Trade and food security in a climate change-impacted world

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Abstract

Today's climate-turbulent world is rife with food insecurity – threatening economic development trajectories by stunting growth, subsequently reducing employability and labor productivity, especially for developing countries. The pandemic has exacerbated these adverse effects and reveals the critical need to put in place policies that can safeguard and sustain trade flows in agricultural products. For the vast majority of countries, food security cannot be guaranteed by domestic production alone. If certain crops are domestically untenable or yields are temporarily poor, imports are essential. Additionally, exports of agricultural products provide a major source of income for some of the poorest people around the world. This paper explores the interplay between climate change, the production and the trade of agricultural products, and the resulting food security implications. It then examines the existing trade policies governing agricultural trade and provides recommendations for action at the global, regional and country level.

Key words: trade; climate change; food security; agriculture; policy reform

JEL codes: F13, F63, O13, Q54

Introduction

The COVID-19 pandemic and the economic downturns it has caused have dramatically increased food insecurity throughout the world but especially in those countries and regions where providing access to sufficient food for all was already a major challenge. The FAO estimates that as many as 161 million more people faced hunger in 2020 than in 2019 and that over 2.25 billion people had inadequate food in 2020, a rise of 320 million people on the previous year. Addressing nutrition security challenges for women/mothers and the very young are particularly important since child undernutrition has adverse lifelong health and economic consequences. Childhood undernutrition increases the likelihood of death from common childhood illnesses such as diarrhea, measles, pneumonia and malaria.[2] Child undernutrition leads to delays in cognitive development which tend to result in lower learning outcomes in school and decreased productivity and earning potential in adulthood. It is estimated by the FAO that stunting affected 22 percent (149.2 million) of all children under 5 in 2020.[3] Recent studies indicate that the pandemic has worsened malnutrition outcomes, contributing to an additional 2.6 million stunted and 9.3 million children wasted in 2022 alone.

Even before COVID-19 hit, favorable trends in food security had already stalled by 2014 and actually gone into reverse after 2017. The pandemic has exacerbated an already troubling inability to address food security challenges that are required to meet the Sustainable Development Goals

[2] Black et al., (2013) argue that undernutrition is a cause of approximately 3.1 million child deaths annually, most of which occur in developing countries.
[3] FAO (2021)

of ensuring access all year round to safe, nutritious and sufficient food for all people (Target 2.1) and of eradicating all forms of malnutrition (Target 2.2).

It is increasingly being recognized that the impacts of climate change are one of the main factors behind this reversal in the trend towards improving food security.[4] Climate change is no longer a distant threat. Rising temperatures, changing precipitation patterns and more frequent extreme weather events are impacting food production and distribution systems throughout the world. Ortiz-Bobea et al. (2021) find that climate change has reduced global agricultural productivity by about 21 percent since 1961, with substantially greater effects in warmer regions such as Africa and Latin America and the Caribbean where productivity has fallen by between 26 and 40 percent. 2020 was the hottest year on record[5] and saw the most active Atlantic hurricane season in recorded history.[6] Devastating typhoons swamped the Indian subcontinent and south-east Asia while the Sahel and Greater Horn regions of Africa experienced severe droughts and devastation from locust swarms linked to climate change.[7] Low-income countries are particularly vulnerable to the impacts of climate change and have the lowest capacity to adapt. The challenge of food security and climate change collide most heavily in fragile and conflict afflicted states, where inability to deliver reliable access to food can often be a major factor behind unrest and instability.

For most countries, food security cannot be guaranteed by domestic production alone. If certain

[4] See, for example, Brown et al (2015), IPCC (2019). World Bank (2020) emphasizes three main drivers of food insecurity (in addition to economic shocks) – climate change, conflict, and COVID-19, with COVID-19 compounding ongoing crises.
[5] https://www.space.com/nasa-confirms-2020-hottest-year-on-record
[6] https://www.noaa.gov/news/2020-atlantic-hurricane-season-takes-infamous-top-spot-for-busiest-on-record
[7] https://www.unep.org/news-and-stories/story/locust-swarms-and-climate-change

crops are domestically untenable or yields are temporarily poor, imports are essential. Exports of agricultural products provide a major source of income for some of the poorest people around the world - especially in Sub-Saharan Africa - and can be a key mechanism for increasing returns to farmers and raising a country's aggregate income.

