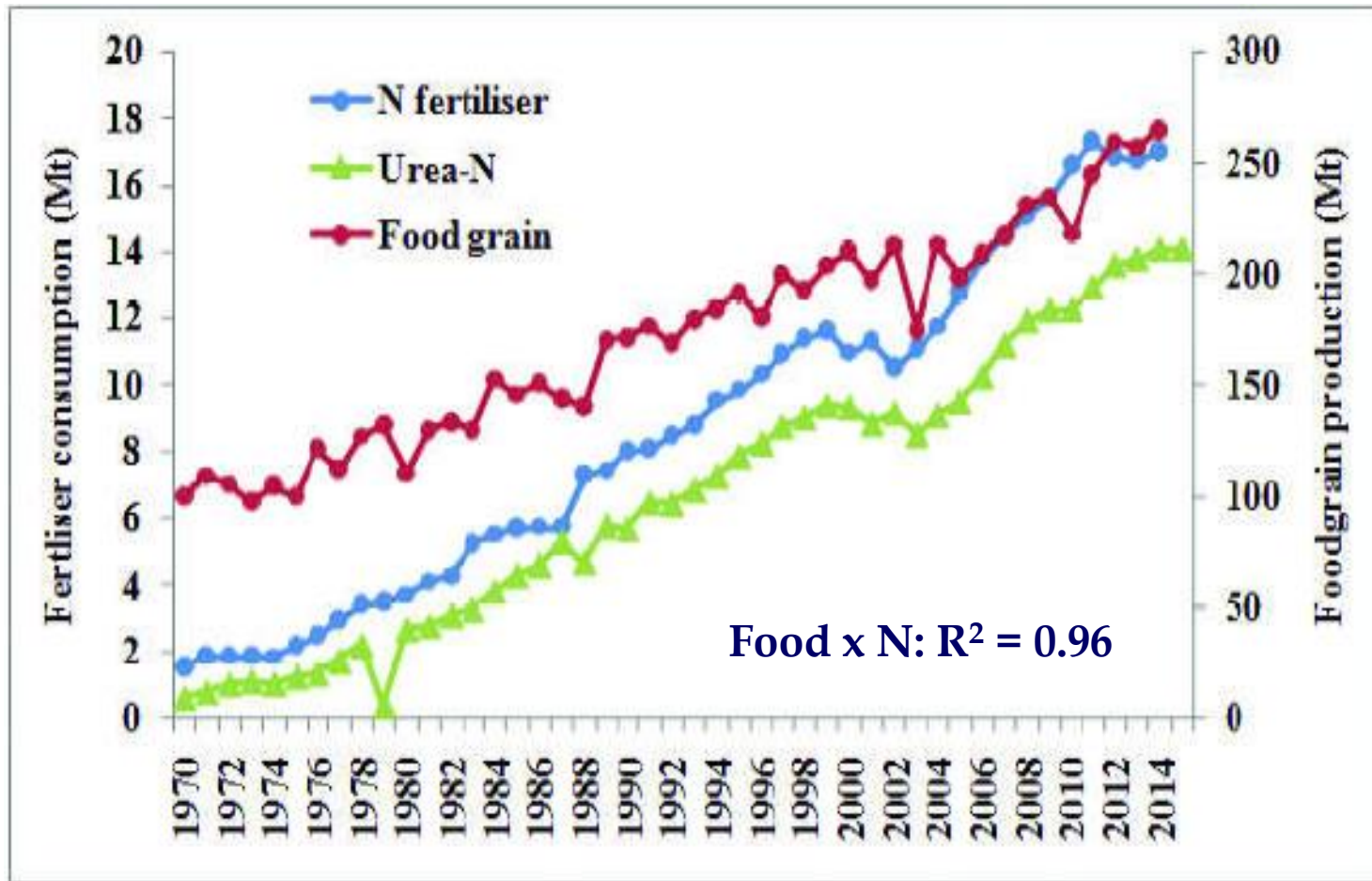
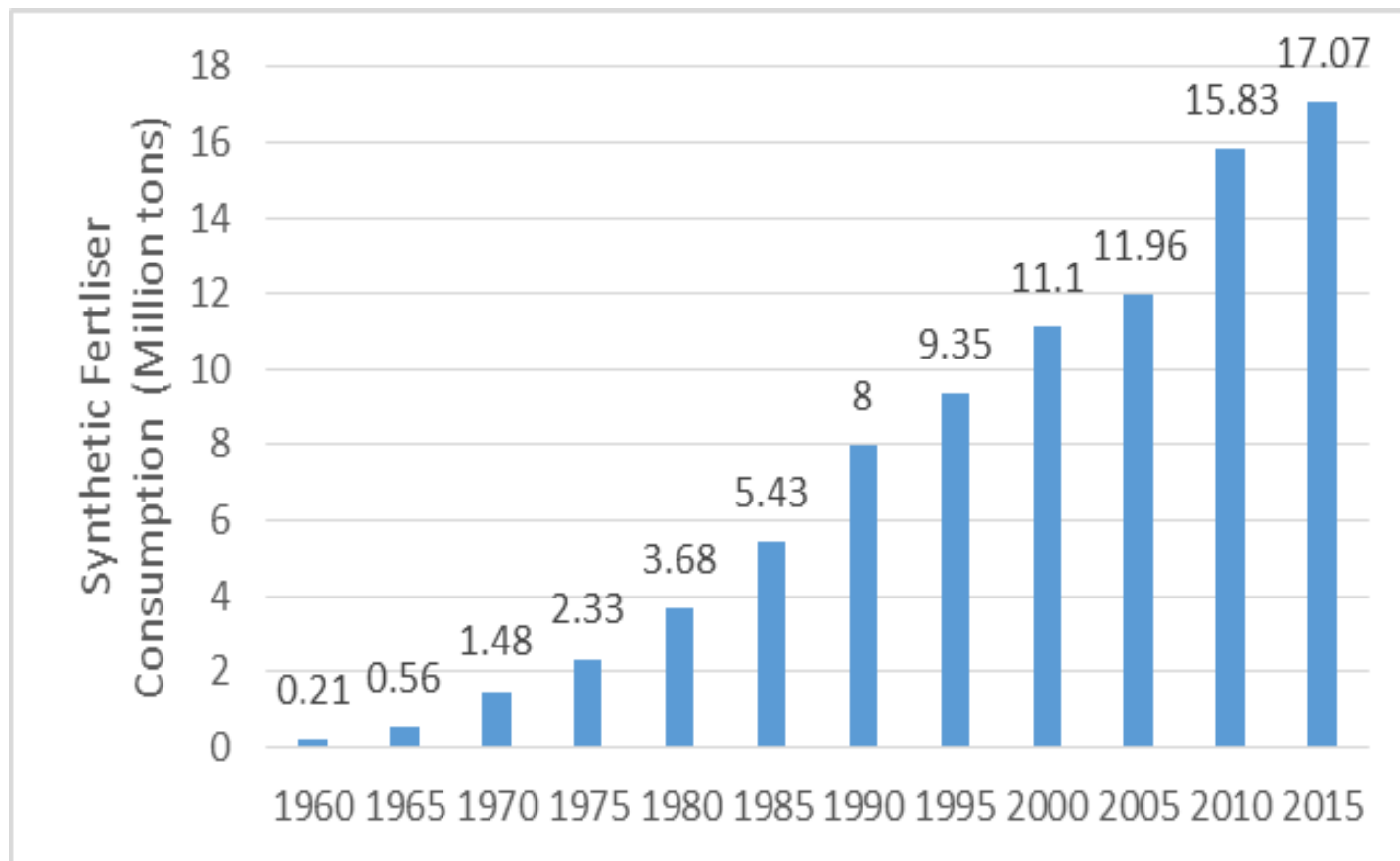


