FCRN
Food Climate Research Network

China briefings
Environmental transformations

Photo:
Rice terraces in Yuanyang, Yunnan Province, China

Peter Liu via Flickr

Summary

China's food system generates domestic and global environmental impacts. These include land and water pollution and degradation, excessive consumption of water, greenhouse gas emissions, food waste, and deforestation at home and abroad. The expansion of the livestock sector is a significant contributor to these impacts.

Domestically, the food supply chain is a significant source of **pollution**, which affects limited land and water resources. **Chemical fertilisers and livestock waste** are major contributors to this pollution. **Agriculture** is the largest user of water resources in China and water requirements are increasing as meat and dairy consumption rises. **Food waste** is also emerging as a significant issue with consumer stage waste a leading concern. **Greenhouse gas emissions** from China's food system arise due to the use of synthetic fertilisers, from livestock and – post-harvest – from energy inefficiencies and the use of carbon-intensive fuels. China's imports of commodities from abroad (especially soybeans and palm oil) may contribute to **deforestation** and other forms of environmental damage in exporting countries.

To address these local and global issues, the policy response has been to promote more efficient use of nutrient inputs, scale up and concentrate fertiliser production in more efficient factories, set targets for water consumption, water use efficiency and quality, and standardise large-scale livestock production.

CHINA BRIEFINGS
OVERVIEW OF CHANGES AND DRIVERS IN CHINA'S FOOD SYSTEM

May 2015

Written by Huw Pohlner based on Garnett, T. and Wilkes, A. (2014) *Appetite for change: Social, economic and environmental transformations in China's food system.*

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Domestic environmental impacts

Land resources

- Per capita arable land resources are very limited in China (0.08 hectare, compared to a global per capita average of about 0.21 ha), and a large proportion of soils are of poor quality.
- Poor soil and crop management practices have contributed to significant soil erosion in some areas (e.g. the Loess Plateau).
- The Grain for Green programme was launched in 1999 to convert marginal farmed lands to forest or grassland through farmer subsidies. This has reduced soil erosion, restored degraded lands and increased water retention and carbon sequestration, while having only a limited effect on food output.

Water resources

- China has only 5.3% of the world's total renewable water resources but 20% of its population, with climate change effects potentially limiting future availability even further.
- Existing water resources are unevenly distributed and do not match the distribution of croplands.
- Agriculture remains the largest user of water, accounting for more than 60% of water use in 2011.
- Water use efficiency is low and improvements to irrigation systems are a national policy priority.
- Competition for water resources from industrial and urban water demand is rising. New systems are being piloted, such as water pricing and water rights transfers, in which industry invests in agricultural efficiency in return for the right to use the water saved.
- Groundwater abstraction has increased ten-fold between the 1950s and the 2000s and is lowering the water table across large areas of northern China.

Nutrient and mineral pollution

- Agriculture is recognised as a major source of water pollution by Chinese policymakers.
- Efficient use of nitrogen and phosphorus in the food system has decreased over time as more fertiliser is used per unit of output and more food is wasted.
- There is huge scope for increased efficiency of phosphorus use through effective sewage treatment and reuse, as all phosphorus eaten in food is excreted.

Post-harvest environmental impacts

- Food waste is a significant concern – it is a source of unnecessary methane emissions and more significantly represents a waste of scarce resources and embedded emissions.

Per capita food-related water requirements increased more than three-fold from 1961 to 2003. The increased consumption of water-intensive products such as meat and dairy is likely to drive further increases.

In 2011, nearly 40% of China's rivers were severely polluted and more than 57% of its lakes suffered from eutrophication, further reducing the availability of water for agriculture.

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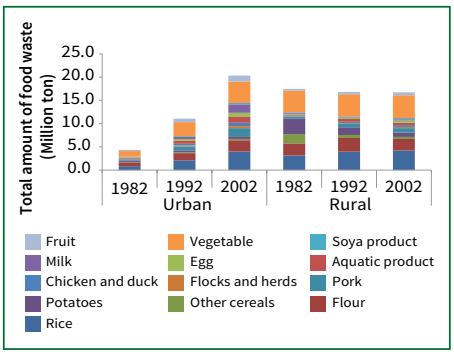
- Food waste has grown over the decades, especially consumer stage waste in urban areas (Figure 23). This is due not only to an increase in unavoidable waste from animals (e.g. bones) but also changing attitudes to waste as incomes grow and eating out, where more food tends to be wasted than in the home, increases in popularity.

