2006 IPCC Software for National Greenhouse Gas Inventories: Application and use for India

Presentation for NGGIP Side Event
Bonn, June 8, 2013

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GHG Inventory Software

- Objectives for Indian inventory preparation (by IIMA team)
  - Creating a TACCC and UNFCCC compliant GHG inventory for latest years
  - Converting all previous years' inventories into a consistent framework through an appropriate software
  - Software should be easy to become a part of any proposed National Inventory Management System (NIMS) for India as and when designed
- Historical GHG inventory preparation
  - Indian government has submitted INC and SNC to UNFCCC
  - Years covered in various Indian official GHG inventory reports – 1994, 2000, 2005 and 2007
  - IIMA team has been creating national inventories for last 15 years (covering all sectors except LULUCF) and also feeding into India's national inventory process appropriately
- Reasons for using IPCC 2006 software (by us)
  - We were not using any inventory software before
  - Had an option for preparing our own software, but went for this software
  - Of course IPCC 2006 software has many advantages
  - Other available softwares were not easily available, or we didn't look enough

Reasons for Using 2006 IPCC Software

- It's the latest available software for GHG inventory preparation
- For preparation of 2006 IPCC guidelines, many LAs / CLAs from India, so more conversant with guidelines of various sectors
- Many Indian experts also involved with 2006 IPCC software creation process
- The software is simple to use
- It is able to produce different reporting tables as per requirement
- It helps capturing missing sources for emission reporting
- It has helped synchronization of activity data across sectors
  - Energy and Non-energy from Iron & Steel sector
  - Biomass consumption for energy (CH_4 & N_2O) and its reporting in AFOLU sector
  - Energy from waste sector
- Checking time series consistency of data across years has become easier
- It fits in the proposed National plans of National Inventory Management System (NIMS)

2006 IPCC Software

- Allows flexibility of CO_2 equivalent numbers i.e. given scenarios and user defined
- Allows region selection and incorporation of country specific numbers
- Selection of base year and addition of new years available to see constancy of values
- Provides with proper structure for detailed estimation of sectoral emissions
- It captures TACCC
  - Transparency: creates database with data checks at different levels
  - Completeness: by checking if all the sources are covered
  - Consistency: helps revise the older emission number for latest methodology and guidelines
- Helps analyze uncertainty % in AD and EF at different sectors and gas levels from base year to current
- This aids in QA of existing database

CO_2 Emission Estimation, 2005

Source categories	1996 guidelines	2006 guidelines*
Power	638	603
Industry	**334**	**384**
Cement	98	43
Iron & Steel	103	96
Fertilizer	24	22
Other Industries	109	223
Transport	**155**	**111**
Road	143	93
Railway	6	6
Aviation	5	10
Shipping	1	2
Residential	-	56
Industrial Processes	-	179
Other Sectors	102	146
TOTAL	**1229**	**1478**

* Recalculated numbers using software, also some revised EF and updated AD

CH$_4$ Emission Estimation with t...

Source categ...

	1996 Meth	20.. Me
All Energy*	2.9.	3.9
Biomass	1.67	2.8.
Coal mining		0.38
Oil...	0.64	0.7.
A...	14.67	12.
F...	0.181	0.10
E...	9.42	7.26
M...	0.99	0.92
R...		4.01
W...	1.20	2.2.
S...	0.75	1.82
Was...		0.42
TO...	.8.85	18.41	2..0. 2..31

* S... ...ated, but found miniscule and thus not reported here.

Detailed plant type estimation made based on the organic content in the plant

EF numbers refined at process level like Flaring (offshore / onshore), venting etc

EFs obtained from actual measurements (NATCOM) used.

