Soil Erosion in India-extent, causes and effects

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COLLAPSE OF HISTORIC CIVILIZATIONS

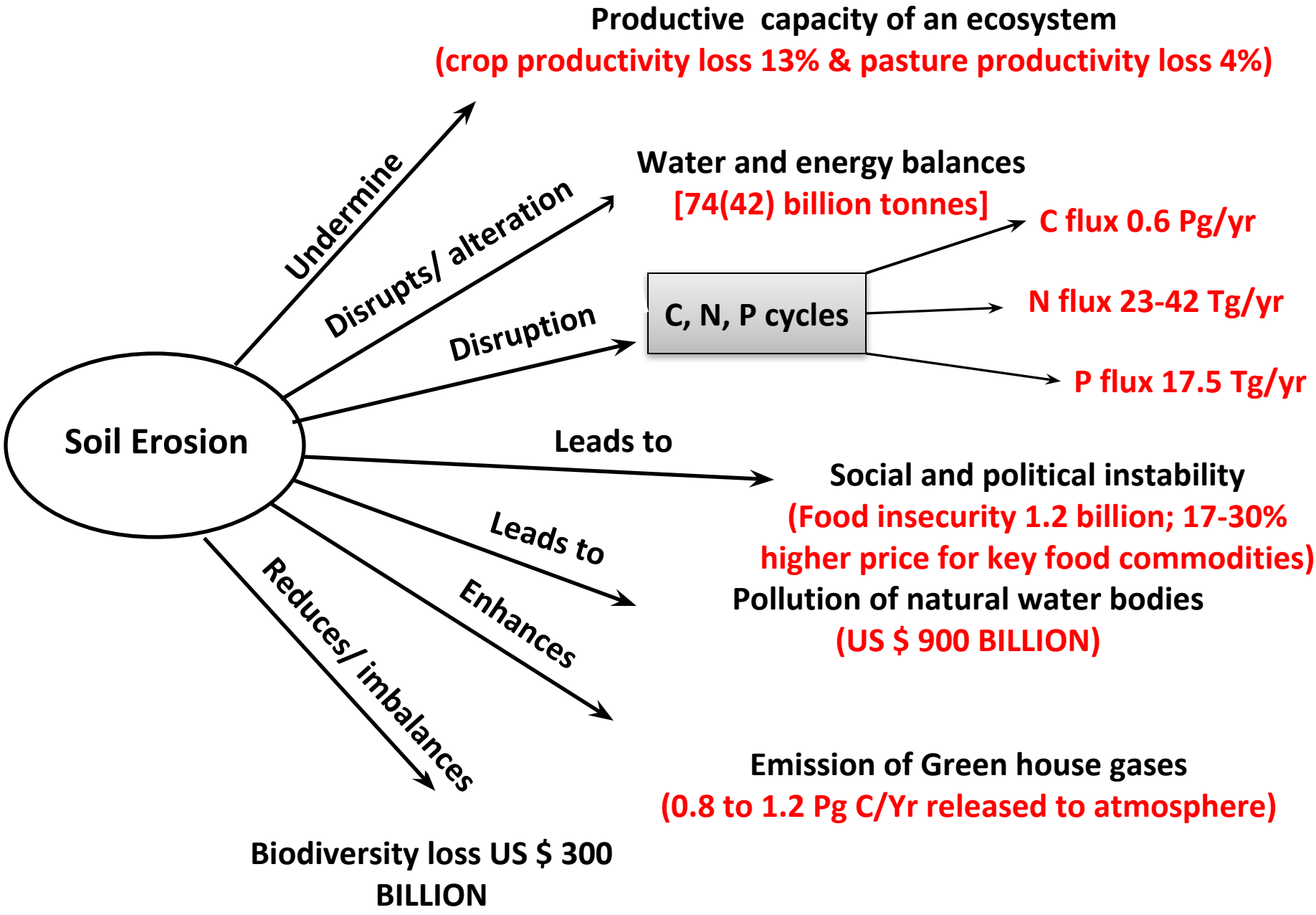
Civilization	Region	Era	Cause of Collapse
Sumerian	Mesopotamia	10,000 BCE	Salinization
Harappan	Indus Valley	2,000-2,000 BCE	Desiccation
Inca	Andean Region	750-900 CE	Soil Erosion
Maya	Central America	750-900 CE	Soil Erosion
Axum	Northern Ethiopia	100-600 CE	Ecological Degradation
Roman	Mediterranean	27BC – 395 AD	Exhaustion of soil

- **Between 1870-1945, 17% land lost about 25 cm soil depth in Sholapur, Maharashtra (Patel, 1998)**

- **In 40-50 years total land abandoned in Pranmati hilly watershed, Uttarakhand(AEE, 2004)**

- **In NEHR similar results are found.**

Soil Erosion and its impact



Comparative status soil erosion and its impact

India	World
Soil loss of 7.5 billion tonnes annually	Soil loss of 75 billion tonnes annually
Average erosion 23.06 t/ ha/ yr (upto 80 t/ha/yr)	Erosion on cropland 30 t/ ha/ yr (upto 400 t/ha/yr)
Area affected:- 83 mha area affected	Area affected :-1.09 billion ha
•**Off site damages** •**Siltation affected :2.73 M ha**	US 4 18.5 BILLION
Ecosystem service	US 9.4 trillion

HARMONIZED AREA STATISTICS OF DEGRADED LANDS/WASTELANDS OF INDIA

S. No	Type of Degradation	Arable land (in Mha)	Open forest (<40% Canopy) (in Mha)
1.	Water erosion (>10 t/ha/yr)	73.27	9.30
2.	Wind erosion (Aeolian)**	12.40	-
	Sub total	85.67	9.30
3.	Chemical degradation		
	a) Exclusively salt affected soils	5.44	-
	b) Salt-affected and water eroded soils	1.20	0.10
	c) Exclusively acidic soils (pH< 5.5)	5.09	-
	d) Acidic (pH < 5.5) and water eroded soils	5.72	7.13
	Sub total	17.45	7.23
4.	Physical degradation		
	a) Mining and industrial waste	0.19	
	b) Water logging (permanent) (water table within 2 mts depth)*	0.88	
	Sub total	1.07	
	Total	104.19	16.53
	Grand total (Arable land and Open forest)	120.72	

Unculturable Wastelands

Barren rocky/stony waste: 6.46 Mha, They are the source for runoff water and building material.

Snow covered/ Ice caps: 5.58 Mha, They are the best source of water and cannot be treated as wastelands.