# **Reactive nitrogen scenario for Indian agriculture: Impacts and policies**

**Prof. (Dr.) T.K. Adhya, FNA  
Director, South Asian Nitrogen Centre  
New Delhi, India**



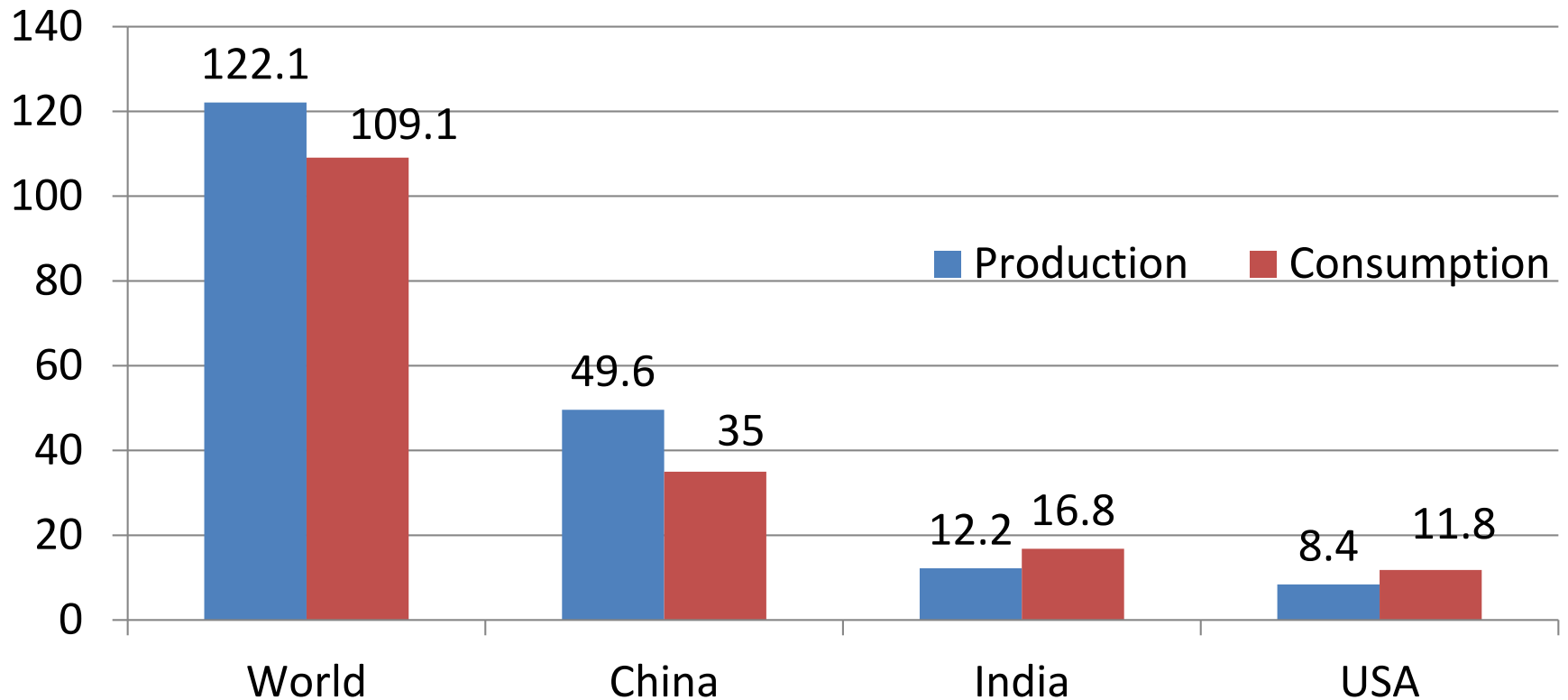
**Relationship between food grain production, N fertiliser and urea consumption in India**

