

# An assessment of the efficiency of climate services in a tropical state of India

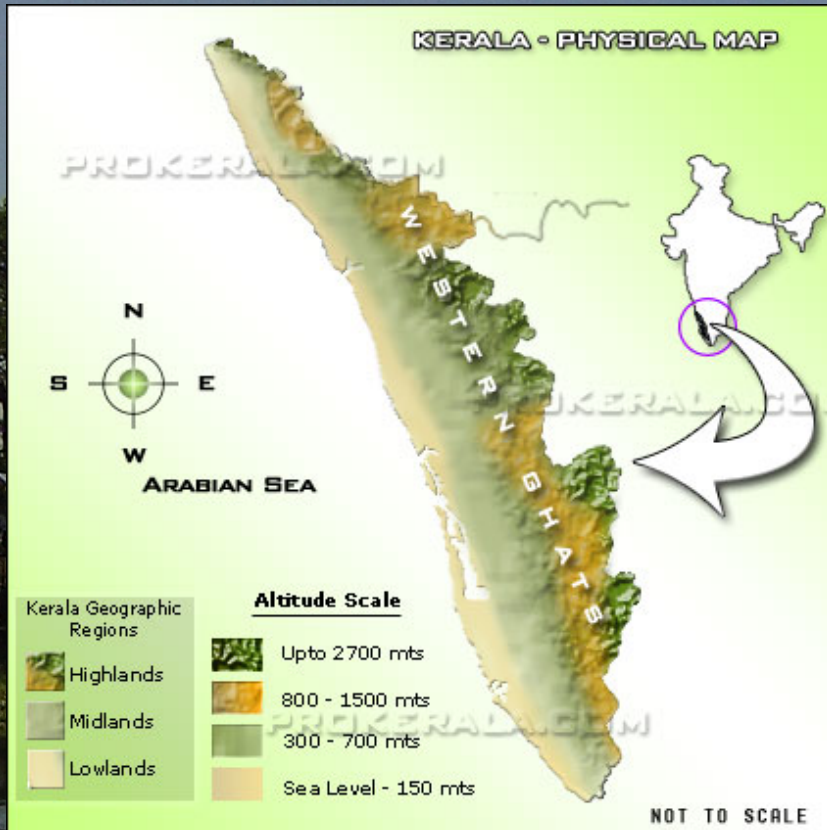
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- Kerala: - small state in the Arabian Sea coast of India
- $8^{\circ}30'$  -  $12^{\circ}30'$  N &  $75^{\circ}15'$  -  $77^{\circ}45'$  E
- Length:  $> 600\text{Km}$ , width:— 35 to  $120\text{Km}$
- Area  $38864\text{ Km}^2$  (1.18% of India)



## Kerala is highly vulnerable to climate change:

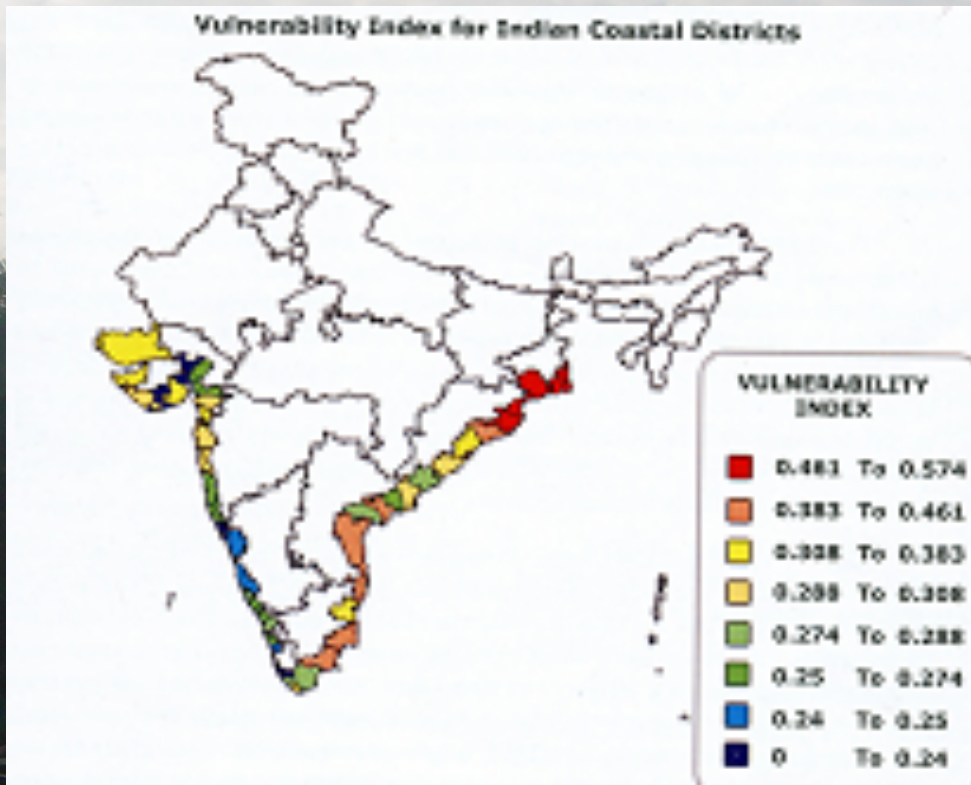
- High population density (859/Sq km, 3 times national average)
- Millions with low adaptive capacity living in wetlands and 700 Km long coastal zones
- Weak economy-lack of funds for adaptation and mitigation measures