Quantity of nutrients lost through 1 mm soil loss and their replacement cost

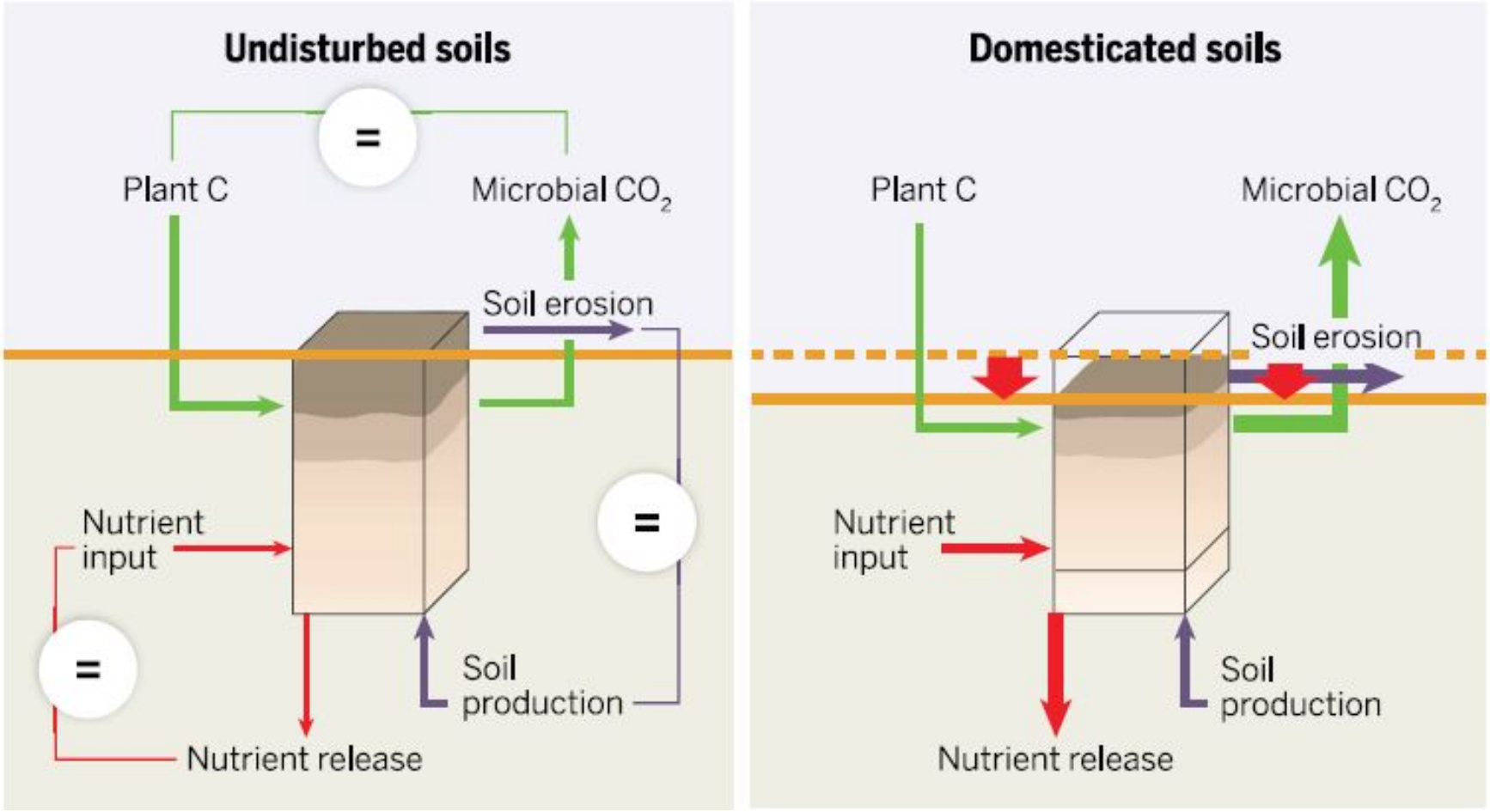
Nutrients (Kg)		Replacement cost (Rs.)
C – 225 kg	FYM	1,000
N – 24 kg	Urea	546
P – 1 kg	SSP	308
K – 10.5 kg	MOP	158
	Total	2,012=00

Land abandoned in 40-50 years IN Garhwal Himalaya

Potato cultivation in sloppy land of NEHR followed by land abandonment

Erosion control and reversing land degradation

- Topsoil is a non-renewal resource
- Sharp acceleration in NRD due to several drivers and pressures
- 25% of global croplands are degraded
- Food security and environmental protection are interdependent
- LDN by 2030 (TARGET 26M ha)
- Mitigating climate change, Energy conservation and Ecological Intensification



Changes in balance of important soil processes by anthropogenic disturbances

ILL –EFFECTS OF LAND DEGRADATION

ON PRODUCTION

- Total abandonment of land
- Reduced crop yields
- Increased inputs and greater costs
- Reduced responses to inputs
- Loss of flexibility in land management
- Loss of water resources
- Diversion of resources for reclamation

For the People

- Increased landlessness
- Lower and less reliable food supplies
- Increased labour requirements
- Lower incomes

Reduced crop yields

Direct effects of accelerated erosion on crop yield

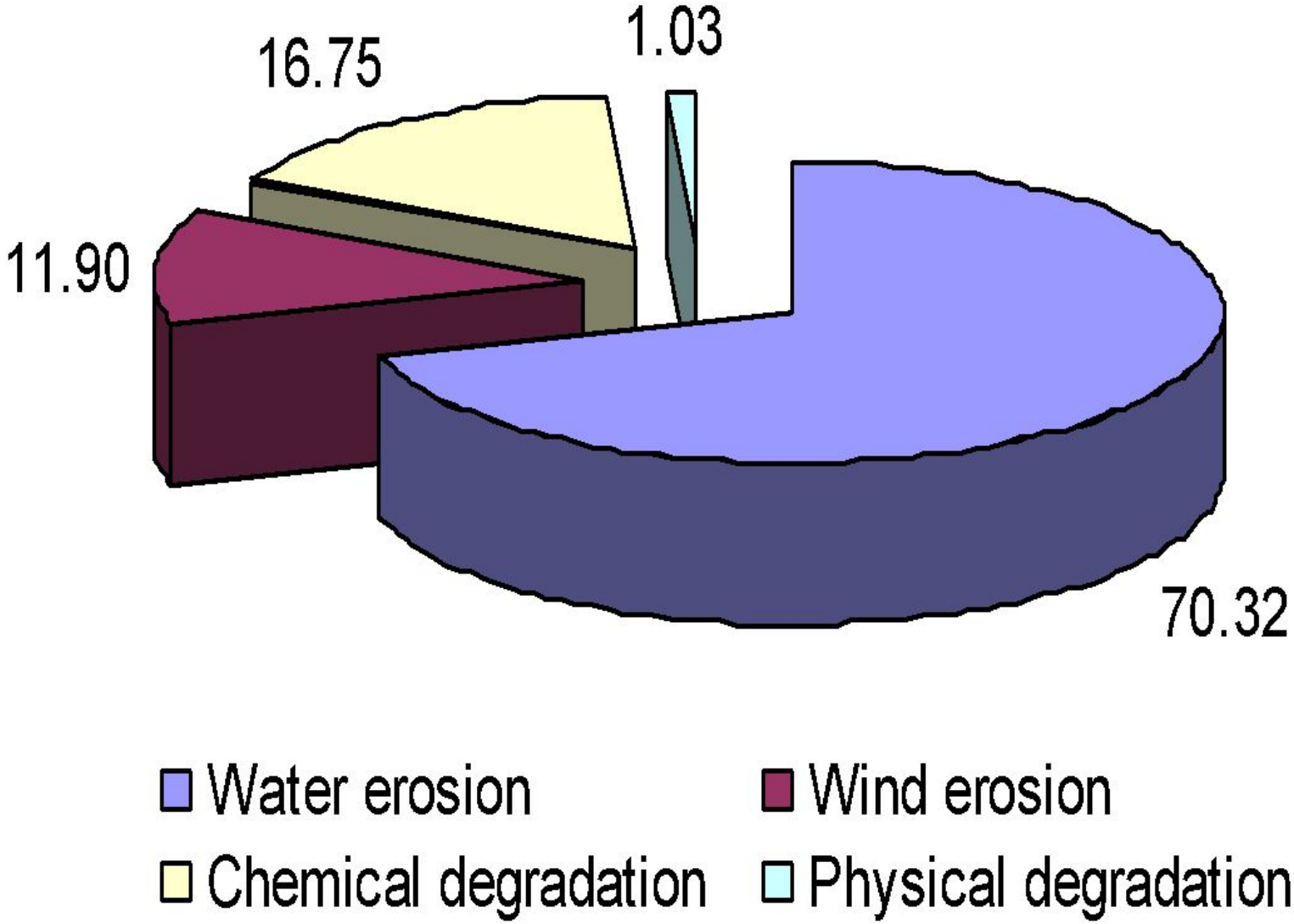
Process	Mechanism of effect
Reduction in effective rooting depth	Water and nutrient imbalance Unfavourable soil temperature regime Edaphological unfavourable subsoil
Loss of plant nutrients	Nutrient deficiency Elemental toxicity Unfavourable soil pH Low effective rooting depth
Loss of plant available water	Reduced water infiltration High losses due to runoff Low effective rooting depth
Loss of land area	Land area lost due to permanent or ephemeral gullies Unfavourable conditions in depositional sites
Damage to seeding	Washing away of seeds and seedlings Seedling burial by deposition of water-borne sediments

