

# Challenge of Balance State of India's Environment

It's social, environmental and  
economical

# Dual challenges

## 1. **Environment as a development challenge..**

Poor live on their environment. **Environment is biggest asset for economic growth.** But its “sustainable” use demands new management systems. Use environment to build assets

## 2. **Development as an environmental challenge.** Wealth creation (economic growth) leads to environmental degradation. Don't have money or resources to 'fix' problem. **Cannot afford pollution.**

# Development challenge: Need to redefine poverty

- Not as shortage of cash, but shortage/lack of access to natural resources.
- A small change in ecosystem triggers poverty
- Poor live on the environment (50% depend on agriculture even today). Environment is not a luxury but a *basic survival* need -- indicator of economic well-being is *Gross Nature Product* not *Gross National Product*.
- The problem is not *economic* poverty, but *ecological poverty*

# Growth vs poverty

## AGRICULTURE

- Highest economic growth rate; Lowest agriculture growth rate
- **Agriculture and allied activities still employ about 50% people**
- 'Informal' sector employs 92% of India
- About 68% of the net sown area drought-prone
- **Rainfed: 60% of cultivable area. Produce 42% food for India**
- 80% of India's landholding is less than one hectare
- **33% landless (22% in 1991-92)**
- 57% of land facing degradation (increase of 53% since 1994).
- Every second farmer today indebted. Farmer suicides common

## POVERTY

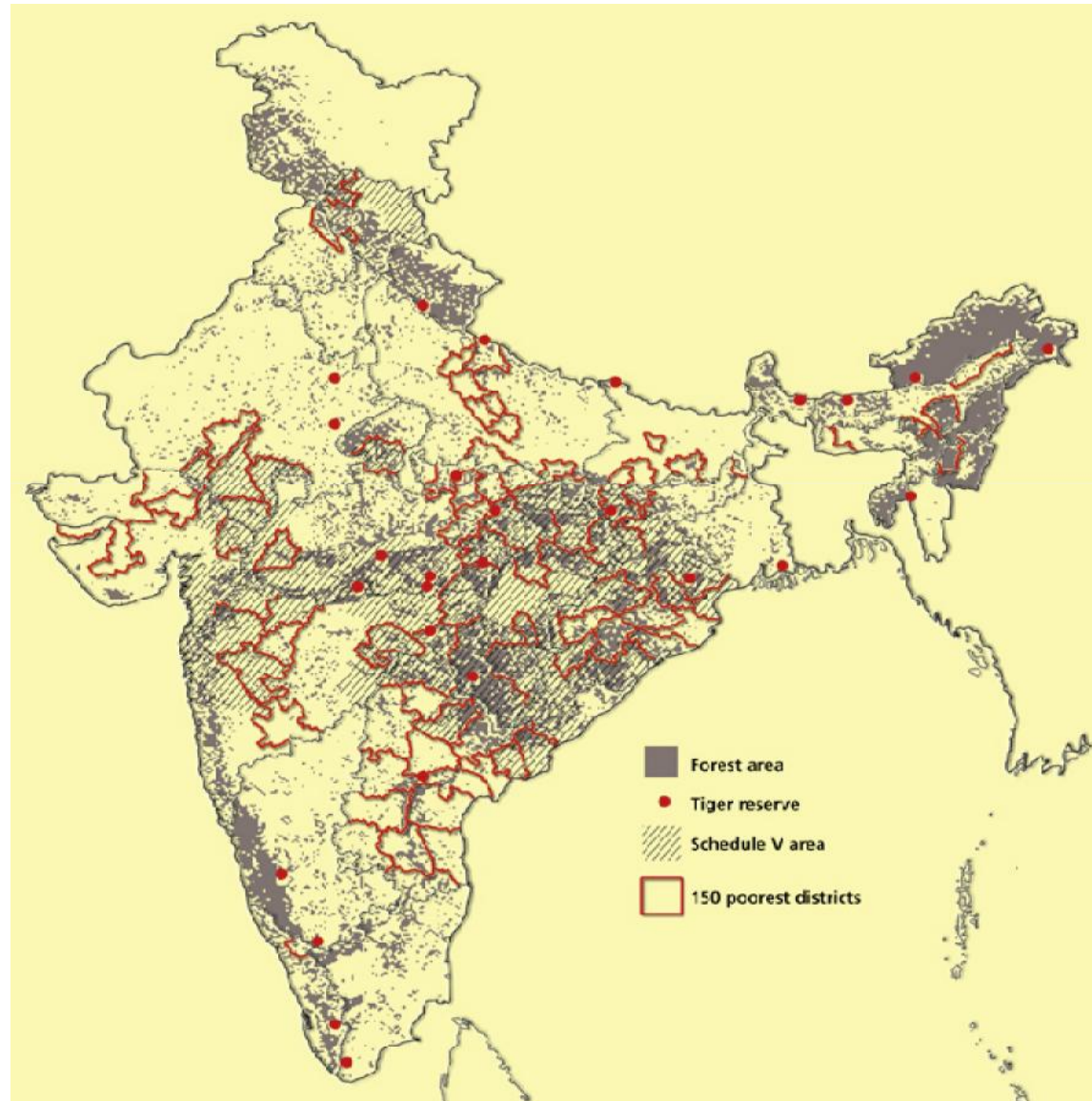
- Poverty line: Rs. 32/day for rural and Rs. 47/day urban (Rangarajan).
- 1/3 of population below the poverty line (363 million: Rural poor = 260.5 million / Urban poor: 102.5 million)
- **India has 42% of the world's underweight children**
- Poverty is getting chronic, concentrated

