Greenhouse Gas Emissions and Reduction Potentials by Agriculture Activity

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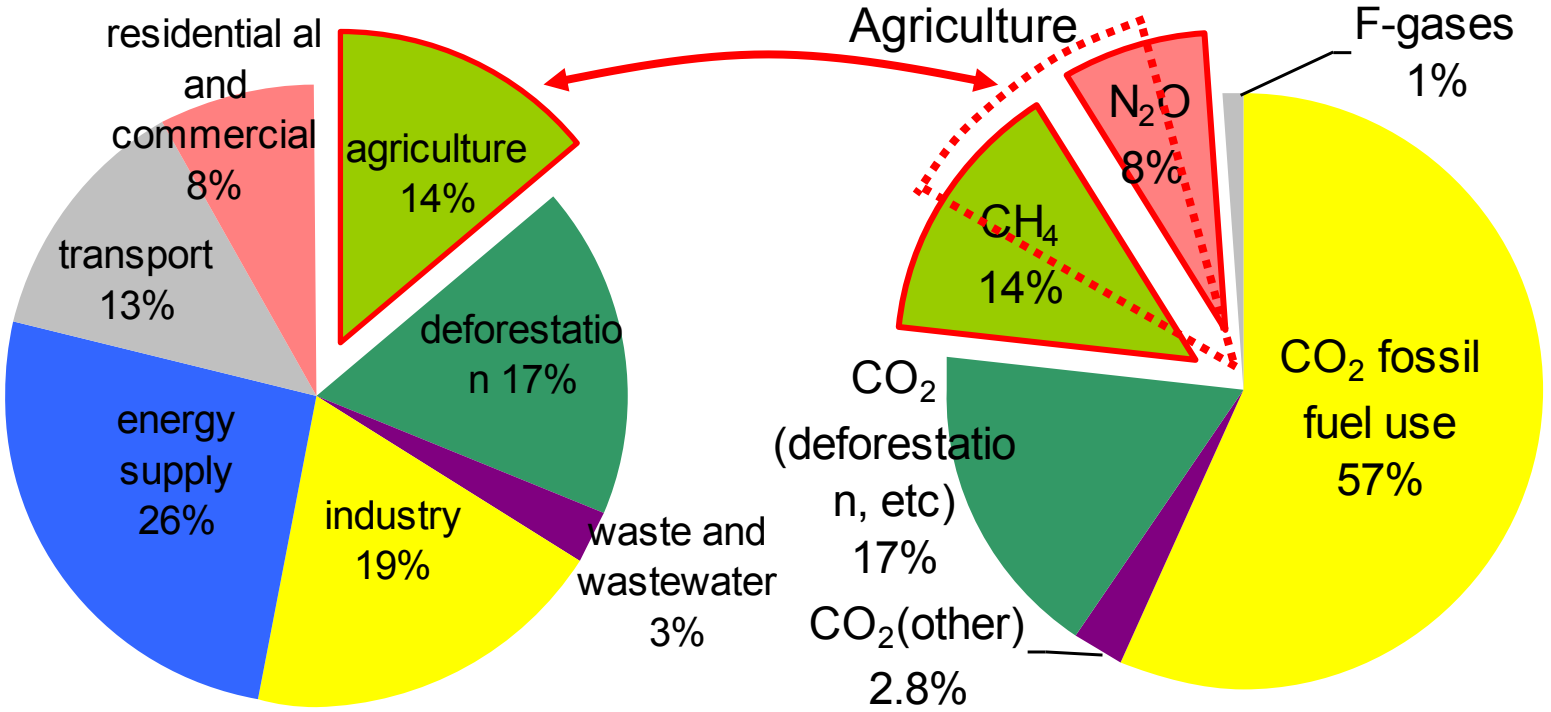
Outline

- Background
- Objectives
- Methodology
  - Agricultural model
  - Data and assumptions
- Results
  - Future food production
  - Marginal abatement cost carve

Contribution Ratio to Global Warming

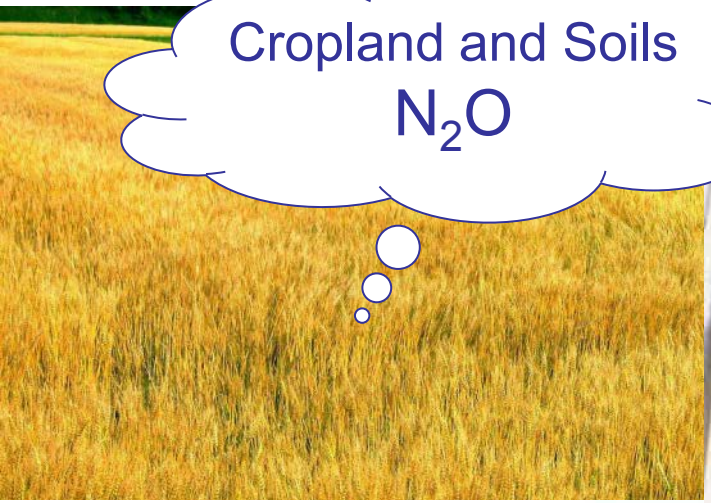
- Agriculture accounts for ...
  - 14% of total GHG emission.
  - 50% of total CH_4, and 60% of total N_2O in 2005 (IPCC, 2007).
- GHG reduction measures in agriculture
  - Higher economic efficiency
  - Expected to play an important role



contribution ratio by sector

contribution ratio by gas

GHG emission sources in agriculture



Cropland and Soils
N_2O

Livestock enteric fermentation
CH_4

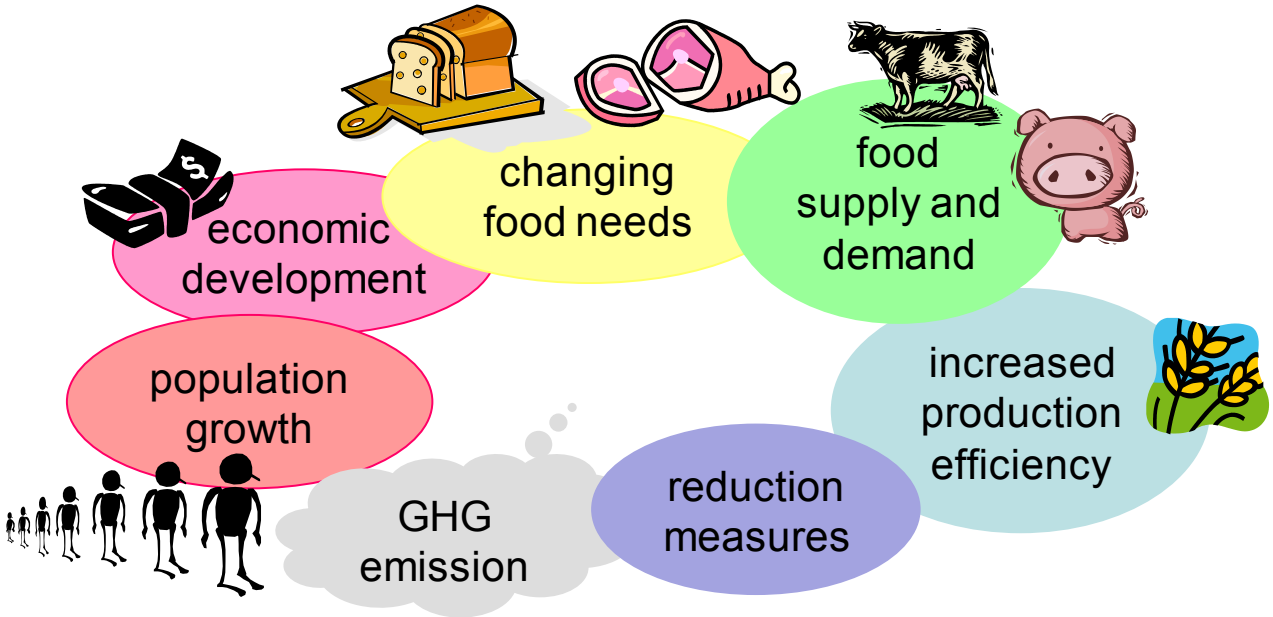
Rice paddy
CH_4

Livestock manure management
CH_4/N_2O

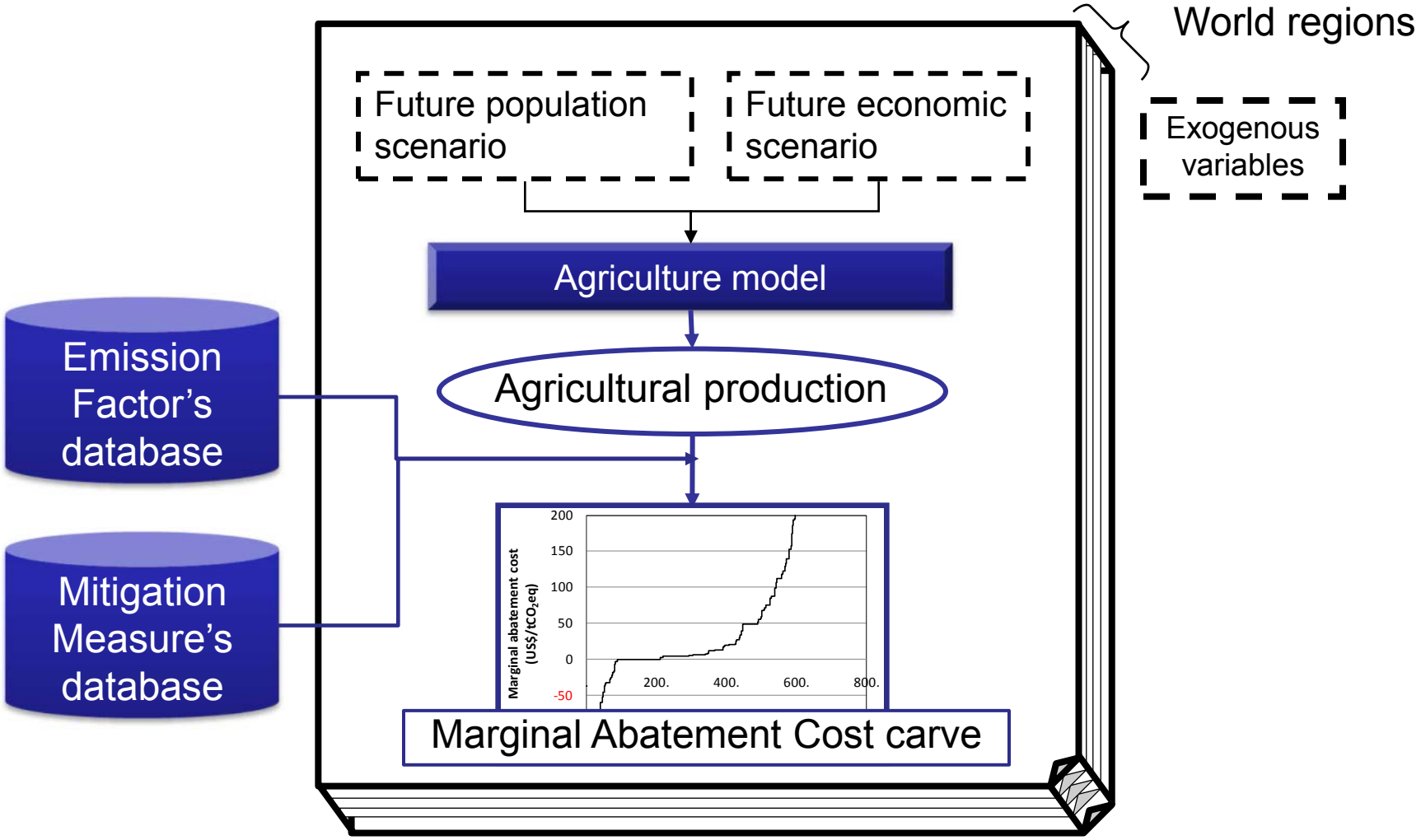
Today's topics

(1) Estimation and evaluation of GHG emissions and reduction potentials in agriculture in 2030
(2) Specification of effective measures, countries/regions and emission sources with high reduction potentials

To evaluate GHG emissions and reduction potentials, we need to integrate the related phenomenon such as…



