



International Water
Management Institute

Earth Observation for flood and drought monitoring

Online workshop on the Space Technology Applications for Drought, Flood
and Water Resource Management organized by UNOOSA and Islamic
Republic of Iran

09 August 2021

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Research Group Leader: Water Risks
to Development and Resilience



RESEARCH PROGRAM ON
Climate Change,
Agriculture and
Food Security



Research
Program on
Water, Land and
Ecosystems



IWMI's strategy

WATER CHALLENGES



Food

- Improve Food Security
- Conserve Ecosystems & Water Resources



Climate

- Adapt to & Mitigate Climate Change
- Build Resilience to Societal Disruption



Growth

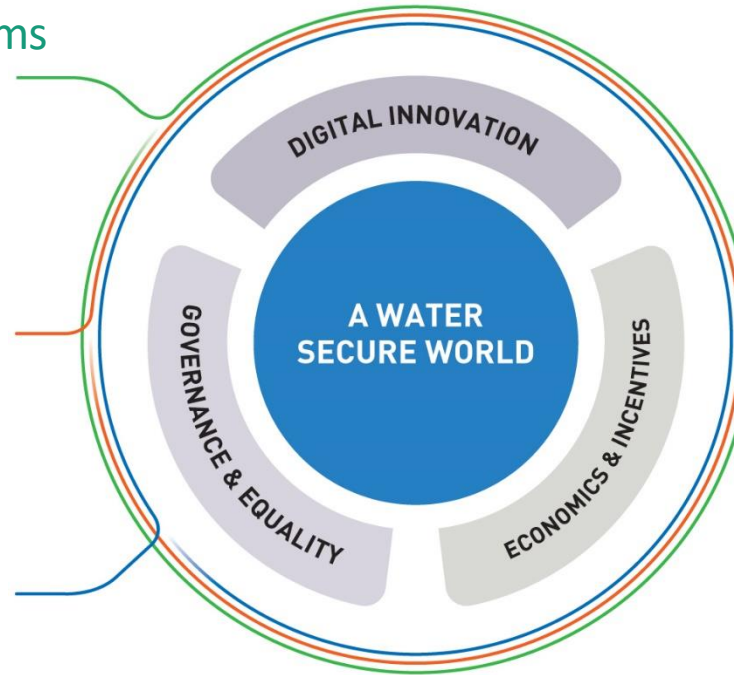
- Promote Sustainable Growth
- Achieve Gender Equality & Inclusive Societies

IWMI'S STRATEGIC PROGRAMS

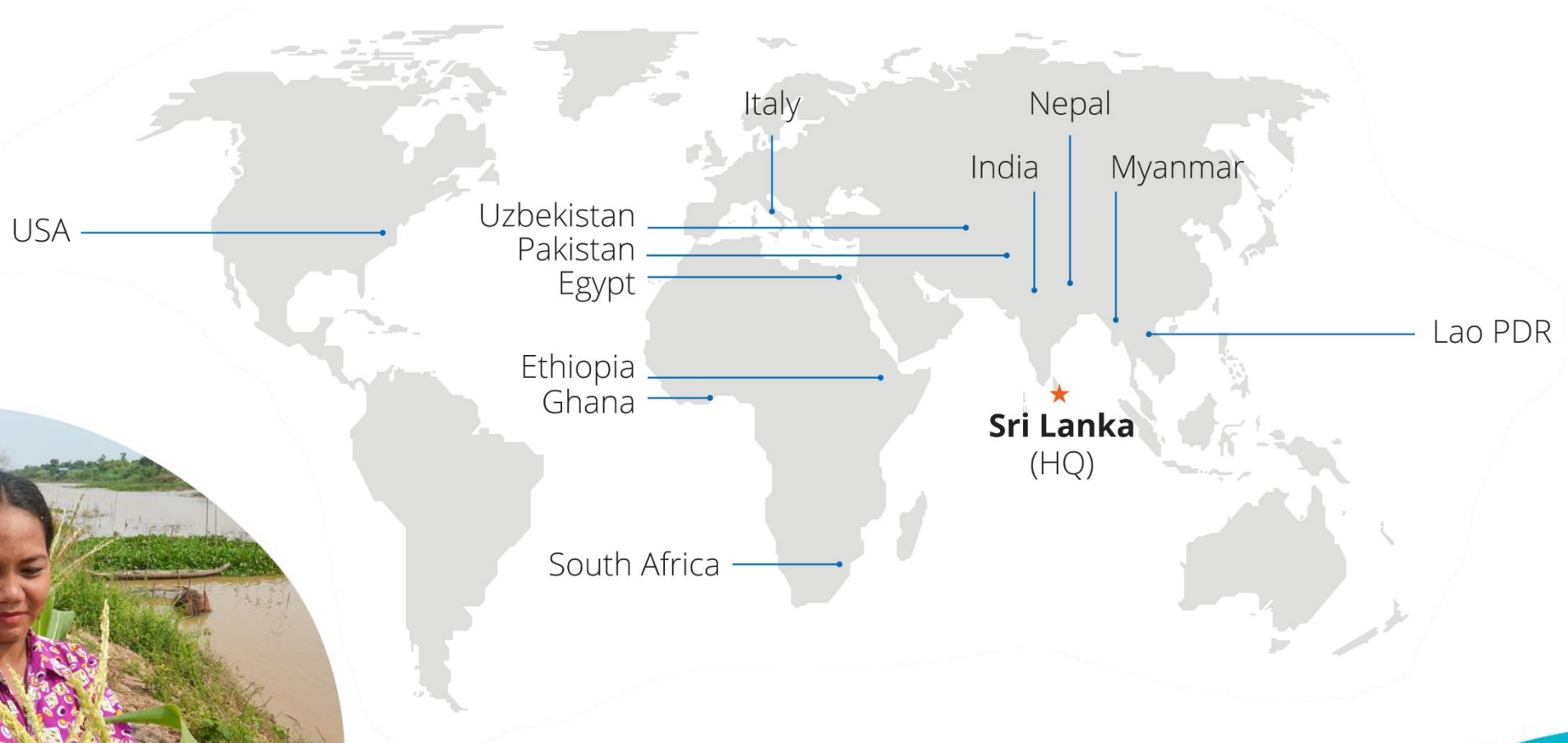
Water, food & ecosystems

Water, climate change & resilience

Water, growth & inclusion



IWMI offices



IWMI's ongoing efforts in Water Risk Program

01

Monitoring and Risk Assessment

Floods monitoring using remote sensing data and climate hazard mapping

02

Forecast and Early Warning

Regional flood forecast using hydrological and hydraulic models for alert and flood forecast based financing system (FBFS)

03

Flood and Drought Management

Climate bulletin to advise stakeholders to develop contingency plans to mitigate flood and drought risks

04

Rapid Response Mapping

Emergency maps to support NDMOs to support relief and rescue operations

05

Index Based Flood Insurance | BICSA

Flood parameters (depth, duration) from computer models and satellite data to design insurance payout for flood affected farmers in SA

06

Advisory services

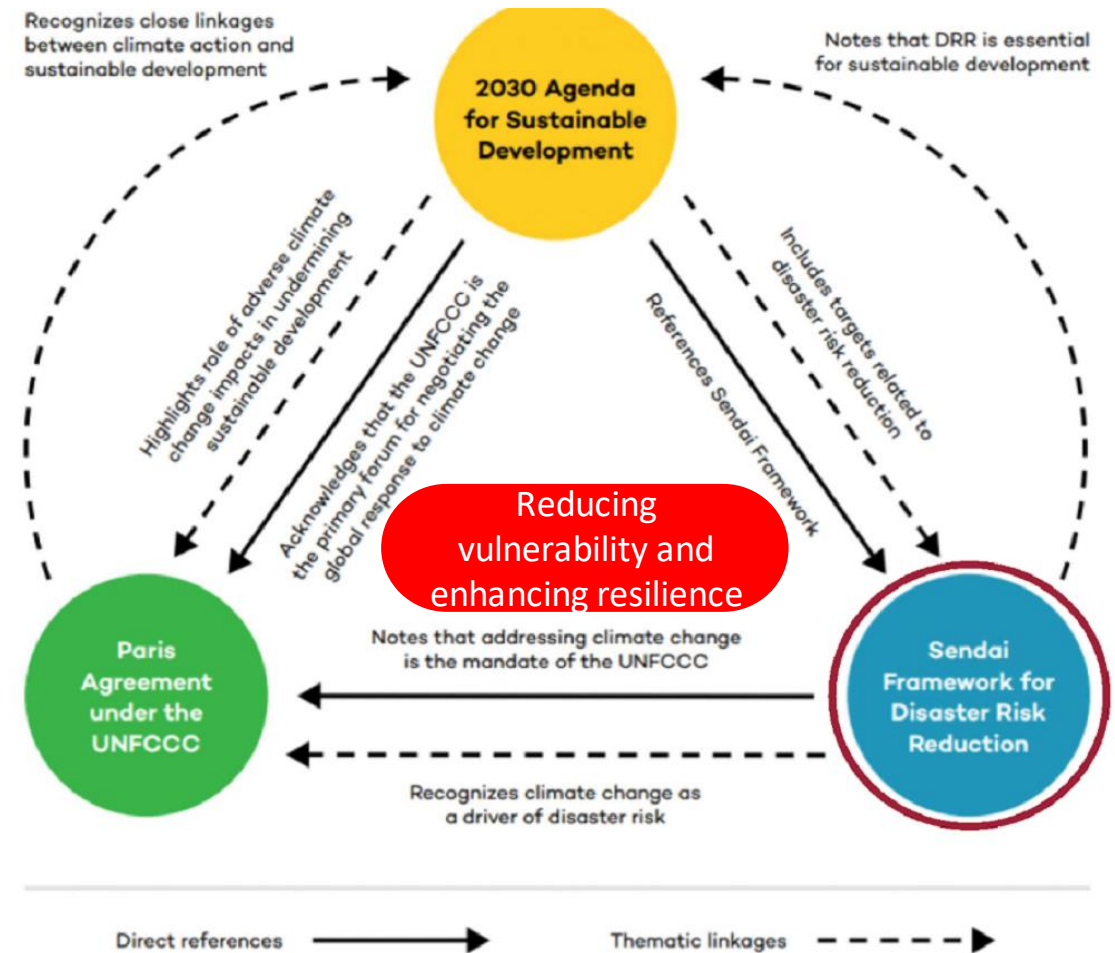
Provide timely weather forecast and agronomic practices to enhance agriculture resilience to smallholder farmers



