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# **An overview of the issues of Desertification, Land Degradation and Drought (DLDD)- TERI**

## **Biophysical Estimates**

# Objectives



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- Assess scale of land degradation in the country with the economic impacts.
- Assess the quantum, along with the sources, of investment required for undertaking preventive and restorative measures which can help achieve the aspirational goal of land degradation neutral India by 2030

# Scope of Study



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1. Examine economic valuation studies and data available from secondary literature and published sources.
2. Review Government's programmes and schemes relating to DLDD issues, targets, financial allocations and achievements.
3. Select 6 case study sites for micro-economic assessment in **arid, semi-arid and dry sub-humid regions** of the country, identify the data requirements and sources of information.
4. A macro-economic assessment for the entire country and scenario development (till 2030).
5. A micro-economic assessment for 6 case study sites for full economic assessment and scenario development (till 2030).

# Defining the issue



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## Land

- *The terrestrial bio-productive system that comprises soil, vegetation, other biota, and the ecological and hydrological processes that operate within the system.(UNCCD, 1996, Part1, Article 1e)*

## Land Degradation

- *Reduction or loss of biological or economic productivity and complexity of rain-fed cropland, irrigated cropland or range, pasture, forests, & woodlands resulting from land use or from a process or combination of processes arising from human activities & habitation patterns such as*
  - ***Soil erosion caused by water and/or wind***
  - ***Deterioration of physical, chemical, biological or economic properties of soil***
  - ***Long-term loss of natural vegetation***

## Desertification

- *Land degradation in **arid, semi-arid and dry sub-humid** areas resulting from various factors, including climatic variations and human activities (UNCCD)*

# What's involved in Land Degradation?



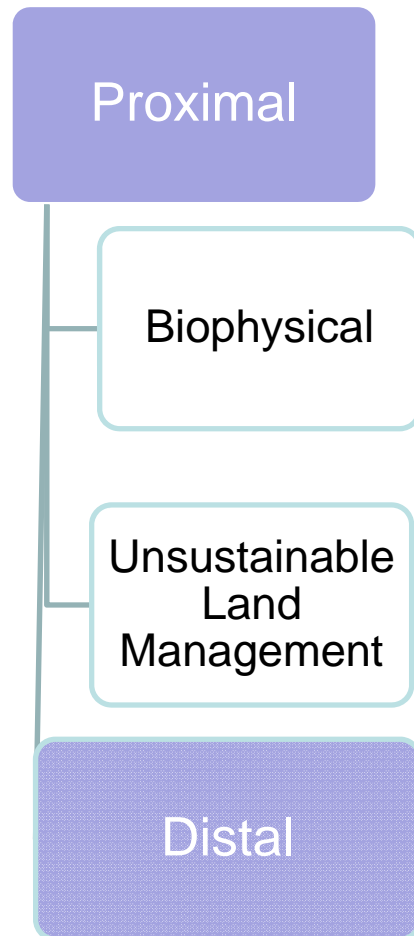
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- Broadly divided into physical, chemical & biological degradation
- **Physical degradation** is erosion, soil organic carbon loss, change in soil's physical structure-e.g. compaction, waterlogging.
- Globally soil erosion most important LD process resulting in removal of topsoil.
- Soil productivity depleted through reduced rooting depth, loss of plant nutrients, physical loss of topsoil
- **Chemical degradation**-leaching, salinisation, fertility depletion, acidification, nutrient imbalances
- **Biological degradation**: Loss of vegetation, rangeland degradation, loss in biodiversity including soil organic matter

# DLDD- Causes



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- **Proximal**
- **Biophysical**
  - Topography, climatic conditions (rainfall, temperature, wind)
- **Unsustainable Land Management**
  - **Deforestation**, degradation, overgrazing, conversion to other land uses, forest fires, excessive fuel wood collection
  - **Unsustainable agricultural practices**-extensive and frequent cropping, excessive fertiliser use, shifting cultivation with short fallows
  - **Industrial, mining**-few land restoration measures
- **Distal**
  - Poverty
  - Policy failures-e.g. subsidising fertiliser use
  - Weak local institutions, top-down approaches, poor decentralisation: Impacts on land use management

# Land Degradation Status of India



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- 2.4% of Geographical area: Over 16.57% of world's population
- 0.5% of world's grazing area: 16% of cattle population
- Major cause of degradation is soil erosion caused by water & wind

Processes of Desertification / land degradation	Area covered	
	Area (mha)	% of Total Geog. Area
Water Erosion	33.56	10.21
Vegetal Degradation	31.66	9.63
Wind/Eolian Degradation	17.56	5.34
Frost Shattering	10.21	3.10
Salinity/Alkalinity	5.26	1.60
Mass Movement	4.45	1.35
Water logging	0.98	0.30
Rocky areas/ Barren	1.65	0.50
Others (Man made, frost heaving etc.)	0.15	0.04
	105.48	32.07

**NE- Highest vegetal degradation**

**Gujarat: 68.43% (Salinisation & : Water erosion)**

**Rajasthan: 67% (Wind Erosion)**

**J and K (cold): 60.7%**

Process of LD/Desertification	Area (mha)	% of GA
Water and Wind Erosion	94.87	28.86
Acid Soil	17.93	5.45
Alkali/Sodic soil	3.7	1.13
Saline Soil	2.73	0.83
Water logged Areas	0.91	0.28
Mining/Industrial	0.26	0.08
Total Degraded Area	120.4	36.63