Figure 23: Average food waste (kg per capita) in rural and urban households in 1982, 1992 and 2002



Source: Wei J, Ma L et al. (2008). The influence of urbanisation on nitrogen flow and recycling utilization in food consumption system of China. *Acta Ecologica Sinica*. 28(3): 1016-1025 (in Chinese).

For a more detailed discussion, see the original report here.

- One survey estimates that 80% of consumption waste is due to government and enterprise banqueting.
- There is a strong consensus among Chinese policymakers that increasing the scale of food production can help in limiting environmental impacts, though evidence in support of this approach is mixed and inconclusive.
- Longer distance food transport and more complex food chains reliant on food processing and other mechanised processes all imply increased post-harvest use of energy. This increases greenhouse gas emissions if the processes rely on non-renewable energy sources.
- Food refrigeration and freezing (especially meat and seafood) is increasing in major cities. This can potentially reduce food waste but might at the same time increase energy use.

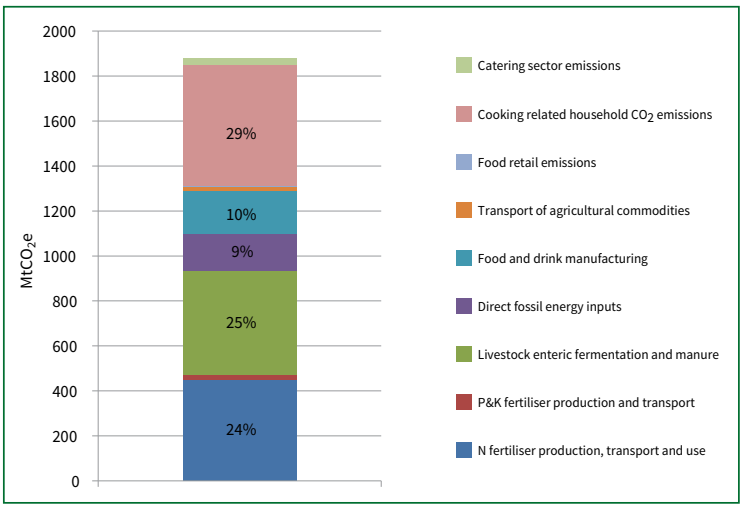
International and global environmental impacts

Greenhouse gases (GHGs)

- Total GHG emissions from the food system, production through to consumption, are a significant proportion (ca. 20–25%) of China's total national emissions and account for 4–5% of total global emissions.
- Major contributors to GHG emissions within China's food supply chain are: production, transport and use of synthetic fertilisers; natural digestive processes in livestock; and household cooking (Figure 24 - on next page).
- Policies to reduce over-use of nitrogen fertilisers, if successful, will also reduce non-point pollution of water resources, total energy use in the industrial sector, and individual farmers' costs, with no decline in yields.
- Up to 40% of total GHG emissions in the food system may occur after harvesting, mainly due to energy use in household cooking.

In 2005, direct emissions from livestock production and manure management (445 $MtCO_2e$) accounted for 6% of China's total GHG emissions. An estimation is already given (between 10–15%) indicating that there are different views/evidence on this issue.

Figure 24: GHG emissions arising from different stages in the food supply chain (production based approach)



Source: This study.

For a more detailed discussion, see the original report here.

Overseas impacts of crop imports

- China has been a net importer of virtual land resources since 1987 and net virtual water imports have also increased significantly over recent years.
- Studies of links between changes in commodity exports to China and changes in deforestation rates (e.g. in the Brazilian Amazon) suggest that China's food system also has environmental impacts in overseas regions, although more detailed analysis is required.

