GHG emission from China croplands

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Introduction

- Signatory states to the United Nations framework on Climate Change (UNFCC) are required to produce annual national inventory

- As a Party though not included in Annex I to UNFCCC, China pays great attention to global climate change
  * China agrees to the principles of UNFCCC and taking into account the “common but differentiated responsibility”
  * China has submitted its Initial National Communication (including China GHG inventory in 1994) to UNFCCC in December 2004, which was funded by the Global Environmental Facility (GEF)
  * In 2012, China will submit its Second National Communication (including China GHG inventory in 2005) to UNFCCC.
GHG: CO₂, CH₄, N₂O, etc.

Agriculture is a major source of CH₄ and N₂O emissions in China in 1994:

- Paddy fields accounted for 17.93% of CH₄ source, equal to 6147 Gg CH₄.
- Cropland accounted for 74.22% of N₂O source, equal to 628 Gg N₂O.
GHG emission from China Cropland in 1994

- Paddy field
  - CH$_4$
  - CH4MOD model (Tier 3)
  - Local emission factor (Tier 2)

- Non-rice season of YWLR (Paddy field with Year-round Water Logged)

Cropland

- N$_2$O
  - Direct emission
  - IAP-N 模型 (Tier 2)
  - Indirect emission

Vegetable fields yearly non-vegetable dryland,
Paddy fields (single rice, double rice)/fellow/year round flooding/upland crop
Grazing (manure system)

- From N-deposition
- From N-leaching/runoff

(Excluding Taiwan, Hong Kong and Macau)
CH₄ emission from paddy field

- **method** (Tier 3, IPCC, 2006)

\[ \text{CH}_4 \text{ emission} = \sum (\text{Area} \times \text{EF}) \]

- Different rice harvest area
- Corresponding CH₄ emissions factor
- CH4MOD
CH4 emissions factor of different paddy fields:

\[
g \text{g CH4/m}^2
\]

(Huang et al., 2004; Zhang et al., 2011)

- Single/double Rice harvest area and production;
- Nitrogen fertilizer;
- Residues returning and manure application;
- Climate data (T, P, daily);
- Time of rice transplanting and harvest;
- Soil data;
- Resolution: 10km × 10km
CH$_4$ Emission Factors
EF (g CH$_4$ / m$^2$ / season)

a. double-harvest early rice
b. double-harvest late rice
c. single-harvest rice
Contribution of CH$_4$ emission from China paddy fields (kgCH$_4$/yr)
N$_2$O emission = $\sum N_{\text{input}} \times EF$

- **Method** (Tier 2)
- IAP-N
- Nitrogen input caused to direct / indirect N$_2$O emissions
- Corresponding N$_2$O emissions factor
- Field observation / IPCC
According to the character of climate belt and crop planting regime in China

- **Cropland categories:**

<table>
<thead>
<tr>
<th>Region</th>
<th>Crop regime</th>
<th>Major category of cropland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regions of I, II, III</td>
<td>single crop / year</td>
<td>Upland vegetables&lt;br&gt;Year-round upland crops excluding vegetables&lt;br&gt;Single paddy rice + Fallow (dry)</td>
</tr>
<tr>
<td>Region IV</td>
<td>double crops / year</td>
<td>Upland vegetables&lt;br&gt;Year-round upland crops excluding vegetables&lt;br&gt;Single paddy rice + Fallow (dry)&lt;br&gt;(single/double)paddy+ winter-flooding&lt;br&gt;Single rice -upland crop rotation&lt;br&gt;Double paddy rice + Fallow (dry) or green manure</td>
</tr>
<tr>
<td>Region V</td>
<td>double/three crops / year</td>
<td>Upland vegetables&lt;br&gt;Year-round upland crops excluding vegetables&lt;br&gt;Single rice -upland crop rotation&lt;br&gt;Double rice–upland crop rotation</td>
</tr>
<tr>
<td>Region VI</td>
<td>double crops / year</td>
<td>Upland vegetables&lt;br&gt;Year-round upland crops excluding vegetables&lt;br&gt;Single rice -upland crop rotation&lt;br&gt;single paddy+ winter-flooding</td>
</tr>
</tbody>
</table>
✓ EF (N₂O, NH₃, NOₓ, N₂)
✓ Parameters of crops
✓ parameters of livestock

Direct EF: Field observation
Indirect EF: IPCC

- N_input of different fields
- N-Gases emission of different fields

- Nireogen fertilizer
- harvest area and production of crops
- population of livestock and rural people
- area of administration
- arable land

(Zheng et al., 2002, 2008)
Different fields covering 13 provinces/city

Including Beijing, Hebei, Henan, Shandong, Liaoning, Heilongjiang, Jiangsu, Zhejiang, Jiangxi, Hunan, Sichuan, Guizhou and Guangdong
N$_2$O Emission Factors \textbf{EF} (kgN$_2$O-N/kgN$_{in}$) in 1994 inventory

(Zheng et al., 2004)
Contribution of N$_2$O emission from China cropland in 1994 (GgN/yr)
A correction equation $Y_1 = 0.561 \times X^{1.124}$ was built to correct the error caused by $\text{N}_2\text{O}$ analysis method, where $Y_1$ means corrected $\text{N}_2\text{O}$ emission for season or year, and $X$ means the observation value of $\text{N}_2\text{O}$ emission by analysis method with $\text{N}_2$ acting as carrying gas.

And then another flux correction equation $E_{\text{NL}} = 1.14 \times E_{\text{L}}$ was built to correct the system error caused by flux calculation, where $E_{\text{NL}}$ means $\text{N}_2\text{O}$ flux value by the nonlinear flux calculation, and $E_{\text{L}}$ means $\text{N}_2\text{O}$ flux value by the linear flux calculation.
2) Area of yearly winter-flooding rice field

- Due to high water table, the paddy field is flooded all year around
- High CH$_4$ emission intensity
- No statistic data for this type of paddy field

- Cooperating with local institute and local meteorology department, we get the main YWLR distribution data in Jiangxi province and Sichuan province
- Looking up for literatures
3) Residues returning data

- No statistic data
- Need to do a large survey work and a large funding

4) Manure application

- No statistic data
- Survey work is very very difficult because the weight and nitrogen concentration of manure is various in different region

\[ N\text{\_Manure} = N\text{\_animal} - N\text{\_grazing} - N\text{\_fuel} - N\text{\_volatilization} - N\text{\_N2O} \text{ mms} \]
Thank you for your attention.