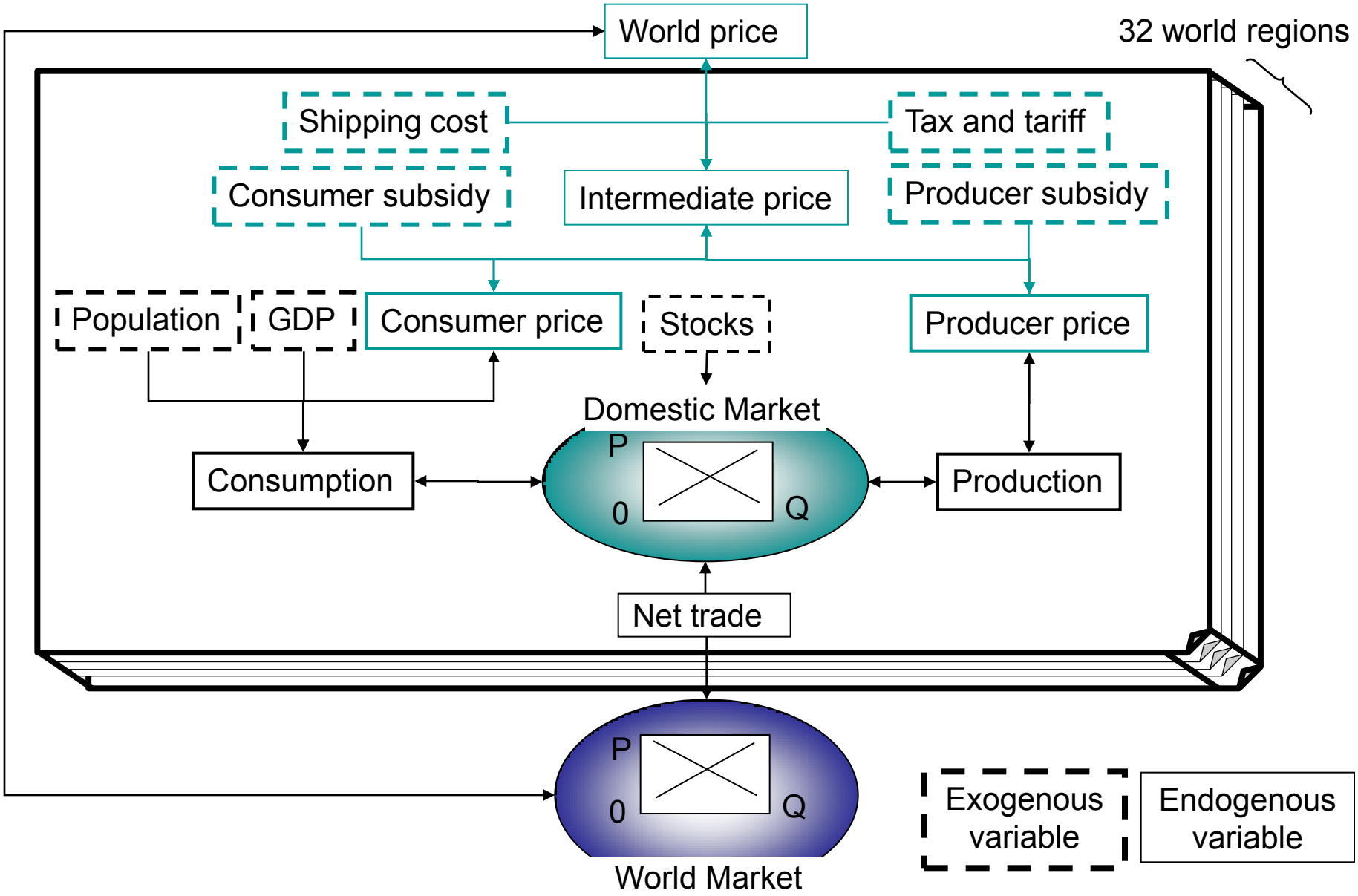
Methodology



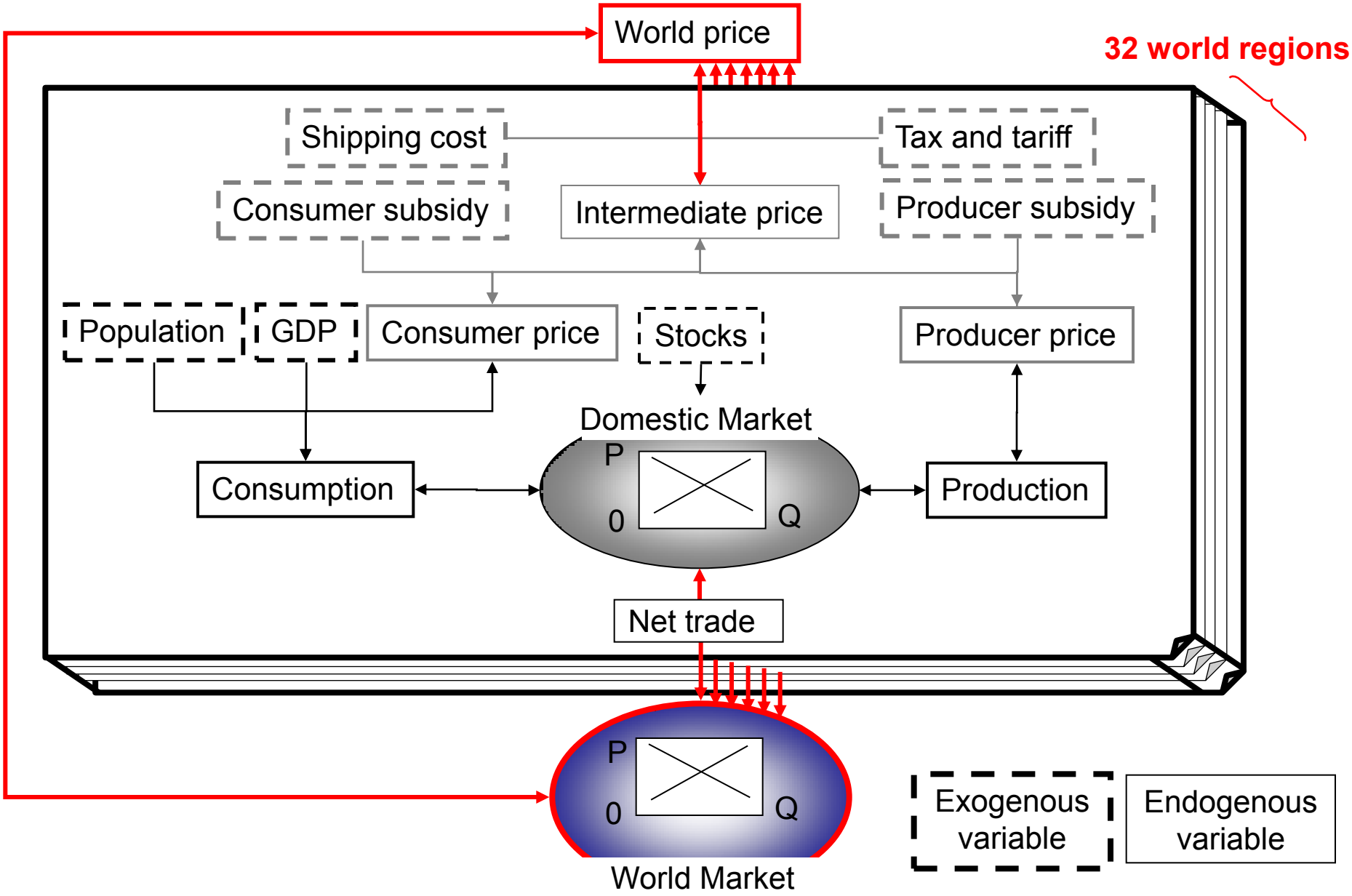
Agricultural model

- Structure: partial equilibrium model
- Input: population and GDP
- Output: agricultural production
- Commodities: 34 commodities
- Region: 32 world regions
- Parameters: based on other literatures
- Estimation term: 2000 – 2030
- Data:
  - Population: UN (2006)
  - GDP: Akashi (2009)
  - Base year's data: FAOSTAT (2007)