SAC (2007)

ICAR, 2010

# The Drylands of India



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## Area under Drylands

Arid: 50.8 mha

Semi-arid:

123.4mha

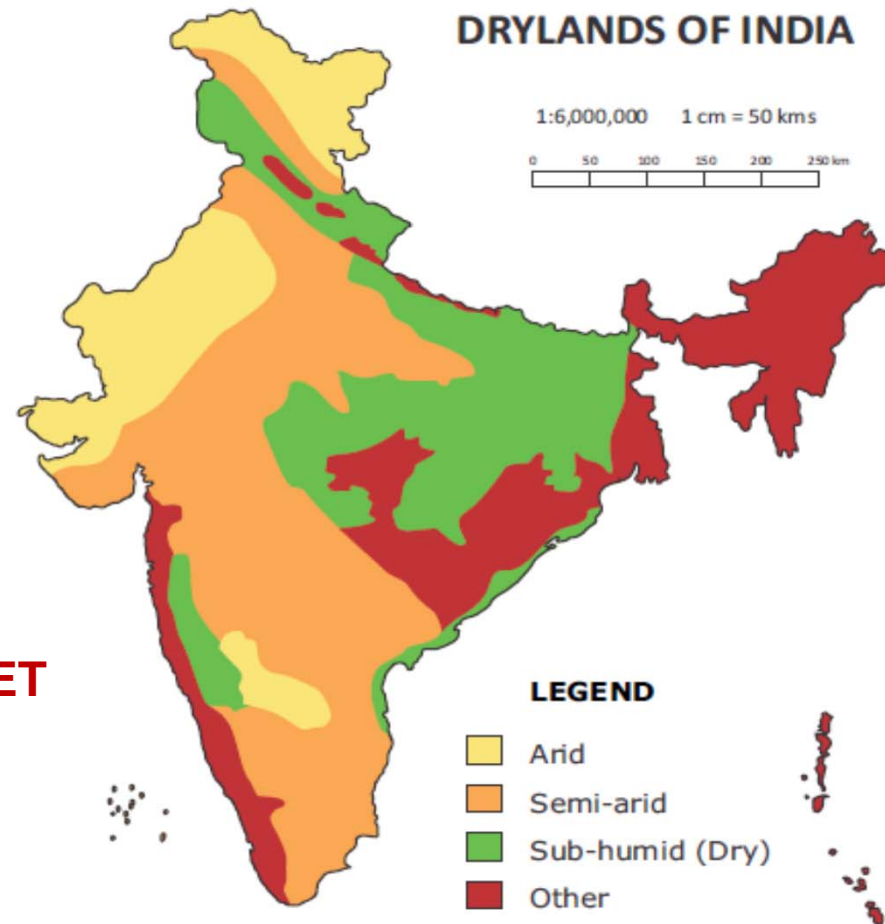
Sub-humid: 54.1  
mha

Total:228.3mha  
(69.6% of GA)

Aridity index= $P/PET$

*P*=Mean annual  
precipitation

*PET*= Potential  
Evapotranspiration



## Desertified Area

Arid: 34.89mha

Semi-arid:

31.99mha

Sub-humid:  
14.57 mha

LD in drylands is 81.45  
mha (24.78% of GA)  
(MoEF, 2014)

