

# Water Resilience

A Kerala case

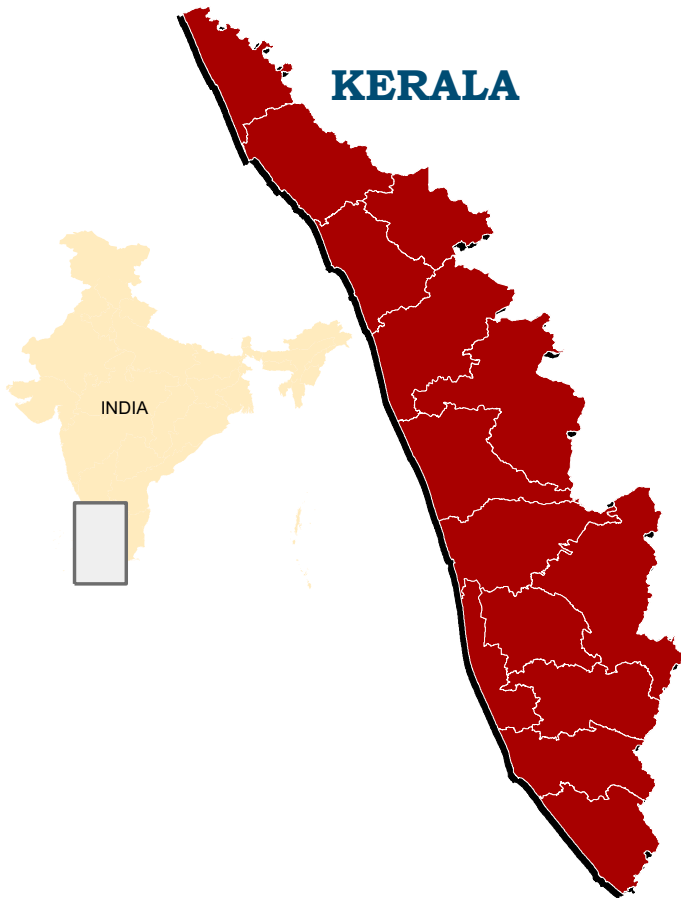


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**Dr. Sekhar L. Kuriakose**  
**Member Secretary, KSDMA, Dept. of Disaster Management**  
**&**  
**Chief Resilience Officer, Kerala, Dept. of Environment**

# Kerala at a Glance

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**Capital: Thiruvananthapuram**

**Geographical area: 38,863 km<sup>2</sup>**

**Population: 33.38 million**

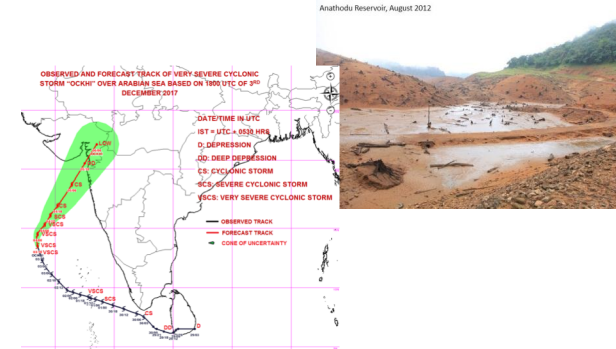
**Population Density: 859/km<sup>2</sup>**

**Administrative Districts: 14**

**Average Annual Rainfall: 3100 mm**

# Recent disaster events in Kerala

Event	Year	Damage/Fatality
Drought	2012-13	₹23.78 billion
Drought	2016	₹9.93 billion
Floods & Landslides	2018	451 fatalities
Floods & Landslides	2019	125 fatalities
Landslides	2020	69 fatalities
Landslides	2021	27 fatalities



# The SENDAI Framework

## 1 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

## 1 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

## 4 PRIORITIES

Understanding disaster risk

Strengthening disaster risk governance to manage disaster risk

Investing in disaster risk reduction for resilience

Enhancing disaster preparedness for effective response, and to "Build Back Better" in recovery, rehabilitation and reconstruction

## 7 TARGETS

- ↓ DISASTER MORTALITY BY 2030
- ↓ NUMBER OF AFFECTED PEOPLE BY 2030
- ↓ ECONOMIC LOSS BY 2030
- ↓ INFRASTRUCTURE DAMAGE BY 2030
- ↑ DRR NATIONAL/LOCAL STRATEGIES BY 2020
- ↑ INTERNATIONAL COOPERATION BY 2030
- ↑ EWS AND DR INFORMATION BY 2030

# 1924 Floods



99ലെ വെള്ളപ്പൊക്കത്തിന്റെ ബാക്കി. പാവുശിനടുത്ത് പുതിയകാവ് അമ്പലത്തിൽ വെള്ളം കയറിയ അടയാളം.



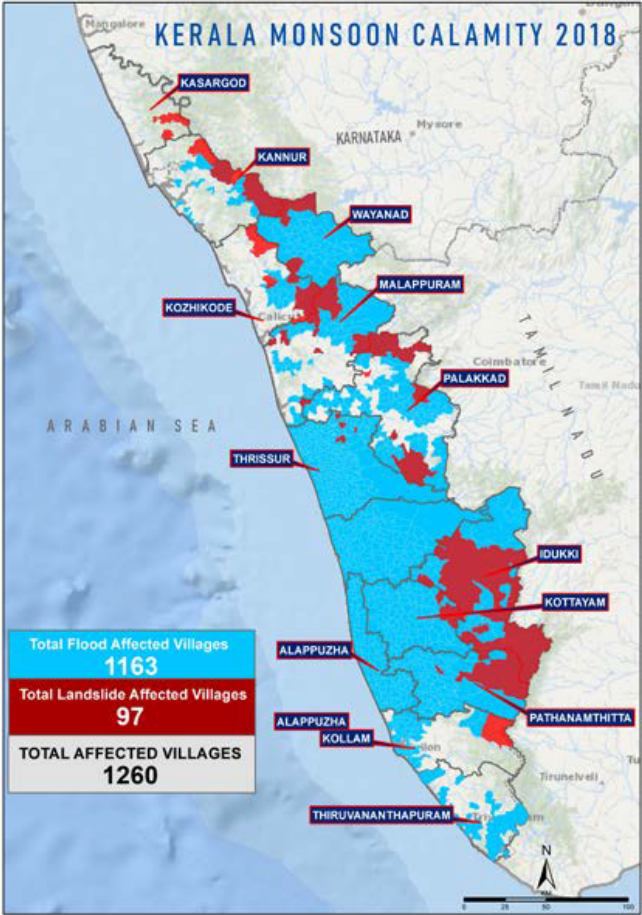
99ലെവെള്ളപ്പൊക്കം. മൂന്നാറിൽനിന്നുള്ള കാഴ്ച.



99ലെവെള്ളപ്പൊക്കം. മൂന്നാറിൽനിന്നുള്ള കാഴ്ച.

- **Recorded fatality of over 10,000**
- **No consolidated record of economic losses**

# 2018 Floods



**All 14 districts affected**

**1260/1664 villages affected**

**687 km<sup>2</sup> land flooded**

**Over 5000 landslide**

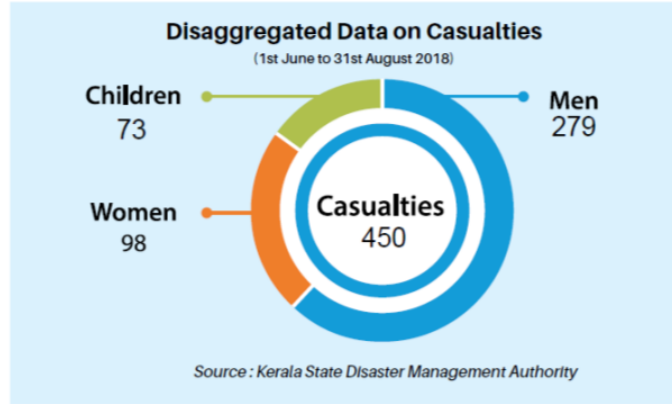
1260 out of 1664 villages were affected

687 km<sup>2</sup> area of land marooned

14,315 houses fully damaged

2,70,000 houses partially damaged

0.15 Million Ha of standing crops damaged



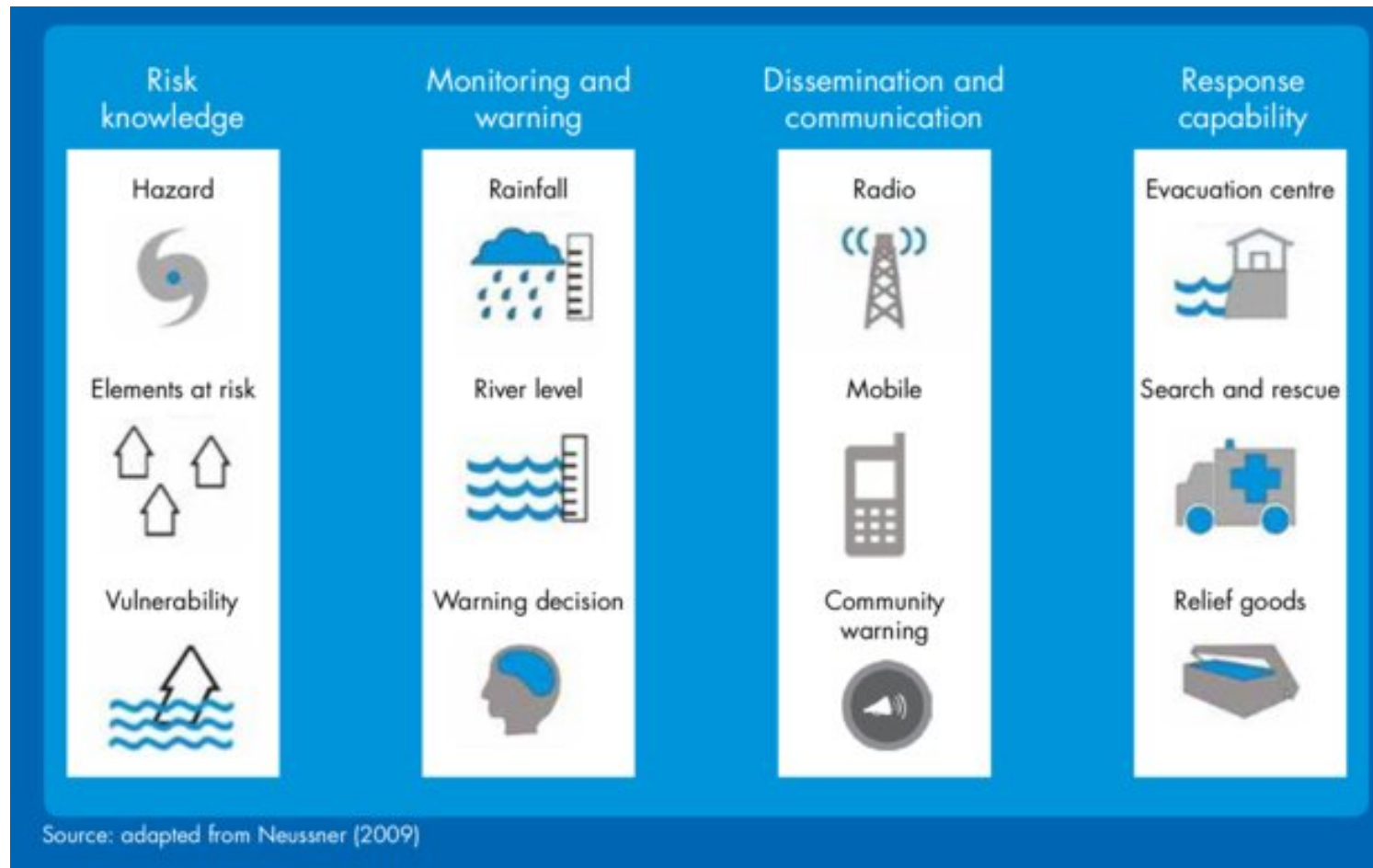
7,51,000 poultry & 7,953 domestic animals lost

