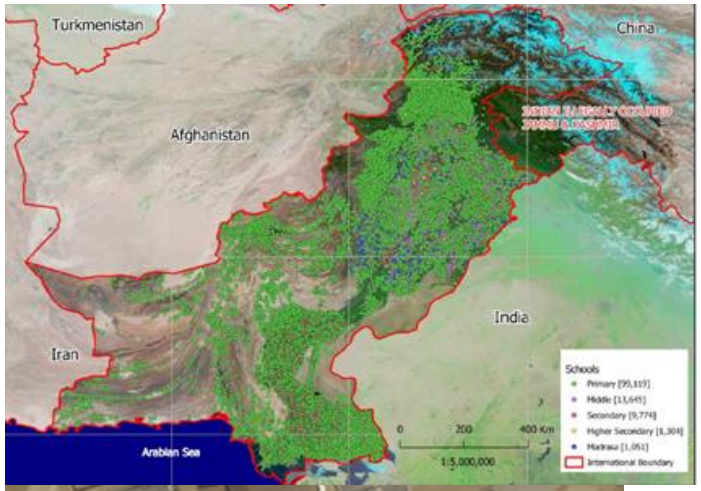


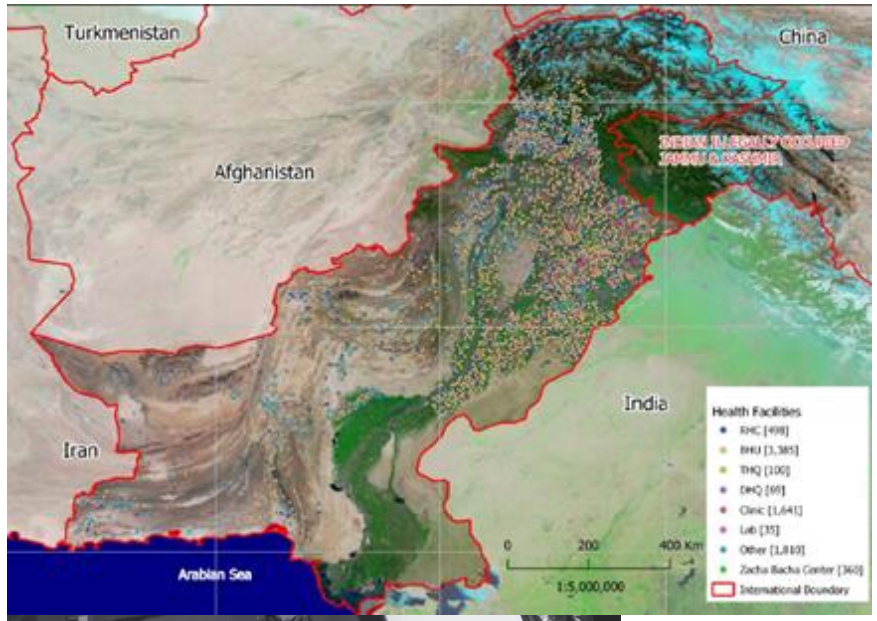
BUILDING TYPOLOGIES

Multi-sectoral Geo-database



ROAD INFRASTRUCTURE





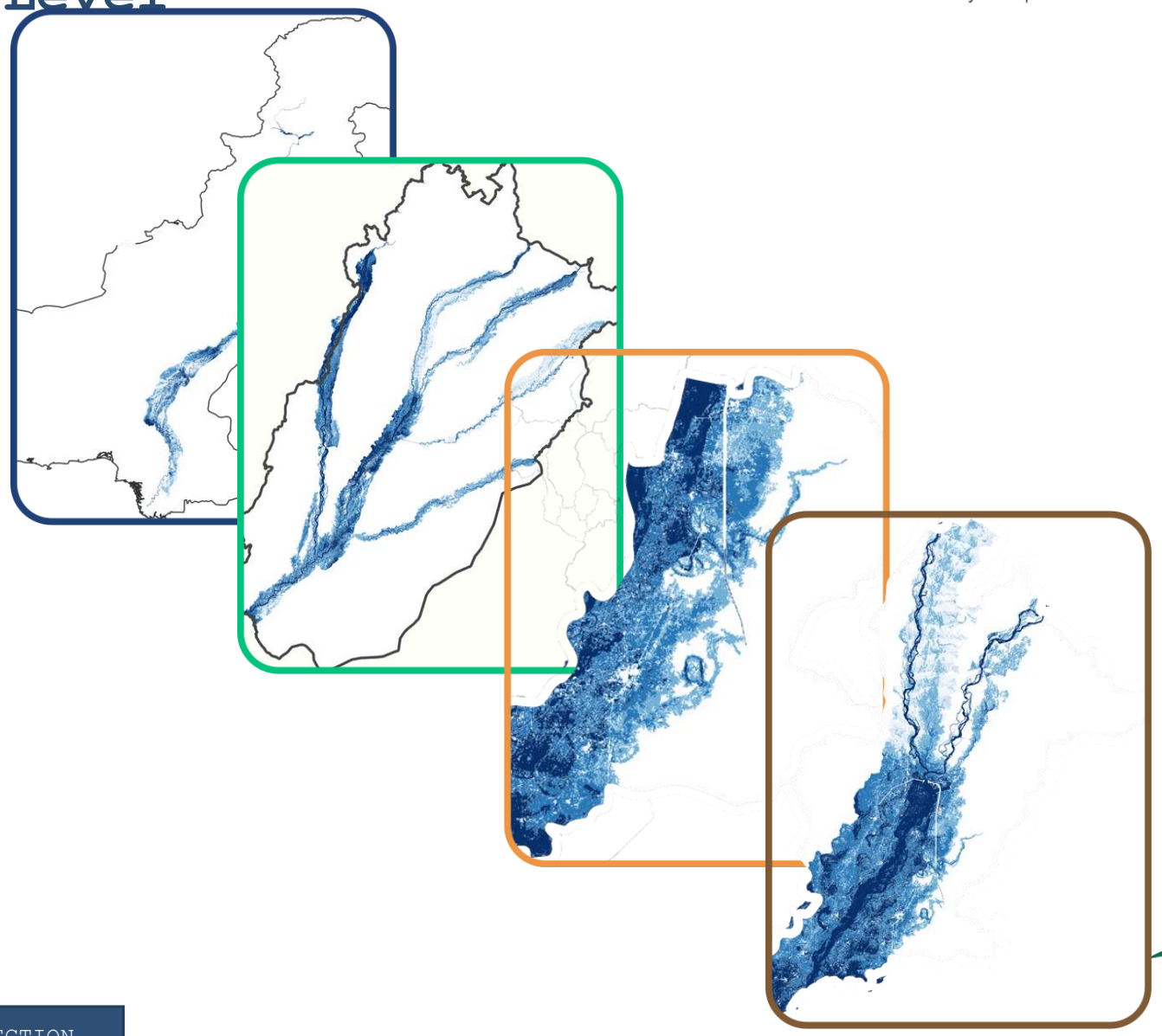
Layer Approach
Tehsil / Sub-district Level

