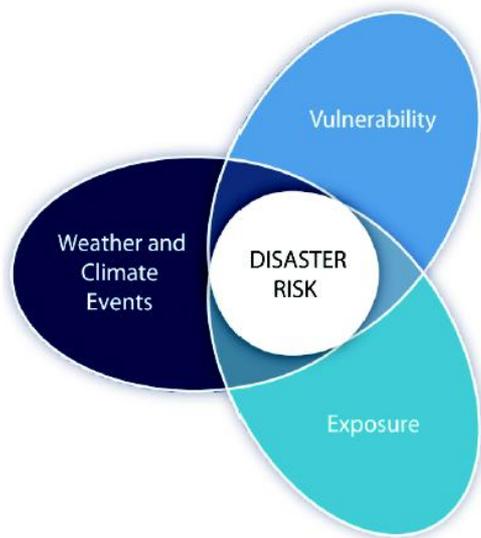


# MONITORING AND IMPACT ON FLOODS AND DROUGHT IN ASIA



**Giriraj Amarnath, Ph.D.**

Sub-Theme Leader: Water-related Disaster Risk Management  
International Water Management Institute (IWMI), Sri Lanka  
[a.giriraj@cgiar.org](mailto:a.giriraj@cgiar.org)

# Where we are based:

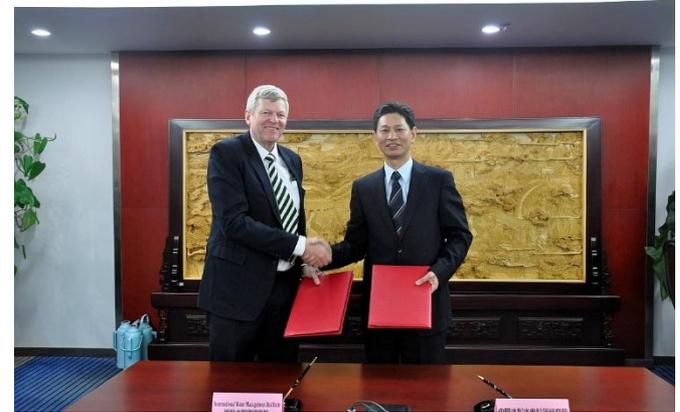


:: LOCATIONS OF IWMI OFFICES



# IWMI's Role in Water-related Disaster Cooperation

1. Member of Sentinel Asia and Working group Chair of WRD
2. UNSPIDER Regional Support Office in Colombo
3. Global Flood Working Group with Joint Research Centre, European Commission
4. Member – Group of Earth Observation (Participating organization)
5. CEOS Flood Pilot
6. CEOS Landslide Pilot (**New**)



# Weather-related Disasters and its losses

Number of weather-related disasters reported per country (1995-2015)

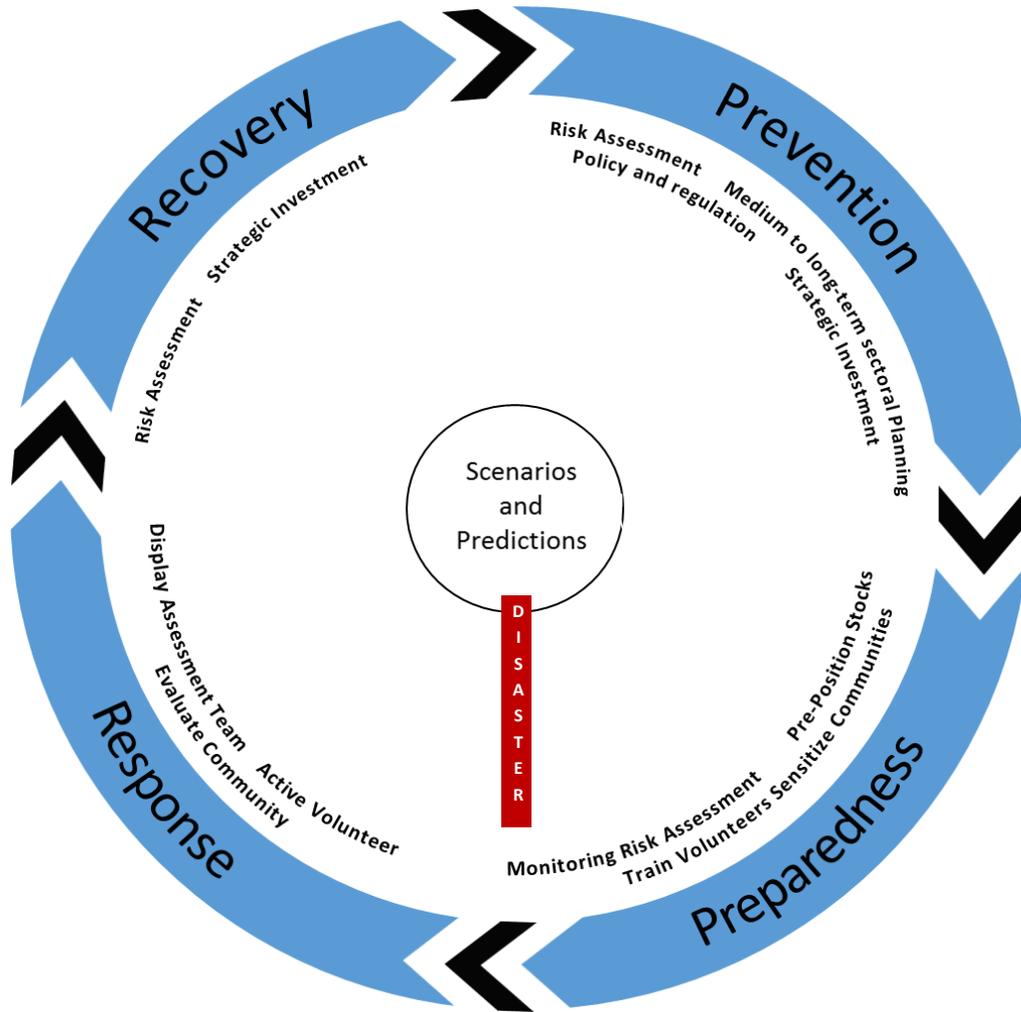
## Natural loss events worldwide 2015 Geographical overview



- **Geophysical events**  
(Earthquake, tsunami, volcanic activity)
- **Meteorological events**  
(Tropical storm, extratropical storm, convective storm, local storm)
- **Hydrological events**  
(Flood, mass movement)
- **Climatological events**  
(Extreme temperature, drought, forest fire)
- **Loss events**
- **Selection of catastrophes**

Source: Munich Re, NatCatSERVICE, 2016

# The Four Part Disaster Cycle



**Prevention.** Long-term efforts to prevent hazards from becoming disasters or make them less damaging. These include structural measures such as creating flood levees or reinforcing buildings, as well as **non-structural measures** such as **risk assessment** and land-use planning.

**Preparedness.** Planning for when disaster strikes, including developing **communication** strategies, **early warning systems**, and stockpiling supplies.

**Response.** Implementing plans after a disaster. This includes mobilising emergency services, coordinating search and rescue, and **mapping the extent of the damage**.