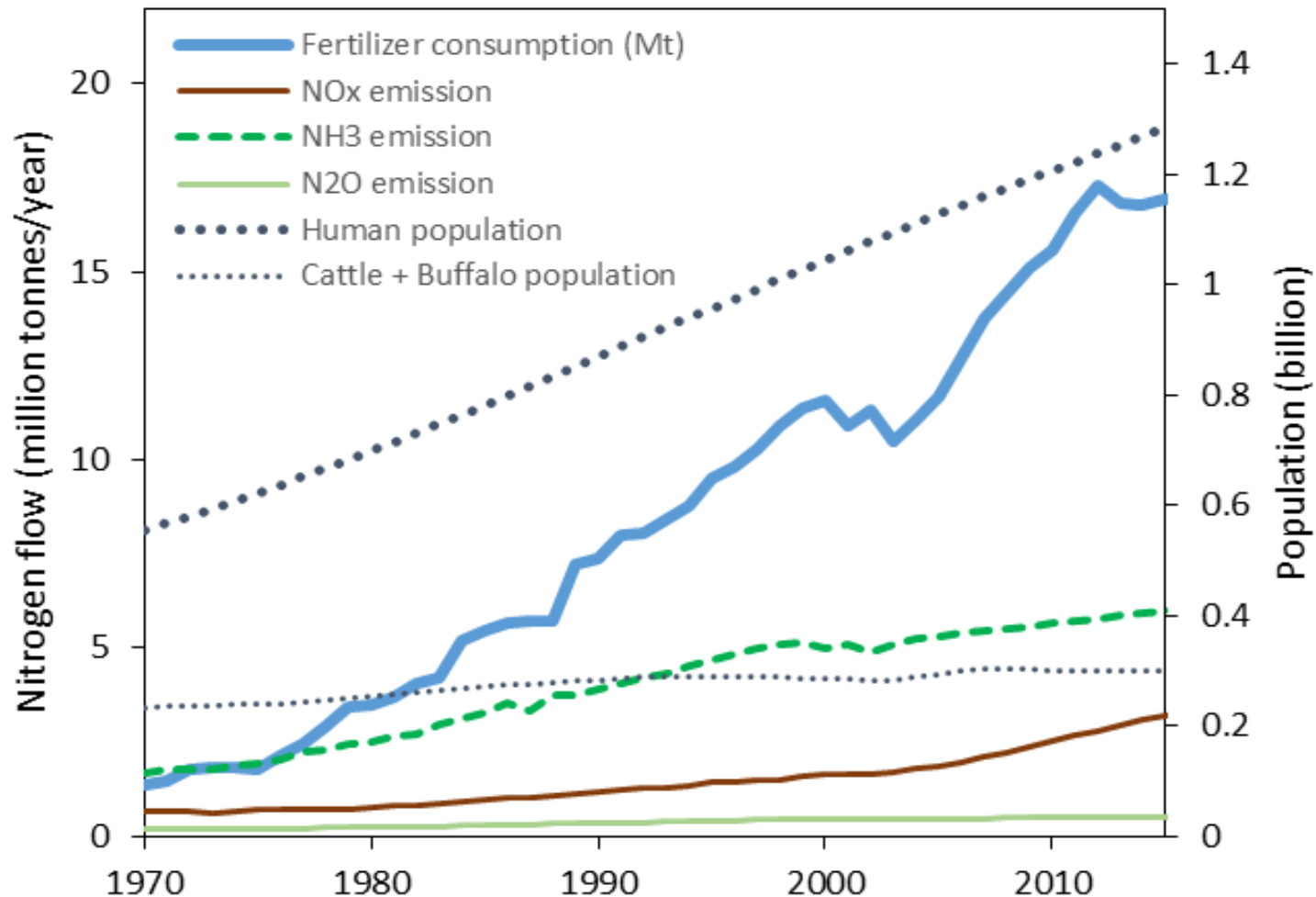


**The per hectare fertiliser-N consumption increased from 0.44 kg ha<sup>-1</sup> in 1951-52 to 86.2 kg ha<sup>-1</sup> in 2013-14 (FAI, 2015)**

**Increasing Fertilizer-N consumption in India (Source: FAI, 2015)**

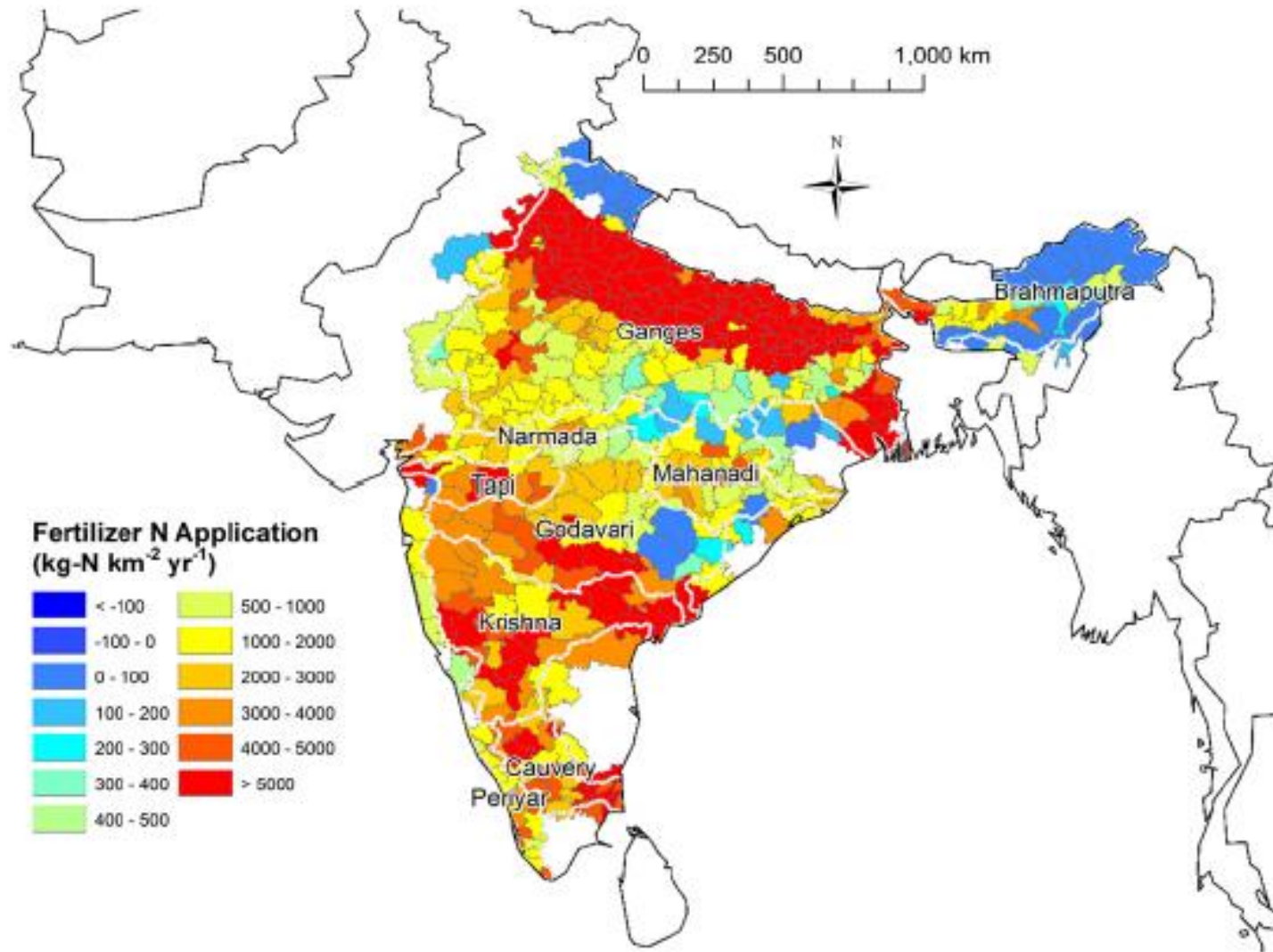
# India's Share in global production & consumption of N (million tonnes)