**Poverty reduction should be linked to ecological regeneration**

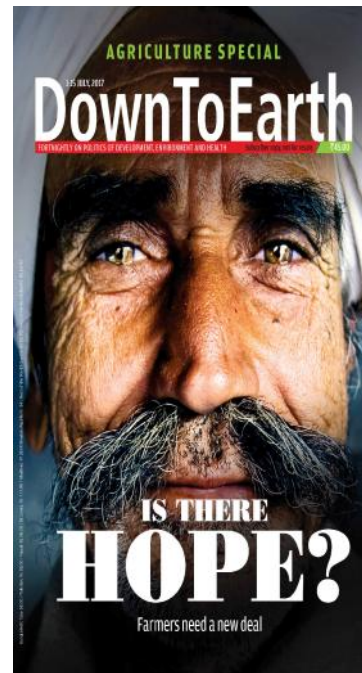
# Food insecure

- Food insecurity: India's pop increasing by roughly 2%/year. But 1990 – 2000, area under food production *shrunk* by 12.5%. Food grain availability (annual) is now 152 kg/capita, 23 kg less than a decade before.
- Poorest 30% of Indian households eat less than 1700 Kcal/day/person (UN figures), but spend up to 70% of their income on food.
- Of 100 mt of extra foodgrain needed by 2020, 36 mt will have to come from rainfed areas alone.
- Drought proofing is key. DPAP + DAP spending thousands of crores.
- Severe droughts led to landmark decisions. 1987 drought = Watershed development approaches. 2002 drought = MGNREGA (Right To Work programme).

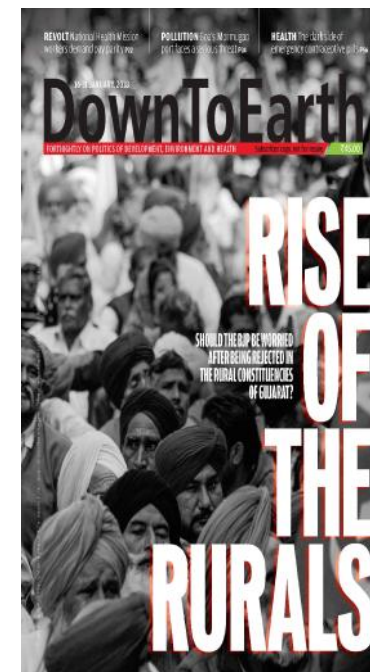
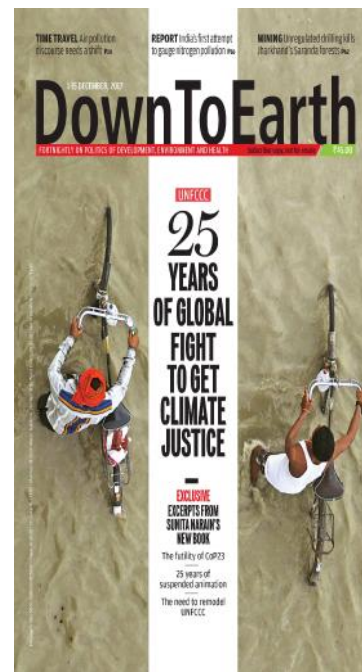
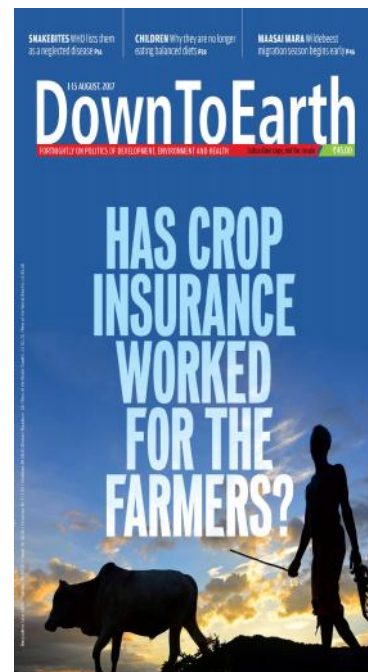
# Re-learn development







**DownToEarth**  
FORGATEWAY ON POLICY OF DEVELOPMENT, ENVIRONMENT AND HEALTH



# A few developments

- Monsoon: Third consecutive contrasting weather events
- 265 districts heavy flooding; 235 drought-like
- Altogether, 500 million people affected by weather-related events
- Flooded districts also rain-deficit



