

# Flood Risk Reduction in Climate Change Regime

Empowering Local Governments in Kerala



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Dept of Disaster Management

&

Chief Resilience Officer, Kerala

Dept. of Environment & Climate Change

# Kerala's three pillars of resilience

Universal & Free Education



Universal & Free Health Care



Strong Local Governance



# Towards a Safer State...

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2012-17

**Focus: Human Resource, State & District Institutional Strengthening**

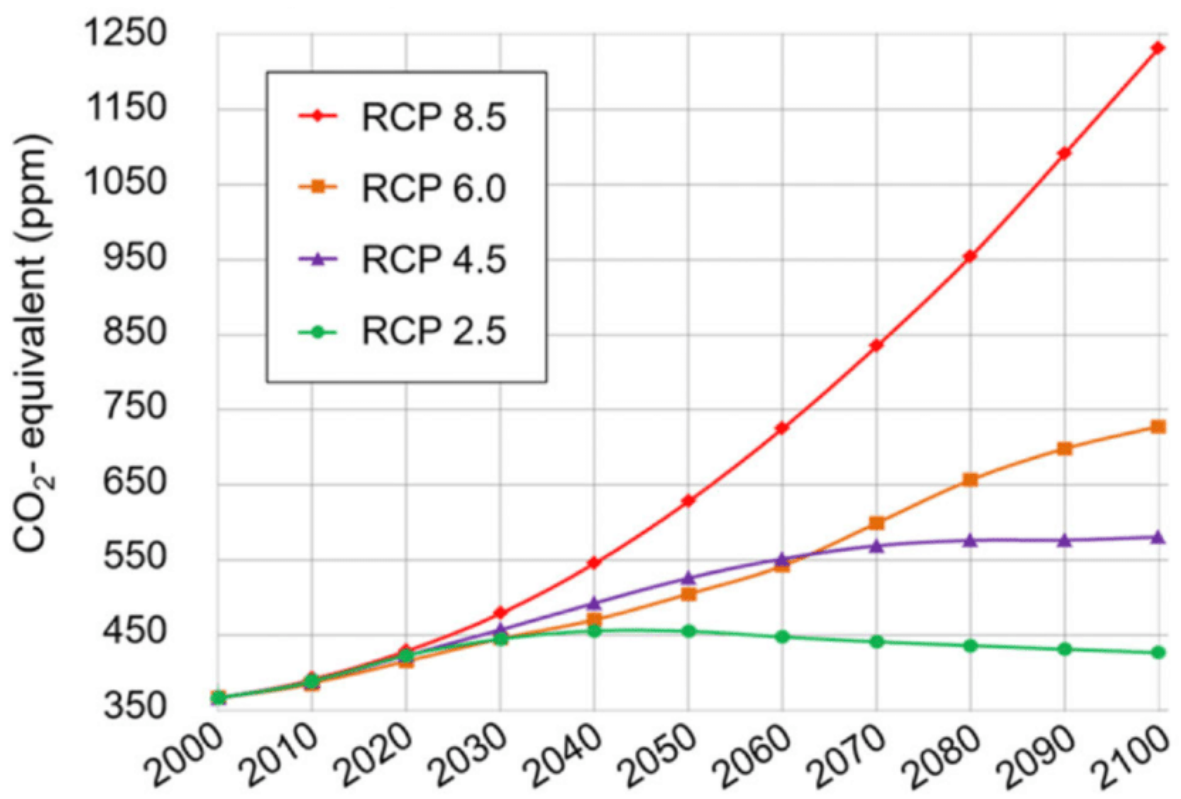
2017-22

**Focus: Decentralisation – devolution of DM into Local Governments**

2022-27

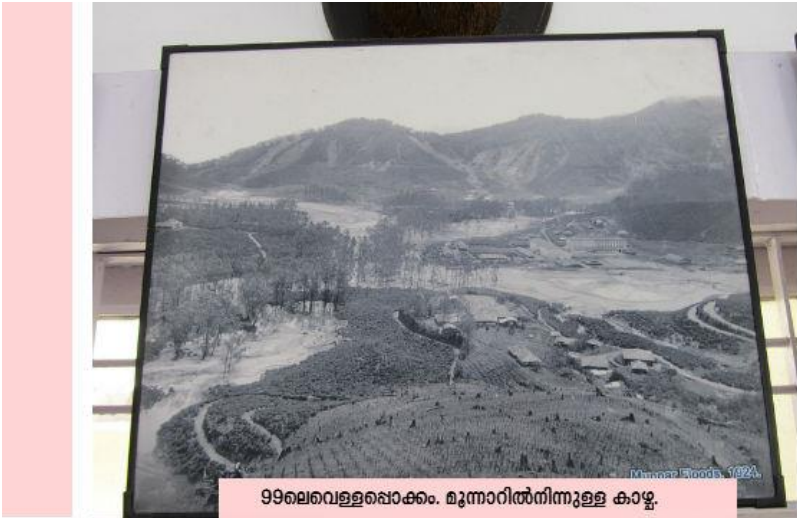
**Focus: Resilient Homes – Climate Change and DRR Aware**

# Actions for adaptation between RCP 2.5 and 4.5



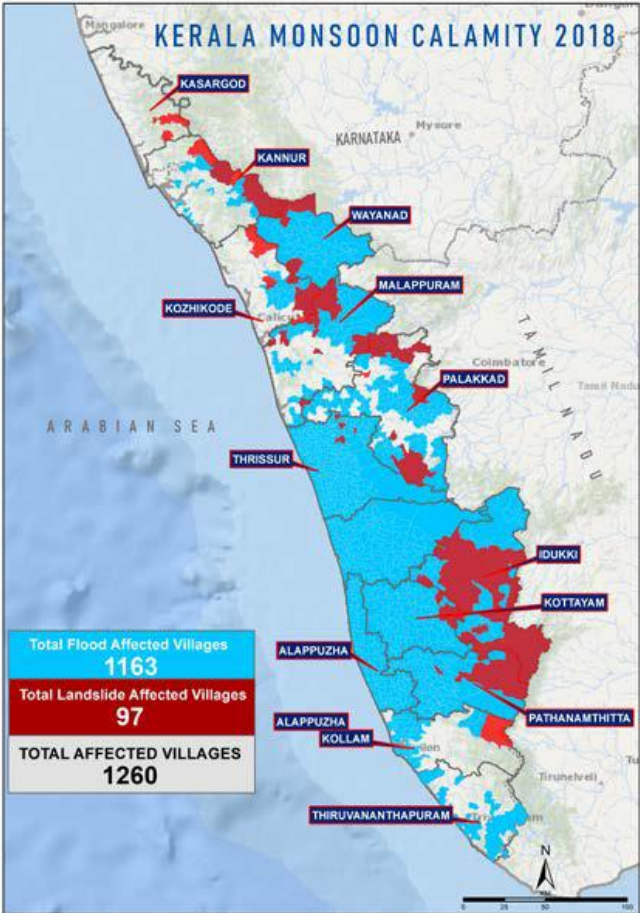
All forcing agents' atmospheric CO<sub>2</sub>-equivalent concentrations (in parts-per-million-by-volume (ppmv)) according to the four RCPs

# 1924 Floods



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

# 2018 Floods

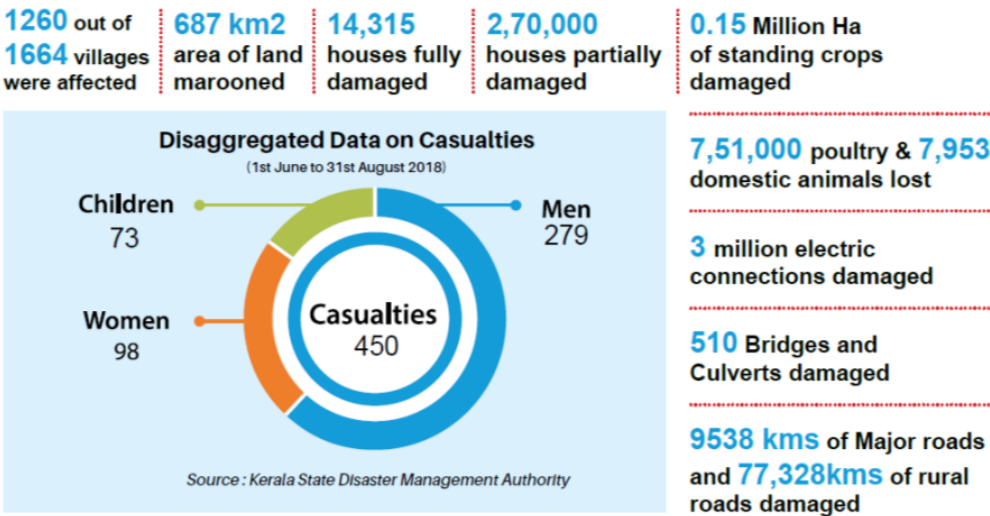


**All 14 districts affected**

**1260/1664 villages affected**

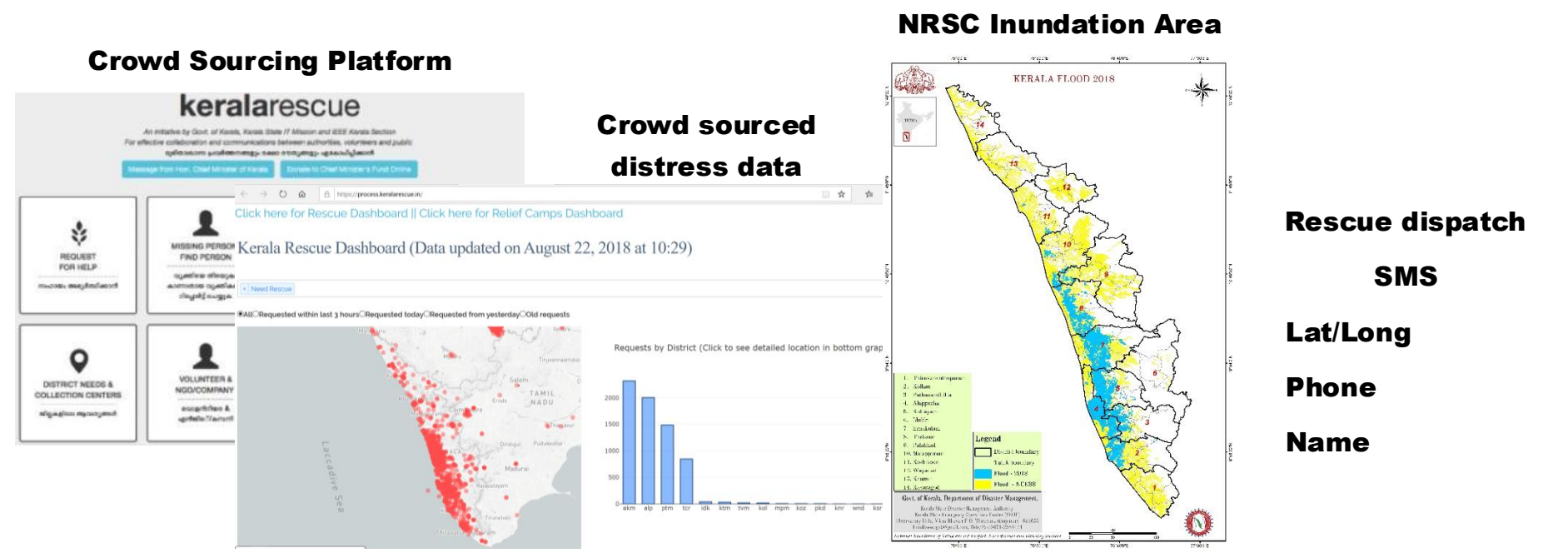
**687 km<sup>2</sup> land flooded**

**Over 5000 landslide**



# IT Voluntarism – Rescue

- **Mapping of distress calls by 4000 volunteers & concurrent dissemination to rescue agencies**
- **Alternate day flood inundation maps from NRSC – since 18<sup>th</sup> July 2018**