Changing climate has large impact on the water resources and thus in the production of food and energy and on the public health



## Changing climate:

- Increasing rainfall seasonality – water shortage during pre-monsoon months
  - Increasing rainfall intensity: floods/landslides – erosion and sedimentation in rivers and reservoirs
  - Increasing convection: convective clouds with large rain drops- erosion of surface soil, casualties associated with lightning
  - Failure in northeast monsoon (end of rainy season) – prolonged dry season, less groundwater recharge
  - Increasing trend in temperature :  $> 40^{\circ}\text{C}$  in isolated areas
  - Increasing frequency and intensity of tropical storms – coastal hazards
- 
- ❖ Climate Models predict slight increase (0.2 C) in temperature and annual rainfall (5-10%) in 2 decades
  - ❖ Increase in precipitation may not compensate for the reduction in soil moisture due to evaporation



*Courtesy: Madras school of economics*

**Estimate using tide gauge data shows nearly 1 mm/year rise in sea level in the west coast of India (*Unnikrishnan et al., Current Science, 2006*)**

Tidal ingress and pushing up of saline waters inland may contaminate coastal aquifers

- 1 metre rise in sea level: existing mechanism unable to protect the coast and low-lying wetlands

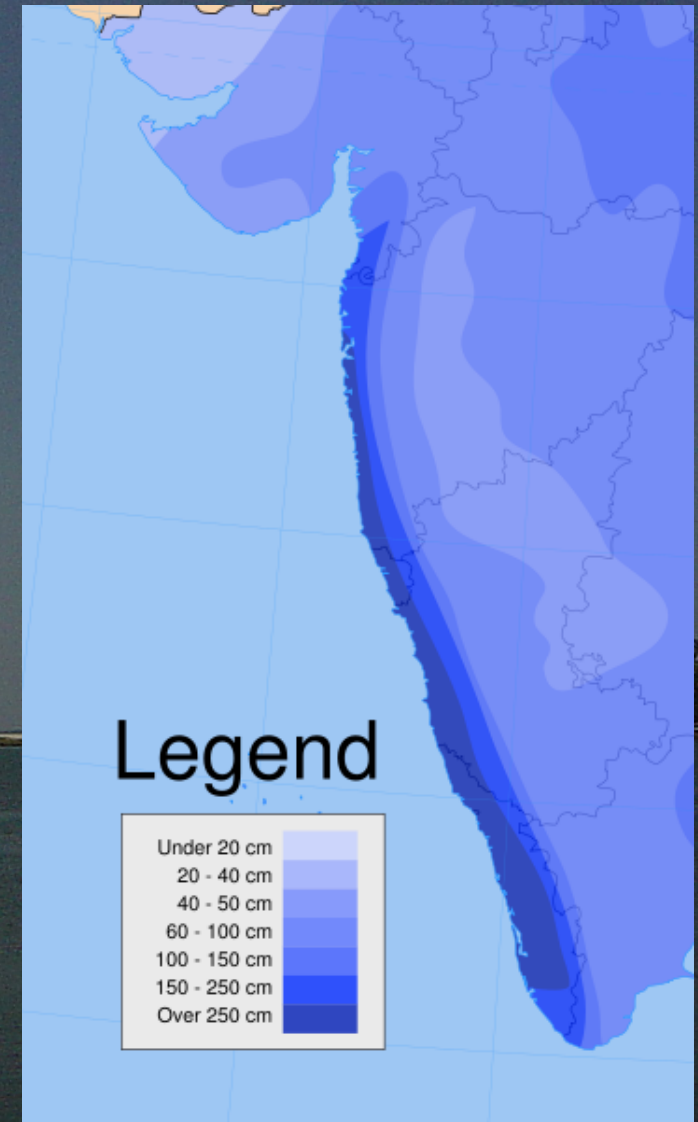
- Major city Kochi may be submerged



State is rich in rainfall and water resources:

