Economic implications of climate change on human health through undernourishment

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Our earlier studies

Socio-economic conditions

Climate change

Mitigation

Hasegawa et al., 2014, EST

Adaptation

Hasegawa et al., 2015, EST

Undernourishment/
Population at risk of hunger

Health impacts through undernutrition

Economic impacts/implications

Now we are here!

Hasegawa et al., under review
Future hunger risk in this century

Population at risk of hunger [million]

- SSP1
- SSP2
- SSP3
- SSP4
- SSP5

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Hasegawa et al., under review
Consequences of mitigation on undernourishment
Health burden due to childhood undernutrition

Ishida et al. 2014
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Hasegawa et al., 2015, EST

Undernourishment/
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Hasegawa et al.,
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Hasegawa et al., 2015, ERL

Ishida et al., 2014

Ishida et al., 2014
Research question

“How large is climate change impact on human health through undernourishment?”

- Economic impacts of decreases in labor force and population, and additional healthcare cost
- Value of lives lost.

Climate change

- Extreme heat
- Change in vector habitat

Agriculture & Food

- Crop production
- Undernourishment
- Child underweight

Human health

- Death and disease
- Labor force productivity
- Medical services

Economic impact

- Death and disease
- Medical service
- Labor force

Economic impact/implications

<Role of this study>
Disability-Adjusted Life Years (DALY)

- DALY is years of "healthy" life lost weighted by disability and mortality (Murray 1996).
- DALYs have been used by WHO as a measurement of disease burden.
- DALY have information of risk factor and disease or disability
- E.g.: risk factor → disease or disability
  - childhood underweight → malaria
  - tobacco → lung cancer
Childhood underweight is the highest risk factor of disability in low income regions.
Major causes of death in children under 5 years old
(Shaded area: contribution of undernutrition to each cause of death)

- Pneumonia 17%
- Diarrhoea 17%
- Measles 4%
- Malaria 7%
- Other infections 12%
- Nutritional deficiencies 2%
- Severe neonatal infections 11%
- Prematurity 11%
- Birth asphyxia and trauma 8%
- Injuries 4%

Shaded area indicates contribution of undernutrition to each cause of death

Source: WHO

Source: WHO 2009
Modeling framework

**Added variables**
- Population at risk of hunger
- DALY
- Medical expenditure
- Mortality
- Value of life lost

**Two feedback**
- 1) Mortality fed back to population and labor force
- 2) Medical cost fed back to household expenditure
DALY model

- Ishida et al. (2014)

\[
\log \left( \frac{DALY_{t,c,d}}{POP_{t,c}} \right) = \varphi_d + \psi_d \cdot \log (Y_{t,c})
\]

- \(t\): year, \(c\): country, \(d\): disease;
- \(DALY_{t,c,d}\): DALY due to disease \(d\) (year)
- \(POP_{t,c}\): population
- \(Y_{t,c}\): Proportion of children stunted.
Economic value of Life lost as a result of Disability

• **Value of Statistical Life (VSL):** an evaluation based on the WTP to avoid the risk of death.

• Approach developed by OECD (2012), where the VSL is derived using an income adjustment.

• The value of the health risk observed in China, 2005 was applied to other mid- or low- income regions.
Scenario settings

• 3 climate conditions: RCP2.6, RCP8.5, No climate change
• 2 socioeconomic conditions: SSP2, SSP3
• Year: 2005-2100

Uncertainty
• 4 crop models
• 5 climate models
• 3 climate conditions

<table>
<thead>
<tr>
<th>Climate conditions</th>
<th>SSP2</th>
<th>SSP3</th>
</tr>
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<tbody>
<tr>
<td>No change</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
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<td>X</td>
</tr>
<tr>
<td>RCP2.6</td>
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