**Recovery.** **Restoring an area**, often through rebuilding and rehabilitation, then returning to mitigation measures.

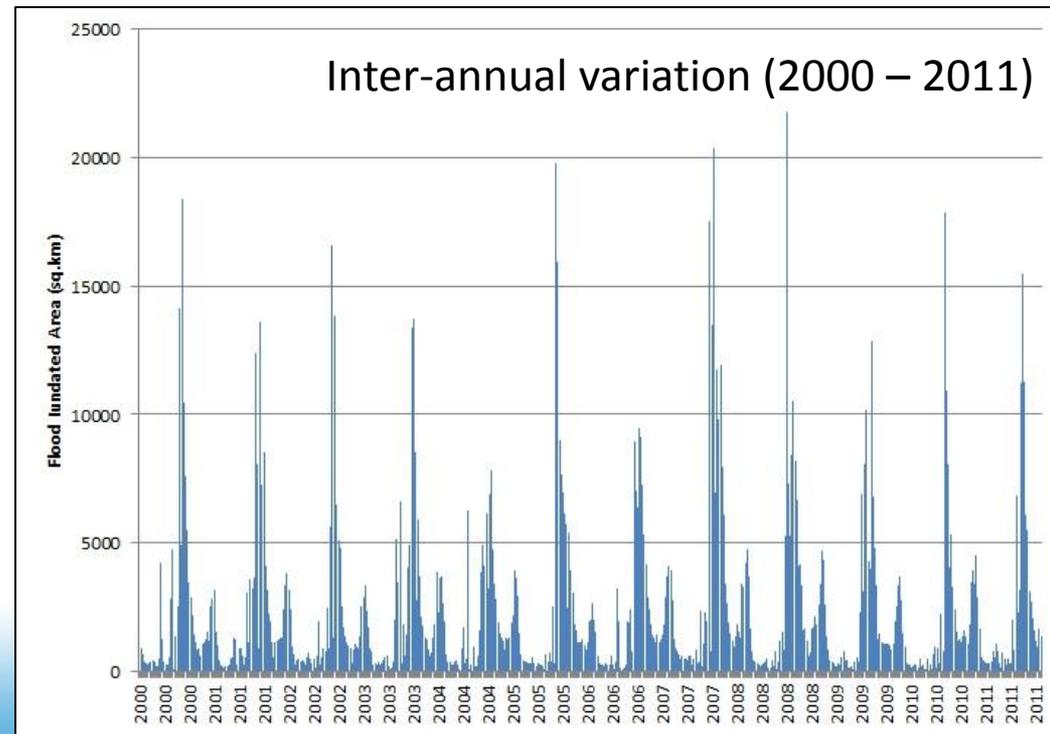
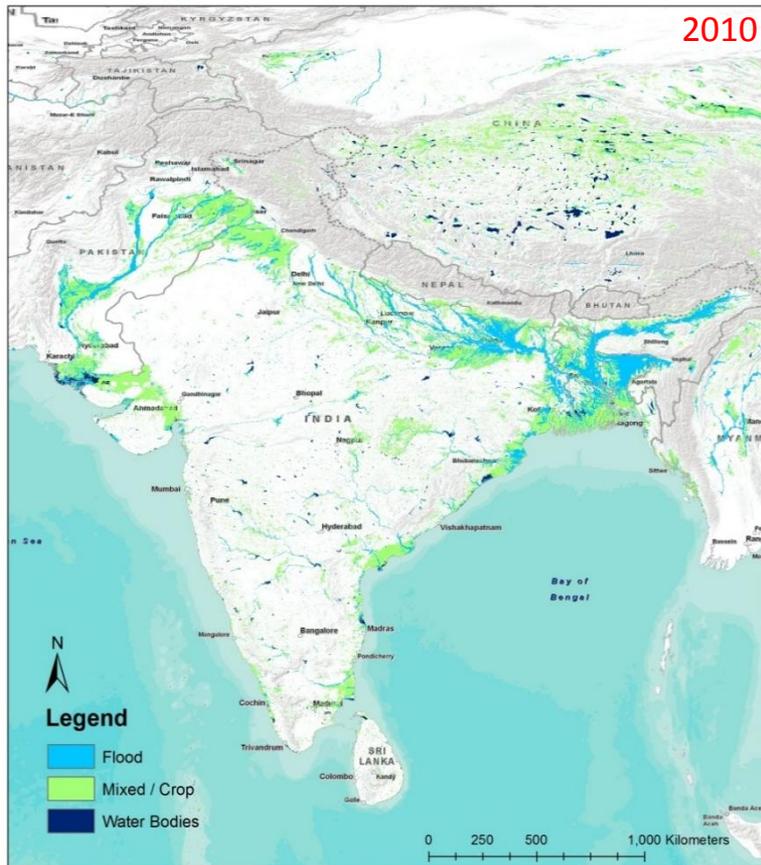
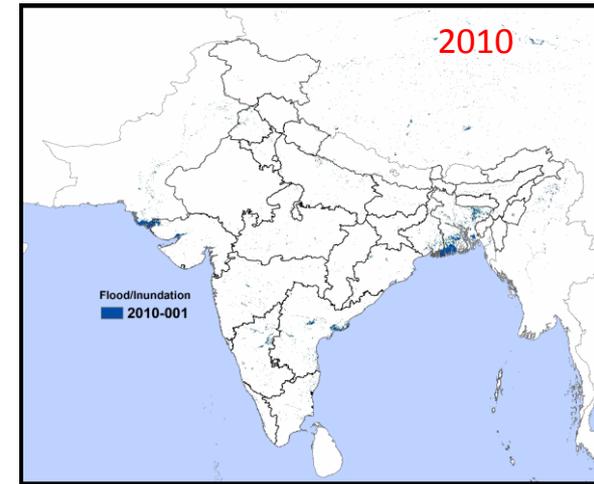
# IWMI's Role in Hydrometeorological Disasters Cycle

Disaster	Prevention	Preparedness	Response	Recovery
Floods	Mapping flood-prone areas; delineating flood-plains; land-use mapping.	Flood detection; early warning; Rainfall mapping.	Flood mapping; evacuation planning; damage assessment.	Damage assessment; spatial planning.
Drought	Risk modelling; vulnerability analysis; land and water management planning.	Weather forecasting; vegetation monitoring; crop water requirement mapping; early warning.	Monitoring vegetation; damage assessment.	Informing drought mitigation.

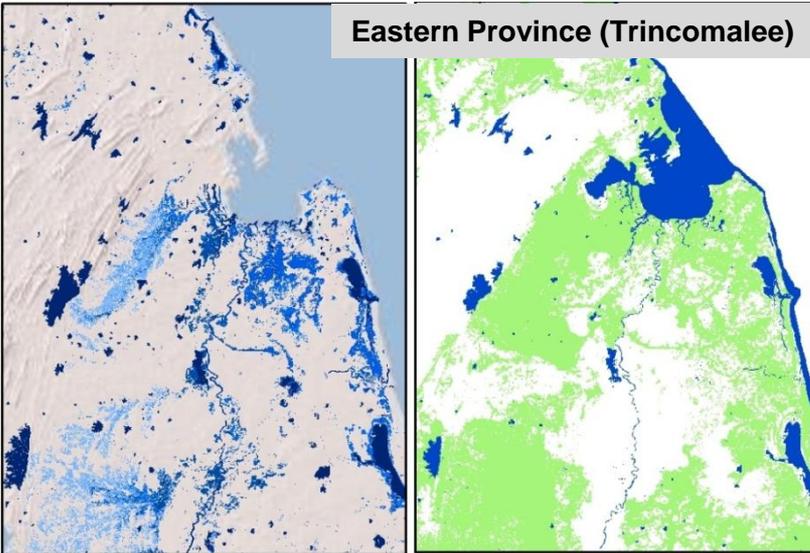
Ways remote sensing can help disaster management

