Australian Government
Department of Agriculture, Fisheries and Forestry
ABARES

ABARES
Insights

ISSUE 6, 2022

Emissions, agricultural support and food security

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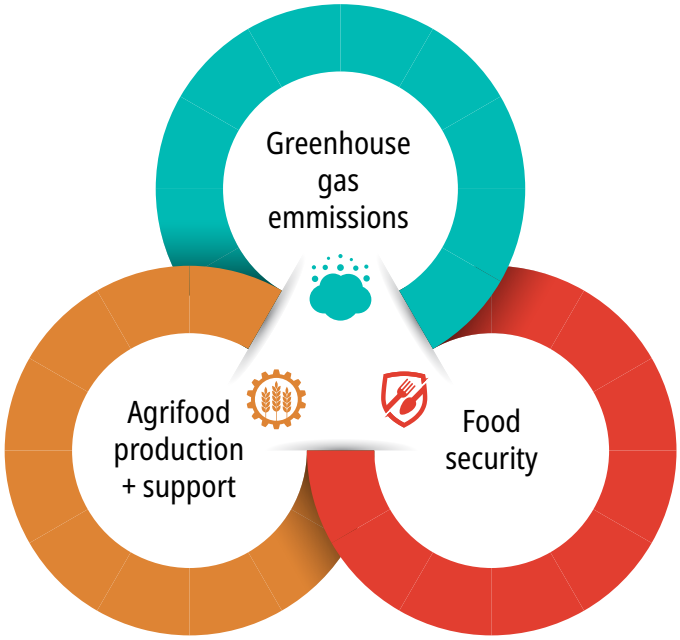
There is a global imperative and commitment to reduce greenhouse gas emissions. To reduce global emissions, it is essential to seek all avenues for reductions. Agriculture and related land use accounts for around 12% of global emissions. Many countries provide agricultural support in order to boost rural incomes and domestic food production. Global agrifood production remains heavily subsidised and protected in many parts of the world, implying that avoidable emissions are subsidised by taxpayers around the world. A reduction in global agrifood subsidies, tariffs and quotas would lead to a recalibration of agrifood production, with implications for emissions. Could the world cut emissions from agrifood production, improve food security and raise global economic growth?

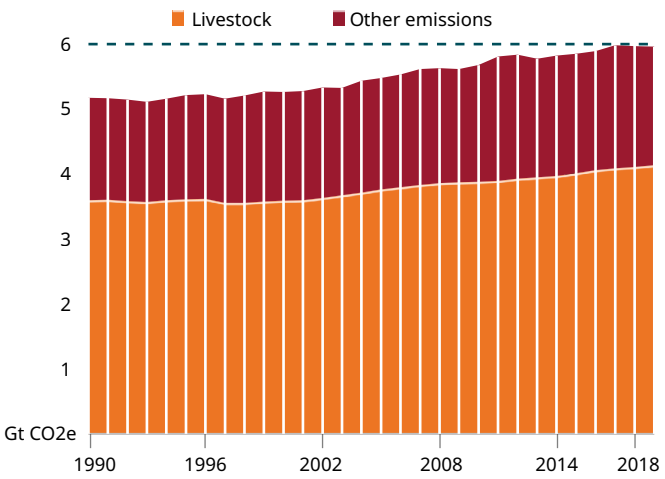
The agrifood nexus: emissions, support and food security



Agrifood production is an emissions-generating process

Greenhouse gas (GHG) emissions are fundamental to the biological processes that underpin agrifood production. But like most areas of economic activity, agricultural GHG emissions need to be managed, reduced or offset in order to cut global emissions to achieve a climate neutral world by mid-century and meet the Paris Agreement (UNFCCC 2015; IPCC 2018). Since the 1990s global emissions attributed to agriculture have increased (Figure 1). However, there is an innate correlation between food security and greenhouse gas emissions from agriculture – the world needs to feed itself. This highlights the global need to identify and remove unnecessary emissions from agrifood production.

FIGURE 1 Global emissions from agriculture and related land use have been increasing



Source: FAOStat (2022)

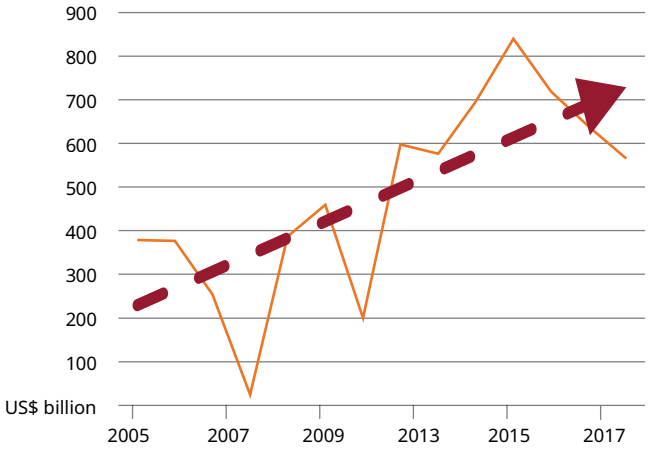
To achieve the twin goals of global food security and reductions in GHG emissions, the emissions intensity of agricultural production has to be significantly reduced. This could be via growth in productivity, changing production/diets, or the development of mitigating technology. This report examines the first two concepts.

Agrifood support has been increasing

Agrifood support can provide a localised boost to agrifood production in the short term. Support can be categorised as i) domestic (mainly subsidies or administered price supports) or ii) trade barriers (such as tariffs and quotas). Many countries around the world provide support to agriculture, and the value of distortions in agriculture has been rising (Figure 2). Domestic support is generally relatively higher in high income regions (Figure 3) and trade barriers are more common in middle and low income regions (Figure 4).

