

# India

**Improved soil carbon, soil health and soil fertility under grassland and cropland as well as integrated systems, including water management**



सत्यमेव जयते

Government Of India

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# Success Story of Indian Agriculture Sector & Food Security

1.3 Billions

1.7 Billion

## More Food Production

- @ Food Security
- @ Nutrition Security
- @ Livelihoods

## Sustainability

- @ Water
- @ Soil
- @ Environment
- @ Biodiversity
- @ Forest

- @ 284 mt Food
- @ 300 mt Fruits & Vegetables; 8.5 times Milk; 43 times Eggs; 13 times Fish

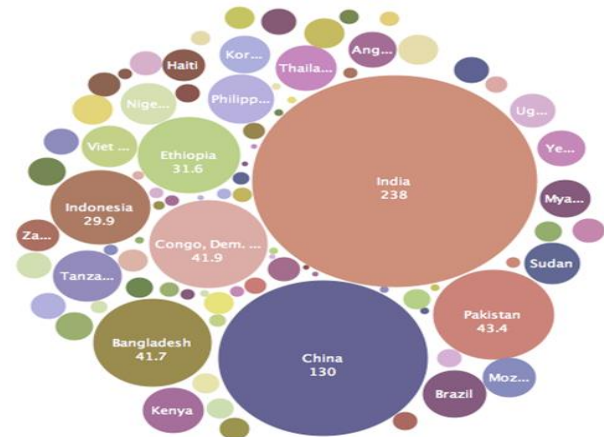
# Sustainable Development Indicators in India: **Constraints**

- @ 7.5/1.30 billion ↑
- @ Small Holder Farmers
- @ Rainfed Agriculture
- @ Food Security
- @ Livelihoods



- @ Declining land
- @ Declining water quality
- @ Declining soil quality
- @ Climate change and impacts

**Hunger &  
Food  
Security**



# **Sustainability** of Food Systems in India with Soil Organic Carbon, Soil Health, Fertility

under grassland and cropland as well as  
integrated systems, including water management

- @ Technologies,**
- @ Government Programs**
- @ Implementation Process**
- @ Innovative Models**
- @ Impacts**