Each year world's farmer are challenged to feed additional 77 million people with less top soils!

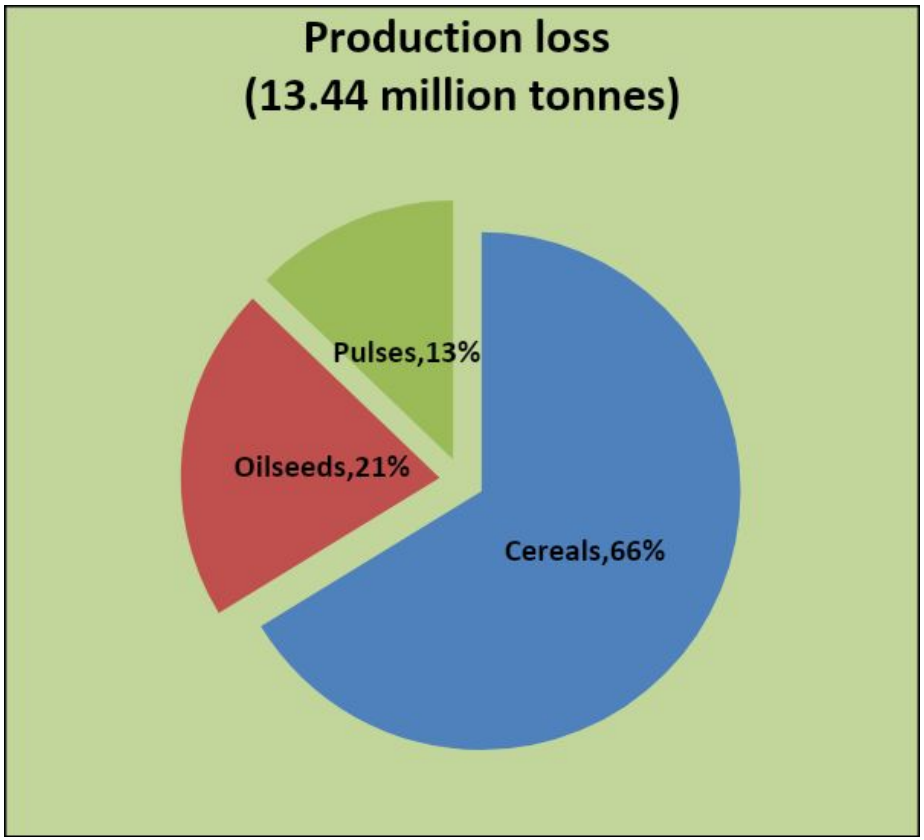
Worldwide for every 1 million people added, 40,000 ha needed for basic living space

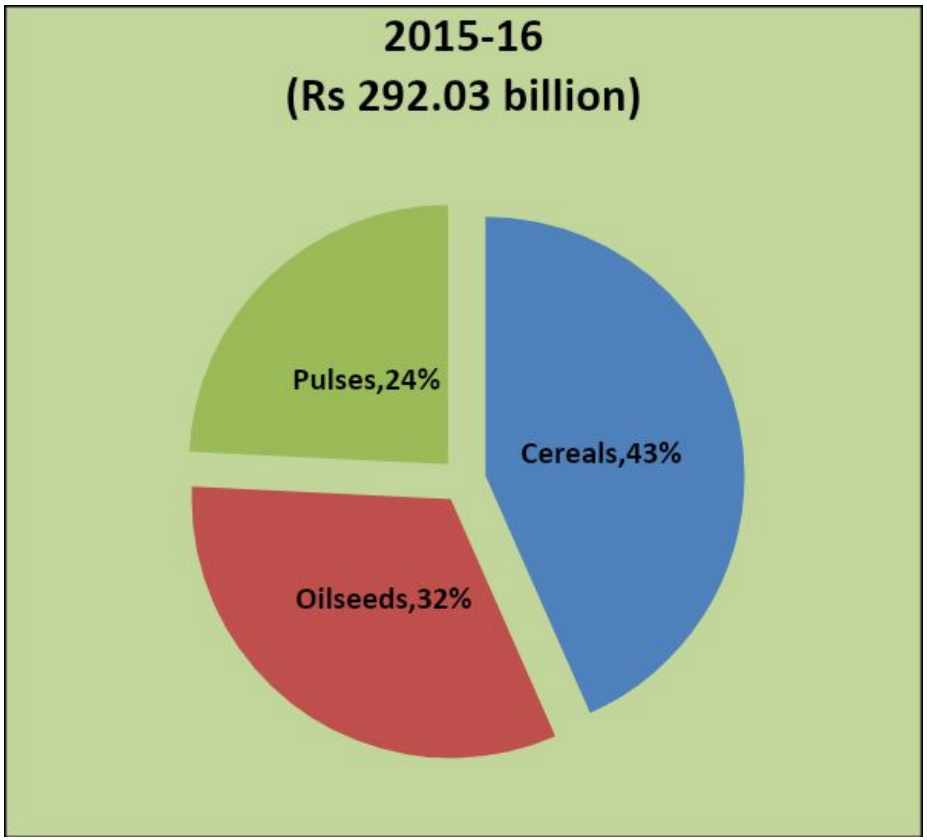
More than 99.7% human food comes from land!