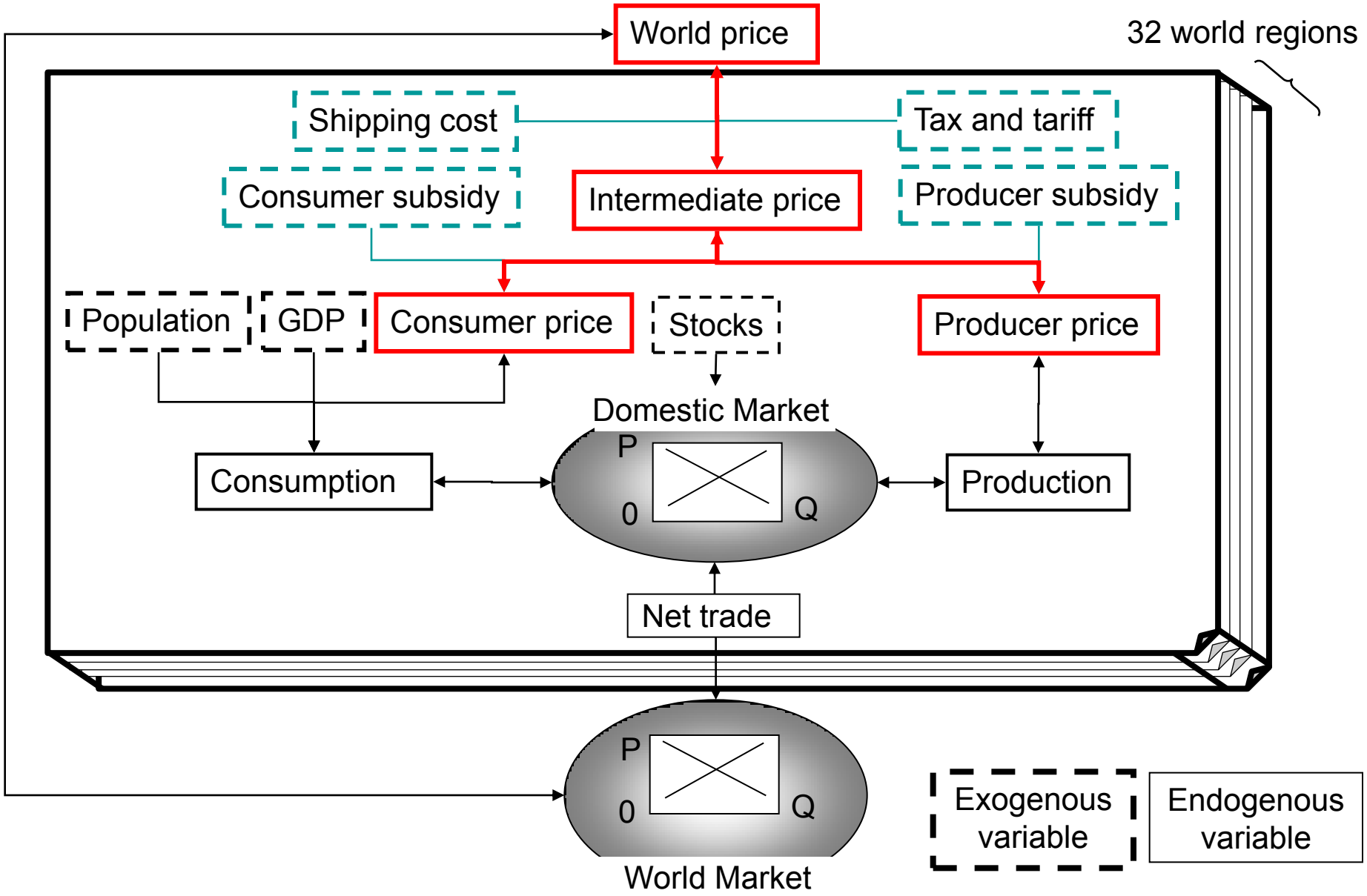
Agricultural model's structure



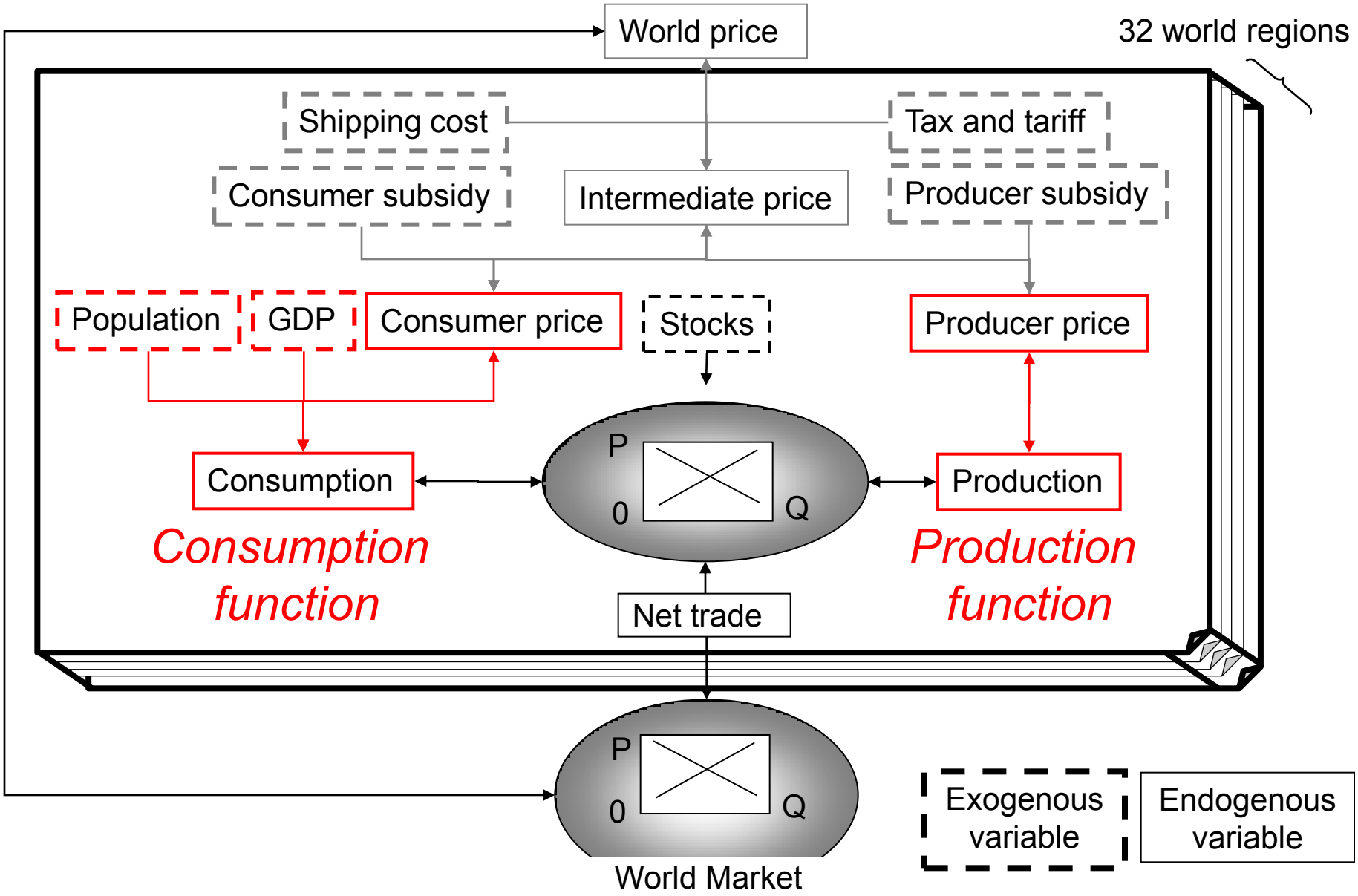
Agricultural model's structure



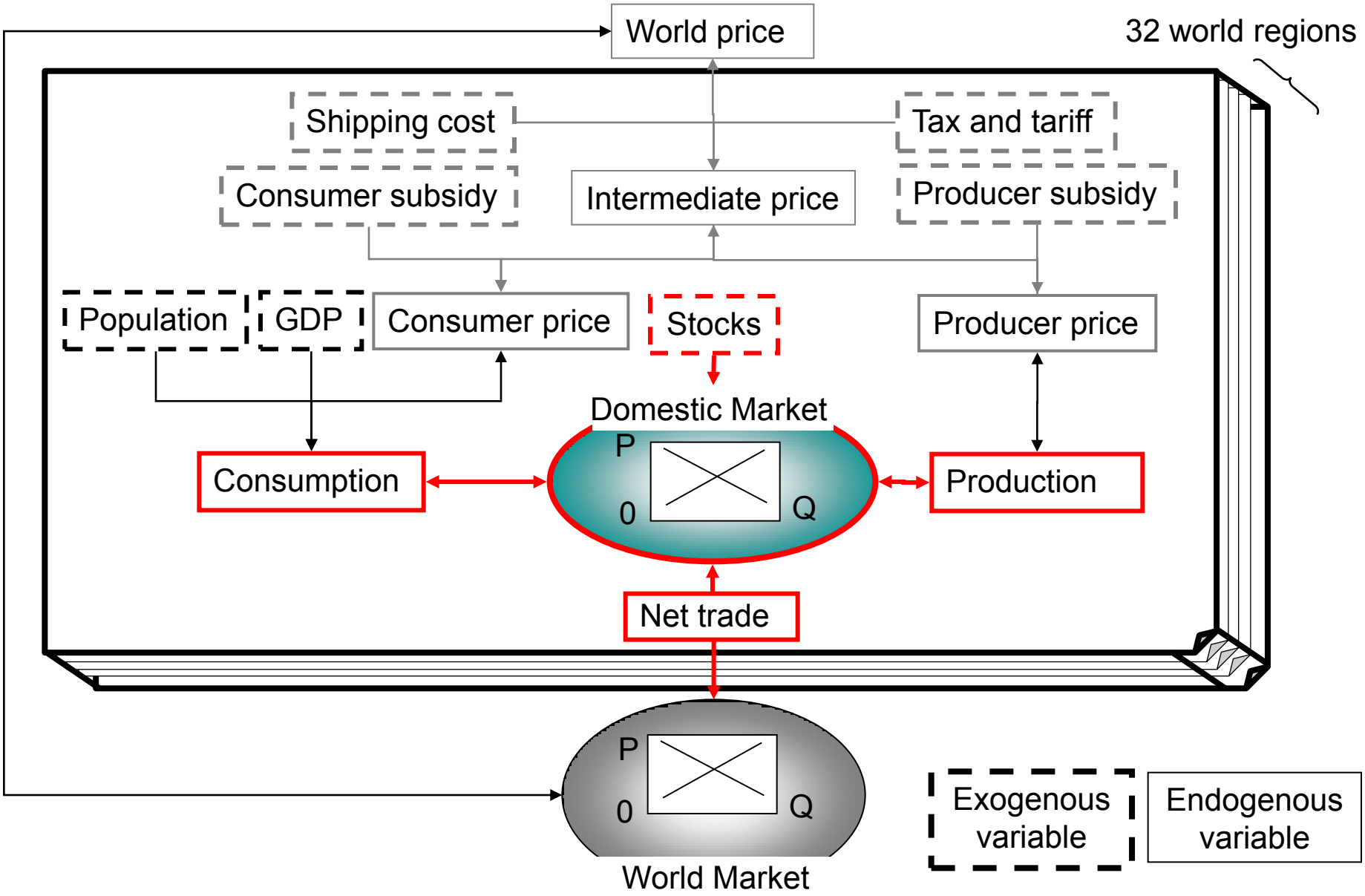
Agricultural model's structure



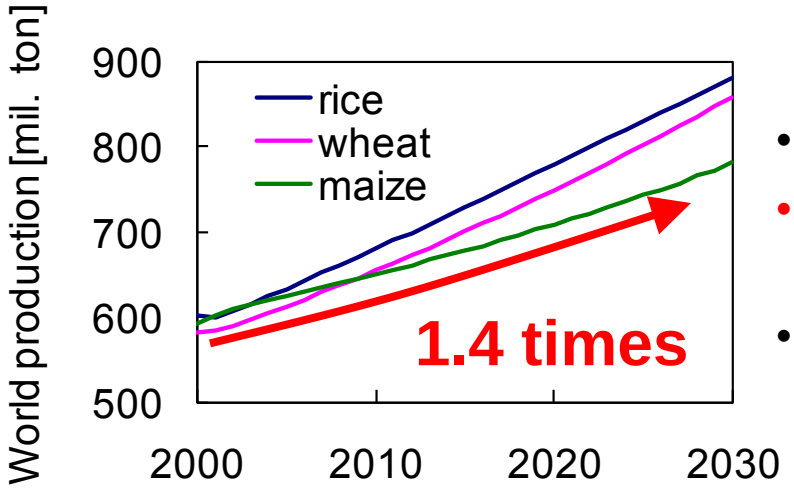
Agricultural model's structure



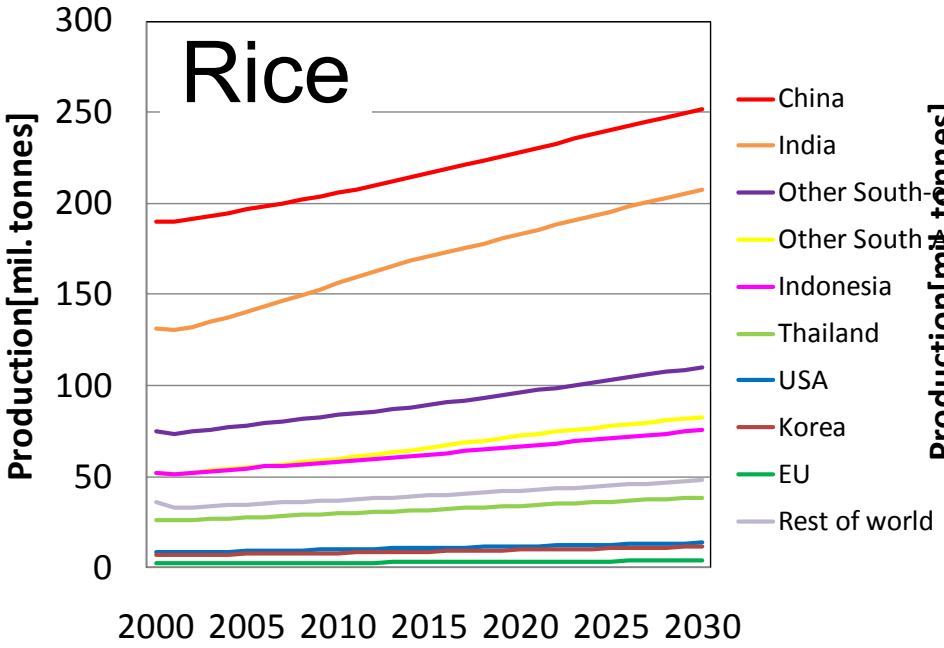
Agricultural model's structure

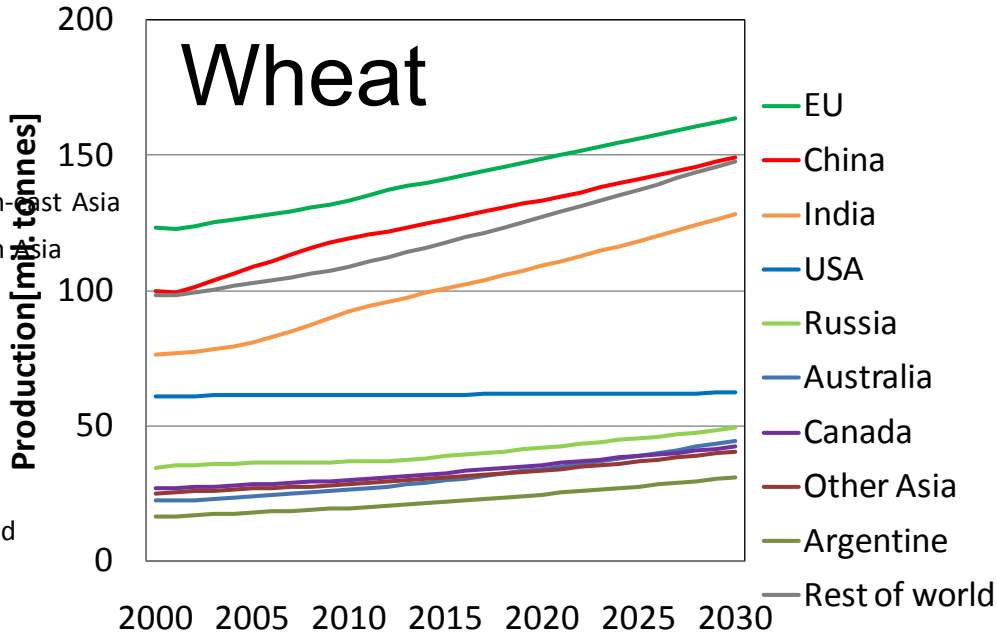


World Cereal Production

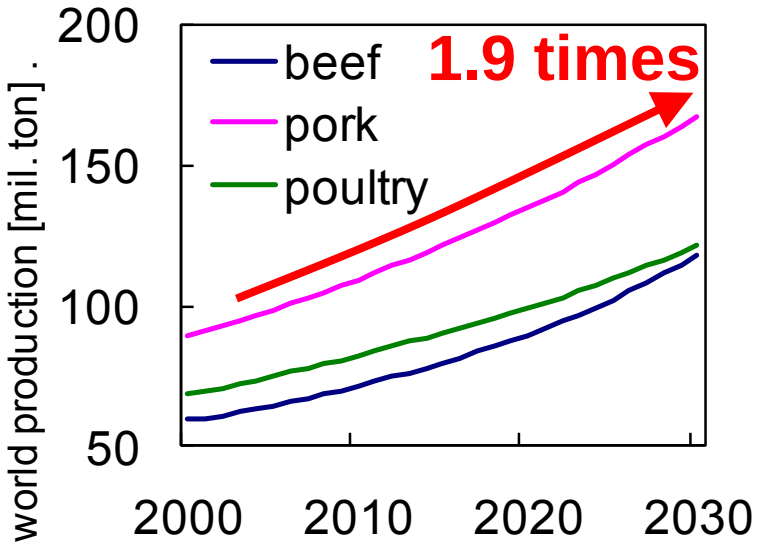


- increase by 1.4 times from 2000 to 2030.
- Wheat production will increase at high growth rate
- increases rapidly in Asia.