# Prevention: Flood Risk Assessment for SA using RS Data

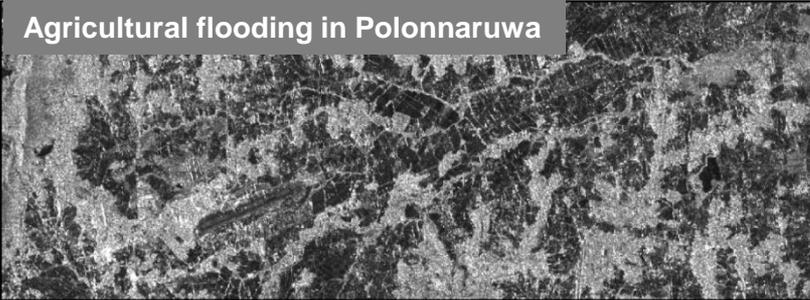
- Assessment of flood risk and the evaluation of measures to reduce flood risks;
- Calculating the averaged annual costs of damages or losses, and economic assessment of flood risk;
- Allows flood risk managers, stakeholders and politicians to propose new strategies;



Eastern Province (Trincomalee)



Agricultural flooding in Polonnaruwa



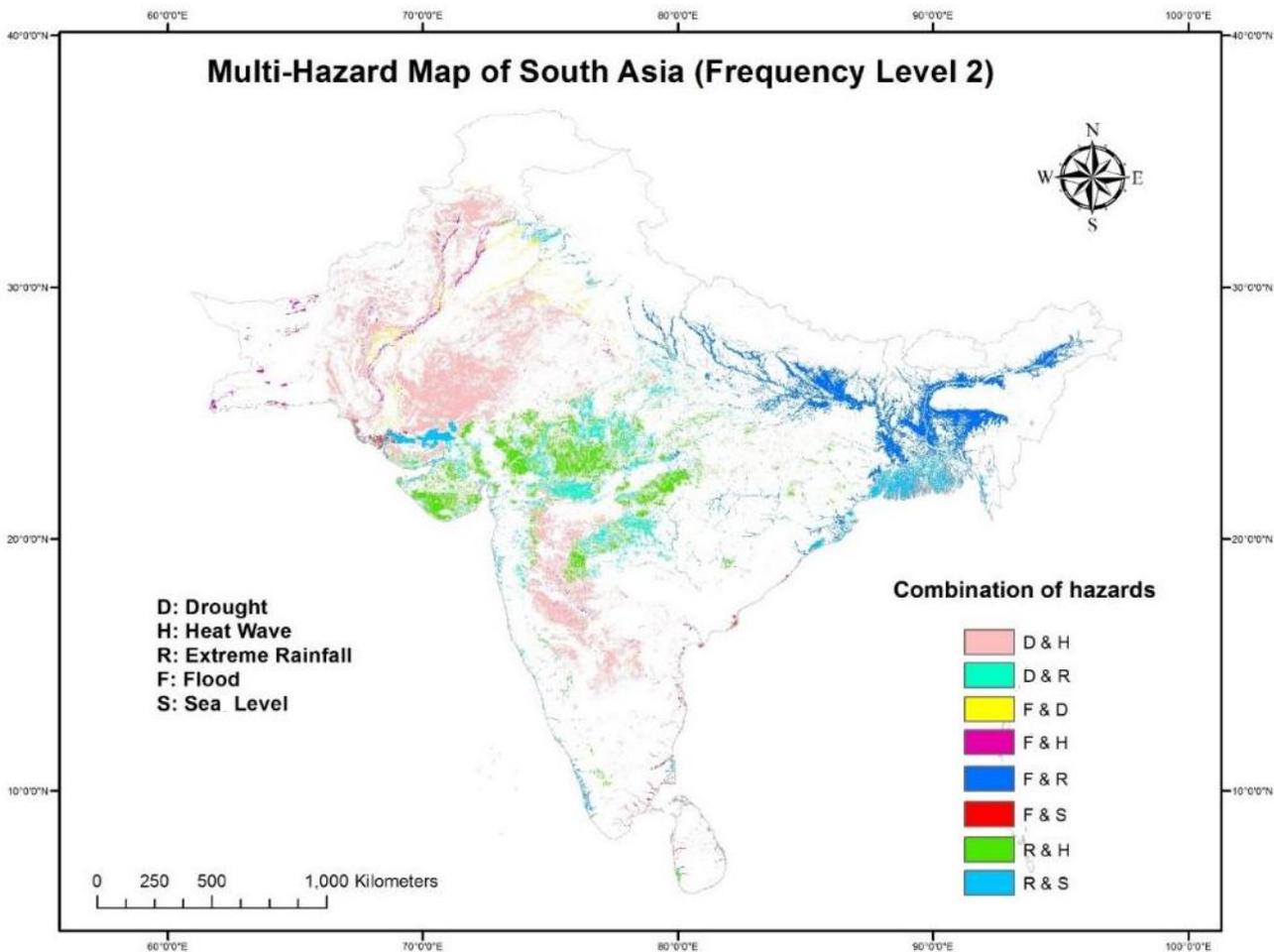
For submission to Remote Sensing Applications: Society and Environment (*final stage*)

## Prevention: Mapping Flood Risk Extent using Satellite Observation Data

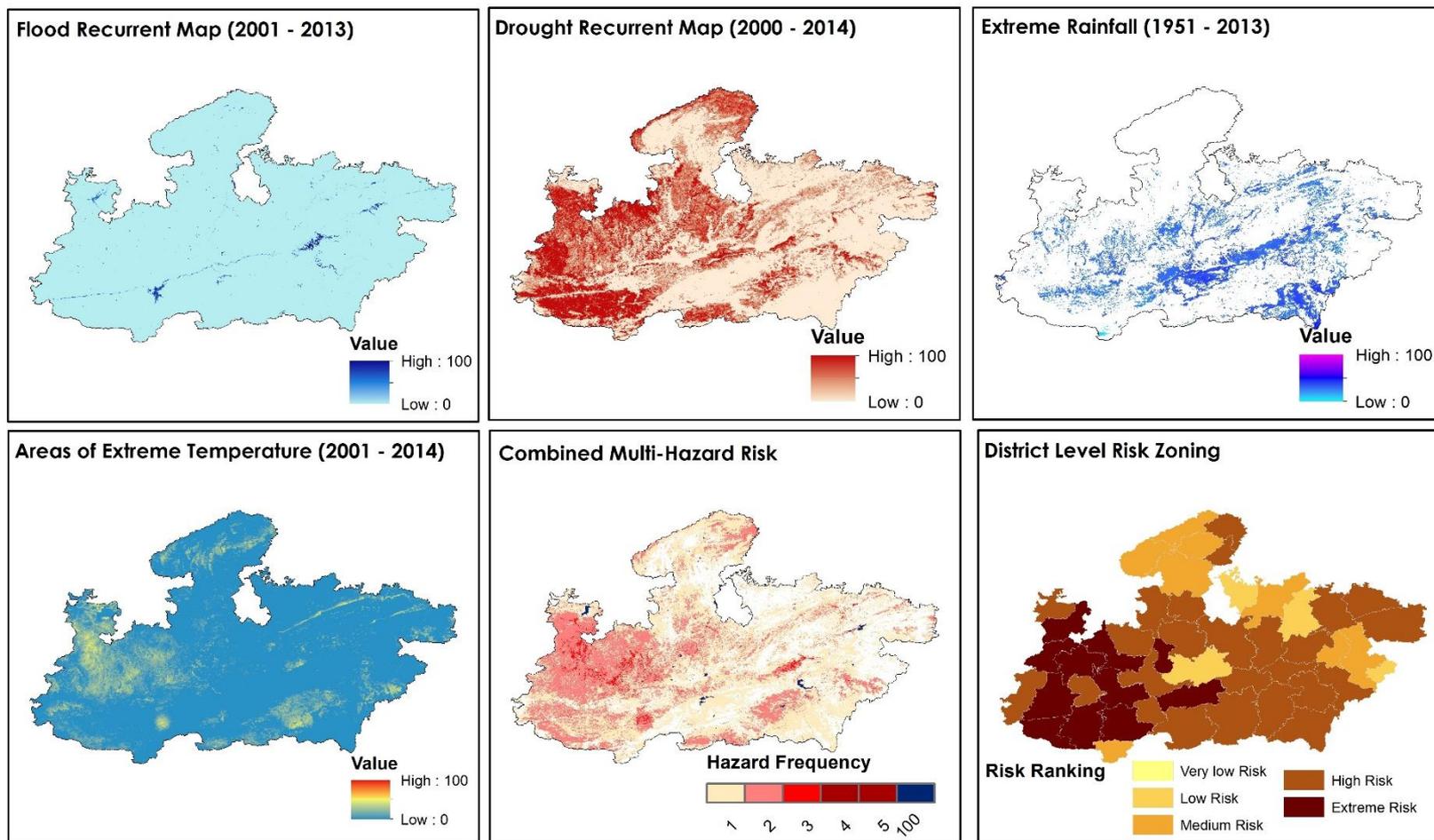
- Fine-scale flood-risk products mapped using satellite datasets from 2000 to 2011.
- Province-wise flood statistics and agricultural impacts are being analyzed.
- Knowledge generated here can be used by the Disaster Management Centre and the Irrigation Department for mitigation, preparedness and index-based crop insurance