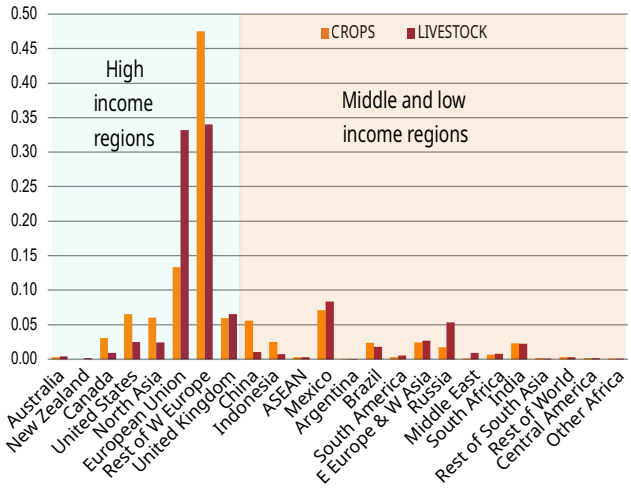
Agrifood support reduces world prices (and therefore incomes) received by farmers in non-supporting countries, cutting the incentives to produce food, and consequently reducing agricultural production in countries that do not impose agricultural support. This has potential flow-on effects to global food security.

FIGURE 2 The value of distortions in global agriculture has trended up



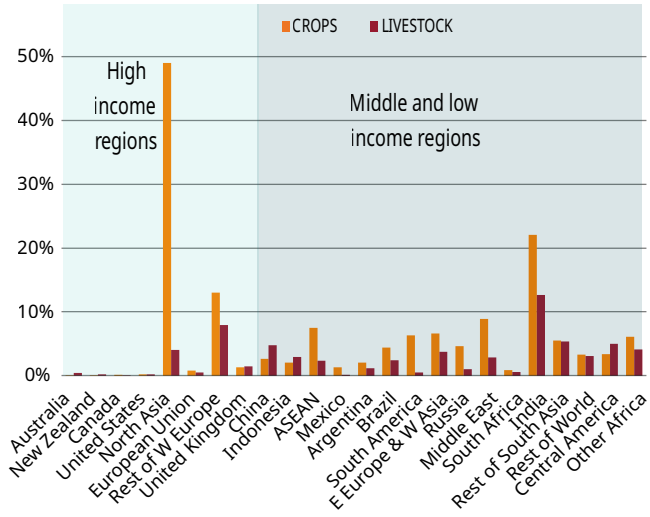
Source: The International Organisations Consortium for Measuring the Policy Environment for Agriculture (2022)

FIGURE 3 Domestic agriculture support is concentrated in the rich world (domestic net subsidies in US dollars per dollar of output)



Note: Definitions of income strata are adopted from DISER 2022 (Table 11). Source: Authors' calculations from GTAP10a database (Aguiar et al. 2019).

FIGURE 4 Agricultural tariffs (averaged from all importing sources) are mostly employed in developing countries (and North Asia)



Note: Chart includes tariffs and tariff-equivalents of quotas. Definitions of income strata are adopted from DISER (Table 11). Source: Authors calculations from GTAP10a database (Aguiar et al. 2019).

Food security and agricultural support

Food security encompasses availability, access, utilisation and stability (FAO 2006). Availability of food (based on energy, fat and protein produced) has continued to rise over time. However, most agricultural support threatens these key pillars, as demonstrated by Eather, Duver & Fell (2022). Agricultural support also adversely affects the development of a competitive agricultural sector and threatens economic access to food by curbing long-run economic development (Burns, Addai & Nelson 2022).

FIGURE 5 The key elements of food security

Source: Adapted from FAO (2006)

Agricultural support and environmental effects

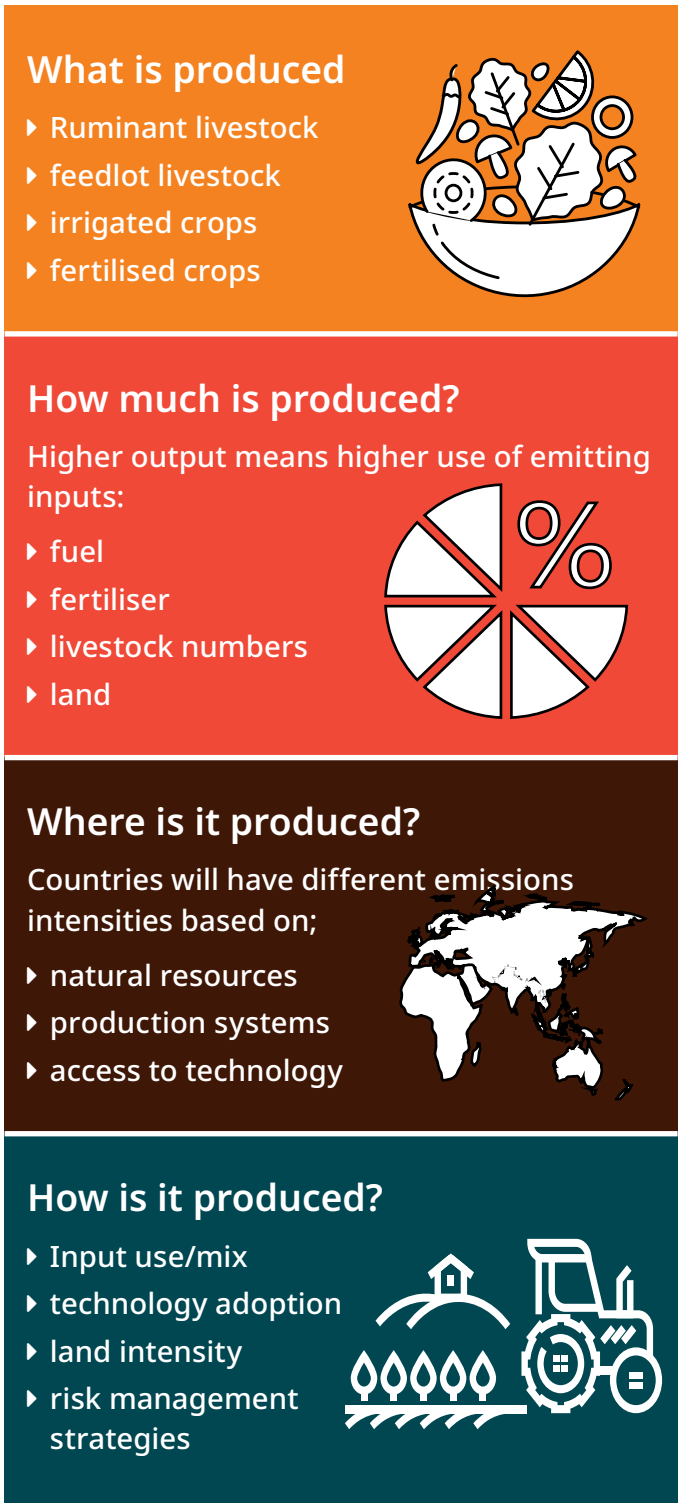
Agricultural support influences production patterns, farming practices and input use by changing the relative costs and returns of using resources in agriculture, or by imposing direct restrictions on input use and output (Henderson & Lankoski 2019). To understand the environmental effects of agricultural support, it is useful to understand how support influences:

1) what is produced
2) how much is produced
3) where it is produced
4) how it is produced.

Mamun et al. (2019) cover these concepts in greater depth. Importantly, some forms of support will also affect consumption decisions for food products, such as by lowering the price of targeted foods, or restricting the availability of some imported foods. These policies will affect both final food consumption and consumption of agricultural products as inputs to the food production process.

Agricultural support can increase GHG emissions by encouraging production of emissions-intensive commodities, by expanding production into more marginal areas requiring greater input use, by shifting production to less productive countries and by encouraging farmers to move away from the most efficient production systems. These ideas are illustrated in Figure 6 with some key concepts explored further in this section.

FIGURE 6 Understanding how agricultural support is linked to emissions



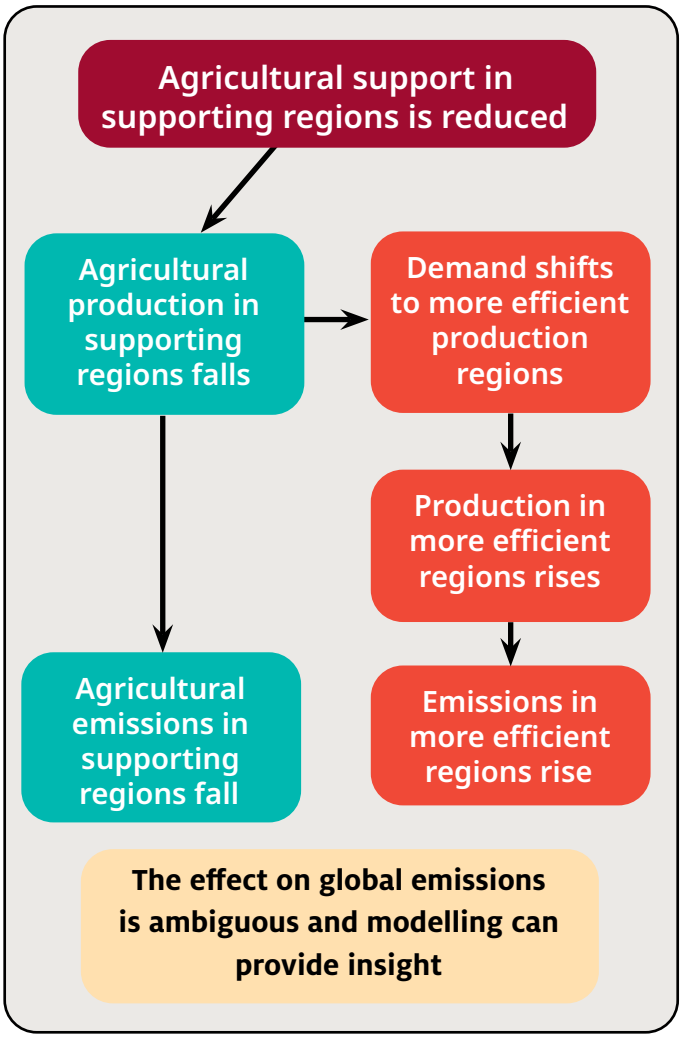
Input use and different emissions intensities are key influences on global emissions outcomes

Emissions intensities

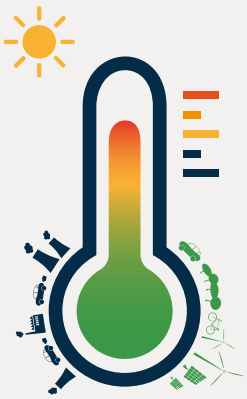
A fall in agricultural support could lead to a fall in production in supporting regions. This likely leads to a reduction in emissions in those regions. However, a fall in production in one country will be offset by increases elsewhere, as food imports increase to satisfy demand.

Production processes in different countries have different emissions intensities. In the absence of restrictions on emissions or carbon pricing, this means that a shift in demand to an alternative (e.g. non-supporting) country could lead to a global rise or fall in emissions depending on relative emissions intensities (Figure 7). These ideas are illustrated through simple demonstrations below.