World Meat Production

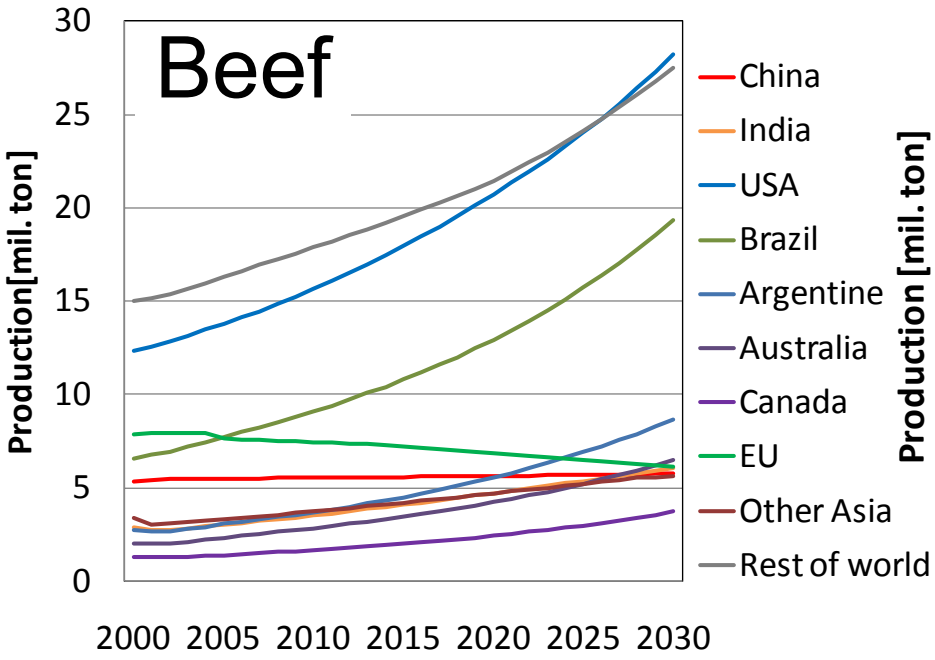


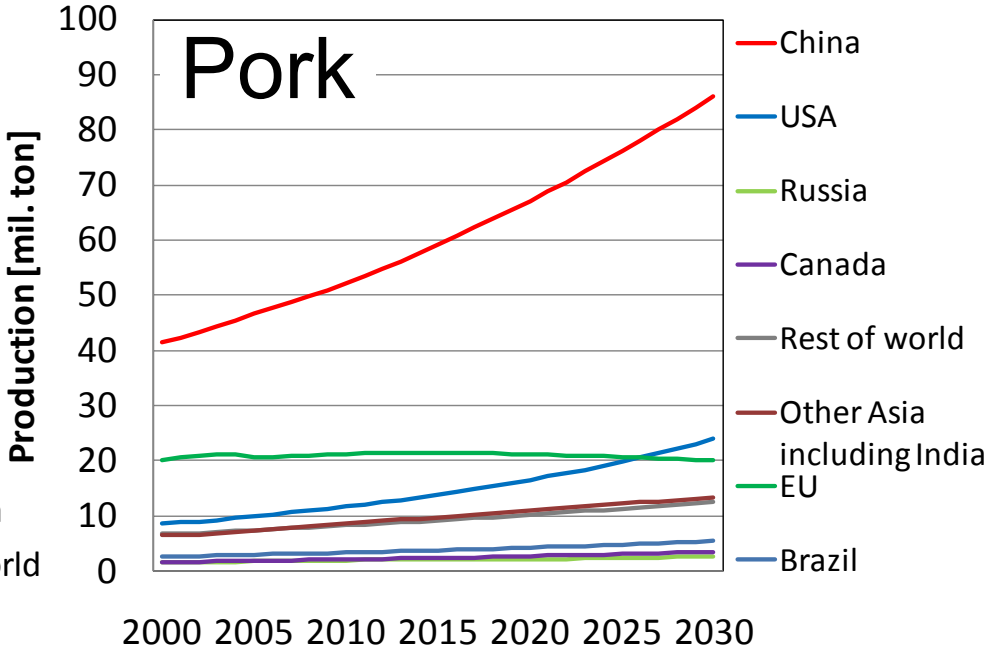
increases by 1.9 times throughout 2030.

- 2.0 times in developing countries

→ Main factors

- Population growth
- Shift from cereals to meat





Mitigation measures

- Measure's information collected from other literatures

  Bates(1998, 2001), DeAngelo et al. (2006), Graveland et al.(2002), Graus et al.(2004), IPCC(2007) and USEPA(2006)

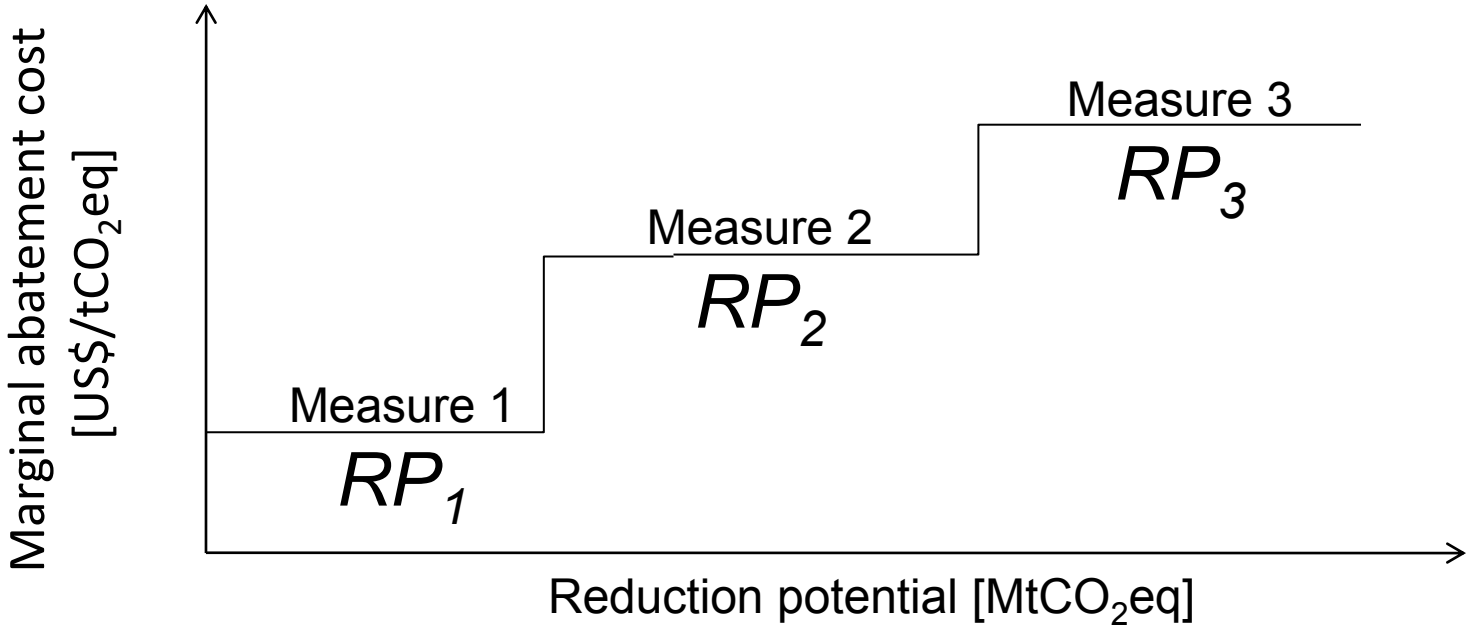
Manure Management	Enteric Fermentation
Anaerobic Digestion (12 types)	Additives to feeds (11 types)
Aerobic decomposition (2 types)	Feed management (5 types)
Covered lagoon (2 types)	Productivity improvement (11 types)
Applied manure as fertirilzer (1 type)	
Slowing down anaerbic decomposition (1 type)	
Cropland and Soils	**Rice Paddy**
Optimal fertilization (4 types)	Cultivate managements (8 types)
Others (2 types)	Fertilizer managements (2 types)

Marginal abatement cost carves (MAC)

- *Reduction potential* (RP_m) = f_0 (1-d_m)·X_m

  m: type of measures
  fo: emission factors
  dm: reduction ratio
  Xm: Activity

- *Cost - initial cost, operating cost, subsidy and emission tax*



Marginal abatement cost carves (MAC) in 2030

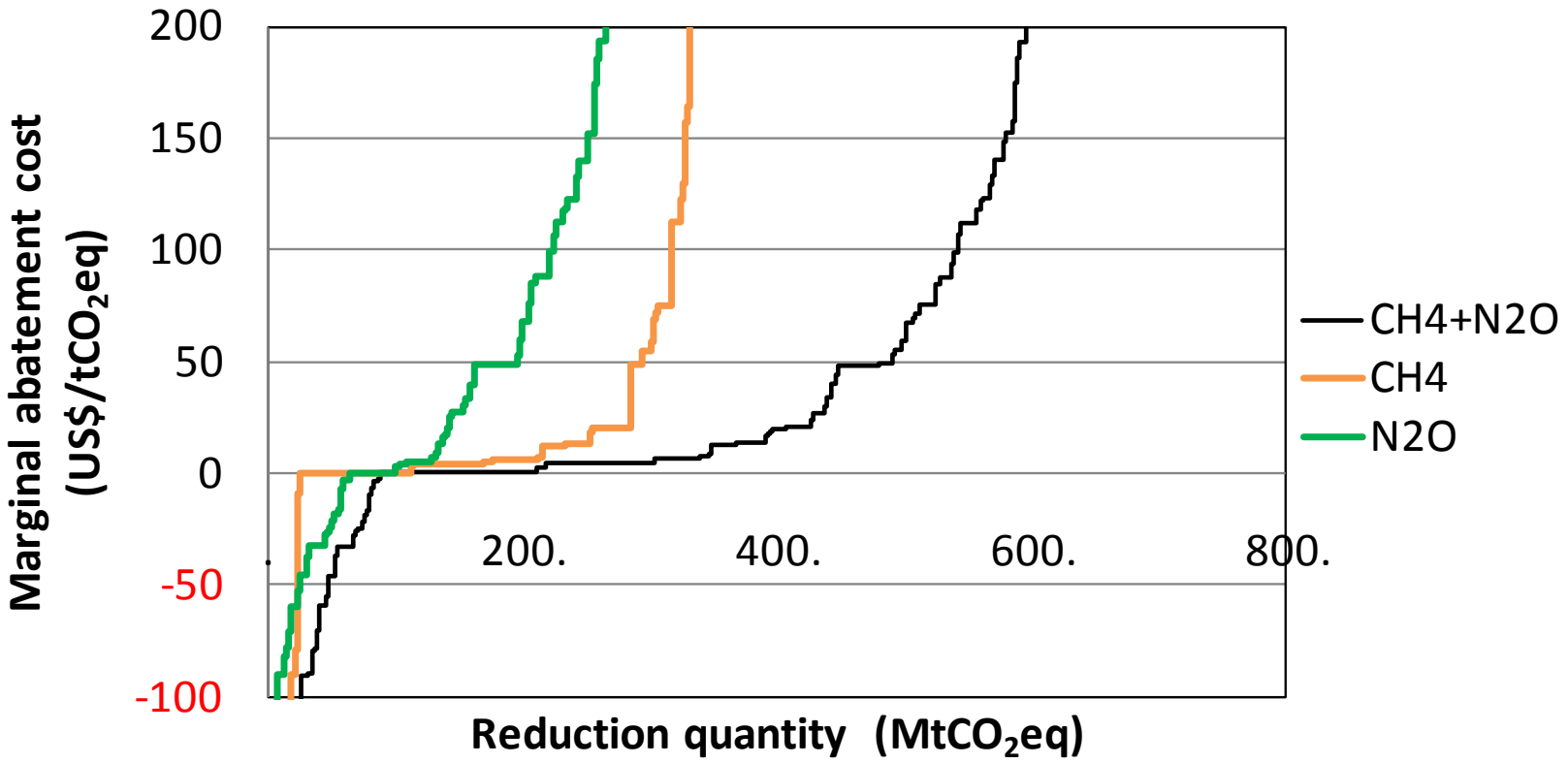
- World
- All countries separately
- Large potential countries (4)
- East Asian countries (2)
- Southeast Asian countries (4)