Mainstreaming environmental considerations through certification

Common Chinese certifications with environmental criteria include:

- **'Green Food' certification**, which began in the early 1990s and requires foods to meet standards for use of pesticides, production methods, and residue testing (US$ 20.7 billion in value in 2006);
- **Organic certification**, which began in the late 1980s, is still very limited in terms of the value of food certified (US$ 2.4 billion in 2009); and,
- **Hazard free certification**, which was introduced in 2001 and focuses on controlling illegal use of toxic chemicals and violations of pesticide residue standards.

Certifications are important for access to export markets, with 90% of China's agricultural exports carrying an eco-food label. However, urban middle class consumers are also buying certified foods due to food safety concerns. Short food supply chains that link farm to consumer directly are becoming more popular. Trust in labels remains low, however, and domestic media reports of inappropriately labelled products are common. Reports of poor enforcement of standards abound.

Policy and other stakeholder responses

Fertiliser management policies

- Improving fertiliser use is the mandate of the Ministry of Agriculture. The main initiative is the National Soil Testing and Fertiliser Program, which supplies location-specific fertiliser formulations to farmers with appropriate guidance. However, there has been little evaluation of its impacts.
- Throughout the 2000s, fertiliser policy has focused on shutting down small, polluting, economically and energetically inefficient plants. By 2010, large- and medium-scale plants accounted for over 70% of production.

Water management policies

- In 2010, the Government issued a 'three red lines' policy, with targets for total water consumption (less than 700 billion m^3 per year), irrigation efficiency (60% by 2030), and water quality (95% of key hydrological zones to exceed minimum standards).
- Water use rights transfers and water pricing policy reforms are other mechanisms increasingly promoted to improve irrigation efficiency.
- The Government has sought to strengthen regulations, monitoring and enforcement to improve water quality, particularly through the 2008 Water Pollution Law, but poor enforcement at the local level is a challenge to full realisation of these reforms.
- Different ministries (e.g. Water Resources, Agriculture, Environment) control different aspects of water management and coordination between these ministries is often lacking.

Livestock sector policies

- Intensive livestock operations, often concentrated in key watersheds and peri-urban areas, are a major cause of soil and water pollution and GHG emissions.
- Since the mid-2000s, national standards have been issued to regulate the physical infrastructure required in large-scale livestock operations, and to establish limits for waste emissions.
- Inclusion of livestock waste emissions in national targets for energy saving and emissions reductions has strengthened focus on the issue.

Food waste policies

- National policies targeting food waste across the food system have existed since the early 1990s.
- Recent public policies and civic campaigns have particularly highlighted waste in the catering industry and have led to initiatives such as the 'Clean Your Plate' campaign, calling on citizens and restaurants alike to cut down on food waste.
- Since 2010 there have been Government restrictions on publicly funded official banquets, which generate substantial volumes of waste.

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Policy implications

1. The interconnections between consumption patterns (e.g. rising meat intakes) and water requirements raise questions for policymakers about how much intervention in demand is appropriate.

2. Increasing demand for meat and dairy foods is likely to compound nutrient pollution problems as animal-based diets are inherently less efficient than plant-based diets.

3. Increased fertiliser use has been actively encouraged through government subsidies for production and distribution – these subsidies could be reoriented in order to achieve environmental policy targets.

4. Food waste mostly occurs in the supply chain rather than at the consumption stage. However, around 19% of food ordered in restaurants is wasted. Policymakers are tasked with reducing waste at several different stages of the food system simultaneously.

5. GHG management policies related to the food system have hitherto focused on pre-harvest interventions (especially in fertiliser production and application), though a significant proportion of emissions occur at the post-harvest stages. There is relatively less focus on livestock-related GHG emissions, although actions to address other forms of pollution have an indirect effect.

6. As meat and dairy consumption increases across China, direct and indirect GHG emissions associated with livestock production are likely to grow – analysis indicates a reduction of 131 $MtCO_2e$ in the sector through production side measures is potentially available (although there are many qualifiers) while also saving costs. The potential arising from demand side changes has not been quantified but is likely to be significant.

7. The future of China's food system and its environmental impacts will be affected by the degree to which international trade is regulated by higher environmental, ethical and food safety standards.

8. In 2011 the government committed to double state investment in water infrastructure over the next ten years. Addressing water pollution will continue to be a major challenge.

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