- Average MSW generation number obtained from latest CPCB report
- EF estimated based on India specific secondary literature
- Used actual wastewater generation and methane emission numbers for some sampled Indian industries of different products, covering 60% of the industrial sources
- Used wastewater generated data from Class II cities of India

- Average MSW generation number obtained from latest CPCB report
- MSW disposal distributed as Landfill / Composting / No treatment from India specific studies
- Emission factor estimated based on DOC, DOCf, Methane-Carbon ratio, etc characteristics of waste

Source Ca... | ... | **Source Category** | **2006 guidelines**

Inclusion of some new

New EF
(0.0065 kg N$_2$O–N per kg synthetic fertilizer applied

New Methodology: full sectoral coverage of indirect N$_2$O emissions

Changed activity data for 2005 (actual numbers available now against estimates in previous inventory)

Synthetic f...
Field burn... agriculture ...
Indirect soi...
Manure man...

Source Category	2006 guidelines
...t N$_2$O emissions	159
...Synthetic fertilizer use*	131
...m crop residue left*	17
...ic N applied to the soil*	12
...ect N$_2$O emissions	34
Field burning of agriculture residue	8
Biomass burning	26
Coal consumption	13
Petroleum fuels consumption	3
Gas consumption	0.09
Industrial processes	9
Waste	14
Total N$_2$O Emissions	267

Methodology for CH$_4$ (2006 IPCC Guidelines)

Emission source	Methodology (2006 IPCC)	Remarks
Enteric fermentation Manure management	Vol. 4, Ch. 10	Tier 2 methodology; use of country specific EFs for livestock
Rice cultivation	Vol. 4, Ch. 5	India specific measured EF and cultivation period used
Biomass burning (off-site)	Vol. 2, Ch. 2	
Coal mining and handling	Vol. 2, Ch. 4	India specific seam level data was available
Oil and natural gas systems	Vol. 2, Ch. 4	Actual crude consumption data used for activity data and refined EF
Agriculture crop residue burning (on-site)	Vol. 4, Ch. 2	Some measured activity data was extrapolated for country level with consultation with experts
Municipal solid waste	Vol. 5, Ch. 3	Industry specific activity data and measured EFs are used
Wastewater disposal		
Domestic wastewater	Vol. 5, Ch. 6	
Industrial wastewater	Vol. 5, Ch. 3	

Methodology for N$_2$O (2006 IPCC Guidelines)

| Emission source	IPCC 2006 Methodology	Tier	Equation no.
Direct N$_2$O emissions	Vol. 4 (AFOLU), Ch. 11	2	11.1
Synthetic fertilizer used	Vol. 4 (AFOLU), Ch. 11	2	11.2
Organic nitrogen applied to the soil	Vol. 4 (AFOLU), Ch. 10, 11	2	11.2 to 11.4, 10.34
Nitrogen from crop residue left	Vol. 4 (AFOLU), Ch. 11	2	11.6
Indirect N$_2$O emission	Vol. 4 (AFOLU), Ch. 11	2	11.9, 11.10
Agriculture residue burning (onsite)	Vol. 4 (AFOLU), Ch. 2, 11	2	2.27
Biomass burning (offsite)	Vol. 2 (ENERGY), Ch. 2	1	2.1
Fossil fuel combustion	Vol. 2 (ENERGY), Ch. 2	1, 2/3*	2.1
Industrial processes	Vol. 3 (IPPU), Ch. 3	2, 3	3.5
Waste management	Vol. 5 (WASTE), Ch. 4, 6	1, 2	4.2, 6.7, 6.8

