# Research Agenda for Sustainable Fertilizer Management

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## Fertilizer and Agricultural Production

| Fertilizer consumption and Food grain production | |
|---|---|
| 1966-67 | Fertilizer: 1.1 Mt<br>Food grain: 74.2 Mt |
| 2013-14 | Fertilizer: 24.7 Mt<br>Food grain: 264.8 Mt |

- Food grains in India increased from 522 kg per hectare in 1950-51 to 2078 kg per hectare in 2011-2012 (Agriculture Statistics, 2012-13)
- Chemical fertilizers contributed towards increasing productivity of cash crops, horticulture and plantation crops.

### Imbalanced Use of Fertilizers & Soil Health

- Consumption tilted more towards N followed by P.
- Imbalanced consumption ratio of 6.2:4:1 in 1990-91 widened to 7:2.7:1 in 2000-01. Today, it is 6.9:2.4:1 against ideal ratio of 4:2:1 for N:P:K.
- Steep rise in fertilizer prices, especially P & K distorted the balance
- Low SoC of 0.2-0.5, against ideal range of 0.75-1.0
- Recently soil-crop-stage specific customized nutrition products started coming up.

## Major Concern: Soil Health Deterioration & low Nutrient Use Efficiency

*Issues*

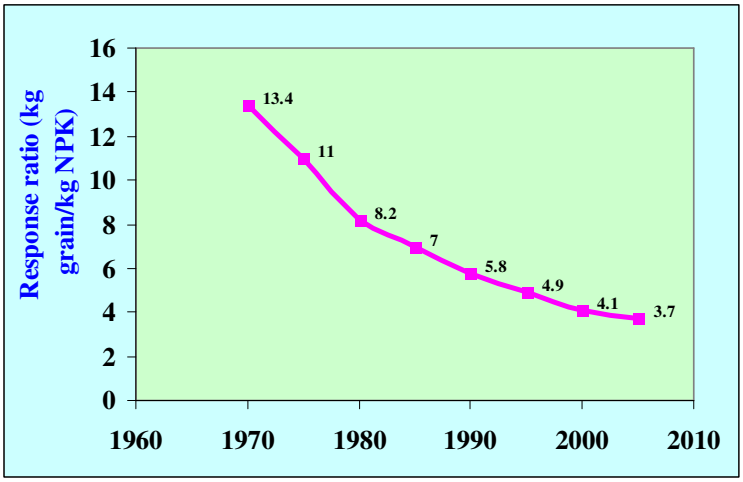
- Nutrient deficiencies: 89, 80, 50, 41, 49, 33, 13, 12, 5 and 3% for N,P,K, S, Zn, B, Mo, Fe, Mn and Cu respectively.
- Nutrient use efficiency varies from 30-50% (N),15-20% (P), 60-70%(K), 8-10%(S) and 1-2% (micronutrients).
- Decline in fertilizer response ratio
- Over 5.3 billion tonnes of soil is lost annually through water erosion with a loss of ~8 mt of plant nutrients (NPK).
- About 90-140 Mt crop residues annually is burnt on-farm causing greenhouse gases emission, losses of plant nutrients and organic carbon

*Major Research Strategy*

- Soil fertility mapping
- Soil quality indices
- Soil test based site specific balanced & Integrated Nutrient Management.
- Liquid biofertilizer consortia
- Crop residue recycling
- Enriched /vermi composting
- Low cost nutrient resources
- Organic farming
- Biofortification
- Resource conservation technologies
- Soil & water conservation.
- Soil carbon sequestration