This paper explores how trade will become even more important in an increasingly climate afflicted world and finds that an age of increasing uncertainty plagued by changing weather and extreme weather events requires greater certainty in trade flows to ensure food security, build resilience and expedite recovery of food systems. It also acknowledges the impact that poor agricultural practices have on exacerbating climate change through land-use emissions, despite low yields. Agricultural and trade policies, as well as public expenditures, play a huge role in determining these outcomes – and there is an urgent need to repurpose them to deliver better outcomes on productivity and incomes, nutrition and climate.[8] Here the focus is on trade, and suggestions are made for measures that can be taken at the global, regional and national level to ensure that trade plays the critical role it can in addressing food security and climate change.

The paper is organized as follows. It starts with a review of how climate change is impacting trade in agricultural products both through the impact of rising temperatures and changing precipitation patterns on traditional comparative advantages and from the increasing prevalence of extreme weather events. The next section explores how agricultural trade, especially through its impact on land use change, is contributing to climate change and measures that can be taken to limit this. The

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[8] Gautam et al (2022)

third section discusses how trade is vital to global food security and how this role will become more important as the impacts of climate change are increasingly felt in the agriculture sector. The fourth section then looks at how current trade policies are constraining the role of trade in fully contributing to food security. The final section concludes with recommendations for action to address these constraints at the global, regional and country level.

The impact of climate change on food trade and food security

The vulnerability of agricultural yields to climate change entails impacts that not only threaten domestic food security[9] but also the competitiveness and market share of agricultural exporting countries. There are multiple mechanisms by which crop yields will be affected by climate change, outcomes may not always be negative and will vary across and within developing countries.[10] Nevertheless, extensive reviews of available studies that seek to identify the impact of climate change relative to other factors that impact crop yields conclude with a high degree of confidence that the yields of crops, such as maize and wheat, have been declining in regions closer to the equator as a result of observed changes in climate.[11] On the other hand, in higher-latitude regions, there has been positive impacts on yields of crops including maize, wheat, and sugar beets, although these are increasingly being negatively impacted by extreme weather events, such as the

[9] It should be noted that climate change is just one of the many factors contributing to food insecurity – others include conflict, macro-economic shocks, trade restrictions, and inadequate access to technology, land, water, other agricultural inputs and markets. These gaps constrain food production, movement, and subsequent consumption.
[10] See Hertel and Lobell (2014) for example, for a discussion of the impacts and feedback mechanisms from climate change and increasing concentrations of carbon in the atmosphere to crop productivity.
[11] IPCC (2019) for example.

recent devastating floods in Europe. There have been large negative impacts on yields in parts of the Mediterranean. Climate change is already significantly affecting food security in drylands areas in Africa, Asia and South America.

Export comparative advantages are changing - global crop and economic models predict an increasing impact of climate change on crop productivity in the coming decades. Despite considerable uncertainties about the precise impacts of climate change and that diverse models, with differing specifications and parameter values, can produce different results, the available studies clearly show with a high degree of confidence that climate change will alter comparative advantages in crop farming. Indicative estimates of impacts on crop yields identify substantial differences across regions for a given crop and across crops globally (See Table 1). Most of the projected impacts of climate change are negative, but in certain regions and for particular crops there will be a boost to yields. These regional estimates hide important impacts at the country level and within countries. Not only do these expected yield changes suggest a major alteration in the current trade structure,[12] but also that trade will be key to climate adaptation efforts—by adjusting the types (and volume) of crops grown in particular regions. In fact, adjustments to production and trade flows may help significantly attenuate the climate change impacts. However, such adjustments will be tempered by the incentives that farmers face as determined by agricultural and

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[12] In the UK, higher temperatures fueling rises in CO2 levels and photosynthesis activity in plants could mean overall growth in crop productivity. In Italy, higher levels of rainfall and humidity in some parts, has become ideal for tropical fruits e.g. avocadoes, bananas and mangoes, which are now being exported. Milder winters in Russia have made the country emerge as the world's largest wheat producer. Additionally, for most wine-growing countries, the areas viable for viticulture are changing. See FT "What growing avocados in Sicily tells us about climate change and the future of food"

trade policies.