Source: Agro-Ecological Subregions of India, NBSS&LLP (ICAR), Nagpur

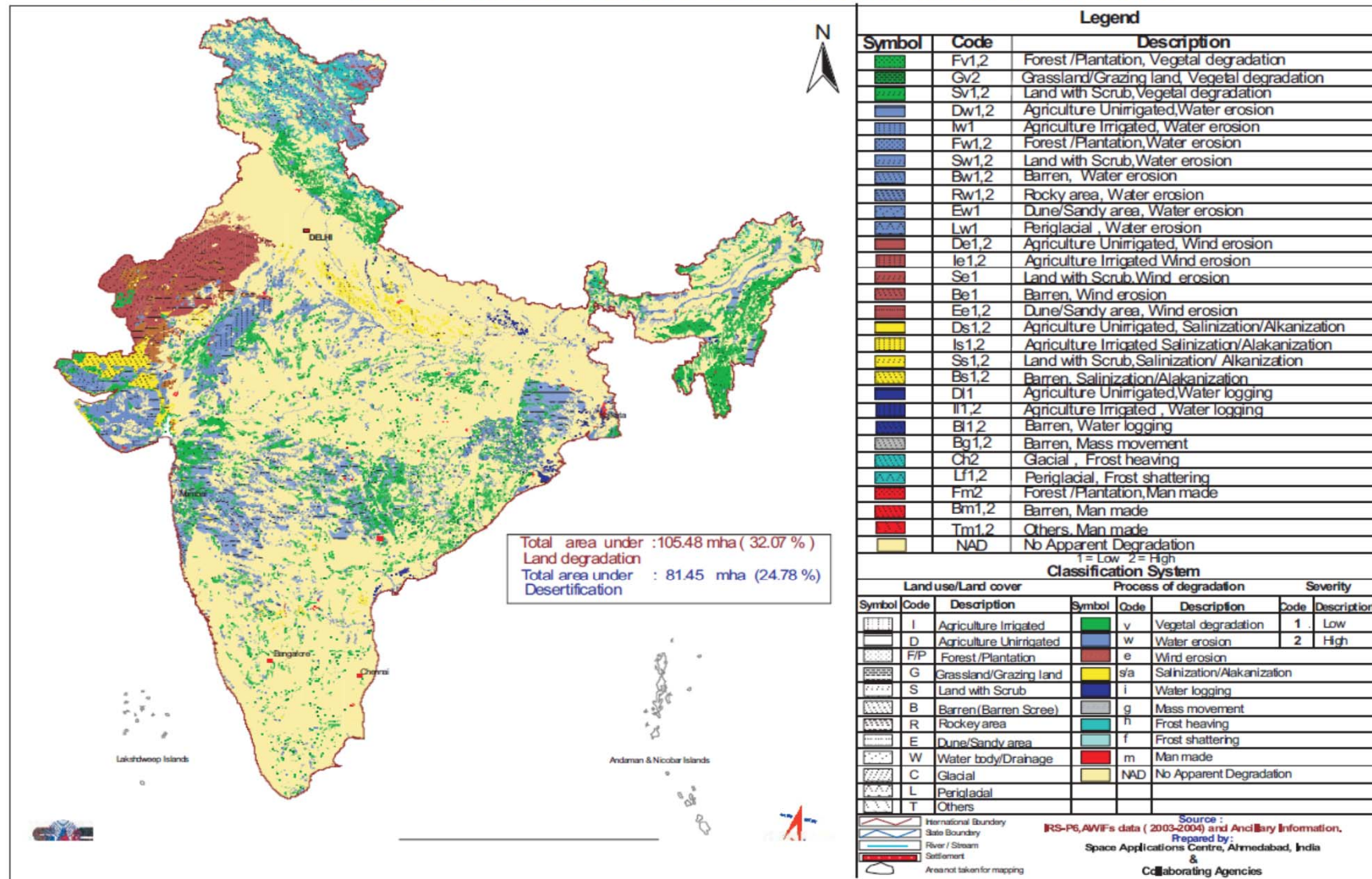


# Land Degradation Status of India



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## DESERTIFICATION/ LAND DEGRADATION STATUS MAP OF INDIA



# Estimates of Degradation



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Agency	Estimated extent (M ha)	Criteria for delineation
National Commission on Agriculture (NCA, 1976)	148.09	Based on the secondary data
Ministry of Agriculture (1978) (Soil and Water Conservation Division)	175.00	Based on the NCA's estimates. No systematic survey was undertaken
Society for Promotion of Wastelands Development (SPWD) (Bhumbla and Khare, 1984)	129.58	Based on the secondary estimates
NRSA (1985)	53.28	Mapping on 1 : 1 million scale based on the remote-sensing techniques
Ministry of Agriculture (MOA, 1985)	173.64	Land degradation statistics for states
Ministry of Agriculture (MOA, 1994)	107.43	Elimination of duplication of area. Area reclaimed counted
NBSS&LUP (1994)	187.70	Mapping on 1 : 4 million scale based on the Global Assessment of Soil Degradation (GLASOD) guidelines
NBSS&LUP (2004) (revised)	146.82	1 : 1 million scale soil map
Department of Environment (Vohra, 1980)	95.00	
National Wasteland Development Board (1985)	123.00	

*Source:* Gautam, N.C. and Narayan, L.R.A. 1988

Soil degradation classes from 1: 250,000 soil map (1985-1995)

NRSA wasteland classes (1986-2000)

Classes	Codes	Area (in M ha)
Water Erosion	W	
Loss of top-soil	Wt	83.31
Terrain deformation	Wd	10.37
Wind Erosion	E	
Loss of top-soil	Wt	4.35
Loss of top-soil/terrain deformation	Et/Ed	3.24
Terrain deformation/overblowing	Ed/Eo	1.89
Chemical Deterioration	C	
Salinization	Cs	5.89
Loss of nutrients (En) – (Acid soils)	En	16.03
Physical Deterioration	P	
Waterlogging	Pw	14.29
Others		
Ice caps/Rock outcrops/Arid mountain	I/R/M	8.38
Total		147.75

*Source:* NBSS&LUP. 2004

Wasteland class	Area (in M ha)	Percentage
Gullied/ravinous land	2.06	0.65
Land with/without scrub	19.40	6.13
Waterlogged/marshy land	1.66	0.52
Land affected by salinity	2.04	0.65
Shifting cultivation area	3.51	1.11
Degraded notified forest land	14.07	4.44
Degraded pastures/grazing land	2.60	0.82
Degraded land under plantation	0.58	0.18
Sandy area	5.00	1.58
Mining/industrial wasteland	0.12	0.04
Barren rocky/stony/sheet rock	6.46	2.04
Steep sloping area	0.77	0.24
Snow covered/glacial area	5.58	1.76
Total	63.85	20.16

*Note:* Total wastelands are estimated at 63.85 M ha, correlating with strong, extreme and part of moderate categories of land degradation

*Source:* NRSA and MoRD. 2000



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# Harmonised land degradation statistics