- 3000 to 7000mm rainfall from SW & NE monsoons & thunderstorms
- 44 rivers and their numerous tributaries, canals, lakes, ponds..etc

*Rivers entirely monsoon-fed, some of them practically turn into rivulets in summer*



## Kerala is heading towards water crisis:

- ❖ Irregularities in temporal and spatial distribution of rainfall
- ❖ Typical topography - steep slope permits water to flow fast to Sea before harnessed: 75% rainwater flows into the Sea, unutilised
- ❖ Extensive degradation of land and water resources
- ❖ Socio-economic issues , e.g. Water disputes
- ❖ Improper water resources conservation & management

In spite of heavy rainfall and rich cultivable land, Kerala is not self sufficient in food –  
Vagaries (onset and rainfall amount) in monsoons and extremes in rainfall

# Impact of climate changes on water yield and availability

<i>R i v e r b a s i n s (numbers)</i>	<i>Present annual yield (*10<sup>6</sup> m<sup>3</sup>)</i>	<i>Yield by 2030 (*10<sup>6</sup> m<sup>3</sup>)</i>	<i>Present per capita water availability (m<sup>3</sup>)</i>	<i>Per capita by 2030 (m<sup>3</sup>)</i>
1-12	6382	6054	3450	2026
13-17	5450	5206	2486	1460
18-21	7135	6811	3796	2230
22-23	7615	7253	1760	1034
24-27	5502	5256	1678	986
28-33	26311	2510	2887	1697
34-36	3031	2890	1571	923
40-41	2593	2470	387	228

- ❖ With the current trends in population and climate, water availability may fall from 2503m<sup>3</sup> to 1470m<sup>3</sup> by year 2030
- ❖ Seasonal water deficiencies show increasing trend
- ❖ Acute water shortage during non-rainy months in many basins by year 2030



# Environmental degradation adds to the impact of climate change



Vanishing forests



Vanishing hills



Vanishing paddy fields



Vanishing wetlands



## Water resources are getting fast deteriorated

- Inflow of untreated domestic/industrial/agricultural effluents
- Farming in riverbanks/dry riverbeds in dry season: *Bank erosion and sedimentation in rivers*