3 million electric connections damaged

510 Bridges and Culverts damaged

9538 kms of Major roads and 77,328kms of rural roads damaged

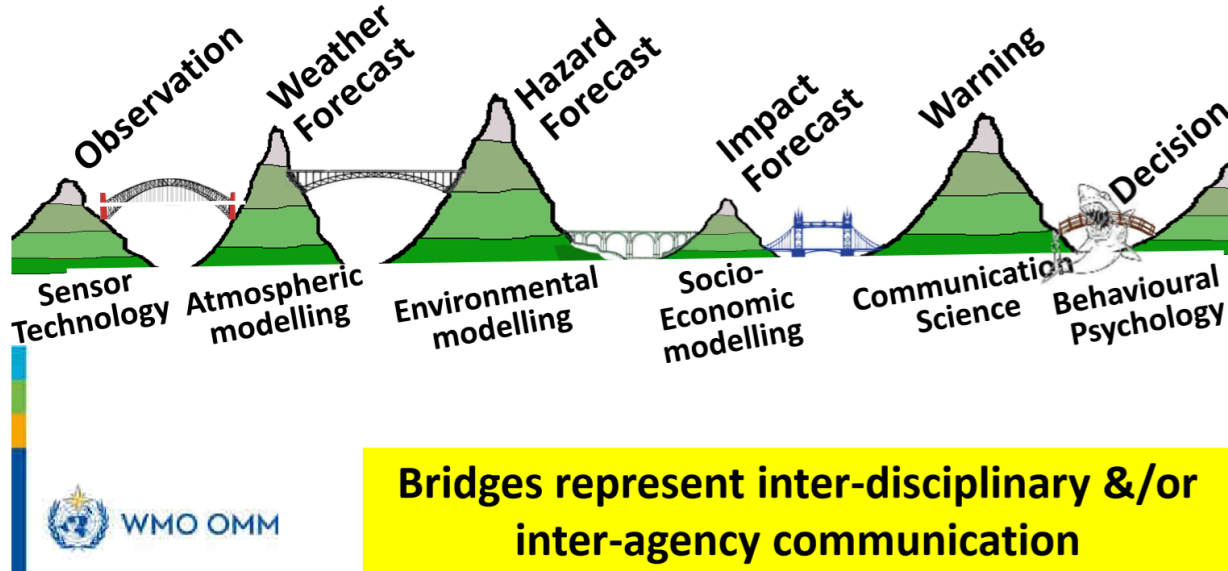
# A conceptual framework of EWDS



# A systemic thinking of Early Warning



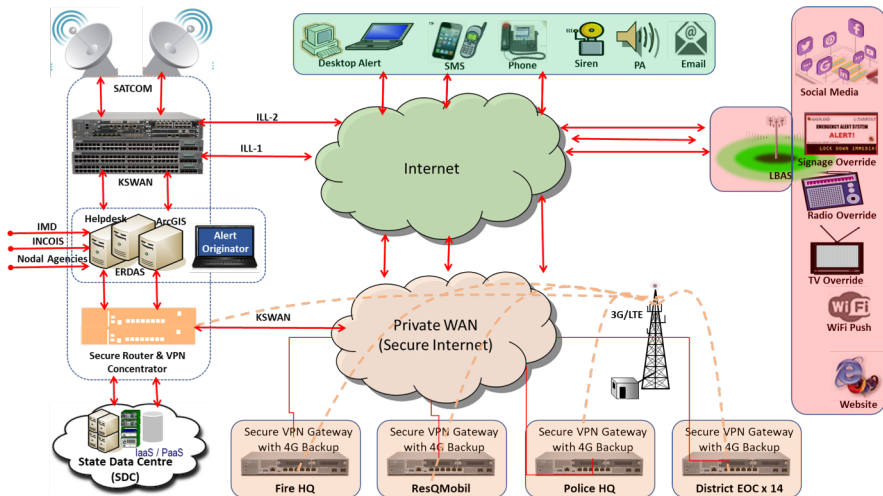
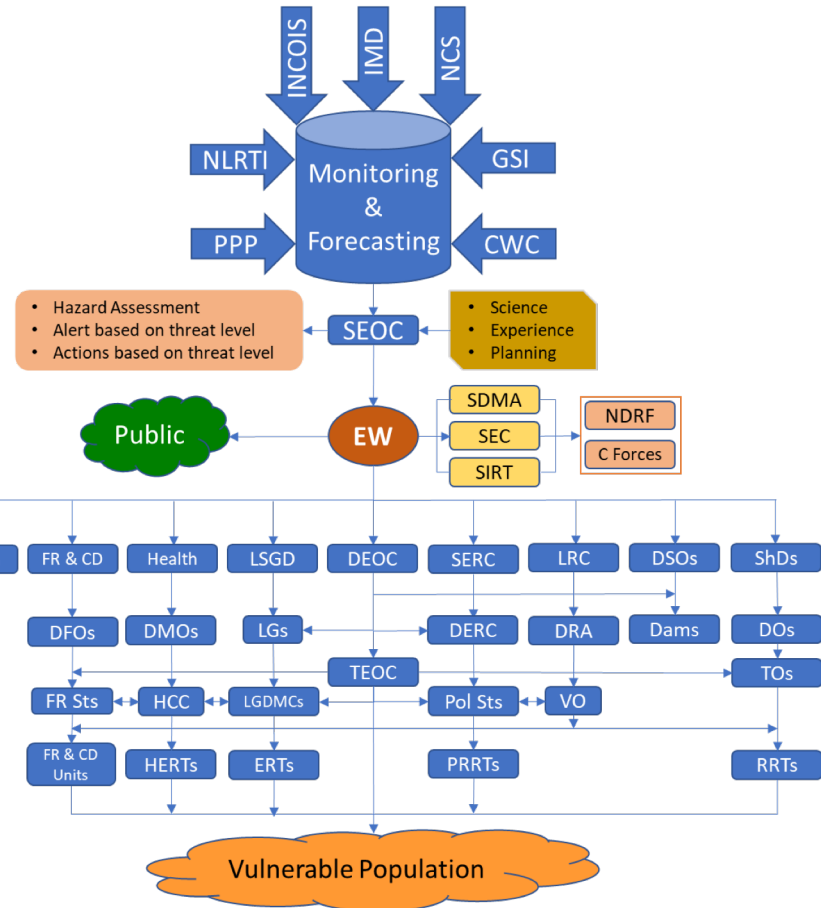
## Conceptual Warning Process: **the 5 valleys of death**





# കുവലം (The Shield)

## KaWaCHaM (Kerala Warnings, Crisis & Hazards Management system)



# കുവുലം (The Shield)

## KaWaCHaM (Kerala Warnings, Crisis & Hazards Management system)

- Intelligent decision support system integrating all SOPs
- Integrates geological & hydro-meteorological sensors in the State
- Integrates forecasting systems of hydro-meteorological hazards
- Backend geodatabase of 280 layers
- Scenario libraries of climate change
- Impact forecasts and assets generated automatically
- ML/AL capable with scalability
- Devised to cover 78 Taluqs, 14 districts and State via VPN
- 1034 local governments, 128 Fire & Rescue Services and 20 Fisheries Stations also under one network



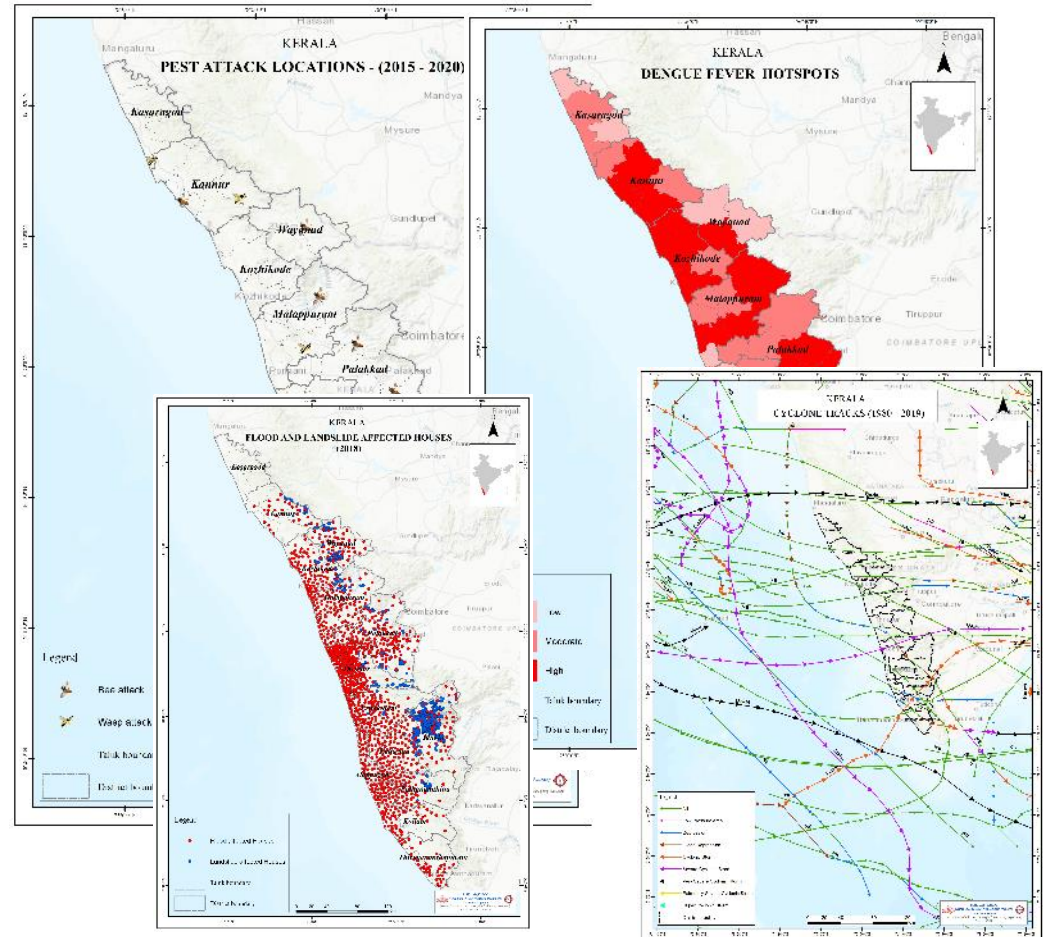
shutterstock.com - 2112002479



# Risk Knowledge - HVRA Version 2

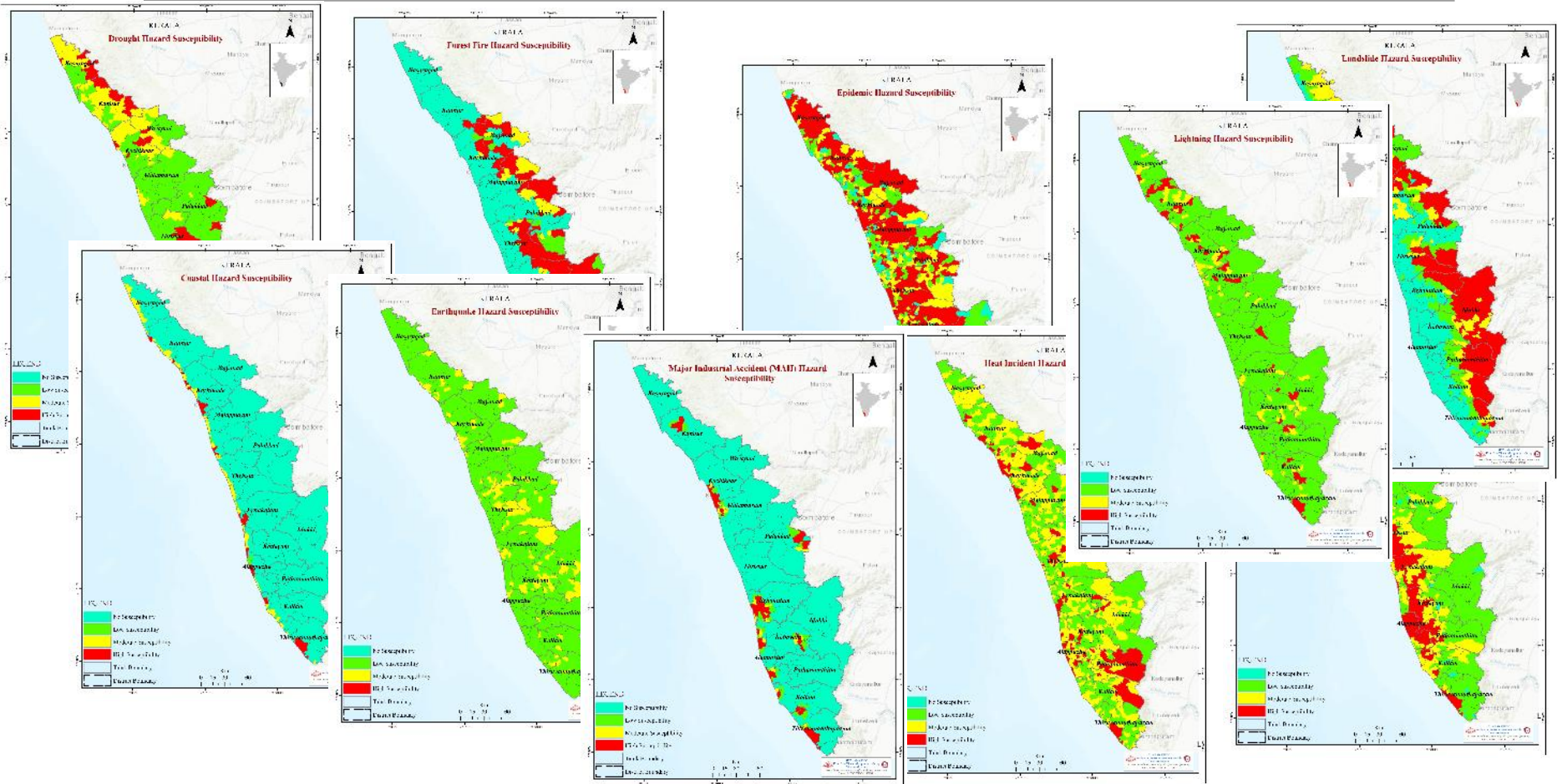
## ➤ Hazard maps

- Prepared by KSDMA in Risk Lab
- No consultancy services are used
- Version 1 was done in 2016
- Version 2 based on risk indexing approach
- Local Governments ranked based on risk index for priority actions



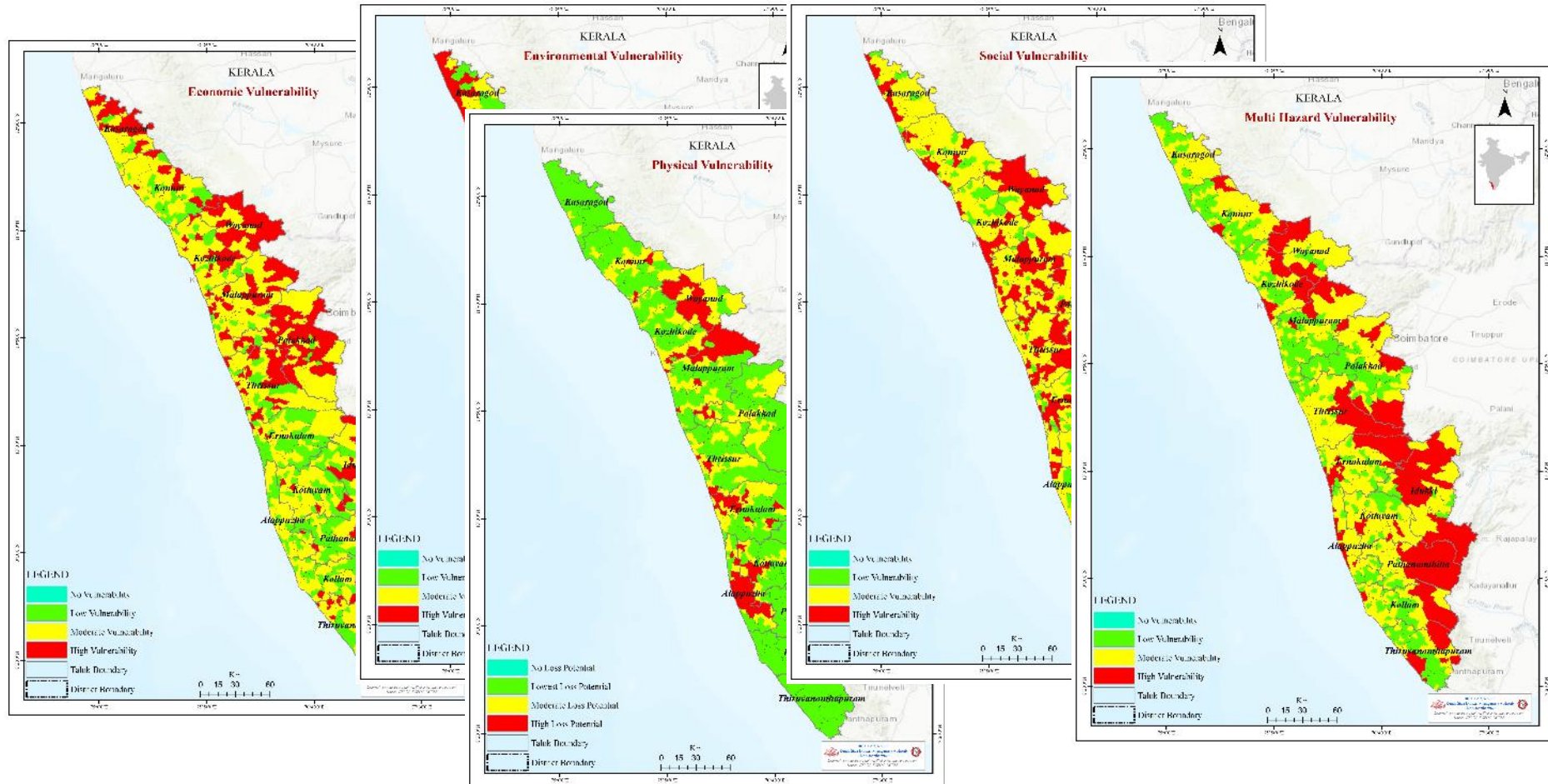
# Risk Knowledge - HVRA Version 2

## ➤ Hazard susceptibility index



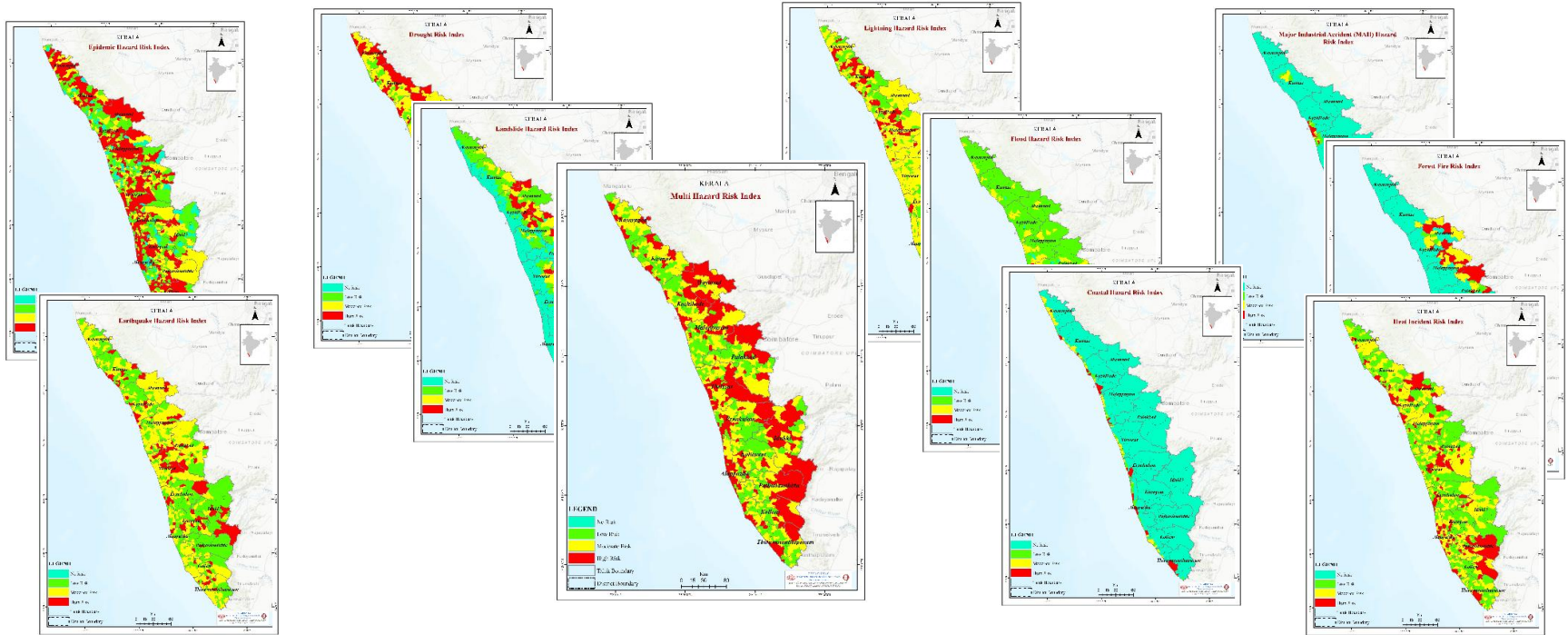
# Risk Knowledge - HVRA Version 2

## ➤ Vulnerability index



# Risk Knowledge - HVRA Version 2

## ➤ Risk index



Risk Index included in Disaster Management and Climate Action Tracking Tool of the Local Governments vide GO (Ms) No. 137/2022/LSGD dated 29-6-2022