FIGURE 7 Modelling of support and emissions can provide insight on global emissions outcomes and inform policy direction

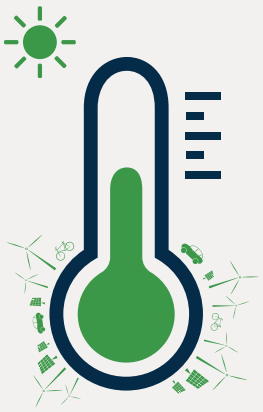


BOX 1 A case where global agricultural emissions rise in the absence of carbon pricing



Global agricultural emissions could rise following the removal of agricultural support. For example, if country A (a low emissions intensity country) provides agricultural support and withdraws that agricultural support, production in A falls and country A starts importing from country B (a high emissions intensity country). If the production increase in country B makes up for the fall in country A, and if B has higher emissions intensity, then global agricultural emissions rise.

BOX 2 A case where global agricultural emissions fall in the absence of carbon pricing



Global agricultural emissions could fall following the removal of agricultural support. For example, if country C (a high emissions intensity country) provides agricultural support but withdraws it, production in C would fall and country C would start importing from country D (a low emissions intensity country). If the increase in production in D makes up for the fall in production in C, and if D has lower emissions intensity, then global agricultural emissions would fall.

Production of inputs also influences emissions

The final outcome on global emissions also depends on changes in production, emissions intensities and changes in final products and inputs consumed (given that production of some products, e.g. livestock products, innately has higher emissions intensity). More efficient producers typically use a lower cost bundle of inputs to produce a unit of their output. The removal of agrifood support would shift food production to more efficient food producers. This could require fewer agricultural inputs into food production and thereby less agricultural production, reducing global emissions from agriculture. Alternatively, it could lead to increased use of cheaply produced agriculture (e.g. from already deforested land), raising the emissions intensity of food production.

Reducing support can affect food security

Food security is multi-pronged (see above), and higher incomes, lower consumer prices and availability are important considerations. Importantly, when agricultural support exists, the price received by agrifood producers is often not the same as the prices paid by agrifood consumers. In other words, agrifood support can introduce a wedge between the prices received by producers and the prices paid by consumers. This reflects government interventions in the market, such as subsidies and border tariffs.

Reflecting the removal of the wedge between production and consumption, the removal of agrifood support would affect global food production and consumption differently, depending on the nature of the support. In the case of removal of border tariffs, it would lower prices paid by consumers and raise prices received by producers in less supported regions thereby raising their production, while also affecting incomes. In the case of removal of domestic production subsidies, it would lower prices received by producers in subsidised regions thereby reducing their production, leading to higher prices to be paid by consumers.

Effects on producers

Depending on the responsiveness to price changes, a cut in support could:

- raise prices received by producers in countries with relatively lower support
- reduce prices received by producers in countries with relatively higher support
- raise production in countries with low support
- reduce production in countries with high support.

Effects on consumers

The removal of agrifood support could affect incomes, consumer prices and consumption as follows:

- higher prices received by agrifood producers in non-subsidising countries could raise rural incomes
- lower prices for consumers in importing countries
- higher long-term income growth in countries removing agricultural support/distortions
- reductions in unnecessary input use (e.g. grains as inputs) for some supported agrifood products (e.g. livestock) reduces agricultural inputs in food production and improves availability of food.

Food security outcomes from cutting agricultural support would be expected to improve, as efficiency in global food production increases as a result of reduced distortions from agricultural support, as discussed by Eather, Duver & Fell (2022).

Curbing emissions and ensuring food security is possible from the removal of agrifood support

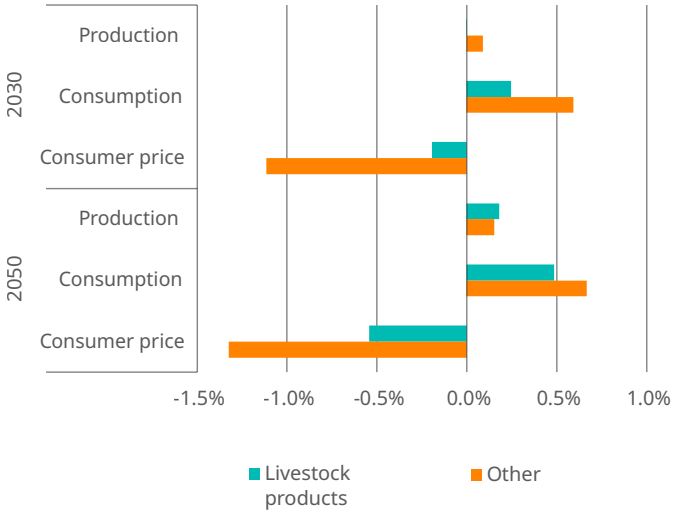
ABARES has investigated the relationship between agrifood support and the multiple goals of curbing emissions and ensuring food security (Greenville, Cao & Burns, forthcoming) using the Global Trade and Environment Model (GTEM) (Pant 2007; Cai et al. 2015). GTEM is well suited for the analysis of domestic support and trade policy, as it incorporates global trade, detailed greenhouse gas emissions accounting, tariffs and subsidy levels for multiple regions and multiple sectors. GTEM accounts for carbon dioxide, methane, nitrous oxide emissions and other greenhouse gases, including F-gases (hydrofluorocarbons and perfluorocarbons) and sulphur hexafluoride (SF6), and incorporates multiple production technologies for emissions-intensive sectors. This means that the modelled emissions outcomes reflect differences in the emissions intensity of agrifood production (comprising both agriculture commodities and food manufactures) in different countries (e.g. through use of energy generated by different technology mixes).