PERCENTAGE OF ARABLE LAND UNDER DIFFERENT DEGRADATION CATEGORIES

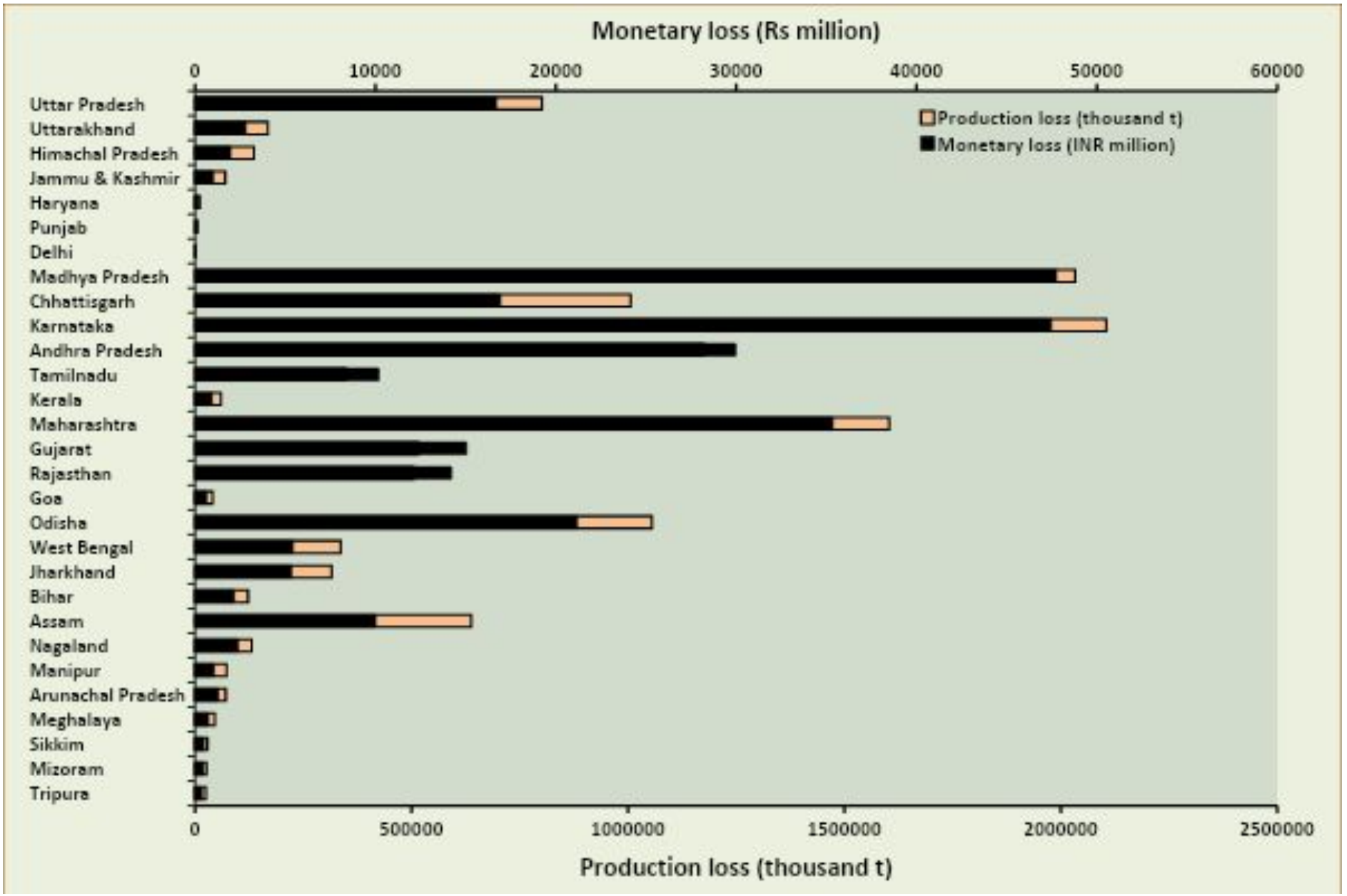


Water Erosion Related Annual Production and Monetary Losses of Cereals, Oilseed and Pulses in Rainfed Areas of India

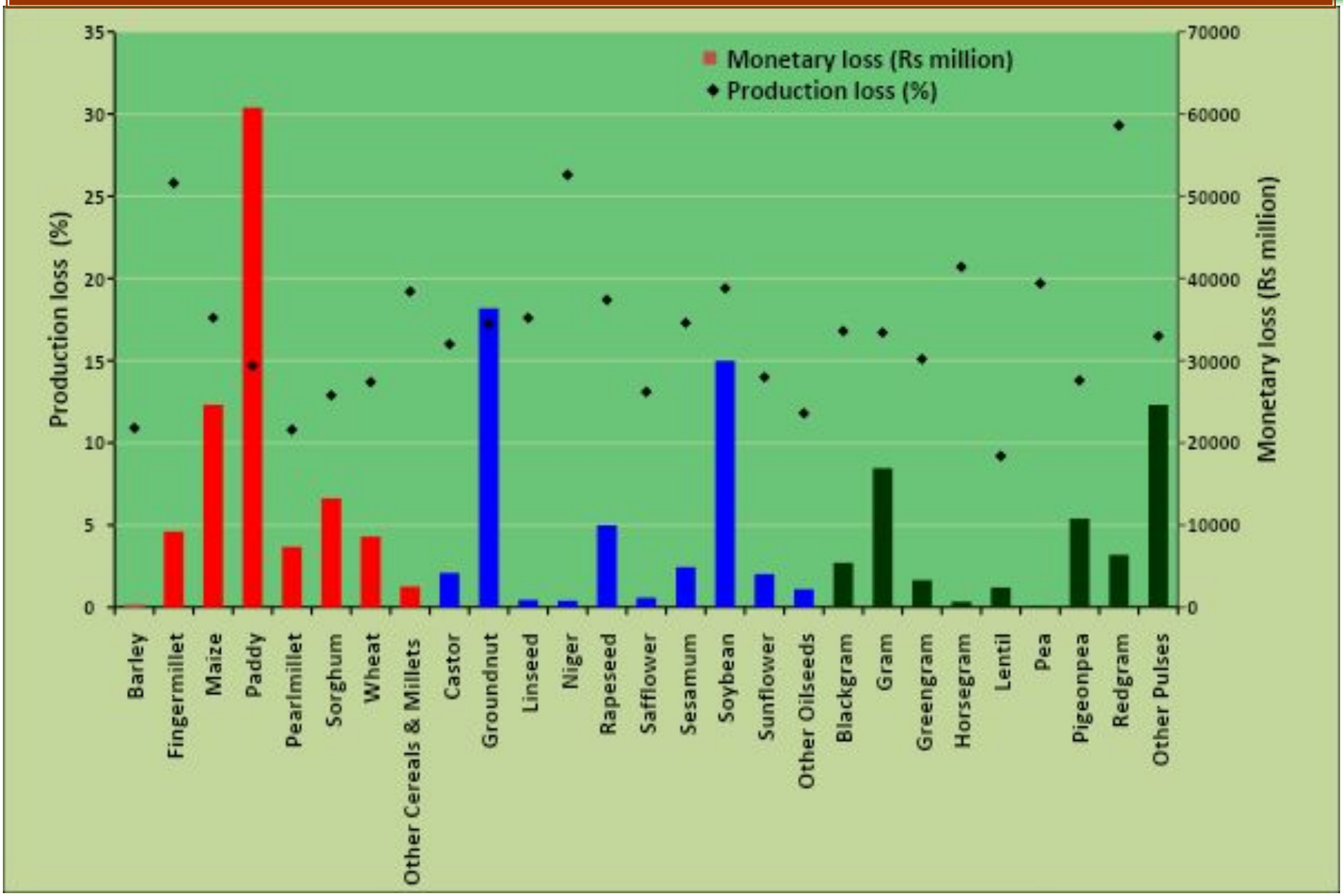




Annual Production and Monetary Losses (2015-16) in Major Rainfed Cereal, Oilseed and Pulse Crops by Water Erosion in States of India