# Monitoring Systems – Weather Observation Systems

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## 100 AWS (IMD-KSDMA)

- Project conceived, site selection and land by KSDMA (Govt. of Kerala Ltr. No. DMA1/447/2018/DMD dated 6-10-2018; GO (Rt) No. 725/2019/DMD dated 18-10-2019)
- Deployment of AWS and continued maintenance by IMD

## 100 AWS (Skymet)

- Data as a service model
- Additional 4 AWS each deployed every year at sites recommended by KSDMA

## 30 ARG (IMD)

## 13 AWS (WRD), 97 ARGs (WRD)

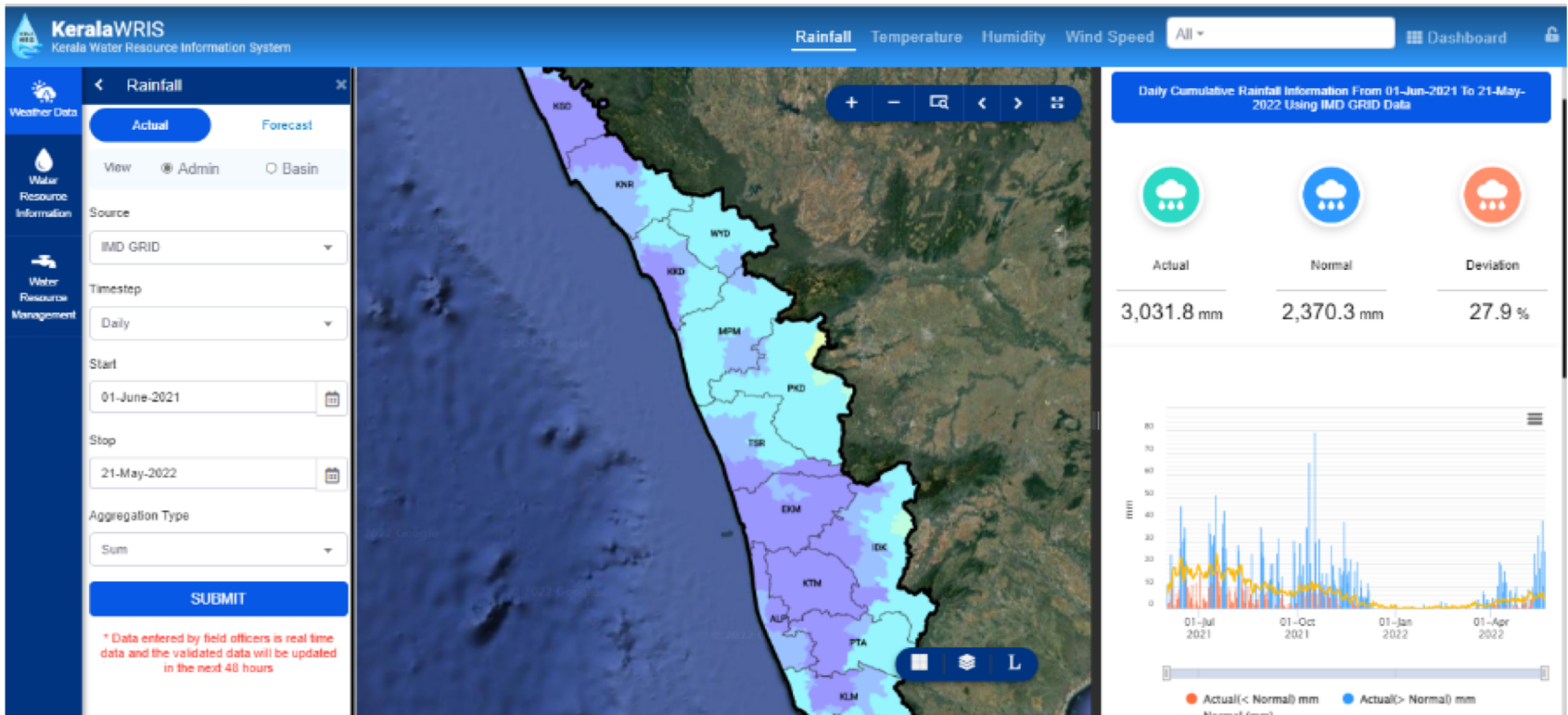
## 4 Lightning detectors



Water Resources Department  
Government of Kerala

EARTH  
NETWORKS®

# Monitoring Systems – Water Resources



**46 Automatic Water Level Recorders; 800 Ground Water Observation Wells**



# Monitoring Systems – Seismic monitoring systems

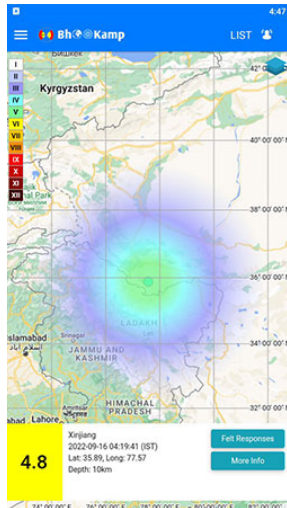


## ❑ National Seismic Centre

- Entire India and Indian Ocean covered
- Data streamed through API to KaWaCHaM

## ❑ KSEB-KSDMA

- 3 seismographs streaming locally
- 3 accelerometers in Idukki



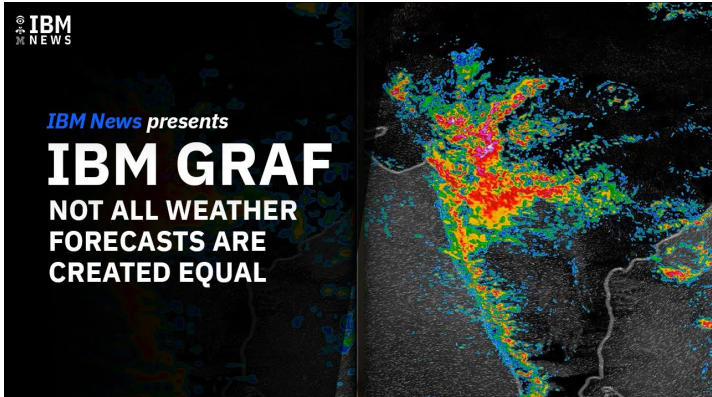
# Weather forecast



- IMD WRF
- IMD GFS

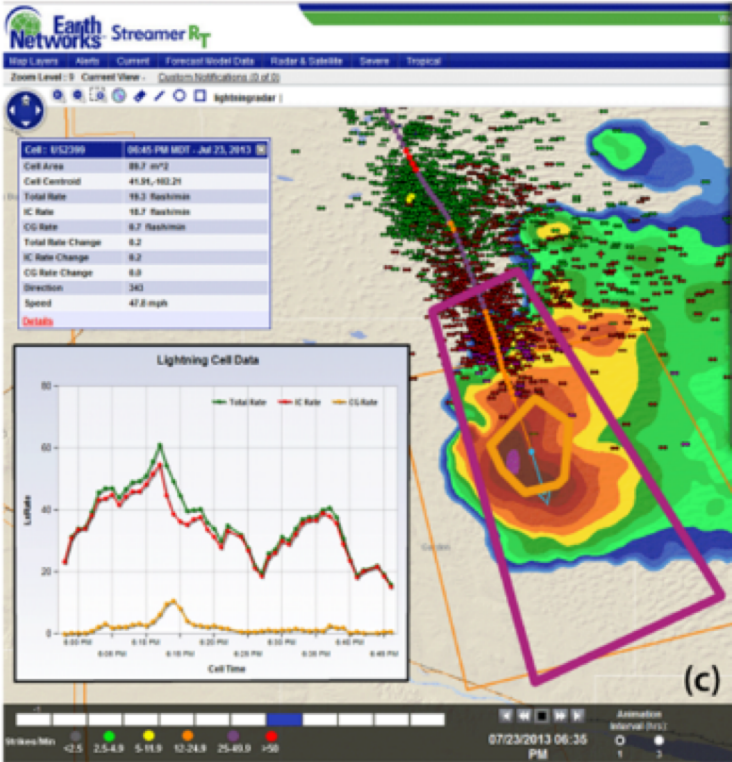
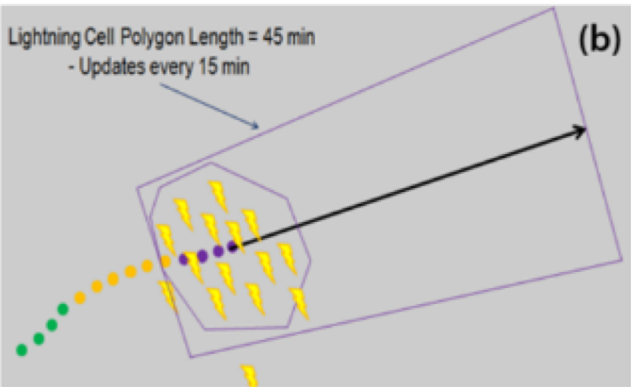
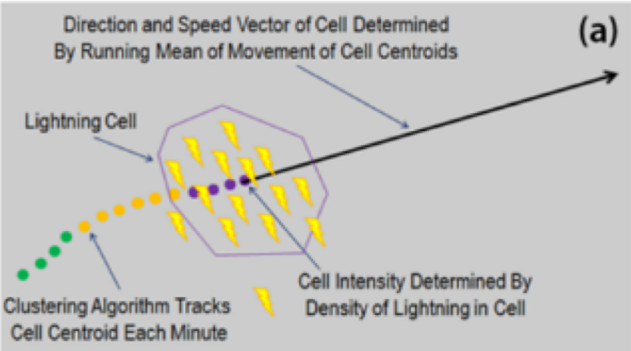


- NCUM



- GFS

# Lightning hazard forecast



# Coastal hazard forecast



- Cyclone Forecast API
- Radar data streams

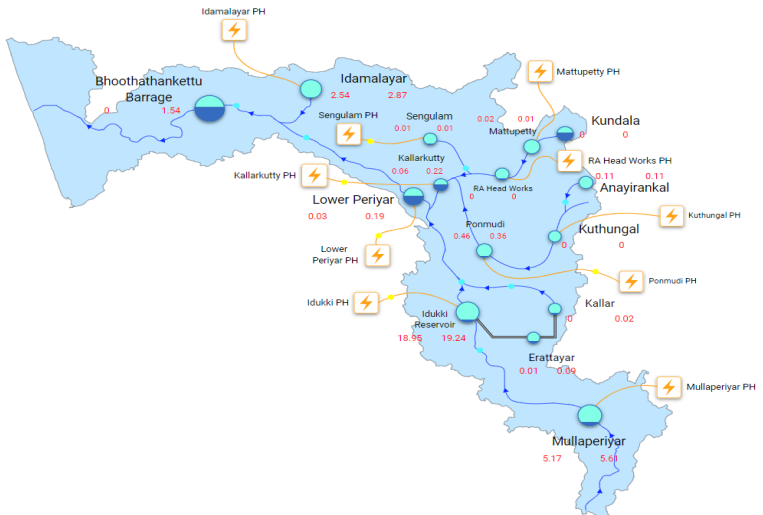


- Cyclone Forecast API

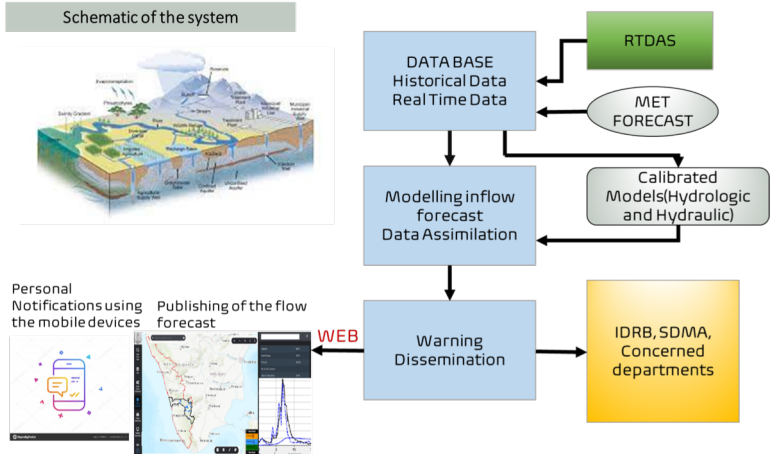
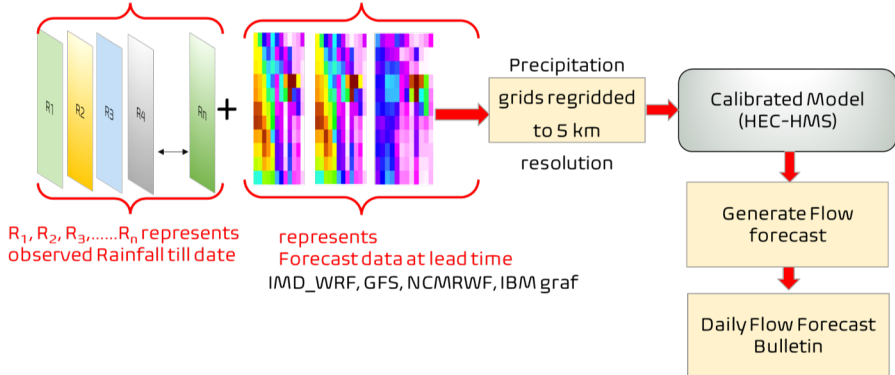