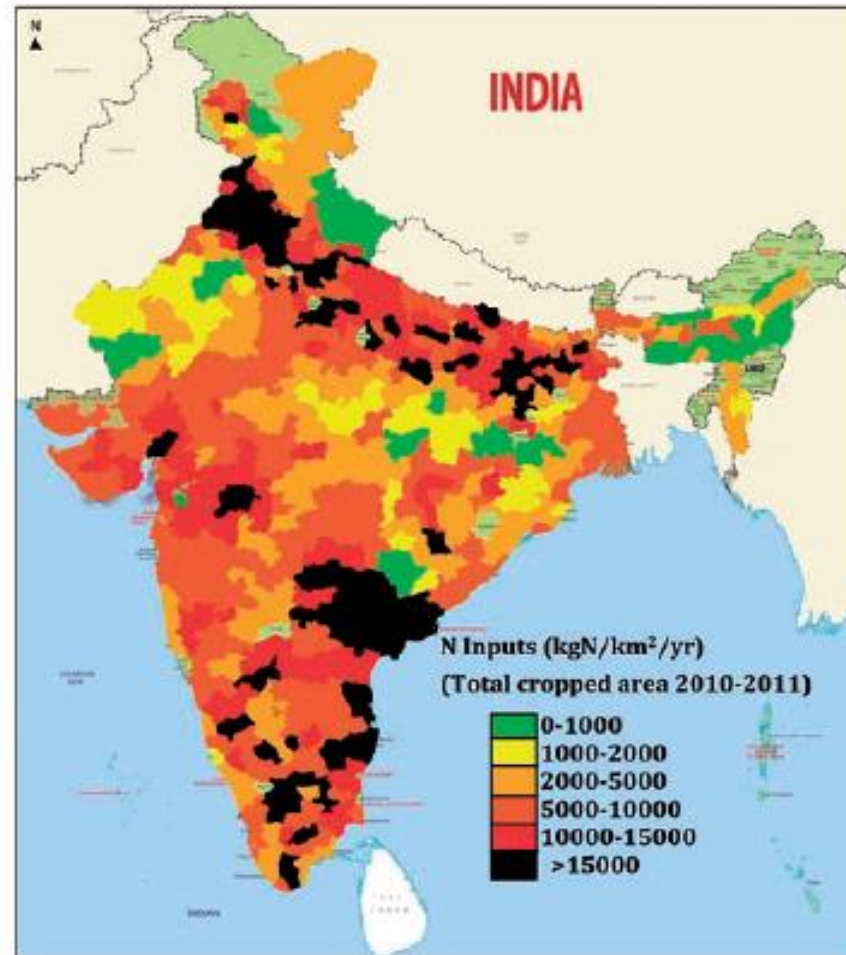
**Trends in nitrogen flows in India through fertilizer consumption, emissions of nitrogen oxides (NO<sub>x</sub>), ammonia (NH<sub>3</sub>) and nitrous oxide (N<sub>2</sub>O), as compared with trends in the population of humans and major livestock (Sutton et al., 2017)**

# District-level N fertilizer consumption from Fertilizer Association of India (Chanda et al., 2001)



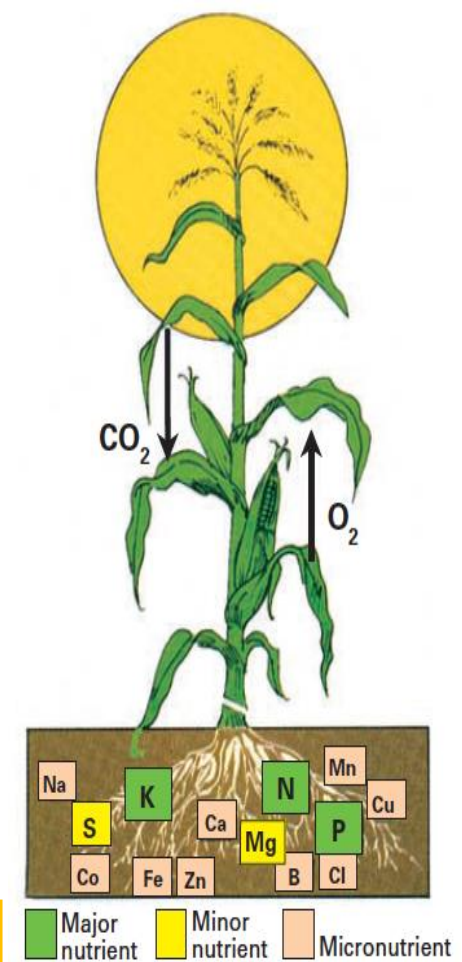
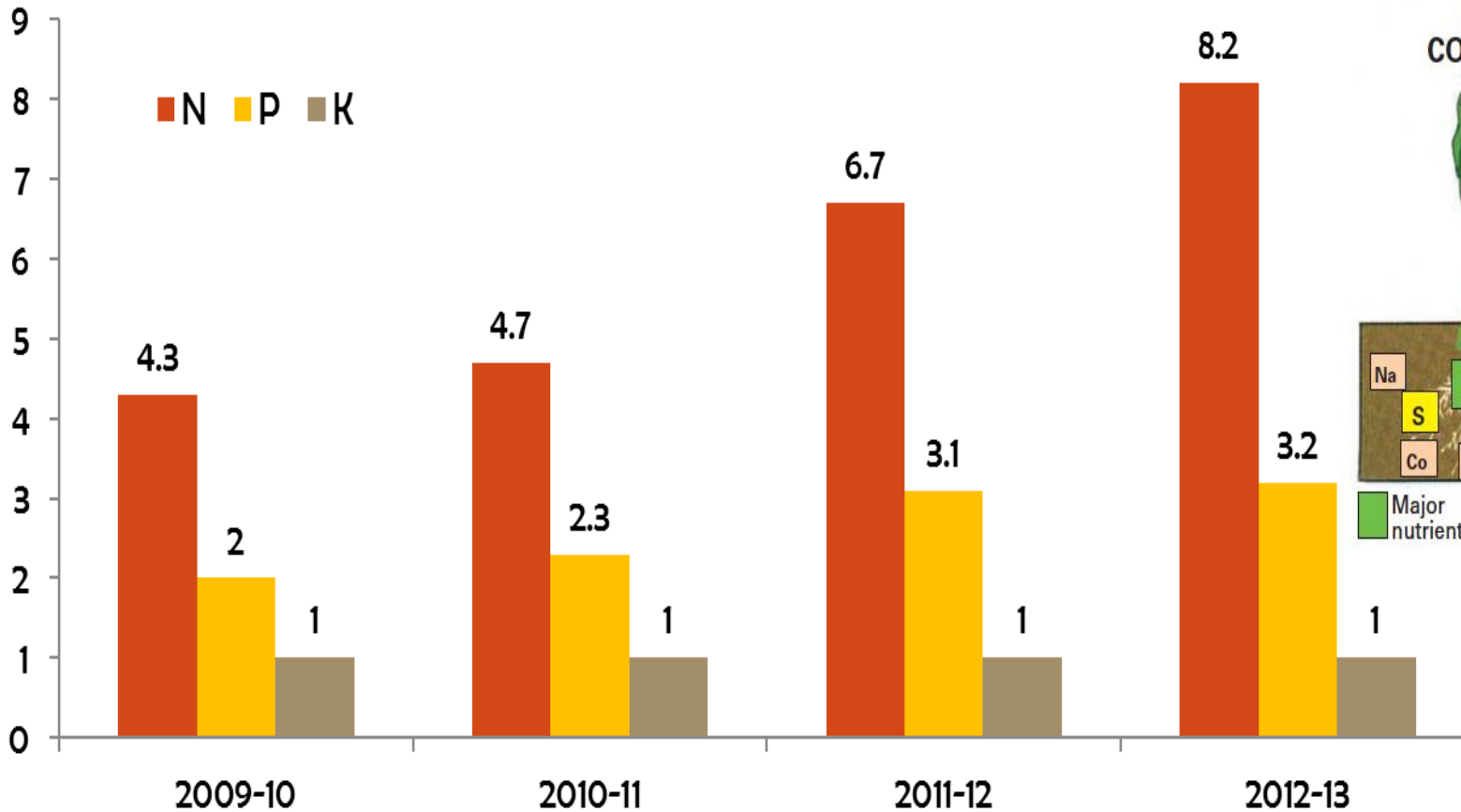
**Some Regions Use Excess while Others Do not Have Enough -Indian N scenario !**