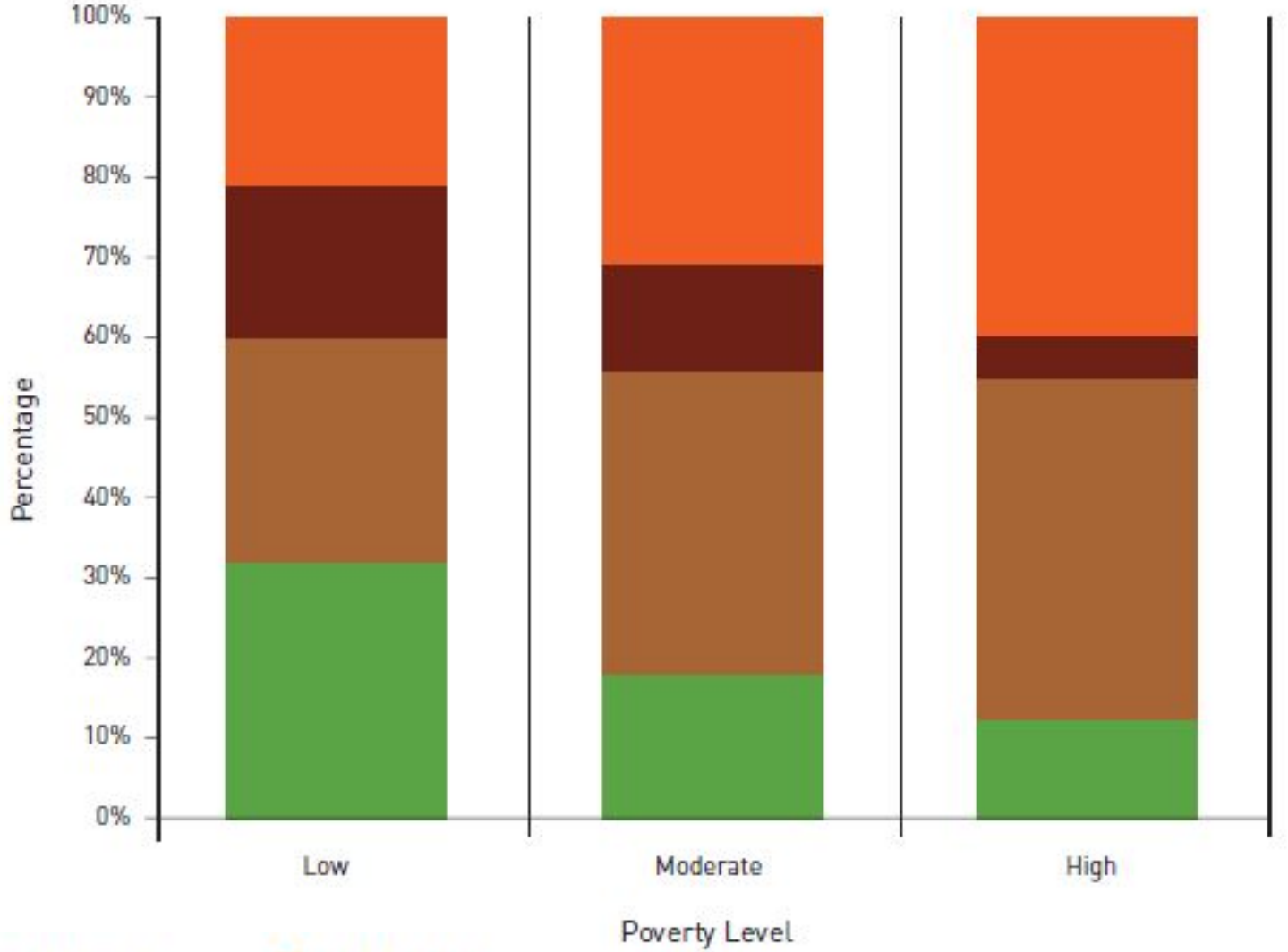
Annual Production and Monetary Losses (2015-16) in Major Rainfed Cereal, Oilseed and Pulse Crops by Water Erosion In India