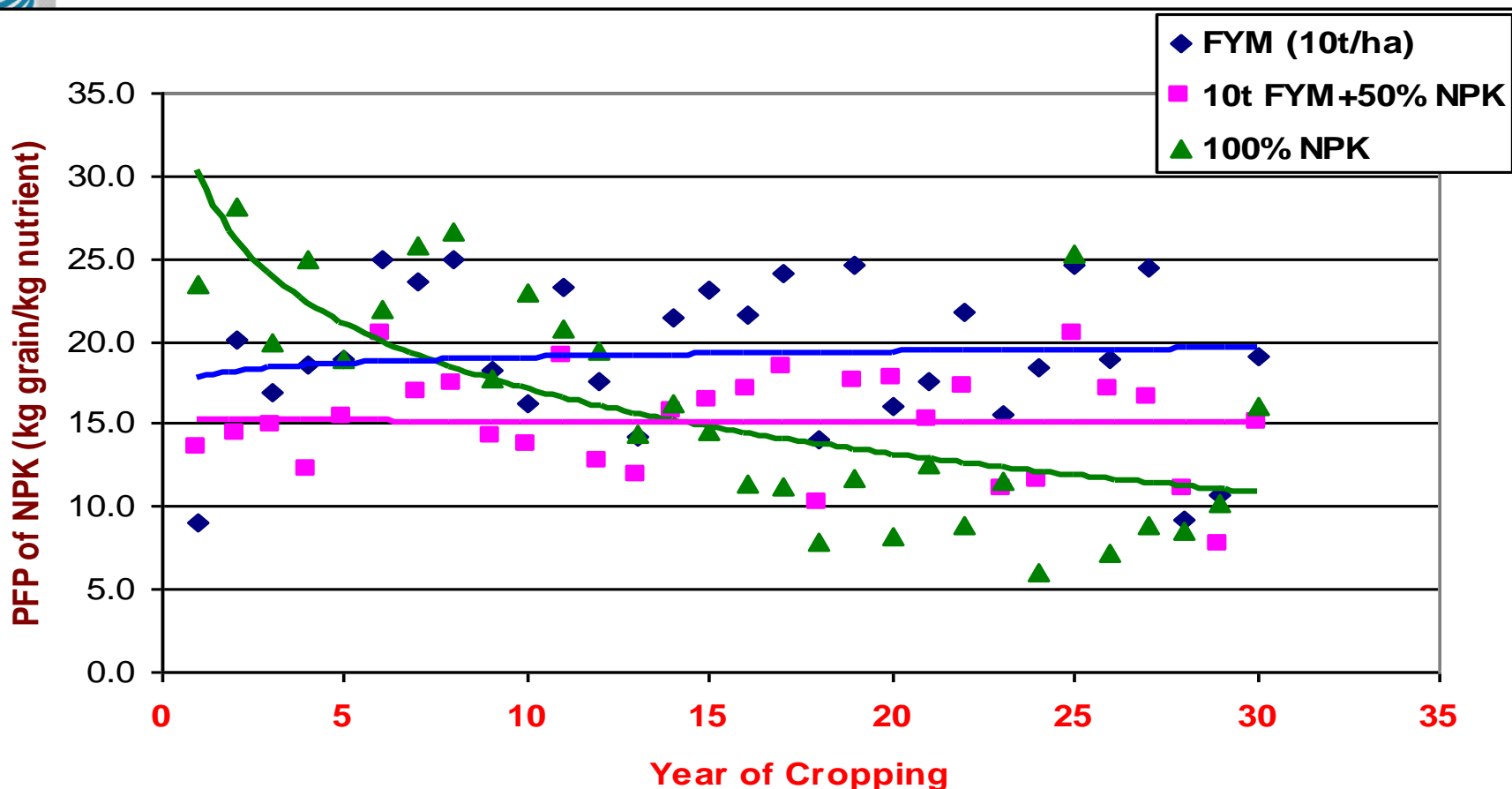
# Technology Implementation and Government Programs

# Soil Organic Carbon (SOC) Sequestration

- @ Soils of India & Tropical countries, SOC is very low: high temperatures & rain dependent Agri.**
- @ SOC to Climate Adaptation particularly for droughts**
- @ However, improving SOC in Tropical Semi-Arid and Arid Systems is a Challenge**
- @ Therefore, the cost per Unit Increase in SOC in Tropical Country like India is Much Higher than Temperate Countries.**
- @ Technology implementation in Small & Marginal Farmers in India & Others**

# Soil Health & Soil Organic Matter: Critical for Agri Sustainability

Partial factor productivity of NPK in finger millet in 30 years old long term experiment at Bangalore under rainfed conditions (1978-2007)



FYM 10t/ha=50-25-50 NPK; 10t FYM+50%NPK=75-50-62 NPK; 100% NPK=50-50-25

# Promotion of Healthy Soils and Healthy Nation



Healthy Nation



Healthy Human Kind



Healthy Food



Healthy Crop / Fodder



Healthy Soils



NAARM



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ICAR-National Academy of Agricultural Research Management



# Some of the easily implementable carbon sequestration strategies at Village Level



Horsegram incorporation



Glyricidia



Crop residue



Biogas linked with vermicomposting



Intercropping with legumes



Community based Vermicomposting

# Recommended Management Practices for Carbon Sequestration

## Principle

## Practices

**Creating positive ecosystem carbon budget**

- Mulch farming
- Conservation agriculture
- Cover cropping
- Agroforestry

**Reducing losses**

- Erosion control
- Moderating mineralization by managing soil temperature, plant species and root:shoot ratio
- Increasing humification by improving C:N, C:P and C:S ratio
- Improving soil aggregation

**Deep transfer of carbon**

- Plants with deep root system
- Bioturbation (e.g., earthworm and termite activity)

