INMS Component 3: Developing regional assessments of nitrogen management

East Asia Demo

Xiaoyuan Yan and Kentaro Hayashi
Baojing Gu, Hideaki Shibata, Xiaotang Ju, Xuejun Liu, Feng Zhou, Lin Ma etc.

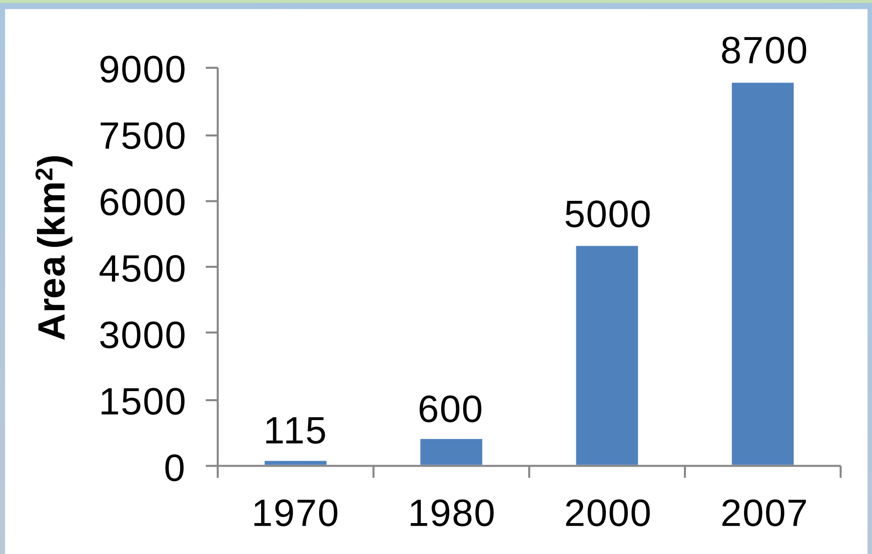
INMS-5 Meeting

1. Context of the region

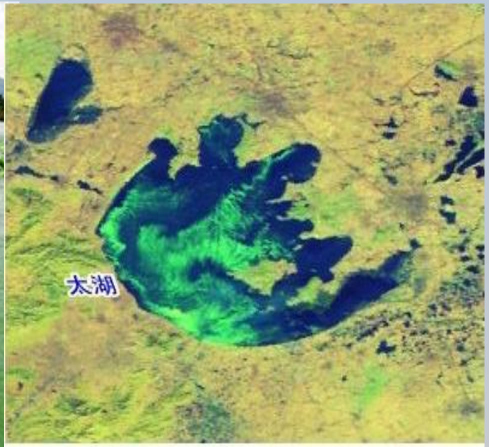
East Asia: China, Japan, and North and South Korea

Water pollution

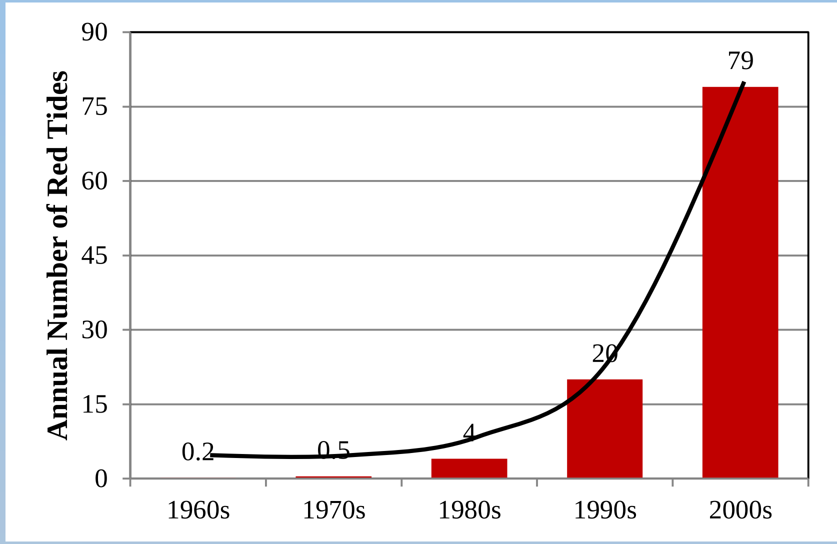
China's eutrophied lake area has increased from 135 (1970) to 8700 km² (2007).



(Jin, 2009)

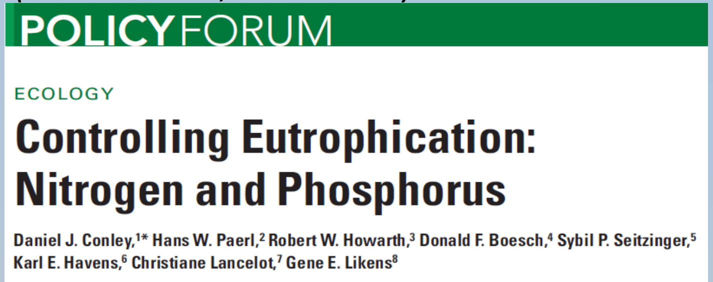


太湖蓝藻监测图像 2007年11月21日11时02分（北京时）



(the State Oceanic Administration, 2009)

(Science 2009, 1014-1015)

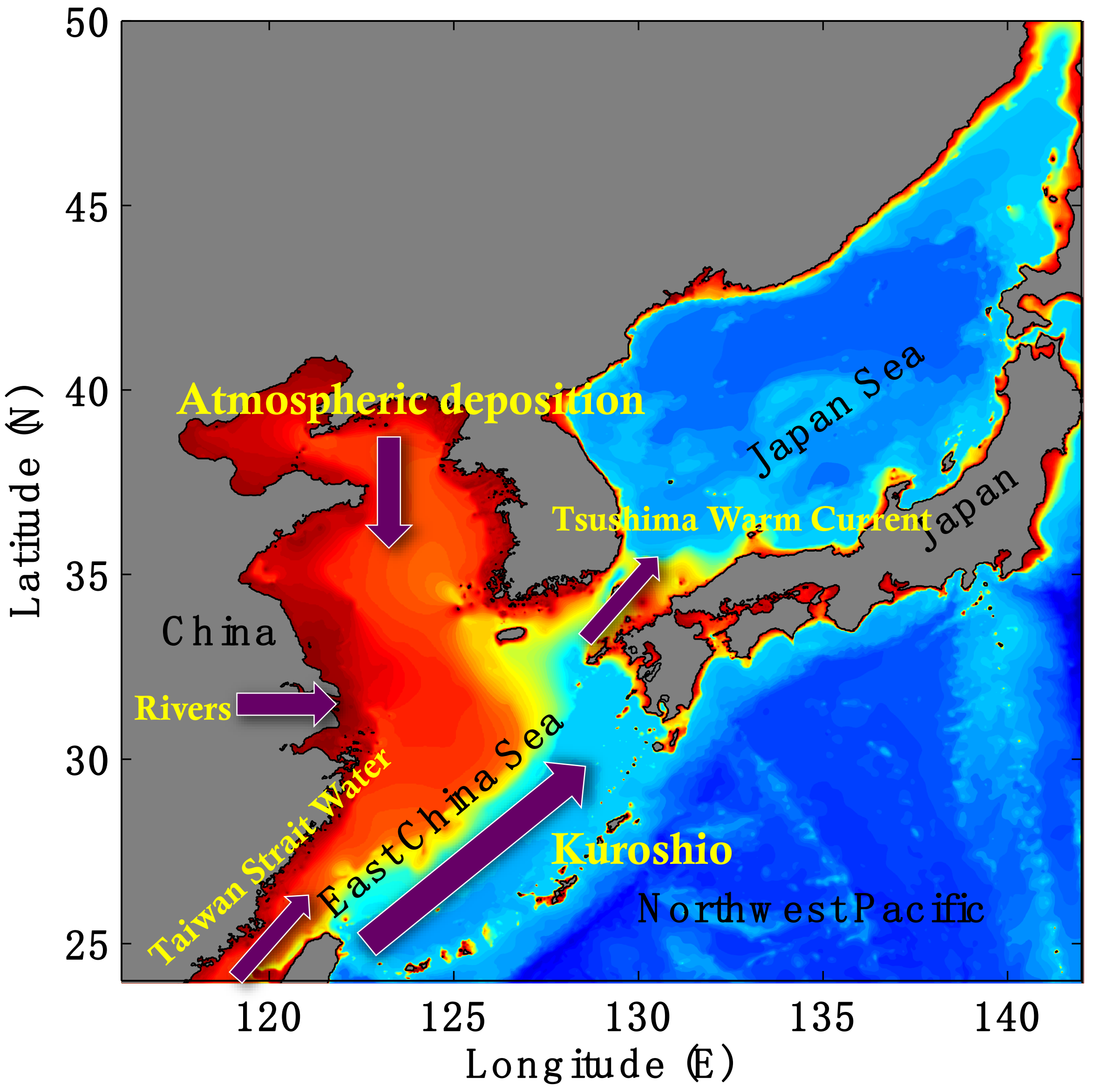

POLICY FORUM

ECOLOGY

Controlling Eutrophication: Nitrogen and Phosphorus

Daniel J. Conley,[1*] Hans W. Paerl,[2] Robert W. Howarth,[3] Donald F. Boesch,[4] Sybil P. Seitzinger,[5] Karl E. Havens,[6] Christiane Lancelot,[7] Gene E. Likens[8]

Nutrient (nitrogen, phosphate, silicate) sources for the ECS



Previous studies:

Rivers:
Zhang (1996); Liu et al. (2009)

Atmospheric deposition:
Zhang et al. (2011); Kim et al. (2011).