NATIONAL LEVEL

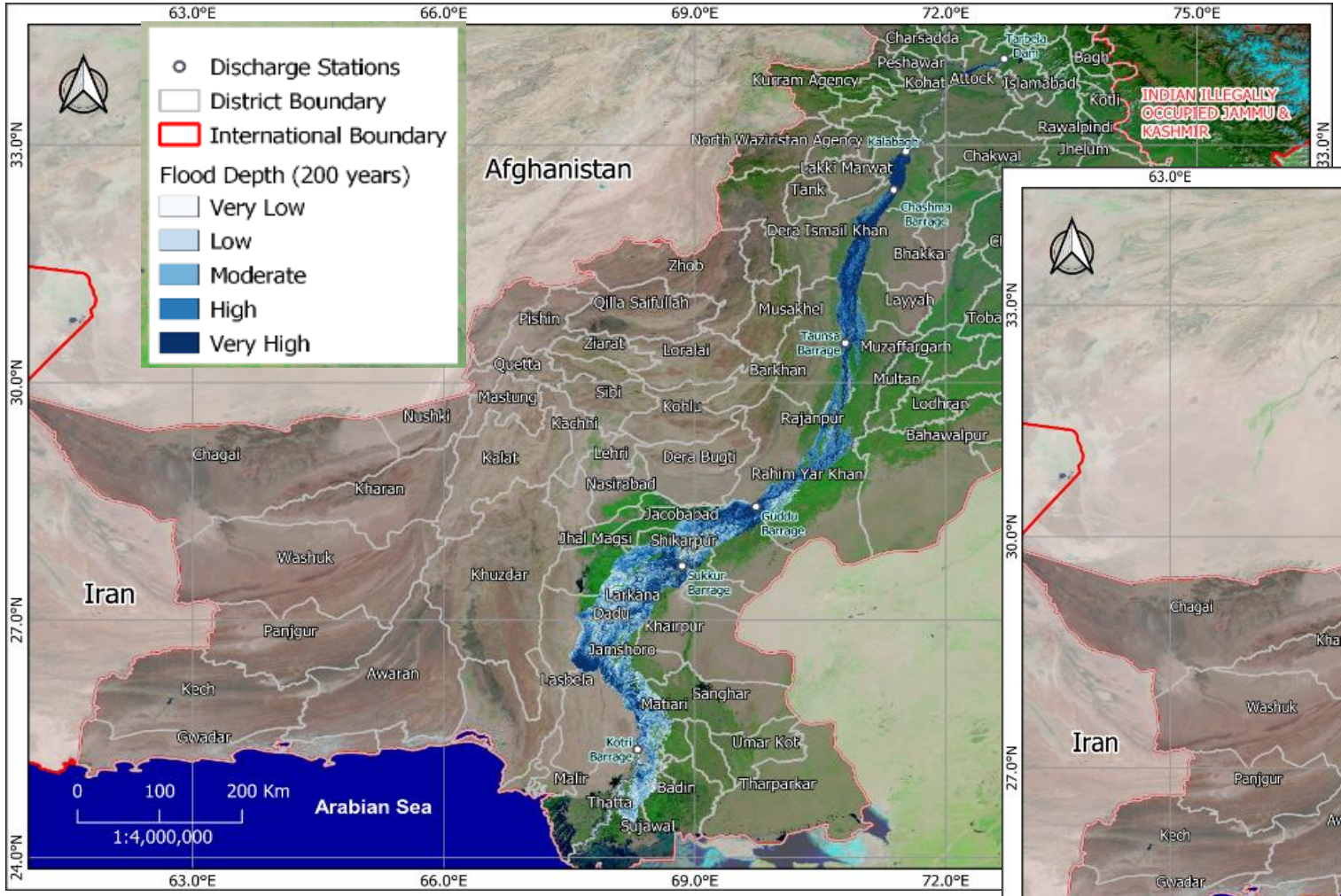
PROVINCIAL LEVEL

DISTRICT LEVEL

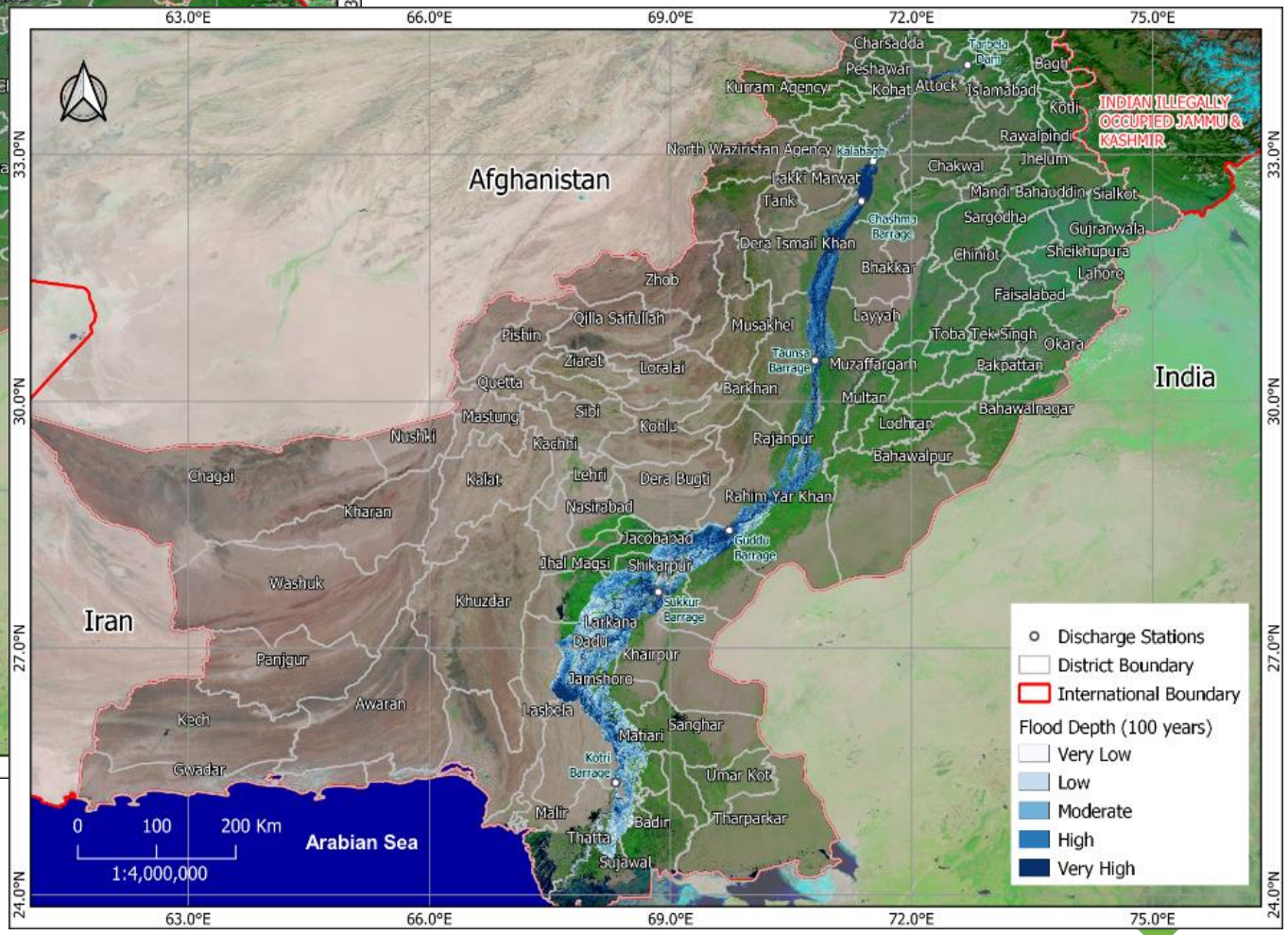
SUB-DISTRICT / TEHSIL LEVEL



Flood Hazard Modeling