- Tsunami API
- Tidal (L & H) API
- High wave API

# Periyar Flood Early Warning System

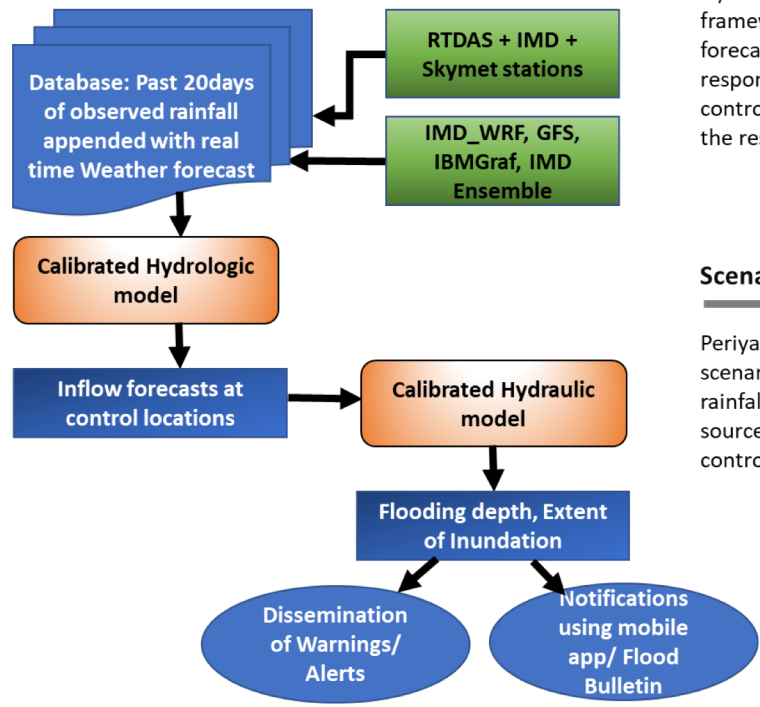


## HEC-HMS run in forecast



# The Periyar FEWS

## Periyar FFEWS framework



### Modelling Framework

Hydrological cum hydraulic model framework with real-time weather forecast which integrates catchment response, influence of reservoirs, control structures, local abstractions on the response of Periyar Basin to rainfall

### Scenario Based Analysis

Periyar FFEWS provide “what-if” scenarios to assess likely impact of rainfall forecasts from multiple sources, catchment conditions and control structures

### Flow Forecast At Multiple Timescales

The Periyar FFEWS system is operated at daily, sub daily or hourly scale to ensure continuous monitoring for potential flood risk

### Warning System for Flood Management

The real-time flow forecasts provide advance warning of the probable magnitude and timing of flooding and is crucial in decision support systems for flood management

### User Interface for Information Dissemination

User interface includes graphical and map based displays, model results, reports, mobile app with alarms and warning information

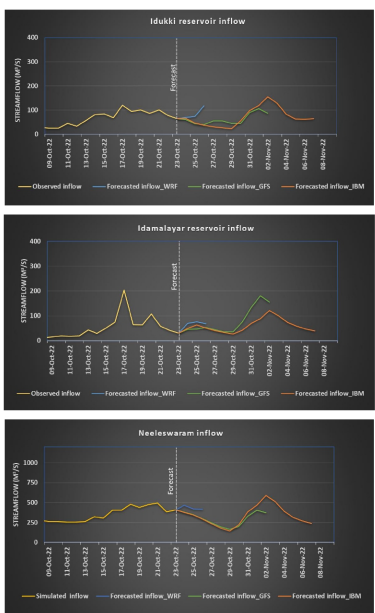
# Periyar FEWS – Bulletin

DEVELOPMENT OF REAL TIME OPERATION OF RESERVOIRS INTEGRATED WITH FLOOD FORECASTING AND WARNING SYSTEM FOR PERIYAR AND CHALAKUDY BASIN IN THE STATE OF KERALA



## Periyar Basin Observed and Forecasted Streamflow

Date: 24 - October - 2022



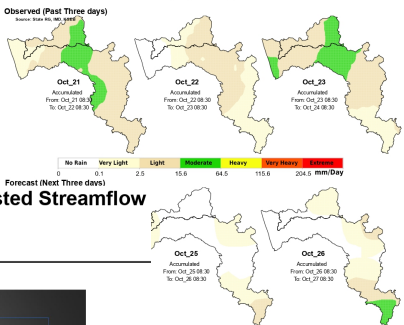
## DAILY FLOW FORECAS



24 October 2022  
Issued Time: 10:00AM

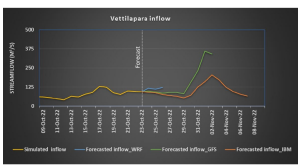
## Periyar Basin Observed and Forecasted Rainfall

24 October 2022



## Periyar Basin Observed and Forecasted Streamflow

Date: 24 - October - 2022



### Forecasted Streamflow magnitudes

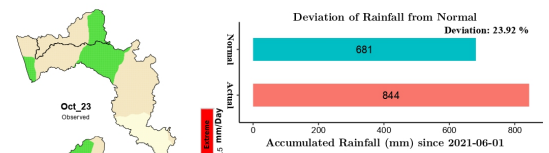
Date	Forecasted inflows in m³/s using GFS data			
	Idukki reservoir	Idamalayar reservoir	Neeleswaram	Vettilapara
24-Oct-22	60.8	45.8	381.3	97.4
25-Oct-22	44.2	47.6	349.4	93.3
26-Oct-22	39.7	53.2	297.8	84.8
27-Oct-22	56	44.9	249.1	89.7
28-Oct-22	54.9	36.2	197.9	90
29-Oct-22	44.8	35.5	165.8	81.5
22-Oct-22	45.4	74.9	201.2	156.4
23-Oct-22	90.5	134.4	330.5	232.3
24-Oct-22	103.9	180.3	406.5	359.6
25-Oct-22	86.8	156	372.8	342.6

Date	Forecasted inflows in m³/s using WRF data			
	Idukki reservoir	Idamalayar reservoir	Neeleswaram	Vettilapara
24-Oct-22	69.6	69.9	466.8	118.3
25-Oct-22	74.1	76.3	421.9	111.1
26-Oct-22	117.2	67.9	416.7	121.9

## Periyar Basin Observed and Forecasted Rainfall

24 October 2022

### Comparison of Observed Rainfall with forecast at different lead times



Source: Observation- State RG, IMD, KSEB  
Forecast- IMD-GFS

No	Name	Station	Observed		Forecast	
			Day0	Day1	Day1	Day2
1	Vandanamshu	1	10.9	27.9	10.9	27.9
2	Aluva	16.2	3.9	6.4	1.6	
3	Ithoolathanchettu	1.8	3.1	10.1	9.8	
4	Chinnor	0	15.2	30.8		
5	Koerampara	NA	1.5	9.3	11.3	
6	Kamil	0	20.1	80.6	12.2	
7	Mathukkam	0.7	3.5	8.1	0.7	

## Periyar Basin Observed and Forecasted Streamflow

Date: 24 - October - 2022

Date	Forecasted inflows in m³/s using IBM data			
	Idukki reservoir	Idamalayar reservoir	Neeleswaram	Vettilapara
24-Oct-22	65.6	49.9	377.2	90.5
25-Oct-22	46.3	63.3	345.3	87.8
26-Oct-22	37.5	50.7	293.2	76.6
27-Oct-22	31.3	41	237.1	69.3
28-Oct-22	27.2	32.9	181.7	65.7
29-Oct-22	22.5	27.1	145	53.9
30-Oct-22	55	41.4	222	71
31-Oct-22	98.5	70.3	384	126.4
01-Nov-22	118.5	88.8	467.5	159.5
02-Nov-22	155.5	121.1	587.6	204.9
03-Nov-22	127.5	99.7	514.5	172.7
04-Nov-22	83.1	73.5	393.8	123.4
05-Nov-22	63.7	58	313.9	96.5
06-Nov-22	62.2	47.3	269.8	78.6
07-Nov-22	64	38.8	238.5	66.4

**Forecast Summary:** As per all forecast sources, Idukki region is expected to receive light rainfall for today with average inflow within the range of 60 to 70 cumecs.

As per WRF forecast source, Idamalayar region is expected to receive moderate rainfall for today with average inflow within the range of 70 cumecs. IBM and GFS forecast source is showing light rainfall for the region with average inflow within the range of 45 to 50 cumecs.

Chalakyady basin is expected to receive moderate rainfall for today as per WRF forecast source.

# Pamba Flood Early Warning System

Observed Rainfall (GPM, KWRD, IMD, KSEBL)      Rainfall Forecast (IMD, GFS, ICONS)



**HEC-HMS**

**Calibration**

**Reservoir Inflow**

**Subbasin inflow**

**Lumped Mass Rainfall Runoff Model**

*Analysis of results comparing with onsite values and updating flood library*

**HEC-RAS**

**Flow**

**Depth**

**Hydraulic Model**

**Inundation Map**

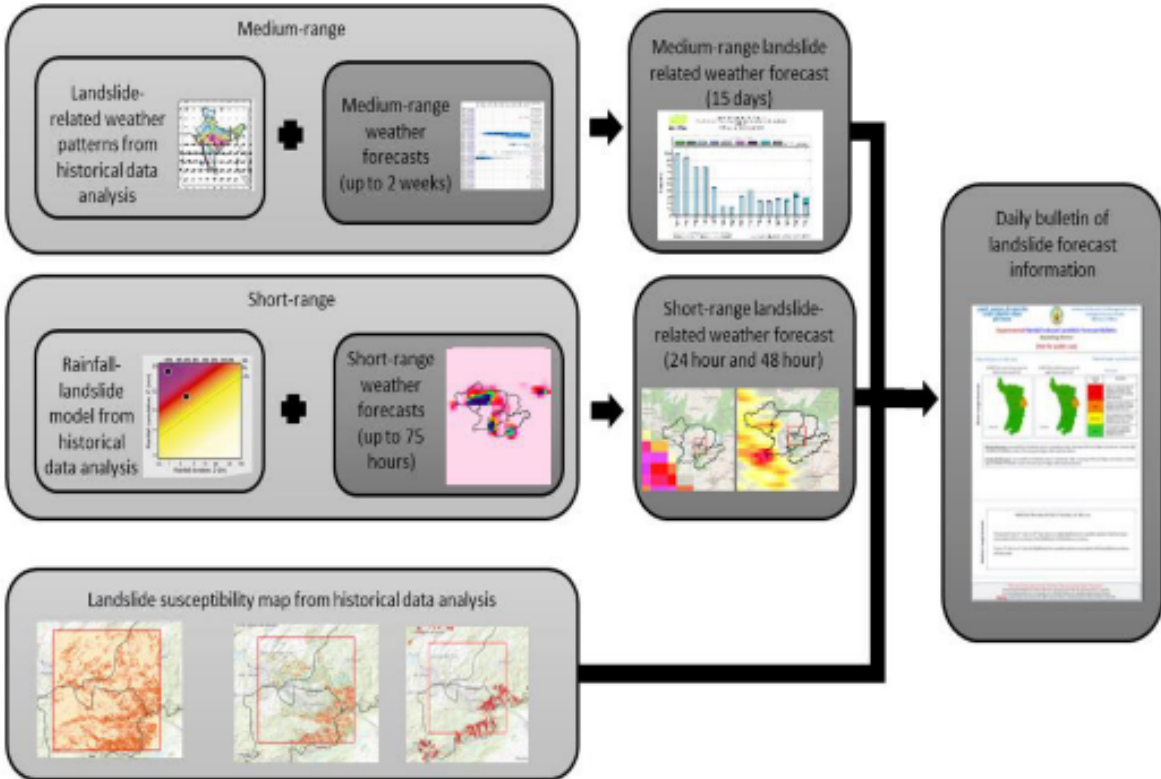


# Landslide Early Warning System

a collaborative project of Geological Survey of India and KSDMA



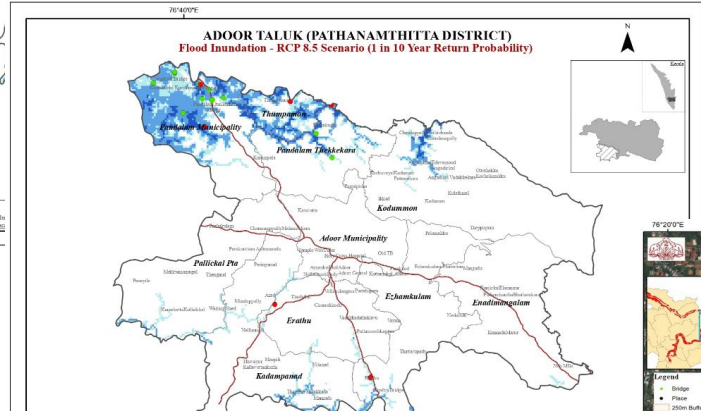
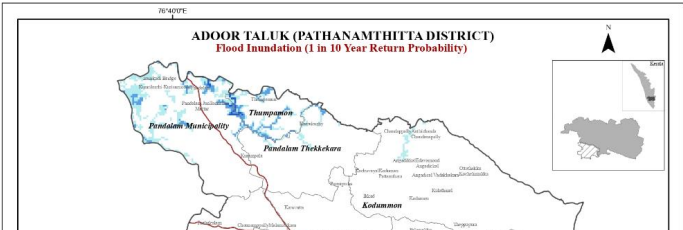
## Science



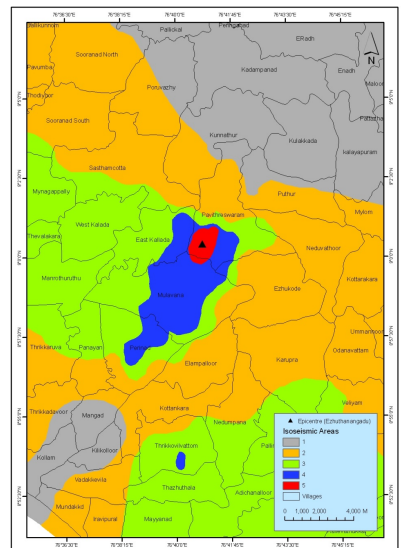
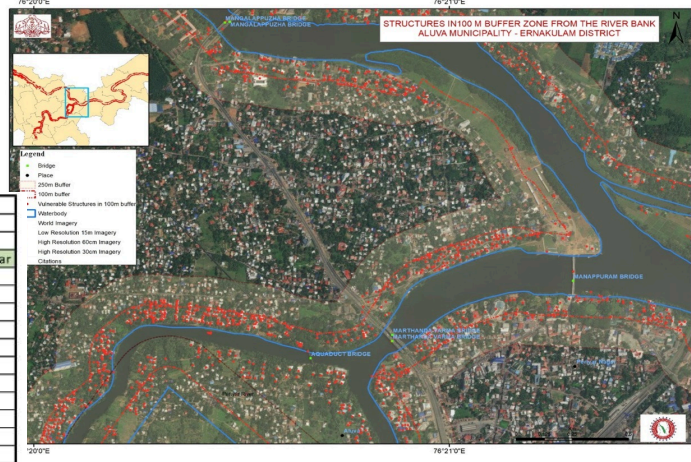
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# Impact forecast