Presentation outline

- Monitoring and early warning of floods and drought
- Understanding risk and investing in resilience
- Water risk knowledge products and tools

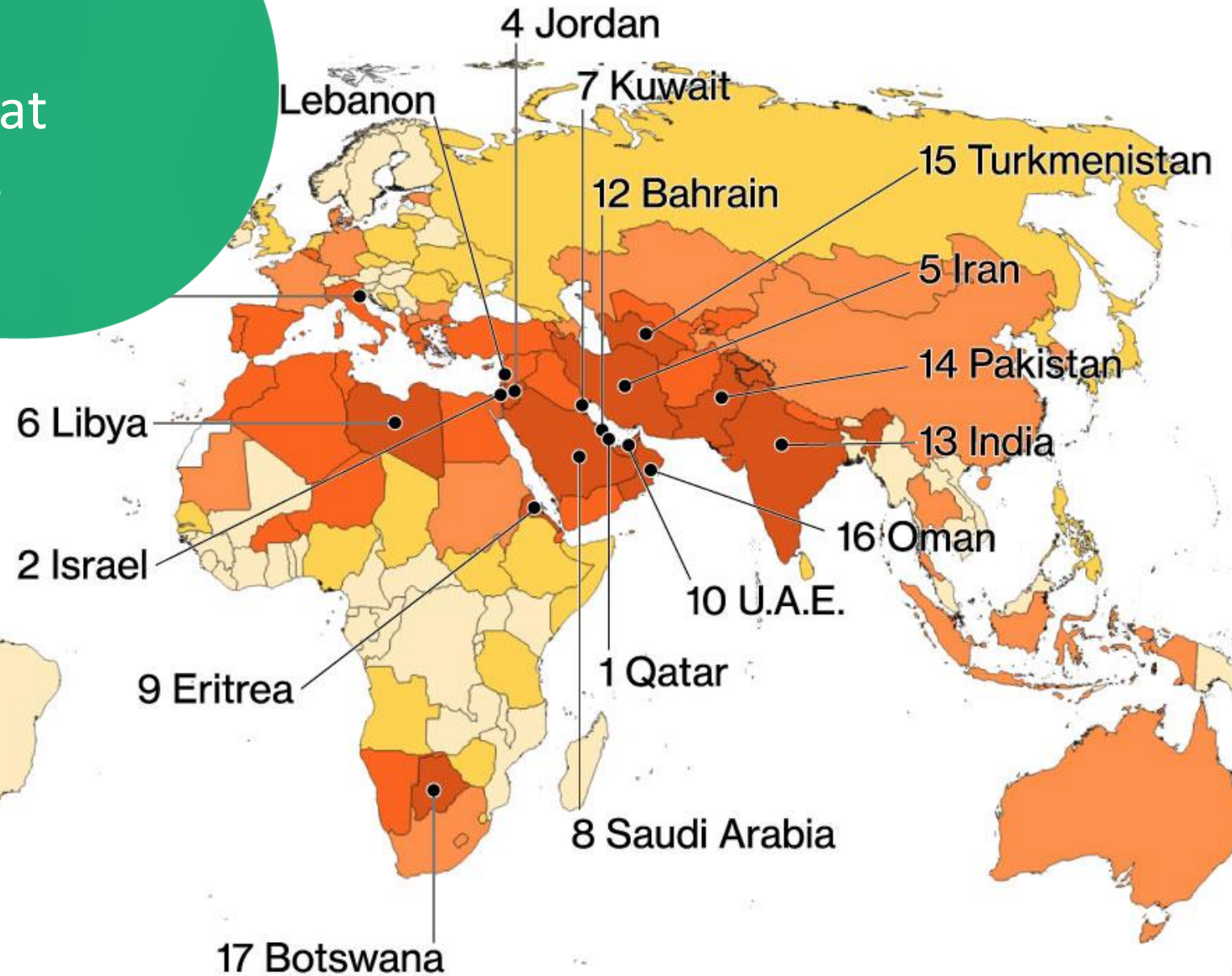
Integrating adaptation into sustainable development and Sendai framework for Disaster Risk Reduction



Source: UNDRR

Water Crisis

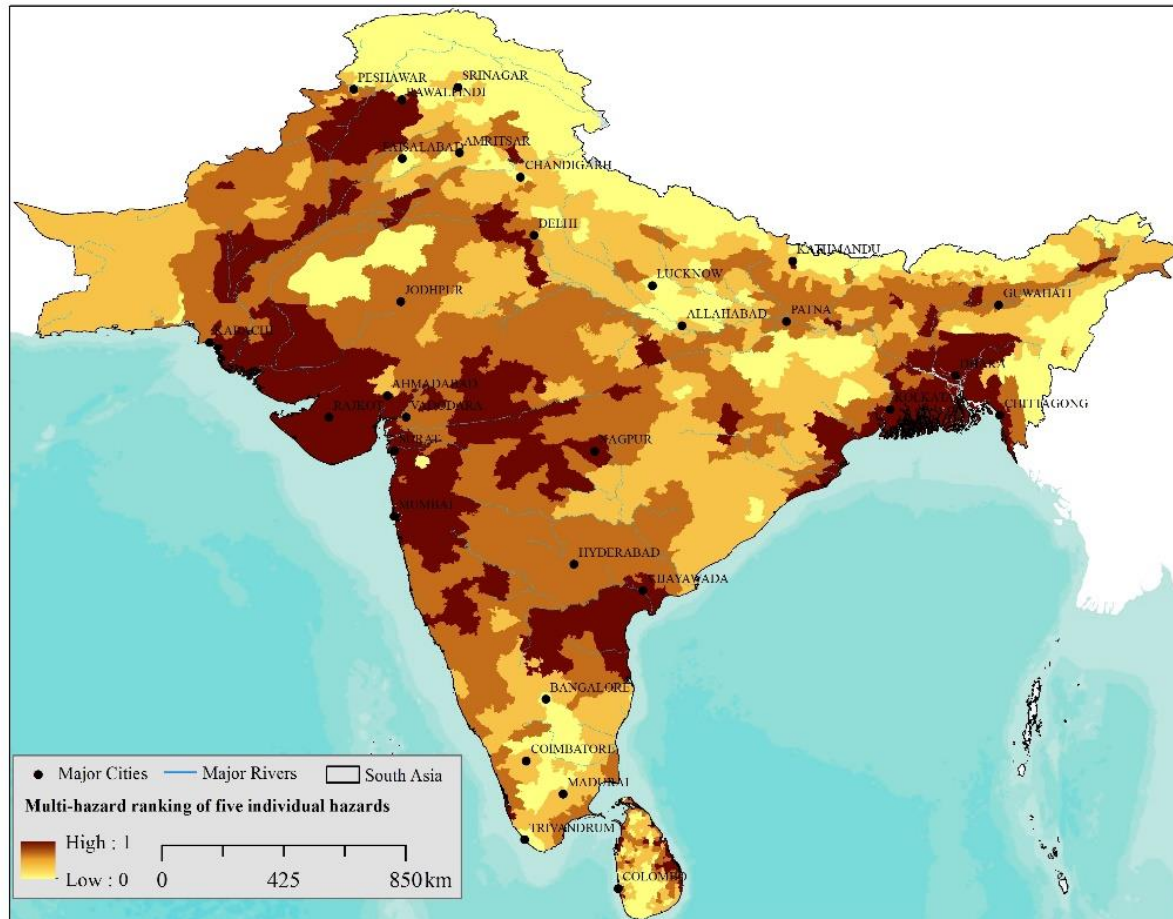
Countries Are the Most at Risk From a Water Crisis



India, which is ranked 13th on the list of countries with extremely high water risk, has more than three times the population of the other 16 countries in this category combined.