# IT Voluntarism – Damage Assessment

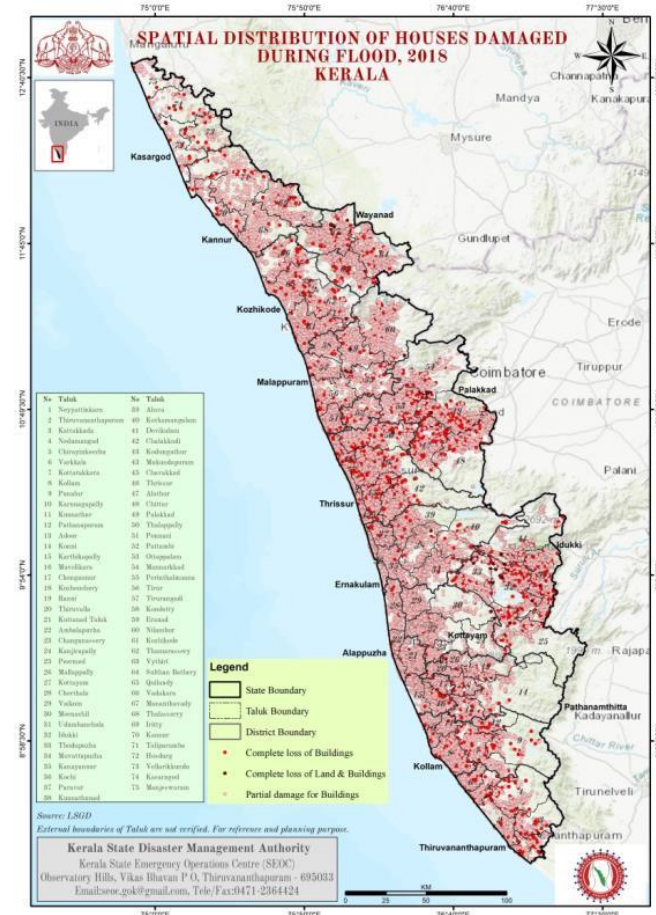
**All data in public domain**

**Mapping and assessment of 330,000 damaged houses**

**<https://rebuild.lsgkerala.gov.in/>**

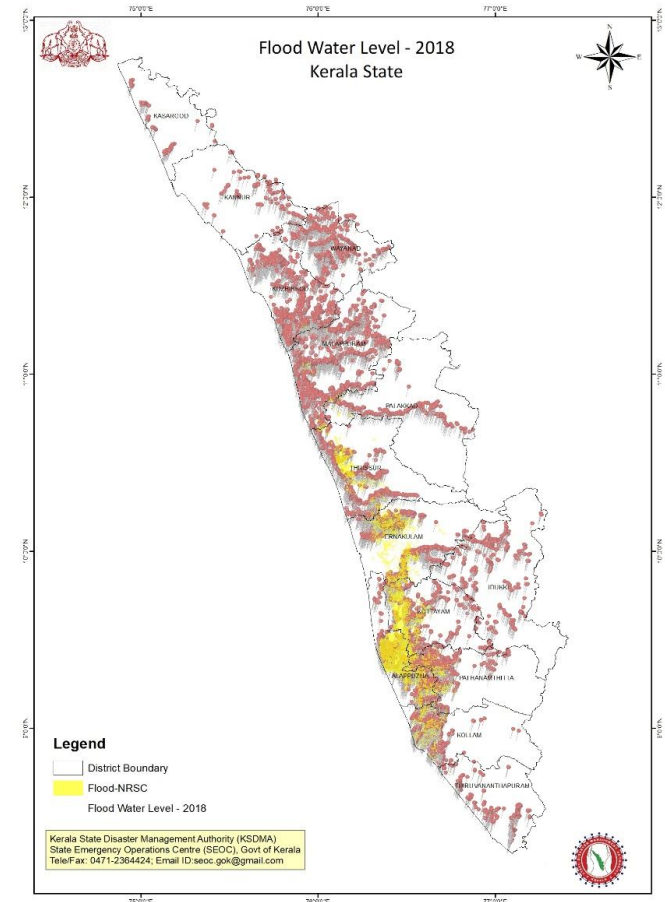
## **FIRST PRIORITY - HOUSING**

- Crowd sourced damage assessment and mapping of affected houses
- Owner driven reconstruction
- Damage magnitude linked cash grant of INR 400,000 to INR 10,000





# Crowd sourced inundation depth mapping and marking



- 13,000 flood water level points geotagged within the 687 km<sup>2</sup>

# Local Government Disaster Management Plans

നമ്മൾ നമുക്കായി... We for Us!

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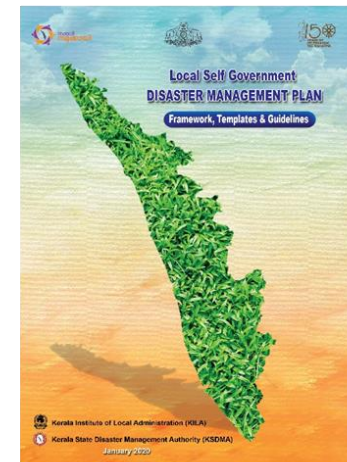
- ▶ **2019 - A paradigm shift - decentralising Disaster Management**
- ▶ **Major responsibilities moved to Local Self Governments**
- ▶ Community is the first responder during disasters
- ▶ They know the place and its resources the best
- ▶ Right to know hazard susceptibility
- ▶ Many local solutions to complex problems
- ▶ LSG is the only last mile entity with authority, funds and resources to make the change



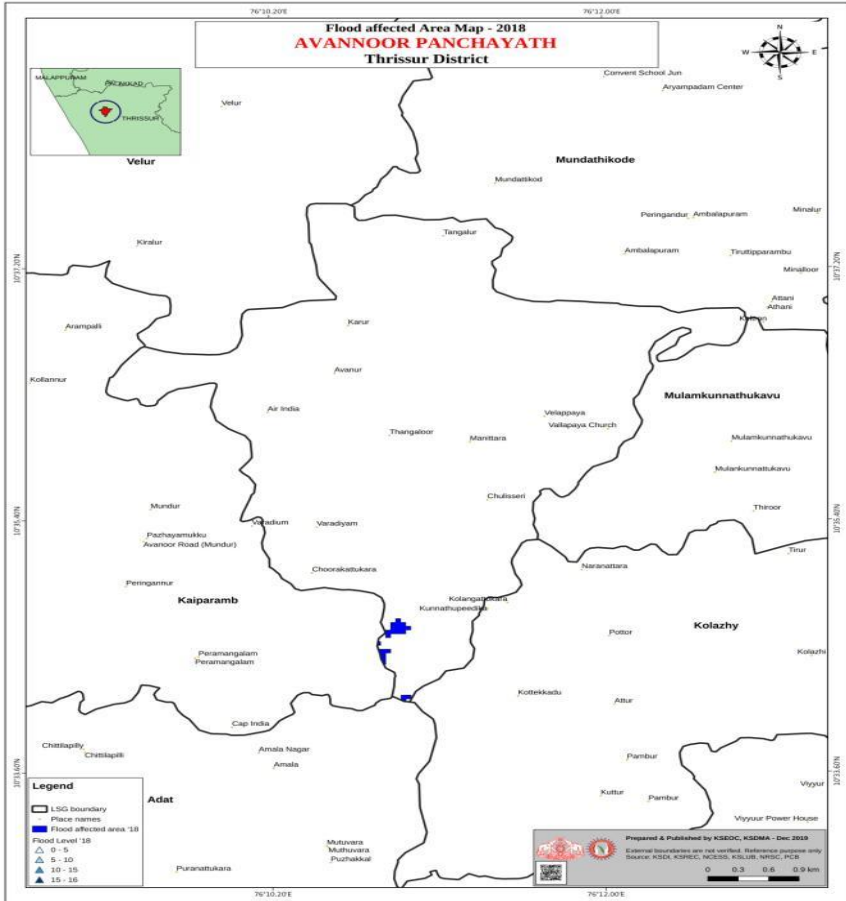
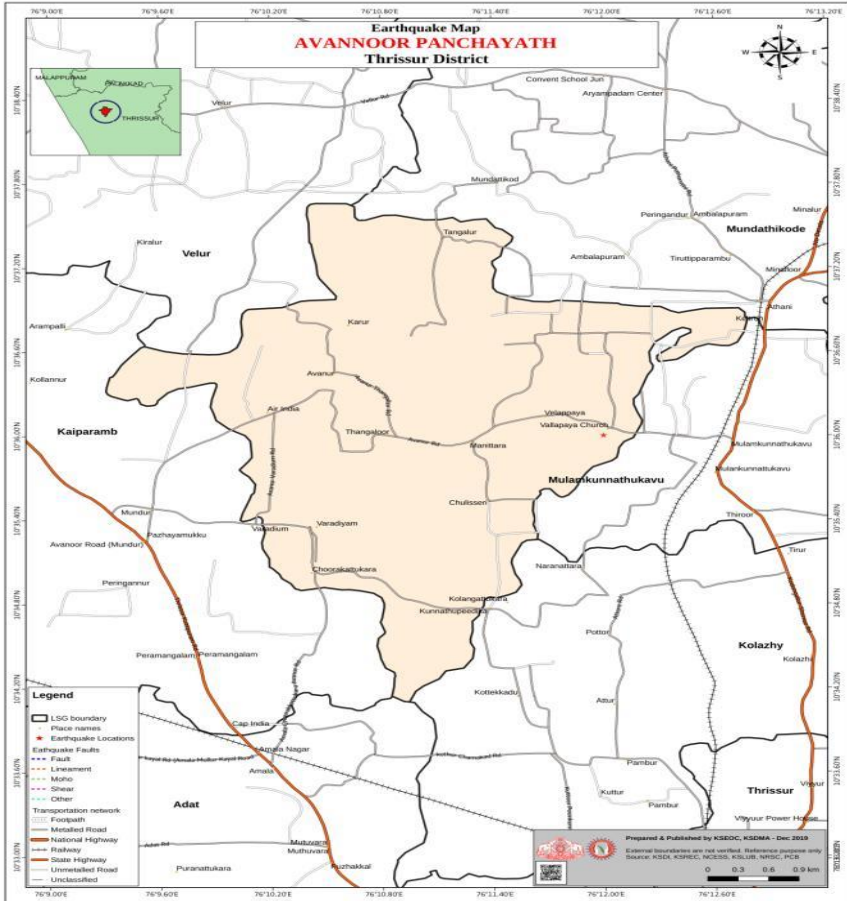
# LSG DM Plans - Contents