# Points of No Agri-return

- Point 1: How India lost its historic agriculture recovery growth phase in just four years
- Point 2: Every year, farmers lose Rs 63,000 crore for not being able to sell their produce
- Point 3: Only 15% landholders earn 91% of total national income
- Point 4: India needs 30,000 agri-markets to give fair deal to farmers
- Point 5: 50,000 dedicated scientists, still, agriculture is an orphan of science

# A convenient escape

- Economic Survey: First time, brought in climate change and impacts on farmers' income
- Climate change might reduce farm incomes by up to 20-25 per cent in the medium term
- Extreme temperature shocks reduce farmer incomes by 4.3 per cent and 4.1 per cent during kharif and rabi respectively
- Whereas extreme rainfall shocks reduce incomes by 13.7 per cent and 5.5 per cent

# It's real

- India ranks **13<sup>th</sup>** most vulnerable country
- 150 **poorest districts** are most **vulnerable**
- **Most** of these districts are also **agrarian**
- CC will lead to **Rs. 700 crore/year** loss by 2030
- Income of **10% population** will be impacted

# The coast and islands

The 7,517 kilometre Indian coast can be divided into the west coast, the eastern coastal plain and the biodiversity-rich Indian islands. The region is already witnessing climate change impacts like frequent, severe cyclones and sea ingression due to sea level rise

## POPULATION

Total  
**201.3 million**

Rural  
**53%**

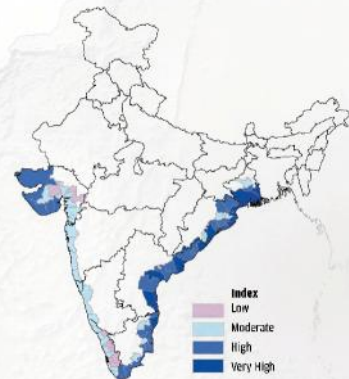
Urban  
**47%**



## CLIMATE CHANGE TRENDS

### Cyclone

The Kutch region in Gujarat and the entire eastern coastal region are projected to have the highest incidence of cyclone



Source: Rama Rao C.A., et al., Atlas on Vulnerability of Indian Agriculture to Climate Change, Central Research Institute for Dryland Agriculture, Hyderabad, 2013

## State-wise projections and impacts

### Gujarat



Decrease in mean minimum temperature  
**0.5°C** (1891-1996)



Increase in mean maximum temperature  
**0.5°C** (1891-1996)

#### Impact and vulnerabilities:

- Junagadh and Porbandar districts to witness increased intensity and frequency of cyclones
- Rainfall to increase by 6-8% in the western coast by the 2030s

### Maharashtra



Increase in mean minimum temperature  
**2.2°C** (by 2021-50)



Increase in mean maximum temperature  
**1.8°C** (by 2021-50)



No. of days with 'high' and 'very high' rainfall to increase (by 2079-99)

#### Impact and vulnerabilities:

- Sea level rise of one metre will inundate 0.18 per cent of the state
- Thane has the highest vulnerability to climate change

### Karnataka



Increase in temperature  
**1.7-2.2°C** (by 2030s)



Monsoon rainfall decreased by 6% in last 50 years

#### Impact and vulnerabilities:

- In Dakshina Kannada and Udupi, 28% coast has reported erosion
- 10-15% decline in rice yield by 2050

### Kerala



Increase in temperature (for coastal areas)  
**2.1°C** (by 2030)



No. of rainy days to decrease; intensity of rainfall to rise by 1-4 mm/day

Sea level rise:  
**1.3 mm ± 0.7 mm/year**

#### Impact and vulnerabilities:

- Coconut yields are projected to increase by 30%

### Tamil Nadu



Increase in mean minimum temperature  
**3.4°C** (by 2100)



Increase in mean maximum temperature  
**3.4°C** (by 2100)



Annual rainfall intensity to increase by 8-14 mm/day (by 2100)

Sea level rise: **0.32 mm/year**

#### Impact and vulnerabilities:

- Sea water intrusion will impact drinking water sources; 13 districts already affected
- Six coastal districts to witness intense cyclones

### Andhra Pradesh



Increase in temperature  
**2.5°C** (by 2080s as compared to 2020s)



Modest increase in future

#### Impact and vulnerabilities:

- Reduction of fish catch in coastal areas
- Temperature fluctuation will negatively impact winter crop
- Coconut production to increase by 10%

### Odisha



Increase in temperature (in coastal areas by 2021-50)  
**1.5°C-2.0°C**



Fewer rainy days with high intensity (by 2020s)

#### Impact and vulnerabilities:

- Cyclonic intensity to increase during July-October by 2020s

### West Bengal



Increase in temperature  
**1.8°C-2.4°C** (by 2021-50)



Little or no change expected

Sea level rise: Sea level rise will be higher than global rate

#### Impact and vulnerabilities:

- Sea surge heights may increase to 7.46 metres
- Kolkata hardest hit by sea level rise, risking one million people and assets worth US \$2 trillion
- Potato production may decline by 4-16% by 2030s