Identifying vulnerability hot spots for climate change

Some areas will be more affected than others.
IWMI design locally relevant adaptation measures



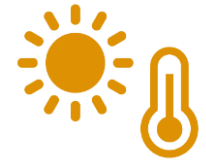
Drought
70% land



Floods
12% land



Cyclones
8% Land



Extreme heat
Widespread



Salinity
Coastal
ingression



Climate change
Very
vulnerable

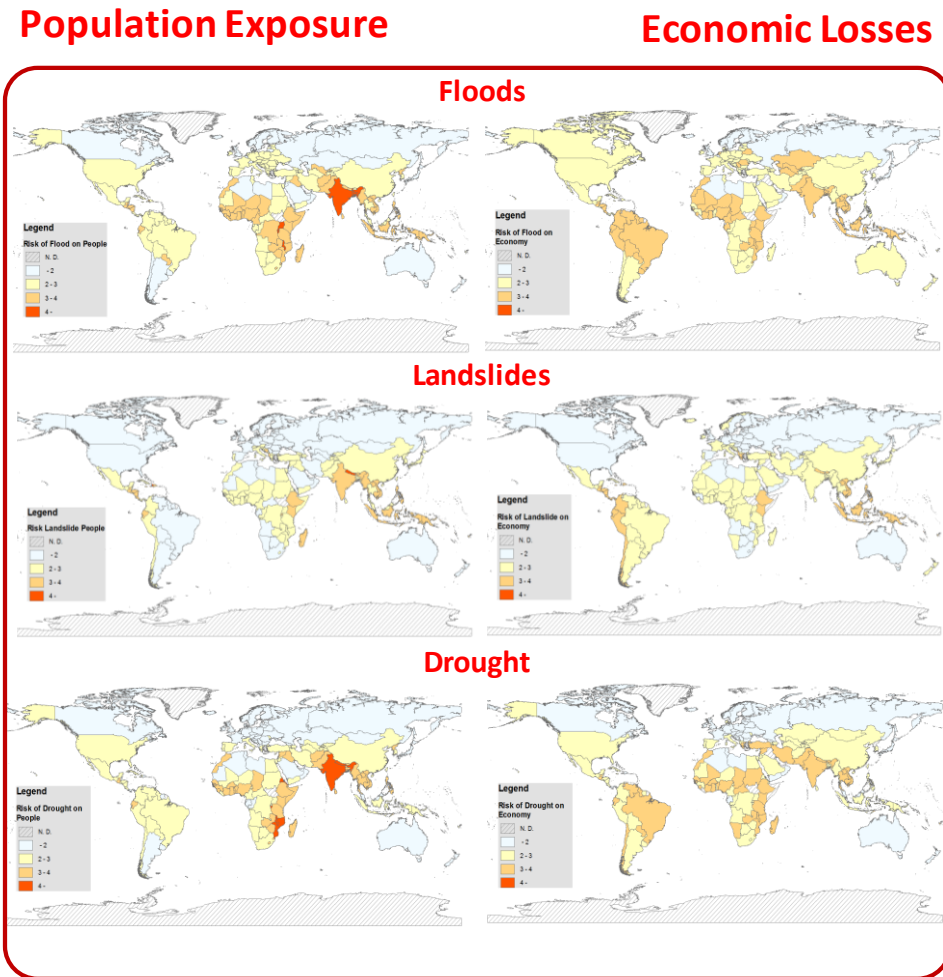
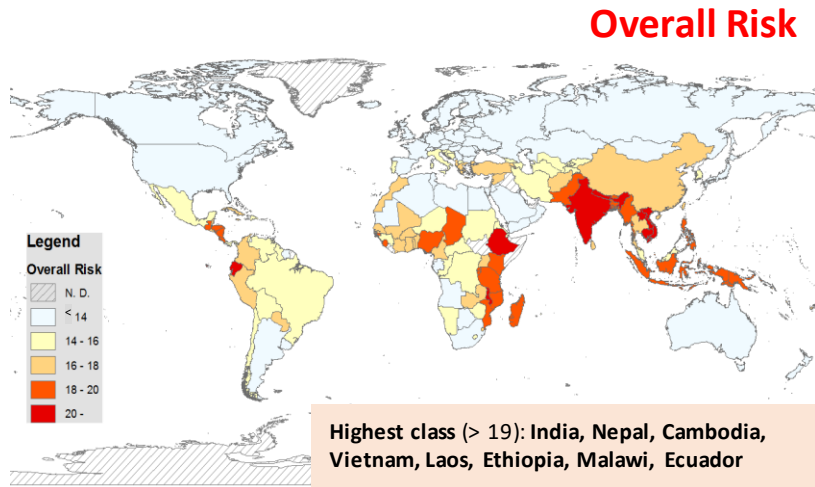


Food security and poverty
key issues



Main Users: World Bank, ADB, CG Centres and academics

Mapping global water-related disaster risk



Publicly available data sources

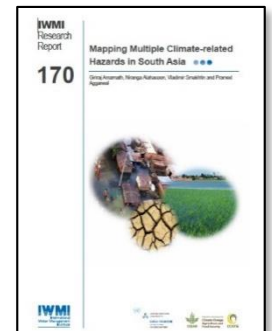
Global Risk Data Platform (UNEP)

Socioeconomic Data and Applications Center (SEDAC)

Human Development Report (UNDP)

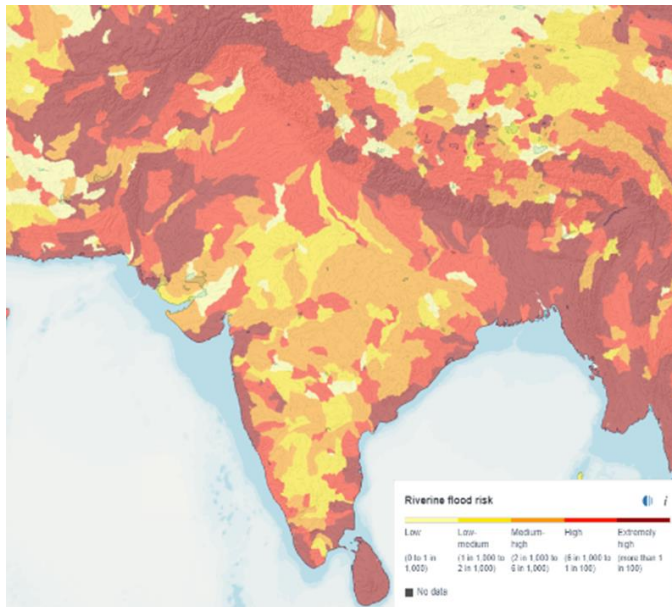
Amarnath G, Yoshimoto S, Goto K, Fujihara M, Smakhtin V, Aggarwal P, Ravan S. 2016. Global trends in water-related disasters using publicly available database for hazard and risk assessment, Congress of JRC SA 2016, held in Kyoto, Japan.

Amarnath, G.; Alahacoon, N.; Smakhtin, V.; Aggarwal, P. 2017. Mapping multiple climate-related hazards in South Asia. IWMI Research Report 170, 41p. doi: 10.5337/2017.207



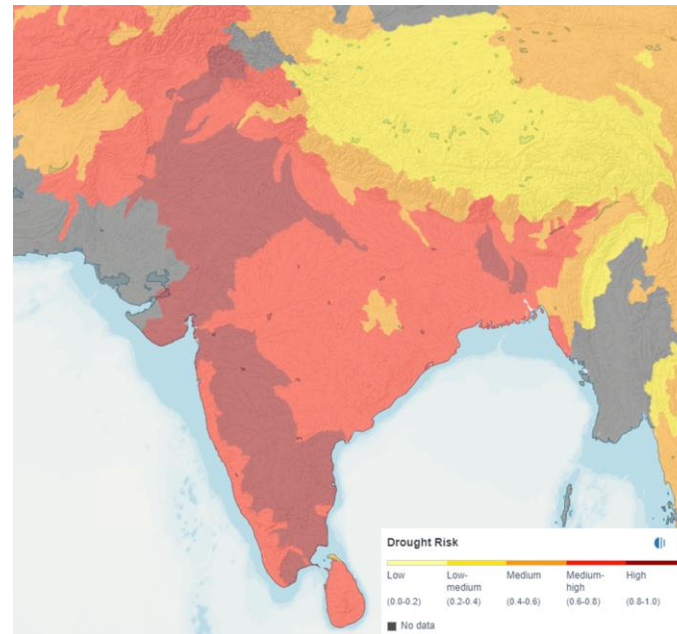
Future Climate Risk to strengthen CCA and DRR

Riverine flood risk



Higher values indicate that a greater proportion of the population is expected to be impacted by Riverine floods on average.