GLOBAL HOT SPOTS OF FOOD INSECURITY

Total = 1020 million

Relation between Land Degradation and poverty

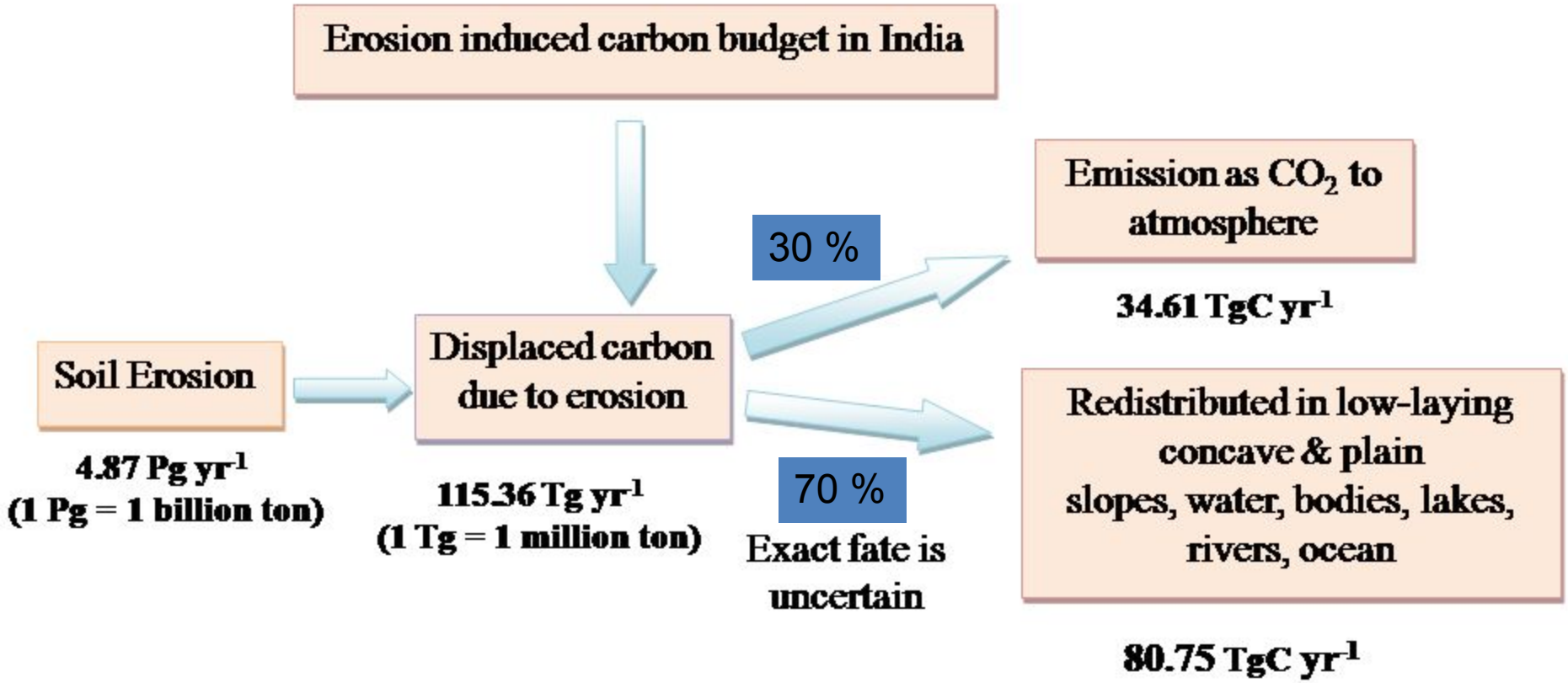


LADA 2010a.. (Available at: http://www.fao.org/ nr/lada/)

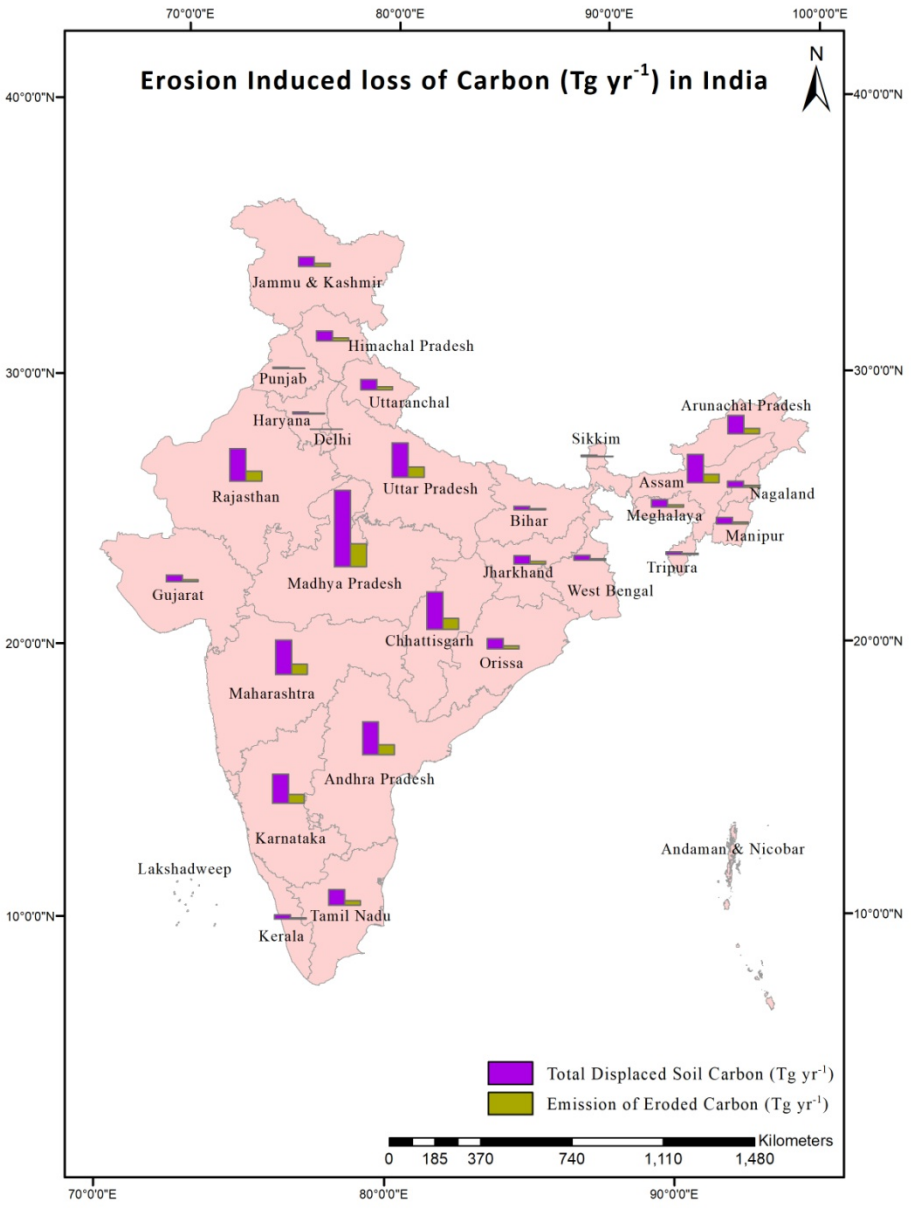
World food production with and without erosion

COMMODITY	Production without erosion (m t)	Production with erosion (mt)	Estimated production loss (%)
Cereal	2086	1896	10
Soybean	132	126	5
Pulses	59	56	5
Roots & tubers	682	609	12
Total	2959	2687	9.2