World's MAC

Reduction potential under 200US$/tCO$_2$eq [MtCO$_2$eq]

CH_4	330
N_2O	265
CH_4+N_2O	596

Wo 15% of emission in 2000



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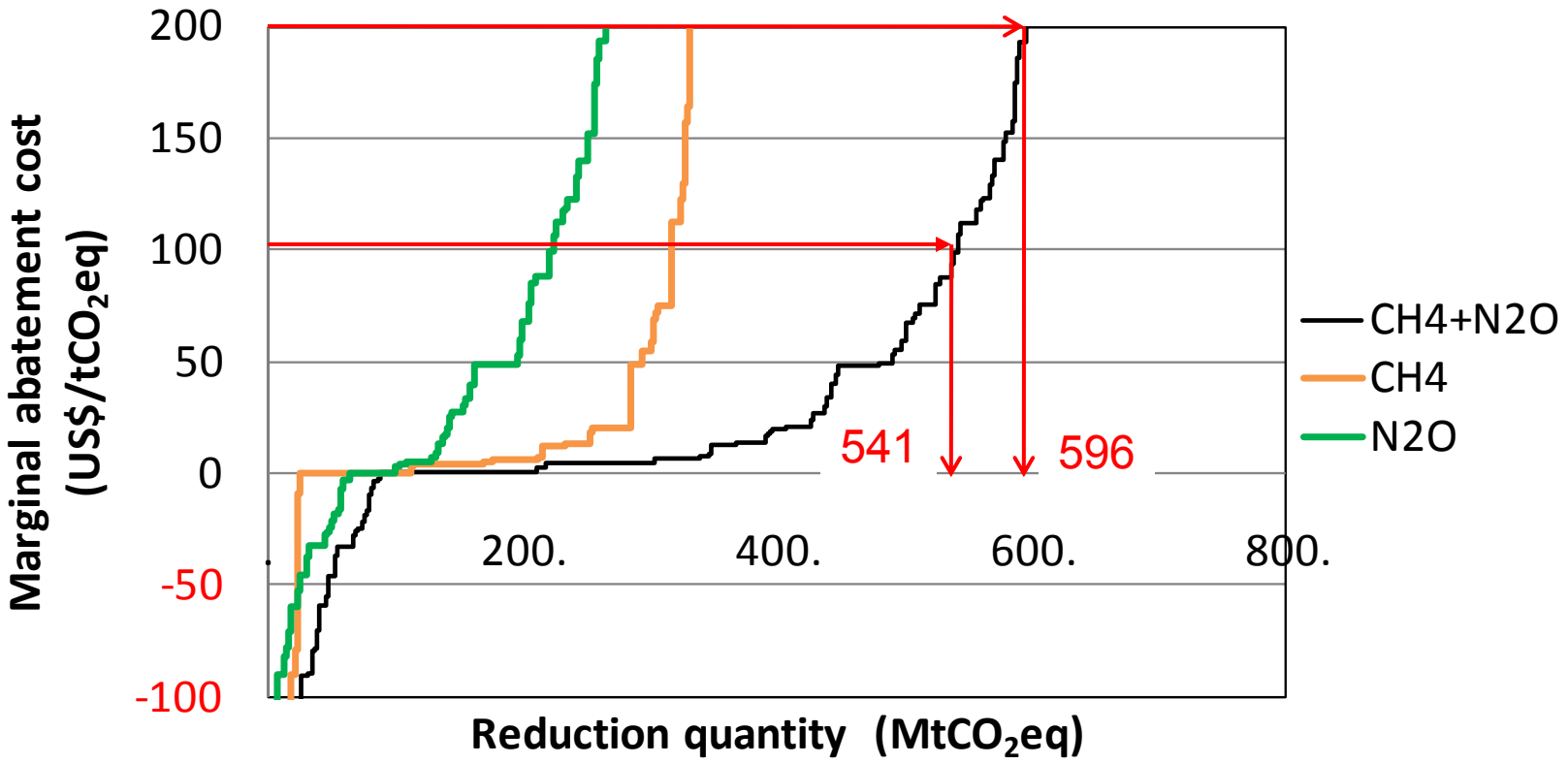
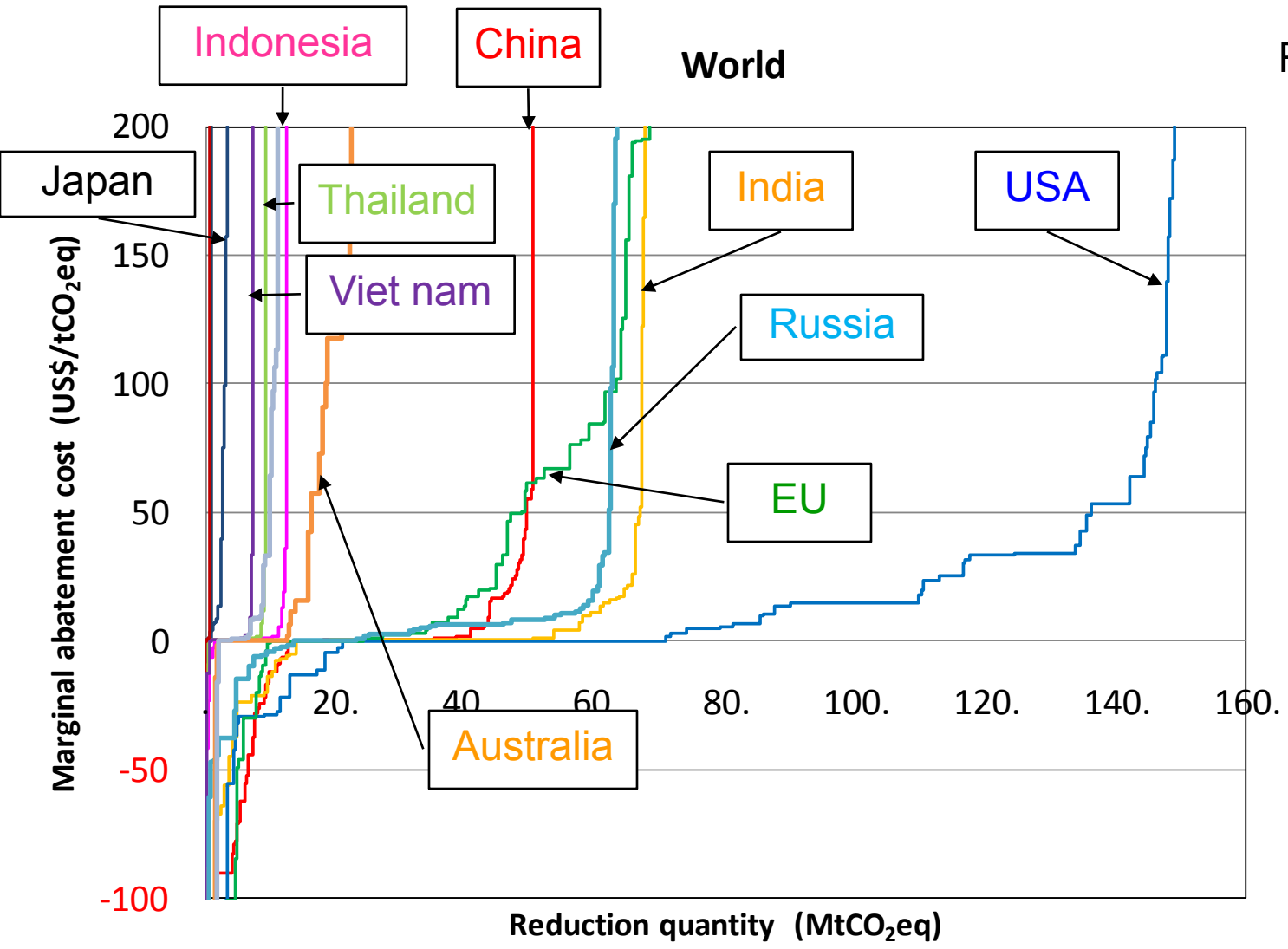


MAC in Agricultural sector by country



Reduction potential under 200US$ [$MtCO_2eq$]

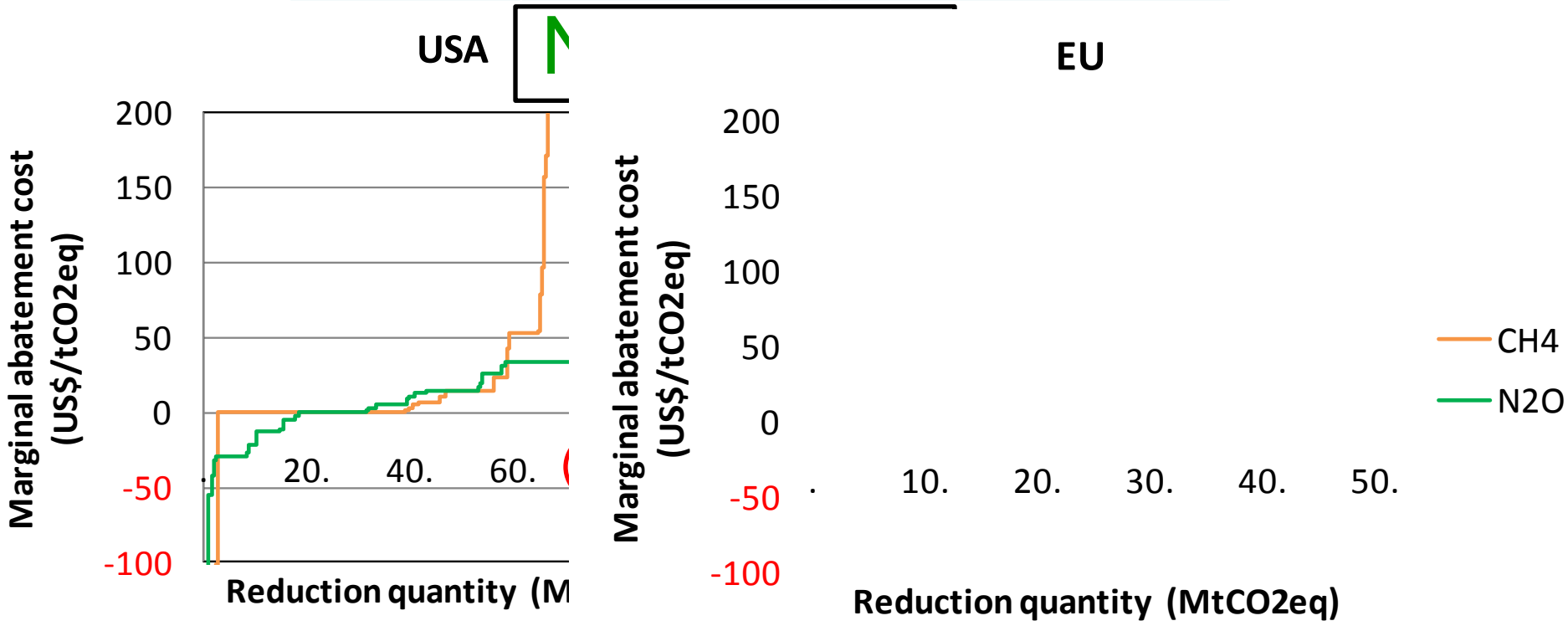
JPN

	CH4+N2O
USA	149
EU	68
India	67
Russia	63
China	50
Australia	23
Indonesia	13
Brazil	11
Thailand	9
Canada	9
Viet Nam	7
Japan	3
Korea	1
Malaysia	1

USA EU

	USA	EU
Cropland	Large	Large
Rumen	Very large	Large
Manure	Large	Large
Rice	Large	Small