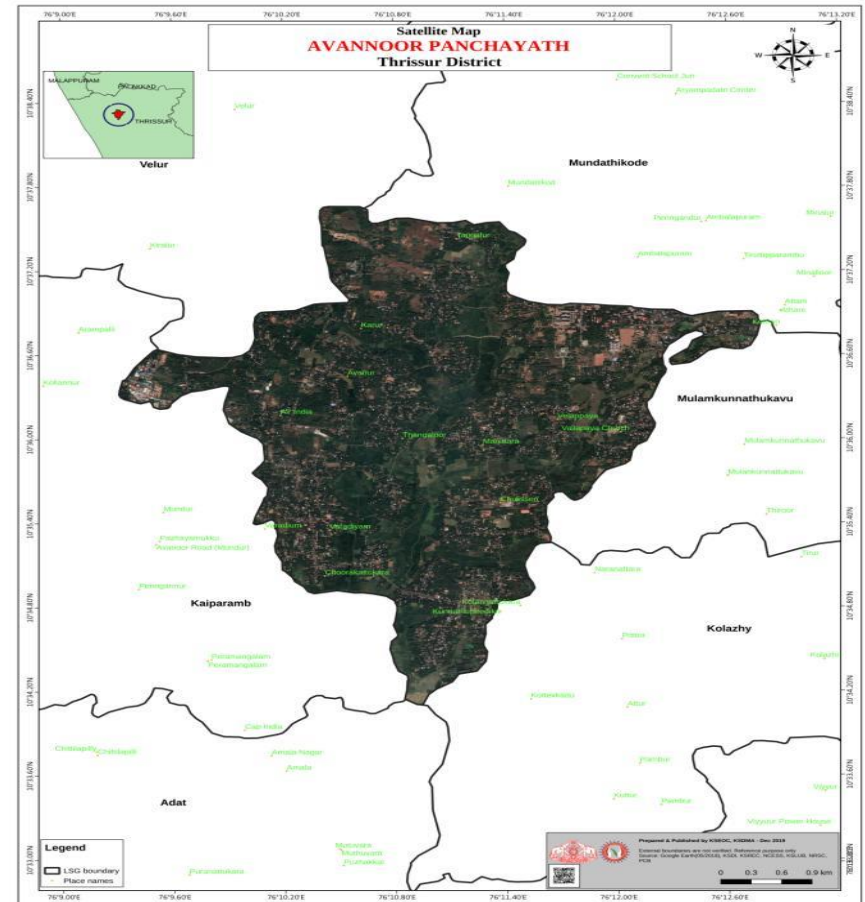
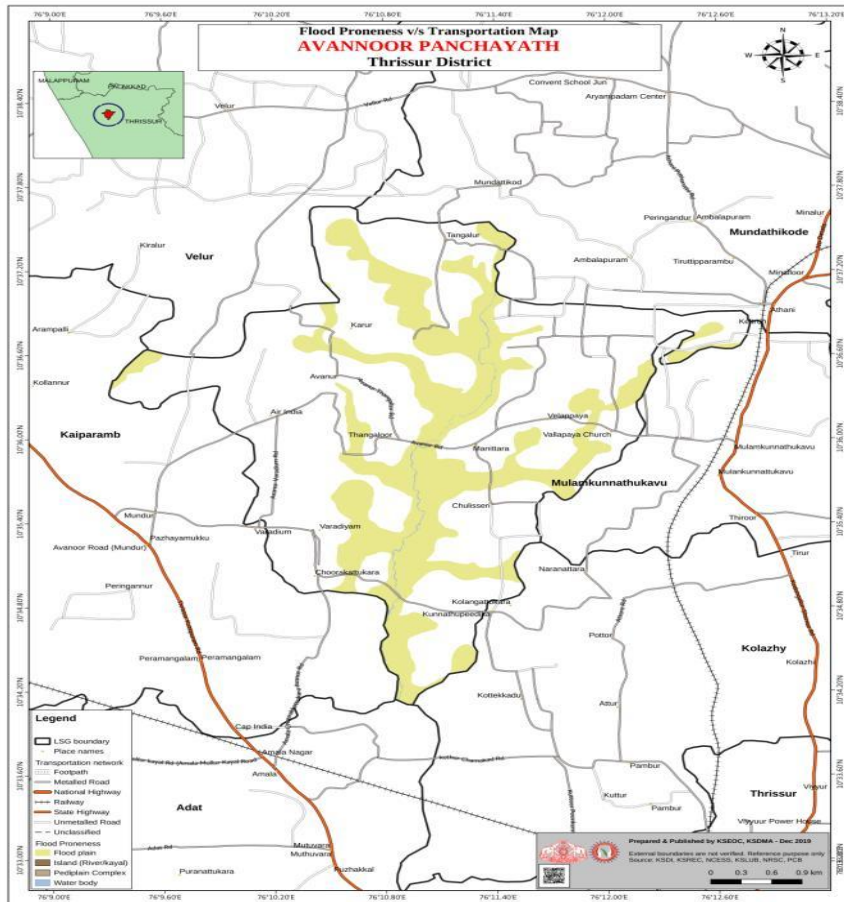
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- **Chapter 1: General Information**
  - ✓ Information about LSG
  - ✓ Revenue Villages
  - ✓ Population Statistics
  - ✓ Number of Wards
  - ✓ Major Occupation
  - ✓ Altitudes and graticules
- **Chapter 2: Disaster Proneness & Analysis**
  - ✓ Disaster 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



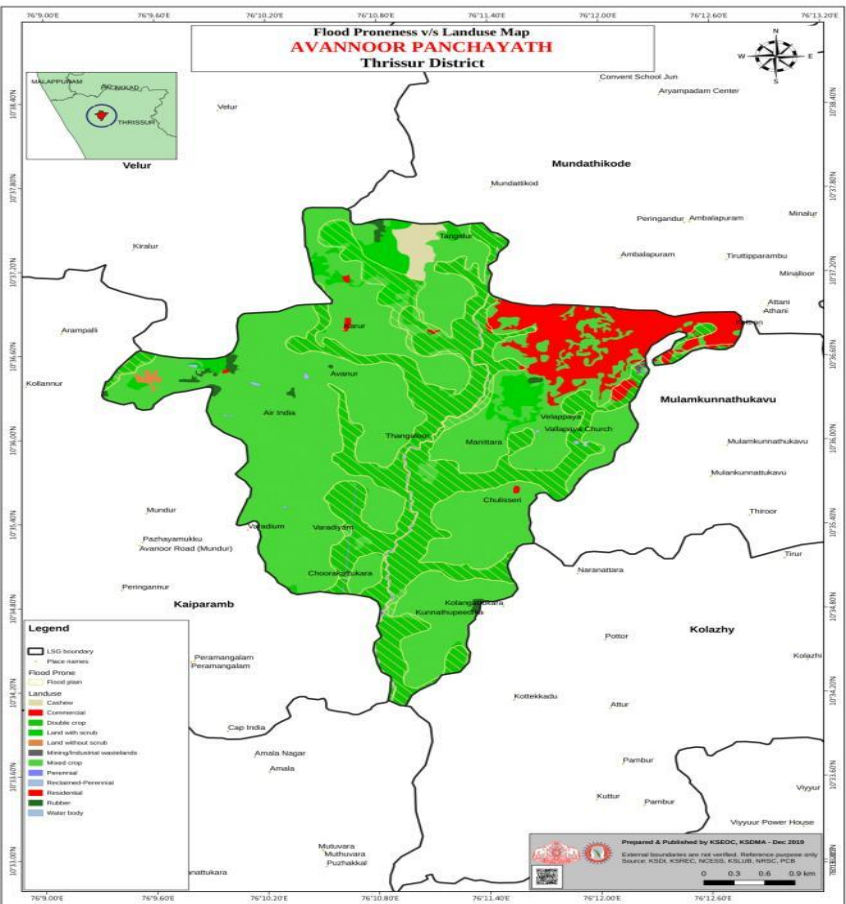
# Down scaling available spatial information of risks to Local Governments







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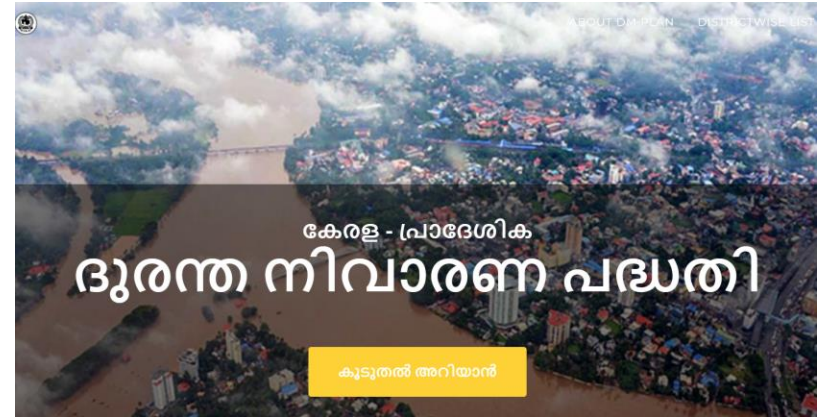