*Transport and residential at tier 1 level, while industry and power estimations at tier 2/3 levels
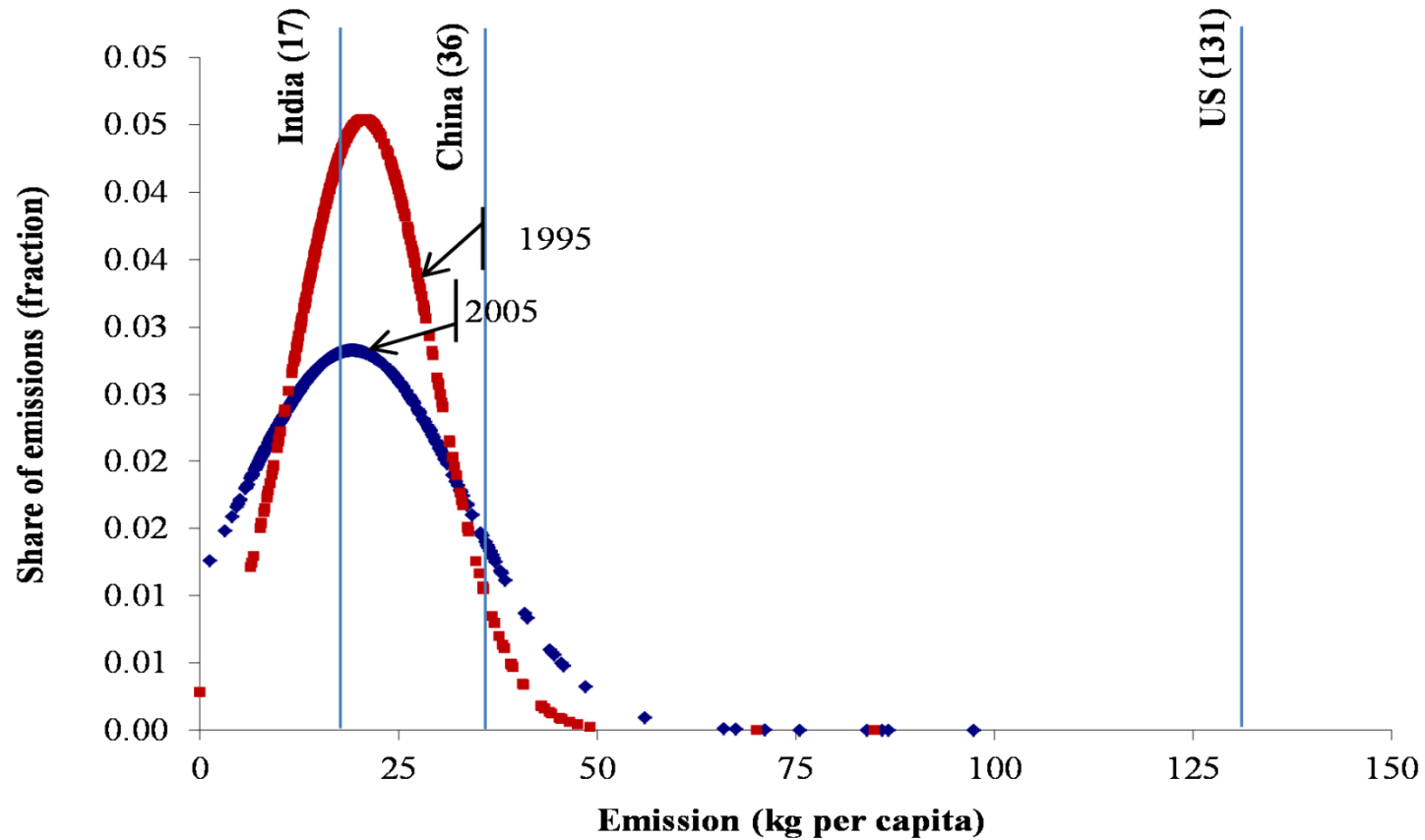
N$_2$O Emission Distribution