# Some Regions Use Excess N while Others Do not Have Enough- N scenario of India



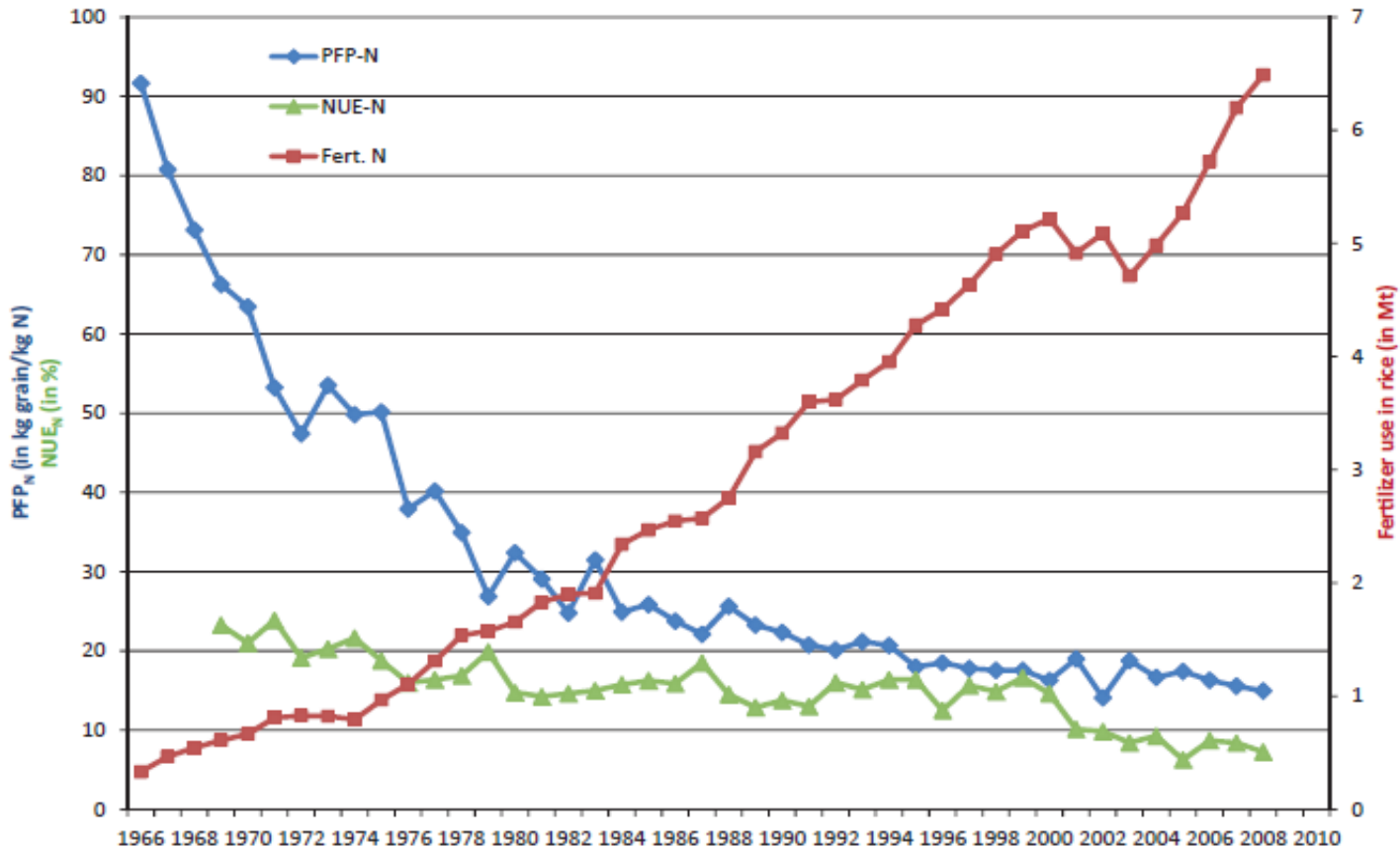
District-wise consumption of N in India (Data Source: Directorate of Economics and Statistics, Ministry of Agriculture, Govt. of India and Fertilizer Association of India)