**Protecting soil carbon**

- Increasing aggregation
- Decreasing soil disturbance
- Enhancing recalcitrance of biomass C

# Enhanced Fertilizer Use Efficiency Reduced Input Cost, Improved Profits & Environmental Services: Technologies and Govt. India Programs

Nutrient	Efficiency percentage
N	30-50
P	10-20
K	<80
S	8-12
Zn	2-5
Fe	1-2
Cu	1-2
Mn	1-2

- @ Precision Nutrient Application
- @ Nano Fertilizers
- @ Soil Health Card Mission
- @ Neem Coated Urea
- @ Variable Rate of Technology
- @ Placement of Nutrients
- @ Water-Nutrient Synergy
- @ Promotion of N Fixing Crops
- @ Organic Farming and
- @ INM

# Crop Residue to Biochar

## For Carbon Sequestration, Drought Adaptation and Co-Benefits

@Per each ton of crop residue provides Nitrogen 5.5 kg; Sulphur 1.2 kg; Phosphorus (~40%) 2.3 kg; Potash (~10%) 25.0 kg; Organic Carbon 400 kg.

@500 million tones of crop residue is available in India, comes 200 million tons of organic carbon.

@ Convert it Biochar or Energy Source ?

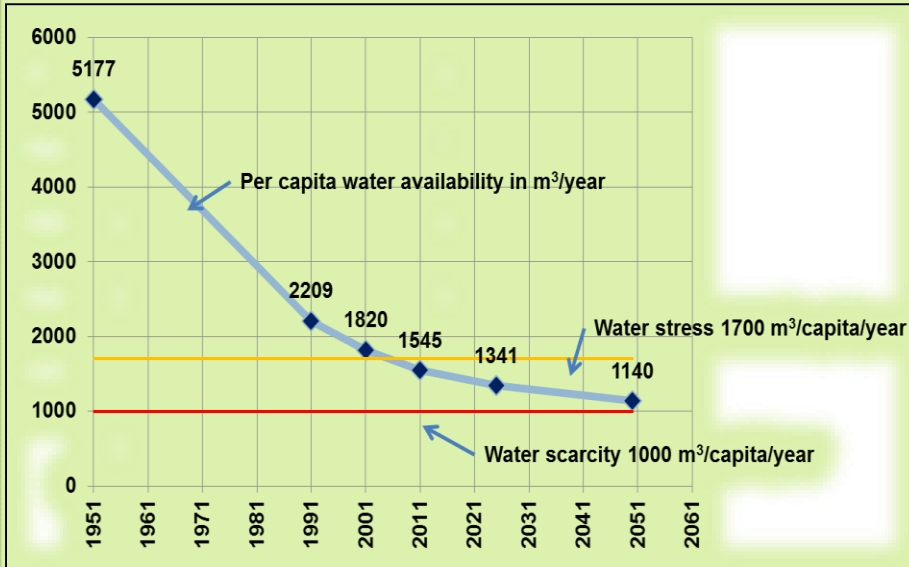
@ Technology support and Scale of Implementation Needs

# Government Programs for Soil Health and Organic Carbon Improvement in Indian Soils



- 1) Promotion of Soil Health Card Mission with Organic Carbon Emphasis
- 2) Crop Residue Recycling (Climate Adaptation)
- 3) Mulch cum Manuring of Organic Residues for Climate Adaptation and Improved Soil Organic Matter (Climate Adaptation)
- 4) Tank Silt Recycling (Bring Back the Eroded Top Soil)
- 5) Promotion of Legume Cover Crops (Climate Adaptation)
- 6) Intercrops with Legumes.
- 7) Conservation Agriculture Systems (Area Increasing)
- 8) Agro Forestry Systems (Area is Increasing)
- 9) Integrated Nutrient Management (Area Increasing)
- 10) Agri Horticulture Systems (Area Increasing)
- 11) Water Saving Rice Systems (Area Increasing)
- 12) Direct Seeded Rice (Area Increasing)