# Prevention: Urban planner / manager: What type and level of protection is appropriate?



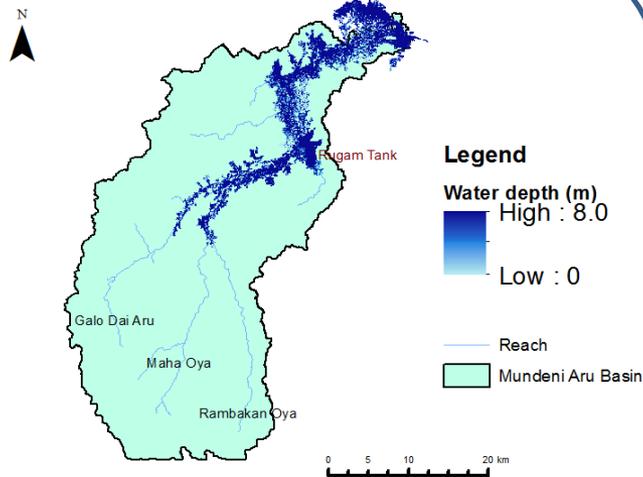
# Prevention: Urban planner / manager: What type and level of protection is appropriate?



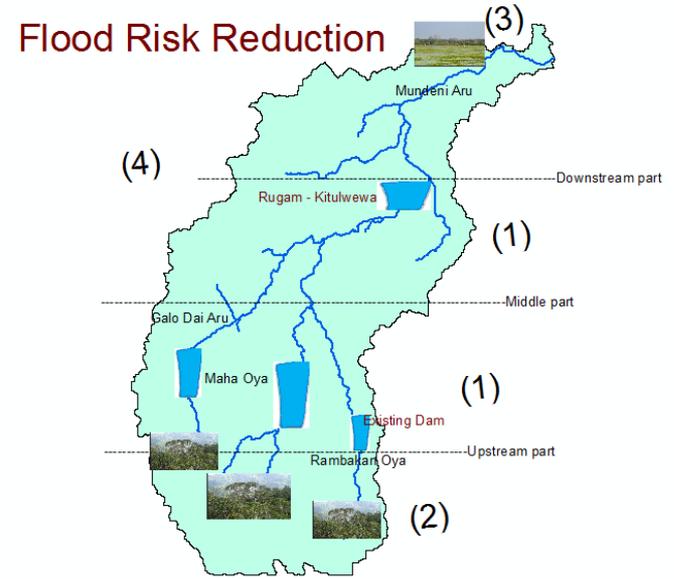
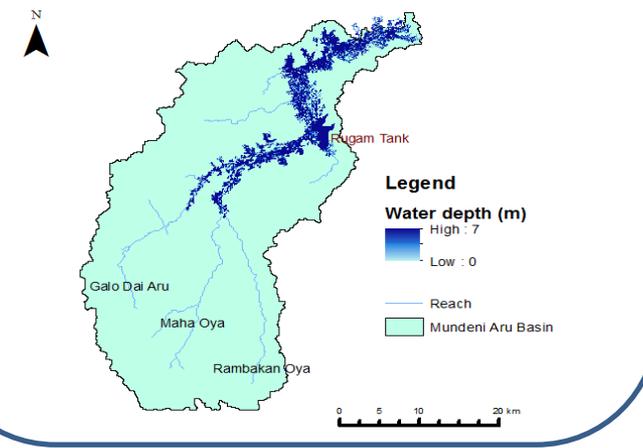
High to Extreme Risk Districts: East and West Nimar, Dhar, Barwani, Ratlam, Mandsaur, Shajapur, Bhopal, Hoshangabad

# Preparedness: Flood Early Warning for Protection measures

Flood extent map without counter measures



Flood extent map with counter measures



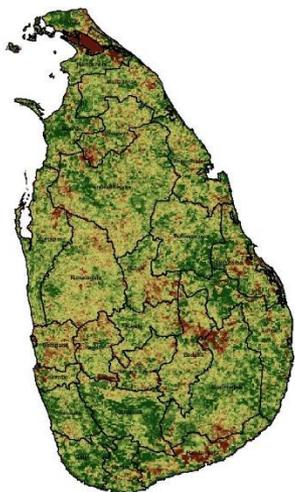
Integrated flood risk management that reduces flood risk while increasing its positive impact is needed

- Socio-economic aspects
  - Building multi-objective reservoir that reduces flood impact during wet season and used stored water for irrigation purpose during dry season
  - Proper Dam operation and application of basin scale forecasting system
- Ecosystem Management aspect
  - Re-establishing wetlands in the downstream of the basin area
  - Re-forestation in the upstream areas

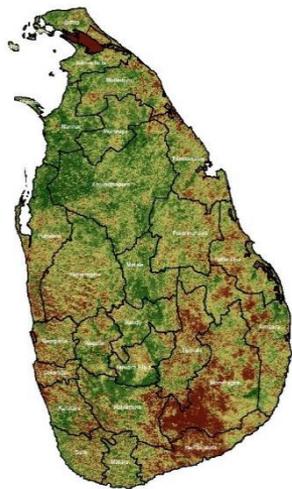
Accepted in IAHS Red Book Series (2015)