Taiwan Strait Water:
Chung et al. (2001).

Tsushima Warm Current:
Morimoto et al. (2009); Morimoto et al. (2012)

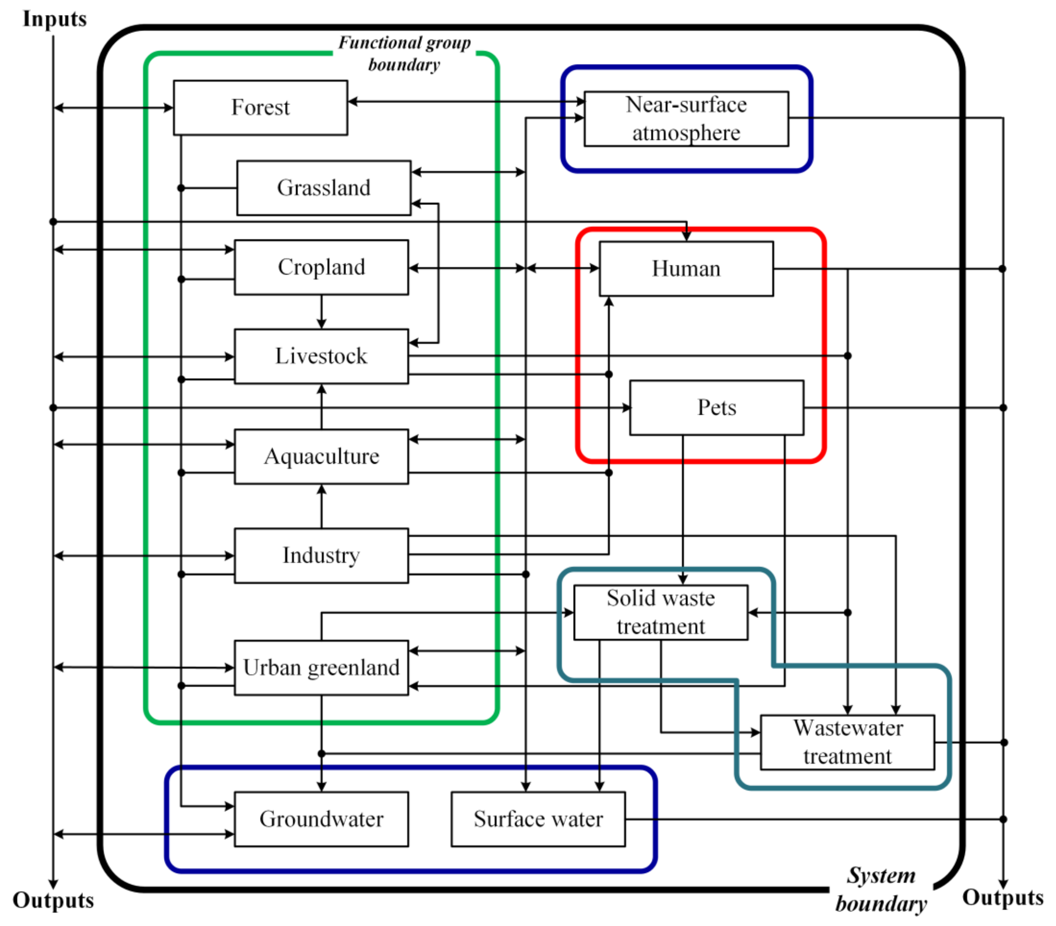
Box model:
Chen and Wang (1999); Zhang et al. (2007)

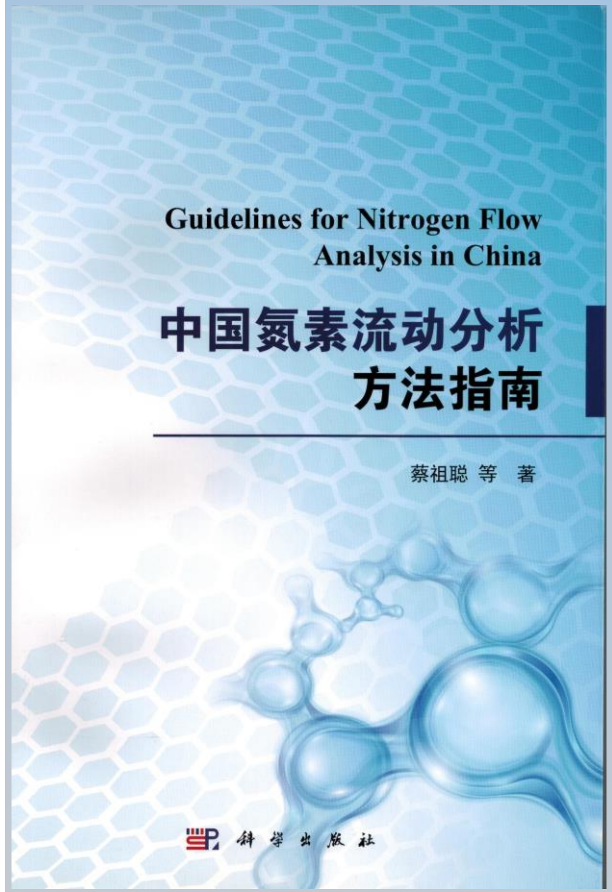
Curtesy of Xingyu Guo

2. Nitrogen budget: Analysis of nitrogen sources and fates, by sector (Tasks 3.1.1-3.1.3)

Integrating human being, human activities and nitrogen cycling processes into the CHANS model

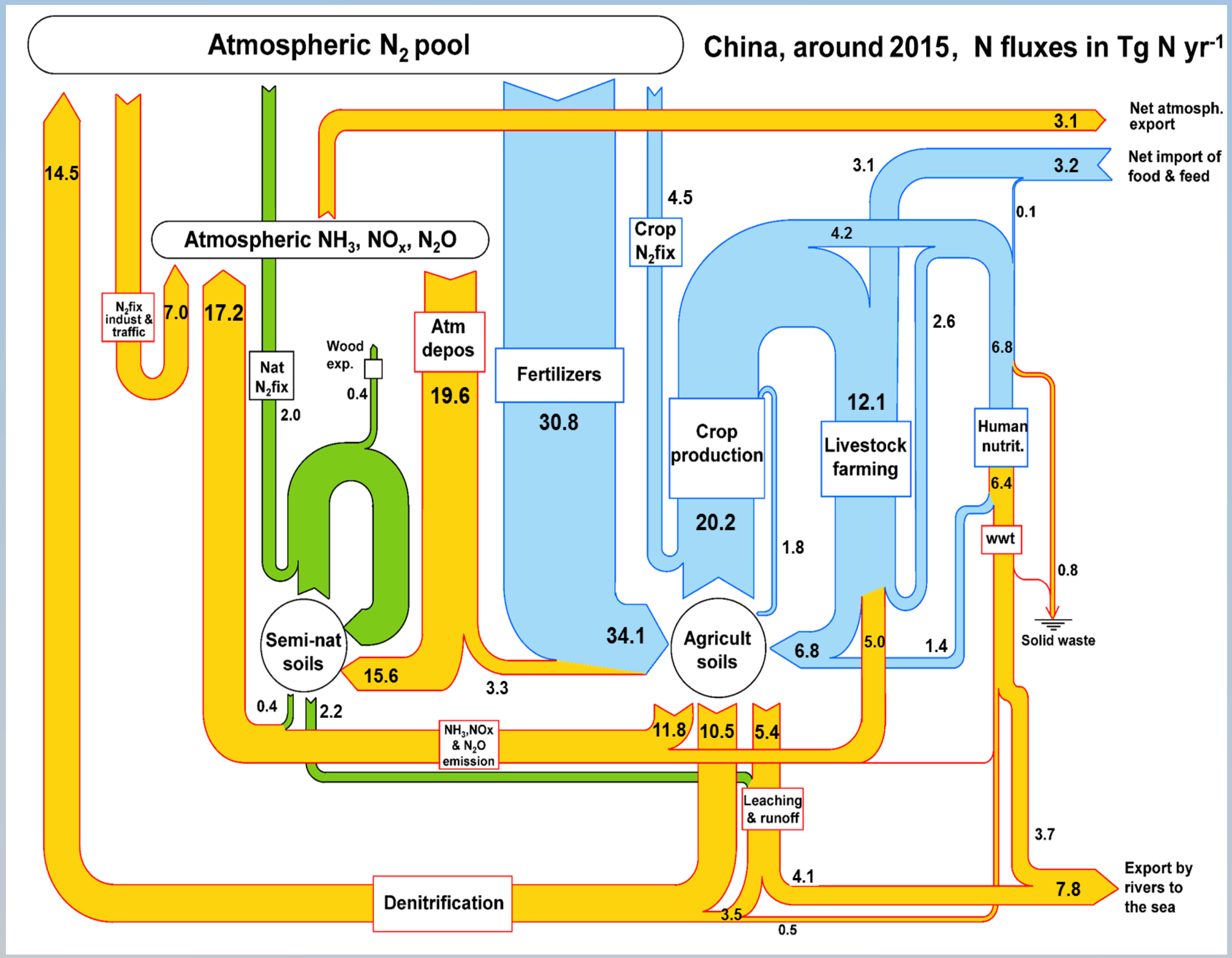
1. Methodology: CHANS model (China), modifying CHANS model (Japan, in progress)
2. Year(s) of focus: 2000–2015
3. All inputs and outputs to and from land surface, food-chain N flows.