Source: Lal, 2010



Mandal et al., 2020



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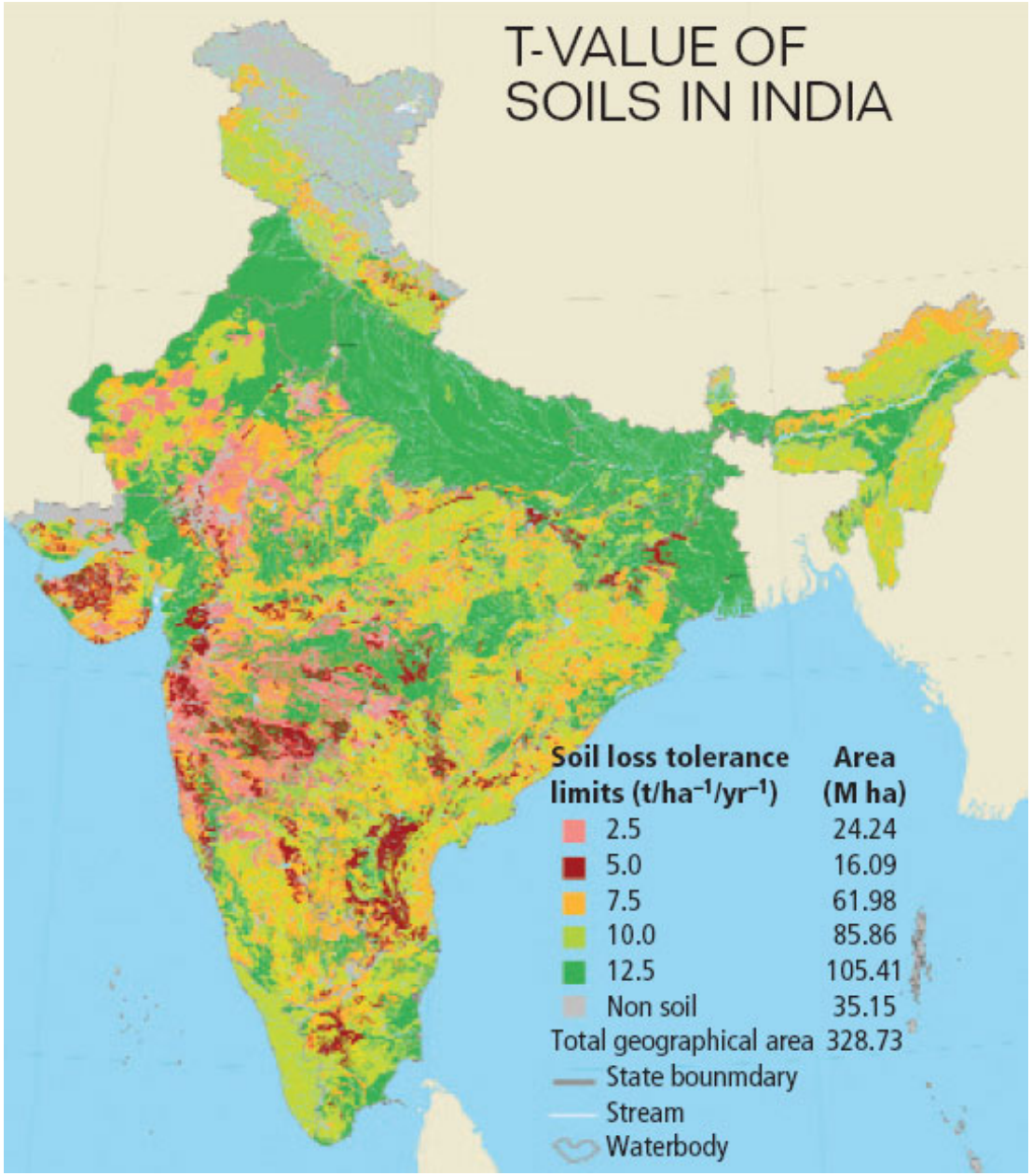


Hot spot areas
NEHR, NWHR and Central plateau region

How much is too much?