Modelling results show that reductions in agricultural support would cut global economy-wide emissions if sufficient constraints to agricultural land expansion (such as a ban deforestation) are in place. A reduction in agricultural support would also improve food security outcomes, while also cutting unnecessary use of agricultural inputs. Economic growth is also boosted across the world, in both high income regions and middle and low income regions, reflecting the removal of distortions and the more efficient flow of resources and investment to activities with greater economic returns.

Global food consumption rises and consumer prices fall when all agricultural support is removed

Modelling results (Figure 8) demonstrate that in the medium (2030) and long term (2050), reforms to remove agrifood support would promote both production of food and households' consumption of food across both high income and middle and low income regions. This reflects the flow of economic resources to specialist agrifood producing regions, allowing food to be produced more efficiently. The results also show that consumer prices fall. Increased food production and lower consumer prices demonstrate that reform can deliver improved food availability and access, two key components of food security.

FIGURE 8 The removal of agricultural support improves global food security by enabling more efficient food production, compared to the baseline



Note: The increase in livestock product consumption without a corresponding increase in production results from a shift towards more efficient food systems that result in less waste, enabling more final good production per unit of agricultural input.

Allowing the expansion of more efficient production systems helps maximise production from land use, and more efficient food sectors help minimise loss and waste, delivering more food at lower prices to the global community. Globally, following the removal of all agrifood support, the food sector's intensity of agricultural input use falls as higher agricultural producer prices (due to the removal of subsidies) and changes in the location of production (due to the removal of border tariffs) drive global efficiencies. Agricultural input intensity to food production falls (Figure 9), helping to deliver lower emissions from the food system in aggregate.

The shift in the type and location of food production is shown in Figure 10. The shift to more efficient food producers, who require less agricultural inputs into food production, means that less agricultural production is required to meet demand, e.g. less crop inputs in livestock product production. While agricultural output declines slightly in some middle and low income countries by 2050 (relative to the baseline), food security improves in these countries due to higher income growth, higher imports and lower food prices (i.e. improved economic access to food).

FIGURE 9 As global food production becomes more efficient (and rises), intensity of agricultural input use falls, compared to the baseline

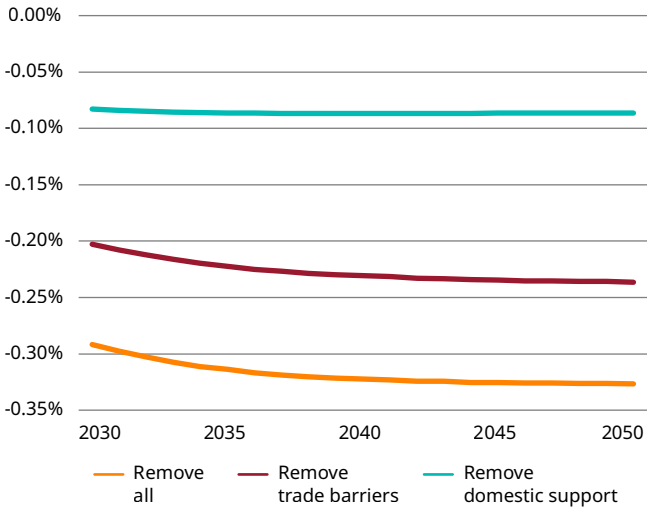
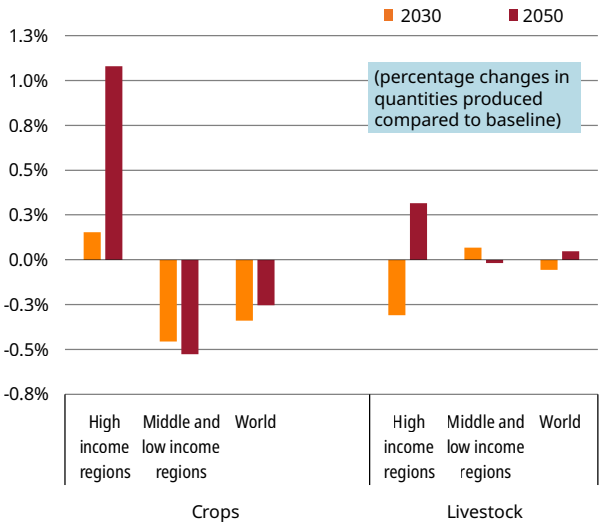


FIGURE 10 Agricultural support reform would lead to a shuffling of locations of production of agricultural products, compared to the baseline



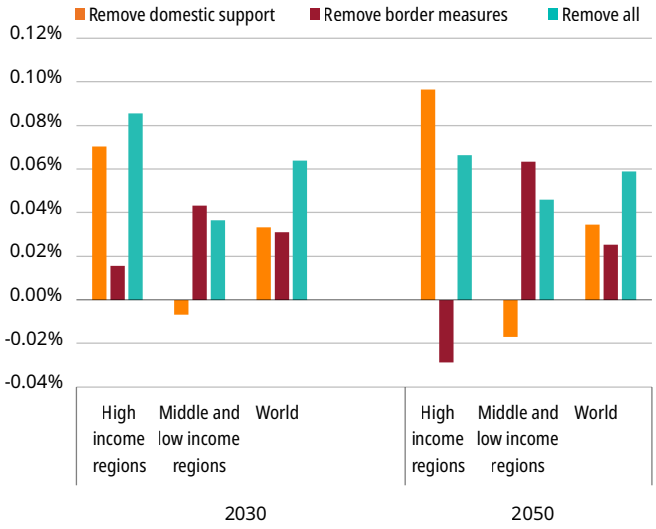
Note: While agricultural production falls in middle and low income regions, food security improves through higher economic growth and lower food prices.