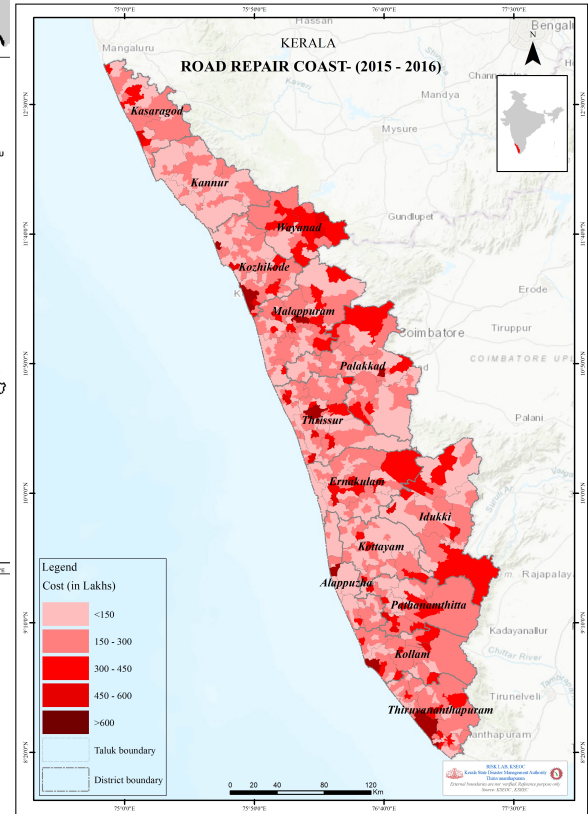
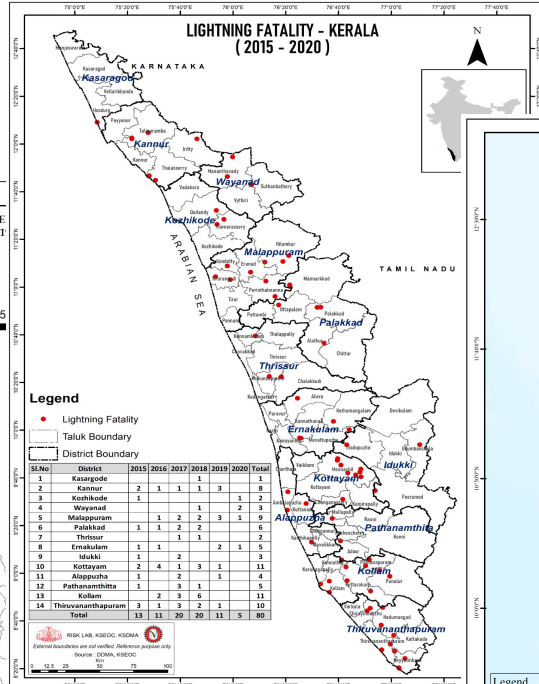
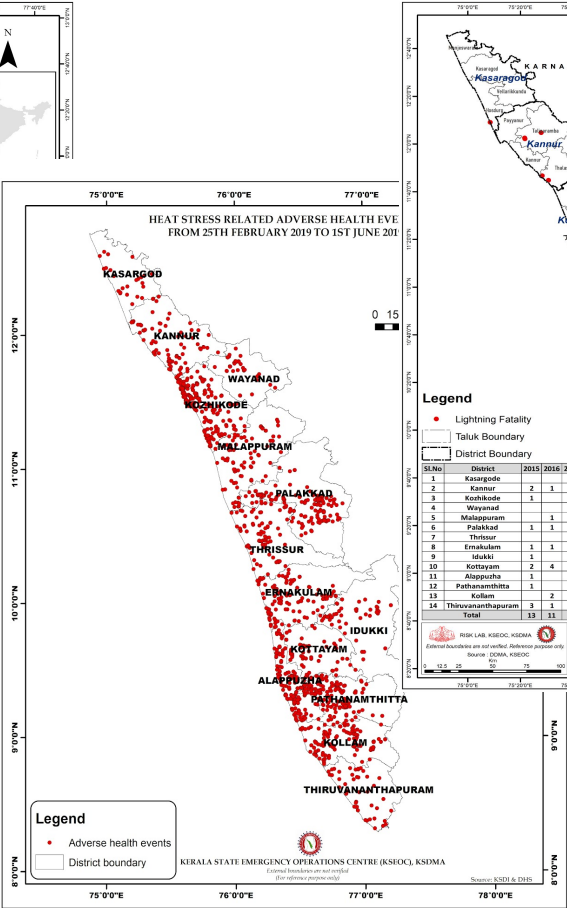
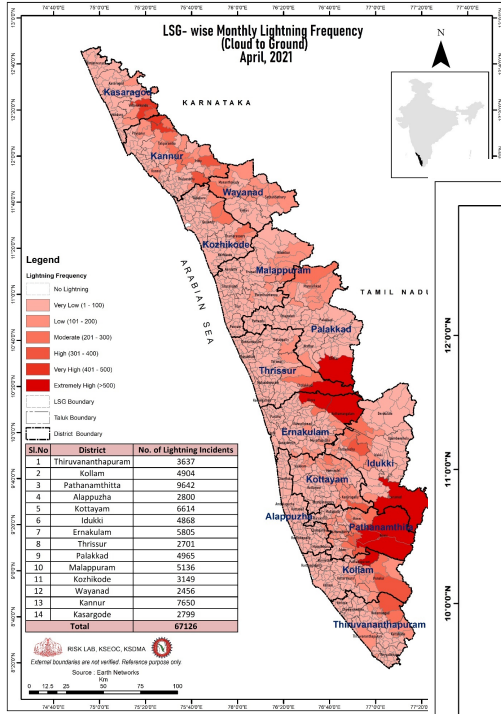
- ❑ Scenario library – floods, cyclones
- ❑ Multi scenario assessment of impacts
- ❑ Major critical assets covered
- ❑ On-the-fly map outputs of critical assets



PATHANAMTHITTA DISTRICT ADOOR TALUK						
Name of exposed Hospital/School (LSGI)	Return Probability (Historic)					
	1 in 10 Year	1 in 25 Year	1 in 50 Year	1 in 100 Year	1 in 200 Year	1 in 500 Year
<b>Erathu</b>						
School						
Erathu	✓	✓	✓	✓	✓	✓
<b>Ezhankulam</b>						
Hospital						
St Thomas Hospital, Malakara					✓	✓
School						
Ezhankulam						✓
<b>Pandalam Municipality</b>						
School						
Govt. S.V.L.P.S Cherical						✓
Govt.U.P.S Mangaram						✓

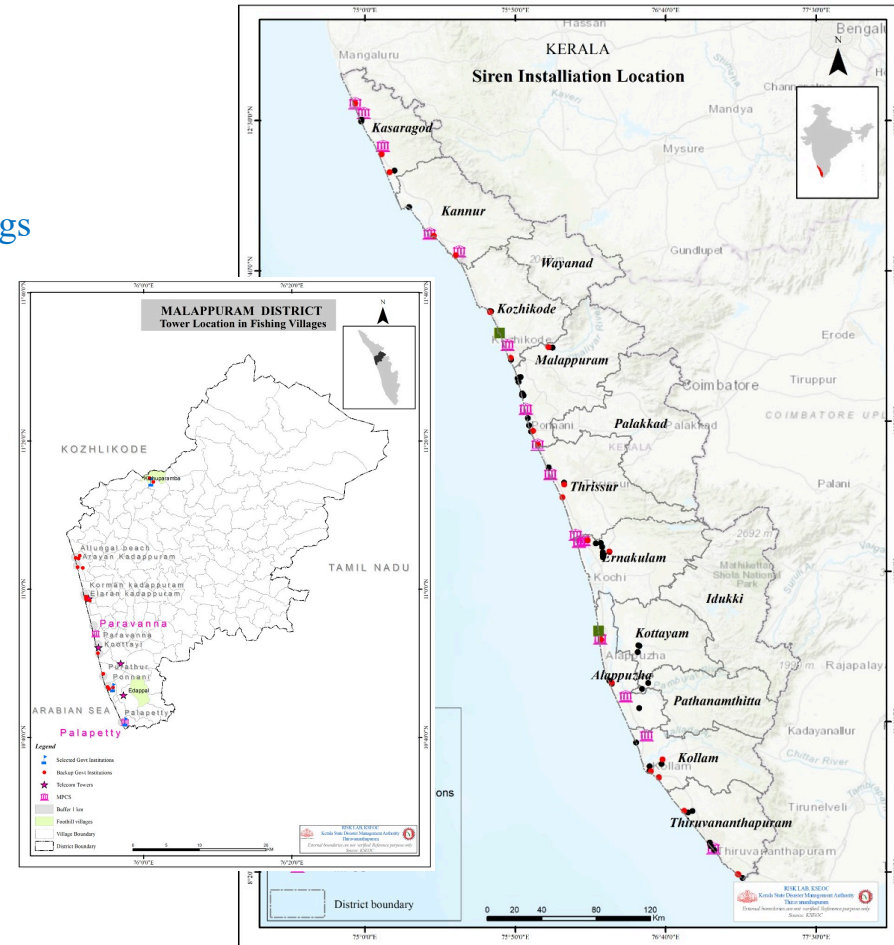


# Impact monitoring



# Sirens and Strobe lights

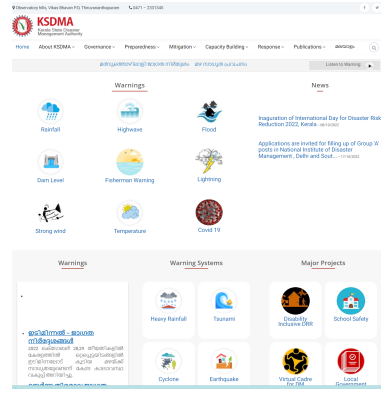
- 126 sirens and strobe lights in towers and Govt. Buildings
- 14 DEOCs, 78 TEOCs, 20 Fishing Centres, 128 Fire Stations
- Pre-recorded voice & hooting incorporated for various warnings
- Connected through 2 wired and 2 wireless systems
- Can activate from site and EOCs (State, District to Taluk)



# Warning dissemination

## CAP integrated alerting

- Website
- WhatsApp Groups, Facebook, Twitter, GoKApp
- Emails
- Hotlines
- GSM Mobiles
- Digital Radio Mobiles
- Satellite-based mobile data voice terminals (SBMDVT)
- IMARSAT Satellite Phones
- Location based messaging services (LBMS)
- Print, Audio & Visual media



# The SOPs – Monsoons & associate disasters

ORANGE BOOK OF DISASTER MANAGEMENT

2

2022

MONSOON PREPAREDNESS AND DISASTER  
RESPONSE GUIDELINES (Malayalam)

Edition 1 – 25 May 2019  
Edition 2 – 25 May 2020  
Edition 3 – 25 May 2021  
Edition 4 – 25 May 2022



Anticipatory Actions Guidelines approved under DM Act 2005

Unifies the actions of state and national actors

IRS notified through orange book and updated every year

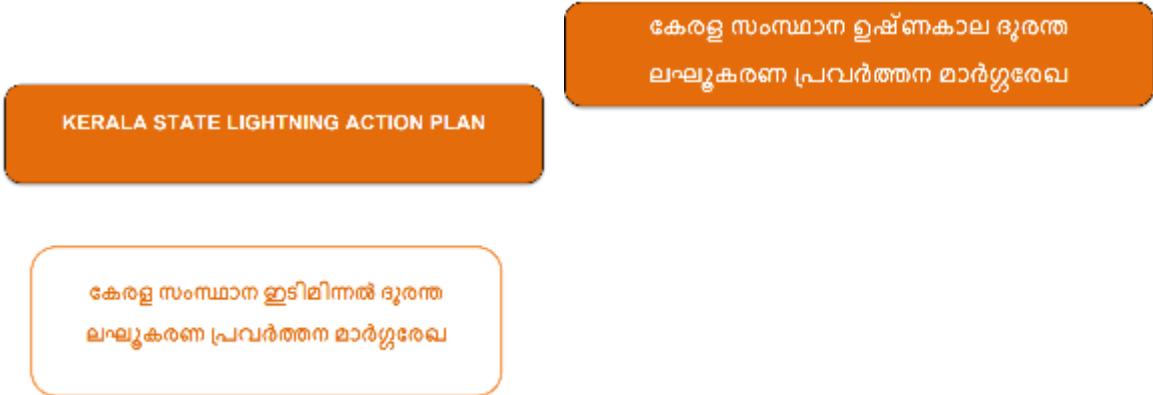
Covers 36 departments

Detailed coverage of financial and legal framework

Evaluation of monsoon prognosis by 24 agencies

Warning and anticipatory actions updated every year

# The SOPs – Heat and Lightning



Trainings held for departments

Trainings held for LSGs

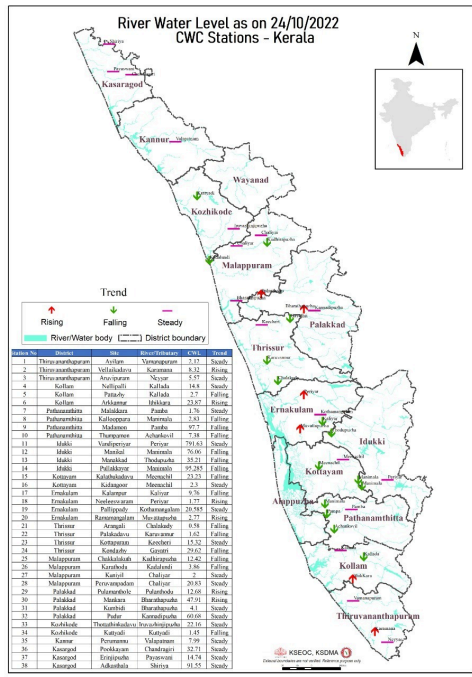
Linked to SDMF

ബനാം പരിഷ്കൃതം - 15 ജൂലൈ 2020

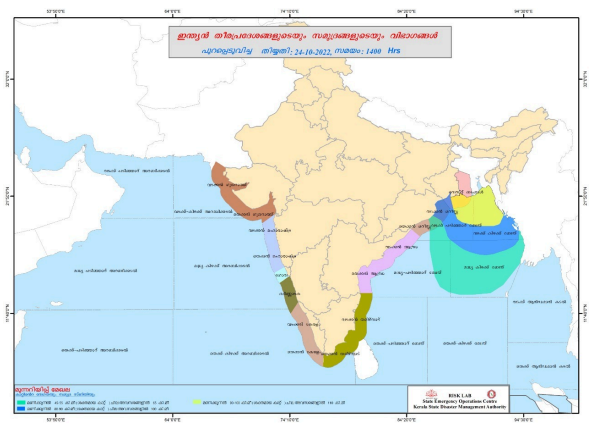
ബനാം പരിഷ്കൃതം



# Localising warnings



Reservoir Name	District	Water Level as on date (m/ft)	Alert Status (Today's Alert)	Spill (cumecs)
1. Malankara Sagar	Idukki	33.02	Yellow	43.34
2. Neyyar Sagar	Thiruvananthapuram	82.96	Yellow	9.70
3. Sivuvani (for TN use) Sagar	Palakkad	87.13	Yellow	0.14
4. Kattiyadi Sagar	Kozhikode	38.80	Yellow	24.40
5. Kizhappuzha Sagar	Wayanad	75.70	Yellow	4.72
6. Kallada Sagar	Kollam	99.56	Yellow	3.71
7. Kappappuzha Sagar	Palakkad	96.31	Yellow	10.06
8. Membraka Sagar	Palakkad	95.97	Orange	0.00
9. Malabar Sagar	Palakkad	282.34	Red	1.83
10. Malappuram Sagar	Palakkad	94.88	Red	15.57
11. Chuliyar Sagar	Palakkad	90.83	Blue	0.00
12. Panchi Sagar	Thiruvananthapuram	78.41	Orange	4.82
13. Mangalam Sagar	Palakkad	77.21	Orange	1.38
14. Manjeri (Barrage) Sagar	Pathanamthitta	34.20	Yellow	10.69
15. Bhoothanamettu (Barrage) Sagar	Ernakulam	29.50	Yellow	260.00
16. Modathura (Barrage) Sagar	Palakkad	81.30	Yellow	16.54
17. Pathassi (Barrage) Sagar	Kannur	64.38	Yellow	98.01



Alert (KSEB) in Kerala	Colour Code (Today's Alert)	Spill (cumecs)
Red	Red	2.95
Orange	Orange	2.40
Yellow	Yellow	4.99