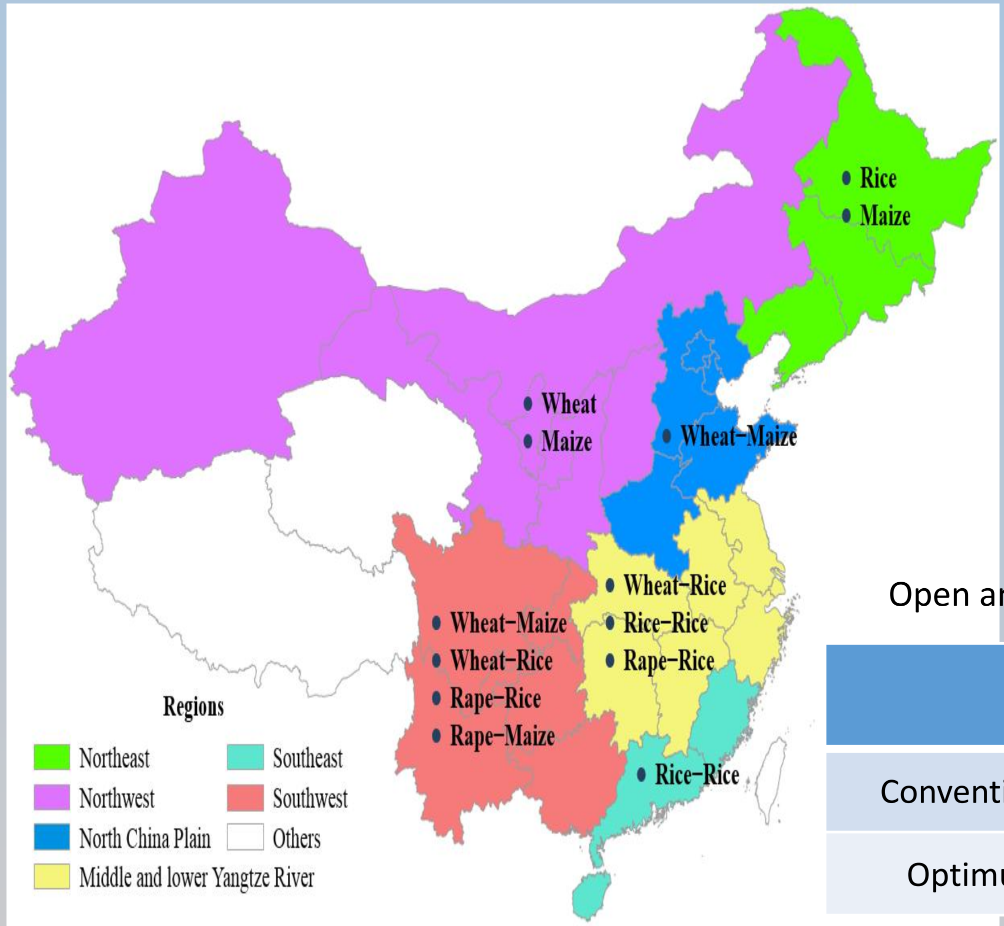
2. Nitrogen budget: Analysis of nitrogen source and fates, by sector (Tasks 3.1.1-3.1.3)

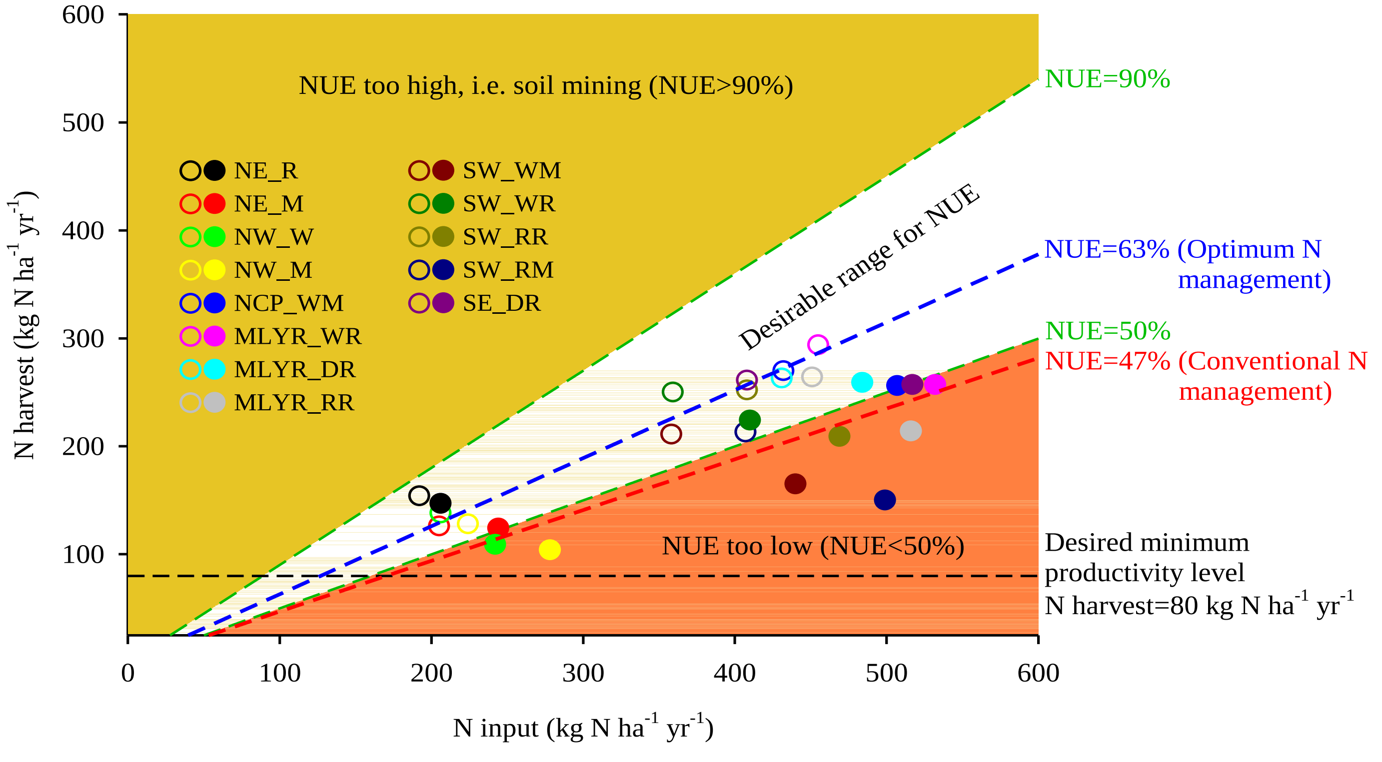
- Calculation for China is finished, still modifying the CHANS model for the case of Japan and south Korea to treat the large differences in key N flows among the countries
- Large Nr loss to the environment (air & water)
- Known gaps, uncertainties: Availability of reliable emission factors and activity data, difference in values among data sources



Gu et al., 2019, Environ Sci Technol*

3. Description of region in relation to agreed performance indicators





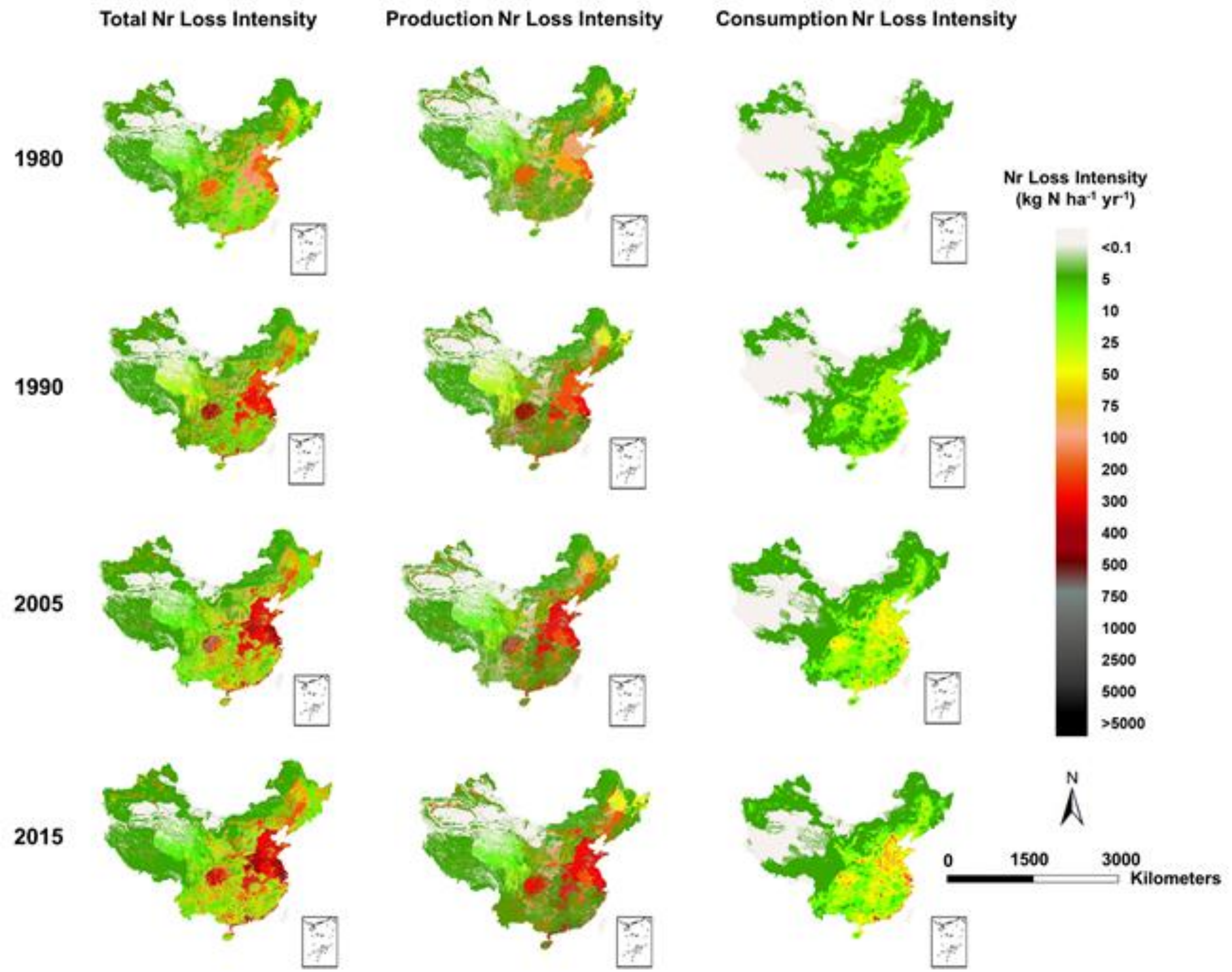
Open and solid circles denote data under economic optimum and conventional N management, respectively