A one-metre rise in sea level will displace  
**7.1 million** people in India

### Andaman & Nicobar Islands

- There is no projected trend on rainfall and temperature, but a rise in sea surface temperature of approximately 1°C above the normal maximum summer temperature over the past 20 years has led to bleaching events
- The sea level along the islands' coast has been rising at above 1.3 mm/year

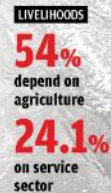
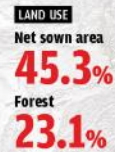
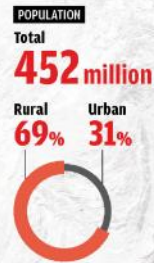
### Lakshadweep

- No projections for temperature and there is no observed change in rainfall in past 30 years
- But in the past 40 years, the observed sea level rise was 1.06-1.75 mm/year
- Projections indicate an estimated loss of 10-40% in crop production by 2100



# Central and peninsular India

The region covers most of India's rainfed areas that contribute more than 40 per cent of the country's foodgrain production. Already ravaged by frequent floods and droughts, this region will be severely impacted by climate change, affecting the country's food security



## Climate change projections and impacts



### Temperature:

- Six of the 11 states will witness a temperature rise of 1°C to 4°C. Maharashtra will record a 3.4°C increase by 2100

- Most states will have hotter summer and winter. The winter temperature in Jharkhand will rise to such an extent that the lowest minimum temperature in the 2080 will be higher than the highest minimum temperature in the 2020s



### Rainfall:

- Tamil Nadu, Telangana, Maharashtra and Jharkhand will witness increase in rainfall. Summer rainfall will increase by the end of this century and the number of rainy days during summer will increase by up to 10 days by 2100 in Jharkhand

- The post-monsoon and pre-monsoon increase in rainfall is projected to be more than the increase in rainfall projected for the monsoon period for 2100

- Rayalaseema region of Andhra Pradesh, parts of Madhya Pradesh and Karnataka will witness less rainfall. In Andhra Pradesh, there will be drastic decrease in southwest rainfall over Anantapur and Kadapa districts

- Northern Karnataka, already witnessing less rainfall and higher temperature, will see the temperature trends accentuated

### Impact and vulnerabilities:

- The number of days with 'high' or 'very high' rainfall (>25 mm/day) is projected to increase over Maharashtra, while the number of days with 'low' to 'moderate' rainfall is expected to reduce

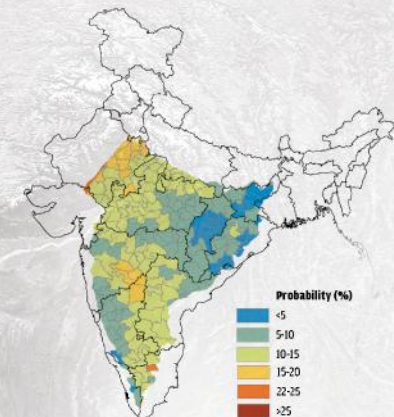
- Fluctuating weather to affect agricultural yield in all the states

- For Karnataka, an increase in droughts is projected for 2021-50 for the two growing seasons. Most of the northern districts of Karnataka would have 10-80% increase in drought incidences

## CLIMATE CHANGE TRENDS

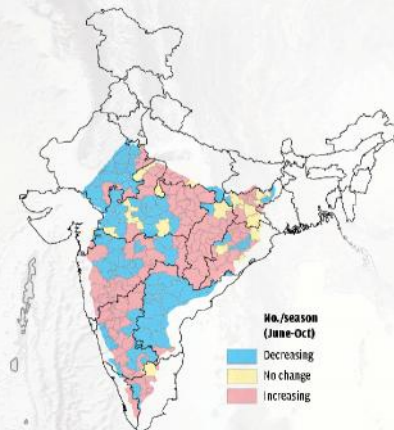
### Drought

Parts of Tamil Nadu, Karnataka and Andhra Pradesh have the highest probability of drought in the region



### Dry spells of >=14 days (2021-50 over 1961-90)

Dry spells are increasing in most of Tamil Nadu, Karnataka, Maharashtra, Chhattisgarh and Madhya Pradesh



Western parts of Karnataka may face fewer droughts due to the projected increase in rainfall

Source: Ramu Rao C.A., et al., Atlas on Vulnerability of Indian Agriculture to Climate Change. Central Research Institute for Dryland Agriculture, Hyderabad, 2013



# The Indian Himalayan region

The Himalayas, which represent about 16.2 per cent of the total area of the country, are not only a key watershed of India but also play a crucial role in the monsoon system. Climate change impacts on the mountain range can affect the entire sub-continent