# Preparedness: Vegetation Drought Monitoring and Early Warning

*2012 Weekly composite*



121 – May 1<sup>st</sup> week



201 – July 3<sup>rd</sup> week



225 – Aug 2<sup>nd</sup> weeks



241 – Aug 4<sup>th</sup> Week



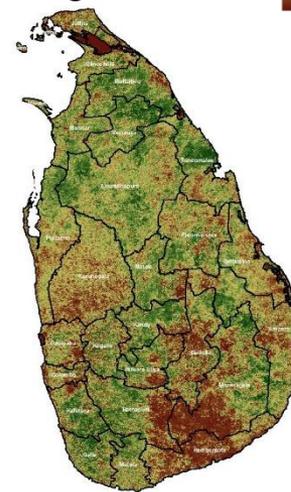
305 – Nov 1<sup>st</sup> week



281 – Oct 3<sup>rd</sup> week



273 – Oct 1<sup>st</sup> week



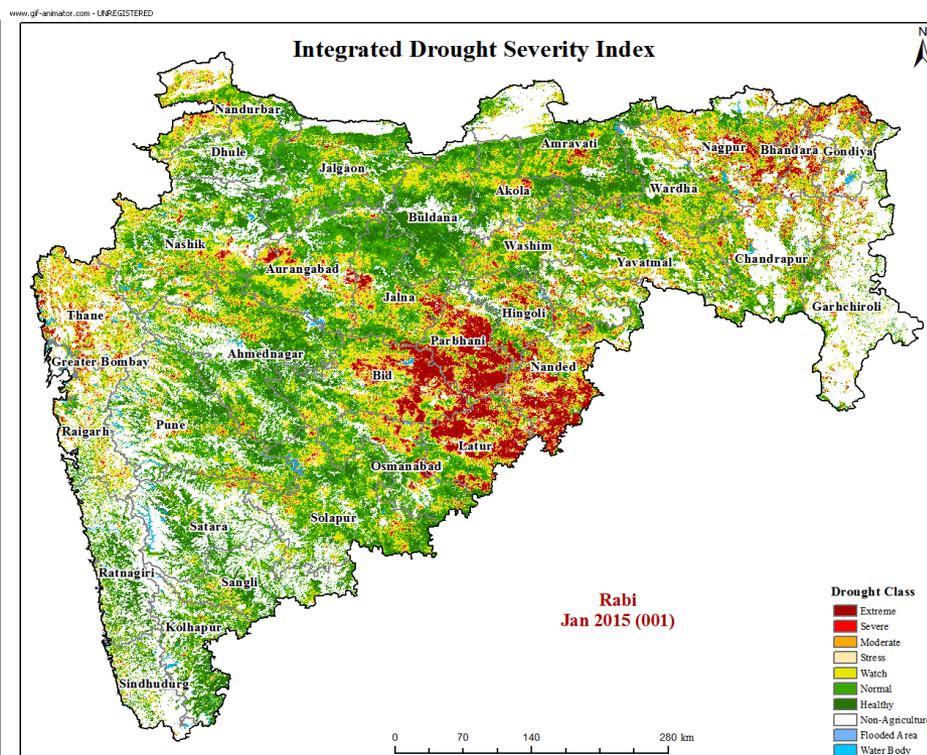
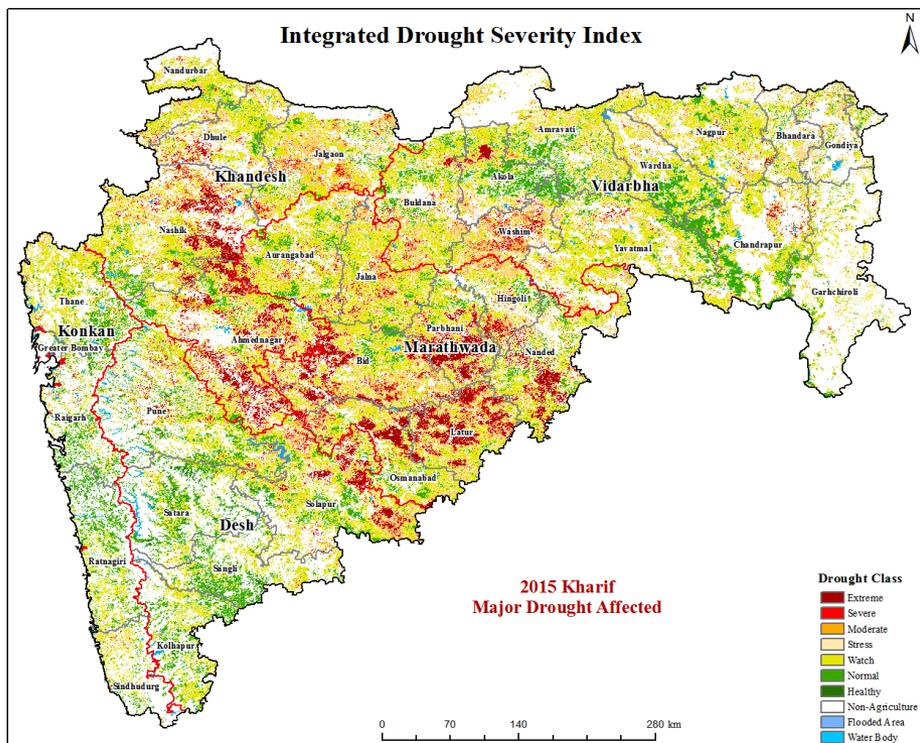
257 – Sep 2<sup>nd</sup> week



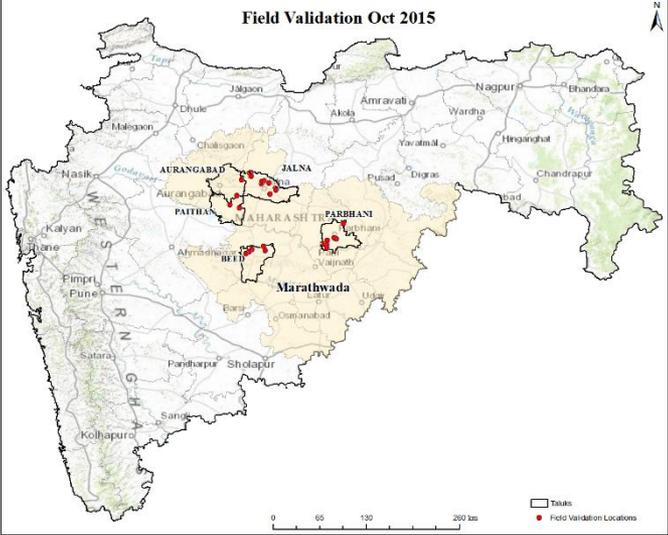
# Preparedness: Vegetation Drought Monitoring and Early Warning