Livestock fertilizer



USA EU

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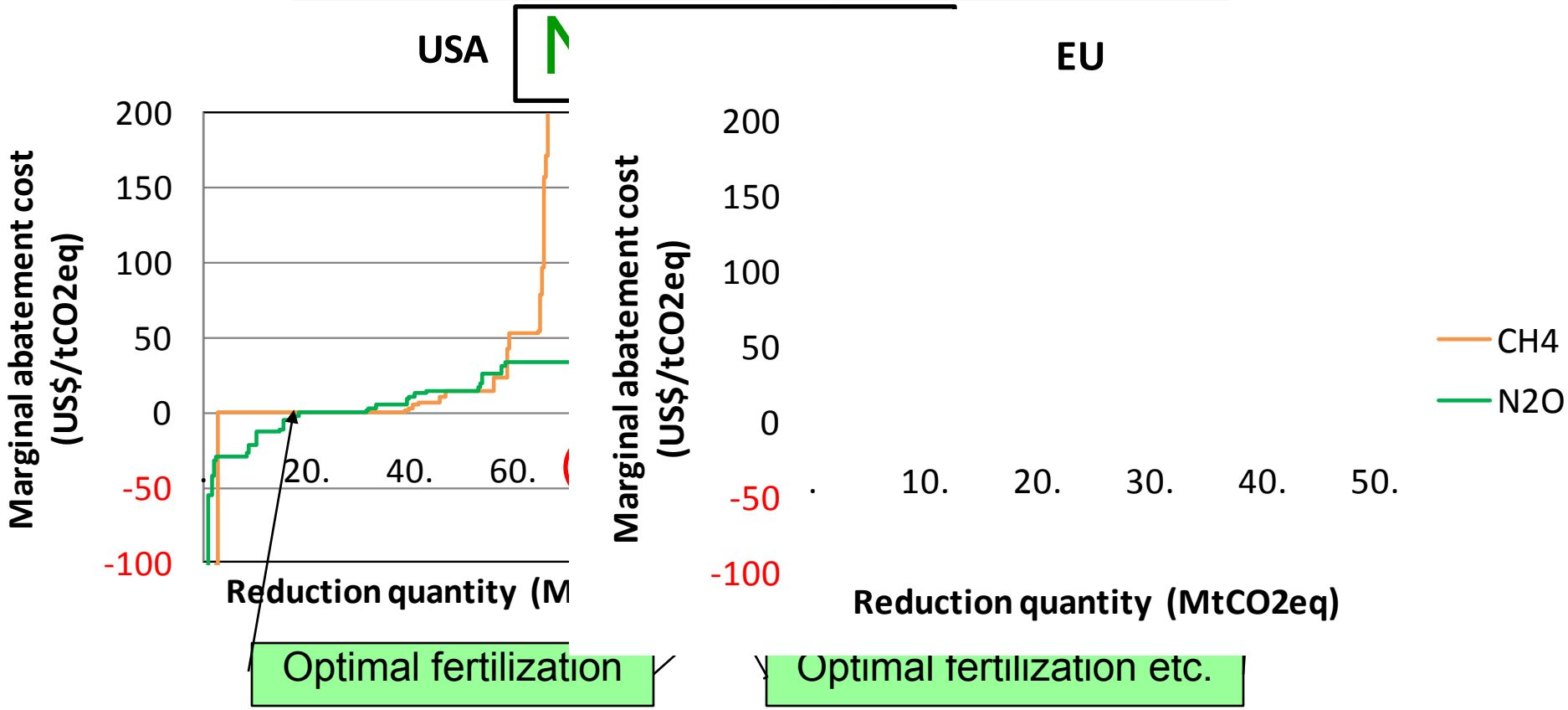
Livestock fertilizer



USA EU

	USA	EU
Cropland	Large	Large
Rumen	Very large	Large
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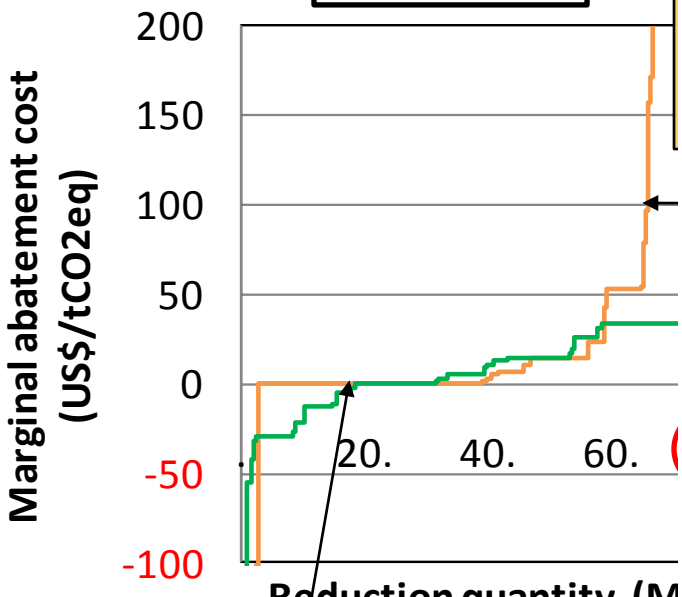
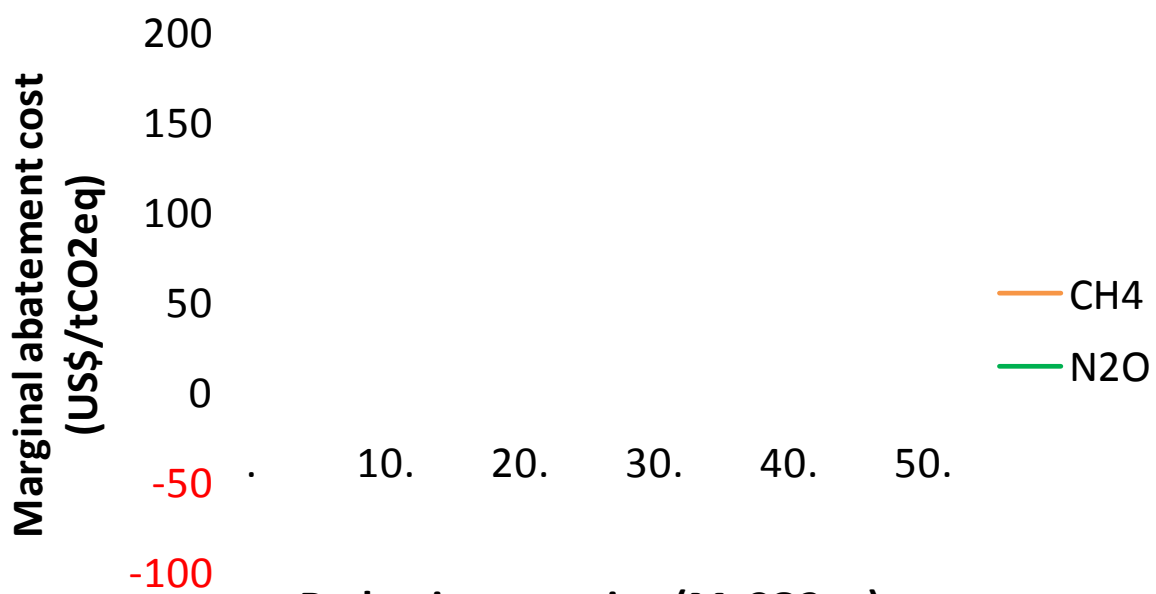
Livestock fertilizer

【Manure】anaerobic digestion

N_2O > CH_4





Optimal fertilization

Optimal fertilization etc.

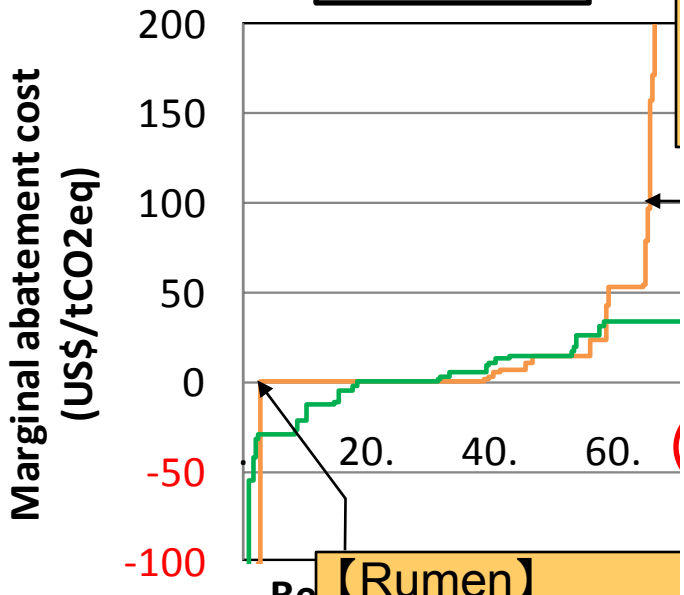
USA

EU

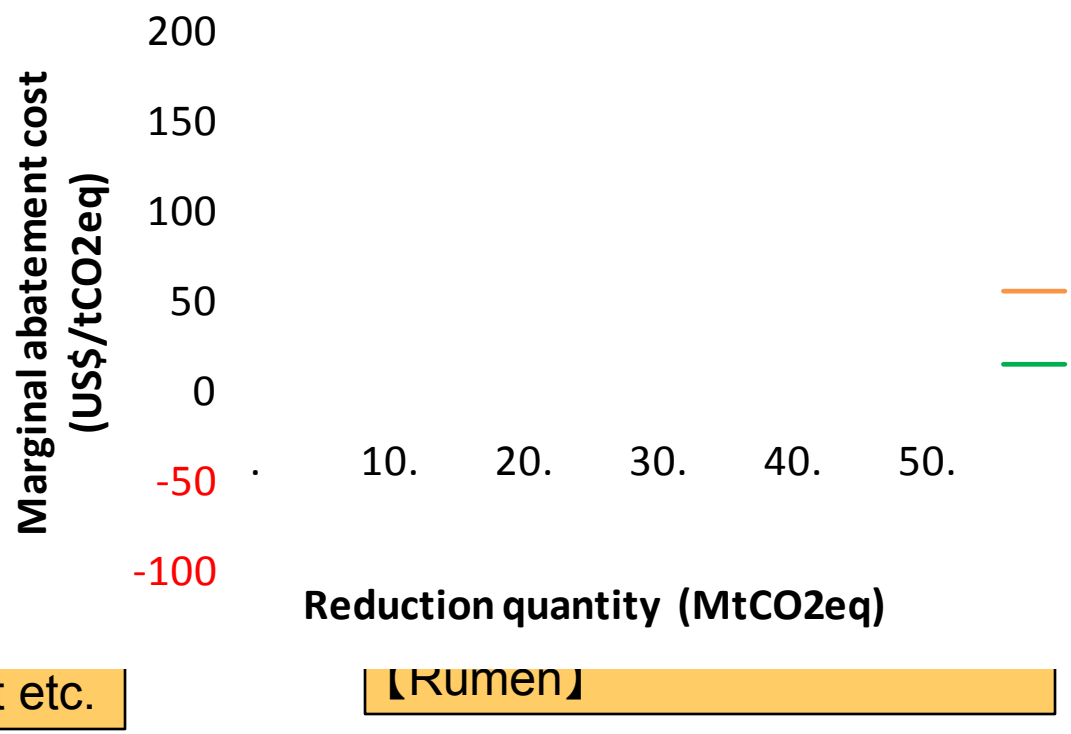
	USA	EU
Cropland	Large	Large
Rumen	Very large	Large
Manure	Large	Large
Rice	Large	Small

Livestock fertilizer

N_2O > CH_4



【Rumen】
improved produc
feed management etc.