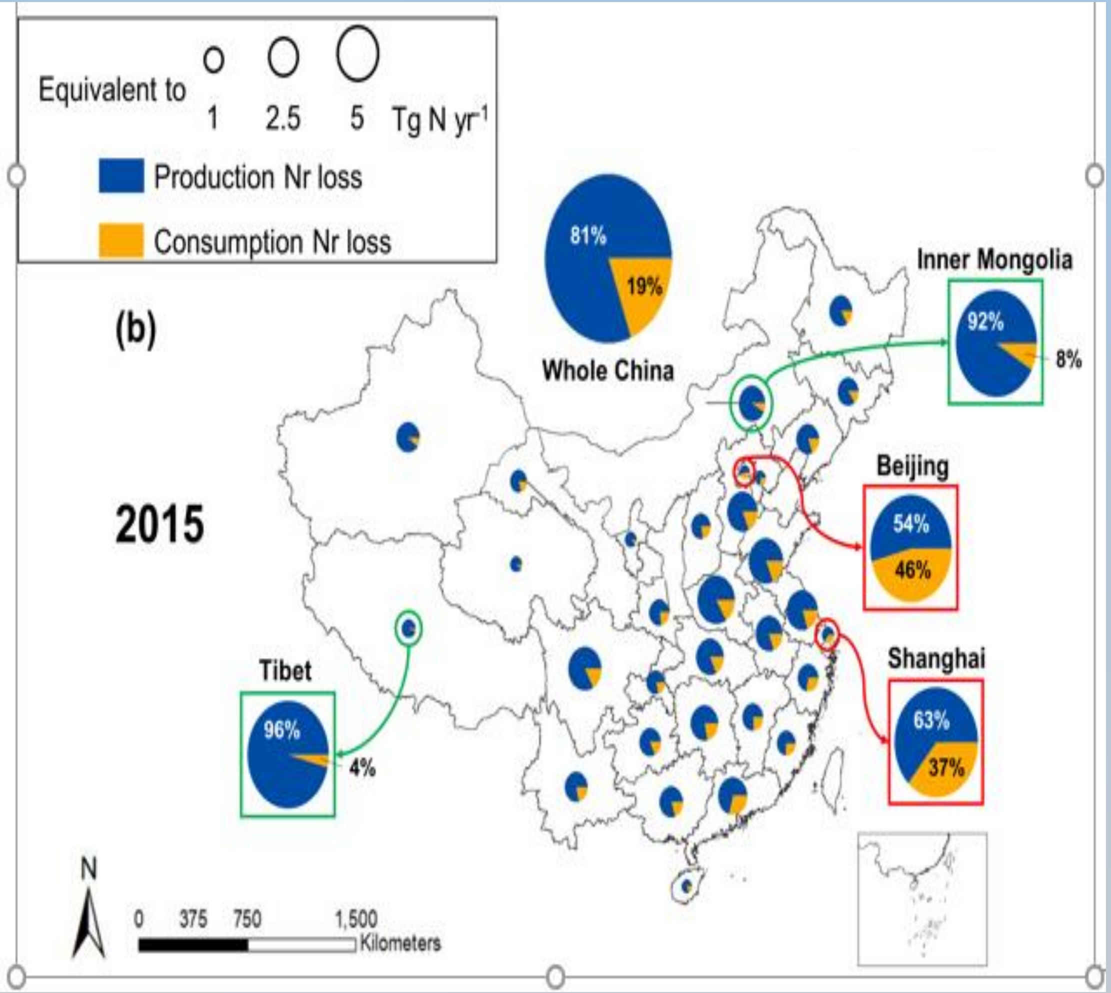
	N harvest (kg N ha^{-1})	NUE (%)	N surplus (kg N ha^{-1})	Yield-scaled Nr losses (kg N Mg^{-1})
Conventional	104~259	30~71	59~349	2.4~13.0
Optimum	126~294	52~80	38~187	2.0~7.6

Modified from EU Nitrogen Expert Panel, 2015

3. Description of region in relation to agreed performance indicators

Reactive Nitrogen loss per area basis





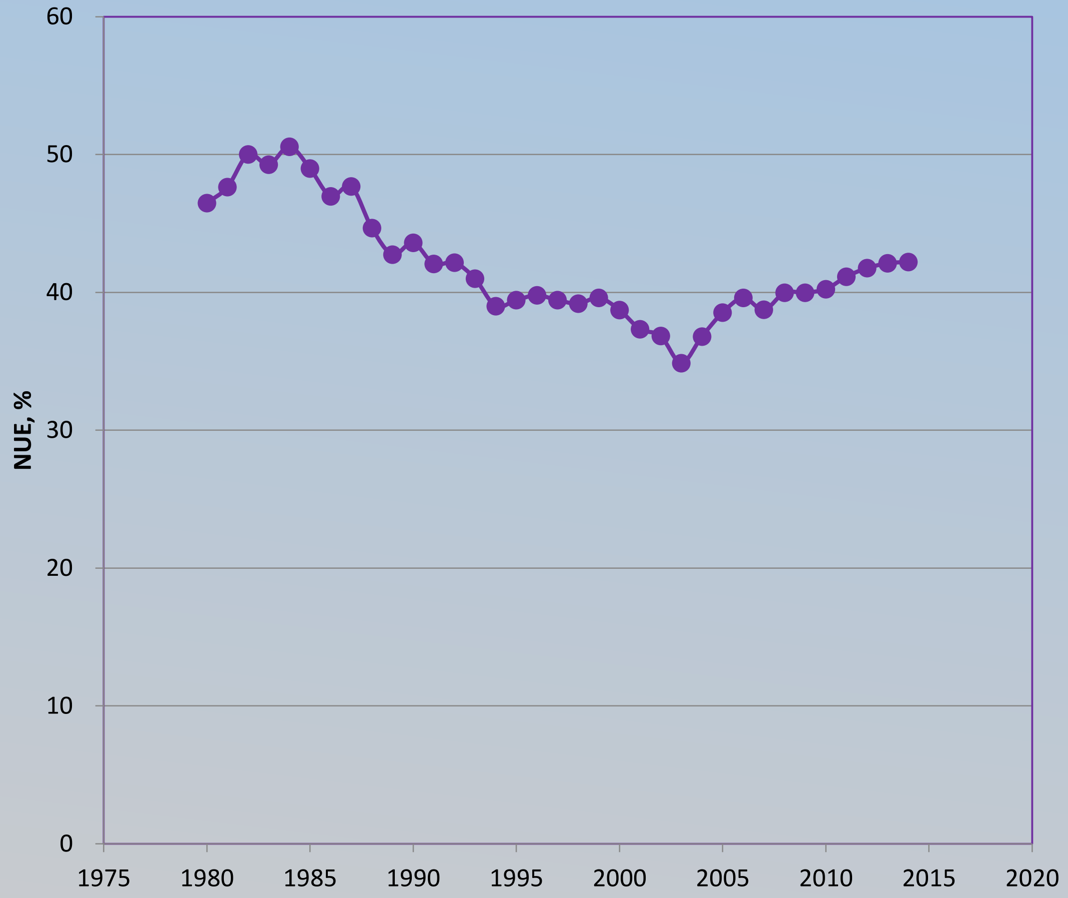
Luo et al., unpublished

4. Options for, progress in and barriers to better nitrogen management (Tasks 3.1.7-3.1.8/A1.6)

Current situation, major barriers and options to overcome them

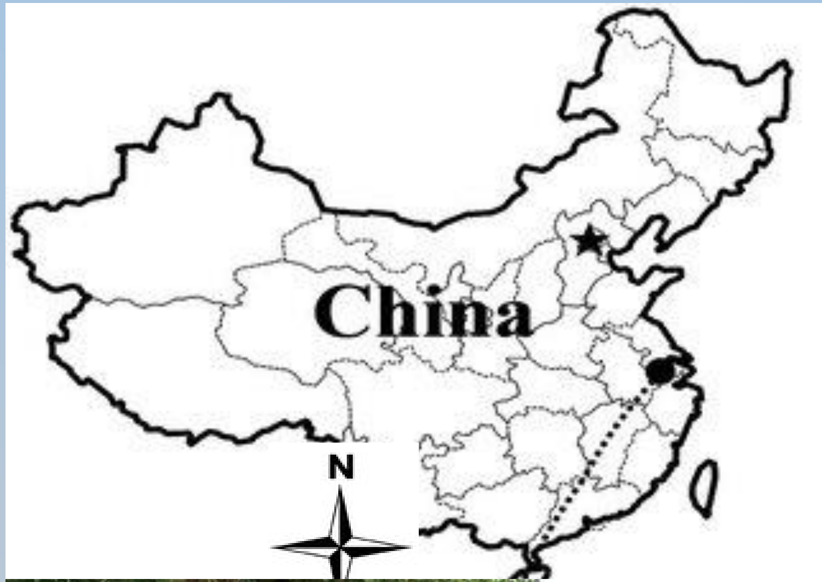
- Highlights of promising actions: Status of barriers survey (A1.6):