# Deteriorating balance in NPK

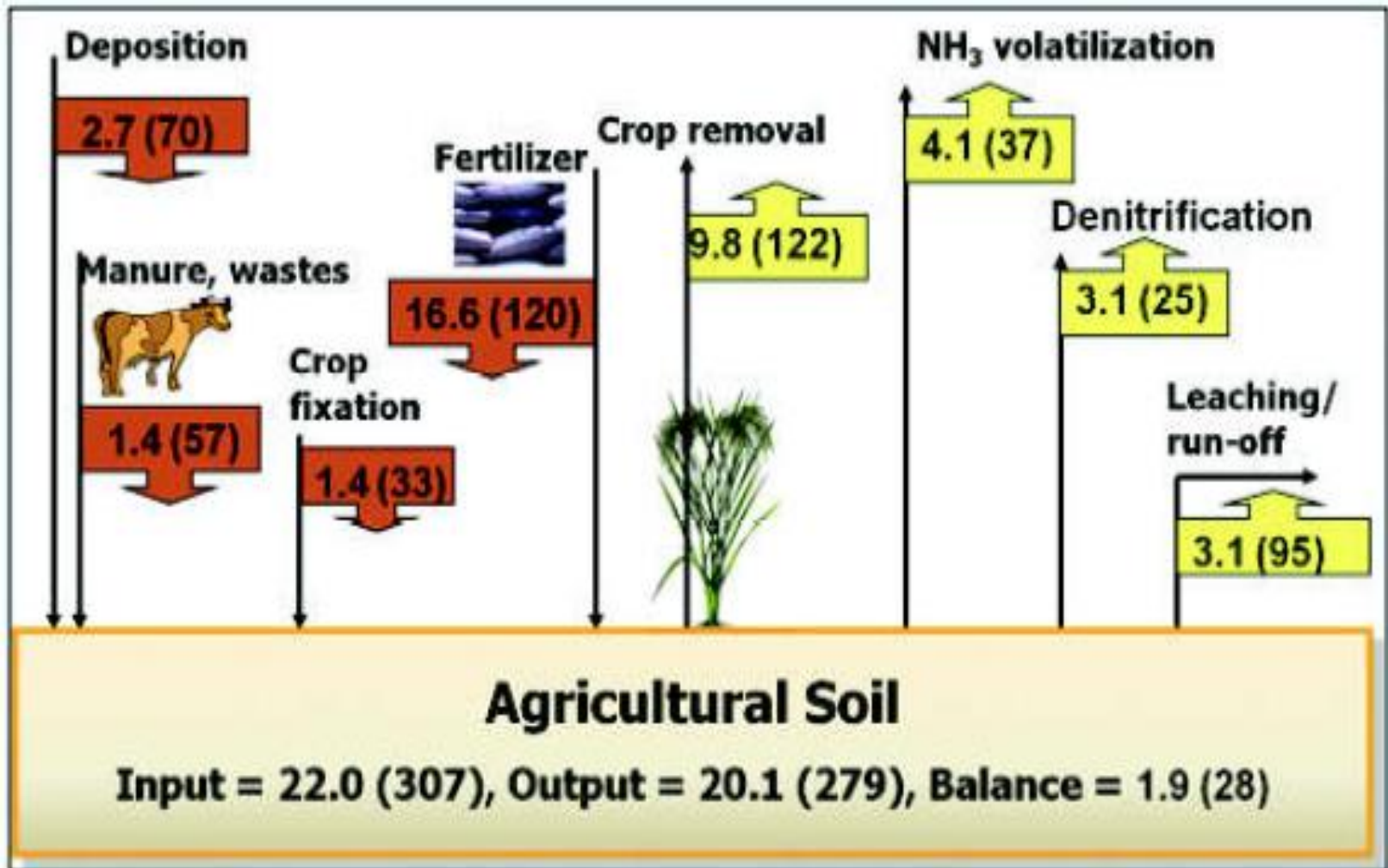


Are threats from N fertilizers increasing?

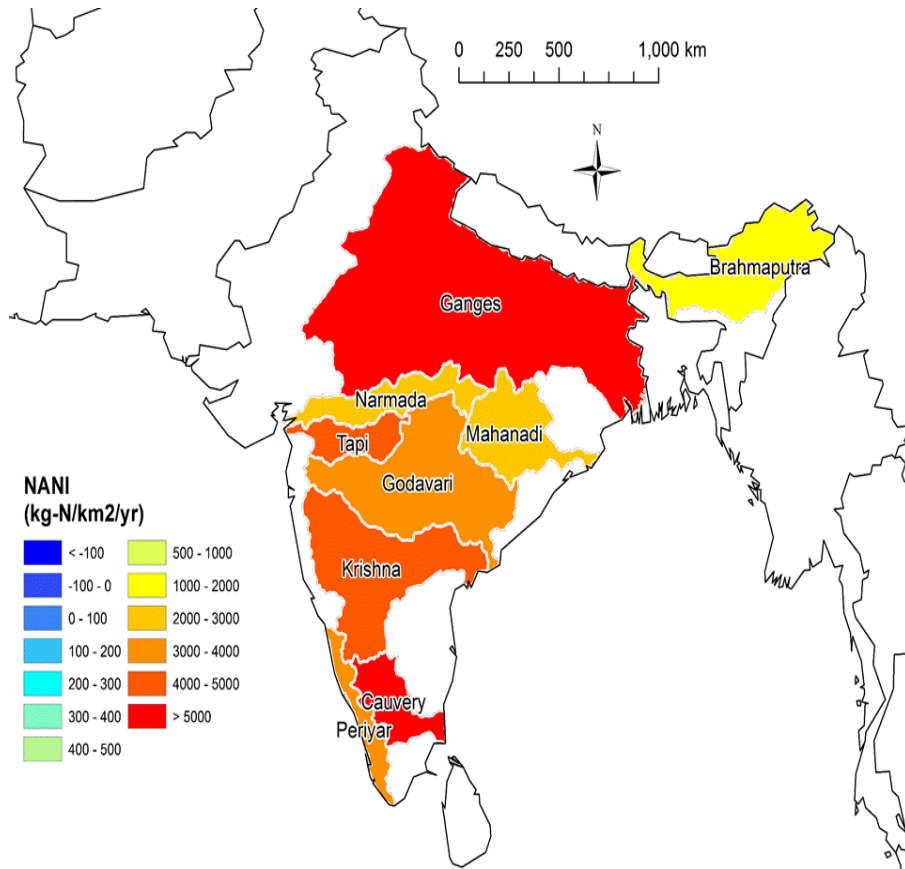




The case of N-use in India: changes in partial factor productivity ( $PFP_N$ ) and nitrogen use efficiency ( $NUE_N$ ) in comparison with the trend of N fertilizer application to rice (Data Source: Adhya et al., 2010)



Annual budget of N (Mt) in agricultural soils of India and World (in parenthesis) during the year 2010 (Source: Pathak et al. 2016)

