Adaptation and Mitigation Options in Cropping System of China

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I. Climate change in China
II. Impact on agriculture and adaptation options
III. GHG emissions in China
IV. Monitoring and mitigation options
V. Expectation on future cooperation
- Human-induced warming reached about 1°C above pre-industrial levels in 2017
- Global temperatures would reach 1.5°C around 2040
- Staying under 1.5°C/2.0°C requires cutting CO2 in half by 2030 and reaching net zero by 2050/20% by 2030 and reaching net zero by 2075.

Source: IPCC, 2019
China’s annual mean surface air T has increased by 1.15°C with an increasing rate of 0.10°C/10a

Between 1951-2016, the increasing rate in average air T has reached 0.23°C/10a

Variation in decadal mean surface air temperature trends during 1961-2016

Regional differences in climate warming

Most obvious in NE China, the northern North China, NW China and the Tibetan Plateau

Source: China TNC, 2019
Climate change in China

- Change in precipitation has varied by regions during 1961-2016
- Significant increase in NW, slight increase in eastern Tibetan Plateau and SE
- Obvious decreases in NC, southern NE and SW

- Daily sunshine hours and solar radiation have significantly decreased during 1961-2016, particularly in North China and the middle and lower reaches of Yangtze River mainly due to pollutants

Source: China TNC, 2019
Annual mean air T increase will be 0.26°C/10a and 0.61°C/10a during 2011-2100, under RCP 4.5 and RCP 8.5, respectively,

Annual mean air T might increase by 2.6°C under RCP4.5, 5.0°C under RCP 8.5

The increase rate of projected increase grows larger from the southeast to the northwest, and is larger in the north than in the south

Source: China TNC, 2019
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Climate change impacts on agriculture

- There have been significant changes in China’s agricultural climate resources
  - Average T during the growing periods for wheat, maize and rice increased by 1.1°C, 0.8°C and 0.8°C during 1960s to 2000s
  - Sunshine hours decreased by 84, 97 and 116 hours
  - The northern limits of double cropping and triple cropping systems significantly shifted northwards
  - The northern limits of winter wheat and double rice shifted northward

Changes in the northern boundaries of winter wheat and double rice during 1950s-1980 to 1981-2007

Adapted from China TNC, 2019
Harm caused by disease pests has been increasing, prevention and control have become more difficult.

- Warming has increased the annual number of reproductive generations of major insects, diseases and insect pests northward and upwards into higher elevation areas.

- During 1961-2010, the area affected by crop diseases increased from 15 million ha to 124 million ha, the area affected by insect pests increased from 43 million ha to 246 million ha.
Climate change impacts on agriculture

Yield change due to the warming during 1961-2010

Vulnerable area of crop production

Adapted from China TNC, 2019

Xiong et al., 2008
Black soil region
Higher warming rate
Grain production 22% of national total
The largest commercial grain supply base
Future climate change impact on crop yield

- a and c: $\Delta T = 1.5^\circ C$
- b and d: $\Delta T = 2.0^\circ C$
- a and b: Without CO$_2$ fertilization effect
- c and d: With CO$_2$ fertilization effect

Tao et al., 2018
Adaption: Exploiting the positive effects

- Wheat production: adjusting sowing date, dense planting, and improving grain filling;
- Rice production: adjusting cropping regions, dense planting, non-flooded irrigation, superior rice cultivar application;
- Corn production: adjusting sowing date, dense planting, and mulching with plastic film
- Breeding improvement with longer growing days, resistant with high temperature, pest and disease.....
Reduce water evaporation
Reduction of evaporation and Rain collection

Ditch sowing, mulched with plastic film and rain collection
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### GHG Emissions in China

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<tbody>
<tr>
<td>Total GHG emission without LULUCF (Pg CO₂e)</td>
<td>4.06</td>
<td>8.02</td>
<td>10.54</td>
<td>11.90</td>
<td>12.30</td>
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<tr>
<td>Emission from agriculture sector (Pg CO₂e)</td>
<td>0.61</td>
<td>0.79</td>
<td>0.83</td>
<td>0.94</td>
<td>0.83</td>
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<tr>
<td>Contribution of Agriculture (%)</td>
<td>15.0</td>
<td>9.9</td>
<td>7.9</td>
<td>8.0</td>
<td>6.7</td>
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**Diagram 1:**
- **Rice cultivation:** 77.7%
- **Agri. Soil:** 14.0%
- **Enteric:** 6.7%
- **Manure manage.:** 1.0%
- **Biomass burning:** 1.0%

**Diagram 2:**
- CH₄:
  - Rice cultivation: 59%
  - Manure management: 19%
  - Enteric fermentation: 15%
  - Others: 6%

- N₂O:
  - Cropland: 29%
  - Manure management: 12%
  - Others: 59%
### Emissions and sequestration in AFOLU

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<tbody>
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<td><strong>Agriculture</strong></td>
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<tr>
<td>Rice cultivation</td>
<td>605</td>
<td>788</td>
<td>828</td>
<td>938</td>
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<td>Agriculture soil</td>
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<tr>
<td>Enteric fermentation</td>
<td>207</td>
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<tr>
<td>Manure management</td>
<td>138</td>
<td></td>
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<tr>
<td><strong>Forest</strong></td>
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<tr>
<td>Forest</td>
<td>-407</td>
<td>-766</td>
<td>-598</td>
<td>-840</td>
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<td>HWP</td>
<td>-</td>
<td>-</td>
<td>-993</td>
<td>-</td>
<td>-111</td>
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<tr>
<td><strong>Other land</strong></td>
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<tr>
<td>Cropland</td>
<td>-</td>
<td>-</td>
<td>-993</td>
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<td>-49</td>
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<tr>
<td>Grassland</td>
<td>-</td>
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<td>-109</td>
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<tr>
<td>Wetland</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-9</td>
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<tr>
<td><strong>AFOLU (million t CO₂eq)</strong></td>
<td>198</td>
<td>22</td>
<td>-175</td>
<td>331</td>
<td>-298</td>
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Measurement of GHG emissions
Mitigation options - Nutrient management

- Reduced application amount of N fertilizer
- Selection of chemical fertilizer type and deep application
Mitigation options - Water management

Under continuously flooded rice paddies

- Mineral fertilizer (90)
- Straw incorporation (44)
- Fresh organic fertilizer (42)
- Compost organic fertilizer (16)
- Control release fertilizer (3)
- No fertilizer (13)

Under intermittent irrigation

- Mineral fertilizer (318)
- Straw incorporation (166)
- Fresh organic fertilizer (7)
- Compost organic fertilizer (29)
- No fertilizer (74)
- Control release fertilizer + inhibitor (29)
- Mineral fertilizer + inhibitor (40)
- Biochar (40)
Mitigation options - Nutrient management

- Under the intermittent irrigation conditions, control release fertilizer and inhibitors can reduce N$_2$O emissions from rice paddies by 40%-50%

- Compost of straw and application of biochar can reduce N$_2$O emissions compared with straw incorporation
Integrated crop-livestock system

五大小龙虾生产省

2018年全国小龙虾产量163.8万吨

THE OTHERS 94
Jiangxi 110
Jiangsu 167
Anhui 218
Hunan 288
Hubei 812
SOC management

◆ Conservation farming, Application of organic fertilizer, Crop straw incorporation
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To promote the implementation of PA

- Capacity building on inventory compilation using IPCC 2006
- Modelling of effect of PMs on GHG emission reduction and carbon sequestration
- Projection the contributions of NBS to address climate change
- Assessment of the progress on adaptation
Thank you for your attention