## The results

- Comprehensive attempt to prepare Disaster Management Plans of all Local Governments in a State

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



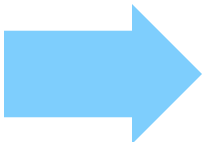
# The results

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## Received

 **941**  
Panchayats

 **87**  
Municipalities

 **6**  
Corporations

**1034**

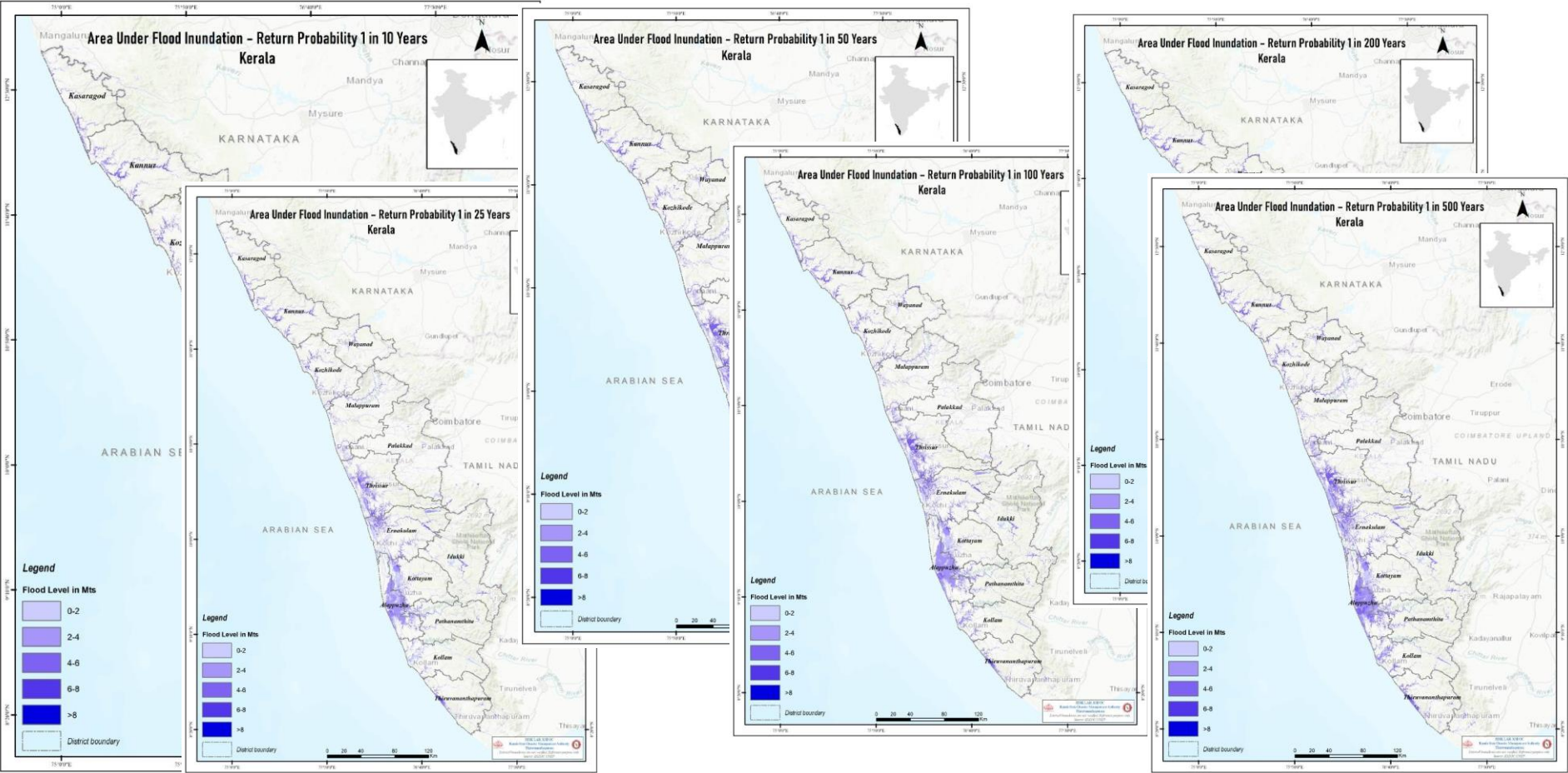
## Reviewed



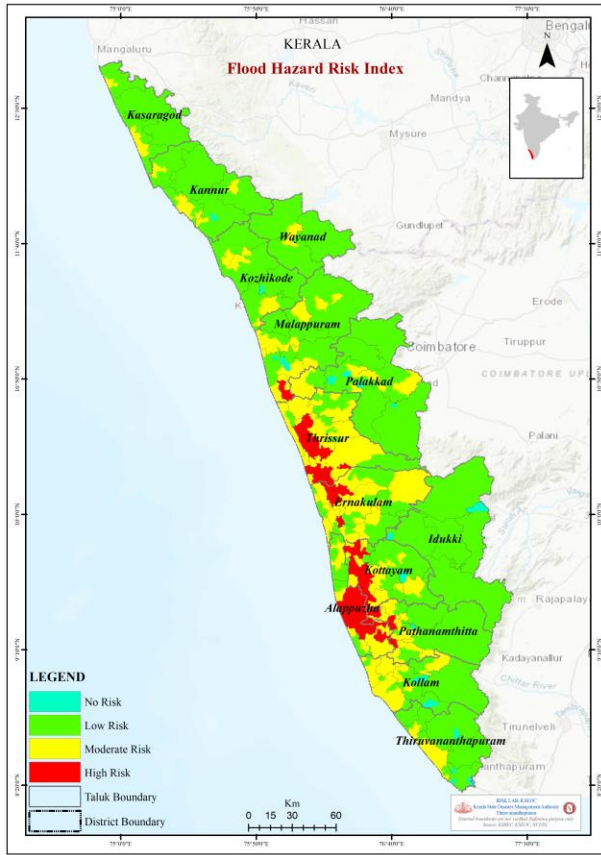
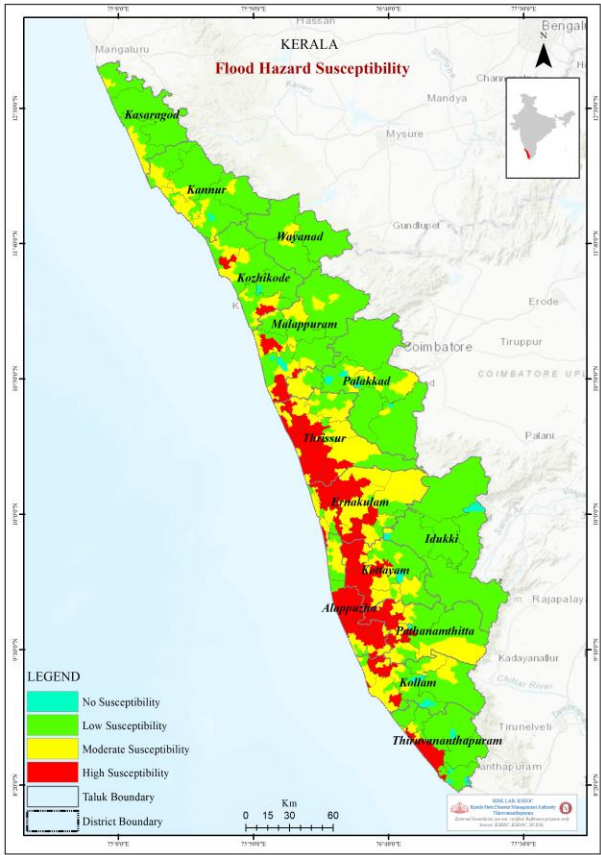
District wise review  
(14 LSG DM Plan Coordinators)-  
**100 % plans**