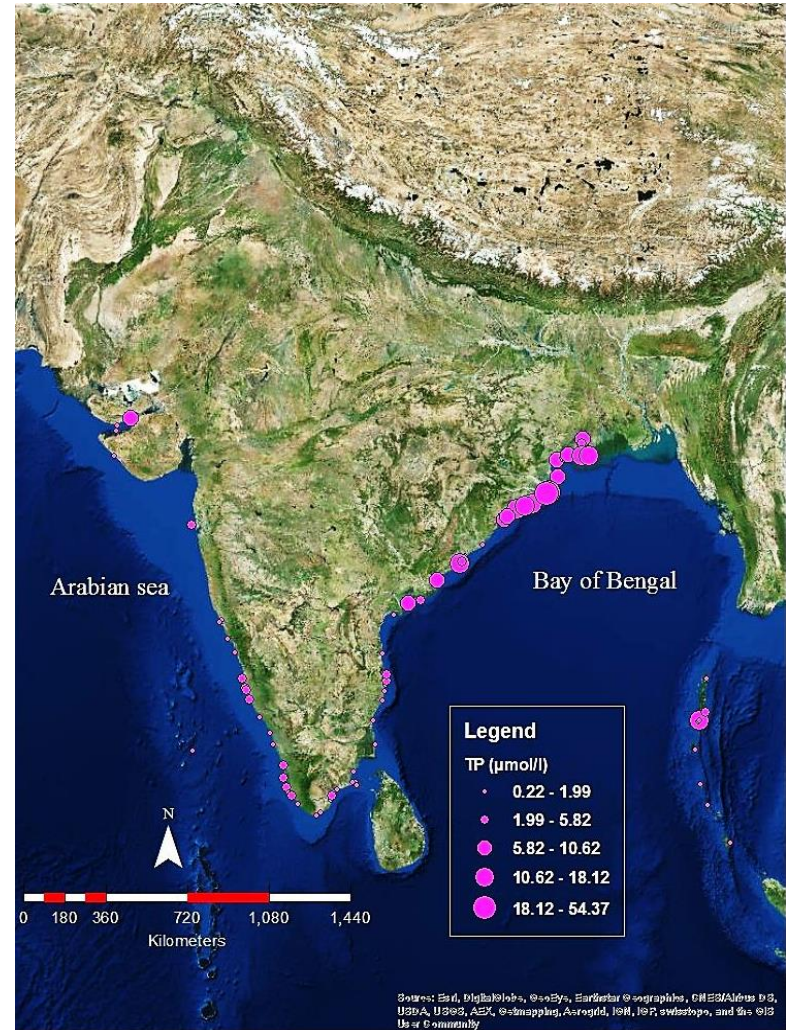
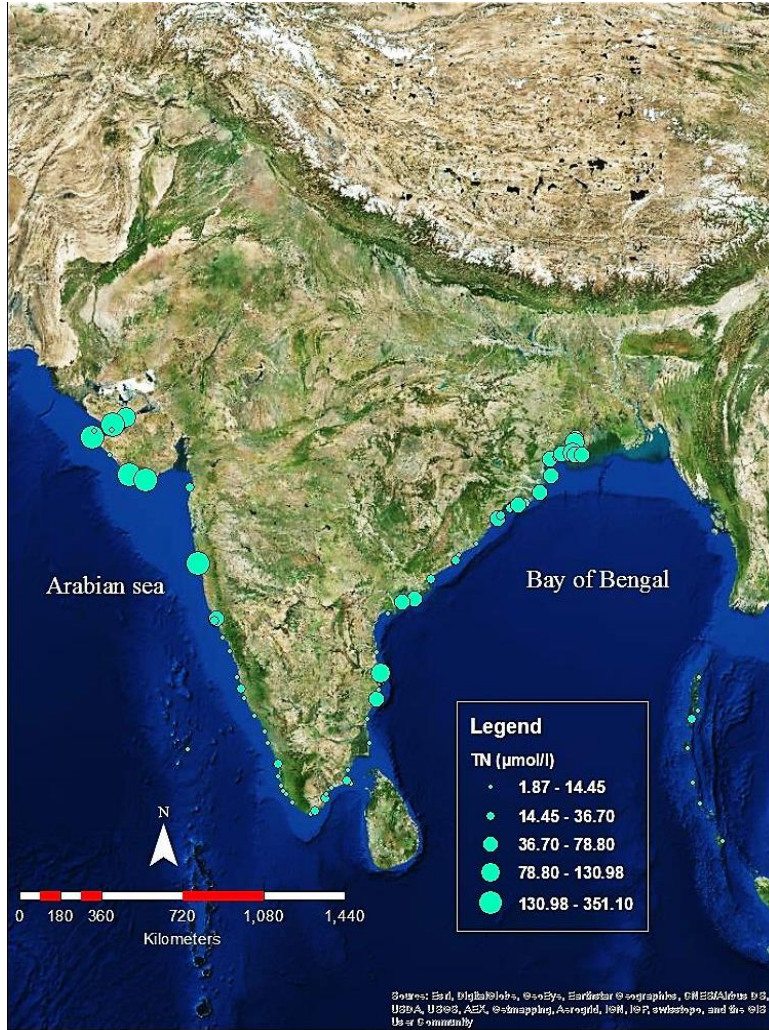


- Fertilizer inputs dominate anthropogenic N inputs of India
- Ganges catchment area shows the highest NANI value driven primarily by high agricultural fertilizer inputs.
- NANI is calculated as the sum of four major components:
  - a) oxidized N deposition
  - b) fertilizer N application
  - c) agricultural N fixation, and
  - d) N in net food and feed imports