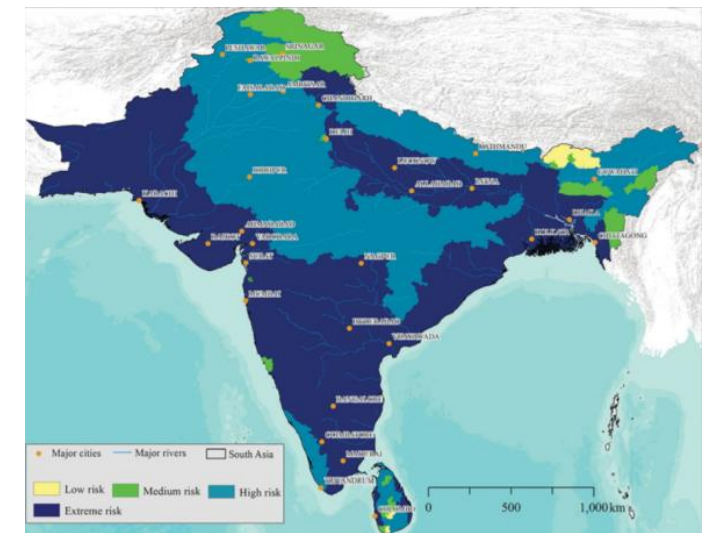
Drought risk



Drought risk measures where droughts are likely to occur, the population and assets exposed, and the vulnerability of the population and assets to adverse effects. Higher values indicate higher risk of drought.

Source: WRI Aqueduct 2019

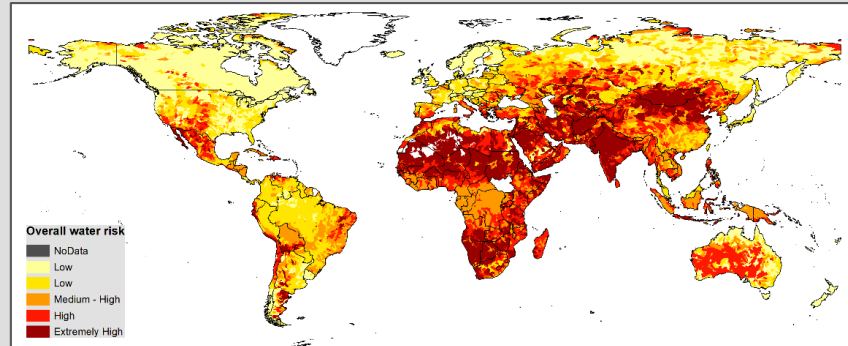
South Asia climate hotspots



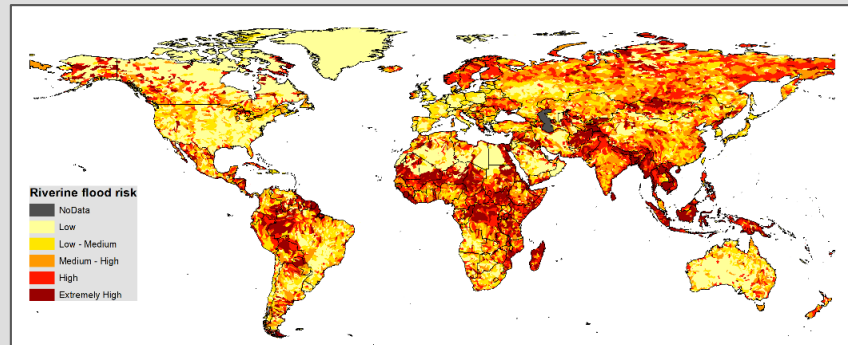
Source: IWMI

Water Stress, agriculture production and food security

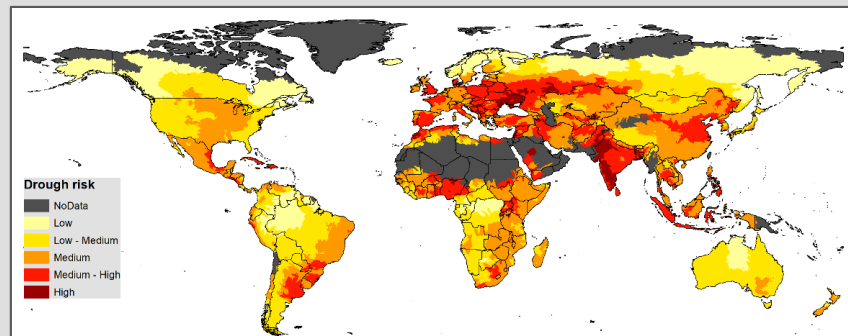
Overall Water Risk



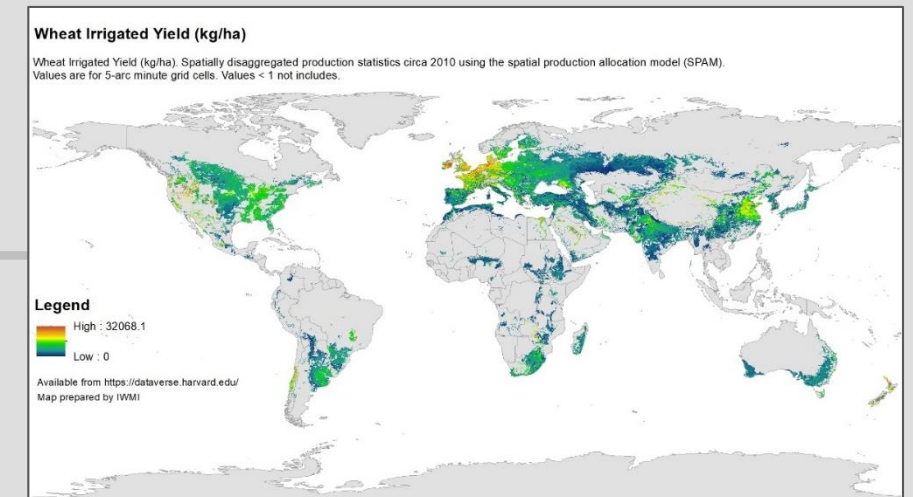
Flood Risk



Drought Risk



“A third of irrigated crop production faces extremely high water stress”



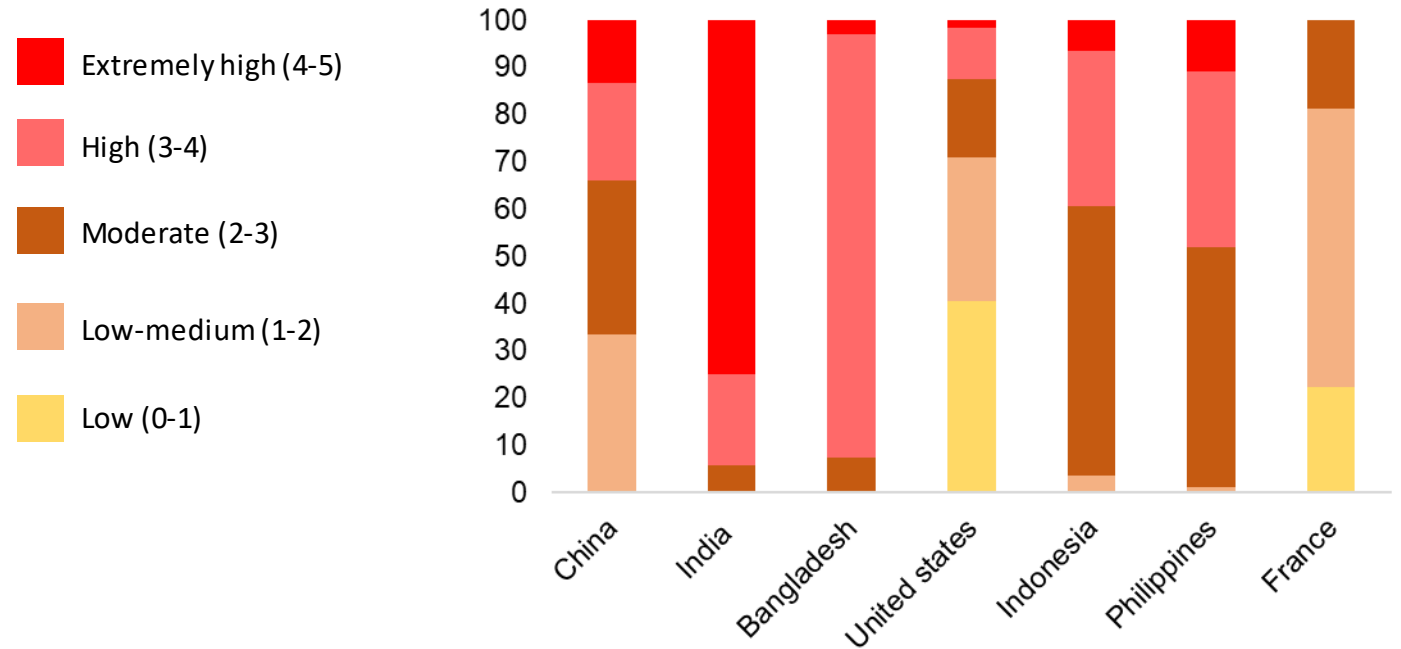
Connecting Water Stress and agriculture production

