ENVIRONMENTAL IMPACTS

China's food news going forward

China's food demand is projected to grow and reshape its production and trade relations. A new study evaluates the consequent challenges for agricultural land, greenhouse gas emissions, fertilizer and irrigation water use in China and its trading partners.

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Food production is a dirty resource predator, consuming half of the world's habitable land¹, 110 million metric tons of nitrogen fertilizer² and 70% of freshwater use worldwide¹, while generating one-quarter of global greenhouse gas (GHG) emissions¹. Growing food demand will inevitably result in food production expansion — and further resource exploitation. It is challenging for any country to self-sufficiently meet its domestic demands with its limited national resources. Trade steps in and offers an opportunity to import from those countries that have a higher production capacity and produce the same good with fewer resources and lower costs. Writing in *Nature Sustainability*, Zhao and colleagues project China's growing food demands to 2030 and 2050, evaluate four corresponding environmental impacts (agricultural land, GHG emissions, nitrogen fertilizer use and irrigation water use) resulting from production and import expansion, and assess the role of trade in satisfying these demands more sustainably³.

The study estimates that China's food demands will first grow and then level off after 2030, along with consequent food production and environmental impacts. This pattern is mainly due to the assumption of saturated per-capita demand and declining population after 2030. The projections span from 2010 to 2050, with 2010 to 2020 for validation, and focus on cereals, oil crops (for example, soybeans), other crops, dairy products, ruminant meat (for example, beef), pork and poultry. Over these 40 years, the authors project that the demand for dairy products will double, and for pork and poultry will rise by one-third. The demand for soybeans, cereals and other crops will increase by twofold, one-quarter and 9%, respectively. Growing crop demands come from both human consumption (66%) and animal feeds (34%).

China will expand its production and imports to meet its growing food demands, imposing various environmental impacts on itself and on its trading partners. Impacts depend on the types and

quantities of food produced in their place of origin, and the resource inputs required to produce one unit output of each food category (that is, resource use efficiency). For example, the authors project China will drastically increase its cereal production for animal feed. Producing one additional unit of cereal requires additional nitrogen fertilizer and irrigation water, resulting in greater impacts. Animal production is a major contributor to GHG emissions compared with crop production. Altogether, the study projects China's food demand will require an additional 25 Mha of agricultural land (cropland and pastures), 17% of nitrogen fertilizer and 25 km³ of irrigation water, and will generate 104 Mt CO₂ equivalent more GHG annually, in its 2030 peak³.

Growing imports assist China in reducing its food production burden, diversifying its food sources and transferring environmental pressures to its trading partners. The changes in bilateral trade partnerships could also help China reduce its import costs while still meeting demands. According to Zhao and colleagues, China will mainly increase its imports for soybeans, beef and dairy, requiring an additional 63 Mha of agricultural land from its trading partners. Brazil will take over the United States as China's largest soybean supplier, causing Brazilian deforestation for cropland expansion. China's demands for US cereals and soybeans, both water-intensive, will employ more US irrigation water. Beef and dairy imports will increase pasture use and GHG emissions in the United States, European Union, Brazil, New Zealand and Australia, but the impacts for each will differ. For example, the United States uses fewer pastures thanks to its productive beef systems, while Brazil will bear the greatest GHG emissions burden.

With such growing production and associated impacts, environmental mitigation becomes increasingly urgent. Zhao and colleagues suggest substituting protein-intensive crops (that is, soybeans) for meat to reduce GHG emissions.

However, the realistic substitutability of protein from plants for that from animals is controversial⁴, and Chinese diets already have a long tradition of soybean use. Consumers consider costs, nutrition and taste when contemplating dietary change. Although China could import more from countries with higher resource use efficiency, its trading partners may have limited production capacities themselves. As well, local farmers may not have strong economic incentives, given their expertise and profits. In Sichuan province, China has successful examples of recycling animal manure as crop fertilizer and of using crops for animal feeds⁵. Promoting such recycling could effectively reduce fertilizer use and GHG and other pollutant generation⁶. Further studies could focus on the effectiveness of other environmental mitigation strategies too.

The future is full of uncertainty. Unexpected events that could reshape the food supply–demand relationship, such as policies, changed international relations, extreme weather, diseases and social unrest, are likely to deviate demand, supply and impacts from these projections. For example, US–China trade tensions have resulted in China importing more soybeans from South America, depressing US soybean production⁷. Owing to labour shortages, high costs of inputs and limited shipping options, food imports have become more expensive during the COVID-19 pandemic⁸. Moreover, China's afforestation policies could constrain land there available for agriculture^{9,10}, while its 10% ethanol-blending mandate could incentivize more corn production as feedstock. Zhao and colleagues take worthwhile initiative in evaluating four key environmental impacts from producing crop and animal food, given proposed future supply–demand relationships. Extending this national and international analysis, future research could downscale projections to better understand regional and local food-driven environmental impacts, allocations and possible mitigations.

Meeting future food wants without sacrificing the environment remains an enormous challenge. Zhao and colleagues show that China's growing food demands continue demanding the environment. Potential conversations and collaborations might be needed between China and its trading partners to collectively reduce possible adverse environmental impacts going forward.

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Competing interests

The author declares no competing interests.