

COMMENTS

## The urgency of Agriculture Green Development

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As Shen et al. and other authors lay out convincingly in this special issue, Agriculture Green Development (AGD) is an urgent imperative for China and the world. Clearly, high-productivity agriculture is vital for food security and economic development, particularly in a country like China, which comprises 20% of the world's population but only has 8% of the arable land.

However, the environmental costs of modern farming, as described in this special issue, are high and growing. Their impact is felt locally through pollution of water, air, and soil; biodiversity loss, including pollinators that depress agricultural productivity; soil degradation. In other countries that lack rigorous land-use planning frameworks akin to China's Agricultural and Ecological Conservation Redlines<sup>[1]</sup>, large-scale land-use change and the ensuing biodiversity loss are major local challenges. The regional impacts include growing water scarcity driven by inefficient water use, eutrophication of surface waters and dead zones in coastal waters. At the global level, greenhouse gas emissions from farming and livestock, ensuing ocean acidification and desertification rank among the highest environmental priorities. Indeed, agriculture and food production more generally are by far the sectors with the greatest environmental impact<sup>[2]</sup>. It is for this reason that Sustainable Development Goal (SDG) 2 calls for sustainable agriculture. The food system as a whole contributes to at least eight SDGs: (1) no poverty; (2) zero hunger; (3) good health and well-being; (4) clean water and sanitation; (5) responsible consumption and production; (6) climate action; (7) life below water; and (8) life on land<sup>[3]</sup>.

Researchers from China and around the world have come together in the Food, Agriculture, Biodiversity, Land-Use and Energy (FABLE) Pathways consortium to diagnose the challenges and chart national pathways toward sustainable land-use and food systems. The work lends strong support to the findings and recommendation to pursue AGD. The shift toward sustainable agriculture is an urgent priority for sustainable development in every country around the world.

A key finding of the FABLE work so far is that the greening of agriculture must be pursued as part of an integrated strategy toward sustainable land-use and food systems in every country. We have identified three core pillars (Fig. 1) for this transformation<sup>[4]</sup>: (1) efficient and resilient agriculture systems, (2) conservation and restoration of biodiversity, and (3) food security and healthy diets. This describes one of the six major transformations toward achieving the SDGs<sup>[5]</sup>.

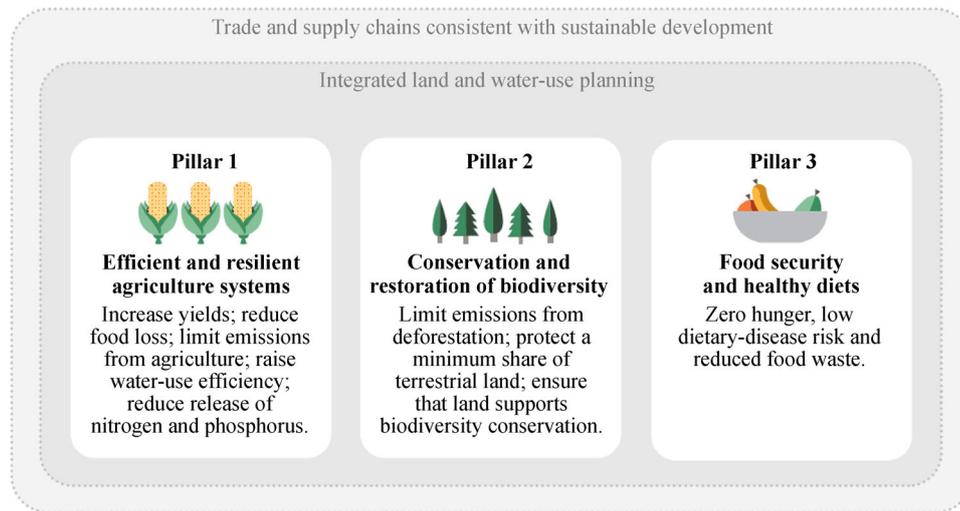
AGD is a compelling framework to reduce the environmental impact of agricultural production systems. Our experience suggests that this transformation must be pursued in parallel to efforts in support of pillars 2 and 3. For example, shift toward healthy diets, including limited consumption of meat<sup>[6]</sup>, as well as reduced food loss and waste will all reduce pressure on the supply side. Similarly, effective management systems for biodiversity conservation and restoration, such as the Ecological Conservation Redlines, are needed to curb deforestation and other land-use change. They also strengthen incentives for the sustainable intensification of agriculture, a key part of AGD.

Indeed, FABLE recommends that countries pursue integrated land-use management frameworks covering all major forms of land use, ranging from agriculture, urbanization, industry, recreation, biodiversity conservation and ecosystem services management. Such comprehensive management frameworks are critical for identifying and adjudicating competition among different forms of land-use. Policy frameworks take on very different forms across

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**Fig. 1** The pillars of sustainable land-use and food systems (adapted from Schmidt-Traub et al.<sup>[4]</sup>, with permission from Nature).

countries, owing to different governance forms, historical traditions, and institutional frameworks. Again, China's experience in managing redlines for agriculture, ecology, but also water and the expansion of urban settlements sets an interesting example for the world.

A final challenge in shifting toward sustainable land-use and food systems concerns international spillover effects. We know from the European and US experiences with promoting biofuels that well-intentioned policies can have highly adverse impacts on agriculture and the environment in other countries<sup>[7]</sup>. All major importers of food and feed must therefore consider their international footprint and work with exporting countries to curb the ensuing environmental damage<sup>[8]</sup>.

I congratulate the editors and contributors to this special issue for synthesizing the need and technique for AGD in a clear and rigorous manner. It makes an important contribution to understanding and acting on agriculture's role in meeting the SDGs. Keeping with China's tradition of holistic development approaches, AGD should be pursued with vigor in all countries as part of integrated strategies toward sustainable land-use and food systems.

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