## POPULATION

Total  
**47 million**

Rural **80%** Urban **20%**



## LAND USE

Net sown area  
**14.5%**

Forest **47%**

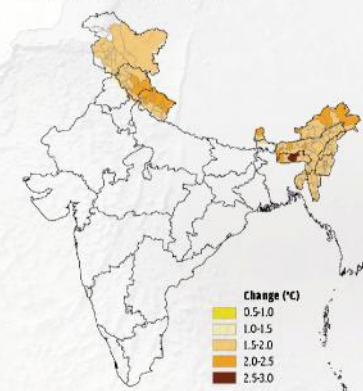
## LIVELIHOODS

**61.5%**  
on hill  
agriculture and  
cultivation

**20.5%**  
on service  
sector

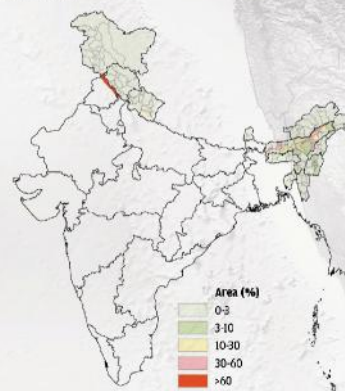
## CLIMATE CHANGE TRENDS

**Change in maximum temperature (2021-50 over 1961-90)**  
Change in the maximum temperature of most districts of the region is projected to increase by at least 1.5°C-2°C



## Flood

The northeastern states of India, particularly parts of Assam and Manipur, are vulnerable



The mean  
temperature of the  
Himalayas has gone up by  
**0.6°C**  
in the past 30 years; the  
frequency of warmer days  
is also increasing

## Climate change projections and impacts



Increase in annual  
temperature

**0.9°C ± 0.6°C to 2.6°C ± 0.7°C**



Annual rainfall is likely  
to increase (by 2021-50)

**5-13%**

**Flood:** An increase in flooding to the extent of  
**10% to >30%** (by 2021-50)

**Drought:** Moderate to extreme drought is projected in certain parts

### Impact and vulnerabilities:

- Flash flood due to glacial lake outbursts may lead to landslides and affect large-scale food security
- Himalayan glaciers melting faster than others elsewhere in the world
- Productivity of apple has decreased by 2-3% over the past few years; this will go down further
- Projected increase in intensity of rainy days is 2-12% in the Himalayan region

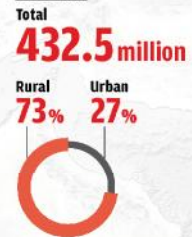
Source: Rama Rao C.A., et al., Action on Vulnerability of Indian Agriculture to Climate Change, Central Research Institute for Dryland Agriculture, Hyderabad, 2013



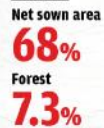
# The Indo-Gangetic plain

The Indo-Gangetic plain is one of the most populous and productive agricultural ecosystems in the world. The region is 400-800-km-wide, low-relief, east-west zone between the Himalayas in the north and the peninsula in the south. Climate change will result in both flood and drought, impacting agriculture in the region

## POPULATION



## LAND USE



## LIVELIHOODS

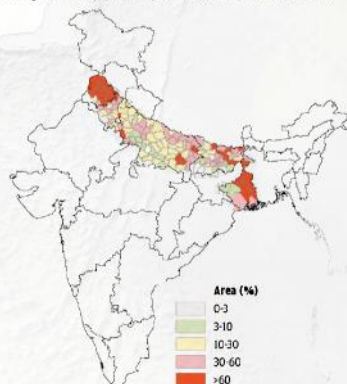


Wheat yields to decline by **4.6-32%** in Punjab by 2021-50

## CLIMATE CHANGE TRENDS

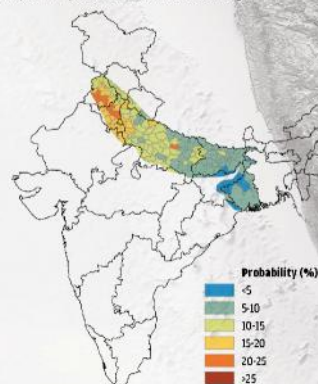
### Flood

High-intensity precipitation events projected to increase, leading to floods, particularly in the eastern parts of the basin



### Drought

Western parts of the basin—Haryana and Punjab—likely to become vulnerable to drought



Source: Rama Rao C.A., et al., Action on Vulnerability of Indian Agriculture to Climate Change, Central Research Institute for Dryland Agriculture, Hyderabad, 2013

## State-wise projections and impacts

### Punjab



Increase in mean minimum temperature  
**1.9°C-2.1°C**



Increase in mean maximum temperature  
**1°C-1.8°C**



Increase in annual rainfall  
**13-22%**

### Impact and vulnerabilities:

- Drought days to extend by 23-46 days in lower Sutlej basin
- Increase in flash floods
- Severe water-logging in south-western region

### Haryana



Increase in mean minimum temperature  
**2.1°C**



Increase in mean maximum temperature  
**1.3°C**



Increase in annual rainfall (by 2100)  
**17%**

### Impact and vulnerabilities:

- Increase in water evaporation
- Not much change in groundwater recharge despite high rainfall
- Increase in agricultural water stress by 2100

### West Bengal



Increase in temperature  
**1.8°C-2.4°C**



Not much change in monsoon but winter rain to reduce

### Impact and vulnerabilities:

- Intensity of cyclone to increase
- Sea surge height may increase to 7.46 metres
- Sea level rise will be higher than global average
- Sunderbans and Darjeeling hill to have more rain