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Degradation type	Arable land (M ha)	Open forest (<40% canopy) (M ha)	Data source
Water erosion (>10 tonnes/ha/yr)	73.27	9.30	Soil Loss Map of India–CSWCR&TI
Wind erosion (Aeolian)	12.40	–	Wind Erosion Map of India–CAZRI
Sub-total	85.67	9.30	
Chemical degradation			
Exclusively salt-affected soils	5.44	–	Salt-Affected Soils Map of India, CSSRI, NBSS&LUP, NRSA and others
Salt-affected and water eroded soils	1.20	0.10	
Exclusively acidic soils (pH < 5.5) <sup>#</sup>	5.09	–	Acid Soil Map of India NBSS&LUP
Acidic (pH < 5.5) and water eroded soils <sup>#</sup>	5.72	7.13	
Sub-total	17.45	7.23	
Physical degradation			
Mining and industrial waste	0.19		Wasteland Map of India–NRSA
Waterlogging (permanent surface inundation) <sup>\$</sup>	0.88		
Sub-total	1.07		
Total	104.19	16.53	
<b>Grand total (Arable land and open forest)</b>	<b>120.72</b>		

*Notes:* Forest Survey of India Map (1999) was used to exclude degraded land under dense forest; Unculturable Wastelands: Barren rocky/stony waste: 6 M ha, are the source for runoff water and building material; Snow covered/ice-caps: 6 M ha, are best source of water and are not treated as wastelands.  
<sup>#</sup> For acid soils, areas under paddy growing and plantation crops were also included in the total acid soils  
<sup>\$</sup> Sub-surface waterlogging not considered.  
*Source:* NBSS&LUP