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

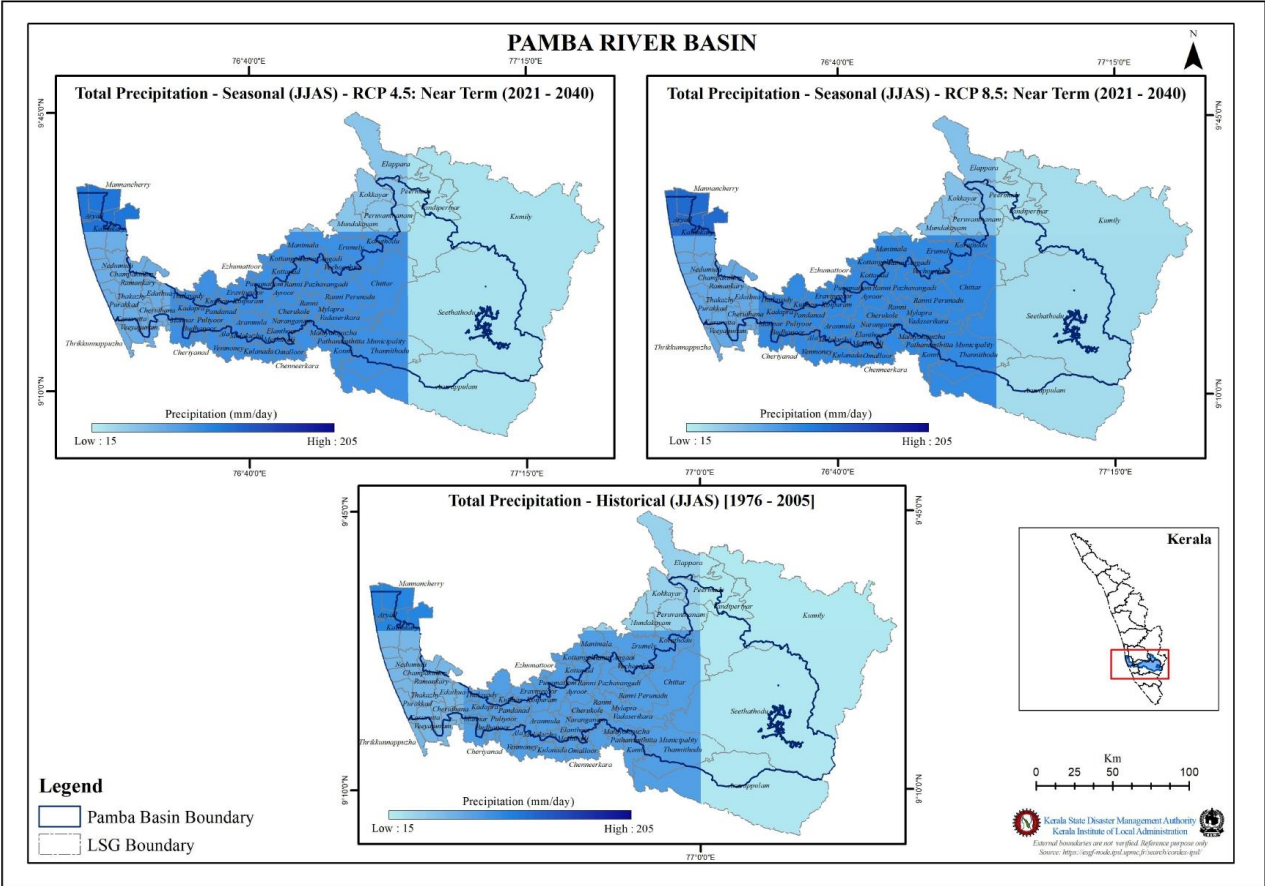
# Flood Hazard Assessment



# Risk Index of Local Governments

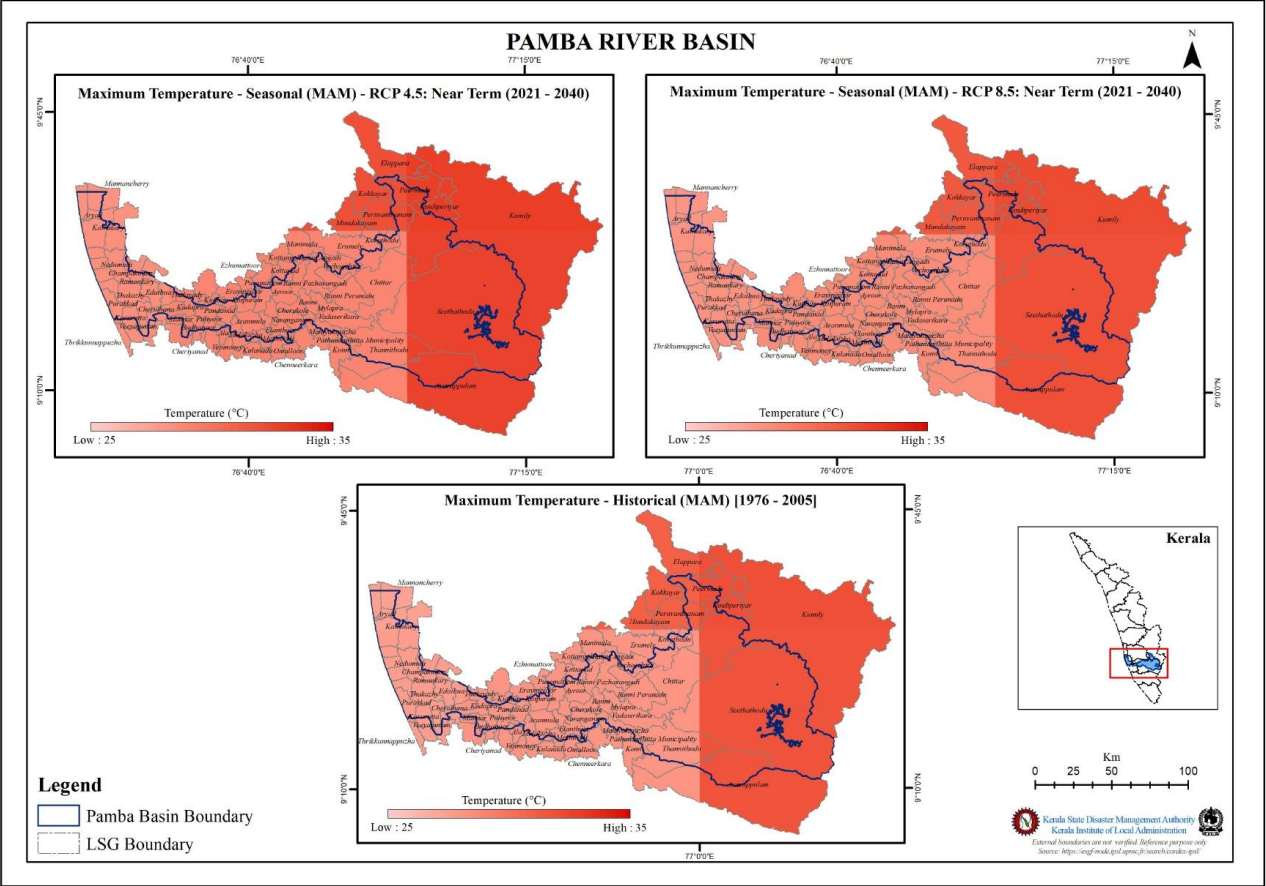


# CC info for local governments



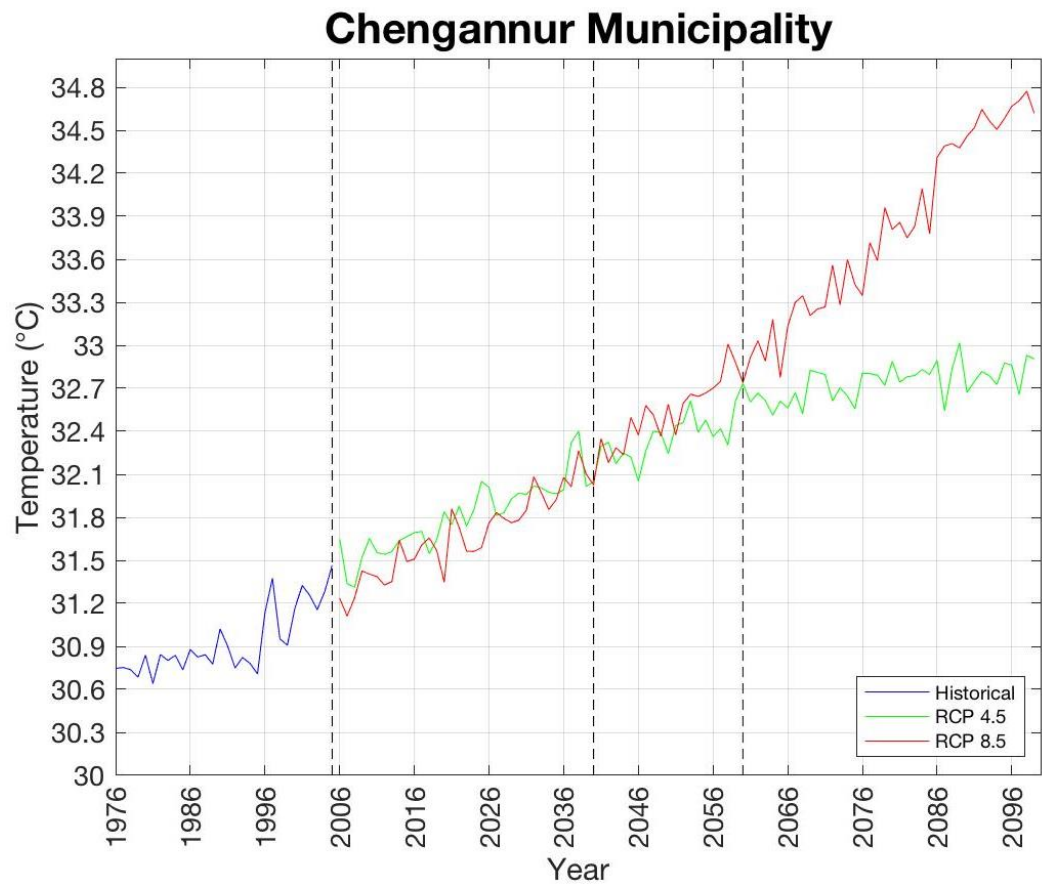


# CC info for local governments





# CC effects on local governments



# CC effects on local governments

**Table 1. Total precipitation in the LSGs of Pamba river basin during south west monsoon season (JJAS) for the scenarios RCP 4.5, RCP 8.5 [Near Term (2021-2040), Medium term (2041- 2060) and Long term (2061- 2099)] and historical period (1976-2005)**

LSG	Total Precipitation (mm/day) - JJAS						
	Historical	RCP4.5			RCP8.5		
		Near	Medium	Long	Near	Medium	Long
Ala	84.75	96.31	101.72	113.07	102.57	114.09	127.68
Alappuzha Municipality	106.85	119.23	125.08	137.67	128.93	140.73	155.56
Ambalapuzha North	60.85	68.84	72.92	81.80	72.16	81.21	93.04