Change in NUE with time



- **Enhanced efficiency N fertilizers**
  - **Controlled release N fertilizer**
  - **Nitrification inhibitor**
  - **Urease inhibitor**
- **Optimized N application**
  - **Reducing basal fertilizer N ratio**
  - **Increasing N splitting frequency**
  - **Deep placement of fertilizer**
  - **Fertilizer recommendation based on soil test**

Taihu Lake watershed: case study



Algae blooming in 2007

Drinking water crisis in Wuxi

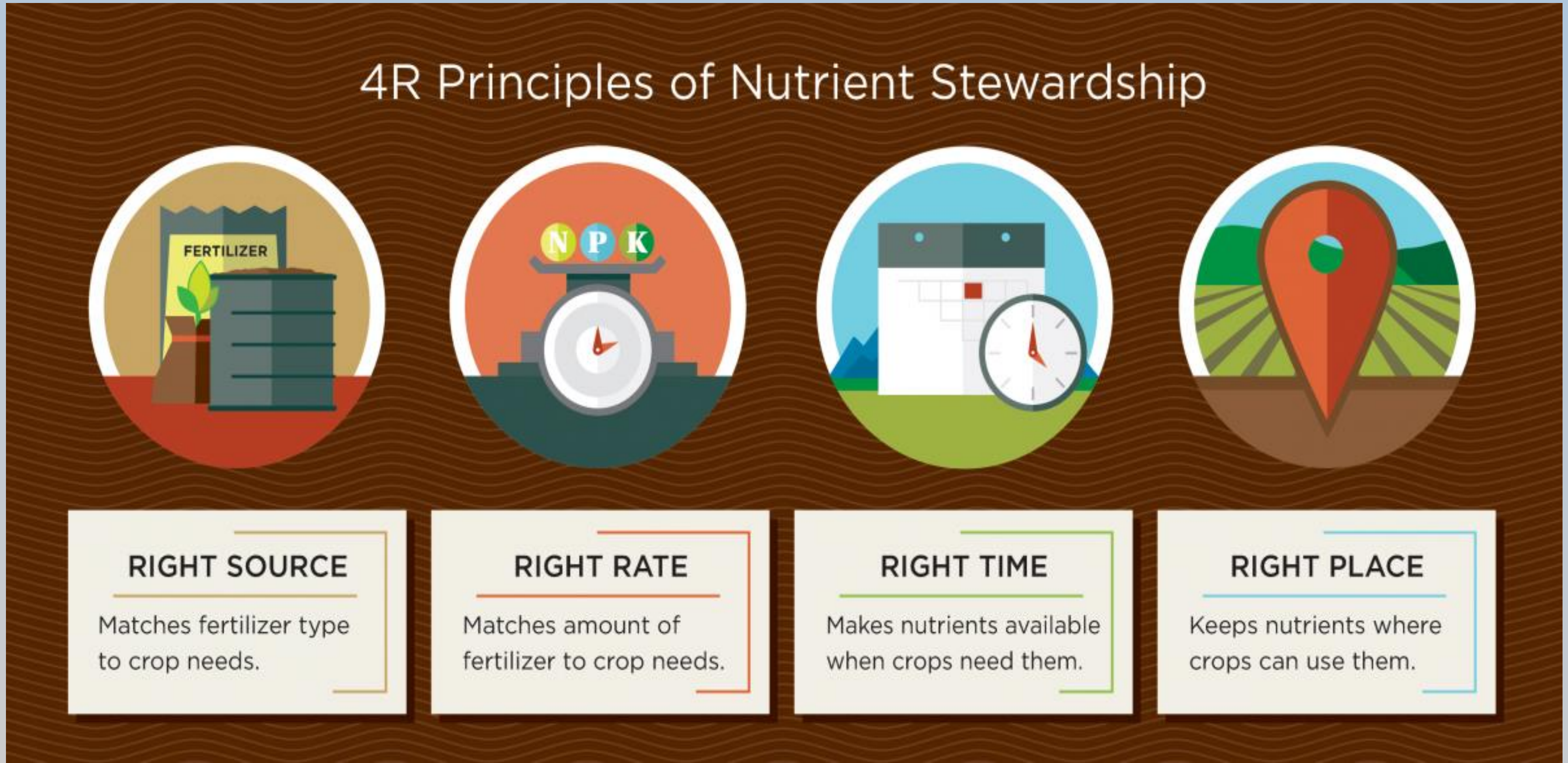
Latest Updated by 2007-05-31 14:03:39

Customers queue to buy bottled water at a supermarket in Wuxi, East China's Jiangsu Province, May 30, 2007. Local residents in Wuxi rushed to buy bottled water when the tap water developed a strange smell. The blue-green algae outbreak in Taihu Lake affected the underground water in Wuxi and caused the water crisis, Xinhua said. [newsphoto]

Customers queue to buy bottled water at a supermarket in Wuxi, East China's Jiangsu Province, May 30, 2007. Local residents in Wuxi rushed to buy bottled water when the tap water developed a strange smell. The blue-green algae outbreak in Taihu Lake affected the underground water in Wuxi and caused the water crisis, Xinhua said. [newsphoto]

Agricultural actions were strengthened

- **Source control**
- **Process retention**



Process retention technologies

Ecological ditches/channels → Vegetated ponds → Constructed wetland → Buffer strips