Station	Water Level (m)	Alert Status	Spill (cumecs)
4. Sagarini Ponnudi	706.70	Red	231.61
6. Sagarini Kundala	421.05	Red	0.00
6. Sagarini Idukki	1758.10	Red	2.50
7. Sagarini Kallarkutti	456.10	Red	15.00
8. Sagarini Mooliyar	187.70	Yellow	1.81

District	24.10.2022	25.10.2022	26.10.2022
തിരുവനന്തപുരം	L to M	L to M	L to M
കൊല്ലം	L to M	L to M	L to M
പാലക്കാട്	ISOL_H	L to M	L to M
തൃശ്ശൂർ	L to M	L to M	L to M
കോട്ടയം	L to M	L to M	L to M
എറണാകുളം	L to M	L to M	L to M
ഇടുക്കി	ISOL_H	L to M	L to M
തൃശ്ശൂർ	L to M	L to M	L to M
പാലക്കാട്	L to M	L to M	L to M
തൃശ്ശൂർ	L to M	L to M	L to M
കോട്ടയം	L to M	L to M	L to M
കണ്ണൂർ	L to M	L to M	L to M
കാസർഗോഡ്	L to M	L to M	L to M

**Indian Meteorological Department's District Wise Rainfall Forecast For Next Five Days**

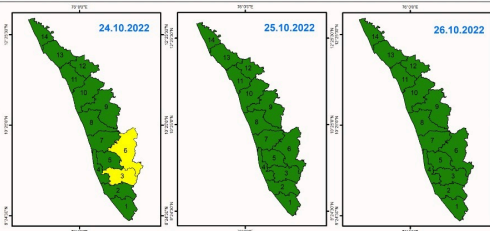
**216 (൧16.൧൧) mm** (Kerala)

**24.10.2022 13:00 hrs**

Intensity	24.10.2022	25.10.2022	26.10.2022
Light (Moderate)	25 - 155 mm	156 - 645 mm	645 - 1155 mm
Heavy	645 - 1155 mm	1156 - 2044 mm	>2045 mm

**Alert (KSEB) in Kerala**

Alert	Colour Code	Spill (cumecs)
Red	Red	2.95
Orange	Orange	2.40
Yellow	Yellow	4.99



Alert	Colour Code	Spill (cumecs)
Red	Red	2.95
Orange	Orange	2.40
Yellow	Yellow	4.99

Station	District
1. Sagarini Ponnudi	Thiruvananthapuram
2. Sagarini Kundala	Kollam
3. Sagarini Idukki	Pathanamthitta
4. Sagarini Kallarkutti	Alappuzha
5. Sagarini Mooliyar	Kottayam
6. Sagarini Chuliyar	Idukki
7. Sagarini Chuliyar	Ernakulam
8. Sagarini Chuliyar	Thiruvananthapuram
9. Sagarini Chuliyar	Palakkad
10. Sagarini Chuliyar	Malappuram
11. Sagarini Chuliyar	Kozhikode
12. Sagarini Chuliyar	Wayanad
13. Sagarini Chuliyar	Kannur
14. Sagarini Chuliyar	Kasaragod



# Inclusive warnings

Disability Inclusive



Transgender Inclusive



Palliative Care Inclusive



Tribal DM Plans



# Disability Inclusive DRR – Recognition

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REFORMS THAT TRANSFORMED

"Kerala has done focused work on disability inclusive disaster risk reduction and the National Guidelines have been inspired by that work"

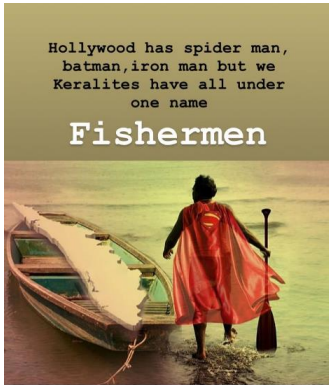
**Dr. Kamal Kishore, Member Secretary, National Disaster Management Authority**



"I am moved and touched deeply to see this Model Initiative of Kerala for considering Differently abled right from the preparedness stage"

**Dr. Eddie Ndopu, UN Secretary General's SDG Advocate**

# Response capacity – Community based systems



Legendary Fishermen

## Volunteers are utilized in

- Preparedness
- Rescue, Relief
- Animal care
- Technological Solutions
- Packaging, Sorting – Collection Centres
- Cleaning the houses
- Distribution of relief materials
- Counselling



Directorate of Voluntarism



**Local Government  
Emergency Response  
Teams**



Pan State Civil Defence



Aapda Mitra

# Response capacity – Shelters

---



- 17 specialized shelters across Kerala
- All coastal districts covered
- 20,000 buildings notified as camps which can house 350,000 people at a time

# Response Capability - Virtual Cadre

- 15 officers per department (26 departments)
- Separate training programmes for the virtual cadre officers
- Legalised under DM Act 2005 vide GO (Rt) No. 56/2017/DMD dated 25-11-2017
- <https://sdma.kerala.gov.in/virtual-cadre/>



## TRAINING MODULE

**Project**  
Virtual Cadre for Disaster Risk Reduction

**Department**  
Animal Husbandry Department

**Published by**  
Kerala State Disaster Management Authority

**Technical Support**  
UNDP & SEEDS India



Capacity Development of Virtual Cadre Officials of  
Eight Departments of Government of Kerala  
Training Needs Assessment  
30- Aug-2019

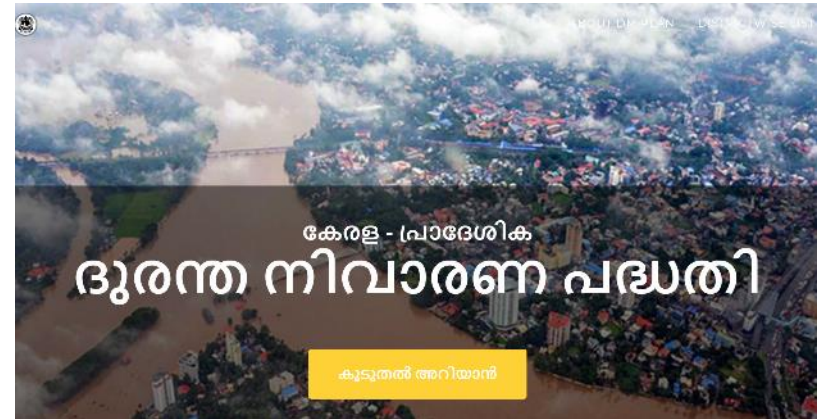


Kerala State Disaster Management Authority  
**In association with**  
United Nations Development Programme  
**And technical support by**  
SEEDS Technical Services, India

# Local Government Disaster Management Plans

- India's first pan state Disaster Management Plans of all Local Governments
- Mainstreamed through allocation of own funds by LSGs
- Separate working group under Panchayathi Raj Act for DRR

<https://dmp.kila.ac.in/>



# Local Government Disaster Management Plans – Capacity Building

- Several field level trainings
- Online trainings and open resource materials



<p>ഘട്ടം 1 നമ്മൾ നമുക്കായി</p> <p>Download</p>	<p>ഘട്ടം 2 Disaster Risk Reduction</p> <p>Download</p>	<p>ഘട്ടം 3 Disaster Preparedness</p> <p>Download</p>
<p>ഘട്ടം 4 Disaster Response</p> <p>Download</p>	<p>ഘട്ടം 5 Disaster Recovery</p> <p>Download</p>	<p>ഘട്ടം 6 Disaster Mitigation</p> <p>Download</p>
<p>ഘട്ടം 7 Disaster Management Plan</p> <p>Download</p>		

<https://www.kila.ac.in/dmp/>

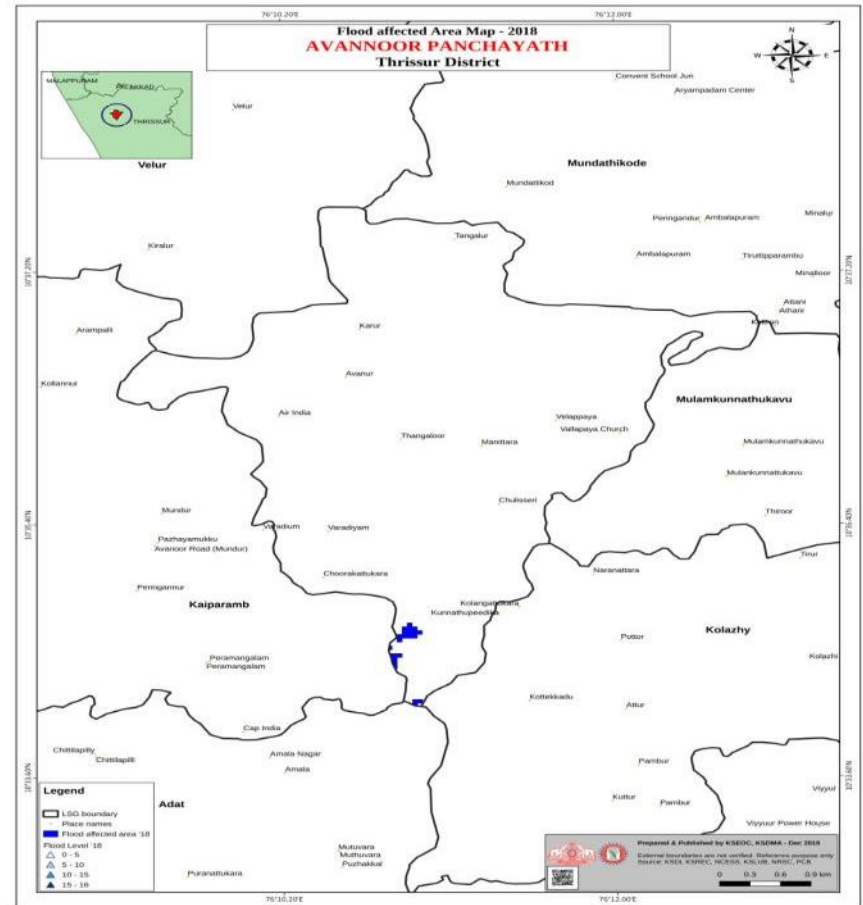
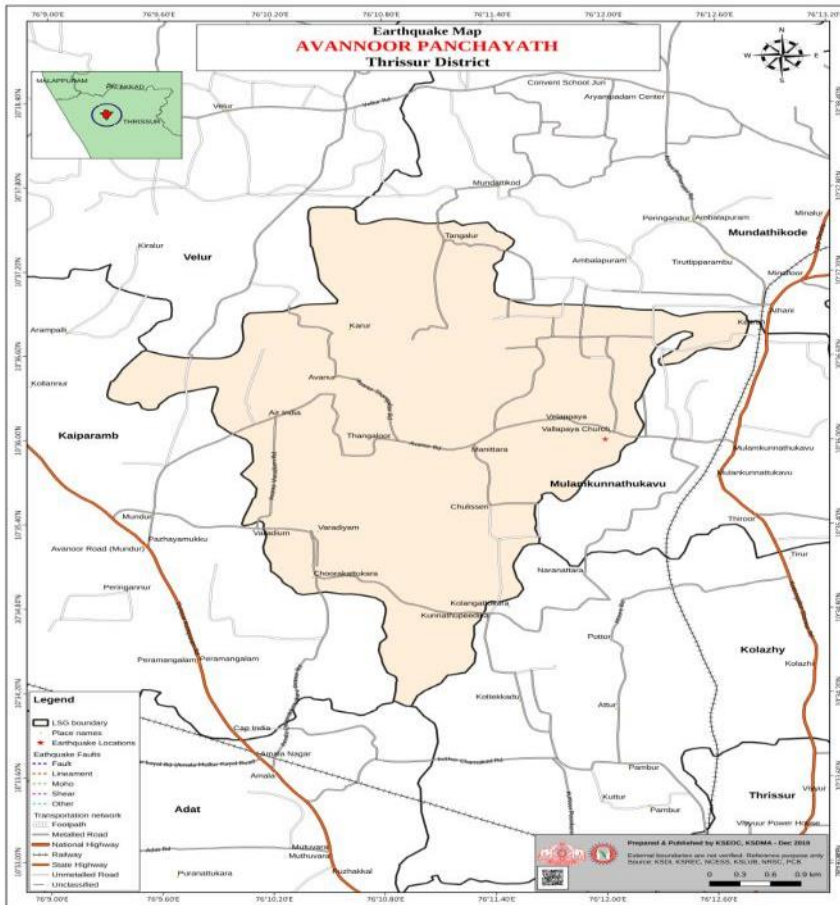
# Local Government Disaster Management Plans - Contents

- **Chapter 1: General Information**
  - ✓ Information about LSG
  - ✓ Revenue Villages
  - ✓ Population Statistics
  - ✓ Number of Wards
  - ✓ Major Occupation
  - ✓ Altitudes and graticules
- **Chapter 2: Disaster Proneness & Analysis**
  - ✓ Disaster Prone areas
  - ✓ Maps
- **Chapter 3: Disaster Response Plan**
  - ✓ Emergency Response teams
  - ✓ Capacity Building
- **Chapter 4: Preparation, Mitigation & Social Empowerment**
  - ✓ Social assessment of possible mitigations solutions
  - ✓ Capacity building of local community
- **Chapter 5: Capabilities & Resources**
  - ✓ Emergency Response Tools
  - ✓ Human Resource
- **Chapter 6: Climate Change Adaptation, disaster reduction & projects**
  - ✓ Projects to support disaster Management
  - ✓ Mitigation
  - ✓ Adaptation
  - ✓ Suggestions to others and tiers
- **Chapter 7: Key Contacts**
  - ✓ Emergency response contact list