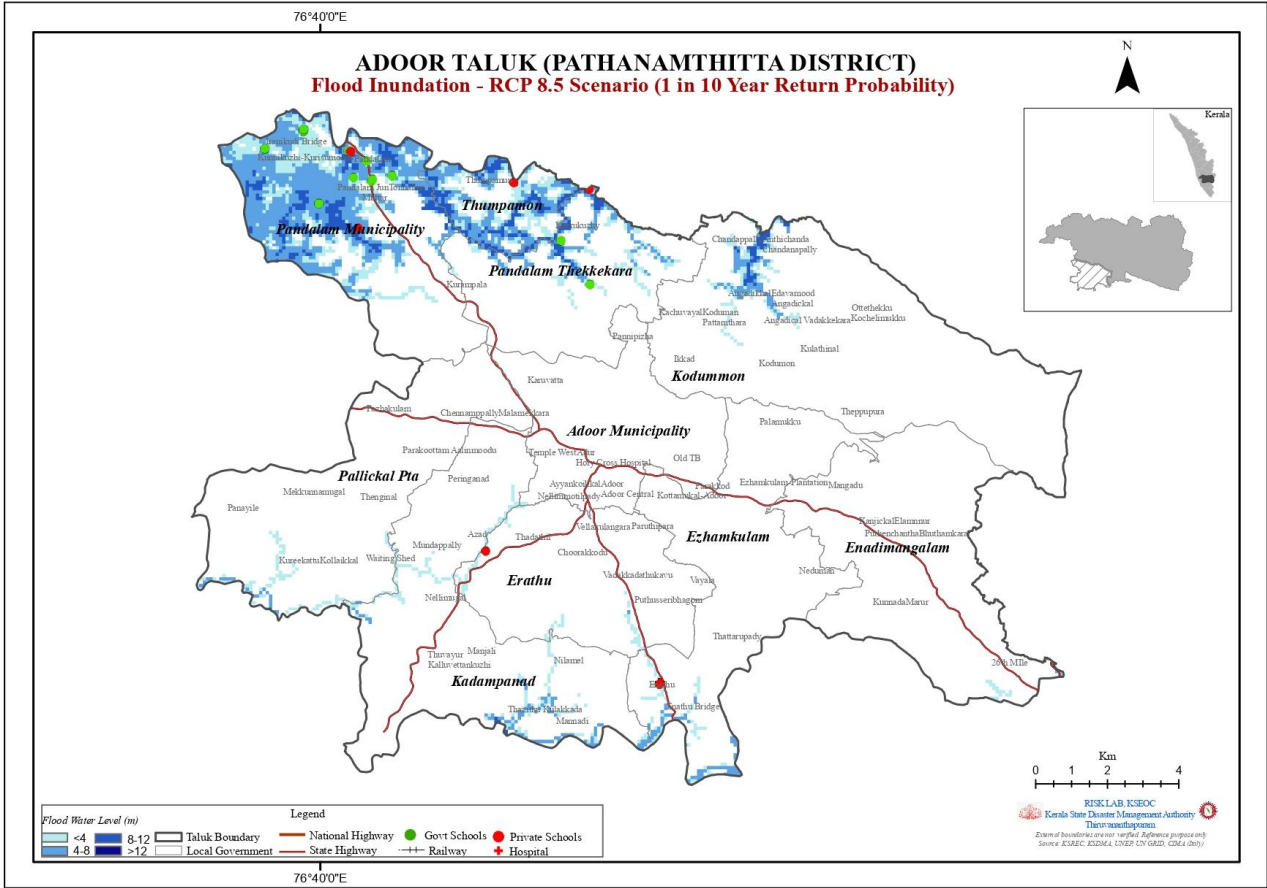
# CC effects on local governments

**Table 2: Mean surface temperature in the LSGs of Pamba river basin during pre-monsoon season (MAM) for the scenarios RCP 4.5, RCP 8.5 [Near Term (2021-2040), Medium term (2041-2060) and Long term (2061- 2099)] and historical period (1976-2005)**

LSG	Surface Temperature (°C) - MAM						
	Historical	RCP4.5			RCP8.5		
		Near	Medium	Long	Near	Medium	Long
Ala	28.23	29.13	29.56	29.99	28.89	29.55	31.00
Alappuzha Municipality	28.96	29.82	30.22	30.65	29.68	30.29	31.60
Ambalapuzha North	28.96	29.82	30.22	30.65	29.63	30.25	31.60

[illegible]

# CC effects on Flooding



# More Room for River

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
Erathu						
School						
Erathu	✓	✓	✓	✓	✓	✓
Ezhamkulam						
Hospital						
St Thomas Hospital, Malakara					✓	✓
School						
Ezhamkulam						✓
Pandalam Municipality						
School						
Govt. S.V.L.P.S Cherickal						✓
Govt.U.P.S Mangaram						✓

- If a critical infrastructure is in 1 in 10 in Historical and RCP 8.5 scenario flood probable area, move it out to 1 in 25

PATHANAMTHITTA DISTRICT						
ADOOR TALUK						
Name of exposed Hospital/School (LSG)	Return Probability (Climate Change Scenario - RCP 8.5)					
	1 in 10 Year	1 in 25 Year	1 in 50 Year	1 in 100 Year	1 in 200 Year	1 in 500 Year
Erathu						
School						
Erathu	✓	✓	✓	✓	✓	✓
Ezhamkulam						
Hospital						
St Thomas Hospital, Malakara	✓	✓	✓	✓	✓	✓
School						
Ezhamkulam	✓	✓	✓	✓	✓	✓
School For Deaf, Enathu					✓	✓
Kadampnad						
School						
Govt L.P.G.S Mannady						✓
Govt. L.P.B.S Mannady						✓
V.H.S.S Mannady						✓
Kodungallur Municipality						
School						
Govt.L.P.S Angadical			✓	✓	✓	✓
Pandalam Municipality						
School						
Govt. L.P.S Edayadiyil		✓	✓	✓	✓	✓
Govt. S.V.L.P.S Cherickal	✓	✓	✓	✓	✓	✓
Govt. S.V.L.P.S. Kadakkad		✓	✓	✓	✓	✓
Govt. U.P.S Panthalam	✓	✓	✓	✓	✓	✓
Govt.H.S.S. Thottakonam	✓	✓	✓	✓	✓	✓
Govt.L.P.S Kadakkad	✓	✓	✓	✓	✓	✓
Govt.L.P.S. Thottakonam	✓	✓	✓	✓	✓	✓
Govt.U.P.S Mangaram	✓	✓	✓	✓	✓	✓
Govt.U.P.S Poozhikkadu					✓	✓
M.S.M. L.P.S. Pandalam	✓	✓	✓	✓	✓	✓
M.T.L.P.S. Mudliyoorkonam	✓	✓	✓	✓	✓	✓
N.S.S. Boys H.S.S Pandalam	✓	✓	✓	✓	✓	✓
N.S.S. G.H.S Pandalam	✓	✓	✓	✓	✓	✓
Pandalam Thekkekkara						
School						
Govt. L.P.G.S. Thattayil	✓	✓	✓	✓	✓	✓
Govt.L.P.S. Noombizhi	✓	✓	✓	✓	✓	✓
S.V.L.P.S. Perumpulickal		✓	✓	✓	✓	✓
St. Paul'S HSS Nariyapuram	✓	✓	✓	✓	✓	✓
Thumpamon	✓	✓	✓	✓	✓	✓
Thumpamon						
School						
Govt. L.P.S. Muttom		✓	✓	✓	✓	✓
Thumpamon	✓	✓	✓	✓	✓	✓





# The SOPs – Monsoons & associate disasters

ദുരന്ത നിവാരണത്തിനുള്ള ഓറഞ്ച് പുസ്തകം

2

2023

കാലവർഷ-തുലാവർഷ മുന്നൊരുക്കം,  
ദുരന്ത പ്രതികരണ മാർഗ്ഗരേഖ

അഞ്ചാം പതിപ്പ് - 30 മെയ് 2023



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

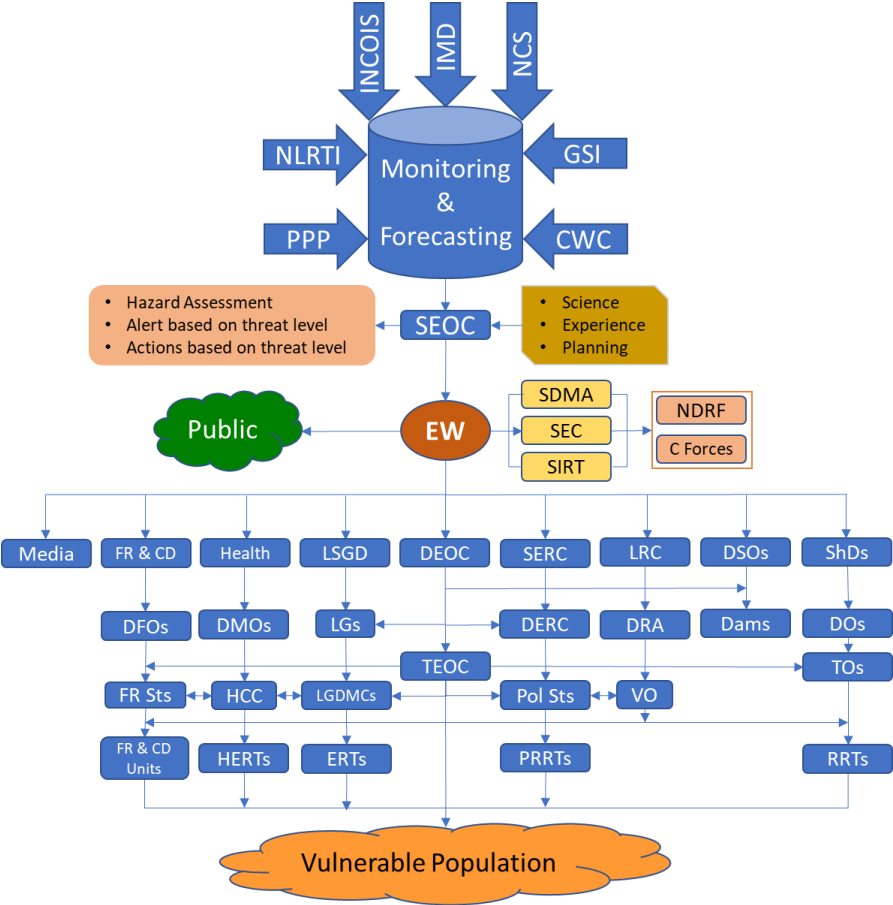
Covers 36 departments

Detailed coverage of financial and legal framework

Evaluation of monsoon prognosis by 24 agencies


Warning and anticipatory actions updated every year

# Warning Systems



# Location Based Messaging service with GIS integration

- CAP integrated Location Based Public Messaging through GIS platform
- Developed by CDoT with funding from NDMA
- Since 2018 Kerala is using this platform



## Disaster Early Warning System

Welcome user

Menu

Home

Early Warning

New Alert

Update Alert

Cancel Alert

Notification

Statistical Analysis

Docket Management

GIS Query

Contact Us

Log Out

Enter New Alert

1. Alert Details

2. Information Details

3. Area Details

4. Resource Details



5. Notify to Whom

Area Description \*

sample testing



Selected Polygon Area

30.101131,78.903554  
30.115684,78.980801  
30.059539,78.955052  
30.054434,78.903554



Selected Circle Area

30.095784,79.029210  
4.927#30.042006,78.977368  
2.939#



Minimum Altitude


Minimum altitude(in Feet)

Maximum Altitude

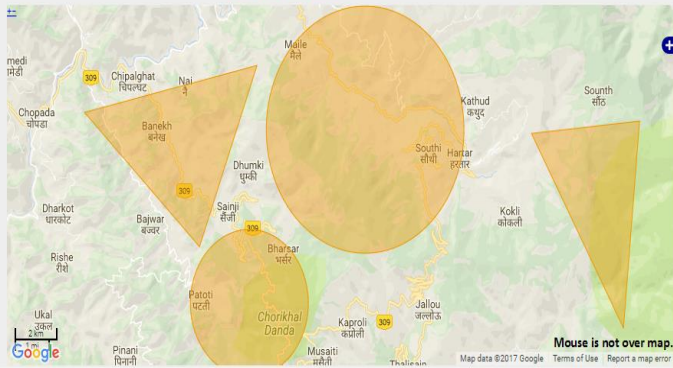
Maximum altitude(in Feet)

(\*) Mandatory

Uttarakhand, India



Radius- 2.939 KM



Mouse is not over map.