## 2015 Drought Extent

## Maharashtra



# 2015 DROUGHT IN MAHARASHTRA STATE, INDIA



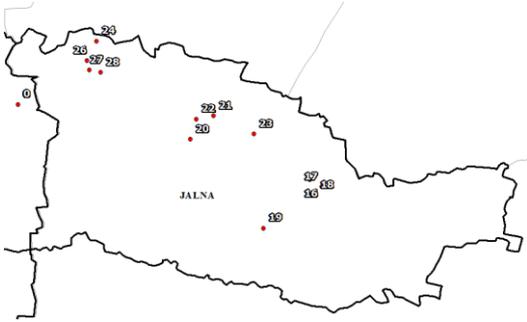
21



18



20



22



16

# Preparedness: Drought Forecast System for India

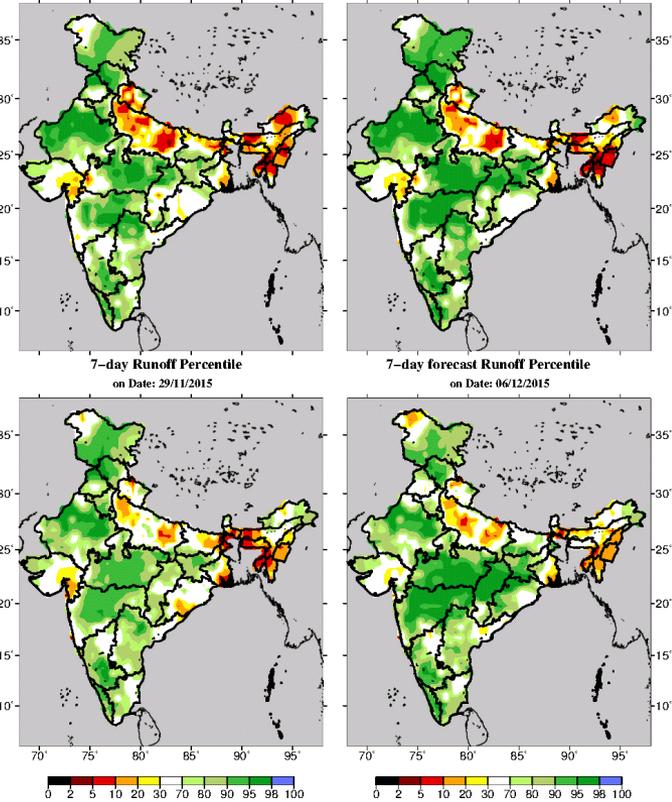
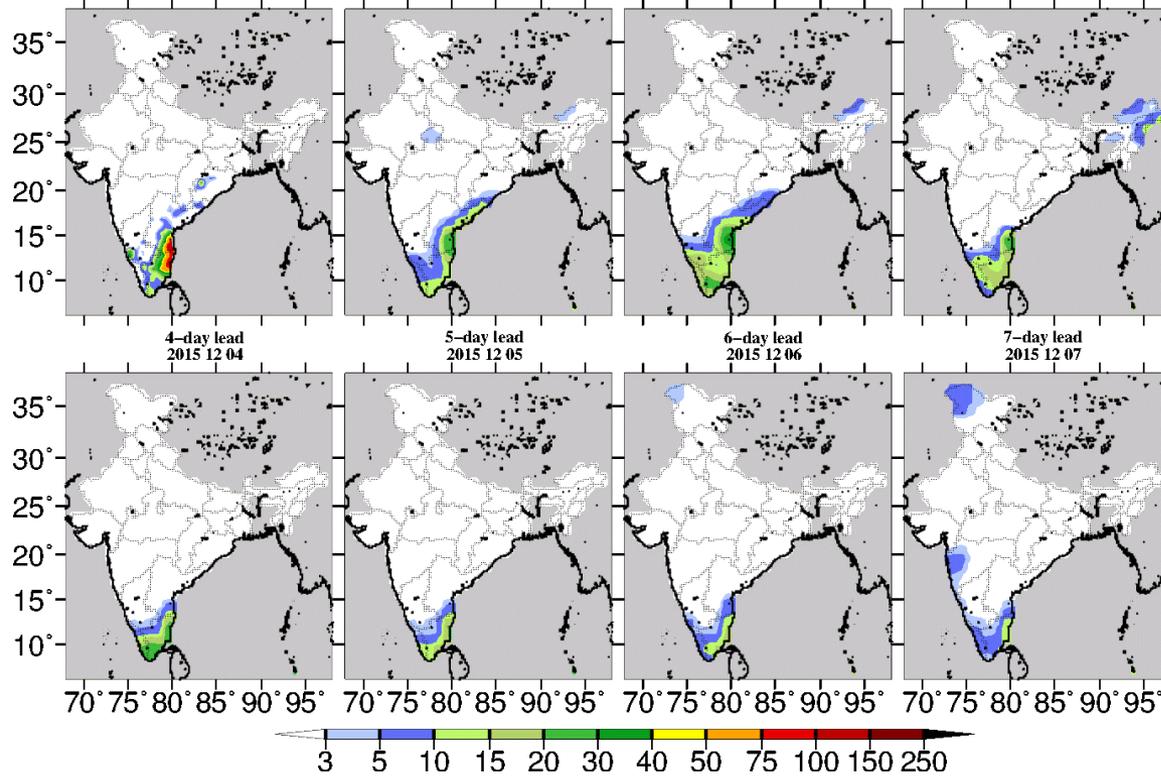
Observed Precipitation (mm/day)

GEFS Forecast Precipitation (mm/day)

VIC Model Simulated Soil Moisture Percentiles

7-day Soil Moisture Percentile (SMP)  
on Date: 29/11/2015

7-day forecast Soil Moisture Percentile (SMP)  
on Date: 06/12/2015



# Response: Rapid Emergency Response Mapping for Relief and Rehabilitation Measures

Mapping Floods in Southern Provinces - Sri Lanka using ALOS PALSAR Satellite Images

02 October 2015 | FL-2015-0001-SL | Version 1.0



IWMI and DMC in close association with Sentinel Asia System (SAS) and JAXA activated the charter on October 1, 2015 to provide satellite images covering the Southern Provinces. SAS quickly provided images of 30 September 2015 and 1st October 2015 for its use in emergency response and relief operation. IWMI using the IFMAN tool processed the flood extent covering the districts of Hambantota, Galle, Matara, Monaragala and Ratnapura.

In total an area of 365 sq.km were inundated as viewed by ALOS PALSAR Satellite images taken on 30 September 2015. Approximately 150sq km of paddy fields were flooded. The data sources from Survey Department of Sri Lanka was used for this analysis purpose. Major flooded affected divisions are Hambantota, Tanamalwila, Lunugamwehara, Tissamaharama, Wellawaya and Embilipitiya. In terms of major paddy field affected division's area Hambantota, Tanamalwila, Tissamaharama, Lunugamwehara and Tangalla. For the ALOS PALSAR-2 images taken on 1st October 2015, the affected districts are mainly the Matara and Galle. The divisions that includes Thihagoda, Kamburupitiya, Malimbada, Akuessa, Mulatiyana. In total 15 divisions were affected with a maximum inundation of 89sq.km of which paddy fields affected area is 47sq.km. The division with paddy field affected areas are Thihagoda, Malimbada, Kamburupitiya.