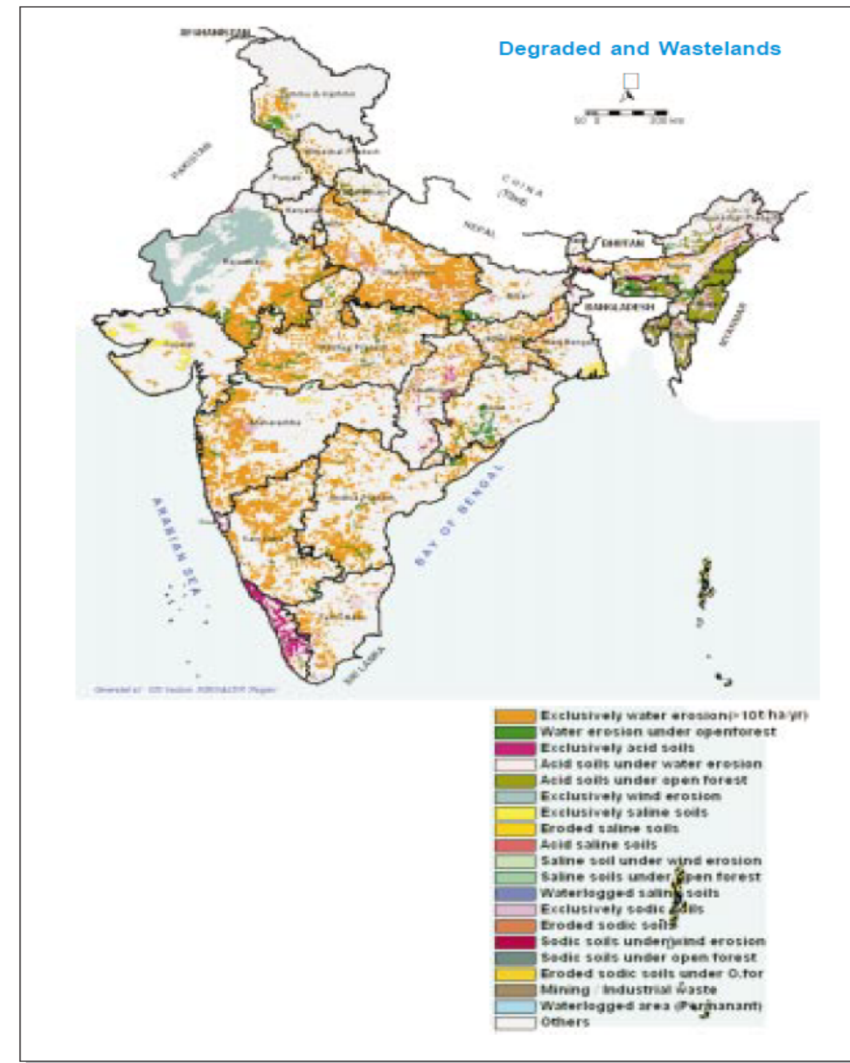


Fig. 8. Degraded and wastelands of India  
Source: NBSS&LUP

# Harmonised figures of LD



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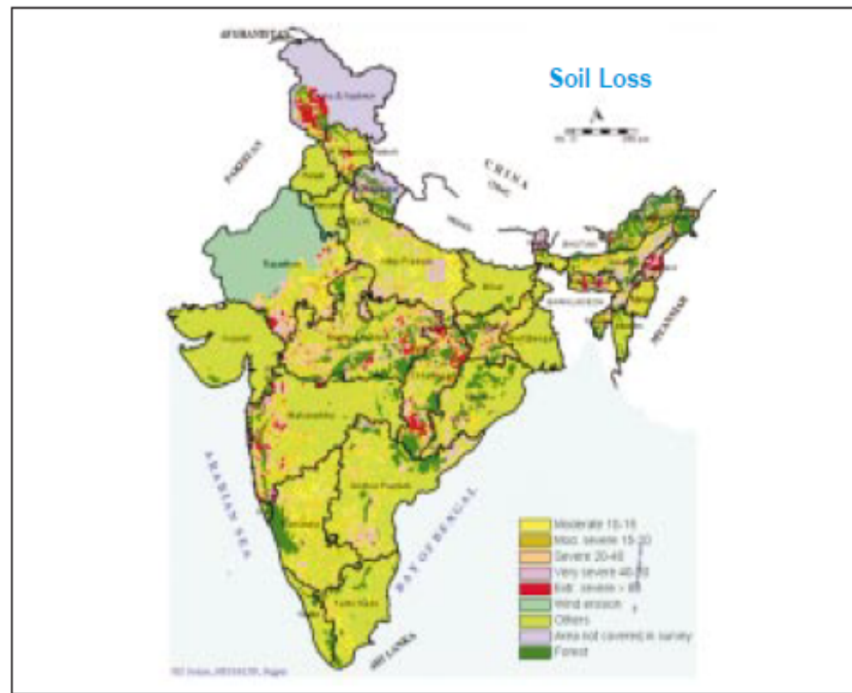
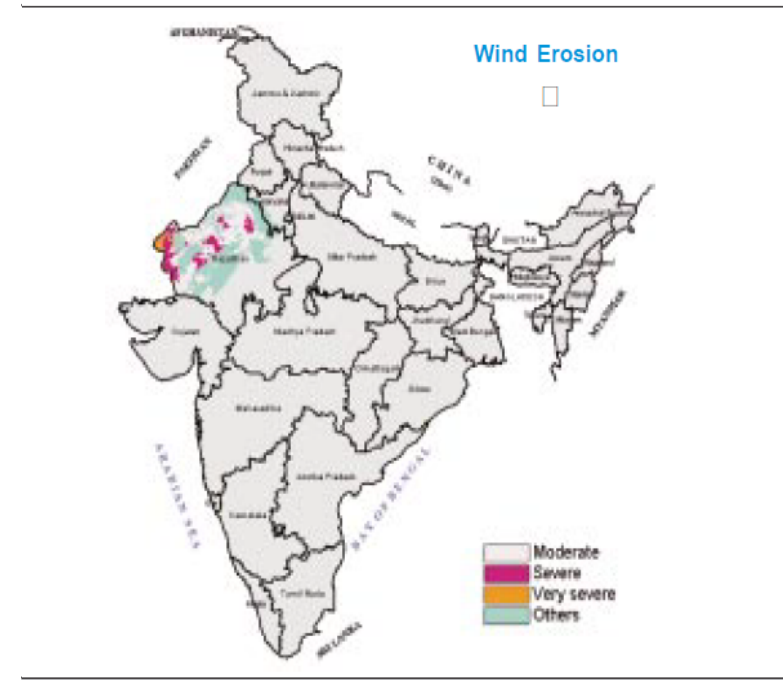


Fig. 1. Soil loss by water erosion in India (>10 tonnes/ha/yr)  
Source: Maji *et al.* 2008

126 m ha water erosion (39% TGA).  
Function of land use, soils, slope,  
intensity of rainfall



Wind erosion in India (>10 tonnes/ha/yr)  
Source: CAZRI and NBSS&LUP. 2008, unpublished

Severe and very severe erosion-16% of TGA.  
Moderate-32% of TGA. Total 11m ha.  
Function of land use, wind velocity & soil  
characteristics

# Acid and saline soils



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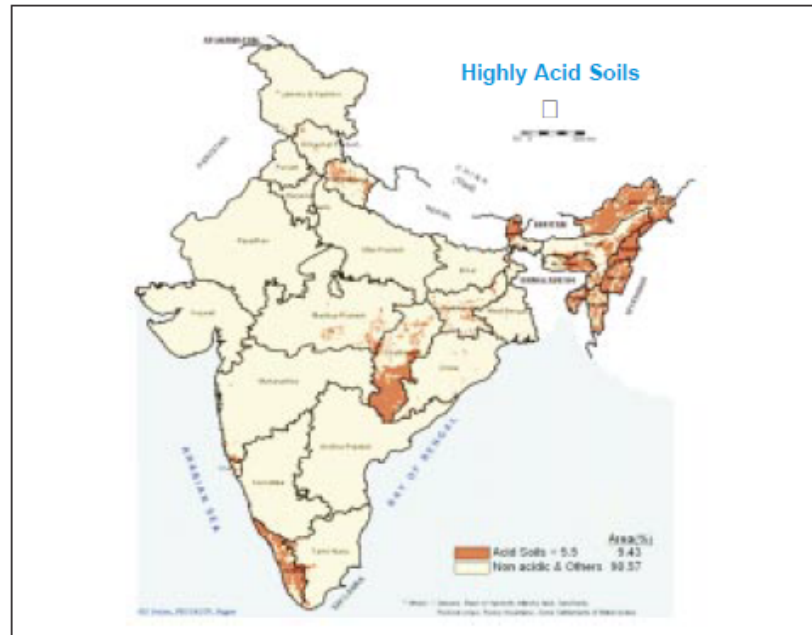