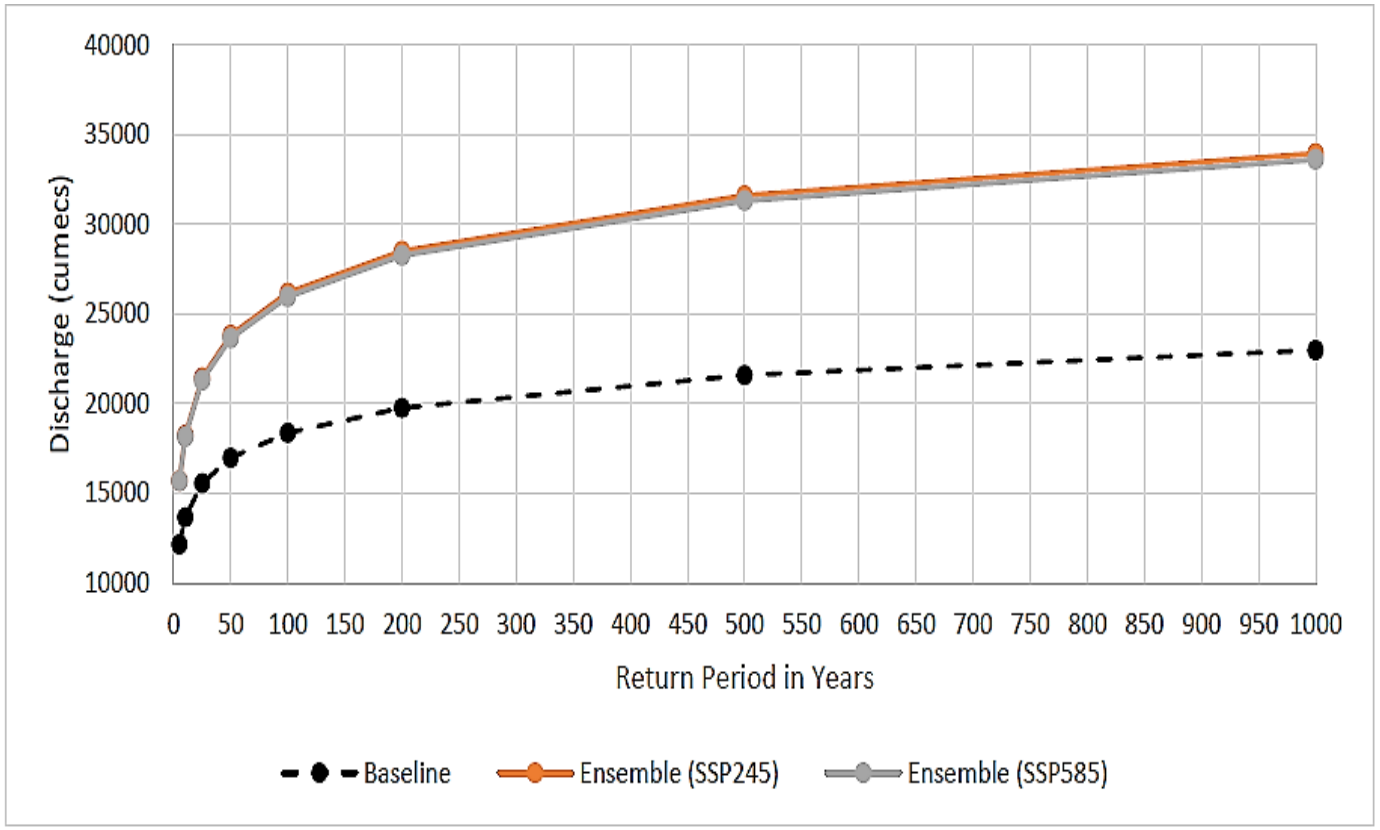


Flood Depth Map (200 years return period) - Indus River



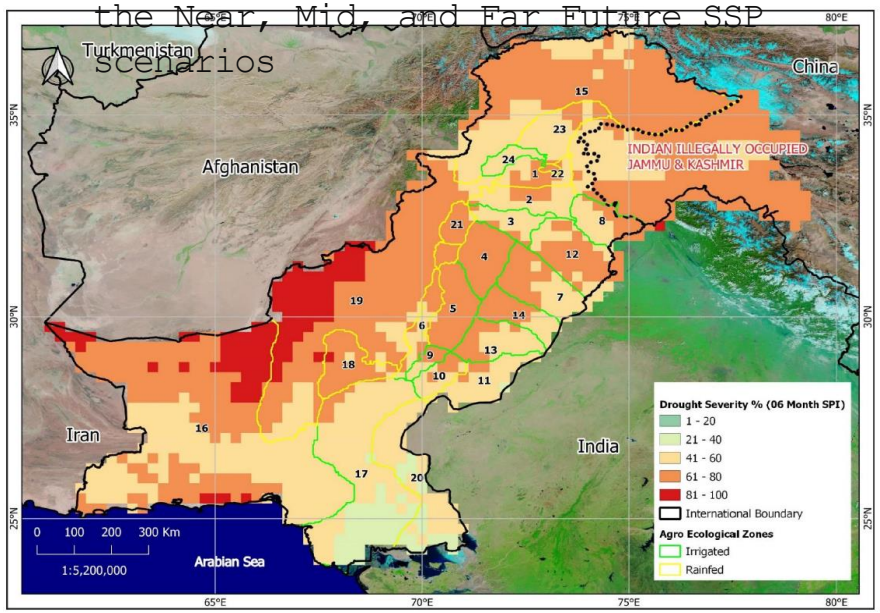
Flood Depth Map (100 years return period) - Indus River

