

Methane and Nitrous Oxide Emissions from Agriculture: A Developing Country Perspective

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Structure of Presentation

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Background

- Since the industrial revolution,
 - CH₄ is doubled in their emissions and
 - N₂O is contributed more than 15%
- Global mean surface temperatures rose by 0.7°C

Potential Impacts

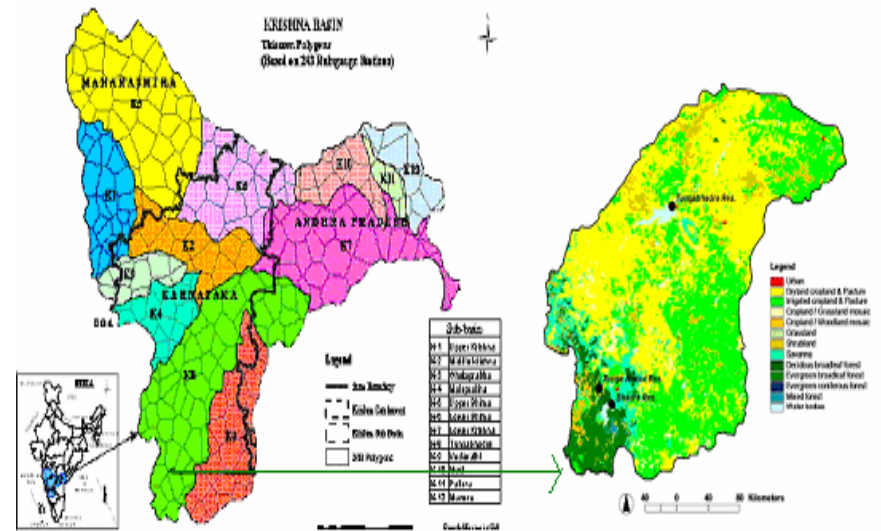
- As per the regional model (HadRM2, IS92a scenario), the projections for India, under the IS92a scenario;
 - All-round increase in temperature
 - Large spatial variation in the relative increase in monsoon precipitation
 - An overall decrease in the number of rainy days
 - An overall increase in rain intensity by 1-4 mm/day
 - Increase in the temperature to the order of 2-4°C over southern and may exceed 4°C in northern region of the country

Implications

- Water stress and reduced availability
- Threat to agriculture thereby to food security
- Shift in area and boundary of forest types
- Threats to biodiversity
- Adverse impact on natural ecosystems
- Sea level rise and its impacts on coastal agriculture and settlements.
- Increased vector borne diseases such as malaria.
- Increased energy requirements and
- impact on climate-sensitive industry and infrastructure.

Study Area

- The Tungabhadra river basin is the main sub basin of the Krishna river basin in peninsular India
- stretches over an area of 1.45 % of total geographical area India,
 - Karnataka (81.1 % of the basin)
 - Andhra Pradesh 18.9 % of the basin)
- It has 7.7 million population (2001 Census)
- Belongs to Western Ghat and semi arid zone
- 60 % of area is under irrigation (Paddy is high)
- There are 13.8 million (including both ruminant and non ruminant) livestock are there in the basin



Objectives

- To develop a profile of Methane and Nitrous Oxide emissions from agriculture and livestock
- Estimating the potential for carbon trading

Methodology Followed

The methodology prescribed by the IPCC (Revised 1996) for National Greenhouse Gas Inventories is used to estimate the anthropogenic GHG emissions by sources and removals through sinks (Shukla P R, 2006; Subodh Sharma et al. 2006; Colombia Nationals, 1990; Natcom (Undated); EPA, 2002; Arti Bhatia et al, 2004)

The below equations are adopted

Equation 1: Rice Cultivation

- Methane emissions from rice fields is calculated by using the below said equation

$$F_c = EF \times A \times 10^{-12}$$

Where,

- F_c = estimated annual emission of methane in Gg /yr;
- EF = methane emission factor integrated over integrated cropping season, in g/ m²;
- A = annual harvested area in m²/yr.

Cont.,

Equation 2: Domestic Livestock

$$1. \text{Nex (AWMS) = (T) [N (T) x Nex (T) x AWMS (T)]}$$

Where,

- Nex (AWMS) = N excretion per Animal Waste Management System (kg/yr)
- N (T) = number of animals of type T in the district
- Nex (T) = N excretion of animals of type T in the country (kgN/animal /yr)
- AWMS (T) = fraction of Nex (T) that is managed in one of the different distinguished animal waste management systems for animals of type T in the district
- T = type of animal category

$$2. \text{N}_c\text{O(AWMS)} = [\text{Nex(AWMS)} \times \text{EF3(AWMS)}]$$

Where,

- N₂O (AWMS) = N₂O emissions from all Animal Waste Management Systems in the country (kgN/yr)
- Nex(AWMS) = N excretion per Animal Waste Management System (kg/yr)
- EF3(AWMS) = N₂O emissions factor for an AWMS (kg N₂O -N/kg of Nex(AWMS))