### Uttar Pradesh and Bihar



Increase in temperature  
**2°C (by 2050)**  
**4°C (by 2100)**



High-intensity precipitation events to increase

### Impact and vulnerabilities:

- A mere 1°C rise in temperature to reduce wheat yields significantly in UP
- Rice yields are expected to decline in Bihar
- Drought to increase in UP and Bihar



# First whammy..

- Agriculture is already stressed: **ecological** degradation
- **Market** is not working for farmers
- **Drought** impacts half of India; **increasing** intensity
- **Extreme weather** events: drought to deluge to drought
- **500 million** farmers impacted by drought; **90 million** people impacted by floods

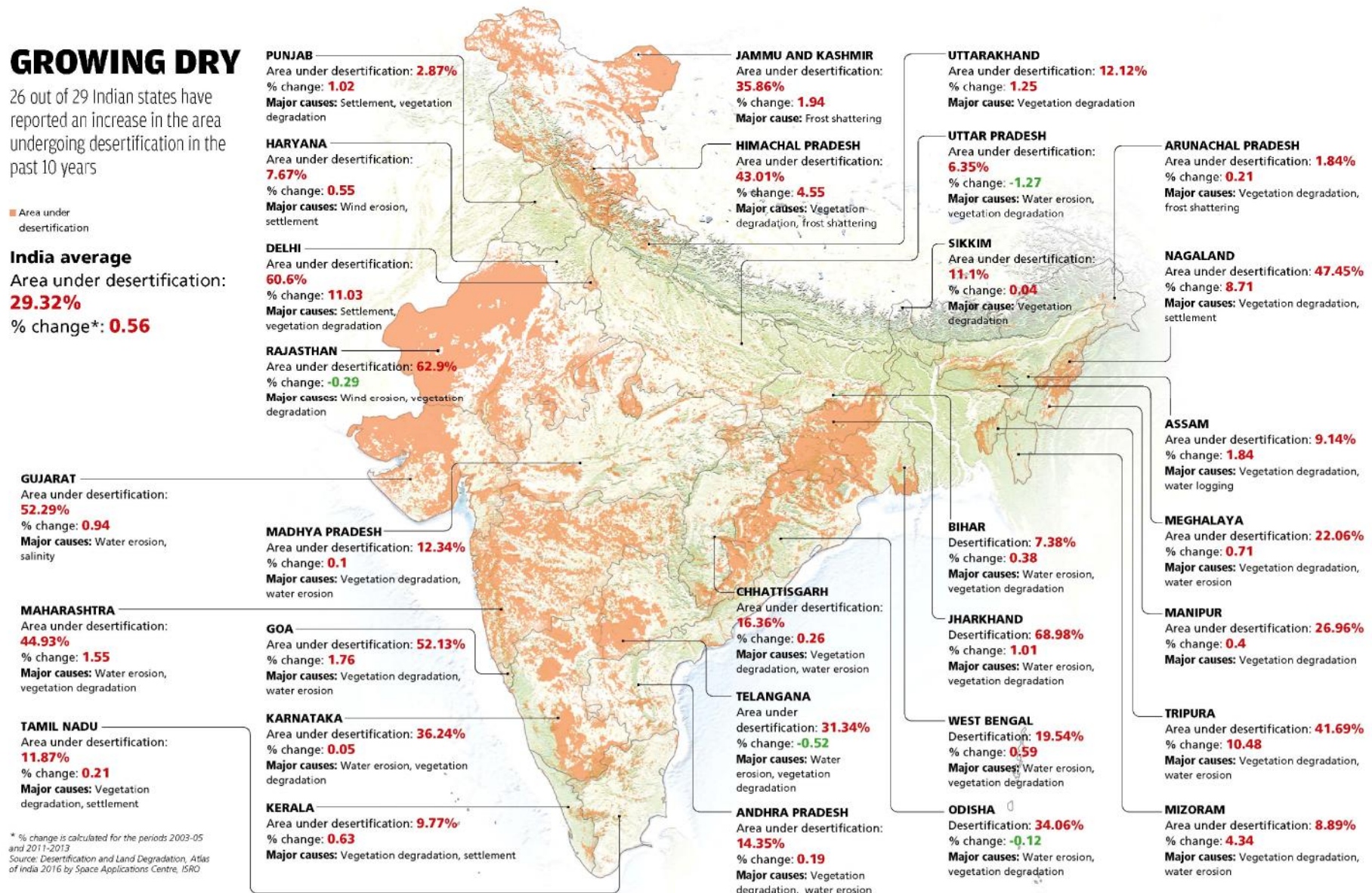
## GROWING DRY

26 out of 29 Indian states have reported an increase in the area undergoing desertification in the past 10 years