Impact on food security

- India ranks 13th for overall water stress and has more than three times the population of the other 17 extremely highly stressed countries combined;
- Nearly 75% of the crop yield are in extreme high risks category compared to countries like US or France, with groundwater resources are severely overdrawn, largely to provide water for irrigation;



Rice Yield (%) in water risk (overall) category, by country



<https://wle.cgiar.org/thrive/2020/08/04/harvesting-crop-data-space-increase-climate-and-nutrition-security>

Disaster Preparedness (Monitoring and Early Warning)



Big Data approaches

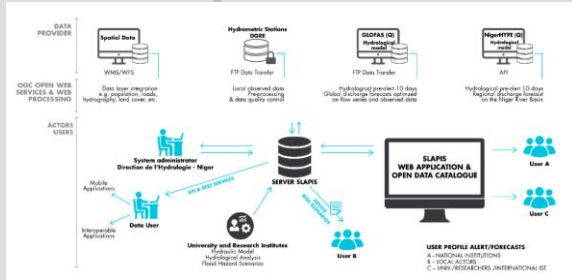
Big data analysis can establish previously unforeseen insights and linkages, which could help create new opportunities for water management



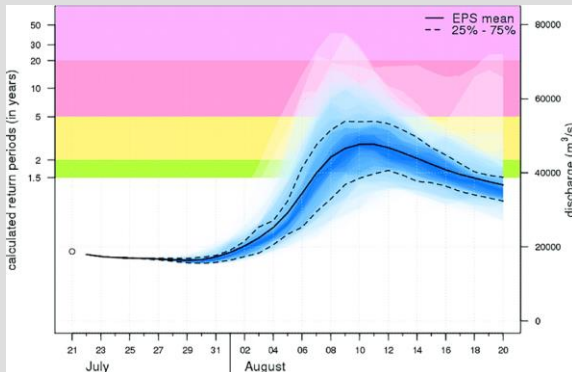
- Hazard and Risk assessment
- Managing floods and drought
- Risk transfer through Insurance
- Digital agriculture risk management
- Post-flood recovery to agriculture

What do the emerging flood risk technologies look like?

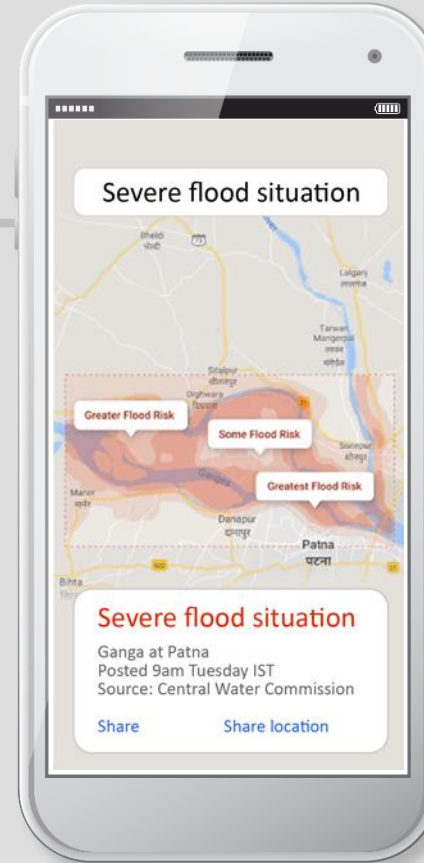
AI-based Prediction System



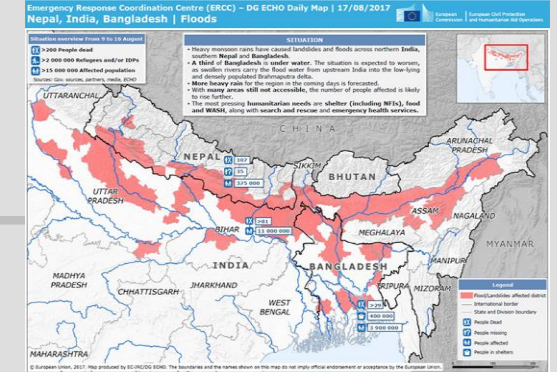
Flood Forecast



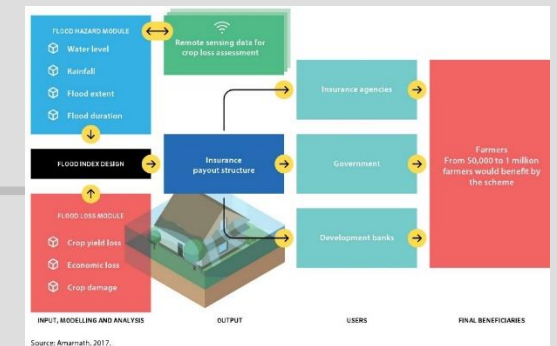
Flood Alert



Emergency maps

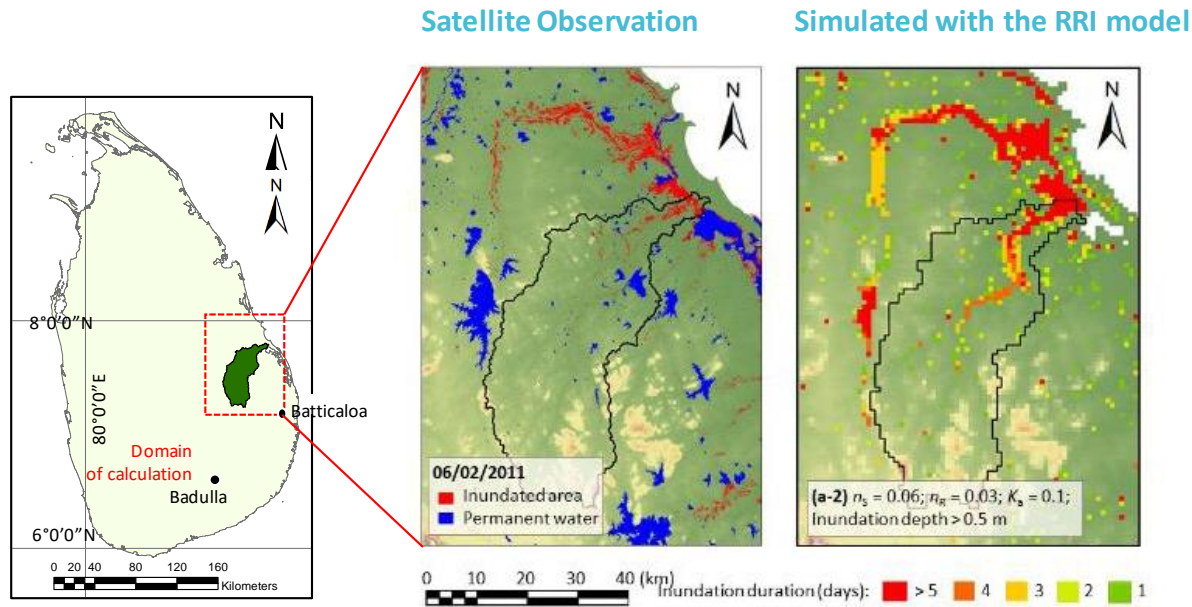


Risk-financing instrument



Flood Inundation Modelling in Sri Lanka (Basin scale)

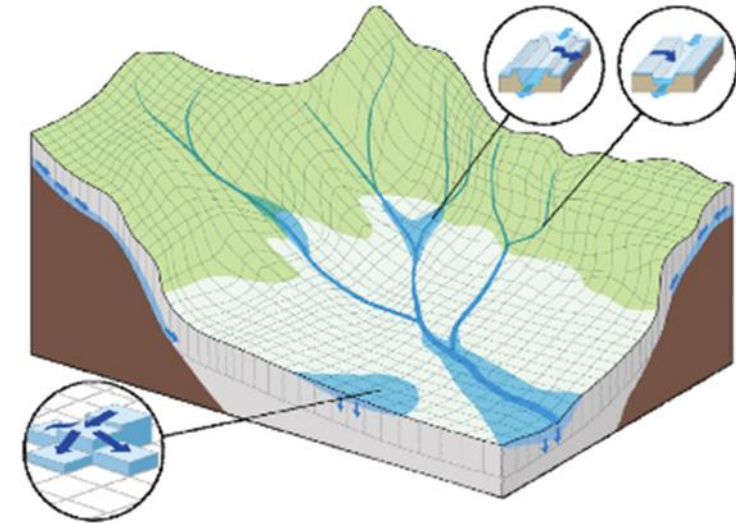
Simulated extents of flood inundation by the models



- Able to complement discrete-time results of satellite images (and also in cloudy periods);
- Applicable to hazard prediction and vulnerability evaluation;
- Able to assist NRT simulation for early alert framework, even in poorly gauged basins.