Fig. 3. Acid soils of India  
Source: Maji *et al.* 2008a

**6.98 Mha impacted by acidic soils (9.4% of GA)**

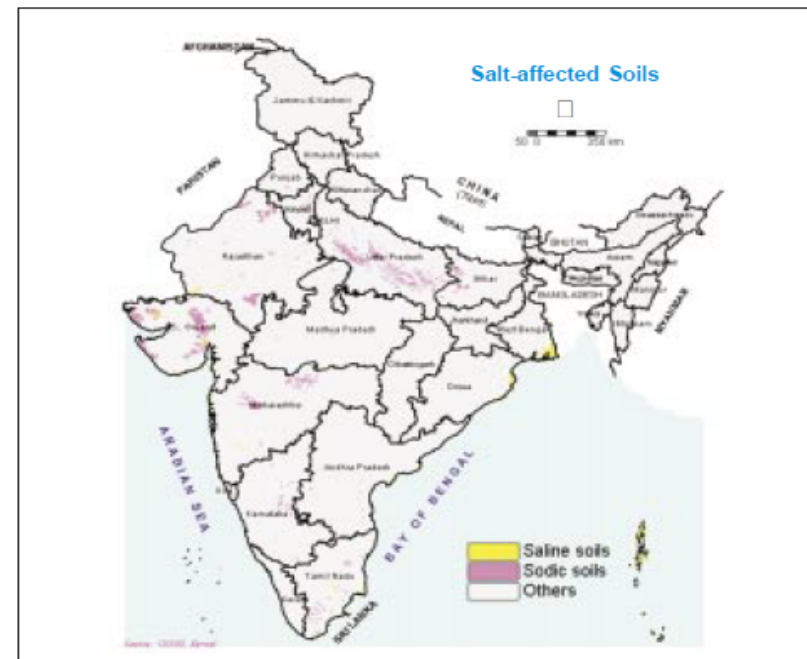


Fig. 4. Salt-affected soils of India  
Source: CSSRI, Karnal

**Excessive amounts of soluble salts or exchangeable sodium affecting crop yields & production (2.08 of TGA)**

# Physical Degradation



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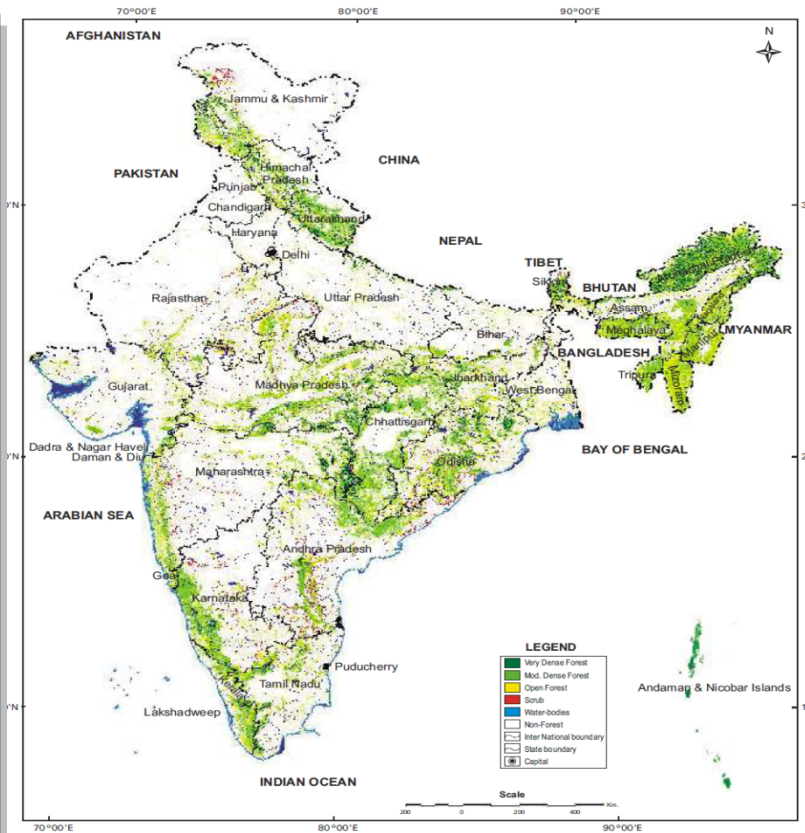
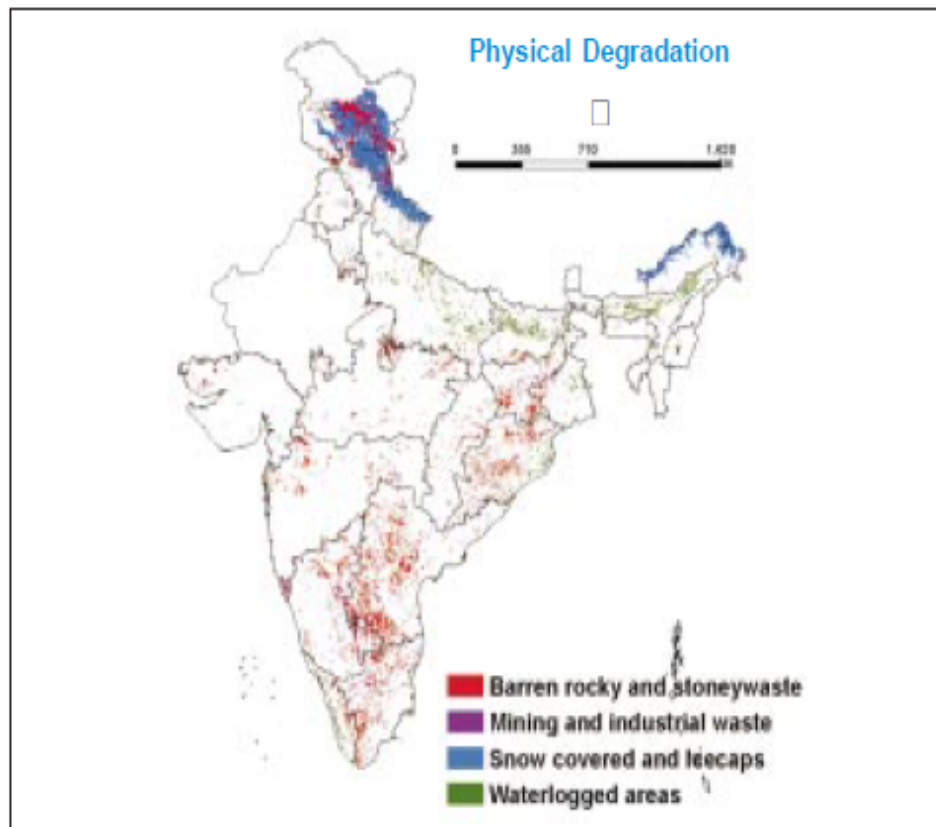