Table 1 about here

A number of studies highlight that adverse impacts will, in general, be much greater for developing countries. For example, Barua and Valenzuela (2018) find that a 1°Celsius increase in temperature lowers the agricultural exports of developing countries by almost 13 percent but those of developed countries decline by less than 6 percent. Agricultural exports from lower middle-income and lower-income countries are at an even higher risk from rising temperatures—a 1°Celsius temperature increase leading to a fall in the agricultural exports of lower middle-income countries by 23 percent and a drop in those of LDCs by 39 percent.

Further, agricultural productivity will also suffer from a drop in labor productivity attributable to rising temperatures. Indeed, in the tropics, the impact of heat stress on humans may be greater than that on (adapted) crops. Hence, the estimated costs of climate change would probably be higher for developing countries located in the tropics if the analysis were extended beyond the direct impacts of climate change on crop yields to also include the indirect effect on labor productivity (Hertel and de Lima 2020).

Nevertheless, future projections of climate-induced volatility in grain production suggest that there will be new opportunities for some developing countries to export grains. To take advantage of these opportunities, however, it will be critical to have policies and public support that facilitate rather than hinder the needed structural shifts within and trade across countries. For example, Ahmed et al. (2012) show that Tanzania is expected to be only mildly impacted during dry periods that will reduce grain output in trading partners and will have the opportunity to export grains during these shortfalls. However, the use, or threat, of measures such as export restrictions or bans limits the incentives to invest to take advantage of these new opportunities. Further, this study shows that in periods in which Tanzania is negatively impacted by climate shocks, it could use imports from less affected countries to buffer impacts on the domestic economy, especially the poor. Hence, this shows the importance at the country level, of trade as a buffer against increasing climate-induced variability of production.

In increasing food production, it will be important to enhance the nutritional value so as to foster a balanced diet and safeguard food security. Most studies of climate change and its impacts on agriculture have focused on cereals and calorie dense foods—the area where modeling infrastructure has been most fully developed. However, there are other important sources of nutrition and a balanced diet, such as fruits and vegetables, access to which can be an essential part of food security. Indeed, attention should not just be focused on increasing crop production and yield in the face of climate change, but also on the nutritional value of food and hence to impacts on fruit and vegetables and perennial cropping systems, which has received much less attention (Leisner 2020). This is also apparent with R&D which has historically sought to improve resilience of cereals/staples to weather and pests/diseases, but which has paid much less attention to more nutrient dense foods such as fruits and vegetables.

Climate change is also increasing the prevalence and strength of extreme weather-related shocks such as storms, floods, and droughts, which has wide-ranging implications for agricultural trade, affecting farming, processing and distribution. Exports of food from, and imports to, the area affected by extreme weather will be directly negatively affected during the crisis and in its aftermath if trade-related transport and logistics infrastructure sustained significant damage. Longer-term adverse impacts on exports will result from loss of life and injury to farmers, employees and damage to farms and the inventories of exporting firms. These will be compounded if long-term contracts are cancelled following inability to fulfill orders during the crisis and its aftermath. This is more likely in countries with weak mechanisms for contract enforcement. Countries exporting agricultural products will suffer severe damages if the extreme weather shock affects the planting or harvesting of their main crops.

Imports are critical to offset crisis-induced shortfalls in supply of domestically produced food. Results from a stylized numerical model show how important trade is for disaster recovery and that restrictions on exports during a crisis amplify the adverse economic impacts (Hu et al., 2021; Cui et al. 2020)). Policies that lead to higher trade barriers undermine the efforts of other countries battling extreme weather events and/or a pandemic. Crisis-hit countries are vulnerable to restrictions which limit access to products through trade, such as export restrictions in countries that are less impacted. Short-term impacts can also have adverse long-term development outcomes. For example, if malnutrition increases during the crisis and children become stunted, as has happened under the COVID-19 pandemic, their long-term development will be jeopardized. These challenges become even greater in poor low-income countries that face the increasing likelihood of recurrent natural disasters.