Data and Information for Social Protection



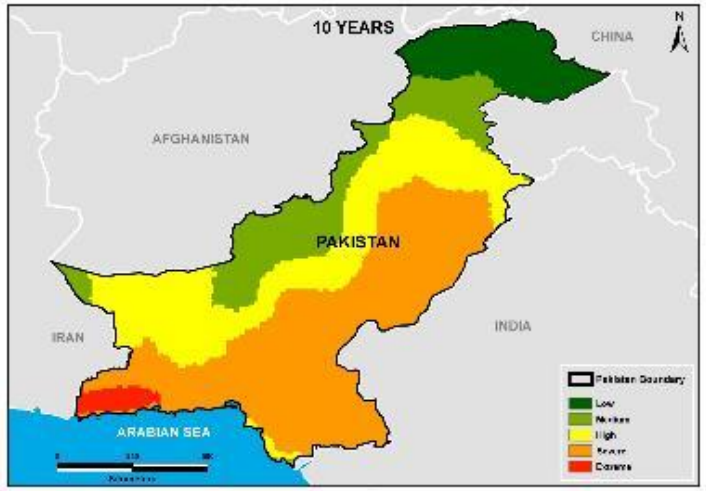
Return Periods under Climate Change (2011-2040) - Indus River

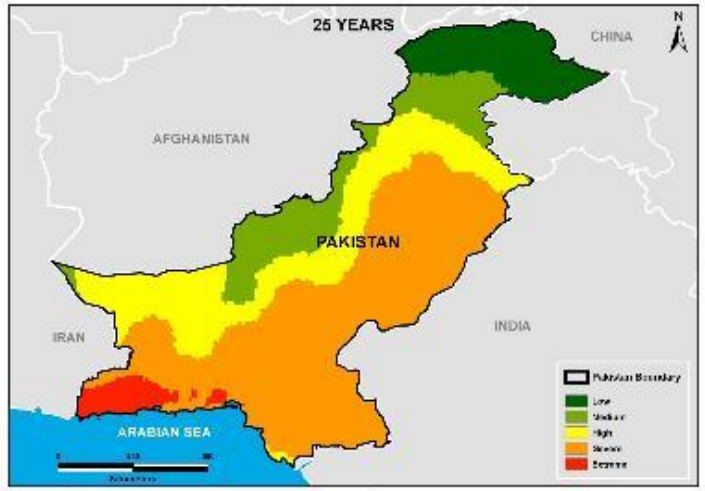
- Hazard modeling under the prevailing climate change scenarios SSP245 (Low-emissions) and SSP585 (High-emissions)
- Flood return periods under the SSP climate change scenarios for the near (2011-2040), mid (2041-2070), and far future (2071-2100) periods.
- Drought's Severity and Dry events occurrence (%) based on 6 Months SPI for the Near, Mid, and Far Future SSP scenarios