# Uncontrolled illegal sand mining in rivers and watersheds:



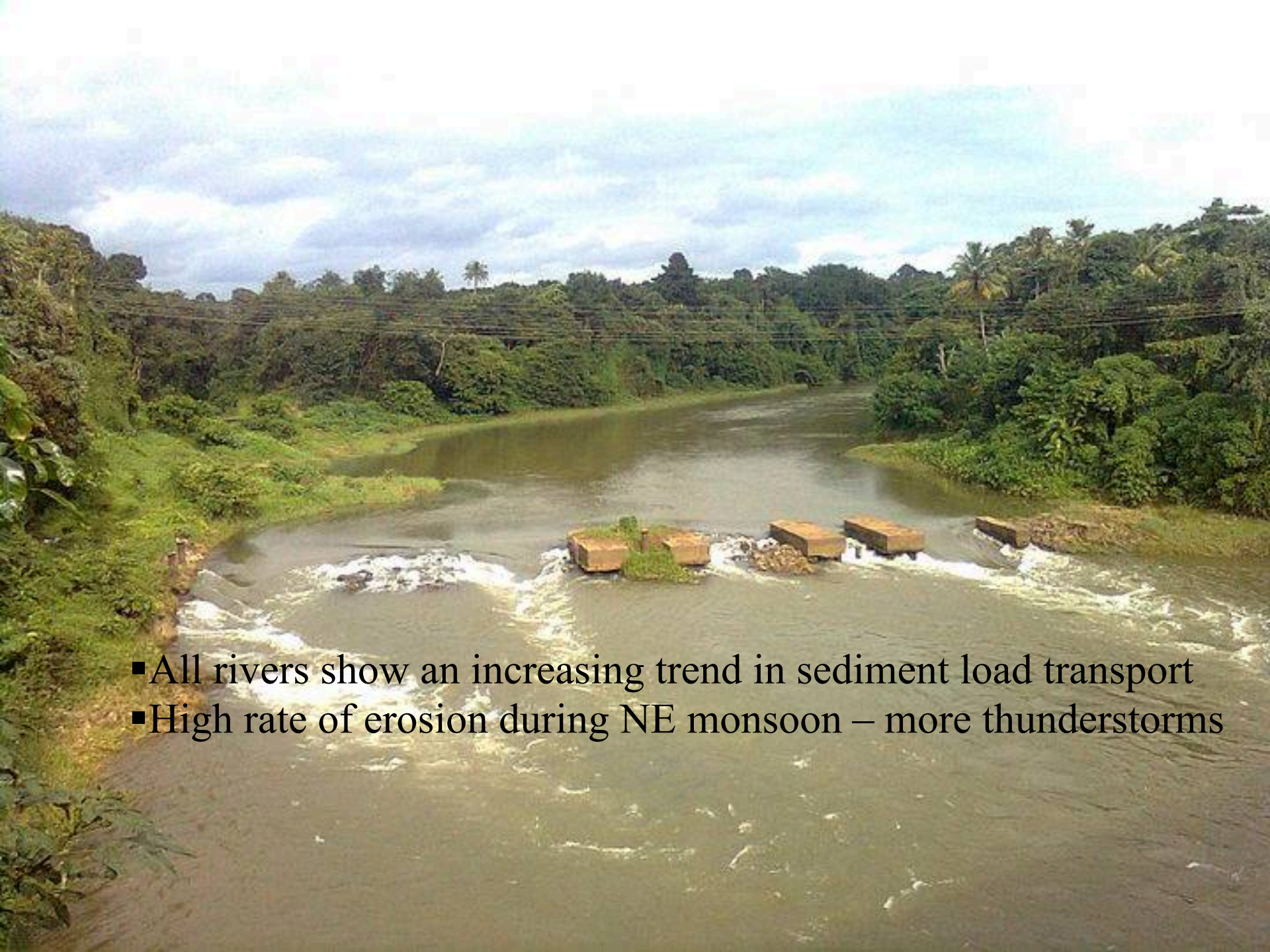
- groundwater level depleted by 1 to 4 metres in 2 decades
- seven once perennial rivers became seasonal in last century
- 20% of water bodies were lost in last 2 decades
- capacity of major reservoirs considerably reduced



Mining alters hydrological regime while enhancing silt movement



- **Encroachment into water bodies:-** Wetlands, paddy fields and ponds are vanishing – special economic zones and housing colonies, *violating existing laws:*
- Canals and ponds were neglected as the farming area shrunk - various social/political developments
- Irreparable damage to the eco-system and environment
  - Affects natural water flow and groundwater recharge
  - Worsens floods, droughts and water crisis