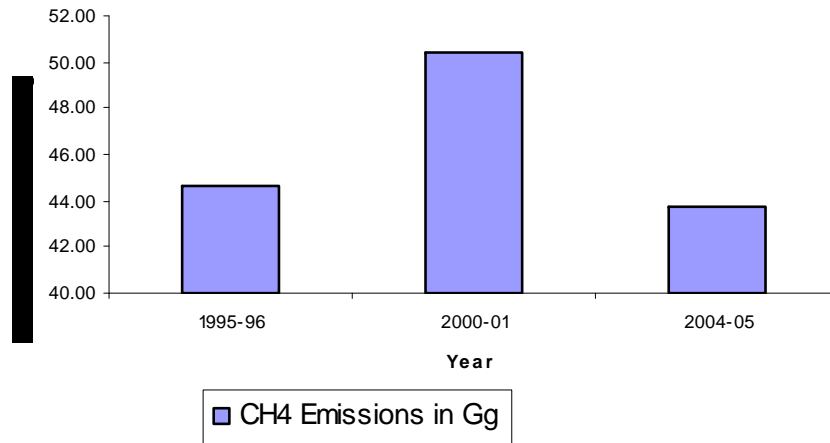
Equation 3: Agricultural Soils

$$\text{T N}_2\text{O} = (\text{A} \times \text{B}) \times 10^{-6}$$

Where,

- T N₂O = Total Nitrous Oxide emissions from the synthetic fertilizers used in Gg
- A = Total synthetic fertilizers applied (in Kg N/Yr)
- B = Emissions factors for direct emissions (in Kg N₂O- N/Kg N)

CH₄ Emissions from Rice Cultivation in Gg



Methane Emissions from Rice Cultivation in Gg

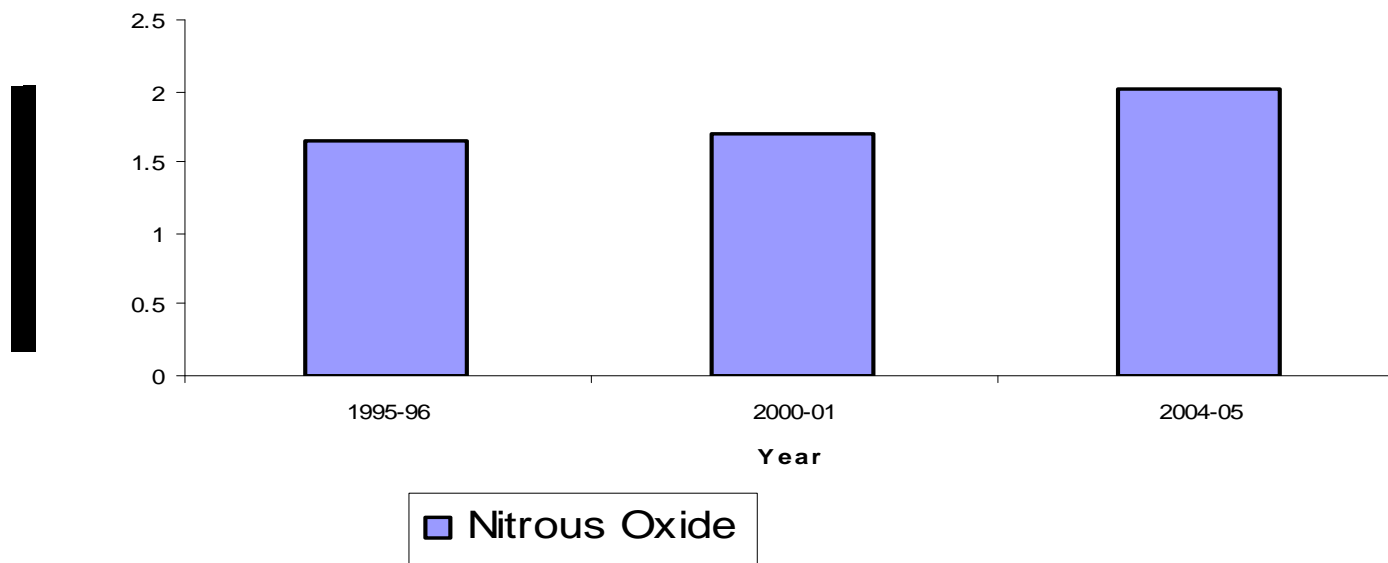
Data Source: Department of Agriculture and Directorate of Economics and Statistics, Bangalore

CH₄ and N₂O Emissions from Field Burning

Variables/Year	1995-96	2000-01	2004-05
CH ₄	1.18	1.45	1.18
N ₂ O	0.04	0.05	0.04

Data Source: Department of Agriculture and Directorate of Economics and Statistics, Bangalore