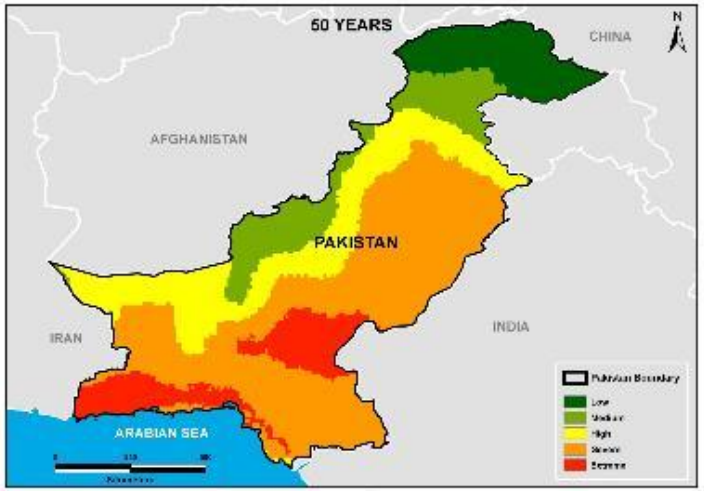


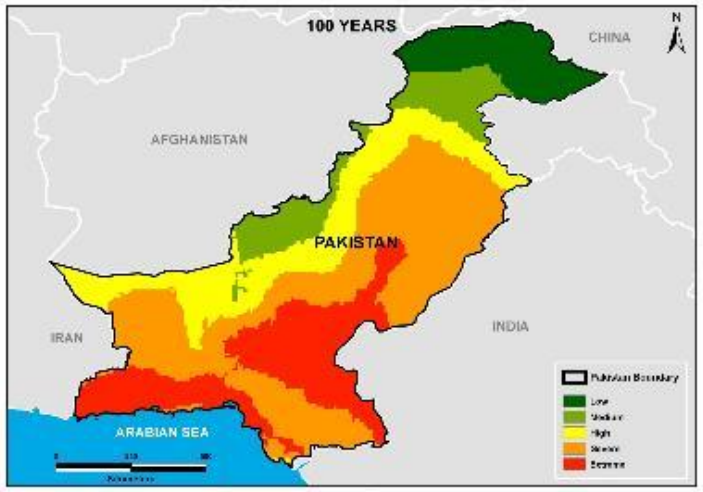
NDRMF

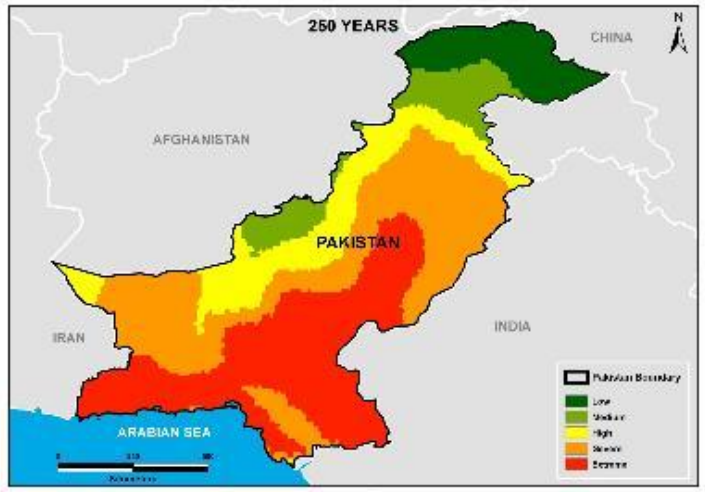
Heatwave Hazard Maps For Return Periods





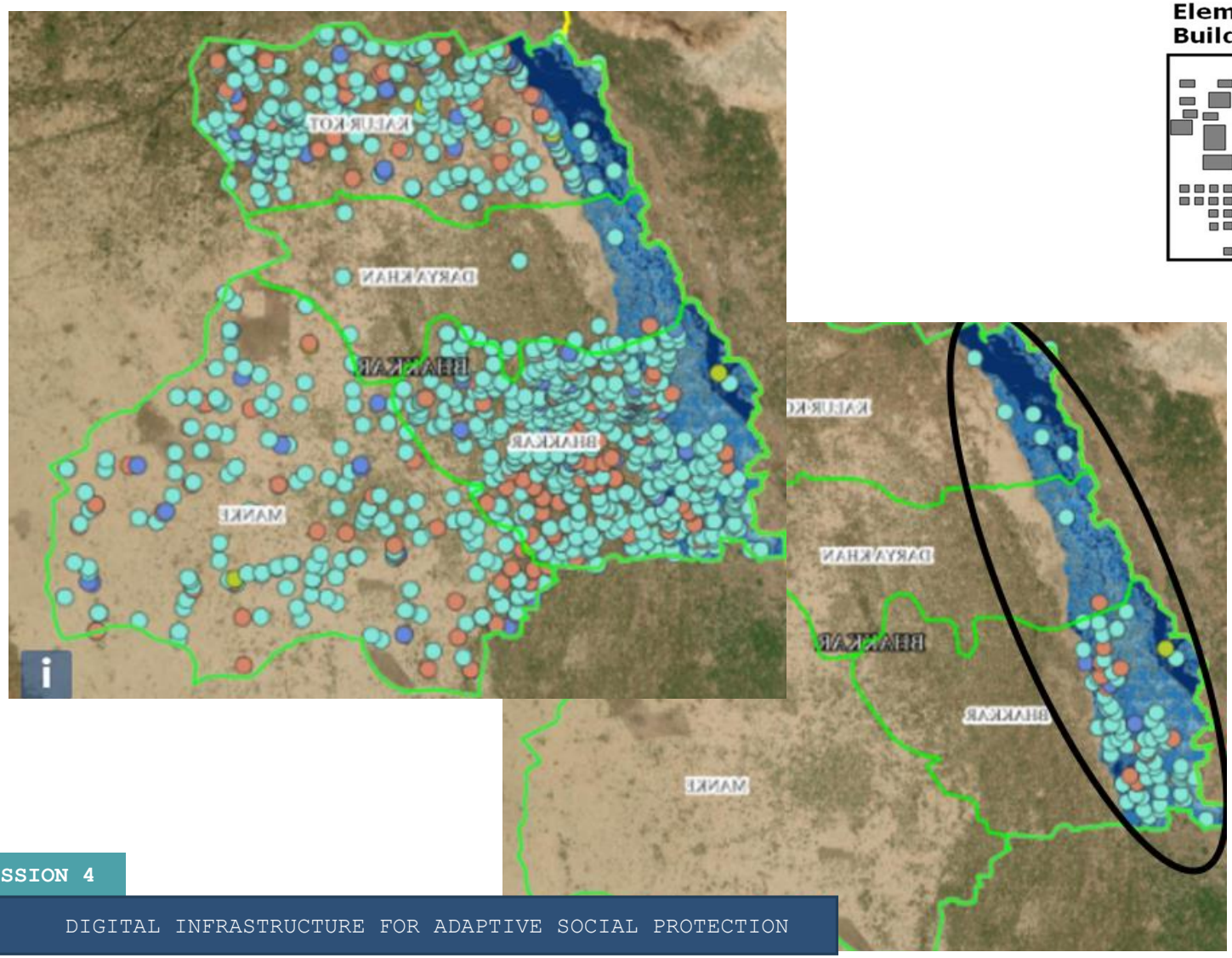


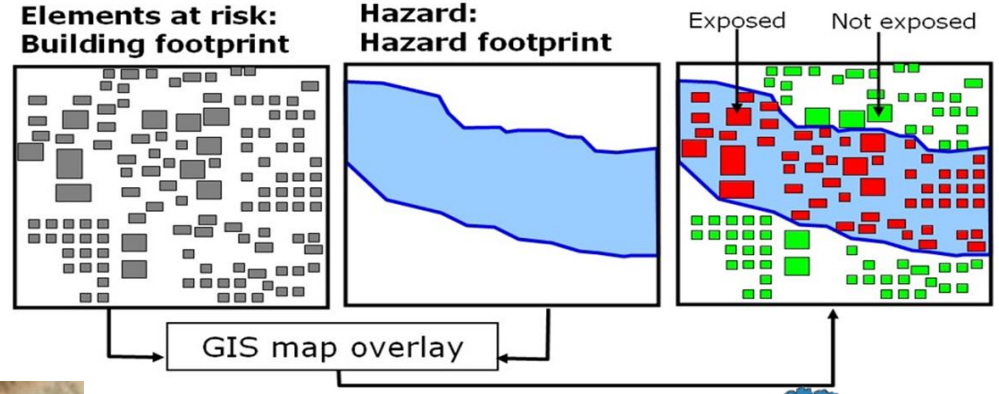


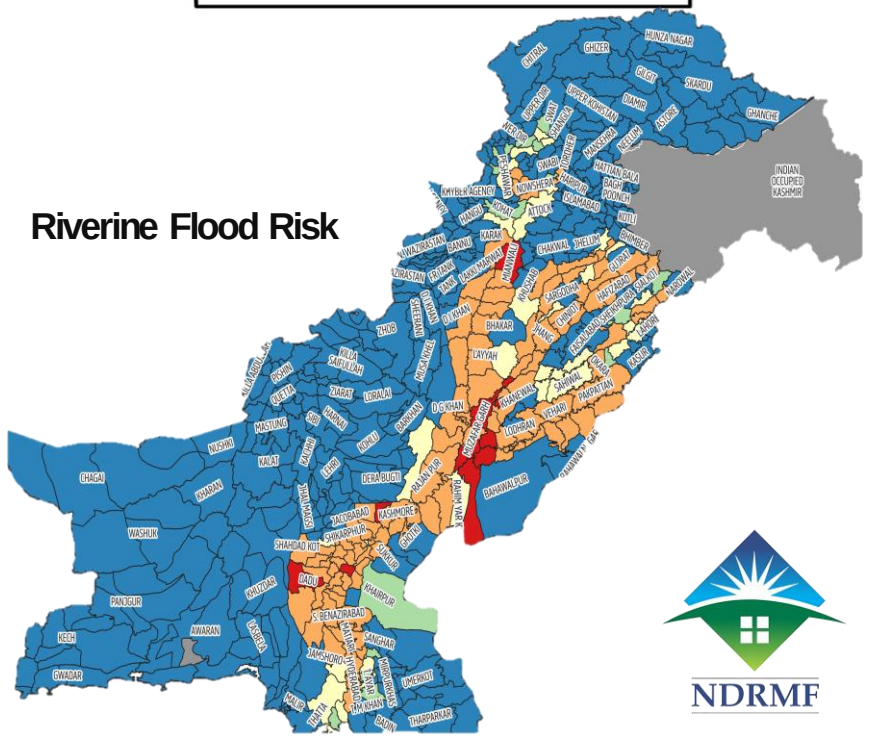


Exposure Mapping

Assets at risk that are exposed to a certain hazard of a return period

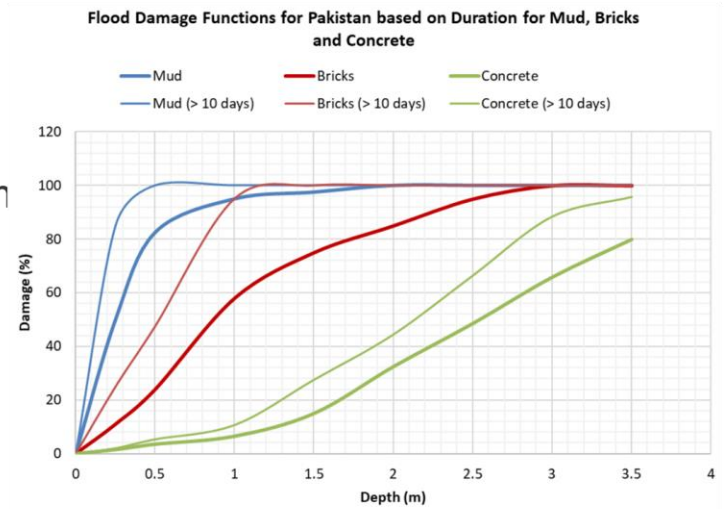


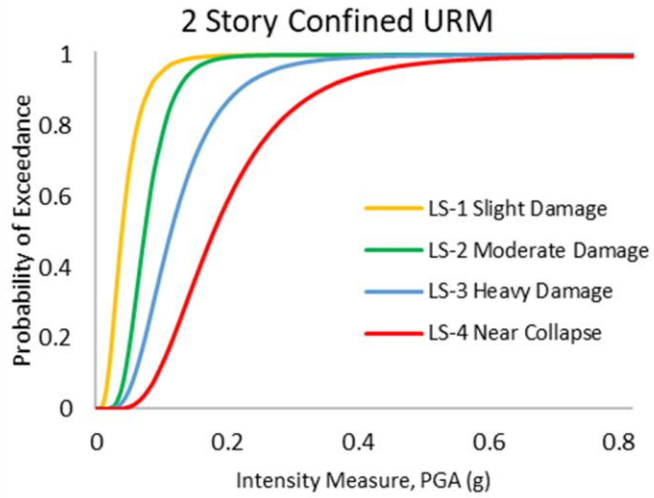