## Net Anthropogenic Nitrogen Inputs (NANI) in Indian Catchments

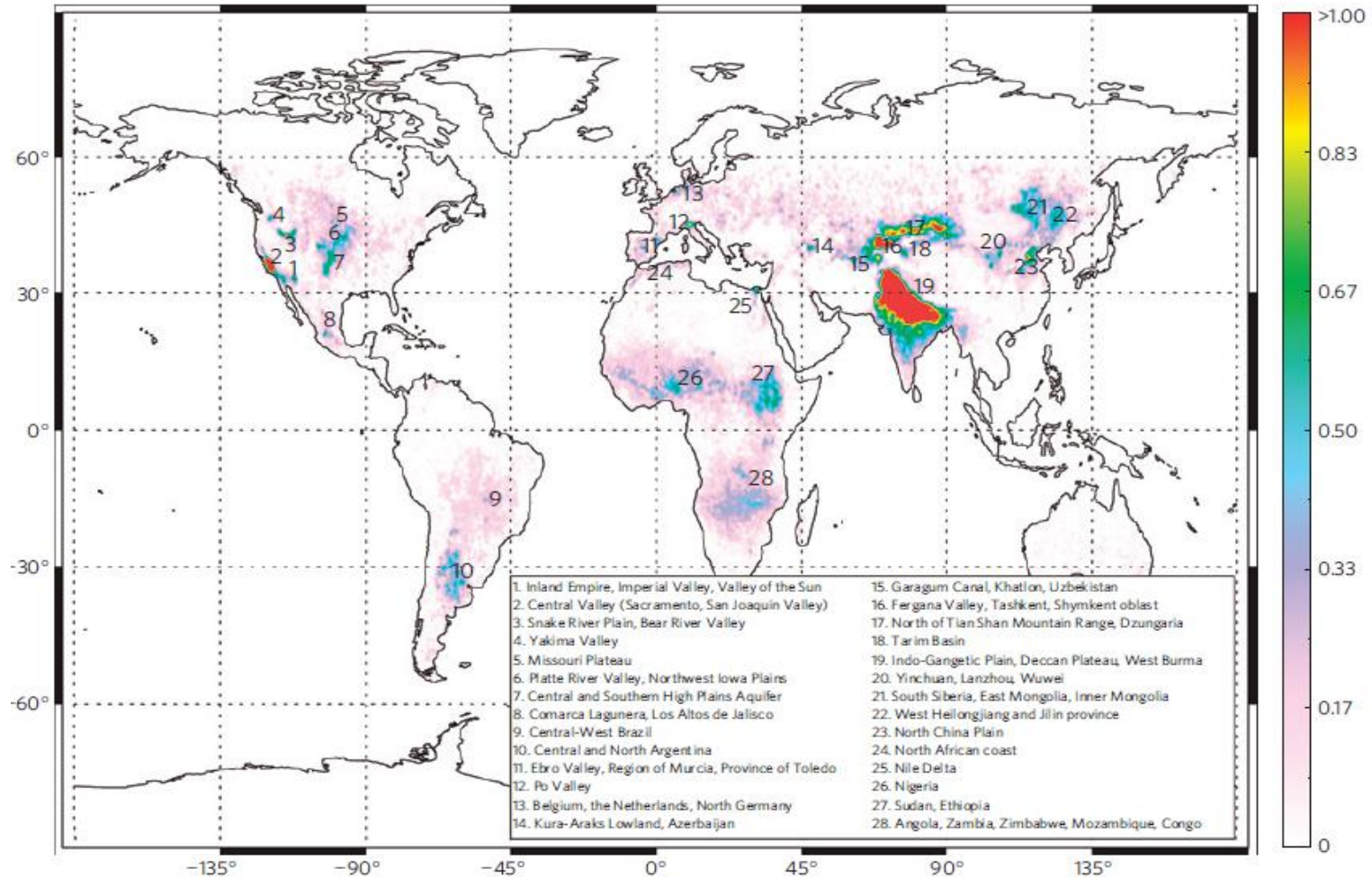
(Swaney et al., 2015)

# Nutrients in coastal Waters



# Why India and South Asia?

## A global hotspot for nitrogen losses



Global ammonia column (mg m<sup>-2</sup>) from IASI satellite  
Clarisse et al., *Nature Geoscience*

## N<sub>2</sub>O Emission (Gg) from Agriculture Sector of India (2007-2012)

| Source                          | 2007   | 2008   | 2009   | 2010   | 2011   | 2012   |
|---------------------------------|--------|--------|--------|--------|--------|--------|
| Direct Emission                 | 134.82 | 141.09 | 145.67 | 154.82 | 161.76 | 157.27 |
| Atmospheric Deposition          | 16.99  | 17.78  | 18.36  | 19.51  | 20.39  | 19.82  |
| Leaching                        | 11.33  | 11.85  | 12.24  | 13.01  | 13.59  | 13.21  |
| Emission from Fertilizer        | 163.14 | 170.73 | 176.27 | 187.34 | 195.74 | 190.31 |
| Biomass burning                 | 5.05   | 4.94   | 4.77   | 5.21   | 5.54   | 5.31   |
| Total N <sub>2</sub> O Emission | 168.19 | 175.68 | 181.05 | 192.56 | 201.28 | 195.63 |
| % Increase                      |        | 4.45   | 3.06   | 6.36   | 4.53   | -2.81  |

Source: Adhya et al (2016)

What can we do with the emerging  
N cycling scenario?

# Approaches and practices for increasing NUE

## Approaches

- 4R's Nutrient Stewardship (Right form, rate, method and time of application)
- Matching N supply with crop demand
- Minimizing N application in wet season to reduce leaching
- Supplying fertiliser N to plant rather than soil

## Promising Practices

- Split application of Nitrogen
- Slow and Controlled release fertilisers
- Use of Neem Coated Urea (NCU)
- Promoting speciality (WSFs) fertilisers and Fertigation
- Use of Leaf Colour chart (LCC)



# Conclusions

- Nitrogen is essential for food production
- It also causes pollution and climate change
- Nitrogen is a part of the problem and also of the solution
- Enhancing N use efficiency is crucial
- Comprehensive assessment of N budget at national scale is needed

# THE INDIAN NITROGEN ASSESSMENT

Sources of Reactive Nitrogen, Environmental and Climate Effects,  
Management Options, and Policies

Yash P. Abrol, Tapan K. Adhya, Viney P. Aneja, Nandula Raghuram,  
Himanshu Pathak, Umesh Kulshrestha, Chhemendra Sharma,  
and Bijay Singh

*The Indian Nitrogen Assessment: Sources of Reactive Nitrogen, Environmental and Climate Effects, Management Options, and Policies* provides a reference for readers interested in reactive nitrogen—from researchers and students to environmental managers. Although the main processes that affect the N cycle are well known, this book focuses on the causes and effects of disruption in the N cycle, specifically in India.

This book helps readers gain a precise understanding of the scale of nitrogen use, misuse, and release through various agricultural, industrial, vehicular, and other activities, also including discussions on its contribution to the pollution of water and air. Drawing upon the collective work of the Indian Nitrogen Group, this reference book helps solve the challenges associated with providing reliable estimates of nitrogen transfers within different ecosystems, also presenting the next steps that should be taken in the development of balanced, cost-effective, and feasible strategies to reduce the amount of reactive nitrogen in the environment.

## Key features

- Identifies all significant sources of reactive nitrogen flows and their contribution to the N cycle on a national, regional, and global level
- Covers nitrogen management across sectors, including the environment, food security, energy, and health
- Provides a single reference on reactive nitrogen in India to help in a number of activities, including the evaluation, analysis, synthesis, documentation, and communications on reactive nitrogen



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**THANK YOU**