The impact of food production and trade on climate change

More land is being allocated to agriculture, often driven by trade opportunities. On average, one-fifth of global cropland area was harvested for export in the 2000s, and almost all growth in cropland area during this decade was for internationally traded crops (Kastner et al. 2014). Between 1990 and 2019, FAO (2021) finds that land use change[13] added 3.5 billion tonnes CO2eq, mostly as CO2 from carbon losses via deforestation and peatland fires. While agriculture generated net emissions into the atmosphere, forest land instead generated net removals in 2019 and in general over the entire 1990–2019 study period. Specifically, removals on forest land were about 2.9 Gt CO2eq in 2019, nearly counterbalancing emissions from net forest conversion. Notably, deforestation has decreased by roughly 30 percent since 1990, while peatland fires have increased by nearly 60 percent. However, CO2 emissions from land use change on the African continent have been growing – with the largest regional increase since 1990 (30 percent), while the largest decrease was in Latin America (20 percent). Thus, while deforestation has been decreasing globally, it has been increasing on the African continent.

However, the increase in agricultural output in many developing countries and especially low-income countries in sub-Saharan Africa, has been driven by the expansion of cropland rather than yield increases. For many crops, yields in Africa remain far below the averages obtained elsewhere in the world. Analysis shows that while the area of land dedicated to cereal production in Africa has been increasing since 1960, yields have been growing at a slower rate (Figure 1). Specifically, between 1960 and 2017 yields grew by a factor of 1.8, while land area under cultivation almost

[13] The Intergovernmental Panel on Climate Change (IPCC) defines land use, land use change and forestry emissions as a greenhouse gas inventory sector that covers emissions and removals of greenhouse gases resulting from direct human-induced land use such as settlements and commercial uses, land-use change, and forestry activities.

tripled. The question arises how much less land-use change might be necessary to achieve global food security now, and in the future, if global average yields were achieved for the main crops harvested in developing countries. For example, if the available innovative technologies in farming, sustainable techniques, and new cereal strains were broadly applied and small farmers had access to fertilizers and modern seeds, there would be less pressure to expand the area for cereal production. This is an avenue where trade can provide solutions to the lack of access to the inputs needed to boost agricultural productivity and thereby limit land use change while supporting adaptation to changing climatic conditions.[14]

For many developing countries, trade is a key mechanism for improving access to inputs such as seeds, fertilizers and machinery which provide the means to increase yields in the face of rising temperatures and changing patterns of precipitation. Trade also supports adaptation through the transfer of new techniques and technologies, such as, new drought-resistant seeds and pesticides for weed control and knowledge on how to adjust planting practices to changing climate. However, access, especially for small farmers, is often constrained by a range of tariffs and non-tariff measures. Such barriers also contribute to the gender gap in agriculture, whereby women farmers achieve lower yields on average than men farmers. Addressing these barriers will be essential to ensure that women farmers do not fall further behind due to constraints in the adaptation process.

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[14] Gautum et al (2022) show that increased support for the development and dissemination of more emission-efficient technologies for crops and livestock, for example by repurposing a portion of existing government spending on agriculture, could lead to a fall in emissions from agriculture in excess of 40 percent. Further, a substantial area of land, amounting to millions of hectares, could be returned to natural habitats.

Figure 1 about here

This challenge is most pressing in Africa and South Asia where farmers face higher prices and less choice for new seed varieties, fertilizers and pesticides. Markets in many developing countries are too small to exploit scale economies linked to seed distribution, fertilizer production and even fertilizer blending. Regional fertilizer markets that could reap the benefits of scale have not emerged because of the continuing segmentation into small individual markets by differing standards, testing and conformity assessment procedures. Regional markets with common specifications and mutual recognition of testing and conformity assessment could generate substantially lower prices and wider choice of varieties and blends. In some African countries, it can take two to three years for new seed varieties to be released, even if they are already used elsewhere on the continent (World Bank 2012).