Economic growth in high, medium and low incomes regions improves when all agricultural support is removed

Modelling results demonstrate that in the medium (2030) and long term (2050) aggregate incomes in high, medium and low income economies rise when agrifood support in all its forms is removed. This demonstrates the importance of holistic reform: when domestic support and trade barriers (tariffs and quotas) are removed, a more equitable outcome is achieved. This is because the global gains from trade are maximised — the wedge between production and consumption that is caused by the support is removed.

In contrast, the removal of just domestic support globally brings a long run overall income increase only to high income regions, while middle and low income regions lose out (Figure 11). This is because domestic support is largely imposed by high income regions. Its removal reduces distortions and allows economic resources within these economies to flow to activities where the economic returns are greatest. This substantially expands the high income economies — at a cost to other economies as resources flow to the high income economies which have become relatively more competitive. In this situation, trade barriers (tariffs and quotas) limit the ability of low support countries to expand agricultural production in response to the changes seen in heavily subsidised high income countries.

FIGURE 11 A removal of all agrifood support (domestic support + trade barriers) brings more equitable outcomes and improves global incomes (measured by Gross National Income), compared to the baseline

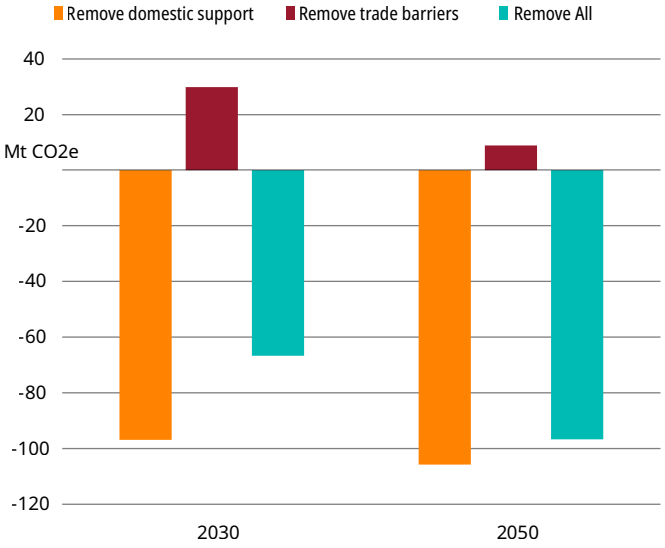


Likewise, when only trade barriers (tariffs and quotas) are removed, the results demonstrate that in the long run (2050) only the middle and low income regions gain, at the expense of high income regions. This is because tariffs are imposed largely by the medium and low income regions. The removal of these trade barriers allows economic resources to flow to their highest return and improves the relative competitiveness of these countries.

Emissions fall when all agricultural support is removed

Overall, global emissions fall when domestic agrifood support is removed and when total agrifood support (domestic support and trade barriers) is removed, as long as sufficient constraints to agricultural land expansion are imposed, such as a ban on deforestation (Figure 12). The drivers of lower emissions are as described above: switching the location of production to more efficient agrifood producers, and lower emissions intensity in food production through reduced intensity of input use. In other words, the results confirm that agrifood support encourages use of inputs above and beyond what is necessary, with adverse climate impacts. Furthermore, the shift towards a more efficient food system helps increase the rate of emissions falls from increased agricultural productivity overtime. This is shown by the greater difference between emissions reductions between 2030 and 2050 with trade reform included (Remove all) versus removing just domestic support. In other words, comprehensive reforms help to enable emissions by promoting agricultural productivity growth.