Fig.6. Physical land degradation in India  
Source: NRSA, 2005

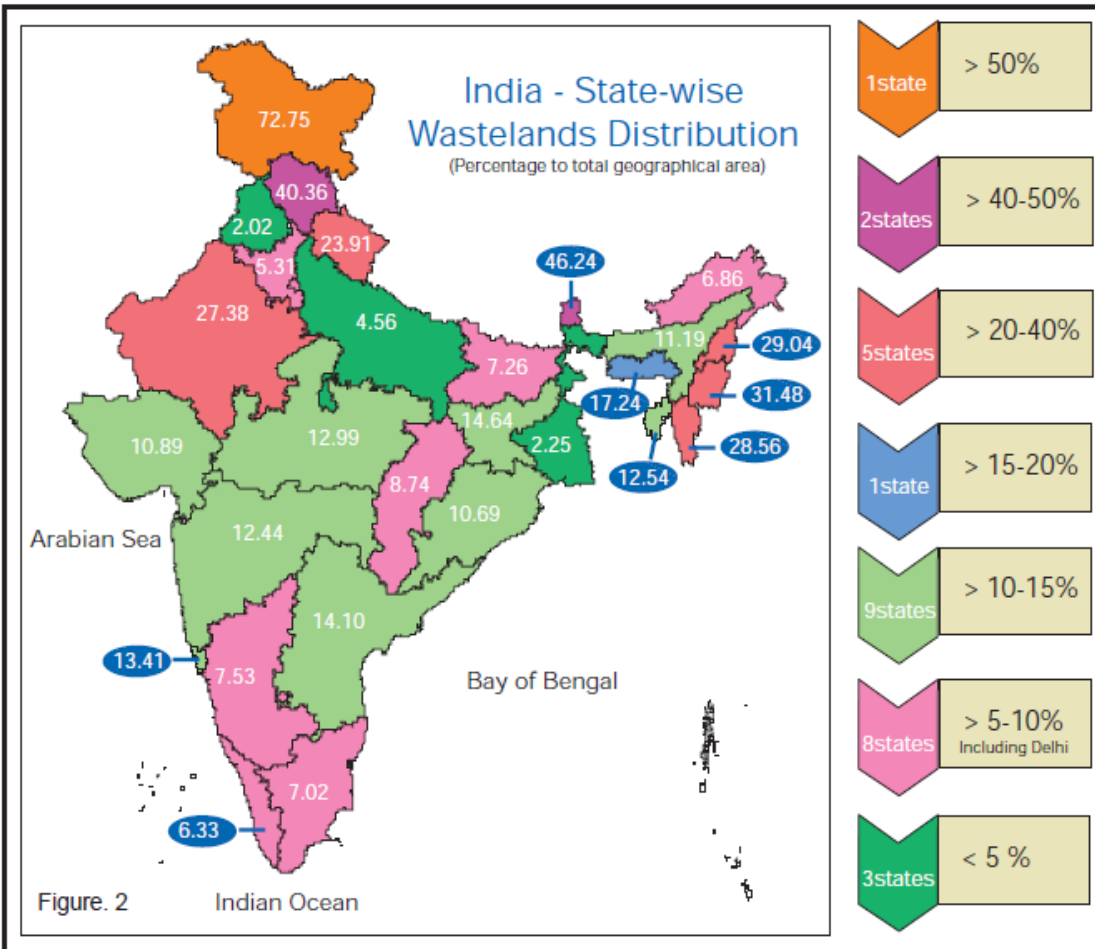
13.8 mha impacted by physical  
degradation

21.23% forest cover (ISFR, 2013)  
V. Dense: 2.54%  
Moderately Dense: 9.75%  
Open: 8.99%