# India to Improve Water Use Efficiency



@ Irrigation uses 83% of water, diversion of water to agriculture expected to reduce (72% by 2025)

@ Efficiency Water Use Systems

@ Efficient Crops and Cultivars

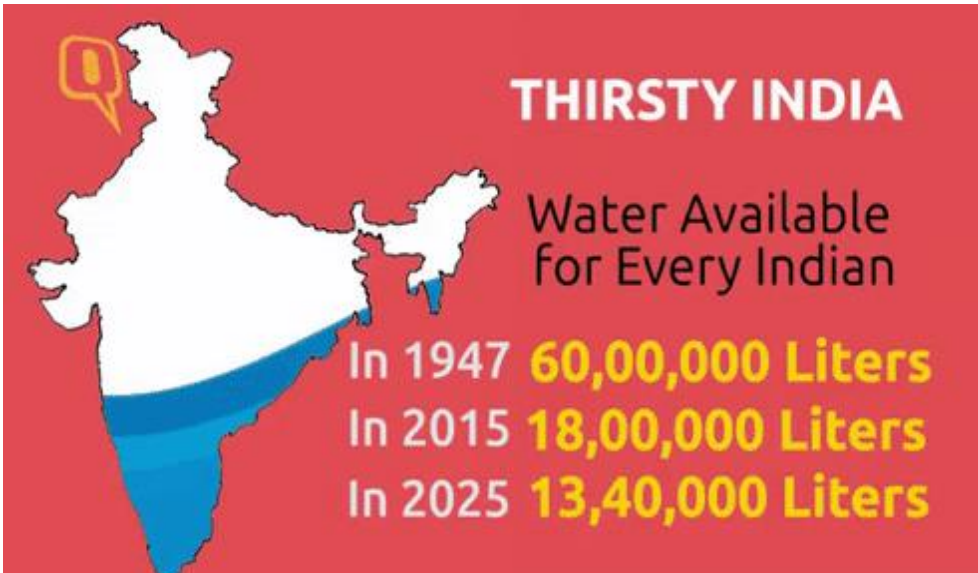
@ Water Saving Rice

1) Prime Minister Krishi Sinchai Yojana (Prime Minister Agriculture Irrigation Plan) for Improving Water Use Efficiency (**More Crop Per Drop of Water; Micro-Irrigation Systems**)

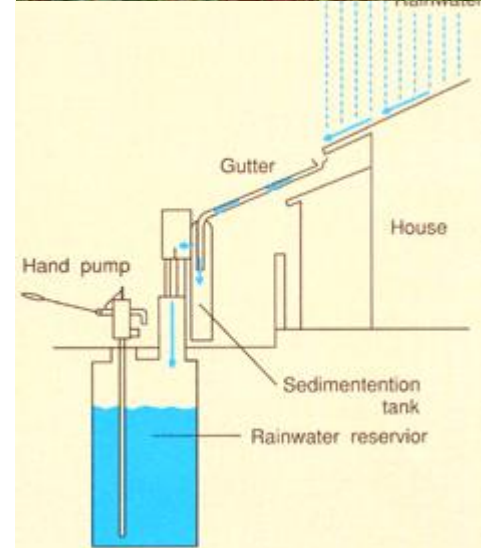
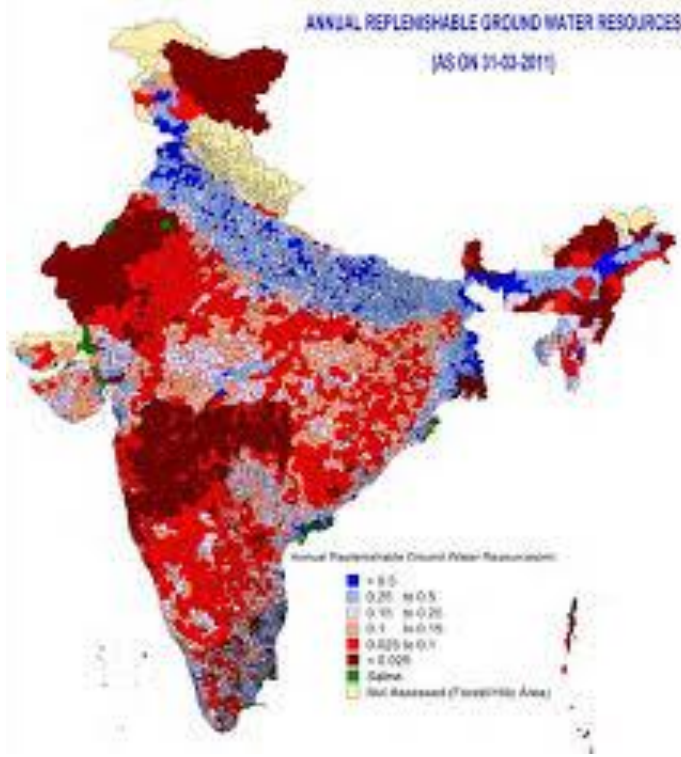
2) National Mission on Water