Trade can make eco-friendly products more accessible, consequently influencing consumption (and thus demand) patterns, in turn reducing potential land-use change. Over the past century, the increasing world population and the shift in global diets toward vegetable oils and animal products has increased the demand for these types of agricultural commodities.[15] Increases in demand for animal products dramatically increases demand for resources, particularly because animal products, and especially beef, are produced in such a highly inefficient way. For example, Fukase and Martin (2020) highlight that the estimated land requirement for beef production is 20.9 m^2 per

[15] Much of the increase in world food demand in the coming decades is expected to be a result of increasing demand to satisfy the evolving diet away from traditional crops toward more animal-based foods. Notably, Fukase and Martin (2020) find that per capita food demand growth is likely to be a more important driver of food demand to 2050 than population growth.

year per kilogram of meat – more than twice that for pork (8.9 m^2 year per kilogram of meat) and 15 times the requirement for cereals (1.4 m^2 per kilogram per year).[16] Managing demand/consumption is very important because it has the potential for climate change mitigation through i) altering production decisions to reduce emissions, including the preservation of land available for carbon sequestration (which would otherwise have been used for farming); and, ii) switching to consumption of less emission-intensive commodities, for example, plant-based foods as well as environmentally friendly goods and services. Springmann et al. (2016, 2017) find that changing to more plant-based diets that are in line with standard dietary guidelines could reduce food-related greenhouse gas emissions by 29-70% compared with a reference scenario in 2050. They find that the largest absolute environmental and health benefits result from diet shifts in developing countries, whereas high-income and middle-income countries gain most in per capita terms. In addition to direct mitigation gains, lowering meat consumption, primarily of ruminants, and reducing waste, further reduces water use, soil degradation, and pressure on forests and land used for feed, potentially freeing up land for mitigation purposes (Tilman and Clark 2014). The end objective is to "awaken a carbon footprint consciousness in consumption," and policymakers and the private sector have a role to play.

Carbon labelling is a tool being implemented by various firms, but mostly in the developed world, to meet their climate objectives. For example, Chipotle, Just Salad and Quorn in the US all include the carbon footprint of their products on the label, and in Europe, supermarkets like Coop in

[16] New research is coming up with innovative solutions. For example, Kinley et al (2020) reveal that productivity of beef cattle can be improved by a seaweed feed ingredient called "a*sparagopsis*" which induces unprecedented enteric methane mitigation. This is a breakthrough option to achieve carbon neutral red meat production.

Denmark have carbon stickers. A grocer in Sweden called Felix prices its goods based on their carbon footprint.[17] For most developing countries, the issue of carbon accounting arises, especially because it is currently difficult to trace the carbon footprint of a product along the value chain. But new innovative solutions are emerging. Van Wassenaer et al. (2021) examine the feasibility of applying blockchain for climate action in agriculture and find that given the appropriate infrastructure and governance arrangements, this can be a transformative mechanism to increase traceability and accuracy of carbon accounting for food products. This technology can contribute to mitigation through creating a foundation for a global carbon database that can be monitored by all actors. On adaptation, blockchain can facilitate the adoption of platforms supporting rural credits as well as track outcomes from improved climate-smart agricultural techniques.

Additionally, perceived emission hotspots in the transportation of internationally traded foods products are often misleading. The amount of carbon emissions embedded in a traded food product should not be limited to transportation – it is also about the production techniques and consumption behavior. Indeed, considering greenhouse gas emissions from food supply chain stages only up to the point of sale can seriously underestimate overall emissions and distort views of where emissions are concentrated. An example from 2008 vividly illustrates the issues – importing a pack of green beans via air freight from Kenya to the UK generated less carbon emissions than driving 6.5 miles to the local UK grocer.[18] Beyond the mode of transport, the production techniques of green beans in Kenya are more environmentally friendly – grown mostly by smallholder farmers,

[17] https://www.fastcompany.com/90621091/heres-one-way-we-can-get-people-to-choose-more-climate-friendly-foods

[18] Statement by Gareth Thomas, UK Minister for Trade and Development, speaking at a 2008 Department for International Development air-freight seminar. Article from The Guardian https://www.theguardian.com/environment/2008/mar/23/food.ethicalliving

without chemical fertilizers, handpicked and with little mechanization (e.g. tractors using diesel contribute to emissions). This is an example of how trading across borders for some food products can reap overall environmental benefits. In addition, the greatest opportunities for emission reduction may not lie in the production but rather the consumption of food. For example, cooking can account for around 60 percent of total emissions for vegetables (products such as potatoes, carrots, cabbage, cauliflower and onions). Cooking using an electric pressure cooker rather than an open pan on the stovetop can lead to significantly lower emissions for the whole of the value chain.[19]