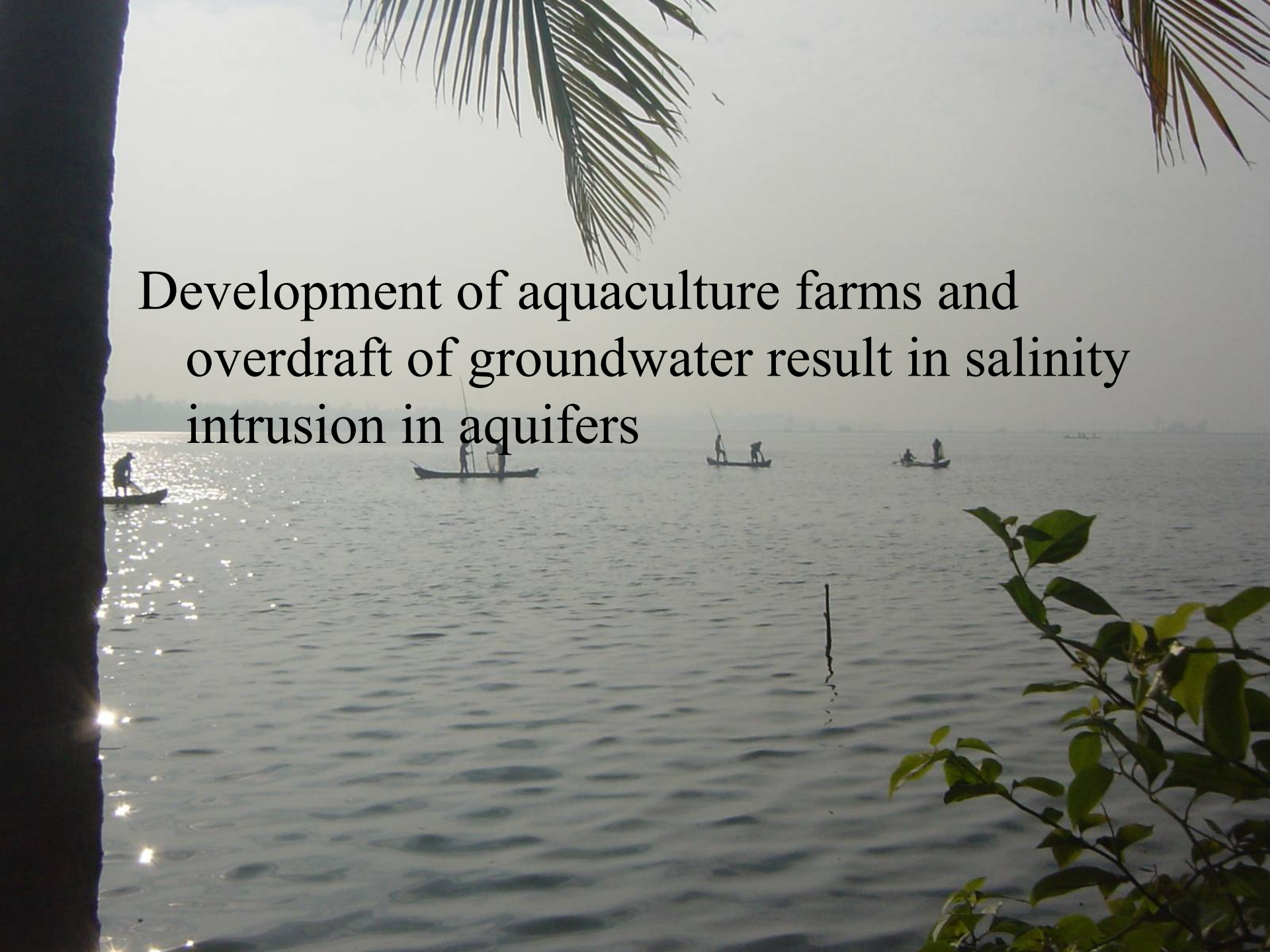


- All rivers show an increasing trend in sediment load transport
- High rate of erosion during NE monsoon – more thunderstorms

## Growing tourism industry:

- Hundreds of houseboats release wastes, grease and oil, in addition to disturbing the living organisms



A tropical coastal scene with palm trees and people in small boats on the water. The text is overlaid on the image.

Development of aquaculture farms and  
overdraft of groundwater result in salinity  
intrusion in aquifers



Millions of hectares of natural forests cleared for tea/rubber/teak plantations:

- landslides and floods
- reduces the water storage capacity of soil
- reduces storage capacity of reservoirs
- soil erosion in watersheds and sedimentation in rivers
- reduces summer flow in rivers



➤ **Rapid urbanisation** - *Expanding urban boundaries and large migration to cities:*



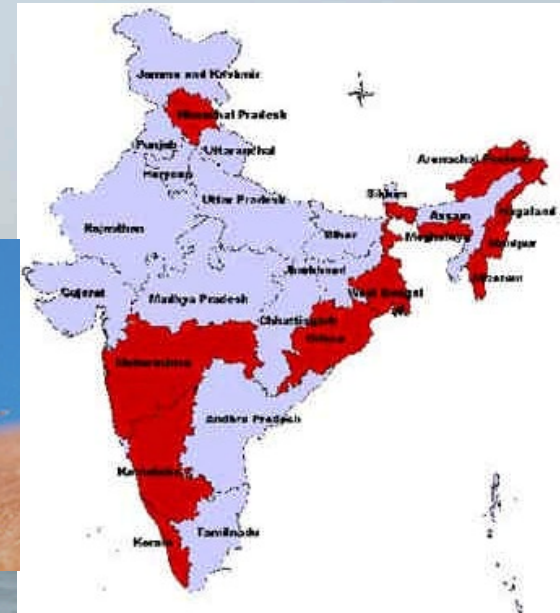
- Cities not well planned to accommodate large population - water supply and waste disposal becomes difficult
- Improper sewage systems and lack of efficient treatment mechanism – all rivers polluted above safety limits – leads to ecological and health issues
- Groundwater in major towns/cities highly contaminated

## Health issues

Vector/water-borne and viral diseases spread fast and into new areas:

- Diseases such as malaria and dengue fever have increased their geographical range
- Every year: - almost one-fourth of the population is affected with one or more diseases such as Conjunctivitis, Viral fever, Chikungunya, Dengue fever, Japanese encephalitis etc
- Heat waves and sunburn - new to the state
- Increasing casualties associated with lightning and floods
- Increasing respiratory diseases

# Entire state will become prone to malaria by 2080



*Bhattacharya et al., CURRENT SCIENCE, 2006*

Endemic regions of malaria (1980 to 2000)

Regions likely to be affected by malaria as per climate change projections

## Socio-economic issues:

- Internal migration – competition and conflicts over land & water
- Rural unemployment in the agricultural sector – urban migration
- Spread of terrorism – terrorist groups exploit unrest in society
- Relocation and rehabilitation of thousands of people from coastal zones
- Water disputes – worsening of existing disputes/beginning of new disputes
- Runoff change and sedimentation – water storage and navigation affected
- Impact of floods on infrastructure
- Hiking price of food and water



*“Climate extremes lead to psychiatric illness in poor people depending on climate sensitive sectors for livelihood like agriculture”*: WHO

## **Mental Illness identified as key Killer by 2025:-WHO**

Every year several debt-ridden farmers commit suicide because of loss in agriculture





## Farmer suicides in India

State	Total farm suicides between 1995 and 2010	Average deaths per year
Maharashtra	50,481	3,155
Madhya Pradesh and Chhattisgarh	41,062	2,566
Karnataka	35,053	2,190
Andhra Pradesh	31,120	1,945
West Bengal	19,328	1,208
Kerala	18,904	1,181
Tamil Nadu	14,864	929
Uttar Pradesh	9,368	586
India	2,56,913	16,057



## Challenges ahead:

- Rising population
- Inflow of migrants- spread of diseases, return of diseases once eradicated  
new settlements, rising demand for food, water and energy
- Climate extremes - shifting rainfall pattern
- Changing government policy prioritising industries over agriculture
- Urbanization
- National river linking programme

State is highly vulnerable to climate change impacts, but climate change does not rank high on policymakers' list of concerns. Certain institutions have started services as part of National Action Plan on Climate Change (NAPCC).

- State Disaster Management Authority with the Chief Minister as Chairman: - Formulation of a state policy, identification of disaster-prone areas and planning of disaster management programmes incorporating the services of various departments
- Department of Environment & Climate Change to deal with Climate change and allied matters, environmental protection, pollution control, administration of biodiversity Act and Rules, River conservation and Coastal Zone Management
- National Centre for Earth Science Studies (NCESS) - Carry out studies in river basin evaluation, ground water management, coastal erosion, natural disaster management and mitigations and other special problems, organize and conduct training courses



- Centre for Water Resources Development and Management (CWRDM): Centre of Excellence - R&D in all spheres of Water and land Management – research, education extension and training activities
- Department of agriculture and animal husbandry: provides five day agromet advisories, twice a week, for all districts. It also provides advisories for irrigation, application of fertilizers, pesticides etc – but, no specific information on what to plant and when to plant, when the rainfall will start.

Insurance for crops, poultry and domestic animals

*Change in the route of migratory birds  
Bird Flu November 2014*



- Department of public health: emergency medical assistance, programmes for vector control, awareness through women's SHGs and NGOs, but, no in-depth research on climate and diseases
- Regional meteorological centre (part of national network): forecasting – general, agricultural, ocean state
- Drought monitoring cell under the state planning board
- Programme (INCOIS and CESS) to establish an Ocean forecast system to district administration with early warning and information on natural hazards - Installation of wave rider buoys for real-time information to generate site-specific models for forecasting - forecast is disseminated to the fishermen community through a website and electronic display boards - wind direction, wave height, wave length, and near-shore characteristic and potential fishing zone advisory. SMS alerts to fishermen

## Initiatives in major sectors:

### ❖ Forestry:

Afforestation programme - successful as several NGOs involved -  
Implementation of new commission reports to control development activities in the Western Ghats Mountain

### ❖ Agriculture:

Research on new crop varieties – tolerant to droughts and floods,  
design of new crop calendar

### ❖ Water:

Cleaning of neglected ponds and canals  
Rainwater harvesting mandatory for buildings >1500 sq ft  
Schemes for groundwater recharge

### ❖ Transport sector:

Pollution control certificate mandatory for all vehicles  
Metro rail system planned for major cities

### ❖ Environment:

Clean environment movement (*no proper treatment mechanism*)

