

# Socioeconomic barriers of agricultural nitrogen use for sustainable development

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## Abstract

Produce more food with less pollution is one of the major global Sustainable Development Goals (SDGs). To achieve such a goal, we need not only technological innovation, but also policy or institutional changes. Here we find that reduce the overuse of nitrogen fertilizers on smallholder farms have to increase their farm sizes to reduce the implementation cost of advanced fertilization technical. Urbanization can increase farm size through releasing more croplands in rural area compared to the lands taken in periphery of urban area. Meanwhile, managing food demand is also important for the sustainable use of agricultural nitrogen.

Keywords: farm size, urbanization, cropland

## 1. Introduction

Overuse of agricultural fertilizers has resulted in enormous damages to environmental quality and human health in many world regions. Reducing the use of agricultural chemicals to an optimal level is a crucial challenge for the sustainable development of agriculture.

## 2. Methods

We collect data on farm size, fertilizer use, economic growth, fertilizer price, cropping system, and cost and benefit of farming. By using these data, we explore the driving forces of fertilizer use and loss regarding to farm size. Then, using remote sensing data, we show how urbanization affect the change of farm size, with considering the changes of human diet, food waste and the efficiencies we produce food.

## 3. Results

### 3.1 Farm size and fertilizer use

Statistically, a 1% increase in farm size is associated with a 0.3% and 0.5% decrease in fertilizer and pesticide use per ha respectively. On the contrary, we found that a 1% increase in farm size is only associated with a statistically insignificant 0.02% decrease in crop yields per ha. As a result, farm size is strongly and positively associated with agricultural labor productivity (crop production per labor), with an estimated elasticity of 0.95 (Wu *et al.*, 2018).

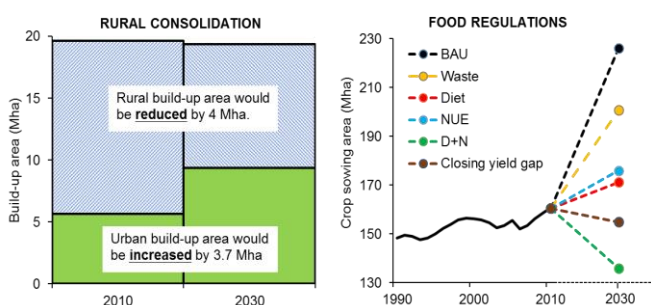


Fig. 1: urbanization, food security and agricultural pollution (Gu *et al.*, 2019).

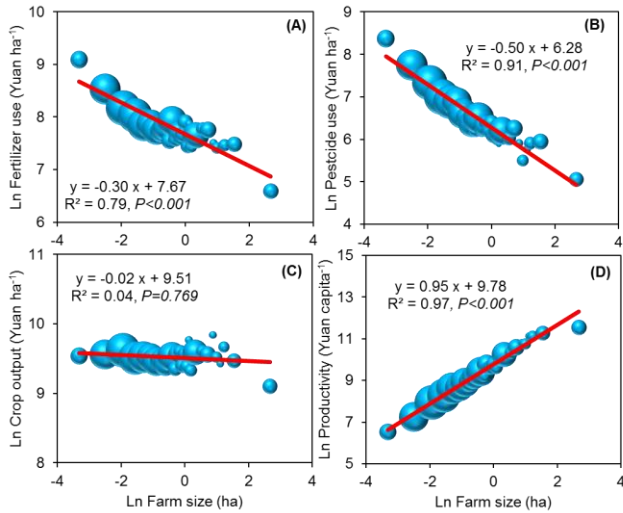


Fig. 2: relationships between farm size and chemical use per area and output per area

### 3.2 Urbanization and farm size

While urbanization takes croplands in close vicinity of cities, more rural built up lands can be potentially released for agriculture use after rural residents move to cities from a regional perspective.

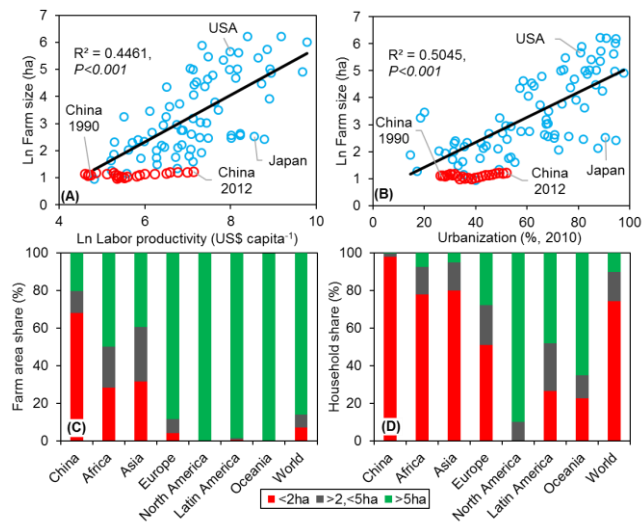


Fig. 3: variations of farm size and their response to urbanization.

### 3.3 Policy and institutional implementation

Rather than purely saving land, governments should focus more on rural land consolidation and building more functional cities to settle more rural migrants. Rural populations could move into these compact cities, so that the relatively larger rural built-up area left behind can be reclaimed for large-scale farming. But these changes need to

work alongside policies to ensure the equal rights of rural migrant families to urban public welfare such as education, public health care, and employment.

#### Acknowledgements

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#### References:

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 Wu Y, Xi X, Tang X, Luo D, Gu B, Lam S K, Vitousek P M and Chen D 2018 Policy distortions, farm size, and the overuse of agricultural chemicals in China *Proc Natl Acad Sci USA* **115** 7010-5