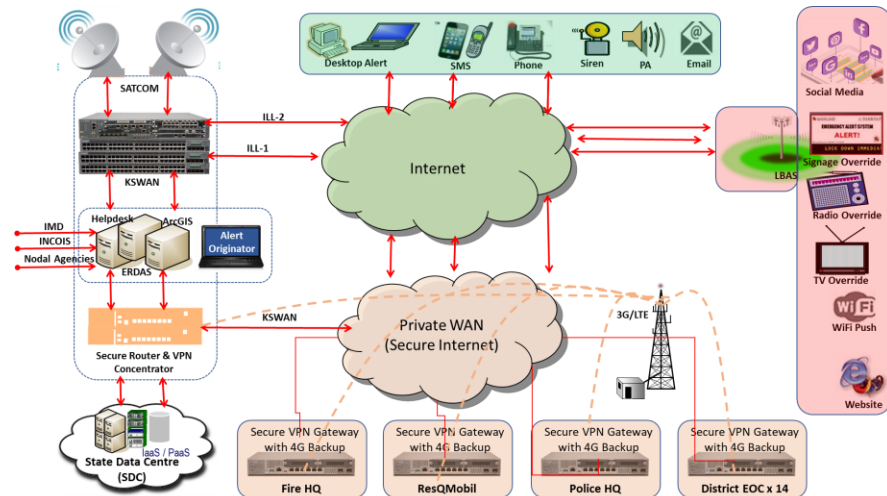
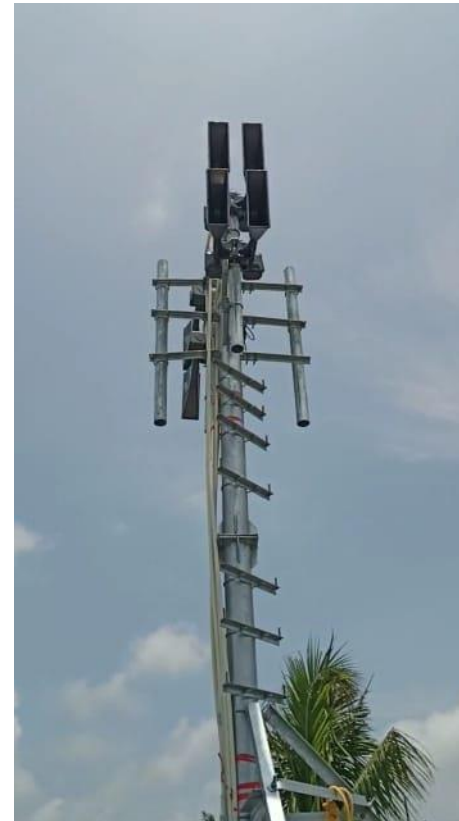
Map data ©2017 Google

Previous Next

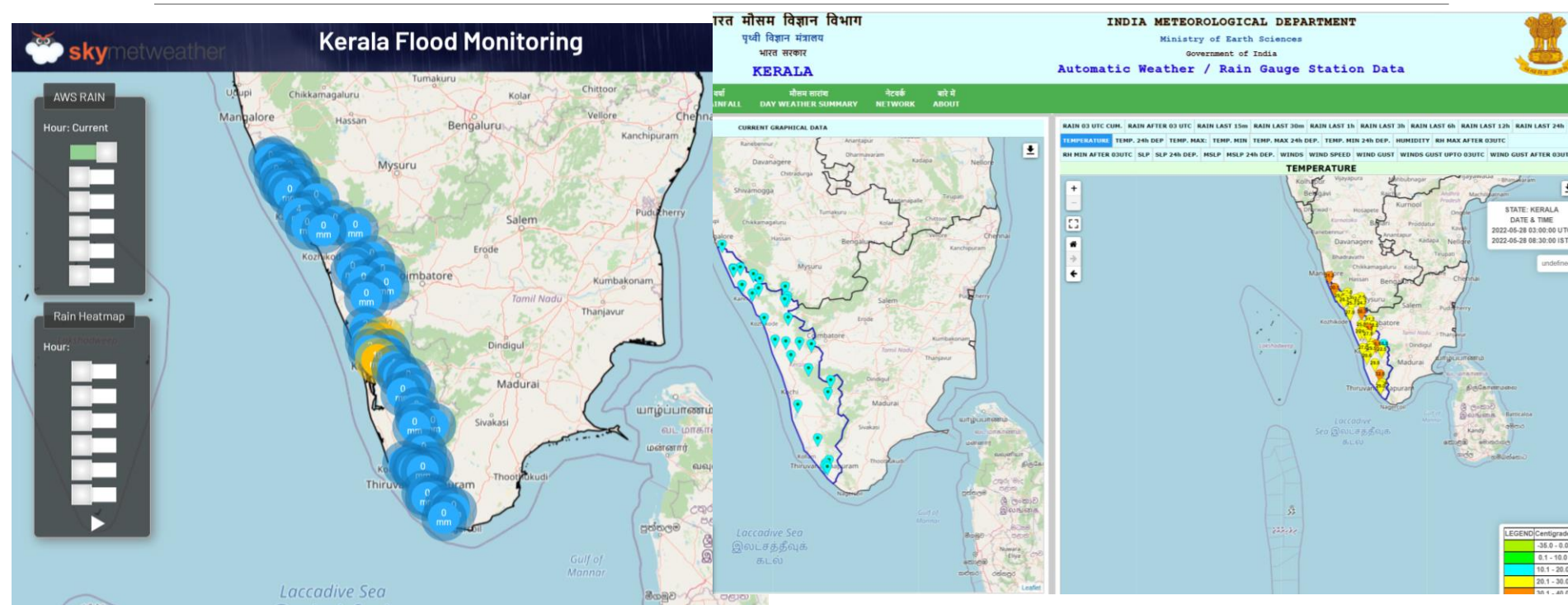
# Sirens and Strobe Lights



- Funded under NCRMP
- 126 sirens and strobe lights
- 14 DEOCs
- 78 TEOCs
- 20 Fishing Centres
- Linked through VPN
- 4 way connectivity



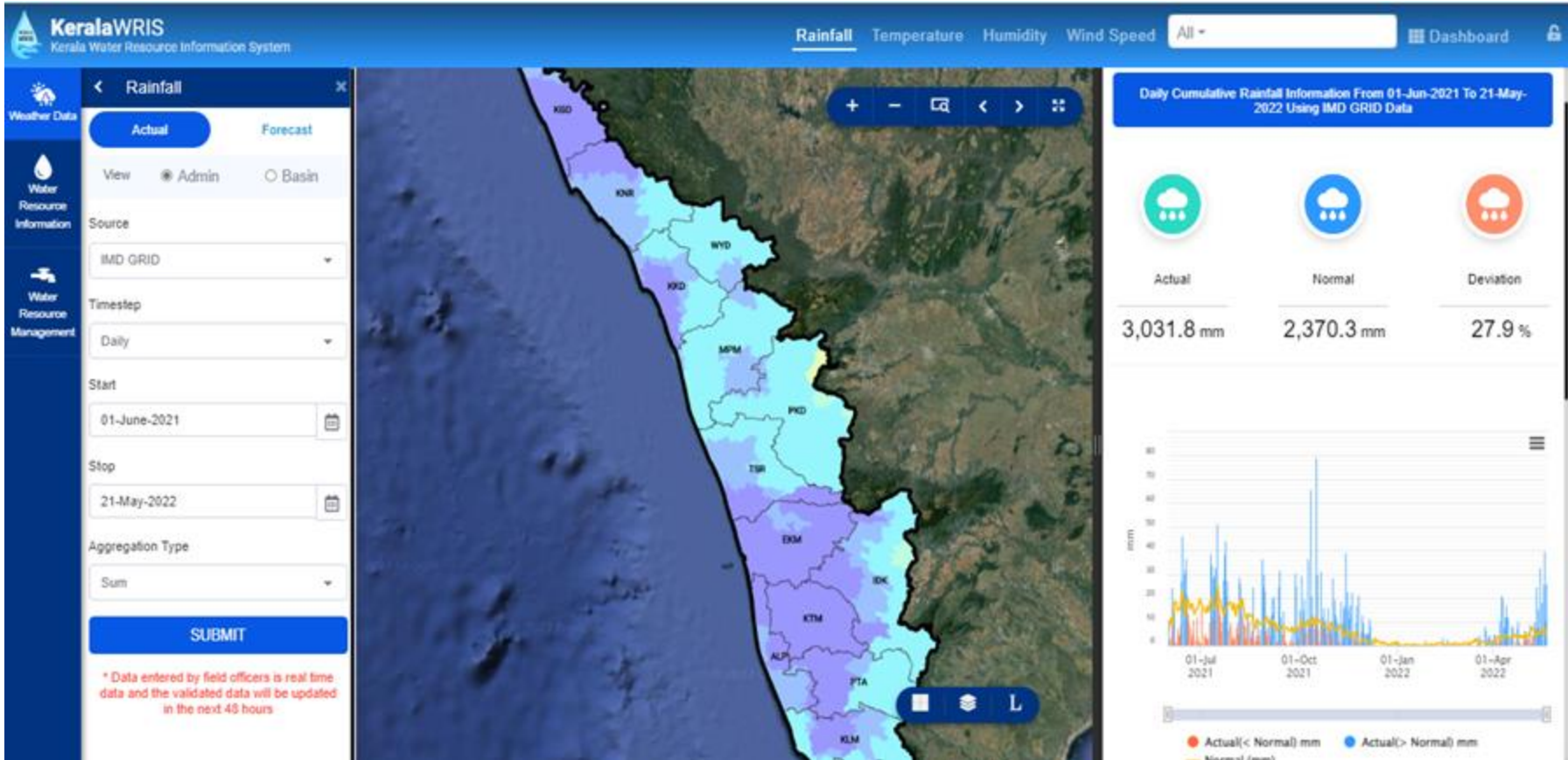
# Weather



- Project 100 AWS: IMD-KSDMA jointly is deploying 100 AWS – 35 functional
- Public-Private Partnership: KSDMA-Skymet - 100 AWS and live in public domain
- Schools in Kerala deploying Rain gauges – 1000 schools