ecological ditches/channels

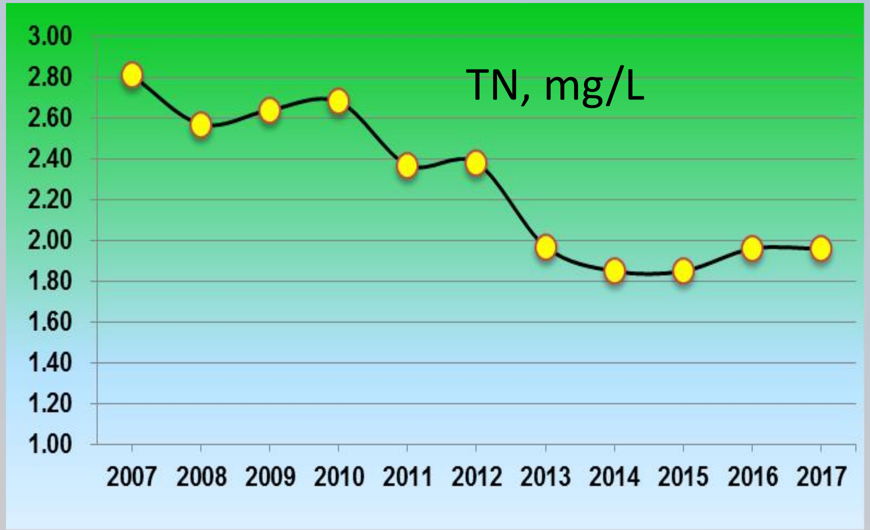
Vegetated ponds

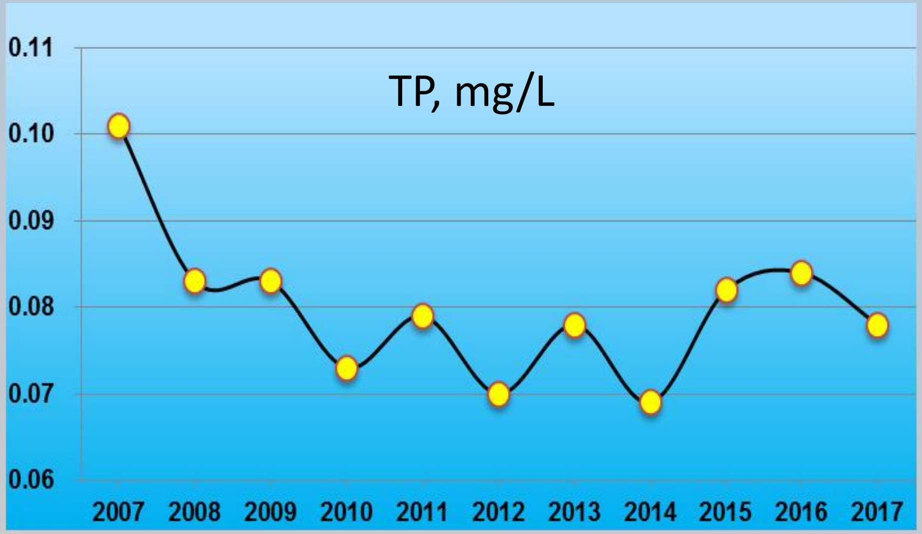
Buffer Strips

Constructed wetlands

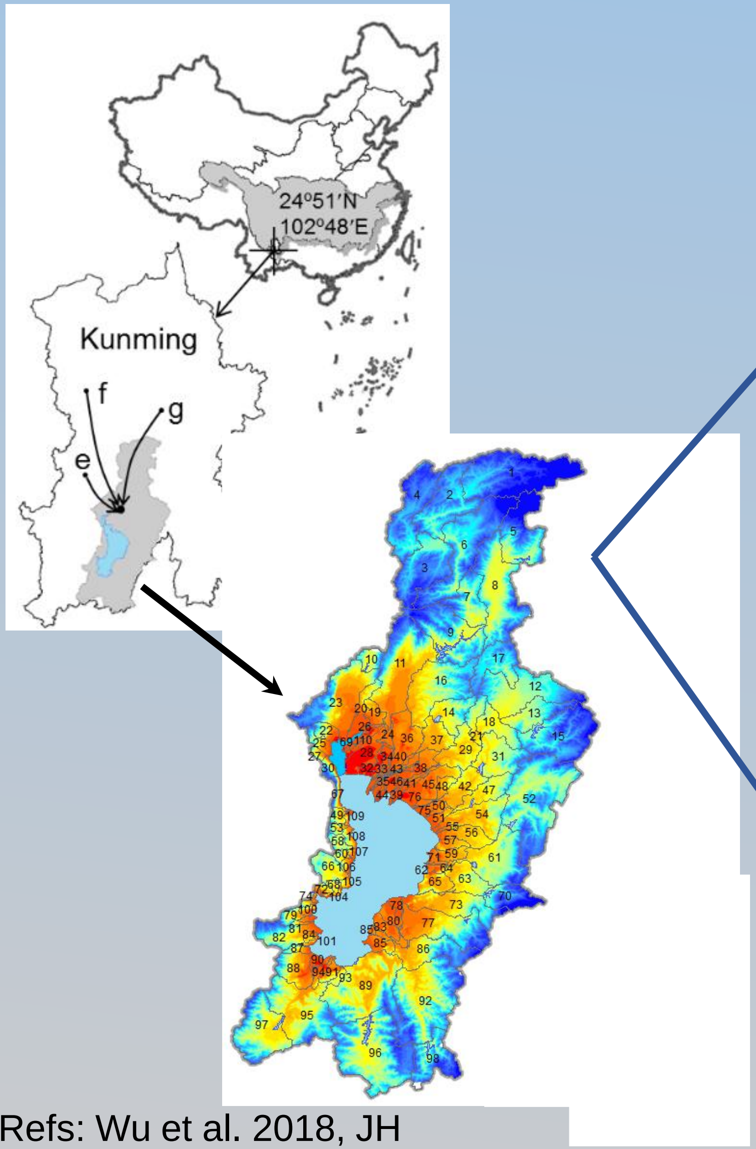
Other efforts in pollution control (2008-2017)

- Closed more than 5300 polluting enterprises
- Ecological dredging: 37 million m^3
- Blue algae salvage: more than 10 million ton
- Wastewater treatment: 8.5 million ton/day





Lake Dianchi as case study

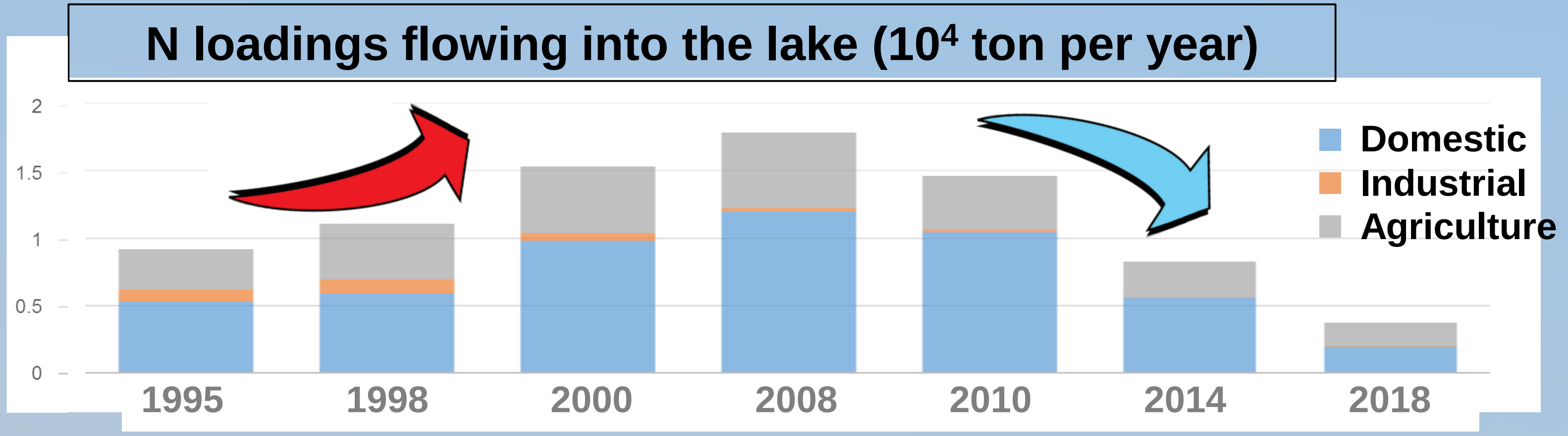


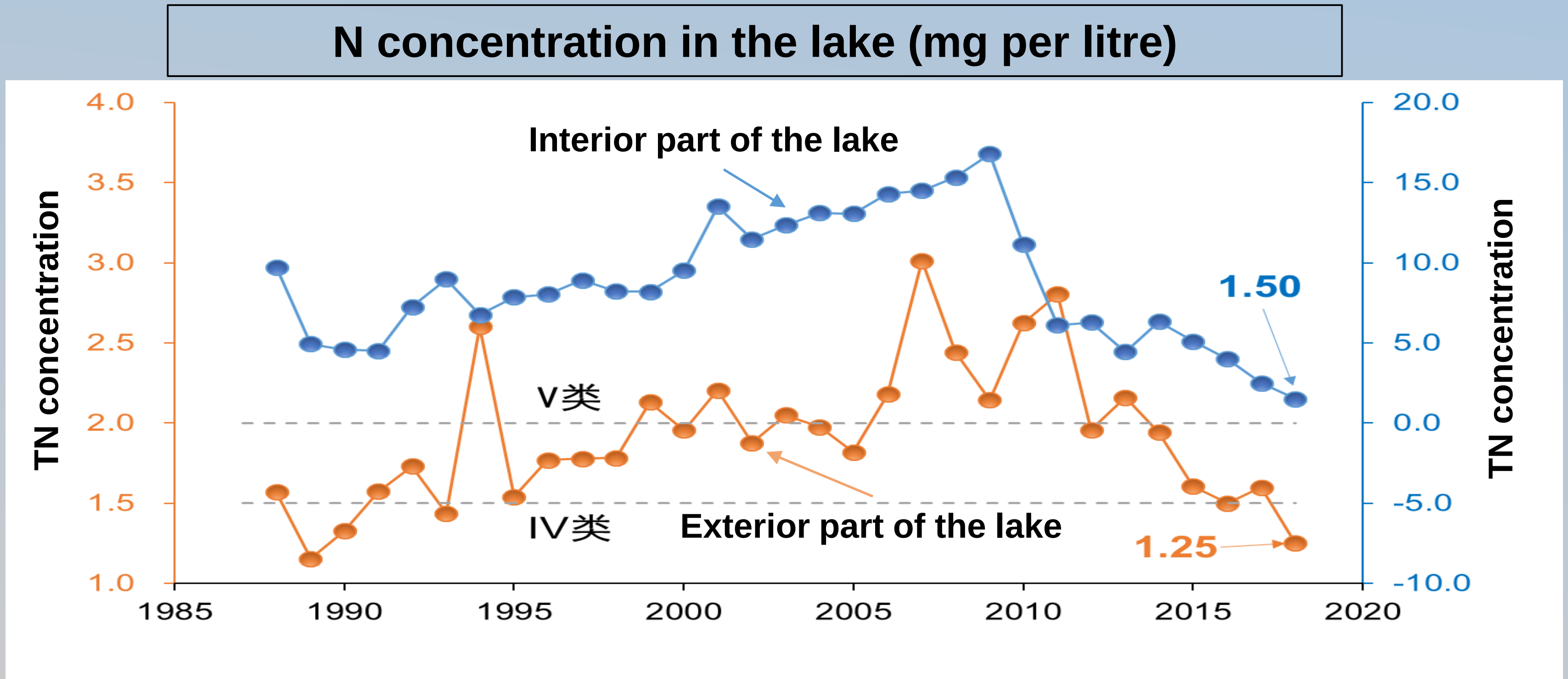
Historical status (pre-2018)

Current status (post-2018)

