The implications of a global dietary shift on regional economy and environmental sustainability: a case of Australia

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The authors and the order are just proposed, subject to change if needed.

The journal we are targeting is:
1)The Lacent Planetary Health (impact factor is over 25)
2)Journal of Cleaner Production

The paper structure and writing style may be different for the above two journals, but we can first just follow our usual journal article version and adapt later.

Abstract

Dietary changes, particularly shifts toward reduced ruminant meat consumption, have the potential to improve food security and health outcomes and mitigate climate change. However, the net emissions benefits and economic consequences of widespread dietary shifts are contested, with concerns around rebound effects, spillovers into non-food sectors, and economic risks. Australia's heavy reliance on agricultural exports, with around 70% of its production value consumed overseas, makes it particularly vulnerable to potential disruptions from global dietary shifts. Additionally, its significant beef exports (around 78% of production) add further sensitivity to changes in global meat demand. We investigate the potential impacts of global diet shifts on Australia's economy and emissions footprint, in the context of its ambitious climate mitigation commitments including net-zero emissions by 2050. Our analysis applies a computable general equilibrium approach using the Global Trade and Environment Model (GTEM-Food) to explore potential implications of diet shifts in Australia. We simulate policy scenarios including global carbon prices aligned with a 1.5°C emissions pathway, combined with global dietary shifts, regionally targeted dietary shifts, and a dietary change solely within Australia. The results suggest that global carbon prices needed to achieve a 1.5°C emissions target could result in Australian agricultural output declines particularly for livestock production. While shifts in diets only within Australia have a marginal impact on the agricultural system. Reduced demand for ruminant meat in Australian export destinations can lead to significant reductions in domestic livestock production. These findings highlight the challenges and potential trade-offs Australia faces in balancing emissions reduction goals with agricultural production and demonstrate the complex interplay between global dietary trends and national economic and environmental priorities.

1. Introduction

In recent years, dietary change has been investigated not only as a strategy to improve food security and health but also as a strategy to reduce greenhouse gas (GHG) emissions (see e.g. Jarmul, Dangour et al. 2020, Aguirre-Sánchez, Teschner et al. 2023, Gatto, Kuiper et al. 2023, Horejs 2023). Crippa, Solazzo et al. (2021) found that food systems are responsible for 25 % to 42 % of the total human induced GHG emissions. Clark, Domingo et al. (2020) even showed that without the reduction of food systems' emissions the global 1.5°C climate target will not be achieved anyway. However, Gatto, Kuiper et al. (2023)'s study found that economy-wide greenhouse gas emissions would actually increase if the world shifts towards the EAT-Lancet diet (Willett, Rockstrom et al. 2020) as the rebound effect is in place for consumption on non-food items to substitute food consumption. Similarly, a regional study for China showed that dramatic reductions in meat consumption may produce smaller reductions in emissions, as the consumption of other ingredients increases to compensate for the nutrients in meat and rice in China is the largest contributor to GHG emissions. A recent review study by Aguirre-Sánchez, Teschner et al. (2023) shows a wide range of climate mitigation potential in the current dietary guidelines across countries. Therefore, further research on regional environmental implications of a dietary shift is needed to assess the effectiveness and feasibility of those global dietary recommendations from a regional perspective.

Australia, therefore, is such a country that needs further investigation. On the one hand, Australia exports around 72% of the total value of agricultural, fisheries and forestry production in the 2021-2022 financial year, among which 78% of beef and veal production is exported. Its agriculture exports accounts for 11.6% of its total exports in the same financial year. With a global dietary shift away from meats, it could be a big shock on Australia's exports and therefore the macro-economy. On the other hand, Australia is very keen to commit to its climate mitigation target as of the Paris Agreement and also the net-zero emissions target before 2050. Since agriculture emissions accounts for 18% in Australia's total GHG emissions in 2022-2023 financial year, reducing agriculture emissions is part of its climate mitigation policy. As a high-income and developed country the dietary shift recommendations, such as the EAT-Lancet diet, are being considered as one of the agriculture emissions reduction strategies. But can such dietary shift really help Australia to mitigate GHG emissions? If yes, by how much? There are some studies on food availability and environmental impacts of a healthy dietary shift in Australia (e.g. Candy, Turner et al. 2019, Ridoutt, Baird et al. 2021). However, these studies on Australia did not address the economic aspect of the shift; and furthermore, the impact assessment of a global dietary shift rather than a shift within Australia is missing. Therefore, a comprehensive study is needed to assess the economic and environmental impacts of a global dietary shift on Australia.

In this study, we aim to bridge the research gap by using a global computable general equilibrium (CGE) model GTEM-Food (Nong, Mason-D'Croz et al. 2021) to assess the economic and environmental impacts of a global dietary shift on Australia. GTEM-Food is developed as a branch of GTEM model (Pant 2007, Cai, Newth et al. 2015) which has been tailored to better represent agriculture and food system in a CGE model. In GTEM-Food's database, livestock and food-processing sectors in the Global Trade Analysis Project (GTAP) database were split into sub-sectors using the information in the Food and Agriculture Biomass Input-Output Model (FABIO) and IMPACT-Fish model. In particular, the animal sector was disaggregated into live cow and live sheep and other animal products were split into live pig and live poultry sectors. Meat was split into beef meat, lamb meat, pig meat, and poultry meat, and fishery was disaggregated

into aquaculture and wild catch fishery. For household consumption, food was split into four different categories (animal-sourced foods, staples, other crops, and processed foods) that allow the substitution within each group. All these features allow us to implement the dietary shift according to different good categories and the food production and consumption system is better represented.

To address our research question, we set up four policy scenarios in additional to the baseline scenario. The first policy scenario (P1) assumes that all the regions have a global carbon price that would hit an emissions pathway consistent with the 1.5°C target by 2100. This specific emissions pathway would be derived from the IPCC AR6 report (IPCC 2022). The second policy scenario (P2) would still need to follow the same emissions pathway as P1, then we obtain a global carbon price pathway with the implementation of a global dietary shift (e.g. EAT-Lancet diet) in all the regions across the world. The third policy scenario (P3) is similar to P2, except that the dietary shift is implemented only in high-income regions. The fourth scenario (P4) is then the case where the dietary shift is only implemented in Australia. This last scenario is more like a reference scenario so that we can see how the results compared to other Australia studies.

In all these scenarios, our analysis would focus on the how the dietary shift would impact the derived global carbon price pathway and the global agriculture emissions. Under the global context, how would Australia respond to those different scenario settings in terms of GDP losses, agriculture production and exports, agriculture emissions, economy-wide GHG emissions, etc. From the results, we can also know on what level the dietary shift would have larger or smaller impact for Australia and in which direction. These results would contribute to the literautre and policy discussion regarding the economic and environmental impact of a dietary shift on the regional basis but under the global context.

2. Methodology

2.1 Overview of GTEM-Food

2.2 Baseline diet projection and calibration

2.3 Scenario design

3. Results

3.1 Global implications

3.2 Economic implications for Australia

3.3 Environmental implications for Australia

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4. Discussion and Conclusion

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