3) Rain Water Conservation and Utilization through Farm Ponds

# Water Sensitive-Agri. Education in India



# Community Participation is the Key for Rain Water Conservation and Recharging





## Important Strategy for Food Saving in India Towards Lowering Carbon Foot Print

@ Loss a kilogram of wheat and rice would mean wasting 1,500 and 3,500 litres of water respectively that goes into their production.

@ Globally, almost 250km<sup>3</sup> of water and 1.4 billion hectares of land are devoted to producing food that is lost or wasted.

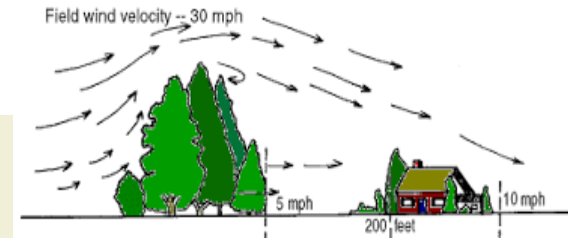
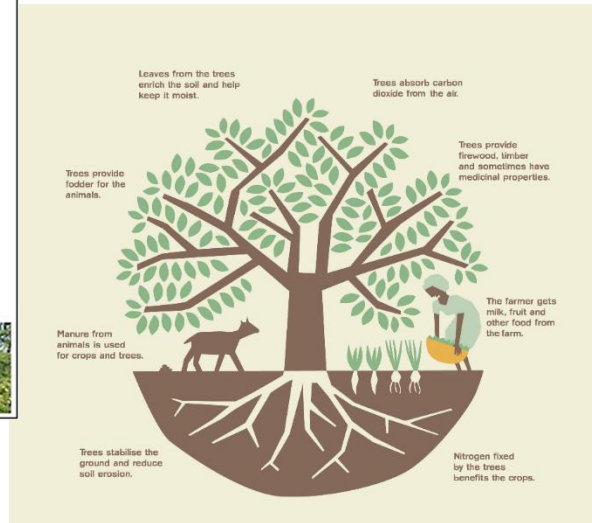
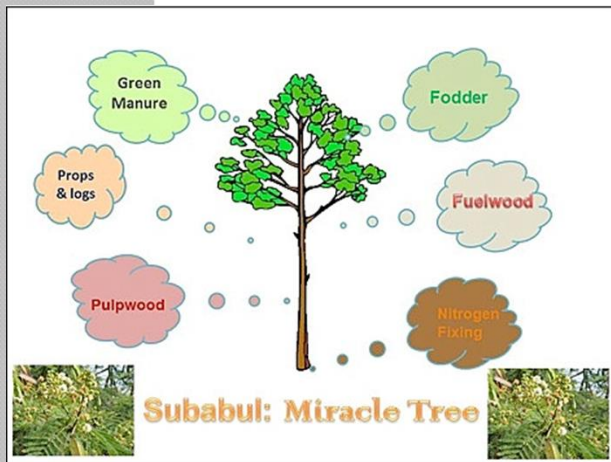
@ According to Food and Agriculture Organization (FAO), every year around 1.7 billion tonnes, or almost one third of food produced for human consumption, are lost or wasted

**Globally.**

@ The associated **economic**, **environmental** and **social costs** of this loss are around **\$1 trillion**, **\$700 billion** and **\$900 billion** per year respectively.