**Legend**

Before Disaster Image : ALOS PALSAR 2  
Date : 18 Feb. 2015  
After Disaster Image : ALOS PALSAR 2  
Date : 30 Sept 2015

□ Division Map  
● Cities/Town  
— Road — Streams

Map Prepared by:





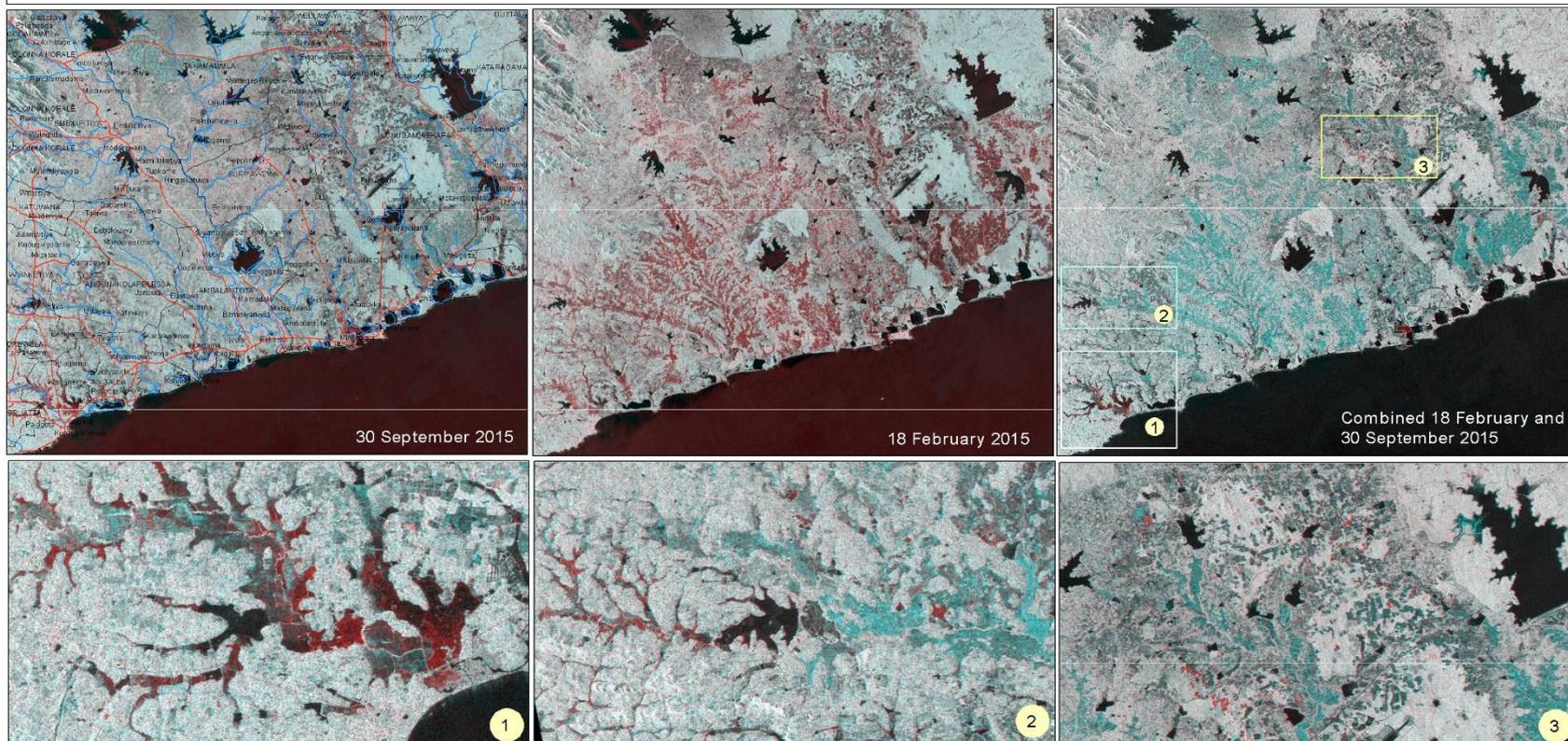

UNITED NATIONS  
Office for Outer Space Affairs  
**UN-SPIDER**

Data Provided by:



The analysis excluded permanent water bodies including reservoir, tanks and ponds and this reflects only the inundation extent. Please note the surface water extent mapped has not yet been validated in the field.

The depiction and use of boundaries, geographic names and related data shown in these maps are based on the sources they have been drawn from and quoted. These are neither error-free nor do they imply official endorsement or the position of IWMI.



# Response: Rapid Emergency Response Mapping for Relief and Rehabilitation Measures

## Second Wave of Catastrophic Flooding in Chennai (Tamil Nadu), India



Last month saw Chennai's wettest November in a century. Home to 4.3 million people, the city's rainfall of 490 mm on 1 December was the highest in 100 years. The result has been widespread flooding with many parts of the conurbation under water. Over 250 people are feared dead, with many more made homeless. On Thursday Prime Minister of India Narendra Modi surveyed the submerged state capital and adjoining areas and announced an immediate relief of 300million USD for flood-hit Tamil Nadu. Other areas of Tamil Nadu and Andhra Pradesh are also affected by floodwater.

IWM in cooperation with Sentinel Asia in particular Japan Aerospace Exploration Agency (JAXA) activated disaster charter for December 03, 2014 at 16:43hrs using ALOS-2 PALSAR-2 images. The images clearly highlight areas of standing water in and around Chennai city. Approximately 25km<sup>2</sup> is still inundated by extreme rainfall between Nov 30 and Dec 2, 2015.

Overflowing rivers and lakes pose added threats to India's fourth largest city as the number of troops deployed in rescue effort is doubled to 4,000. Thousands of people were trying to escape flooding in the Indian city of Chennai on 04 Dec. Friday amid fears that further heavy rain will cause more destruction. "The rain is not a problem now, it is the overflowing river and 30 lakes that continue to flood four districts," a senior home ministry official in New Delhi told Reuters.

The maps can be very well used by NDRF, Flood Control Room and aid agencies to understand the areas where floods are receding and standing water to prepare emergency response maps in support of relief and rescue operations.

### Legend

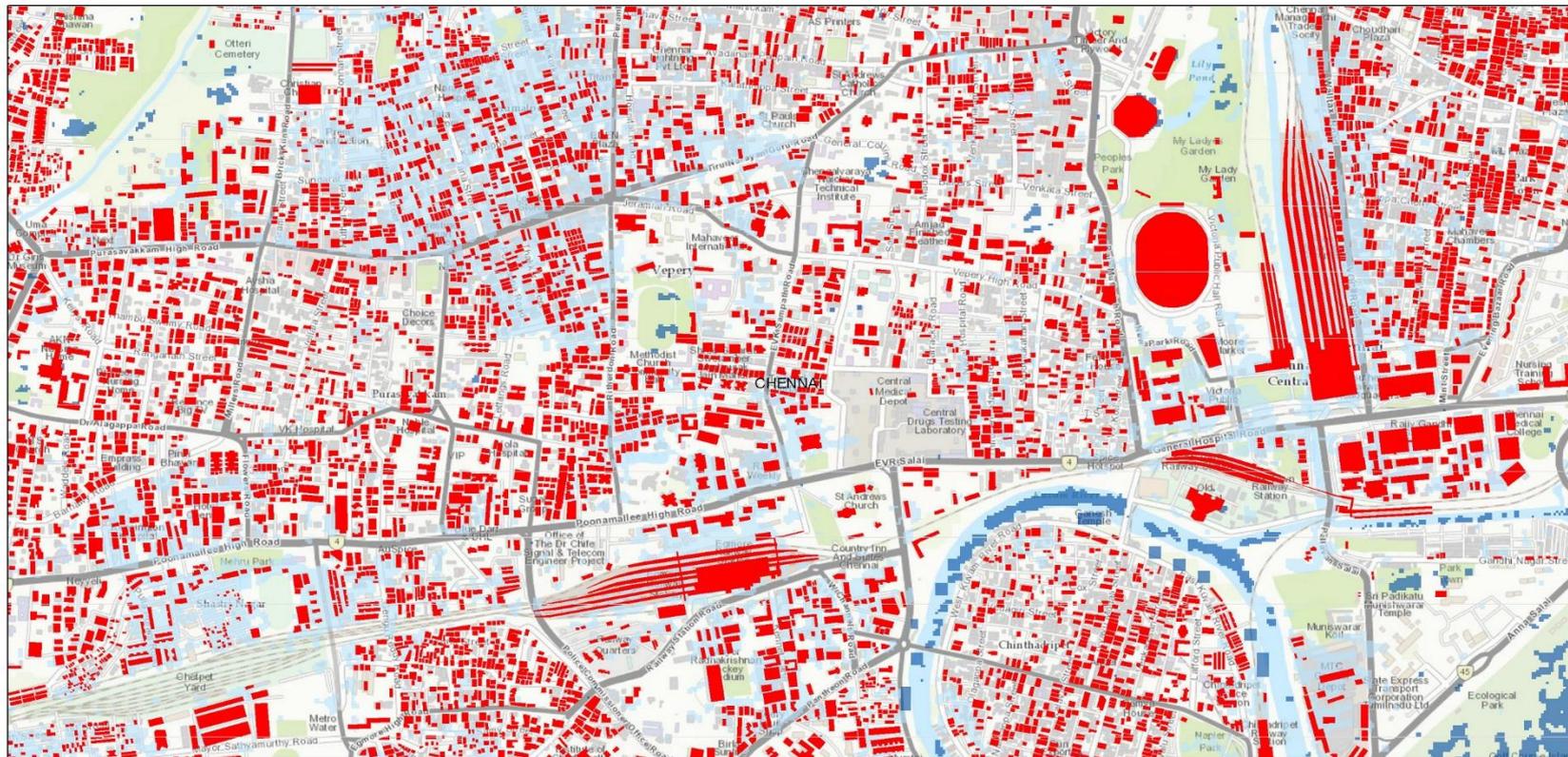
Flood Date : 09 December 2015  
Satellite Image : ALOS-2 PALSAR-2