FIGURE 12 Modelled change in global economy-wide emissions

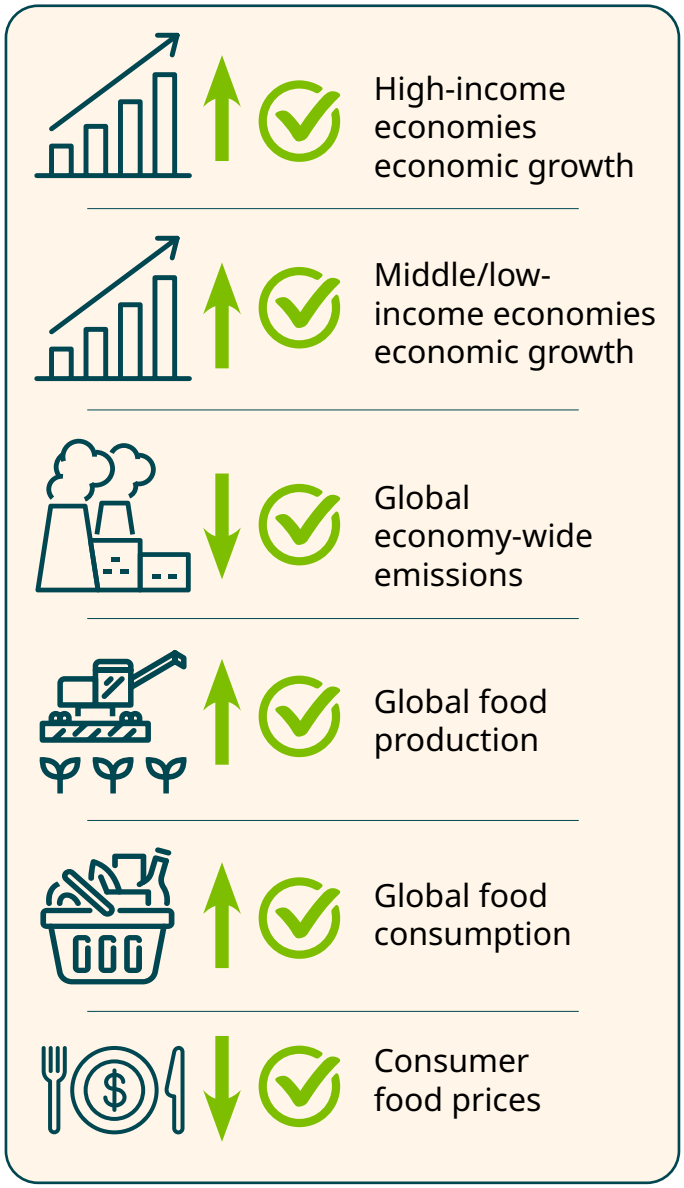


An essential caveat to these results is that they hold true when sufficient constraints to agricultural land expansion are in place. Policy reform which increases farmer incentives to clear forests may lead to higher emissions and other environmental costs. Furthermore, while the projected changes in emissions form a small part of the global emissions story (agriculture emissions currently sit at around 6Gt CO2e), it is imperative to explore all avenues for emissions reductions. These results show that emissions can be reduced while also achieving other goals, such as ensuring food security and advancing economic development (Figure 13), provided reform is carefully targeted to avoid perverse environmental outcomes.

Partial reform does not fulfil multiple goals of lower emissions, food security and economic development

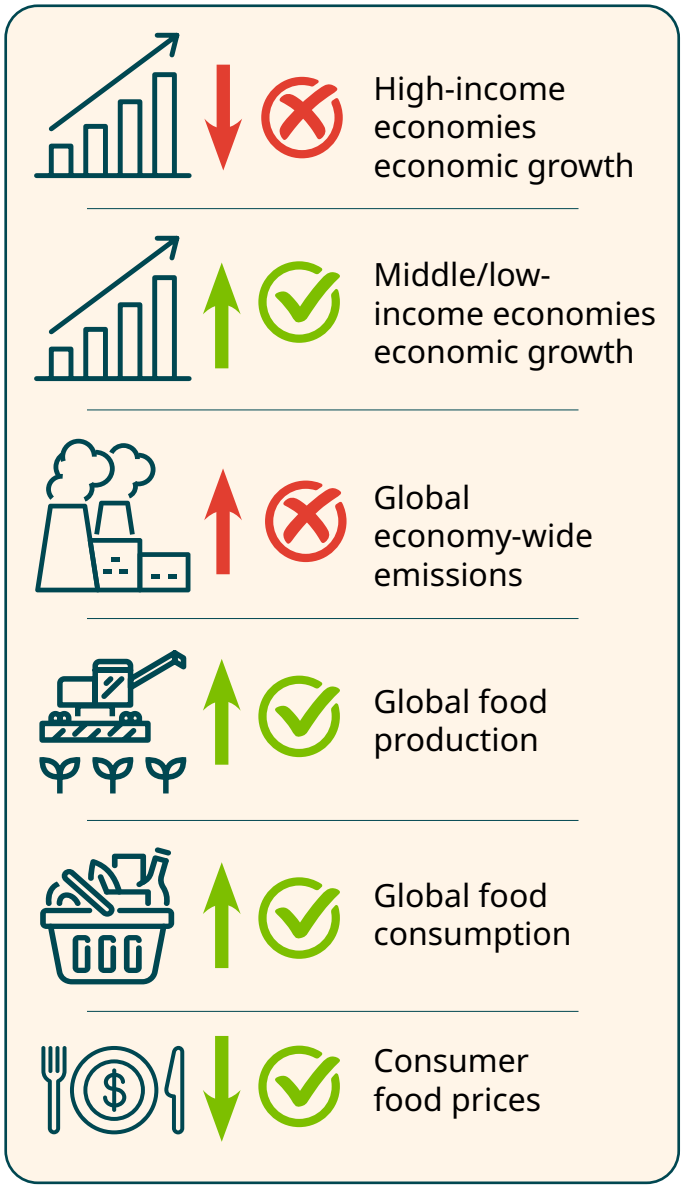
The results also show that higher emissions arise when only trade barriers are removed, since global agrifood production increases (Figure 14) and there is a relocation of production of certain products to countries that have higher emissions intensities. These countries benefit from the exclusive removal of trade barriers (tariffs and quotas), but have higher emissions intensities. However, by 2050, much of the increase in agricultural emissions is eroded by faster global agricultural productivity growth.

FIGURE 13 When all agricultural support (trade barriers + domestic support) is removed