Amarnath et al. 2015

The RRI model



Numerical model for simulation of two-dimensional flood inundation distribution which was developed by ICHARM.

Merit of the RRI model

Combination of slope flow and channel discharge: this helps to apply to areas which have hills and flood plains.

Free of charge; this could help decision making in developing countries.

RRI model (Sayama et al., 2012)

IWMI's ongoing drought resilience projects



South Asia



Southern Africa



MENA

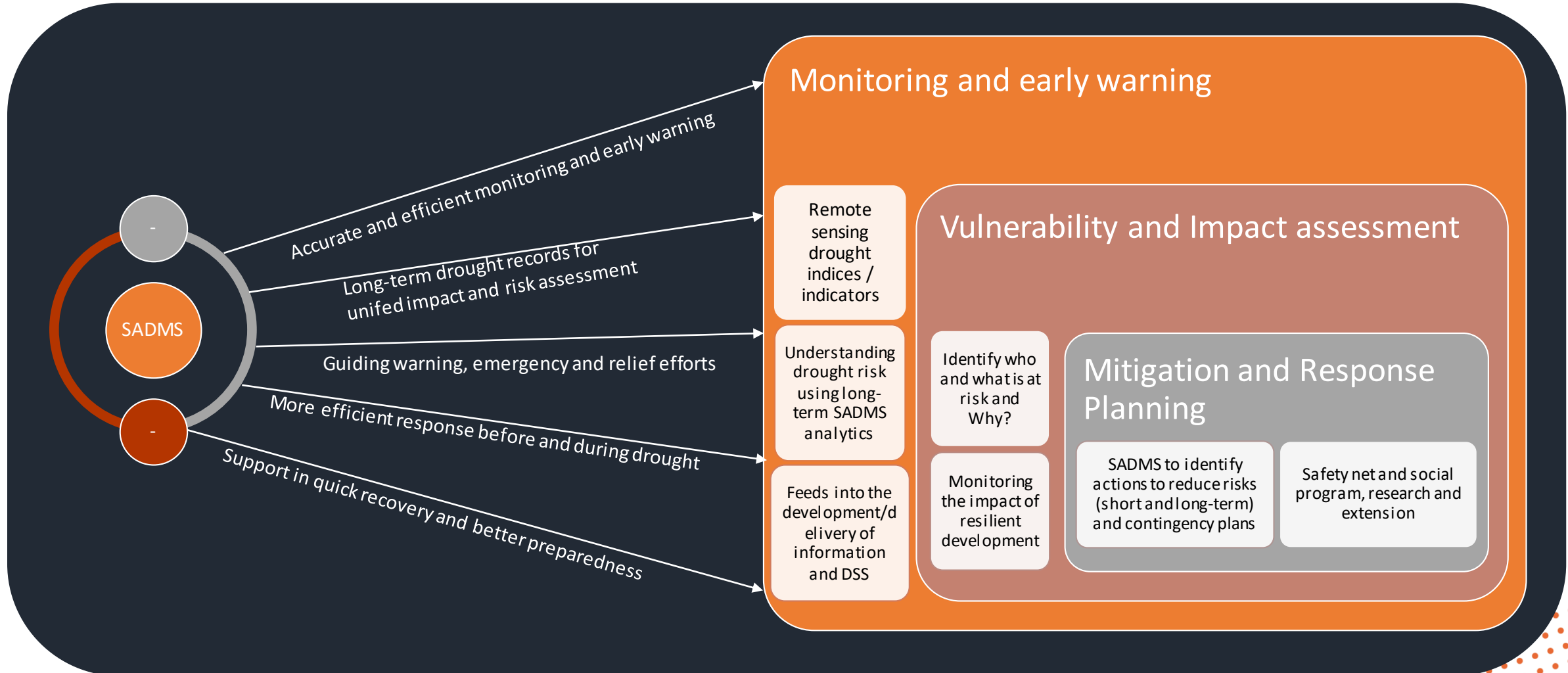


Senegal and Ethiopia



South Asia Drought Monitoring System (SADMS)

strengthens three drought pillars

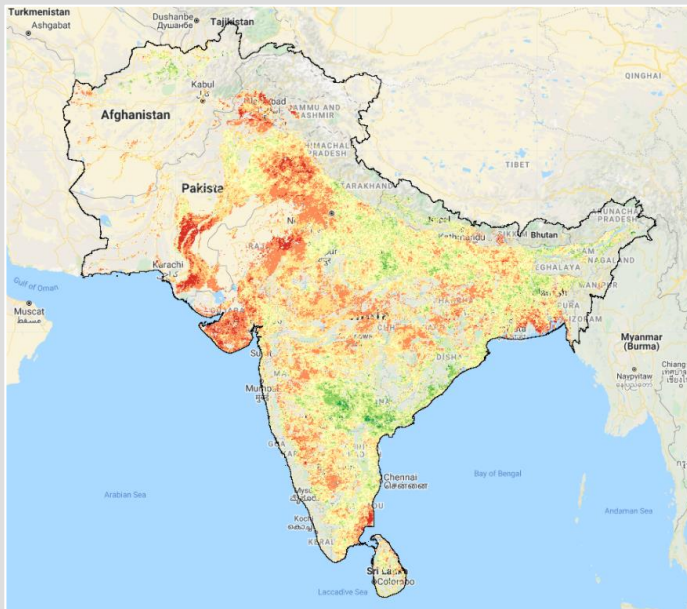


Drought Surveillance System for South Asia

GEOSPATIAL
WORLD
AWARDS



Information and Action



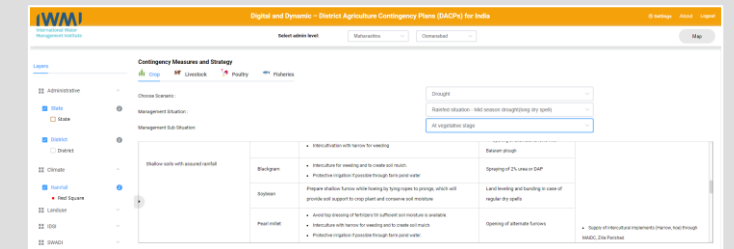
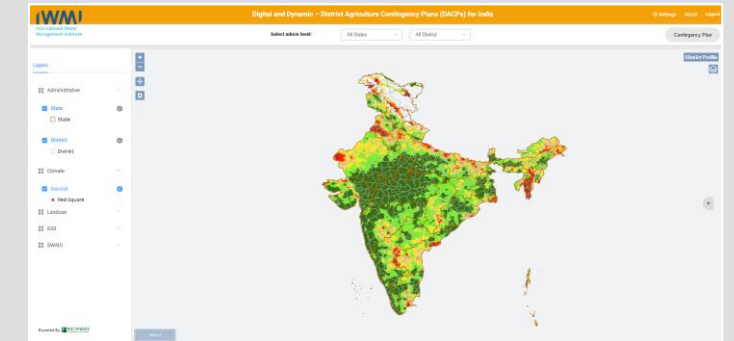
Agriculture Stress monitoring using satellite indices