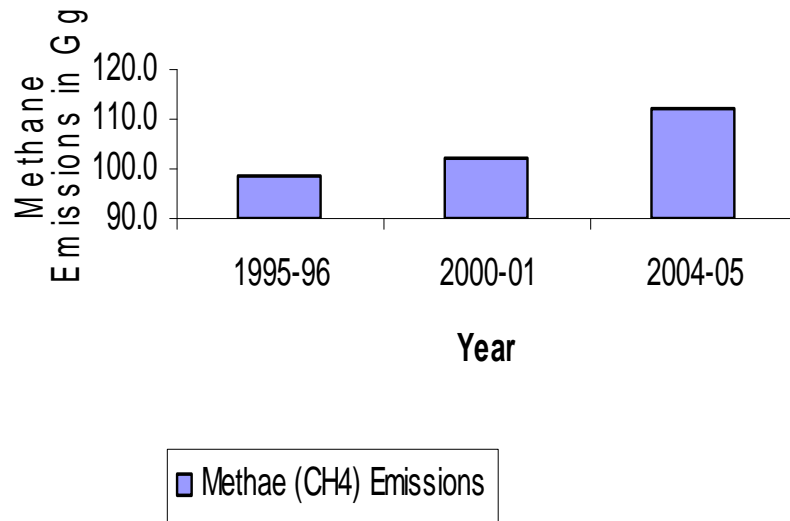
N₂O Emissions from Agricultural Soils in Gg



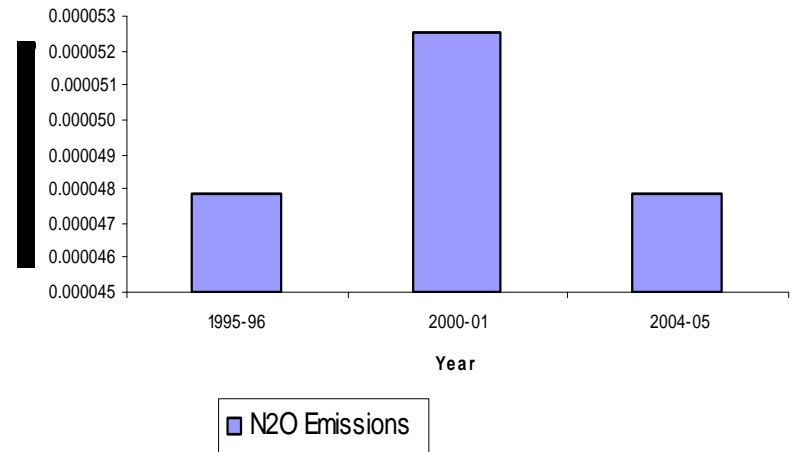
Data Source: Department of Agriculture and Directorate of Economics and Statistics, Bangalore

CH₄ & N₂O Emissions from Livestock

Methane Emissions in Gg



Nitrous Oxide Emissions in Gg



Data Source: Department of Animal Husbandry, Bangalore

CO₂ (Eqvi.) Emissions from Agriculture

Year/Variables	1995		2000		2005	
	in Gg	in %	in Gg	in %	in Gg	in %
Rice Cultivation	937.2	26.70	1059.19	28.1	918.13	23.32
Filed Burning	36.81	1.05	45.27	1.2	36.93	0.94
Agricultural Soils	509.82	14.52	526.79	14.0	621.71	15.79
EF and MM	2026.56	57.73	2139.27	56.7	2359.73	59.94
Total	3510.39		3770.52		3936.5	

Note: 1 CH₄ = 21 CO₂ and 1N₂O = 310 CO₂

Potential for Carbon Sequestration

Districts	Category	Area	Benefits in lakh US\$ (1 tonne of Carbon=10 US\$)	Benefits in lakh Rs. (1US\$=40 INR)	Cost to Plant In lakh Rs (Rs.625 per acre)
TB Basin	Total waste land in Ha	5.33	1,459.4	58,380.0	1,664.9
	Total National, State, Districts and rural roads length in Kms	70,150	763	30,698	438
	Canal length (including distributory also) in Kms	2,848	62.3	2,493	17.8
	Total		2284.7	91,571	2,120.7

Conclusion

- Both EF and MM contribute more 55 per cent
- Followed by rice cultivation, contribute 25 per cent emissions
- The present CH₄ and N₂O emissions can reduce through
 - Converting of wasteland into plantations
 - Planting on the road side and public areas
 - Increase the activities in the forest programmes
 - Adopting biogas plants instead of dumping livestock waste
 - SRI (Systematic Rice Intensification) method of cultivation will be better than flood irrigation
 - Applying the decomposition techniques instead burning the agricultural waste in the field
 - Practice organic farming etc

THANK YOU