Note: Comparison to 2050 baseline results

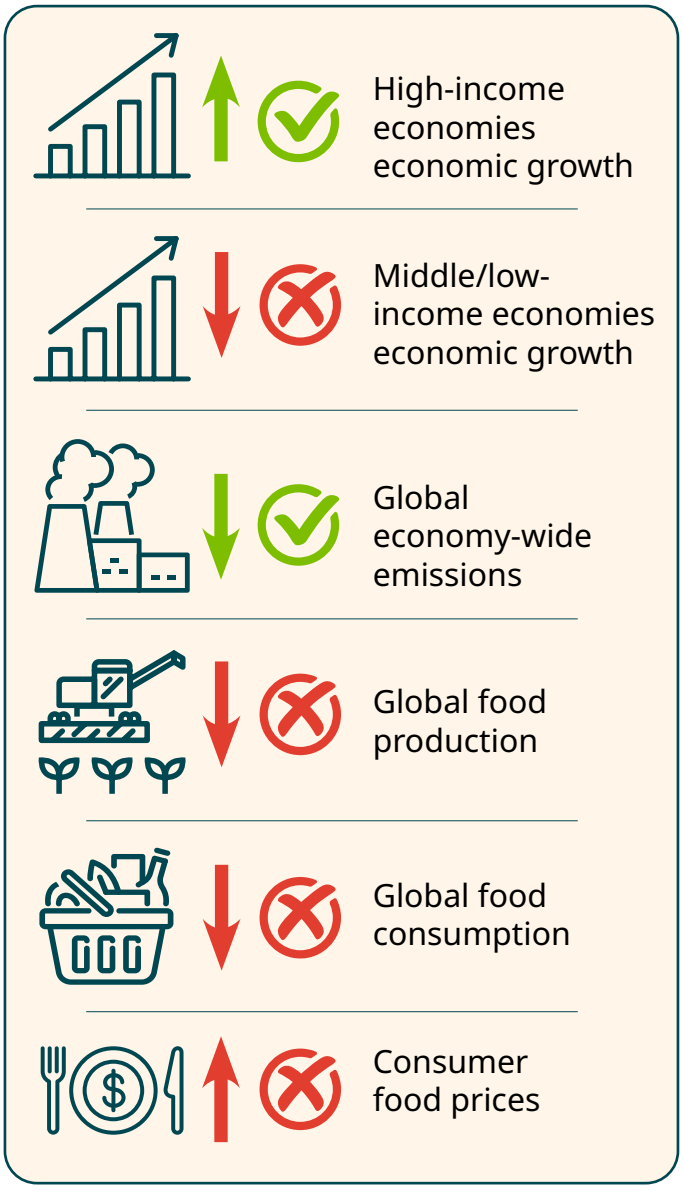
FIGURE 14 When only agricultural trade barriers are removed



Note: Comparison to 2050 baseline results

The removal of just domestic support globally brings an overall income increase to high income regions, while middle and low-income regions lose out (Figure 15). This is because domestic support is largely imposed by high income regions and its removal reduces distortions and allows economic resources to flow to activities where the economic returns are greatest. Emissions fall, reflecting lower global livestock and crop production. As a result of lower global agricultural supply, food production falls, consumer prices of food rise and consumption of food falls.

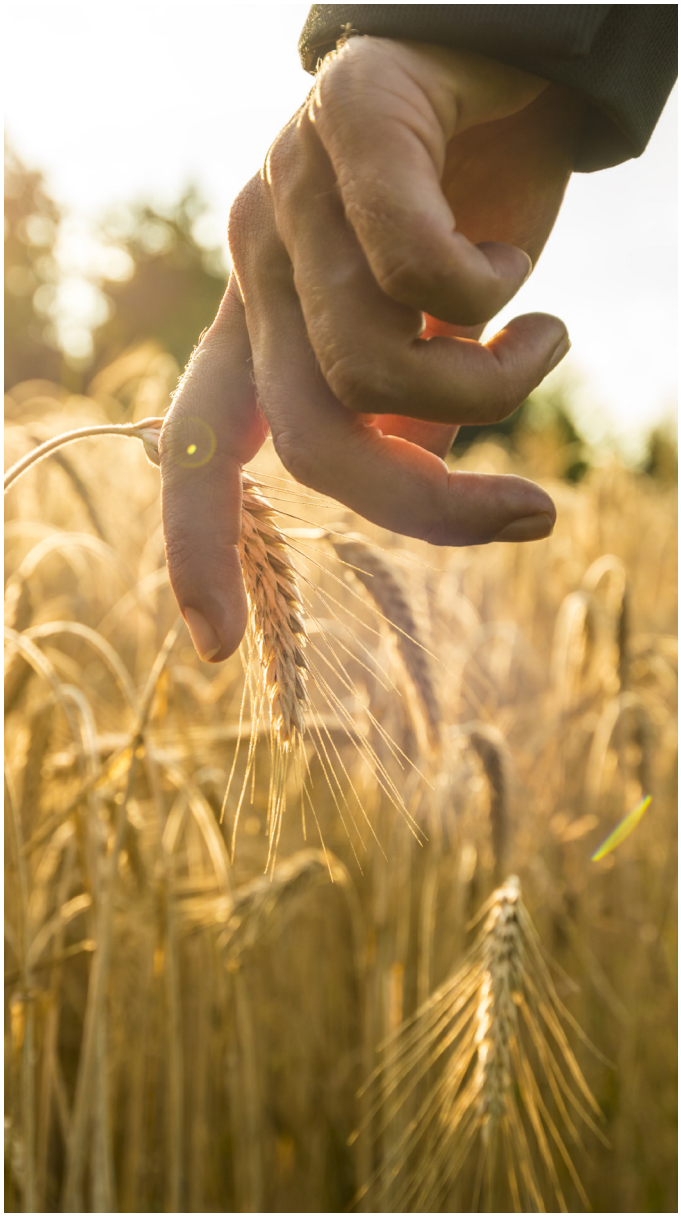
FIGURE 15 When only domestic agricultural support is removed



Note: Comparison to 2050 baseline results

Multilateral action will cut emissions, raise food security and support economic development

The results from this study show that there need not be trade-offs between meaningful action to reduce agricultural distortions and other global priorities. Reforms that help address global agricultural emissions can also help promote global food security and economic development where necessary safeguards are in place to prevent further land expansion through deforestation, and where reforms are complementary and targeted to avoid short-term transition costs. Capturing the benefits to the food insecure, economies and the environment will require coordinated action at the multilateral level, with a clear role to be played by multilateral institutions and organisations.



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Citation and cataloguing data

This publication (and any material sourced from it) should be attributed as Fell, J, Liangyue, C, Burns, K, Greenville, J, 2022, *Emissions, agricultural support and food security*, ABARES Insights, Issue 6, Canberra, November. CC BY 4.0 https://doi.org/10.25814/r6ep-9f06

ISSN: 2209–9123

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AABA096.1022