Knowledge



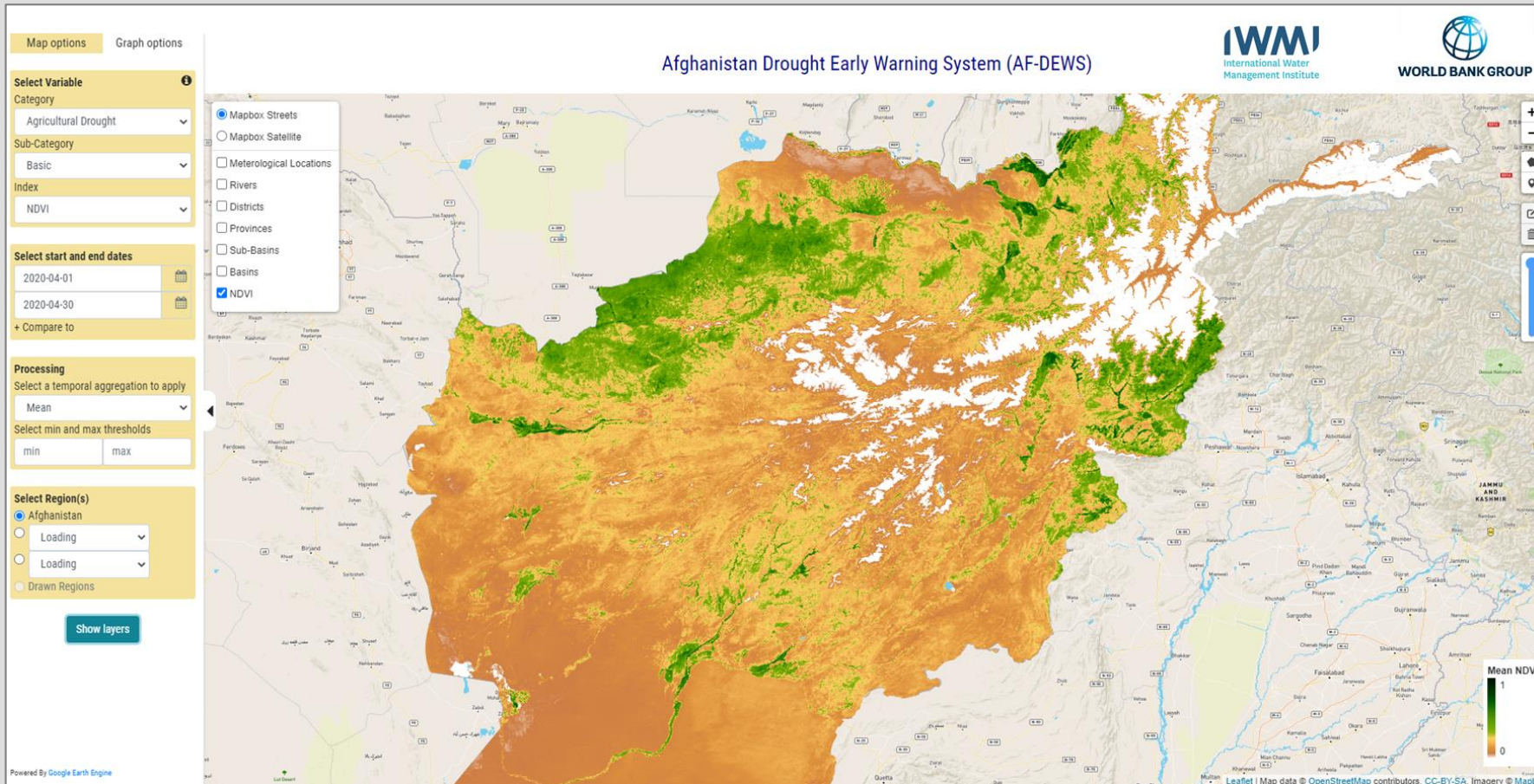
Consultation and awareness on the digital tools and actionable information

Decisions



Drought response strategies integration information and knowledge products for decision making process

Early warning and drought risk assessment in Afghanistan

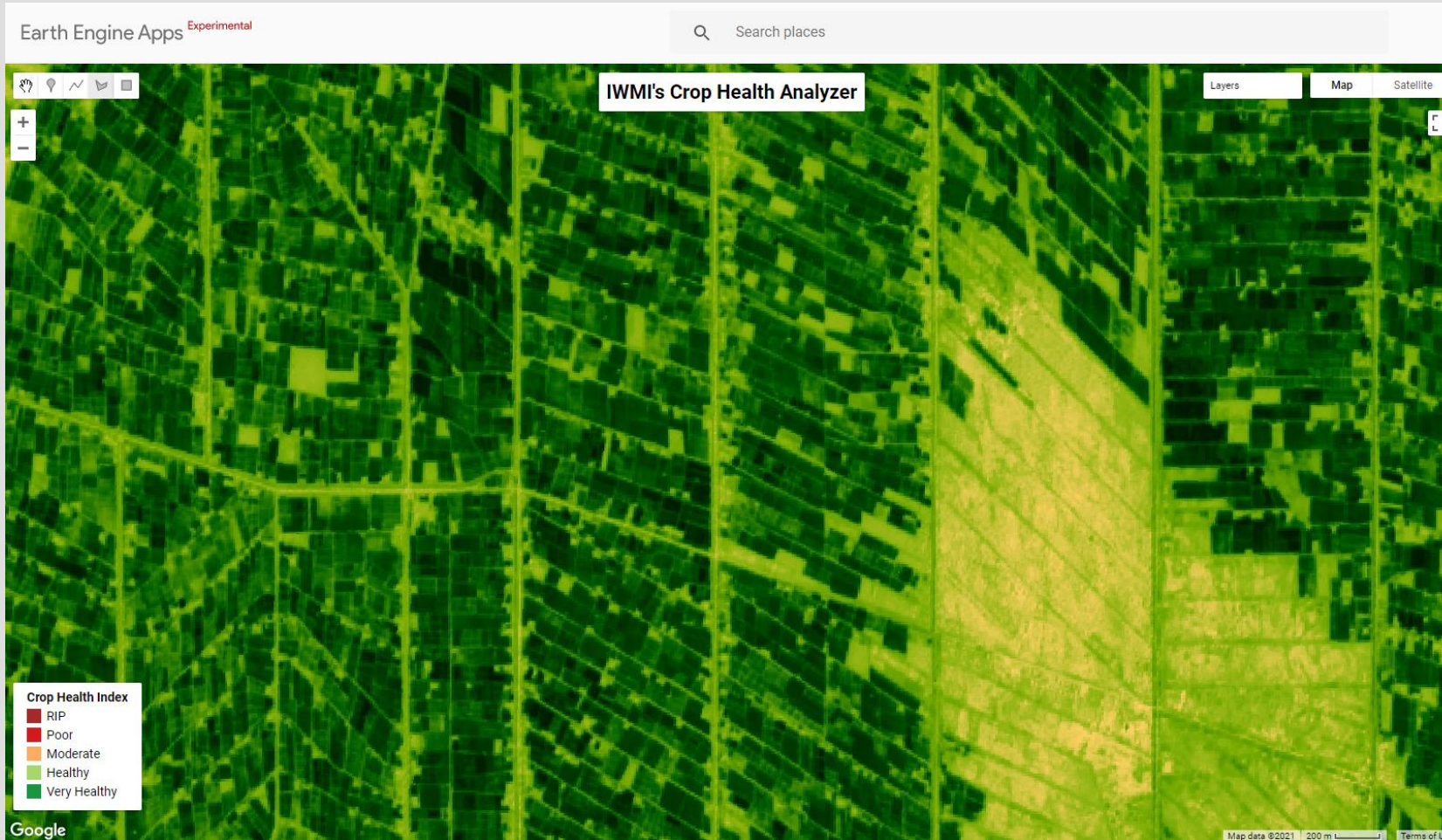


- Fully automated cloud-based system implemented using Google Earth Engine, will be used by GoIRA for drought declaration and response mechanism.
- Scalable from field-scale to national level for early warning, early action and early finance for drought mitigation efforts.