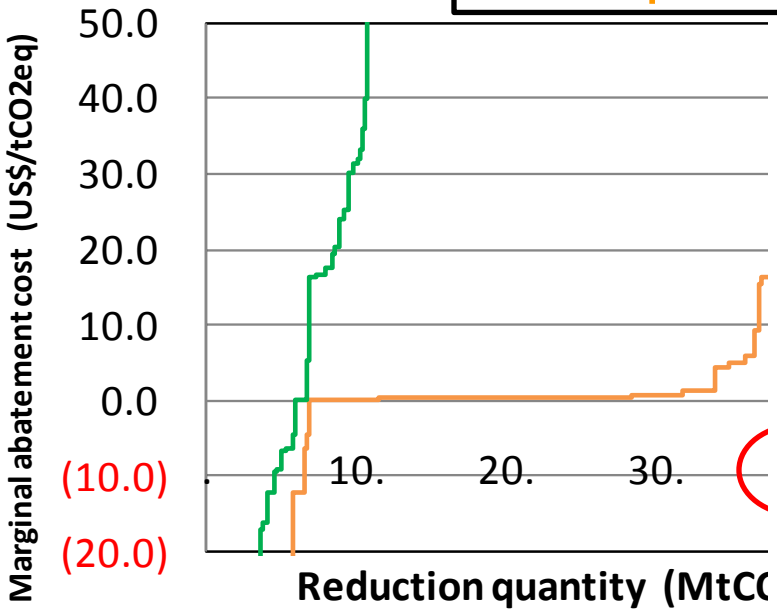
【Rumen】

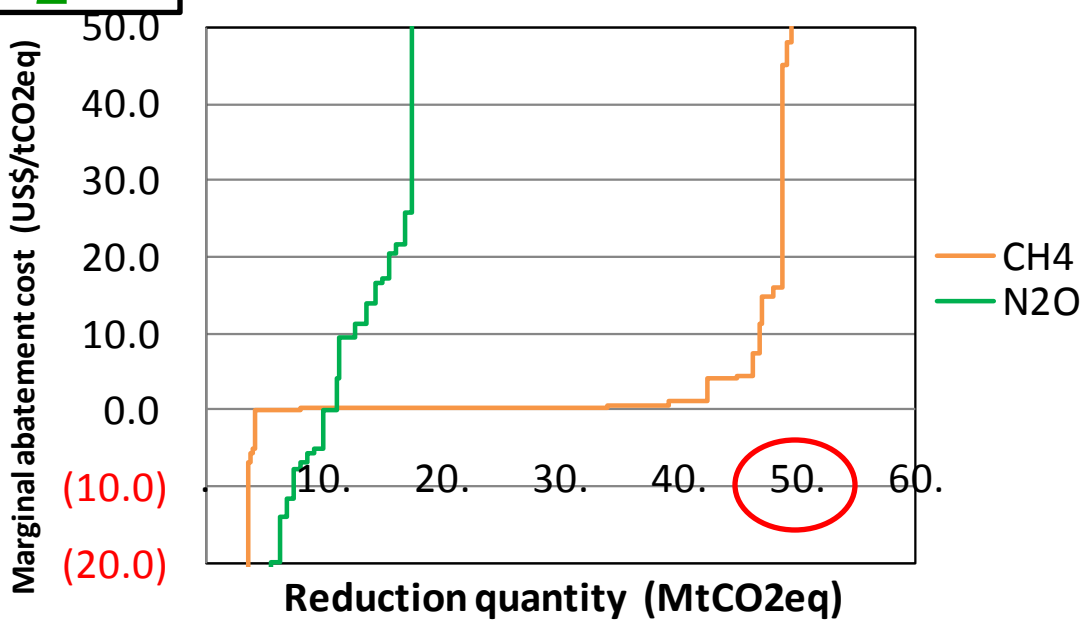
China

India

	China	India
Rice	Large	Large

$CH_4 > N_2O$





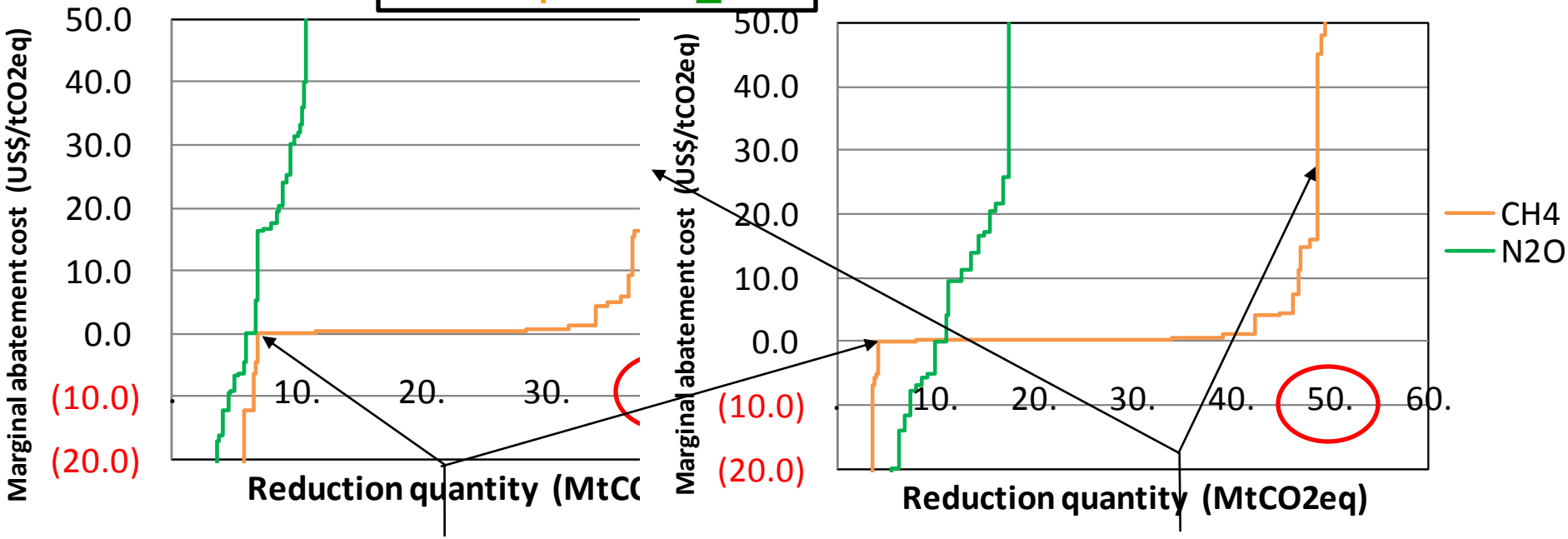
China

India

	China	India
Rice	Large	Large

$CH_4 > N_2O$

100US$/tCO$_2$eq~
【Rumen】improved productivity
additives to feed
【Manure】



【Manure】
Anaerobic digestion etc.
(due to lower labor cost)
【Rumen】

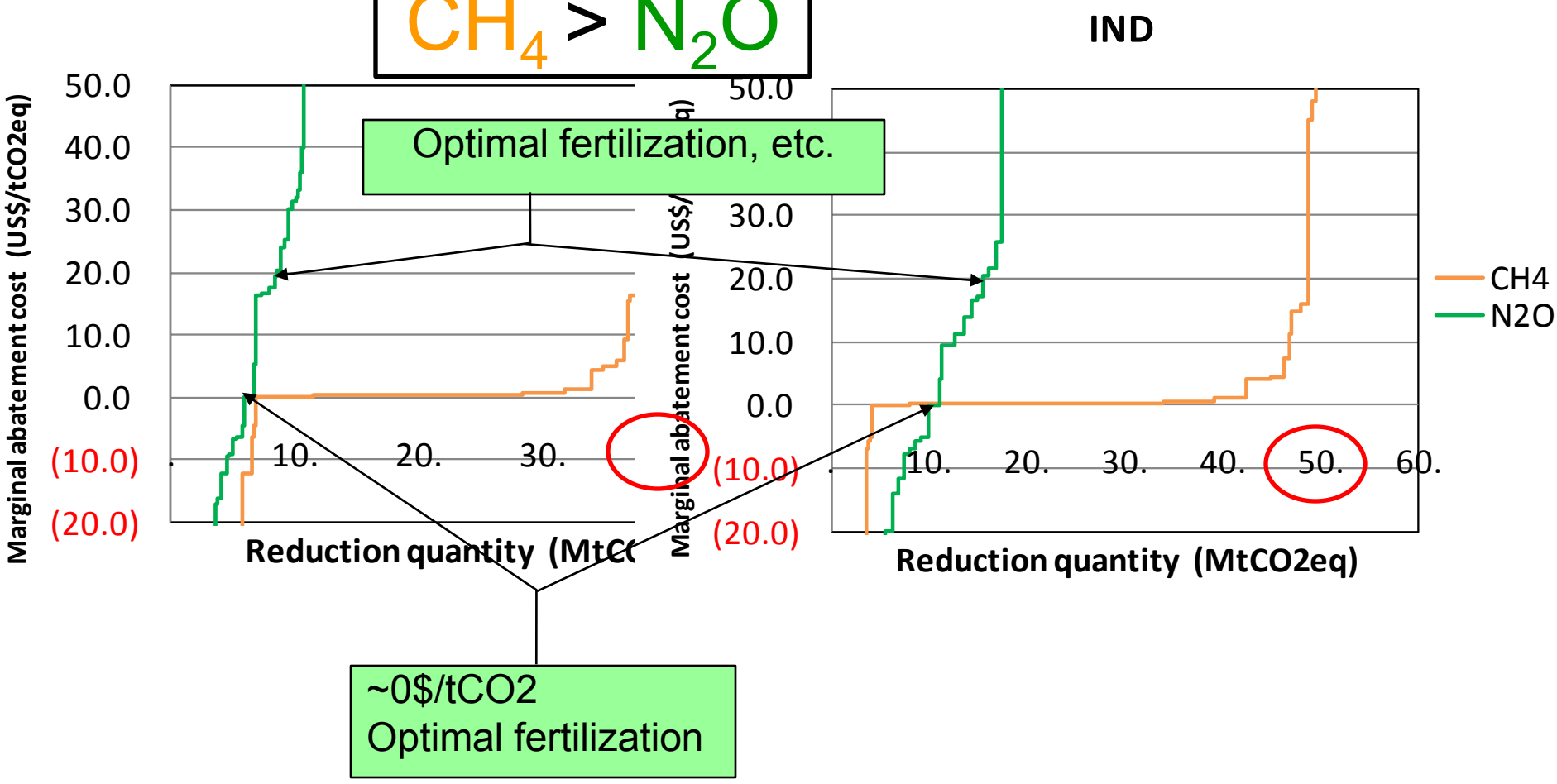
【Rice】
【Manure】anaerobic digestion
covered lagoon, etc.
【Rumen】improved productivity

China

India

	China	India
Rice	Large	Large

$CH_4 > N_2O$



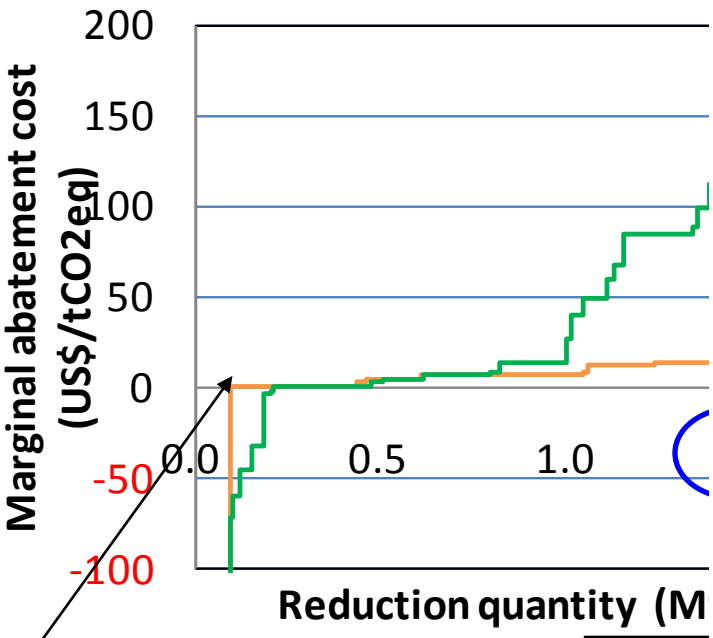
Japan

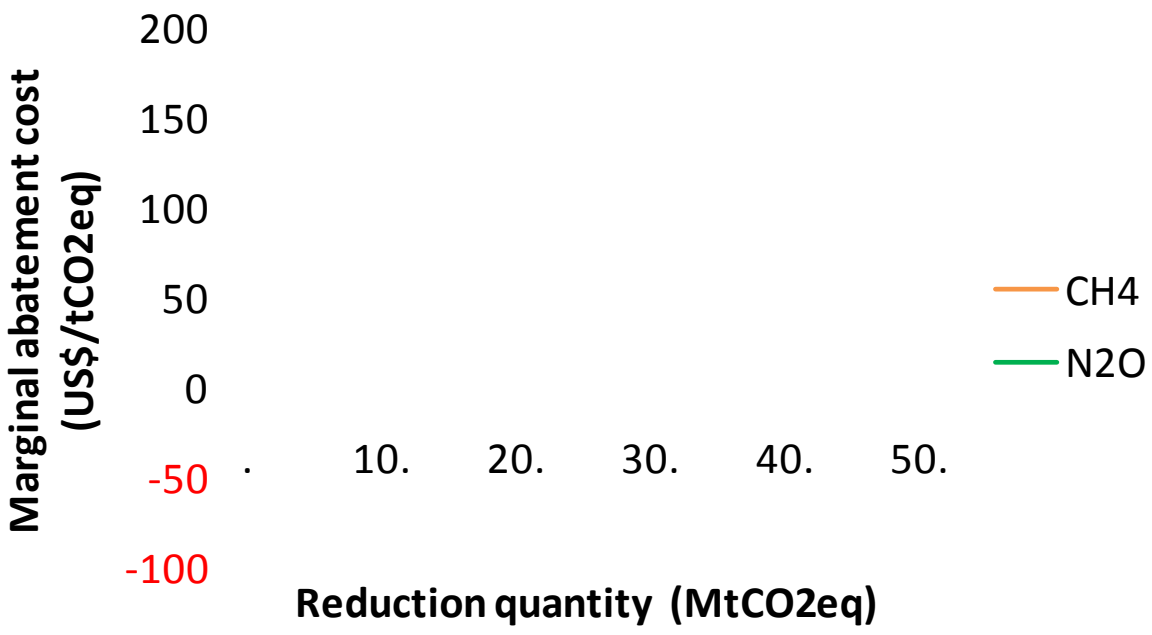
	Japan	Korea
Rice	Very large	Large
Manure	large	Mi

Korea

$CH_4 > N_2O$

EU





【Rumen】
improved productivity
etc.