## Declining Soil Health – A Cause of Concern

### Low Fertilizer Response - Irrigated Areas



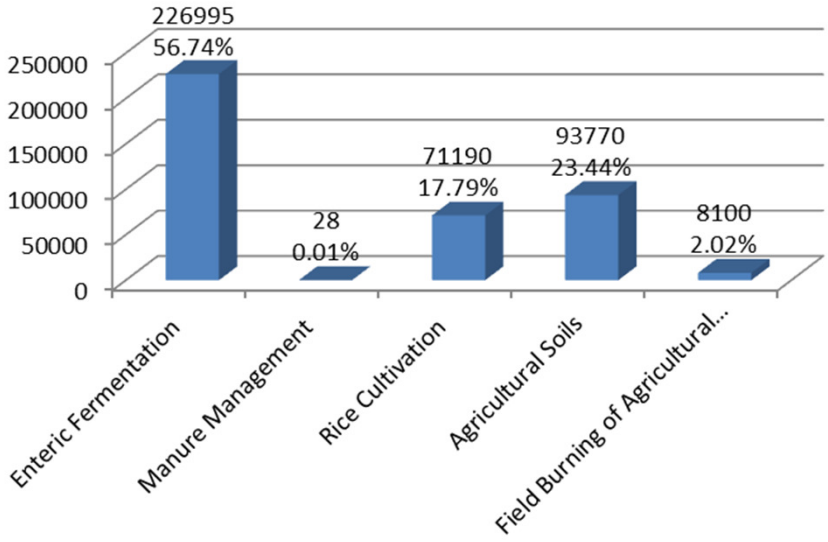
## Keeping pace with Global Carbon Research

- Low energy use
- Low energy releasing
- Low pollute input and
- Higher input use efficiency
- High profitability

## Greenhouse Gas Emission from Indian Agriculture in 2010

| Source | $CH_4$ (Mt) | $N_2O$ (Mt) | $CO_2$ eq. (Mt) |
|---|---|---|---|
| Livestock | 10.9 | - | 228.9 |
| Manure management | 0.13 | 0.08 | 27.5 |
| Rice cultivation | 3.4 | - | 85.0 |
| Crop residue burning | 0.3 | 0.01 | 9.6 |
| Soil | - | 0.26 | 77.8 |
| Total | 14.73 | 0.35 | 417.8 |

## Emission of greenhouse gases from various sub-sectors of agriculture in India in 2010




## Researchable Issues: Sustainable Fertilizer Management

- Liquid/ soluble fertilizer & drip fertigation
- Customized /speciality fertilizers
- Nano/ nano-biofertilizers
- Multi-nutrient solubilizing biofertilizers
- Alternate to rock phosphate

## Water & Fertilizer saving in drip fertigation

| Crop | Locations | Yield (t/ha) | Optimum levels | | Savings (%) | |
|---|---|---|---|---|---|---|
| | | | Irrigation | Fertigation | Water | Fertilizer |
| Banana | Bhavanisagar | 85 | 80% PE | 80% RDF* | 20 | 15 |
| | Rahuri | 83 | 80% PE | 75% RDF | 25 | 17 |
| Brinjal | Gayeshpur | 26 | 80% PE | 125% RDF | 20 | -- |
| | Navsari | 30 | 85% PE | 100% RDF | 15 | -- |
| Cotton | Rahuri | 3.7 | 75% PE | 100% RDF | 25 | -- |
| | Parbhani | 2.9 | 80% PE | 75% RDF | 20 | 25 |
| | Sriganganagar | 3.4 | 60% PE | 80% RDF | 37 | 20 |
| | Bathinda | 1.7 | 60% PE | 100% RDF | 40 | -- |
| Dry chilly | Madurai | 2.2 | 60% PE | 75% RDF | 40 | 25 |
| Sugarcane | Sivganga | 137 | 80% PE | 125% RDF | 20 | -- |
| | Rahuri | 155 | 80% PE | 100% RDF | 20 | -- |
| | Navsari | 110 | 80% PE | 100% RDF | 20 | -- |
| Tomato | Bhavanisagar | 27 | 60% PE | 50% RDF | 40 | 50 |

## Optimum drip fertigation levels and fertilizer saving

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|---|---|---|---|---|---|---|
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# THANK YOU