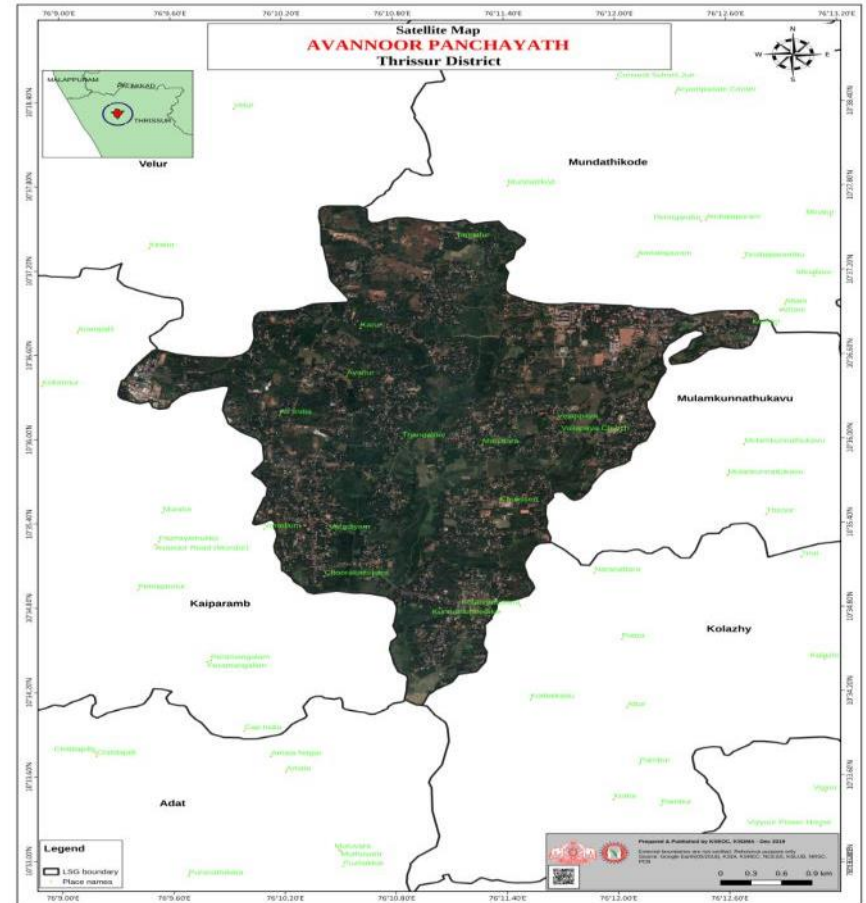
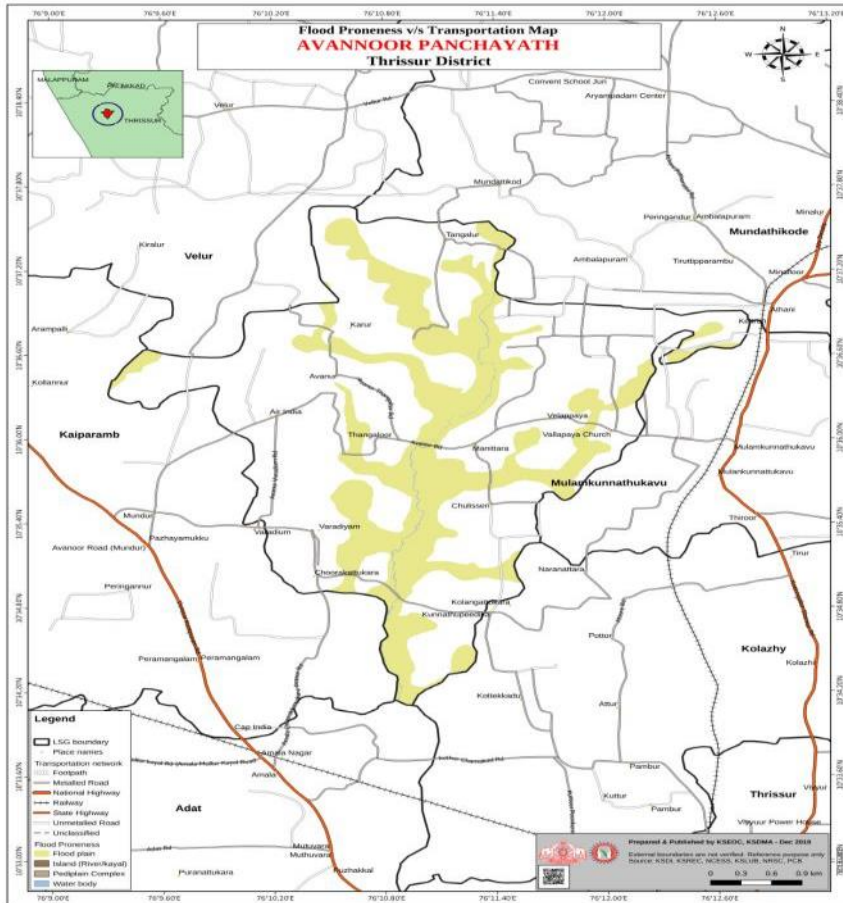




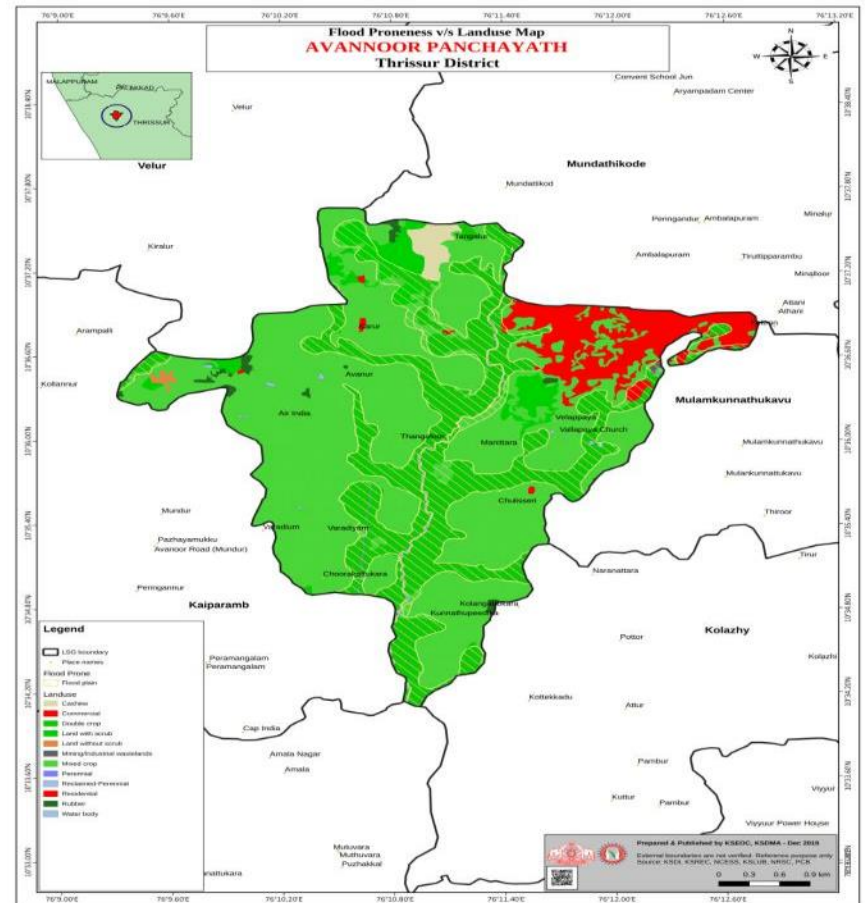
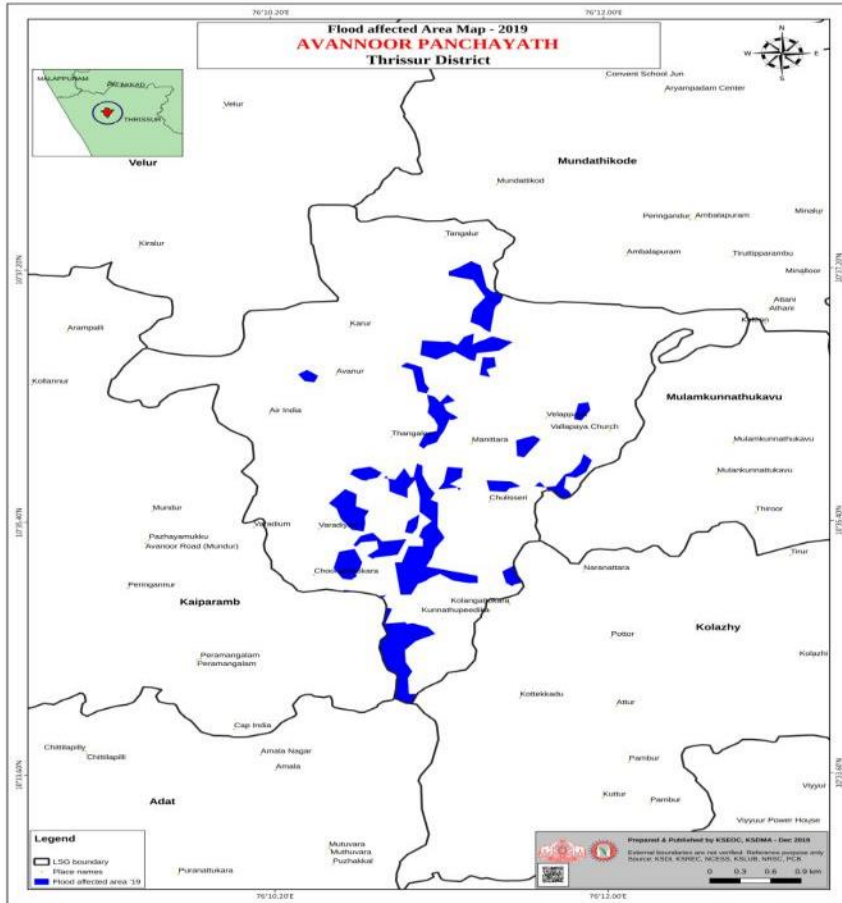
# Local Government Disaster Management Plans - Maps



# Local Government Disaster Management Plans - Maps



# Local Government Disaster Management Plans - Maps



# Local Government Disaster Management Plans

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## Received



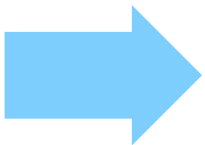
941

Panchayats



87

Municipalities



6

Corporations

1034

## Reviewed



District wise review  
(14 LSG DM Plan Coordinators)- **100 % plans**

Sector Wise Review  
(5 sectors specialists)-  
**10% of plans**

# Behavioural change – Mock drills

📍 Low plotting of location details of stranded people received through multiple channels and handed over to forces  
🚑 Rescue priority: pregnant women, children, elderly and persons with disabilities  
🚁 Biggest deployment of the armed forces for rescue operations in the history of the country

National Disaster Response Force 50 teams	Air Force 22 helicopters	Indian Army & FIC 23 columns	Navy 49 Boats	Coast Guard 34 boats & life rafts	BSF 4 Company including water wings
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**State Wide Field Mock Exercise on Floods and Landslide Response**  
 16-3-2022, 14:00 hrs IST to 16:30 hrs IST

**Table Top Exercise on Flood Response**  
 10-3-2022, 14:30 hrs IST to 17:30 hrs IST

Organised by  
 Kerala State Emergency Operations Centre  
 Kerala State Disaster Management Authority  
 Observatory Hills, Vikas Bhavan P.O  
 Thiruvananthapuram - 695033



# Behavioural change – IEC



കൺട്രോൾ റൂം - 100, 101, 1077, 1070, 1079

### പിടിക്കും തിരപകിടുകിരം

“സുരക്ഷ ഉറപ്പാക്കൂ”

“വായു-ജല-ശബ്ദം മലിനീകരണം, ബധിരത-അന്ധത-ശ്യാസന്ധ്യസം-പൊള്ളൽ എന്നിവയ്ക്ക് കാരണമാകും”

- പൊളിയുന്നതിനോടൊപ്പം കഠിന ശസ്ത്രം ഉള്ളവ ഒഴിവാക്കൂ
- താഴ്ന്നുവരുന്ന സമയങ്ങളിൽ മേന്മ കയ്യാടുക
- കുട്ടികൾ കൈകാര്യം ചെയ്യുന്നതത് ഒഴിവാക്കുക
- പൊള്ളലായ പരിരോധിക്കുന്നതിനോടൊപ്പം
- മരുന്നുകൾ ശുദ്ധമായ തരത്തിൽ കരുതുക

കേരള സംസ്ഥാന ദുരന്ത നിവാരണ അതോറിറ്റി  
 ഹെൽപ്പ് ടാപ്പ് നമ്പർ: കോവ്വേഴ്സ്, തിരുവനന്തപുരം - 696033, ഫോൺ: 0471-2331345, ഫാക്സ്: 0471-2331398  
 E-mail: keralasdma@gmail.com, www.sdma.kerala.gov.in

കൺട്രോൾ റൂം - 1077, 1070, 1079  
 തുറന്നു വെച്ചിട്ടുള്ളവയ്ക്ക് 25%

### ജലത്തെ ബഹുമാനിക്കൂ... വരൾച്ചയെ പ്രതിരോധിക്കൂ..!

കിണറുകൾ കുളങ്ങൾ തണുപ്പിക്കരുത് എന്നിവയെ സംരക്ഷിക്കൂ.. പരിപോഷിപ്പിക്കൂ..!

മഴവെള്ള സംരക്ഷണം ഉറപ്പാക്കുക.. അമിതജലം മണ്ണിൽ താഴ്ന്നു അനുവദിക്കുക.

കേരള സംസ്ഥാന ദുരന്ത നിവാരണ അതോറിറ്റി  
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 Email: keralasdma@gmail.com, www.sdma.kerala.gov.in

കൺട്രോൾ റൂം 100, 101, 1077, 1070, 1079

### മുങ്ങിമരണം

“സുരക്ഷ ഉറപ്പാക്കൂ”

- ജലത്തെ ബഹുമാനിക്കൂ
- വെള്ളത്തിൽ ഇറങ്ങുമ്പോൾ, നിരീക്ഷകനായി ഒരാളെ കരയ്ക്കിക്കൂ
- ആ വ്യക്തിയുടെ കൈവശം നീളമുള്ള കയറും കാറ്റ് തിരിച്ച റൂഡുണ്ണും കരുതുക
- കുട്ടികളെ നീന്തൽ പരിശീലിപ്പിക്കൂ

കേരള സംസ്ഥാന ദുരന്ത നിവാരണ അതോറിറ്റി  
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 E-mail: keralasdma@gmail.com, www.sdma.kerala.gov.in

# Pluvial Flood Mitigation – Operation Anantha

### Short- term Goals

- Cleaning and desilting of drains
- Shifting of KWA pressure pipes across canals
- Completion of box culvert at Thampanoor

### Long- term Goals

- Restoration of water bodies
- Widening of railway culvert at Thampanoor
- Strengthening for solid waste management through Suchitwa mission in consultation with experts



Attakulangara right side Culvert- PWD



Aryasala



IN THE HIGH COURT OF KERALA AT ERNAKULAM

PRESENT:

THE HONOURABLE THE CHIEF JUSTICE MR.ASHOK BHUSHAN  
&  
THE HONOURABLE MR.JUSTICE A.M.SHAFFIQUE

TUESDAY, THE 5TH DAY OF APRIL 2016/16TH CHAITHRA, 1938

WA.No. 2745 of 2015 IN WP(C).26377/2015

AGAINST THE JUDGMENT IN WP(C) 26377/2015 DATED 23.09.2015  
.....

APPELLANTS/RESPONDENTS 1 TO 7 IN WPC.:  
-----

1. STATE OF KERALA  
REPRESENTED BY ITS CHIEF SECRETARY TO GOVERNMENT,  
GOVERNMENT SECRETARIAT, TRIVANDRUM-695 001.

# Pluvial Flooding – Operation Breakthrough

## Operation Breakthrough, 2019

- **Kochi City** was flooded due to improper urban drainage during the rainy spell of 21-10-2019. Critical assets including the main power sub-station and arterial roads were flooded.
- An urban flood mitigation project, Operation Breakthrough was launched following the best practices of Operation Anantha
- **Rs. 20 crores**





# Drought Mitigation

## Jalavarshini

The project funds are exclusively for restoration of ponds in the State

Some landmark outputs under the concept of this scheme are:

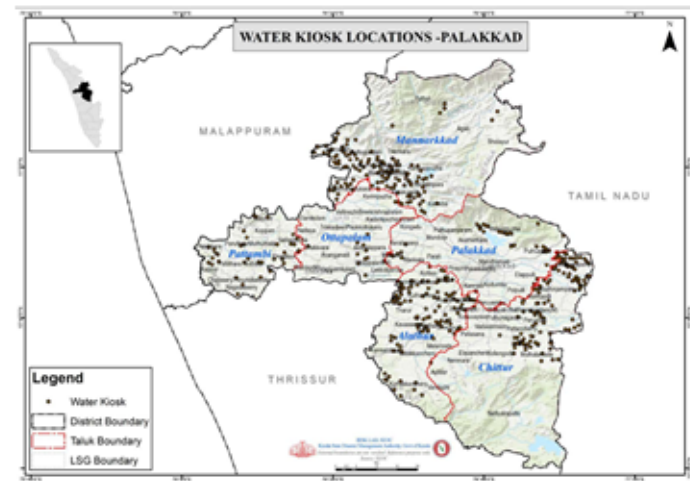
- **Ente Kulam Ernakulam, 2016:** Cleaned 51 ponds in various panchayaths of Ernakulam district with the help of 'Anbodu Kochi', a social media group of like-minded individuals. This may be the first scheme in the country which would have leveraged a social media group for disaster risk reduction
- **Kulam Koru Biriyani Tharam scheme of Kozhikode district, 2016:** Cleaned 26 ponds under this scheme.