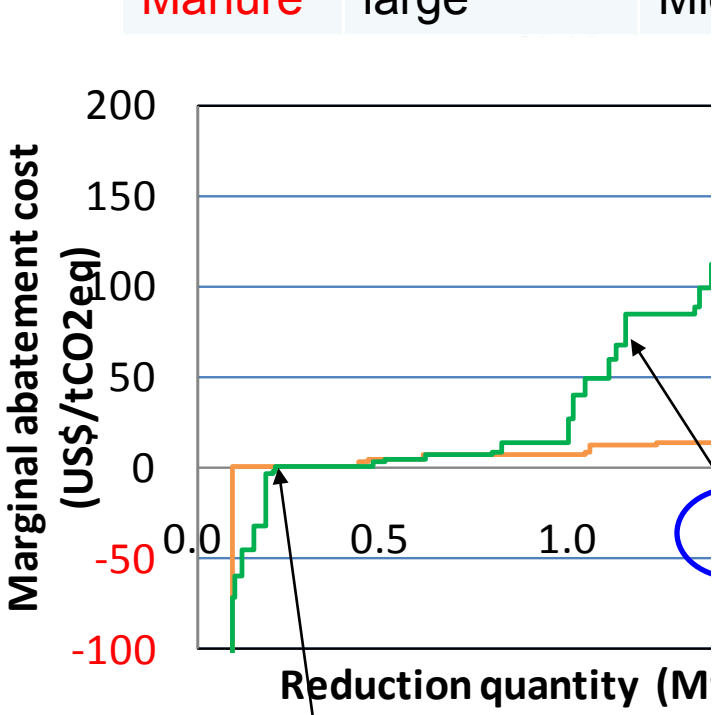
【Rice】
【Manure】anaerobic digestion
【Manure】applied manure as fertilizer
【Rumen】improved productivity etc.

Japan

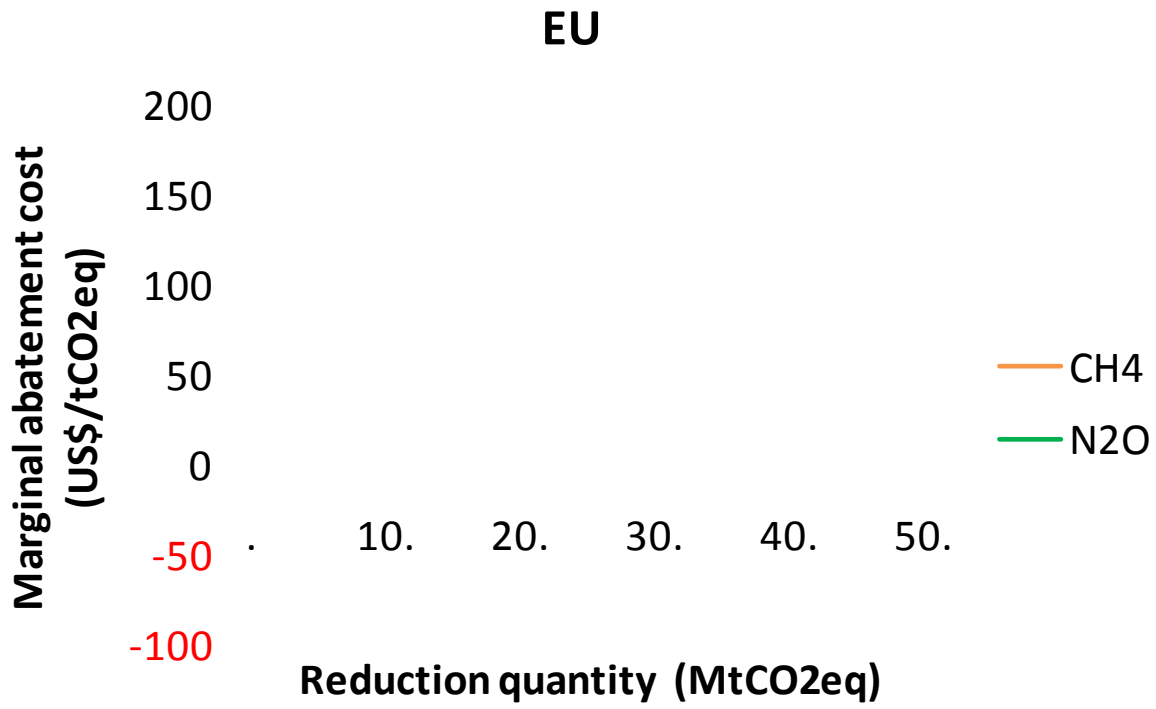
Korea

	Japan	Korea
Rice	Very large	Large
Manure	large	Mi

$CH_4 > N_2O$



EU

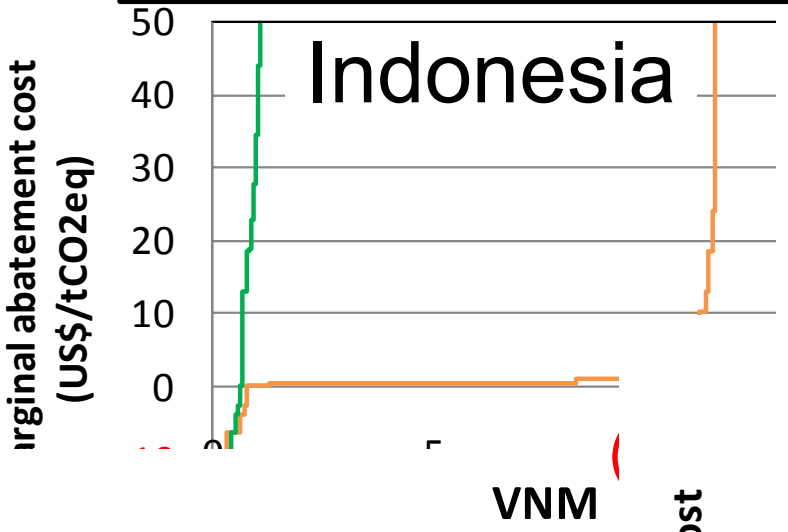


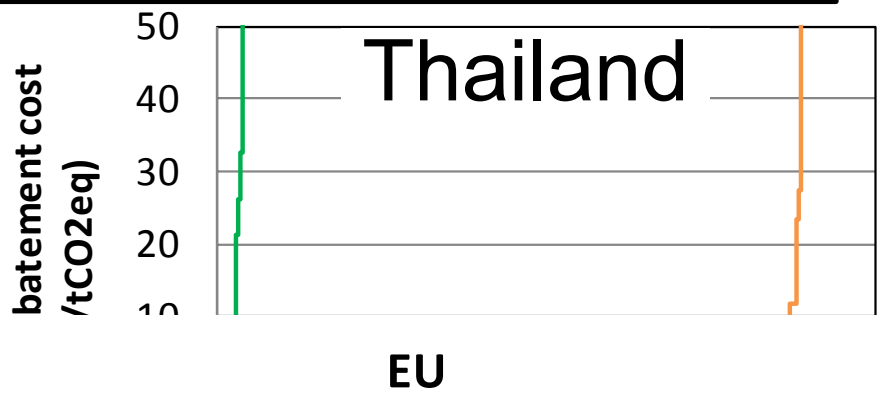
Optimal fertilization

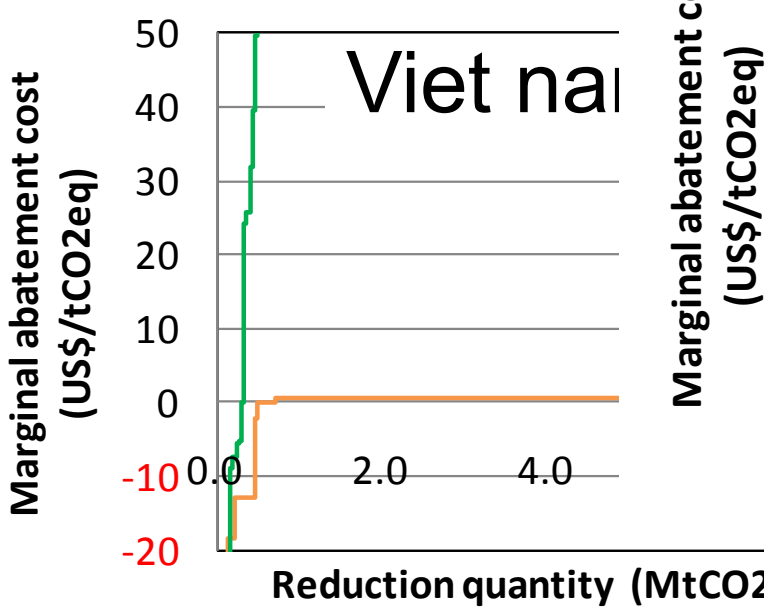
Optimal fertilization etc.

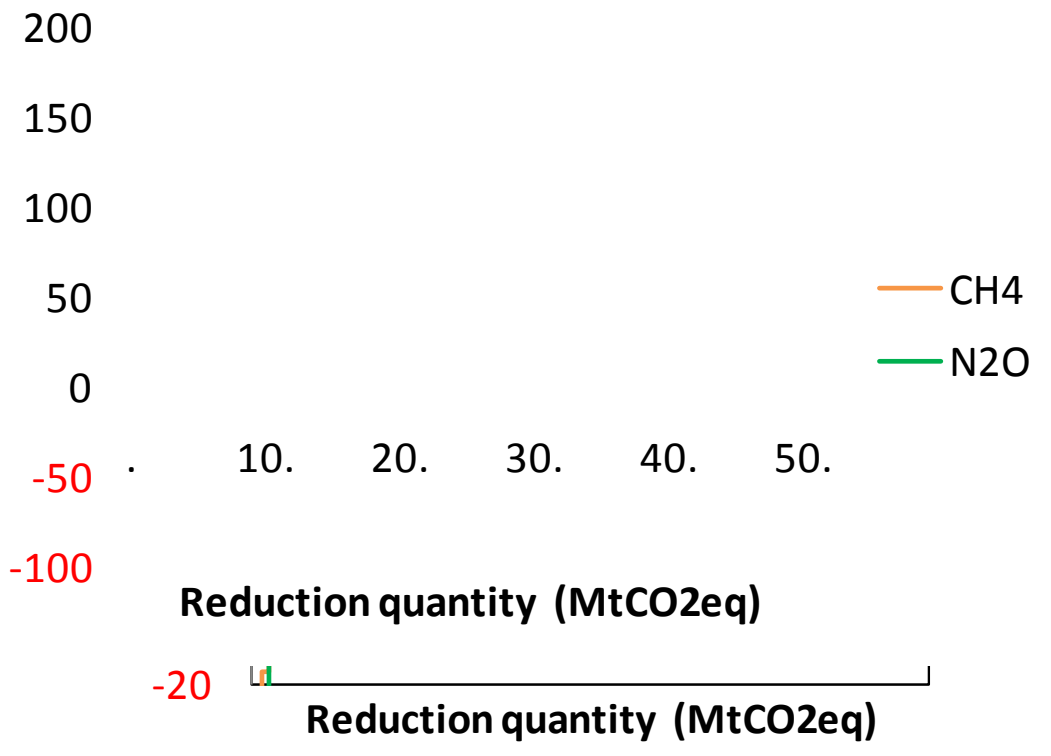
Southeast Asian countries

Reduction potential
Rice : large (the amount depending on rice paddy area)









Conclusion

I introduced GHG emissions and reduction potentials in agriculture. I specified effective measures, countries and emission sources with higher reduction potentials.

- In 2030, the global reduction potential is expected to be 596 $MtCO_2eq$ (15% of emission in 2000).

- High reduction potentials:
  - Region: USA, India, China under 200US$/$tCO_2eq$
  - USA, EU: Large RP in N_2O from croplands
  - East and Southeast Asian countries: large RP in CH_4 from rice paddy.

Thank you for your attention !