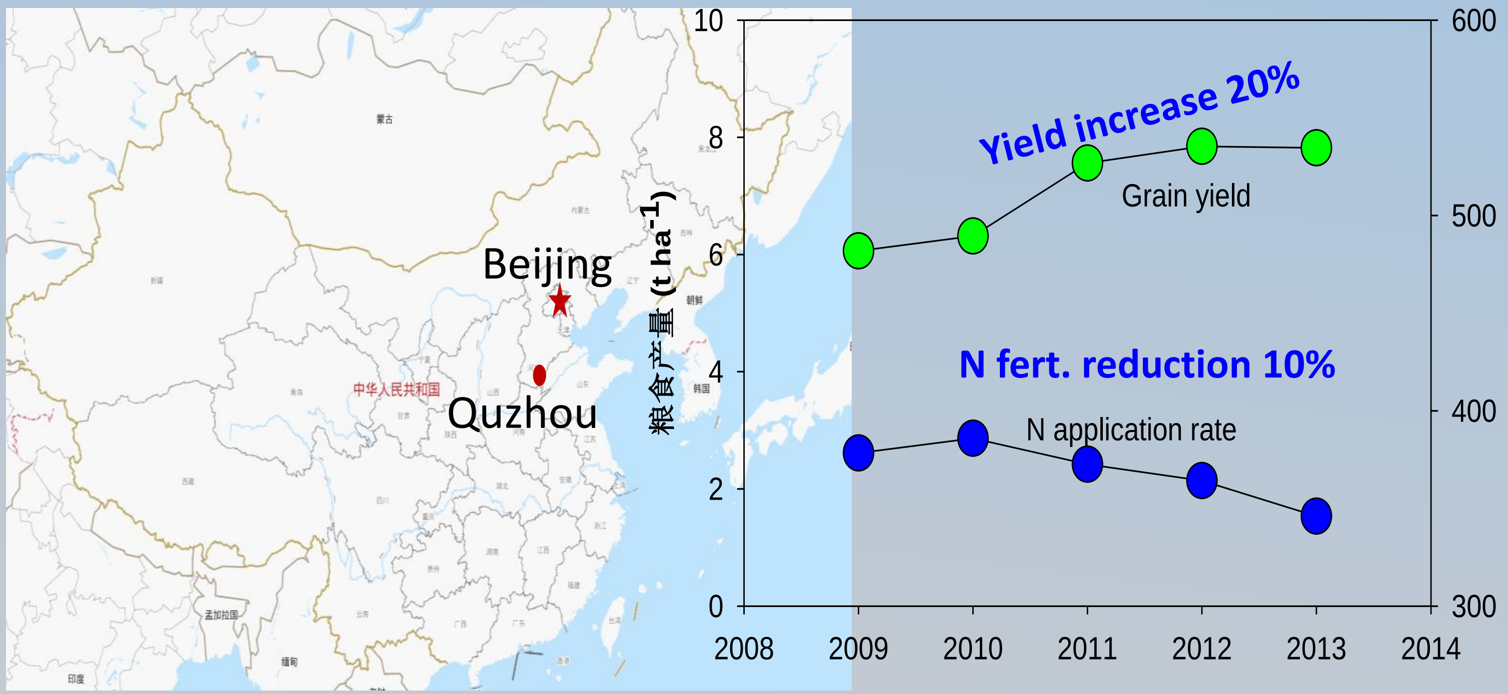
Refs: Wu et al. 2018, JH

Lake Dianchi as case study

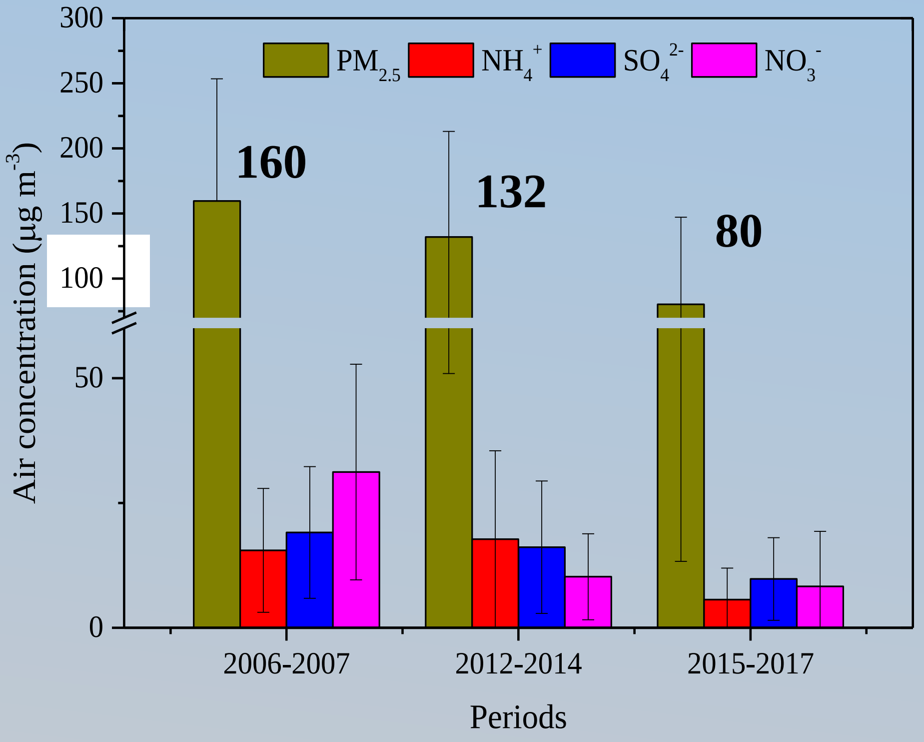




Fertilizer reduction in Quzhou, a agricultural county, with increased yield, reduced N input and PM2.5 conc. over the last decade



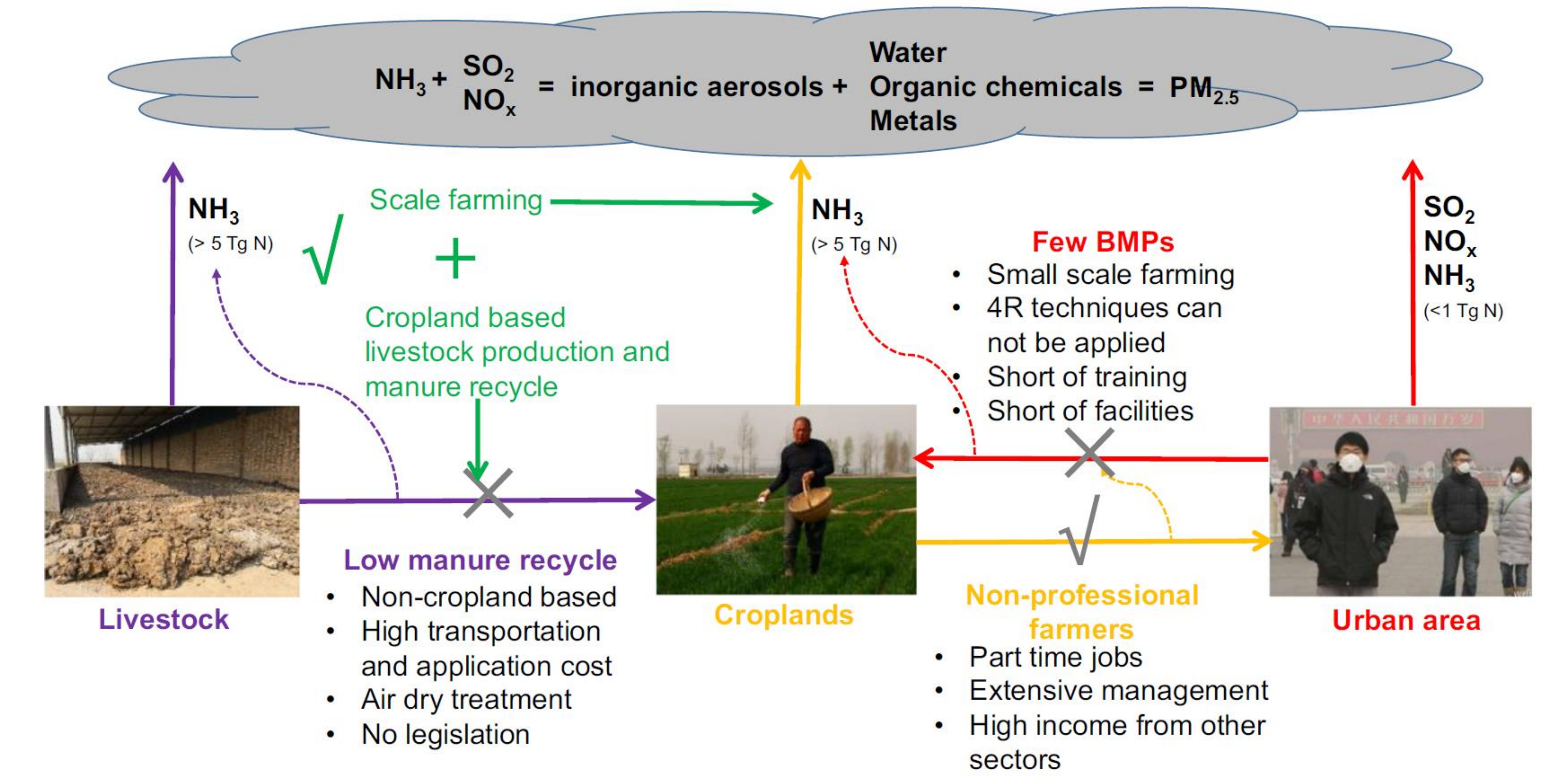
(Liu et al., 2020)



(Zhang, Xu, Liu, unpublished)

Socioeconomic barriers to reduce N loss

- **Small farm size, decoupled livestock and croplands, urban and rural isolation are important drivers**