# Drought Mitigation

## Water Kiosks

- Water supply through GPS monitored tankers
- This model offers the following advantages:
  - a) Reduce pilferage
  - b) Ensure transparency of water usage
- Total of 5000 such kiosks are there across the state



# Drought Mitigation

## Subsurface Dykes 2017

- Ozhalappathy in Vadakarapathy panchayath of Palakkad district is Kerala's most perennially drought prone.
- KSEOC supported Centre for Earth Science Studies in creating a model subsurface dyke in the temple pond of Mariyamman Kovil of Ozhalappathy. By this project, the non-perennial temple pond became perennial and holds 50,000 liters of water.

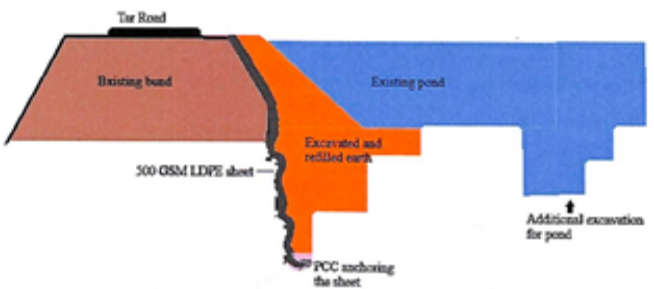
### അടിയനയായി; വടകരപ്പതിയിൽ വരൾച്ച അടിയറവു പറഞ്ഞു

എം.പി.നൂപുക്കുമാരൻ

വടകരപ്പതി നദീതടങ്ങളിൽ നടന്നു പിടിച്ചു കയറിയ വരൾച്ചയെ തടയുന്നതിനായി പലപ്പോഴും നടന്നു വന്നിട്ടുള്ള പദ്ധതികളിൽ പലതും പരാജയപ്പെട്ടിട്ടുണ്ട്. എന്നാൽ ഇപ്പോൾ നടന്നു വരുന്ന പദ്ധതികളിൽ പലതും പരാജയപ്പെട്ടിട്ടുണ്ട്. എന്നാൽ ഇപ്പോൾ നടന്നു വരുന്ന പദ്ധതികളിൽ പലതും പരാജയപ്പെട്ടിട്ടുണ്ട്. എന്നാൽ ഇപ്പോൾ നടന്നു വരുന്ന പദ്ധതികളിൽ പലതും പരാജയപ്പെട്ടിട്ടുണ്ട്.



വടകരപ്പതി നദീതടങ്ങളിൽ നടന്നു പിടിച്ചു കയറിയ വരൾച്ചയെ തടയുന്നതിനായി പലപ്പോഴും നടന്നു വന്നിട്ടുള്ള പദ്ധതികളിൽ പലതും പരാജയപ്പെട്ടിട്ടുണ്ട്. എന്നാൽ ഇപ്പോൾ നടന്നു വരുന്ന പദ്ധതികളിൽ പലതും പരാജയപ്പെട്ടിട്ടുണ്ട്.



# Drought Mitigation

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## Rubber Check Dams

Panathady, Kasargode



Project by: Irrigation Department

# Coastal protection



# Build Back Better – Resilient Housing

Retreat – Fishermen Housing



Adapt – Low Land Housing



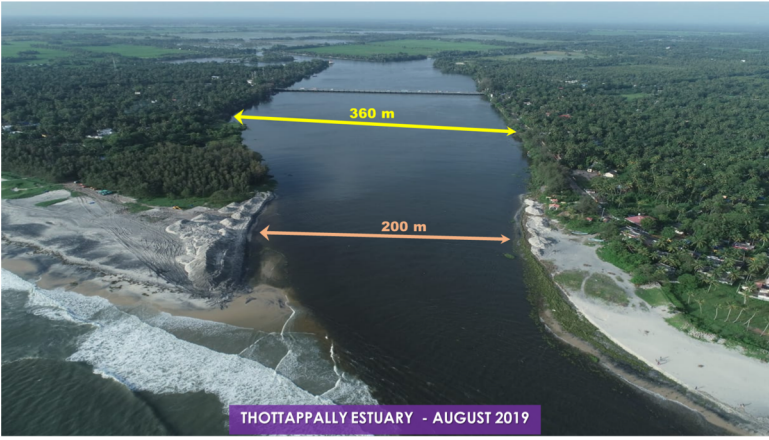
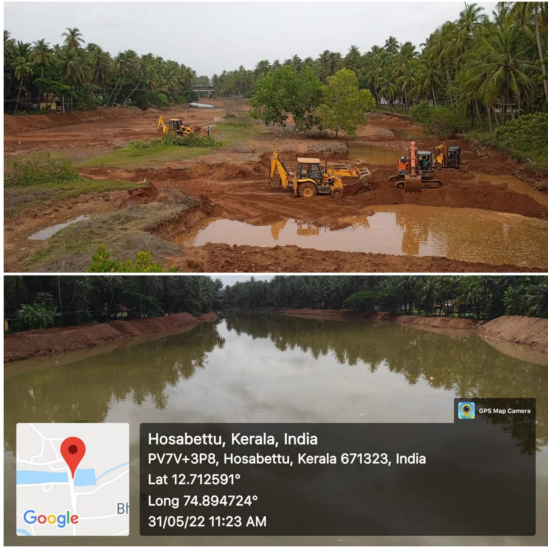
# Build Back Better – Schools



**Over 100 schools made resilient & converted to centres of excellence**



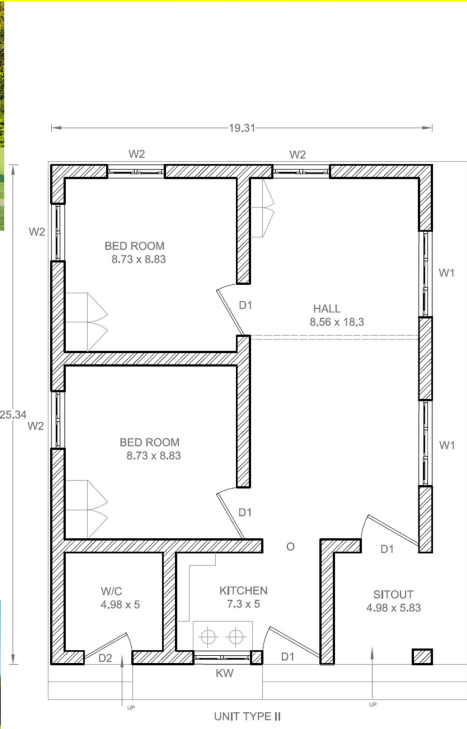
# More Room for Rivers





# Resilient Houses for Indigenous People

Final housing design



**DEVELOPING APPROPRIATE HOUSE DESIGNS FOR TRIBAL COMMUNITIES IN WAYANAD, KERALA**

**Project Team:** Dr. Shyni Anilkumar  
Dr. Chithra K  
Dr. Deepthi Bendi  
Department of Architecture and Planning, National Institute of Technology Calicut



# Build Back Better – Resilient Housing designs

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- Design facilitation through KSDMA-UNDP Shelter Hubs
- Construction funded through SDRF & CDMRF

# Risk Financing

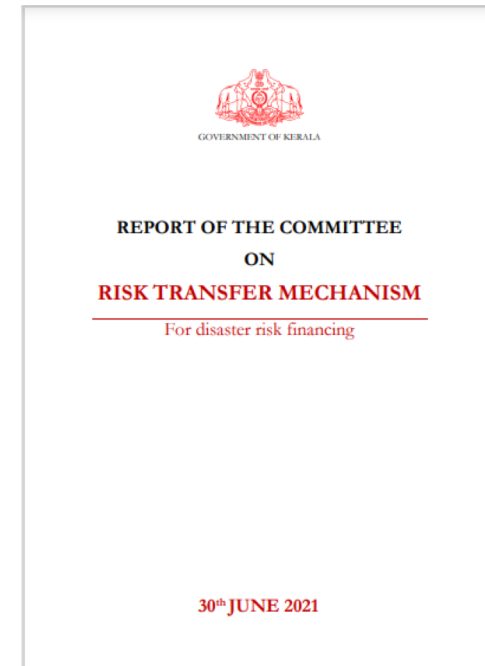
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- Committee constituted vide G.O. (Rt) No.256/2021/DMD dated 20/02/2021

## Key Highlights of the Report

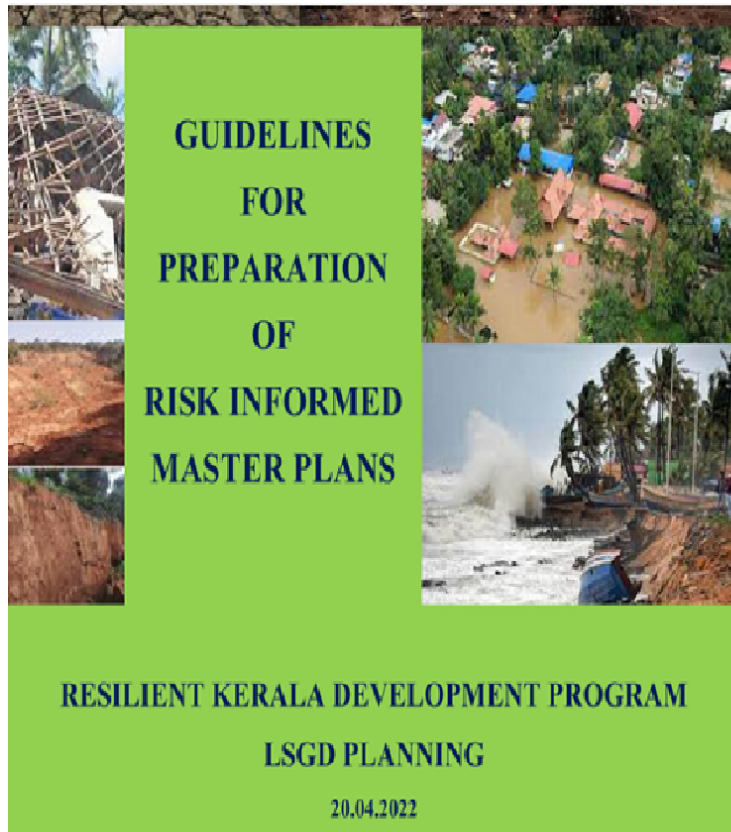
- Climate Risk Insurance model
- Direct and Indirect insurance premium
- Trust/Assurance Mode; Hybrid Mode; and Full Cost Mode
- State Disaster Risk Fund Pool (SDRFP)
- Disaster Risk Pool Account (DRPA)

**ToR issued for Risk Financing Product Development  
Guidance with financial support from KfW through RKI**



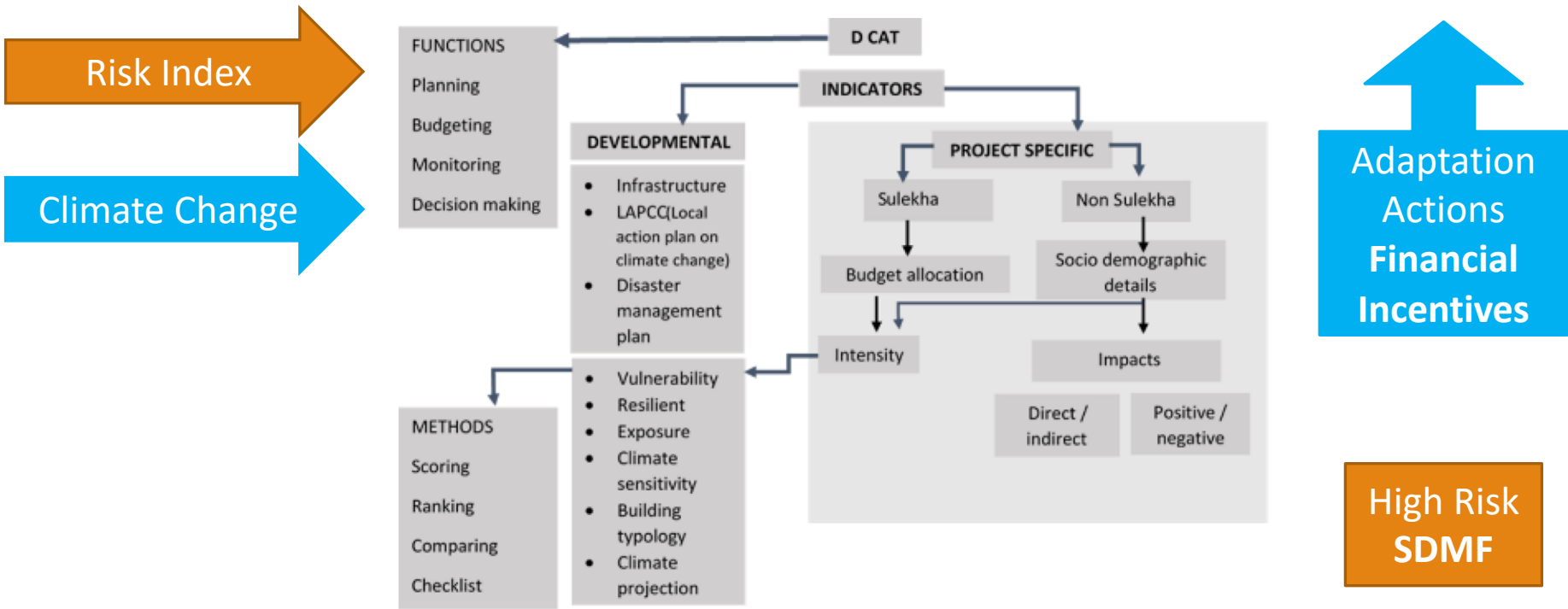
# Risk Informed Master Plans – The new norm

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- First state to legally adopt Risk Informed Master Plans
- GO (Ms) No. 120/2022/LSGD dated 9-6-2022
- Risk Information provided by KSDMA

# Disaster & Climate Action Tracking Tool – incentivising CC & Resilience Building Actions



- Risk Index provided by KSDMA
- Climate Change information at local government level provided by KSDMA
- Project baskets for resilience building under preparation in KSDMA

# International Collaborations



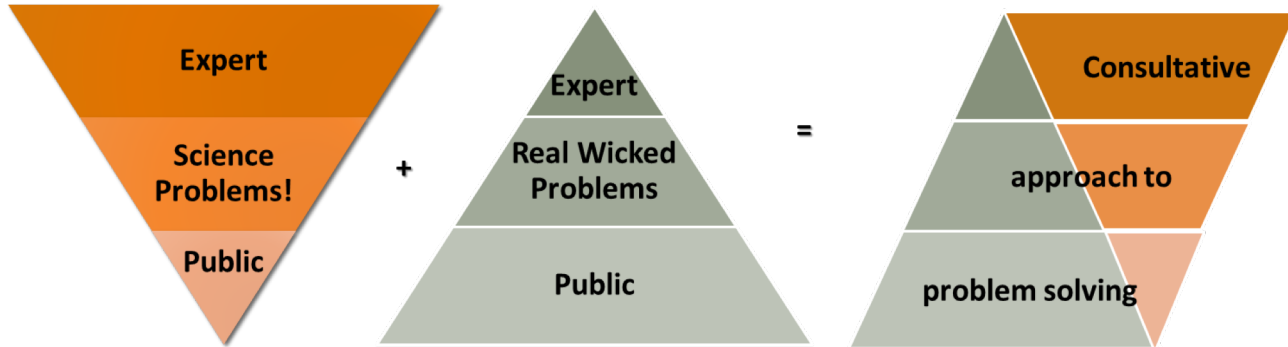
# Concluding Remarks

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- Technology for technology sake is of no use
- If resilience building is what's aimed at then empowering local governments is the key to it
- Technology is also Social Technology and Harnessing Human Spirit
- Inclusive approach is the key to resilience and not technology



# Concluding remarks





**Thank You**

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