@ Carbon value of this 1.7 billion t food= 0.55 billion tonnes in the world.

# Agro-Forestry and Forestry, Cover Crops, Wind Breaks besides Enhanced CO<sub>2</sub> Fixation Climate Adaptation



@ National Agro-forestry Policy  
@ Green-India Mission

Year 2008

# Integrated Farming System for Climate Resilient Agriculture and Food Production Systems

**National Mission for Sustainable Agriculture**



Year 2011



**India**

# Critical Role of Technology Packaging in Rainfed Drylands (Soil-Water-Crops)



Local Ragi

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## Technology

- @ In-situ moisture conservation
- @ Land treatments
- @ Farm ponds
- @ Drought tolerant cultivar
- @ Soil test based nutrients

## Institutions

- @ VCRMC
- @ Seed bank
- @ Custom hiring of farm machines
- @ Water groups

## Adaptation/Mitigation

- @ Adaptation to Droughts: Resilient
- @ Household food and livelihoods: Enhanced
- @ Village carbon balance: +
- @ Co-Benefits of Mitigation



# Technology Targeting

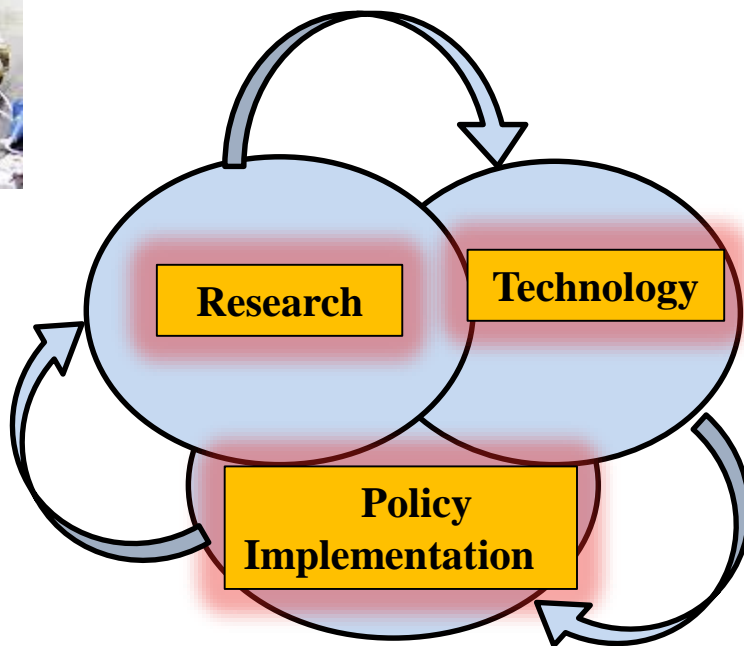
**@ Which technology to Where**

**@ Creation of institutions such as community Seed Banks, farmer producer organisations/farmer producer companies, custom hiring centres for farm machinery and equipment, cooperative credit societies, etc.**

# Research, Technology and Policy Implementation Synergy: for Better Implementation of Carbon Positive Programs in India

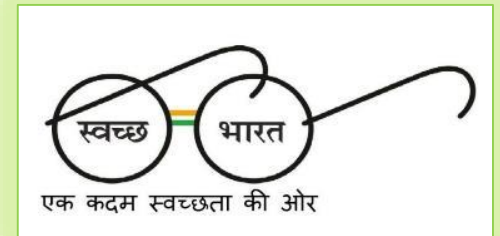


India



# India to Offer

**Knowledge and Implementation for SOC,  
Improved Nutrient and Water Use  
Efficiency Models under South-South  
Cooperation and to Developing Countries**



Thank You