❖ Energy: subsidies for CFL, LED and solar energy, plan to make solar panel mandatory for buildings > 3000 sq ft

## **Major project to protect the wetland is going on: food security, rural employment and biodiversity conservation**

Vembanad-Kol wetland (Ramsar site): Recognised as a Globally Important Agriculture Heritage System (GIAHS) by FAO: unique, below sea level farming practice and traditional knowledge in water management developed ingeniously over a century – Land separating wetland and Arabia Sea less than 1 m – existing mechanism may fail to protect the wetland from sea water intrusion



Climate finance – state level situation is poor with inadequate funds

In India, institutional arrangements around climate finance have mostly followed national policy responses to climate change.



## Obstacles in providing adequate climate service:

- Inadequate climate **finance**
- Lack of **awareness** for the public
- Lack of proper **training** for professionals
- **Poor information** system/unreliable data banks
- Lack of adequate **planning** and vision
- **Beurocracy**/slow government machinery
- **Fragmented** organizational structures
- **Lack of coordination** among agencies and Government departments
- **Weak** administrative and legal frameworks
- **Corruption/misappropriation** of money
- **Vested political/regional interests:** rules/ regulations become farce
- Social issues: **conflict** among different groups
- **Delay** in projects – 60% projects have been lagging for several years, slowing down development and causing waste of money

**“On a scale of 0 to 10, India scores a poor 0.5 in preparedness for the effects of climate change” - Rajendra Pachauri, Chairman, IPCC**

National policies and plans have not considered the situation seriously:

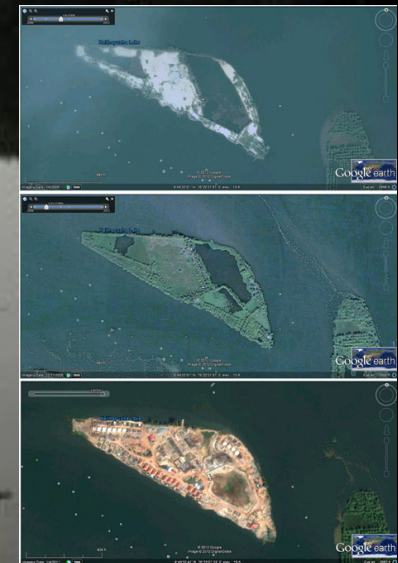
- ❖ India was too late to develop a national climate policy (2008)
- ❖ National water policy and wetland policy are vague guidelines
- ❖ National agriculture policy doesn't provide strong guidelines for adaptation
- ❖ Coastal Zone Regulation Act widely violated – states fail to implement

A High Level Committee constituted by the Ministry of Environment and Forests on 29. 08. 2014 has been given the task of reviewing environmental laws that are several decades old now.

Based on the guidelines of national agencies, Kerala has developed

- State level water policy and wetland policy
- CRZ act that limits development activity in coastal zones