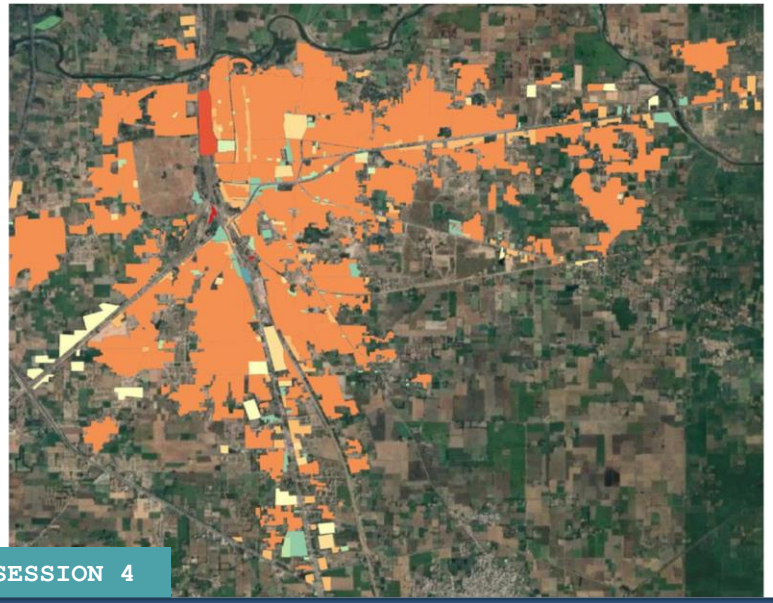


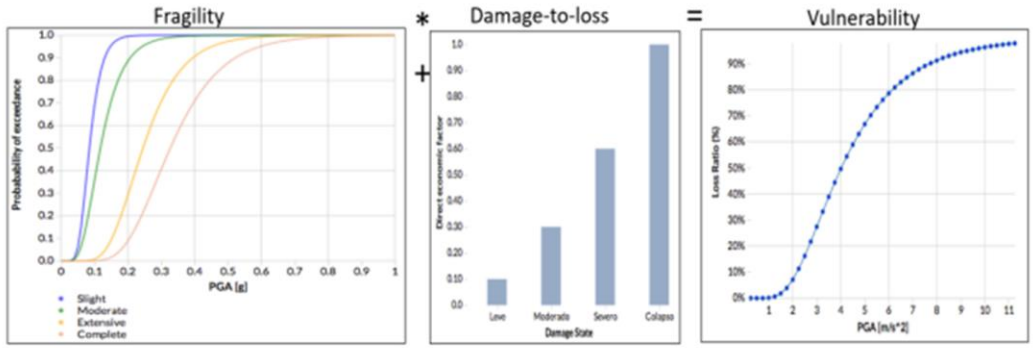
Physical Vulnerability

Probability of reaching or exceeding various levels of damage to a structure, given certain levels of intensity measures such as, Flood Depth, Peak Ground Acceleration (PGA)









Damage Grade	BU-KOERI (2003)	HAZUS (1999)	Bramerini et al. (1995)	ATC 13 (1987)	Tyagunov et al. (2006)
D1	0.05	0.02	0.01	0.05	0.05
D2	0.2	0.1	0.1	0.2	0.1
D3	0.5	0.5	0.35	0.55	0.4
D4	0.8	1	0.75	0.9	0.8
D5	1	1	1	1	1