■ Area under desertification

### India average

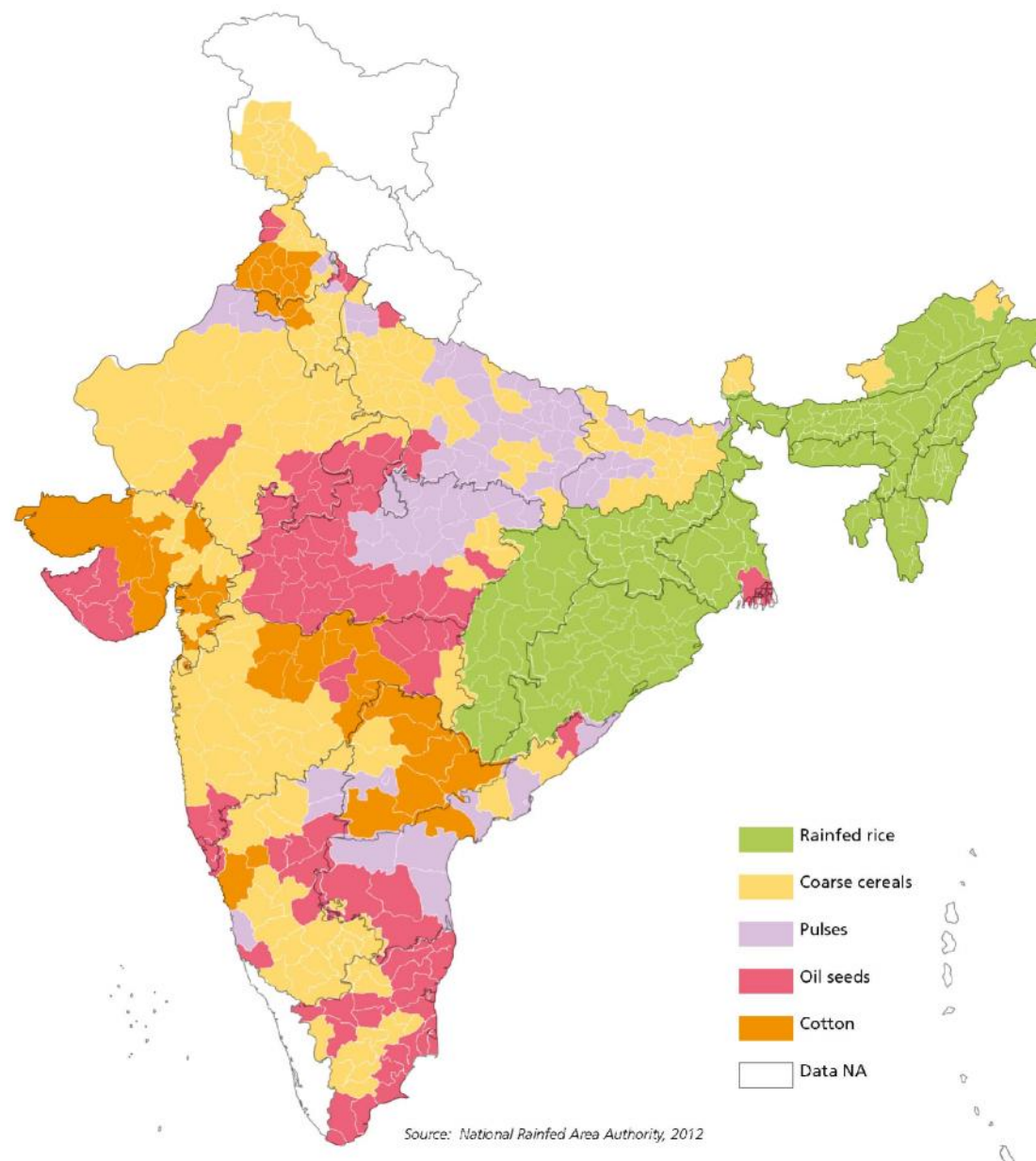
Area under desertification: **29.32%**  
 % change\*: **0.56**



\* % change is calculated for the periods 2003-05 and 2011-2013  
 Source: Desertification and Land Degradation, Atlas of India 2016 by Space Applications Centre, ISRO

## RAINFED DISTRICTS AND THEIR MAIN CROPS

Rainfed agriculture accounts for 68 per cent of the country's total net sown area. Their productivity needs to be improved to ensure food security in coming years



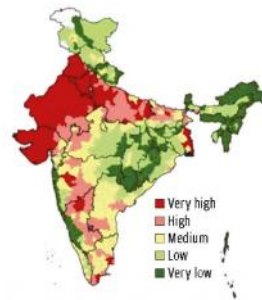
## Second whammy...

- India, a biomass economy: every million Ha support 7.27 million people
- A losing preposition: Income Rs. 6426/month; Expenditure Rs. 6223/month
- Agriculture remains the main driver: Both for poverty reduction and economic growth
- Green revolution area productivity plateaus; food security depends on rainfed areas
- So, the most degraded areas will have to bear this burden. There is more..



# ON THE EDGE

By 2050, India is likely to experience a temperature rise of 1-4°C; rainfall will increase by 9-16 per cent. This will have a detrimental effect on farmers in more than half of the country. However, severity of the impact will differ from district to district, depending on the region's sensitivity. People's resilience in these areas will depend on their exposure to extreme events and on their adaptive capacity.