Per capita N$_2$O emission distributions of India during 1990, 1995 and 2005 as compared to some other countries in 2005
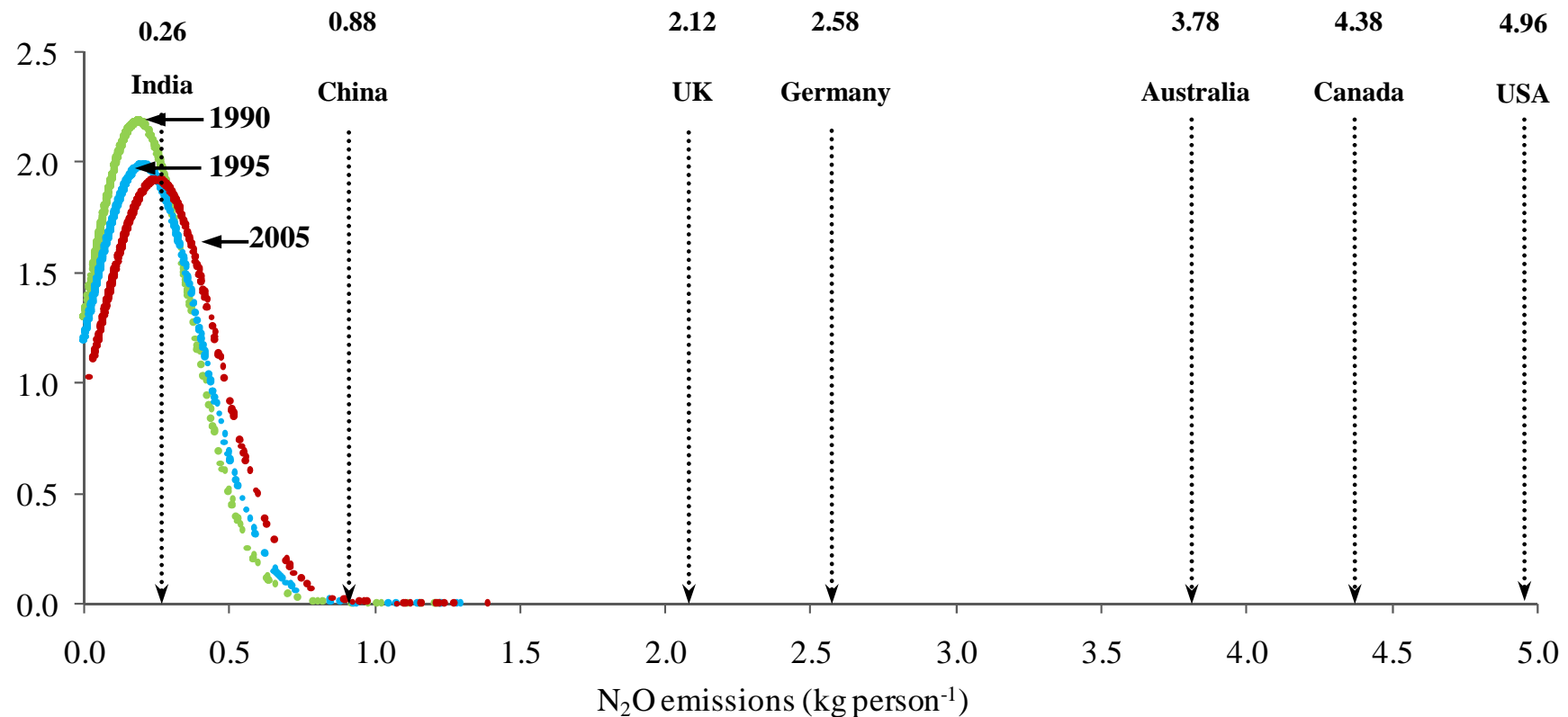
- Indian N$_2$O emissions are 0.26 kg capita, which increased annually by 1.5% over 1995–2005

My Wish List

- Provide focused training in IPCC 2006 software
- Common inventory softwares for IPCC 2006 and UNFCCC tools
- If not possible, then at least allow seamless data portability
- More clarity on database creation and management, especially for
  - time series creation,
  - linking tier 3 data (e.g. large point sources) with national totals,
  - linking tier 3 modeling (e.g. transport sector)
- To fit into proposed National Systems for parties willing to adopt IPCC-2006 software, e.g. Indian plans of National Inventory Management System (NIMS)
- Linking GHG inventory software and NAMA (Policies and Measures) modeling

Thanks