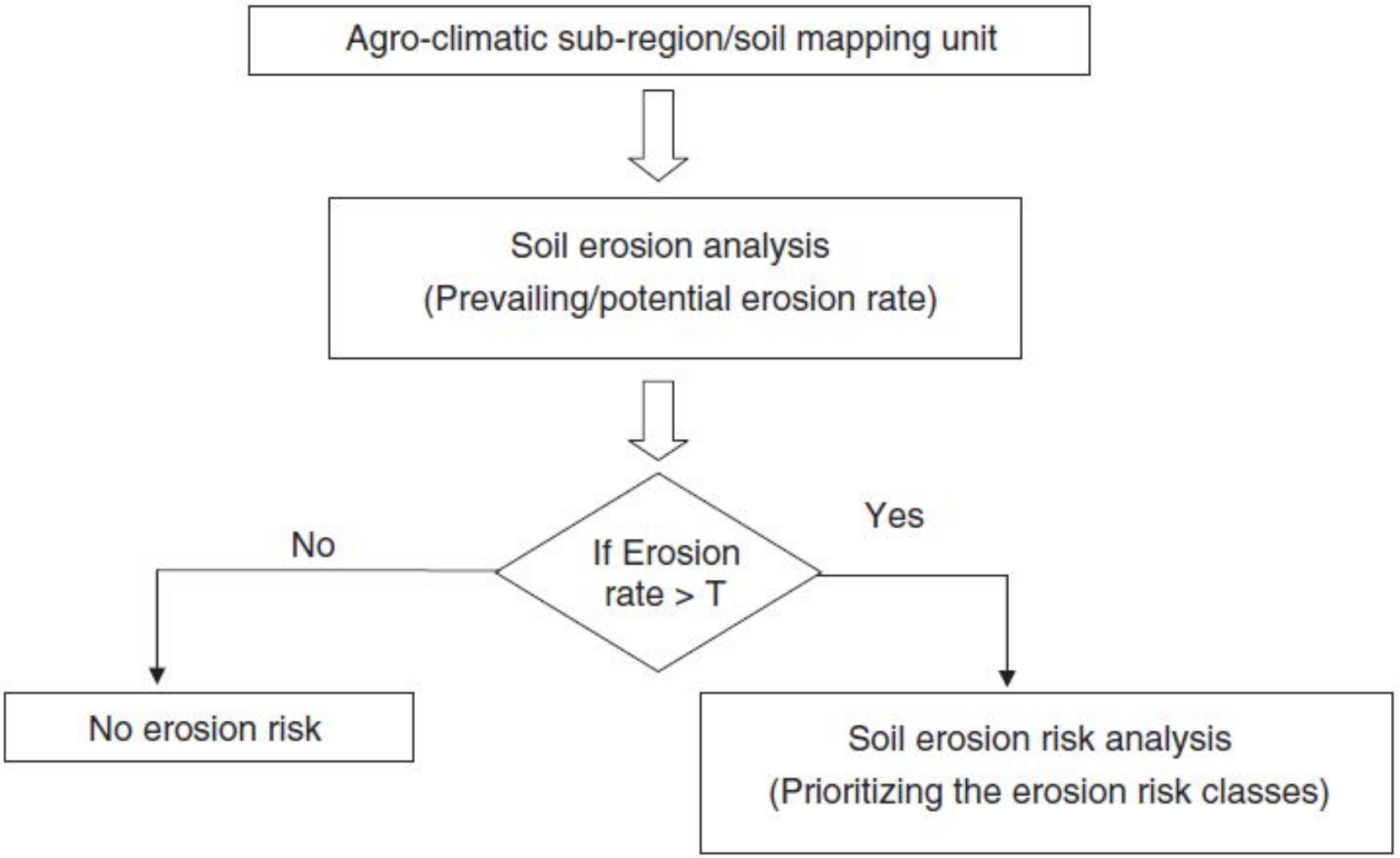
Permissible erosion limit

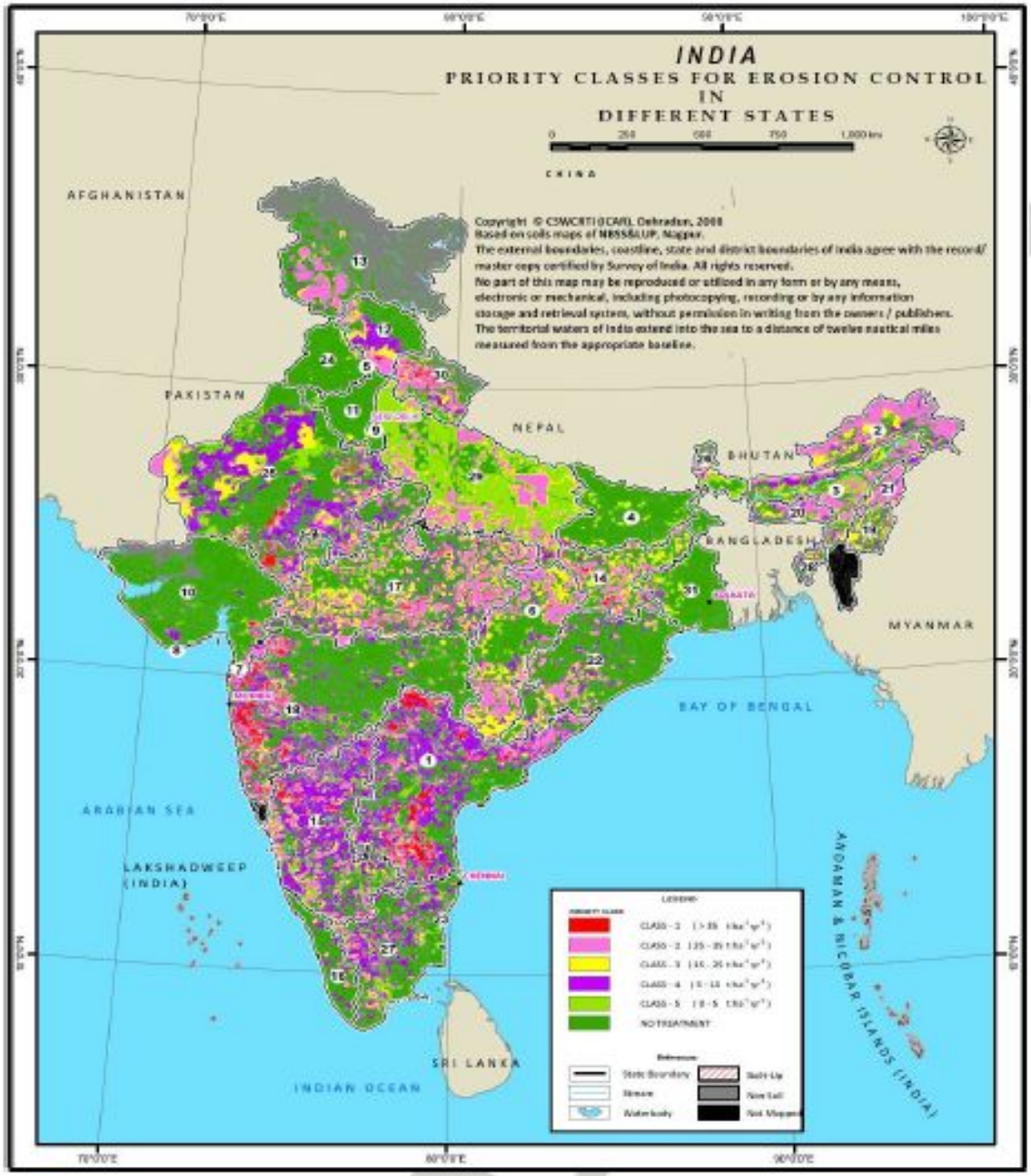
Or

Soil Loss Tolerance Limit

Source: Mandal et al. 2010, JSWC, 65: 42-49
Mandal and Sharda, 2011, Current Science, 100 (3):383-390.

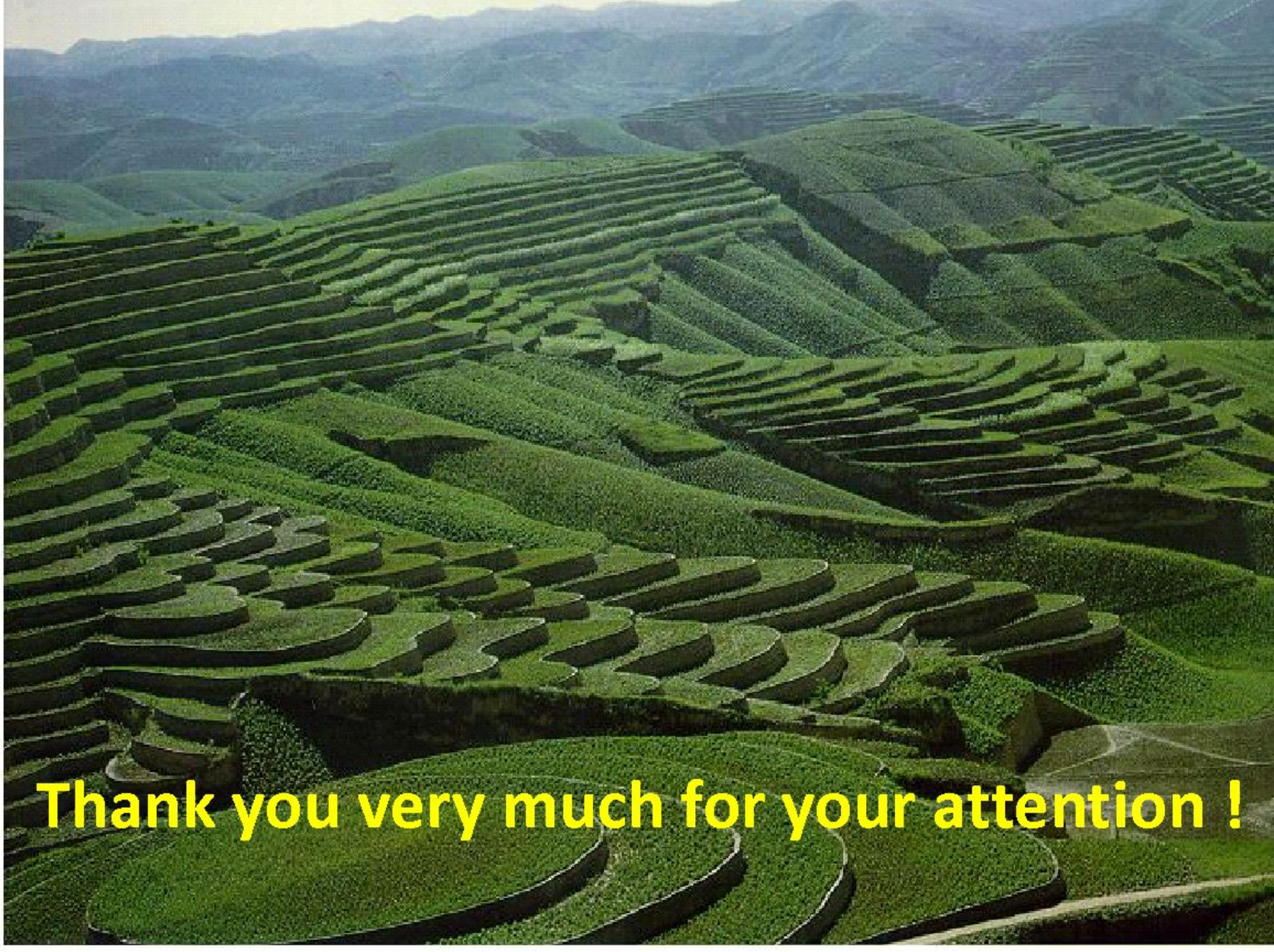
Identification of soil erosion risk areas





Source: Mandal and Sharda(2013), Land Degrad. Develop. 24: 430–437

There is much larger challenge than was faced by Norman Borlaug, M.S. Swaminathanand other Green Revolutionaries.


Thank you very much for your attention !