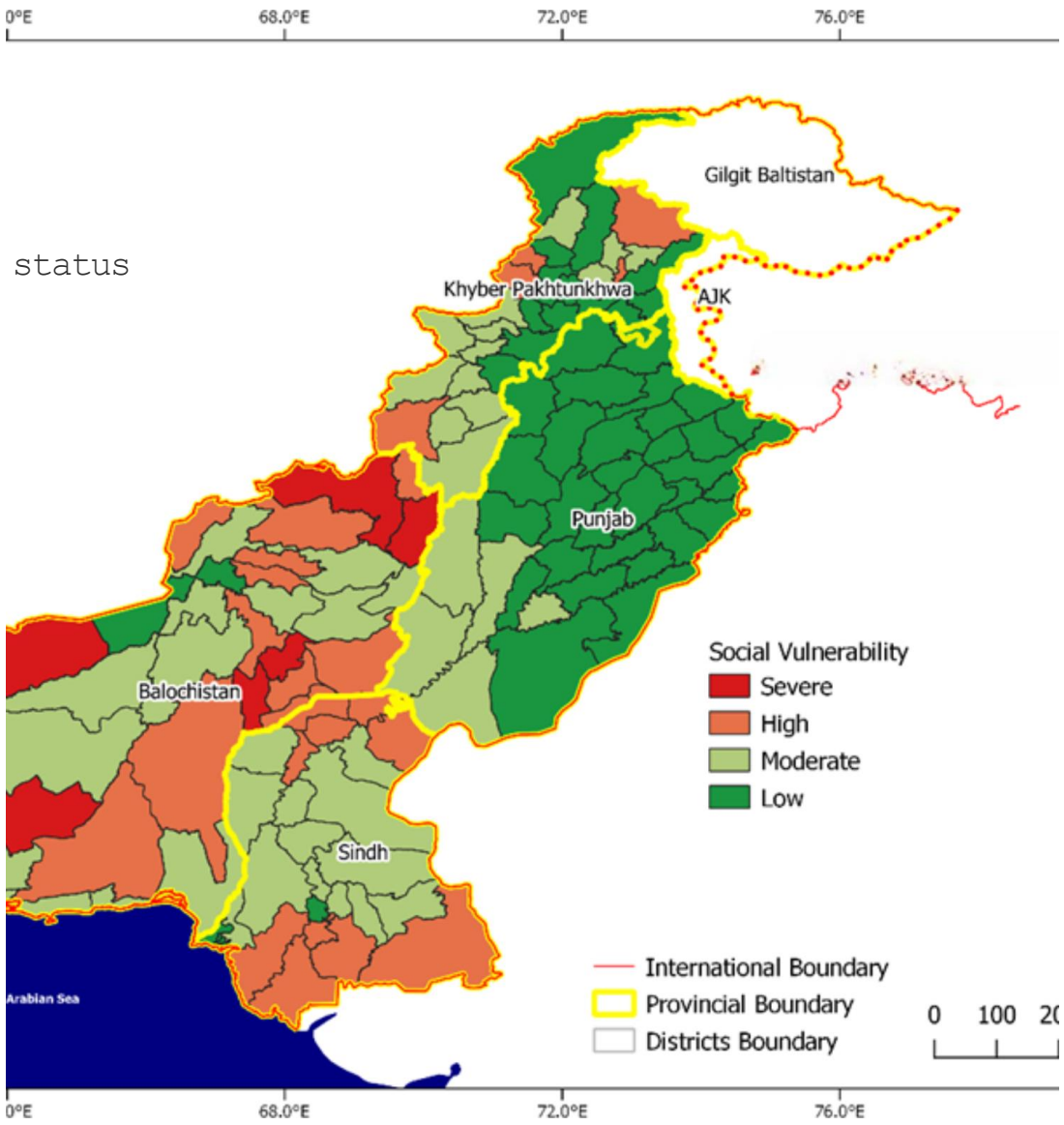
Losses due to damaged buildings are usually expressed in terms of "Mean Damage Ratio (MDR)" defined as the cost of repairing the structure divided by replacement cost.

MDR = (Repair Cost) / (Replacement Value)

Social Vulnerability

The index identifies vulnerable populations and areas likely to suffer disproportionately during and after disasters, guiding targeted interventions and resource allocation. Age, Health, Education & Socio-economic status

- Rural Farm Population
- Information Access
- Children with Disabilities
- Social Benefits
- Infant Safety
- Poverty
- Preventative Health Measures



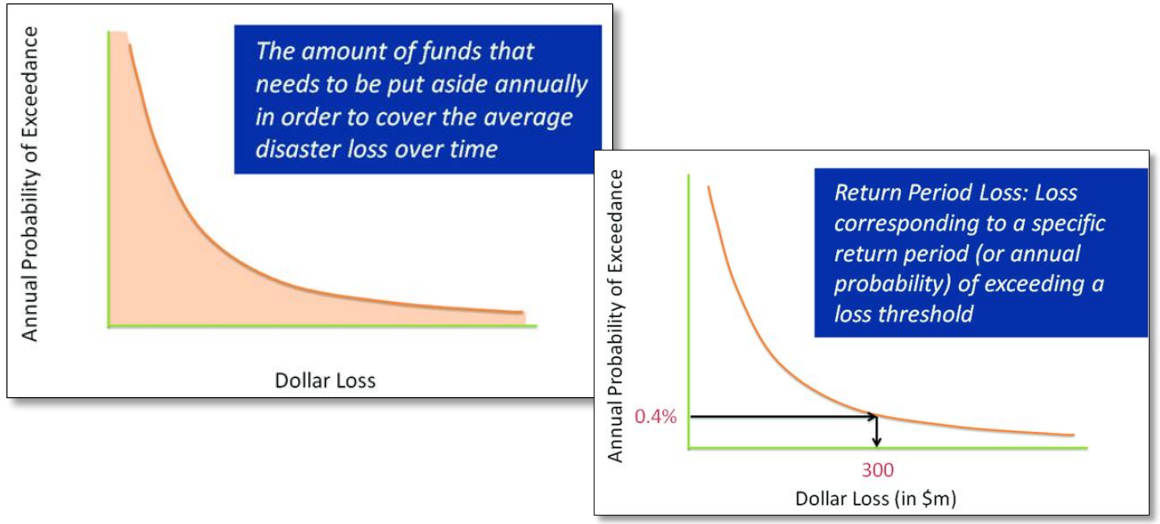
NDRMF

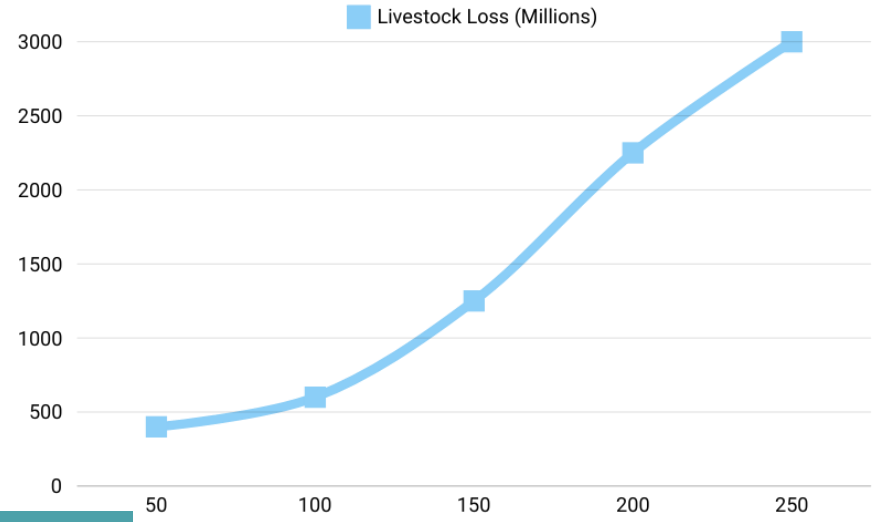
Financial Loss Probability Distributions