- 09 Dec. 2015 (Post Disaster)
- River/Permanent water
- Roads
- Railways
- Waterways
- Urban / Land Use
- District boundary
- Places

Map Prepared by: Data Provided by:



The depiction and use of boundaries, geographic names and related data shown in these maps are based on the sources they have been drawn from and quoted. These are neither error-free nor do they imply official endorsement or the position of IWM.



# INDEX-BASED FLOOD INSURANCE IN INDIA TO ENHANCE AGRICULTURE RESILIENCE AND FLOOD PROOFING LIVELIHOODS



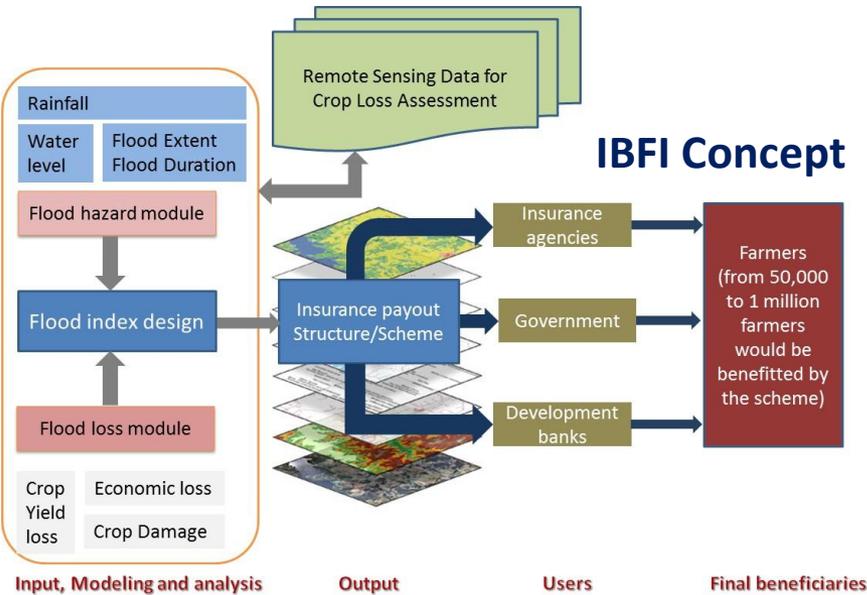
RESEARCH PROGRAM ON  
Climate Change,  
Agriculture and  
Food Security



*Solutions: Risk Transfer Solutions through insurance*

<http://ibfi.iwmi.org/>

## IBFI Concept



- Setting up pilot-scale trials to demonstrate that positive verifiable impacts emerge from IBFI in terms of agriculture resilience and improving productivity, and household incomes, locally and at the broader scale
- Developing tools and strategies that support IBFI development and upscaling, integrated with existing and future flood control measures.

Project Period: 2015 - 2018  
Pilot Sites : Bihar (India) and  
Rajshahi Division  
(Bangladesh)



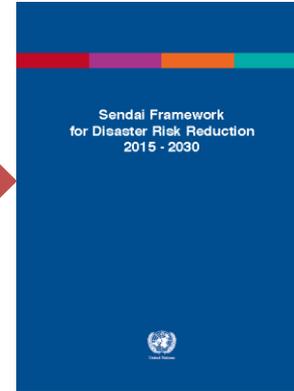
Partners: International Food Policy Research Institute (IFPRI), Indian Institute of Technology (IIT)-Gandhinagar, Indian Institute of Water Management (IIWM-ICAR)\*; Agriculture Insurance Corporation of India, MoA; Bajaj Allianz, Insurer, Swiss Reinsurance



A water-secure world

[www.iwmi.org](http://www.iwmi.org)

# Sustainable Development and Disaster Risk Reduction



**Chart of the Sendai Framework for Disaster Risk Reduction 2015-2030**

**Scope and purpose**

The present framework will apply to the risk of small-scale and large-scale, frequent and infrequent, sudden and slow-onset disasters, caused by natural or manmade hazards as well as related environmental, technological and biological hazards and risks. It aims to guide the multi-hazard management of disaster risk in development at all levels as well as within and across all sectors.

**Expected outcome**

The substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries

**Goal**

Prevent new and reduce existing disaster risk through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery, and thus strengthen resilience

**Targets**

Substantially reduce global disaster mortality by 2030, aiming to lower average per 100,000 global mortality between 2020-2030 compared to 2005-2015	Substantially reduce the number of affected people globally by 2030, aiming to lower the average global figure per 100,000 between 2020-2030 compared to 2005-2015	Reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030	Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030	Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020	Substantially enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation of this framework by 2030	Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to people by 2030
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**Priorities for Action**

There is a need for focused action within and across sectors by States at local, national, regional and global levels in the following four priority areas.

<b>Priority 1</b> Understanding disaster risk	<b>Priority 2</b> Strengthening disaster risk governance to manage disaster risk	<b>Priority 3</b> Investing in disaster risk reduction for resilience	<b>Priority 4</b> Enhancing disaster preparedness for effective response, and to «Build Back Better» in recovery, rehabilitation and reconstruction
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## The Four Priorities for Action

- Priority 1. Understanding disaster risk
- Priority 2. Strengthening disaster risk governance to manage disaster risk
- Priority 3. Investing in disaster risk reduction for resilience
- Priority 4. Enhancing disaster preparedness for effective response and to “Build Back Better” in recovery, rehabilitation and reconstruction

# Partners and engagement



RESEARCH PROGRAM ON  
Water, Land and  
Ecosystems



RESEARCH PROGRAM ON  
Climate Change,  
Agriculture and  
Food Security



...and many, many more.



“Be aware of risk while we are safe  
Awareness leads us preparedness  
Preparedness leaves us no regret”

Source: Zuo Qiuming “Zuoshi Commentary” in Confucius ed. ”Spring and Autumn”, 480BC