# State-wise distribution of wastelands



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Sl. No.	STATE NAME	TGA	Total WL	% to TGA
1	Andhra Pradesh	275068	38788.22	14.10
2	Arunachal Pradesh	83743	5743.84	6.86
3	Assam	78438	8778.02	11.19
4	Bihar	94171	6841.09	7.26
5	Chattisgarh	135194	11817.82	8.74
6	Delhi	1483	83.34	5.62
7	Goa	3702	496.27	13.41
8	Gujarat	196024	21350.38	10.89
9	Haryana	44212	2347.05	5.31
10	Himachal Pradesh	55673	22470.05	40.36
11	Jammu & Kashmir *	101387	73754.38	72.75
12	Jharkhand	79706	11670.14	14.64
13	Karnataka	191791	14438.12	7.53
14	Kerala	38863	2458.69	6.33
15	Madhya Pradesh	308252	40042.98	12.99
16	Maharashtra	307690	38262.81	12.44
17	Manipur	22327	7027.47	31.48
18	Meghalaya	22429	3865.76	17.24
19	Mizoram	21081	6021.14	28.56
20	Nagaland	16579	4815.18	29.04
21	Orissa	155707	16648.27	10.69
22	Punjab	50362	1019.50	2.02
23	Rajasthan	342239	93689.47	27.38
24	Sikkim	7096	3280.88	46.24
25	Tamilnadu	130058	9125.56	7.02
26	Tripura	10486	1315.17	12.54
27	Uttarakhand	53483	12790.06	23.91
28	Uttar Pradesh	240928	10988.59	4.56
29	West Bengal	88752	1994.41	2.25
30	Union Territory	9490	337.30	3.55
<b>Total</b>		<b>3166414</b>	<b>472261.95</b>	<b>14.91</b>

\* Unsurveyed areas (J&K) : 120849.00 Total geographical area : 3287263.00  
Source: 1:50,000 Wasteland Maps-2005-06 prepared based on IRS-P6, LISS III Three season data





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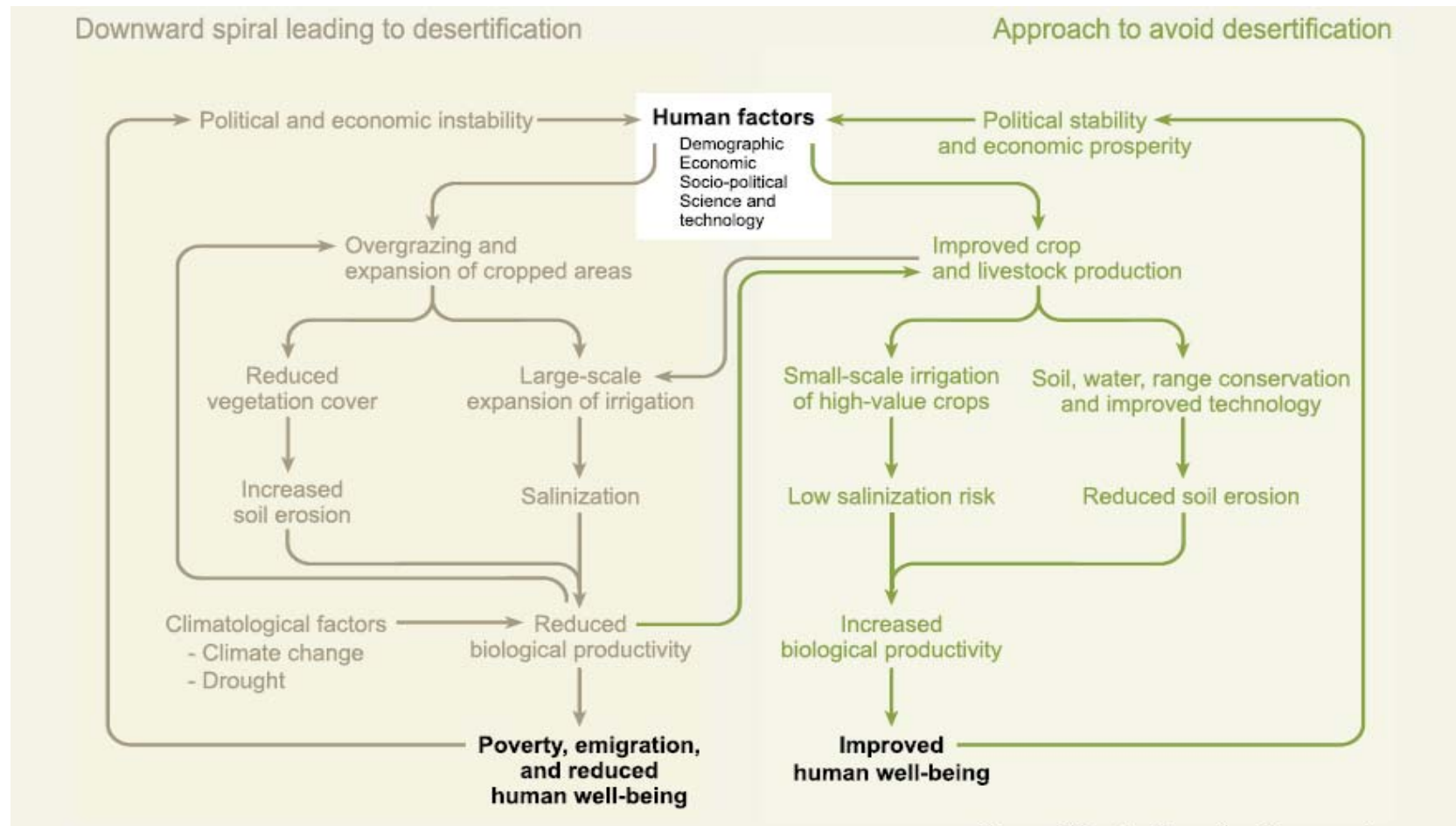


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# Development Pathways in desertification



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**Thank you!**