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Balancing food system greenhouse gas emissions reduction and food security in China

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China's increasing food consumption, particularly for animal products, presents a substantial challenge to mitigating greenhouse gas (GHG) emissions, not only within China but also extending to its trading partners. In this study, we employ the well-established food system integrated assessment model (GLOBIOM-China) to comprehensively investigate GHG emissions within the context of China's future food consumption. Our study indicates that in the baseline scenario (BAU), GHG emissions from China's food consumption side are projected to be 965 million tonnes of CO_2 equivalent (Mt CO_2 eq) by 2060, similar to the current level. Domestically, ruminant production accounts for a substantial 44% of total consumption-based emissions. Meanwhile, livestock-related methane emissions take prominence in terms of different gas categories, comprising a significant 45%. Virtual GHG emissions import is expected to decrease due to the deceleration of land use change, while the GHG emissions attributable to livestock product imports are projected to incrementally rise, eventually constituting 17.2% of the total food consumption-based emissions. Striving for food self-sufficiency (SS scenario) offers a pathway to diminishing China's food system GHG emissions and virtually imported emissions by 6% and 43%, respectively. However, this scenario presents an increase of domestic emissions by 2% and simultaneously poses challenges to domestic land use and other related indicators. Maintaining basic food self-sufficiency, and reducing calorie intake from animal sources and improving production practices contribute to a 216 Mt CO_2eq reduction of total GHG emissions. This approach not only holds promise for emission reduction but also brings broader benefits such as decreased agricultural commodity prices (by -28%), reduced nitrogen fertilizer uses (by -13%), diminished agricultural land requirement (by -10%), and only 2% decline in per capita calorie intake. Our study reconciles GHG mitigation strategies and food security within China's food system, thereby contributing significantly to global sustainable development.