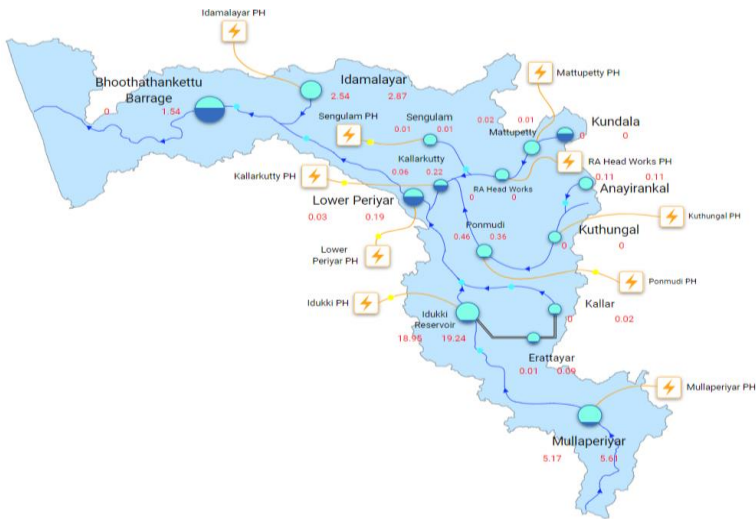


# Hydrology

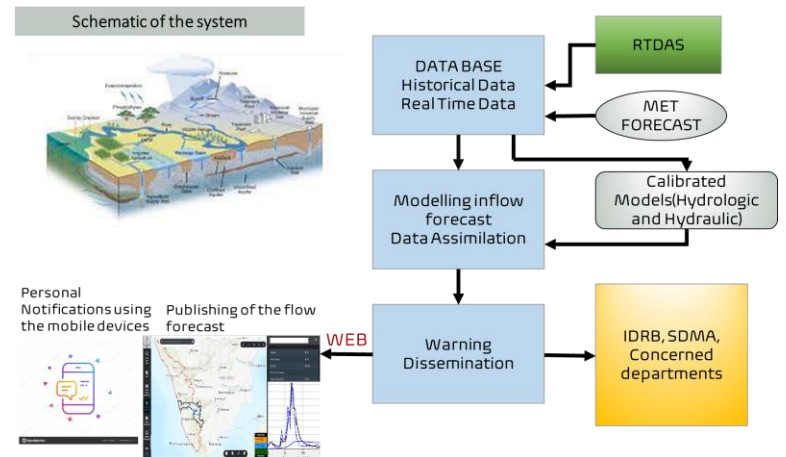
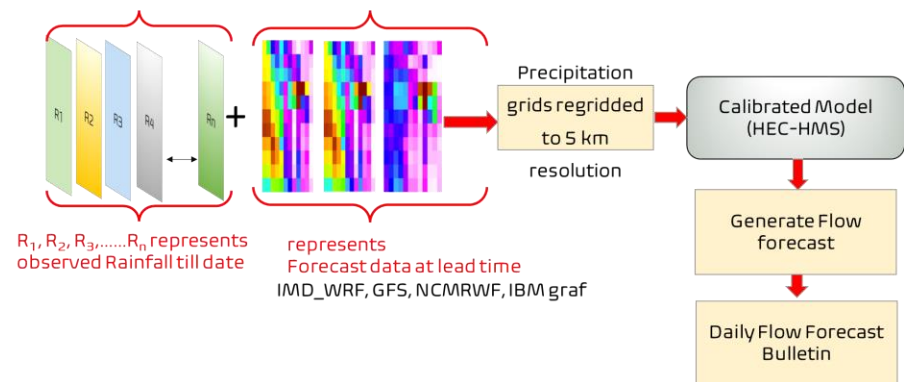




# FEWS - Periyar



## HEC-HMS run in forecast



# Minding Gaps in Disaster Management

**Disability Inclusive**



**Transgender Inclusive**



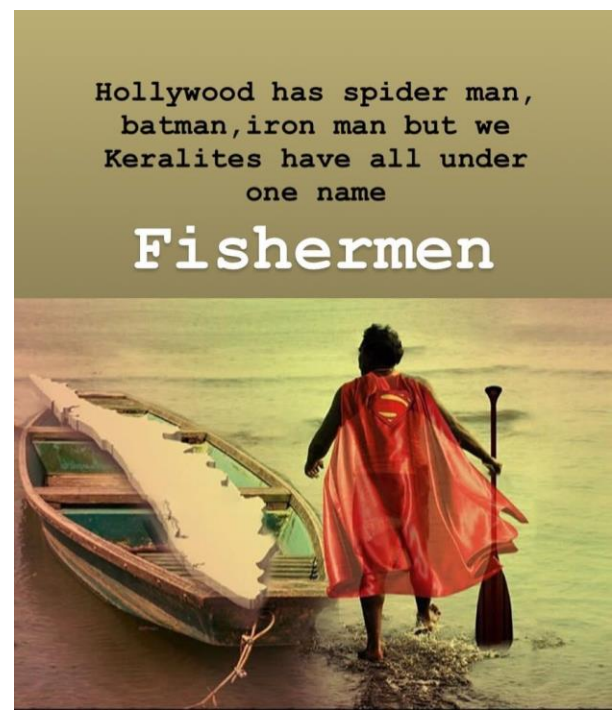
**Palliative Care Inclusive**



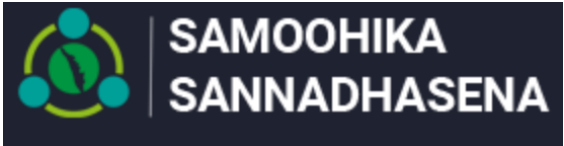
**Indigenous People Inclusive**



# Harnessing Human Spirit



- Official Volunteers – 10,000
- Only state where CD is notified pan State



Directorate of Voluntarism  
3.5 lakh volunteers

Local Government  
Emergency  
Response Teams





# Testing the Plans – Mock Drills

Live 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 59 teams	Air Force 22 helicopters	Indian Army & ETC 23 columns	Navy 40 Boats	Coast Guard 35 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



# Pluvial Flood Mitigation – Operation Anantha 2015-16

### 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.:  
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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**





# Coastal Erosion and Flooding

## Resist – Tetrapods Chellanam



- ❑ 7.3 kms protected
- ❑ Rs. 333 crores
- ❑ Tetrapods and Groyne fields

## Retreat – Punargeham (Fishermen housing)



- ❑ Rs. 10 lakhs per family
- ❑ Move from 0-50 m from Hight tide line
- ❑ About 10,000 families availed

# Future – Risk Informed Master Plans

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# Resilient Houses for Indigenous People

Definition

"process by which people are enabled to become actively and genuinely involved in defining the issues of concern to them, in making decisions about factors that affect their lives, in formulating and implementing policies, in planning, developing and delivering services and in taking action to achieve change" (WHO, 2002)"

Steps for implementing

- assessment of current social, economical and environmental reality.
- determination of community needs through close consultation.
- audit of available resources, skills and capacities.
- identifications issues and concerns

Methodology

- Semi structured interviews
- Household survey using Structured questionnaire
- Community Group Presentations
- Consultation with Community liaison groups

Stage I: Key informant consultation

Form Community Coalition

Problem Identification

Understanding Community Profile

Transect walks

To observe/listen & identify critical settlement conditions and ask relevant questions to identify solutions

Village mapping

represent or model current or historical conditions

Community Activity chart

Different kinds of activities carried out and Spatial connotation of their social activities

Trend analysis

Their adaptability to new circumstances

DEVELOPING APPROPRIATE HOUSE DESIGNS FOR TRIBAL COMMUNITIES IN WAYANAD, KERALA

Project Team:  
Department of Architecture

Stage II: Consultation with Household through structured questionnaire survey

Mapping the preferences & aspirations on future housing

Preference Analysis

Current Condition Building Materials Methods of construction Acceptability & Satisfaction

Mapping Housing Condition

Housing Typology

Adiya Community (Chalighadha Tribal Settlement , Mananthavadi)

- Settlement falls under village Payyampally, near Mananthavadi Taluk, in wayanad district.
- The settlement is more than 80 years old and has a current population of 197 people in 52 families in 43 houses.
- average household size of the settlement is 5.
- Majority of the members are engaged in agricultural labour in nearby farms and fields.
- Majority of the houses in the settlement are semi- Pucca houses.
- nearest Anganwadi is 1.5km away, School is 2.5km away, and the nearest college is at Mananthavadi which is 12km away.
- Nearest PHC is 2.5km away (Kurukkanmoola) and the nearest Taluk Hospital is 12 km away (Mananthavadi).
- The community has two public wells which act as their source of drinking source.
- There are no community facilities such as community meeting place, playground available.
- Unlike most of the other tribal settlement, there is no temple or any religious buildings found in the settlements.
- The settlement is easily accessible from the Chalighadha – Kuruvadweep road.
- The location is highly vulnerable to flooding or low lying inundation.

Site plan of the settlement and general features



- Payyampally Village Mananthavadi Taluk
- walking distance (800m) from Chalighadha – Kuruvadweep road.
- More than 80 years of existence

Phase IV: Executing the participatory design process

Stage 1: Key Informant consultation

Agricultural labourers

Domestication of animals Cow & hen

Average HH size - 5

Community Interaction

Housing Typology Trend



Change in lifestyle

Agricultural labours ➔ Farmers

Recognized the importance of education

Conscious about health – Regular vaccination & Hospital visits

Katcha House ➔ Pucca House

No religious spaces within the community

Open to Change

PANIYA TRIBAL COMMUNITY- Basthipoyil Panamaram

- Payyampally Village, Mananthavadi Taluk
- More than 80 years of existence

Infrastructure Availability

- Water Supply – three community well
- Jalanidhi water supply connection available
- All houses are electrified
- No Playground/ play area within community
- Anganwadi – Kolathara settlement – 1 km away
- School – 1 to 4 – Alternative school @ kolathara
- 5 to 8 – UP School 3 Km away (Gotrasaradhi available)
- High School – Panamaram 5 km away
- College – Mananthavadi – 10km away

Spatial attribution of Activities



DEVELOPING APPROPRIATE HOUSE DESIGNS FOR TRIBAL COMMUNITIES IN WAYANAD, KERALA

Project Team:  
Department of Architecture and Planning, National Institute of Technology Calicut



# Resilient Houses for Indigenous People



# Resilient Homes for Indigenous People

Cluster View



DEVELOPING APPROPRIATE HOUSE DESIGNS FOR TRIBAL COMMUNITIES IN  
WAYANAD, KERALA

Project Team: Dr. Shyni Anilkumar  
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# 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 DRR is the key to resilience and not technology





# Thank You

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