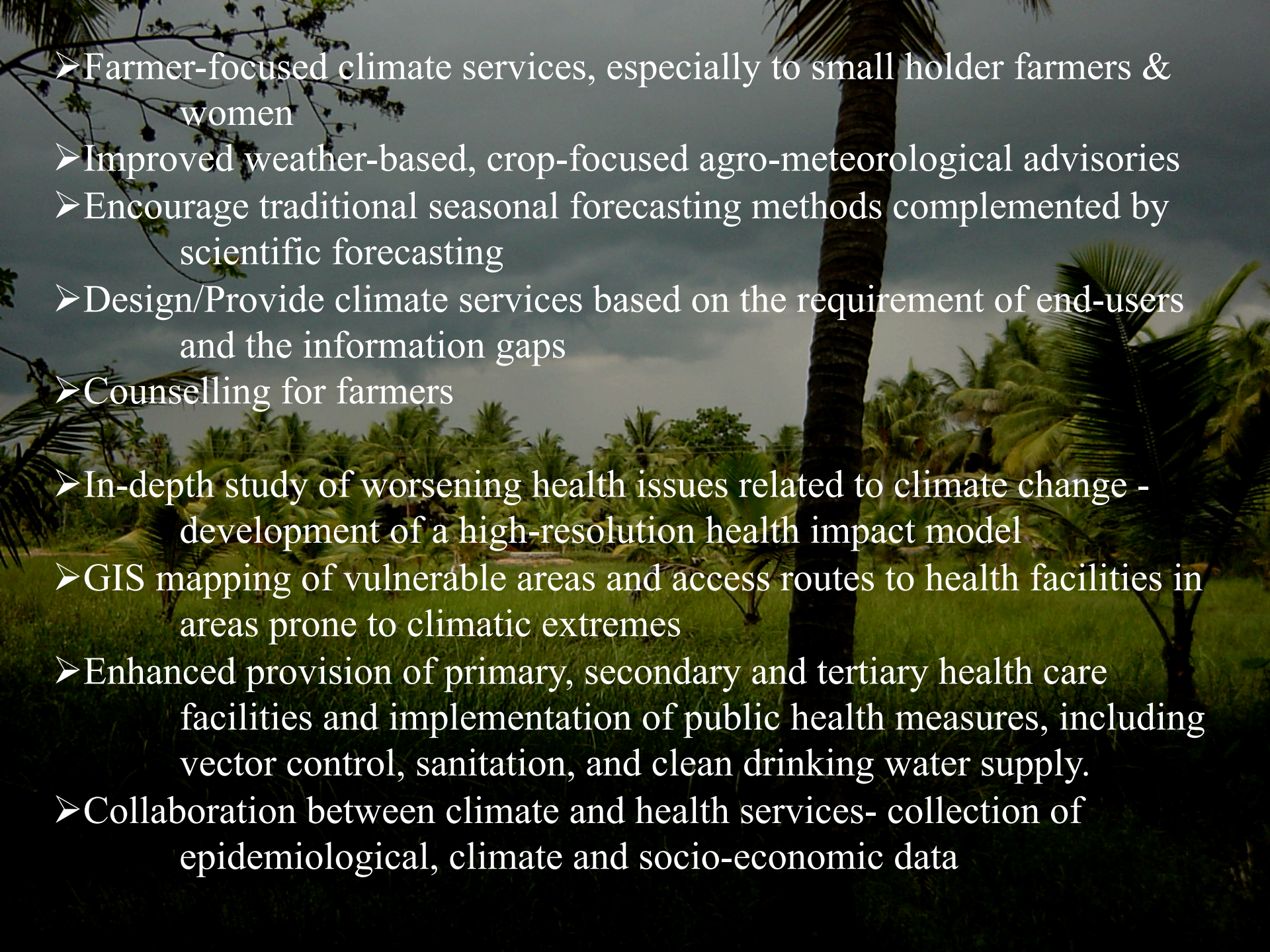


- ❖ CRZ acts prohibits development activity near wetlands
- ❖ Widespread violations by real estate lobby



## Recommendations...

- A comprehensive, frequently updated policy for climate change adaptation and mechanism for effective implementation
- Identifying management practices and policies to reduce vulnerability of ecosystems
- Improved observation methods and good data network
- Improved coordination of departments – finance, law, health, transport...
- Local community involvement
- Proper public awareness on environmental and health issues (heat wave, lightning etc)
- Downscaling of existing climate information to achieve local detail and bridge geographical scales
- Establishment of integrated frameworks for climate service production - multi-disciplinary teams of climate, agricultural, soil, pest, water, seed and extension experts

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- A tropical landscape with palm trees and a cloudy sky. The text is overlaid on the image.
- Farmer-focused climate services, especially to small holder farmers & women
  - Improved weather-based, crop-focused agro-meteorological advisories
  - Encourage traditional seasonal forecasting methods complemented by scientific forecasting
  - Design/Provide climate services based on the requirement of end-users and the information gaps
  - Counselling for farmers
  - In-depth study of worsening health issues related to climate change - development of a high-resolution health impact model
  - GIS mapping of vulnerable areas and access routes to health facilities in areas prone to climatic extremes
  - Enhanced provision of primary, secondary and tertiary health care facilities and implementation of public health measures, including vector control, sanitation, and clean drinking water supply.
  - Collaboration between climate and health services- collection of epidemiological, climate and socio-economic data

- Efficient and effective communication of information - rural radio, SMS, voice messages, agro-met bulletin boards, women's association, NGOs, community based organizations,
- State level department for weather observation – close network of observatories – early warning system
- Establishment of state level Climate Change Finance Unit (e.g cess of costly vehicles, polluting industries etc)



**Climate change could represent an additional stress on ecological and socioeconomic systems that are already facing tremendous pressures due to rapid urbanization, industrialization and development activities**

**Current policies in Kerala are unresponsive to changing climate and the climate services are not very satisfactory**

**State needs improved climate services with special focus on the needs of the most vulnerable - poor, female and marginalized groups etc**