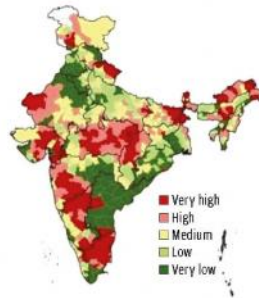


## Sensitivity

### 12 states\*

**have districts that are highly sensitive to climate change**

Sensitivity is the degree to which a region gets affected by climate-related stimuli, such as climate variability and the frequency and magnitude of extremes events like cyclone and drought. It is determined by demographic and environmental conditions of the region. Most districts in north-western India are highly sensitive to climate change impacts. Eastern, north-eastern, northern and west coast of the country have relatively low sensitivity.

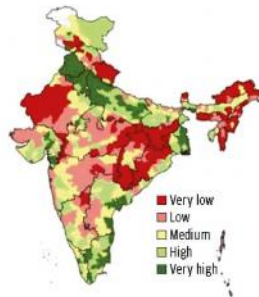


## Exposure

### 21 states\*

**have districts that are highly exposed to climate change risks**

Exposure is defined as the nature and degree to which a system is exposed to significant climatic variations. It includes parameters, such as maximum and minimum temperatures and the number of rainy days. High to very high exposure has been observed in districts in Madhya Pradesh, Karnataka, Rajasthan, Gujarat, Maharashtra, Bihar, Tamil Nadu, north-eastern states and Jammu & Kashmir. Districts with low exposure are in Andhra Pradesh, Odisha, West Bengal, Punjab, Haryana, Rajasthan and Uttar Pradesh.



## Adaptive capacity

### 17 states\*

**have districts with low adaptive capacity to climate change**

Adaptive capacity is the ability of a region to adjust to climate change. It is a function of wealth, technology, education, skills, infrastructure, access to resources, and management capabilities. Adaptive capacity is found to be very low in the eastern and north-eastern states, Rajasthan, Madhya Pradesh, peninsular and hill regions. Adaptive capacity is high in Punjab, Haryana, western Uttar Pradesh and Tamil Nadu.

# Vulnerability 60% of rural districts\*\* are vulnerable to climate change

Vulnerability is assessed on the basis of sensitivity, exposure and adaptive capacity of an area. Districts in Rajasthan, Gujarat, Madhya Pradesh, Karnataka, Maharashtra, Andhra Pradesh, Tamil Nadu, eastern Uttar Pradesh and Bihar exhibit very high and high vulnerability. Districts along the west coast, northern Andhra Pradesh and north-eastern states are relatively less vulnerable

Very high  
Medium  
Very low

High  
Low

**Haryana**  
**79%** districts are vulnerable

**Rajasthan**  
**100%** districts are vulnerable

**Gujarat**  
**84%** districts are vulnerable

**Madhya Pradesh**  
**87%** districts are vulnerable

**Maharashtra**  
**61%** districts are vulnerable

**Goa**  
**100%** districts have low vulnerability

**Karnataka**  
**70%** districts are vulnerable

**Kerala**  
**87%** districts have low vulnerability

**Tamil Nadu**  
**69%** districts are vulnerable

**Jammu & Kashmir**  
**50%** districts are vulnerable

**Himachal Pradesh**  
**50%** districts are vulnerable

**Uttarakhand**  
**62%** districts are vulnerable

**Punjab**  
**53%** districts are vulnerable

**Uttar Pradesh**  
**77%** districts are vulnerable

**Bihar**  
**76%** districts are vulnerable

**Sikkim**  
**100%** districts have low vulnerability

**Arunachal Pradesh**  
**100%** districts have low vulnerability

**Nagaland**  
**100%** districts have low vulnerability

**Manipur**  
**67%** districts have low vulnerability

**Mizoram**  
**88%** districts have low vulnerability

**Tripura**  
**100%** districts have low vulnerability

**Meghalaya**  
**86%** districts have low vulnerability

**Assam**  
**87%** districts have low vulnerability

**Andaman & Nicobar islands**  
**100%** districts have low vulnerability

**West Bengal**  
**53%** districts are vulnerable

**Jharkhand**  
**89%** districts are vulnerable

**Odisha**  
**67%** districts have low vulnerability

**Chhattishgarh**  
**69%** districts are vulnerable

**Telangana**  
**67%** districts have low vulnerability

**Andhra Pradesh**  
**69%** districts have low vulnerability

Note: Andhra Pradesh was reorganised into Telangana and Andhra Pradesh in 2014 and a part of Khammam district in Telangana was placed in Andhra Pradesh. This change was not accounted for. \*Only states with very high and high exposure and sensitivity districts have been counted. \*\*Only states with districts that have very low and low adaptive capacity have been counted. \*\*\*Districts with very high, high and medium levels have been considered vulnerable. Climate projections are for the period 2021-2050

Prepared by DTE/CSE Data Centre

Infographics: Raj Kumar Singh; Analysis: Kiran Pandey and Rajit Sengupta

Data source: A district level assessment of vulnerability of Indian agriculture to climate change, published in Current Science on May 25, 2016. For more such infographics visit: [www.downtoearth.org.in/infographics](http://www.downtoearth.org.in/infographics)