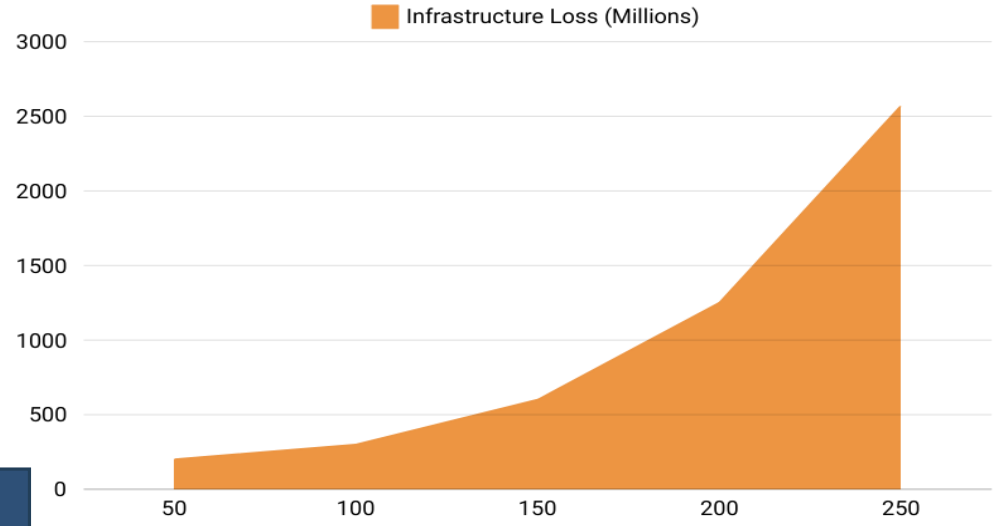
Average Annual Loss

Expected loss per year averaged over a long period and is calculated considering all modeled events and their probabilities.

Exceedance Probability

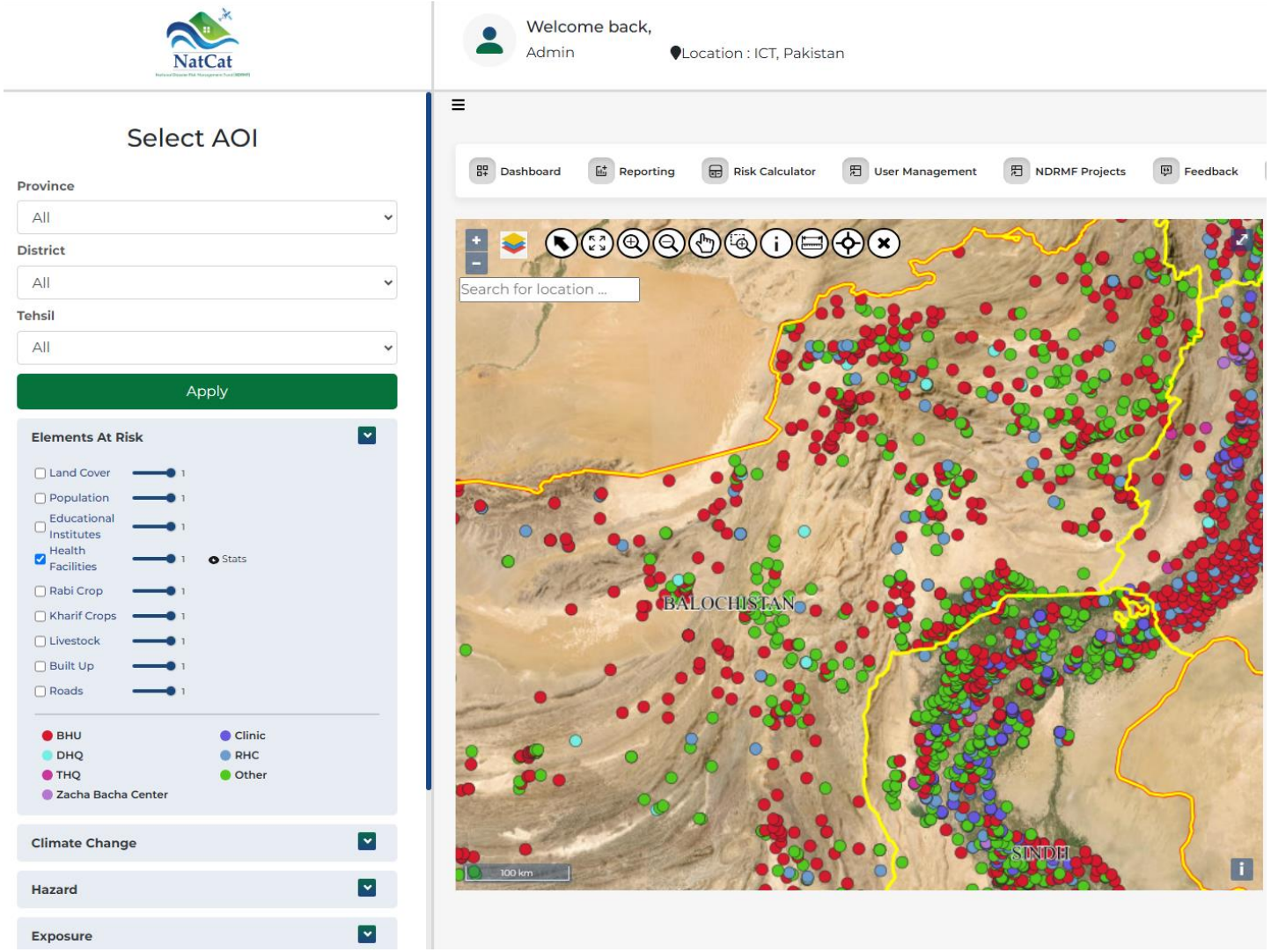






NDRMF

Risk Calculator



Web-based platform designed for end-users to transform geospatial data visualization, analysis, and reporting.

NatCat
National Disaster Risk Management Fund (NDRMF)

Username*
ndrmf

Password*
••••••••••

Login

Don't have access of portal yet? Register Now

NDRMF

National Disaster Risk Management Fund

Thank You

MAKING PAKISTAN RESILIENT

www.ndrmf.pk