Source: Giriraj Amarnath

<http://af-dews.demo.iwmi.org:3000/>

Satellite-Based Crop Health Monitoring System to Help Farmers



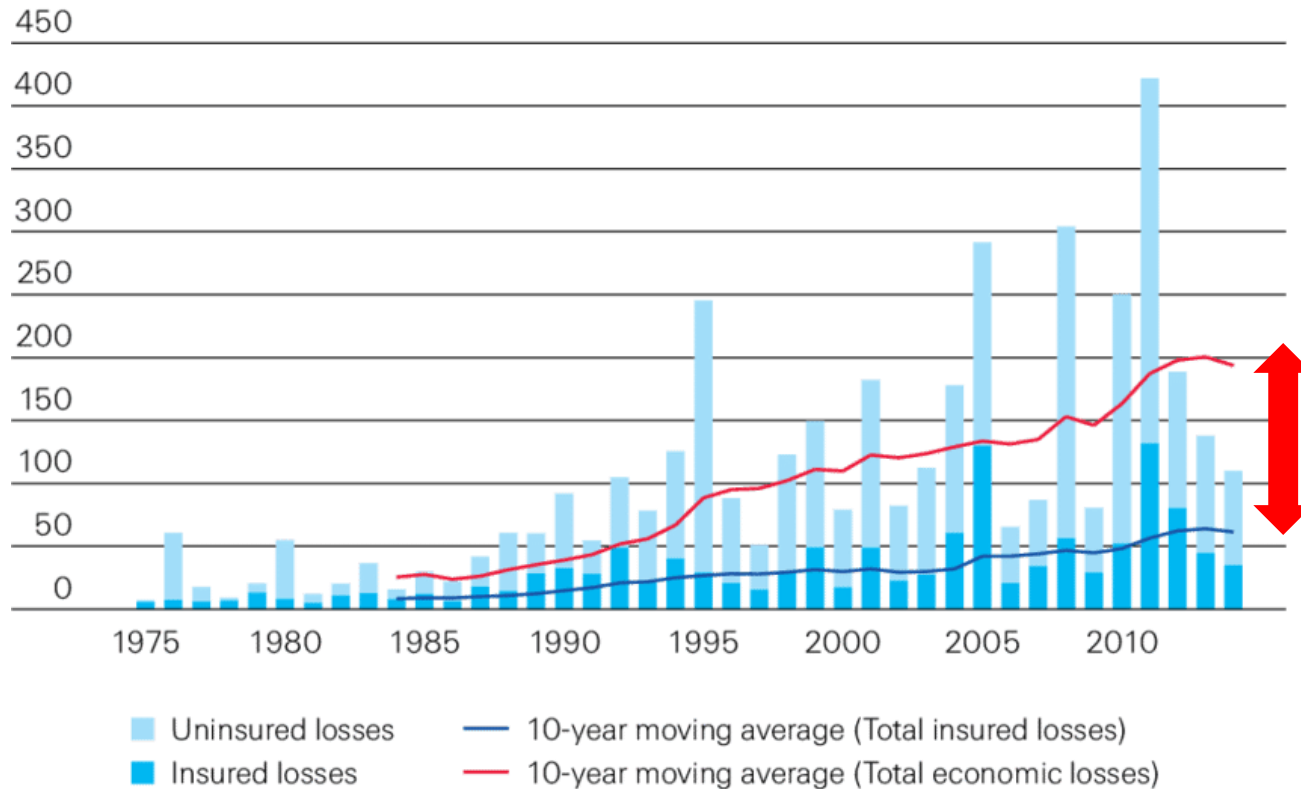
Source: Giriraj Amarnath

- IWMI's Crop Health Analyzer uses high resolution satellite data (10 meters) to understand crops' health without the need for field inspection.
- Tool uses spatio-temporal Vegetation indices to determine problematic crop fields and assess the health of plants, their status and progress over time.
- The application will be handy for irrigation officials to forecast production and market risks
- This tool is scalable to any region and can customize to specific irrigation scheme for periodic monitoring and evaluation.

Investing in financial resilience and climate shocks



Global economic losses due to floods in 1990- 2019



409 catastrophes = loss of \$232 billion



Disaster events claimed more than 11,000 victims in 2019

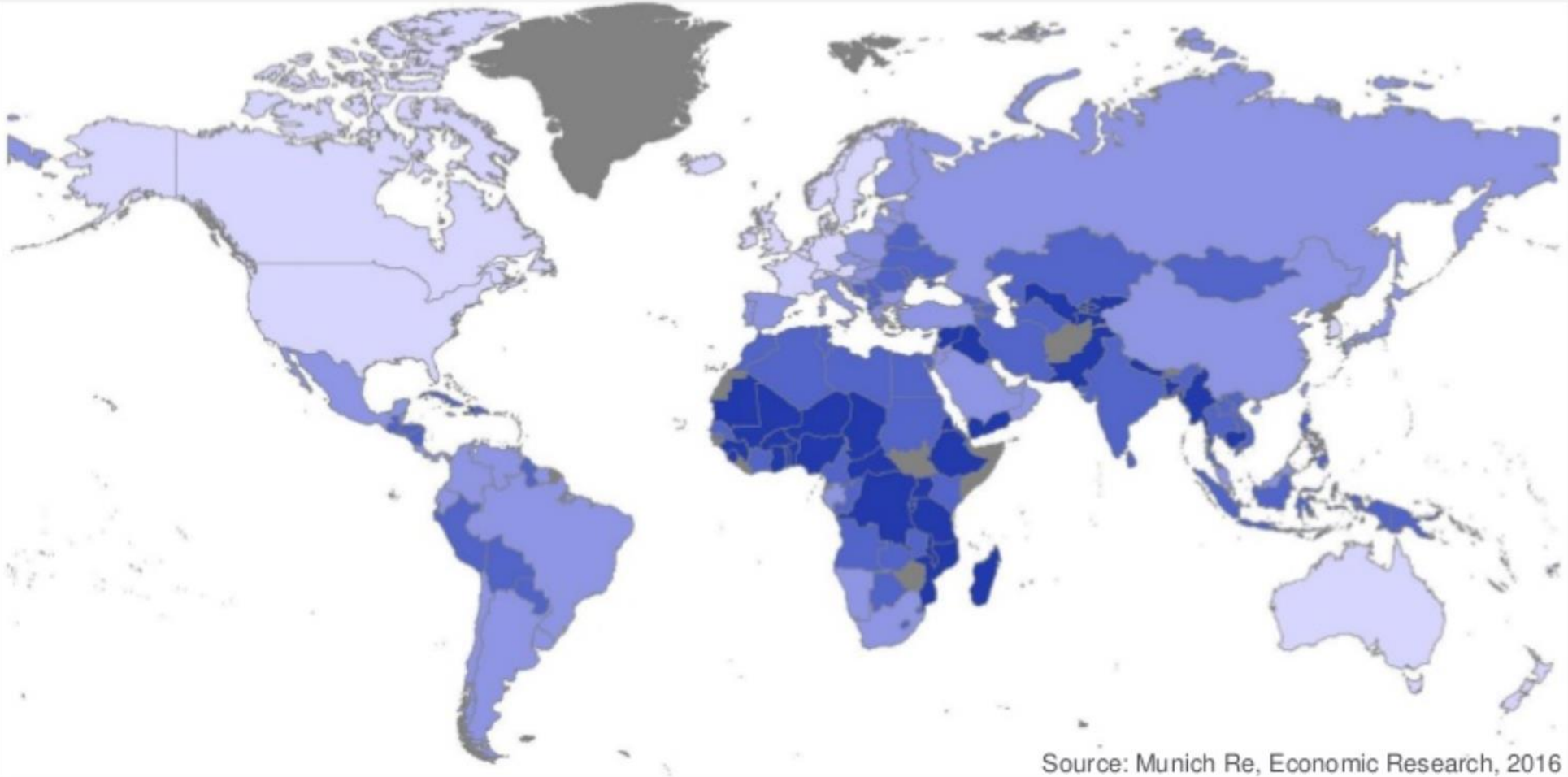


Record-breaking flood events globally the new normal

- Who is funding the deficit between insured and uninsured losses?
- Financial resilience as a component of DRM
- Role of catastrophe insurance in a sustainable development framework



Insurance density worldwide 2014 (defined by Munich Re)



Insurance density per country

Classification per capita by property insurance premium (non-life including health)

- Highly insured (>1,000 US\$)
- Well insured (101 - 1,000 US\$)
- Basically insured (10 - 100 US\$)
- Inadequately Insured (<10 US\$)
- No data

Source: Munich Re, Economic Research, 2016

Why is there poor insurance penetration for floods in Asia?



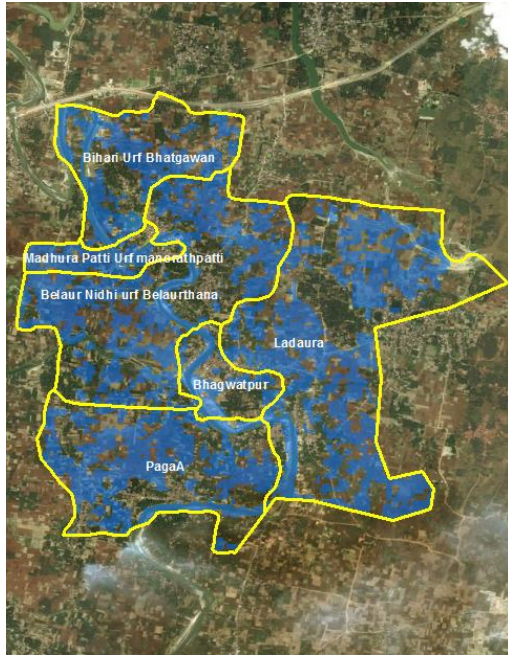
- Lack of adequate flood risk and vulnerability modelling data
- Cost
- Types of floods and associated damage
- Difficulties with flood damage assessment

Insuring the uninsured

- Index –based/parametric insurance
- Self-supporting commercial approach
- Subsidized system managed and guaranteed by government
- Data – essential first step for making flood insurance universally accessible among marginal smallholder farmers



Index based flood insurance (IBFI)



Open access earth observation data and modeling tools strengthen scaling risk solutions in protecting poor and vulnerable people in developing countries.

Insurance solutions could help bolster farming livelihoods, reduce post-disaster costs for governments and contribute to reducing poverty, achieving gender equality and underpinning food security.



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Pilot trials
In India and Bangladesh
since 2017



+7,000
Households



\$150,000 USD
Total payout



125k HH
Scaling



Key messages

- Preparedness through monitoring and early warning is an important step towards **proactively enhance disaster resilience** among communities.
- **Promote institutional coordination** and disaster risk governance are critical in responding to climate shocks
- Promote **knowledge products and information services** can help in achieving resilient society
- **Build capacity among stakeholders** and promote innovation for empowered communities

Thank you

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