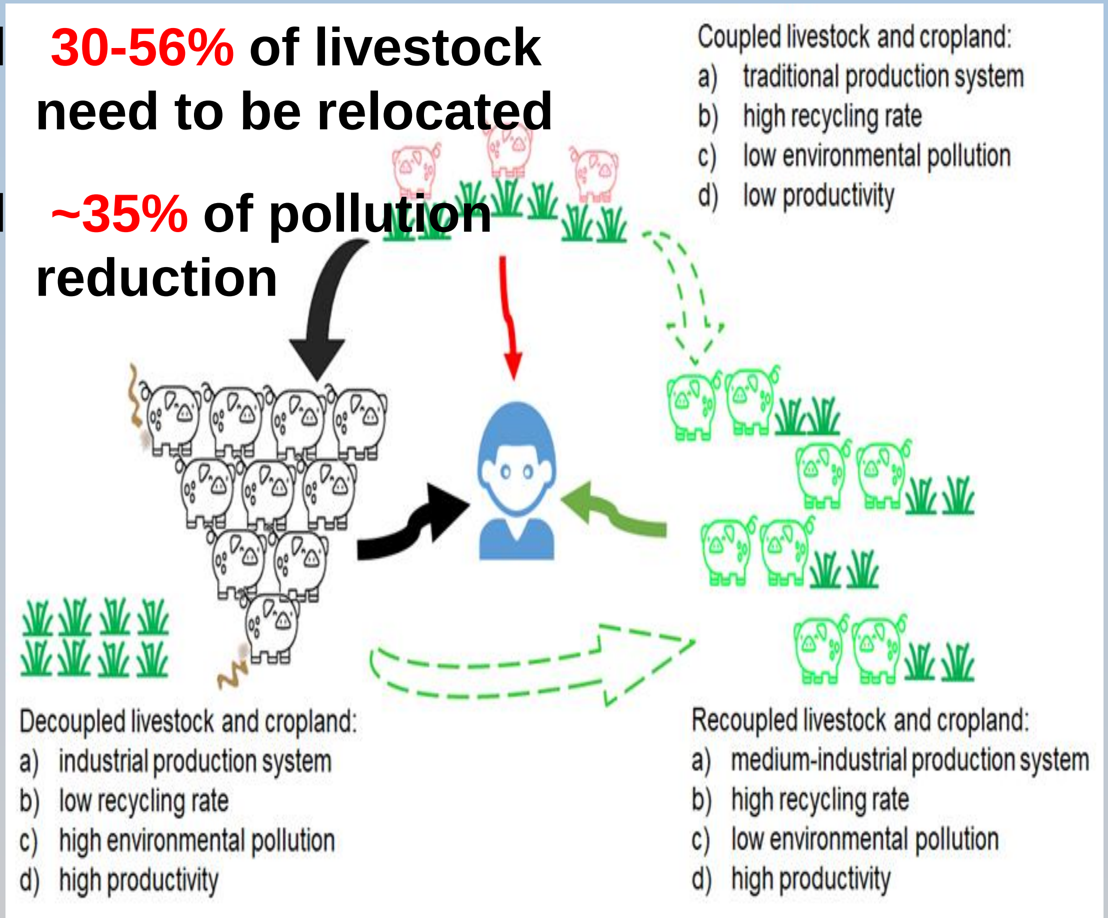


Gu et al., Environ Sci Pollut R, 2020

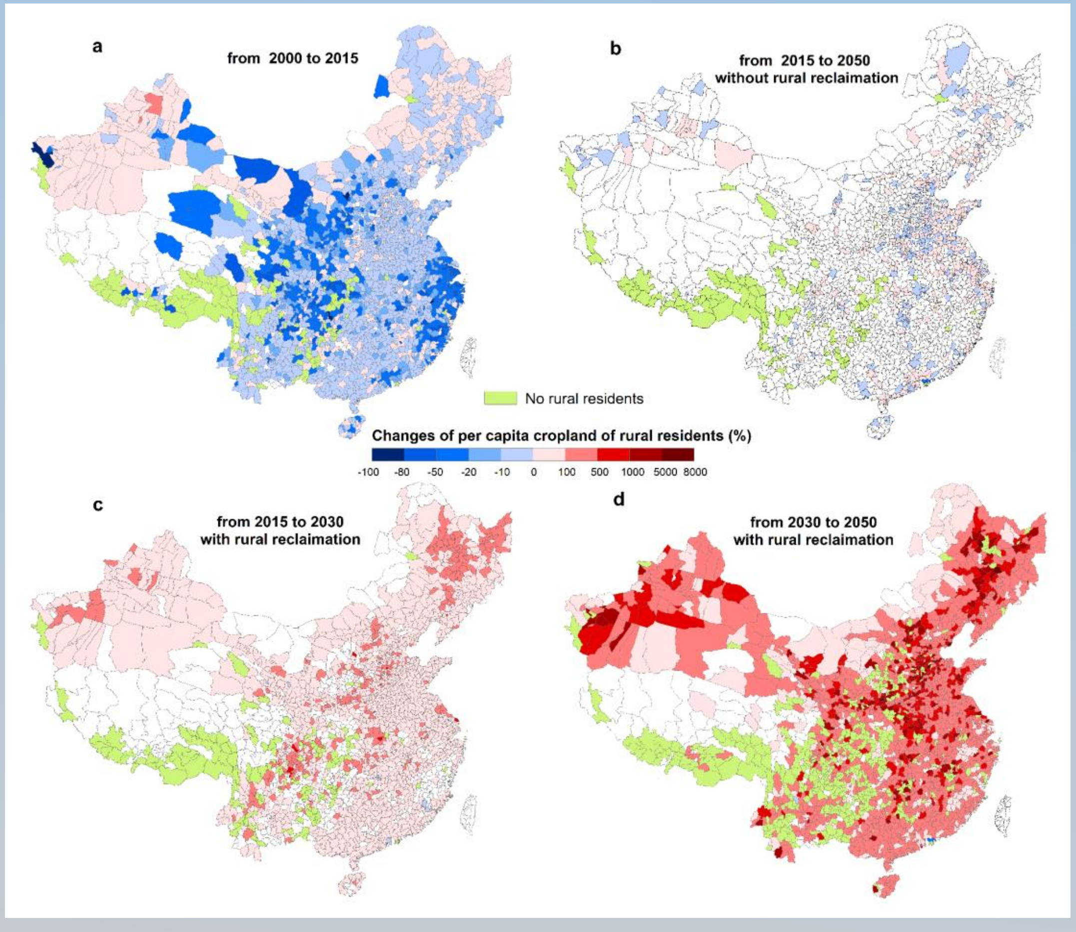
5. Future look (potential scenarios)

Recoupling livestock and cropland

- **30-56% of livestock need to be relocated**
- **~35% of pollution reduction**



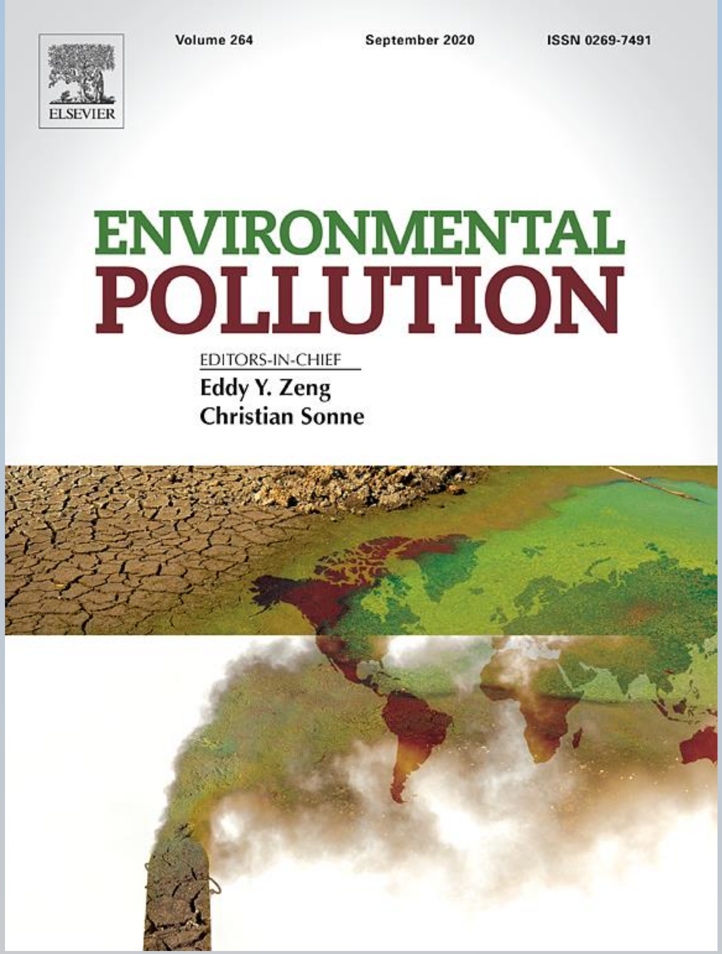
Urbanization increases farm size



Activities

Jinju, South Korea

- *Submission open: October 1, 2020*
- *Submission close: Jan. 31, 2021*
- *Final decision make: June 30, 2021*
- *SI close: August 31, 2021*



1. Nitrogen Budget and its Uncertainties in China, Gu Baojing
2. Nitrogen Use Efficiency in China's Cropping System, Yan Xiaoyuan
3. Nitrogen Use Efficiency in China's Livestock System, Ma Lin
4. Improving Nitrogen Use Efficiency in Chinese croplands, Ju Xiaotang
5. Non-point Source Pollution Control in Tai Lake, Xia Yongqiu
6. Non-point Source Pollution Control in Dianchi Lake, Zhou Feng
7. Ammonia Reduction in China: Policies and Practices, Liu Xuejun
8. Japanese Nitrogen Budgets, Kentaro Hayashi
9. Ammonia Collection Technology, Tohru Kawamoto
10. Riverine Water Quality on Nitrogen, Hideaki Shibata
11. Nitrogen Deposition Trends in Japan: Measurements, Kazuhide Matsuda
12. Nitrogen Deposition over East Asia, Syuichi Itahashi
13. Nitrogen Budgets of East China Sea, Xinyu Guo
14. Nitrogen Management Benefits Greenhouse Gas Emission in Paddy Field, Pil Joo Kim
15. Nitrogen Budget of *Pinus densiflora* Forests in Korea, Yowhan Son
16. Impact of Nitrogen deposition on Biodiversity in East Asia, Binle Lin