Governments are also exploring the role that carbon border adjustment mechanisms (CBAMs) can play in addressing concerns over loss of competitiveness when domestic carbon taxes are introduced to meet Paris Agreement objectives. The EU is at the forefront and has recently released details of a proposed CBAM to complement the EU's Emissions Trading System (ETS). Agriculture is not currently included in the ETS and therefore not in the CBAM. However, it is possible that as pressure for more ambitious carbon reduction mounts and awareness of the contribution of agriculture to current emissions increases that agricultural products may be included in the future. However, the practical problems of implementation are a major hurdle. These arise from the technical challenge of accurately calculating carbon footprints. There is no easy and commonly accepted way to calculate the carbon footprint of a product arriving at the border. But this is required to tax the embedded carbon together with information on carbon taxes

[19] Frankowska et al (2020).

(if any) already levied on the product in the country of production.[20] There is no broad consensus on how to calculate carbon footprints for products; several organizations have developed competing international standards and data is often a problem, especially in developing countries.

It is important that the interests of developing countries are taken into account in how border adjustment schemes address these practical problems. However, current carbon-footprinting methodologies were predominantly developed by industrialized countries for use in industrialized country contexts (Brenton, Edwards-Jones and Jensen 2009; Plassmann et al. 2010). It is apparent that using these carbon accounting standards risks giving a misleading picture of the carbon footprint of developing country exports. Common methodologies to calculate carbon content may be more difficult to apply in LDCs and they may face more severe data limitations. Commonly-used standards for carbon footprinting require that many subjective choices be made in the calculations and leave plenty of room to arrive at different estimates by simply varying plausible assumptions and using different yet respectable data sources. Many carbon footprinting analysts apply life cycle analysis (LCA)[21] to estimate carbon footprints but subjective decisions need to be made regarding systems' boundaries (where the analysis should begin and end), the data on which to base carbon content calculations, and benchmarks to use if data are missing or a producing

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[20] Martin (2021) argues that it is better to base CBAMs on the cost to producers of a domestic carbon tax. This shifts the tax from production to demand and addresses the loss of competitiveness of domestic producers from a carbon tax.

[21] Life cycle analysis (LCA), a method used to evaluate the environmental impact of a product through its life cycle—encompassing extraction and processing of the raw materials, manufacturing, distribution, use, recycling, and final disposal.

country is not willing to submit the necessary data.[22]

Trade can also be a conduit for sustainable agricultural management by exchanging technological innovations that can drive up yields while reducing the potential for adverse land-use change. Villoria (2019) concludes that technological progress in developing Asia and SSA would reduce the cropland area in these regions as well as in the rest of the world. Moreover, large-scale application of climate-smart technologies in Africa and developing Asia could enhance food security. Hertel et al. (2020) find that sluggish growth in farm productivity in SSA has brought to the fore the key role of agricultural technology in alleviating future food insecurity, and that towards 2050, virtual technology trade will be the most important vehicle for reducing nonfarm undernutrition in Africa (Hertel, Baldos, and Fuglie 2020). Generally, technological advancement in the agricultural field, especially in the making and application of fertilizers, will be necessary to mitigate emissions and adapt to climate change. Countries can increase agricultural productivity in a sustainable manner using existing land—and deforestation is not necessary, provided yields improve. With climate-smart techniques, the total area of land that is currently under cultivation can also be reduced.

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[22] Plassmann et al. (2010) provide a sensitivity analysis of calculating the carbon footprint for a typical developing country export, sugar, for two countries, namely Zambia and Mauritius. Calculations were affected by the choice of methodology, data availability, and uncertainty about key variables. With a dominant standard – the PAS 2050 developed by the British Standards Institute (BSI) - emissions from changes in land use dominated the estimated carbon footprint. Prior land use is often undocumented in developing countries. In such a case, PAS 2050 prescribes the use of a worst-case benchmark. For sugar this increased the calculation by 1900 percent! Plassmann et al. (2010) recommended that emission factors be developed for tropical countries and bio-regions and the transparent use of carbon-accounting methodologies, explicitly noting data sources, uncertainties, and variability.

Land-use change effects are not localized and have the potential to adversely affect neighbouring countries, especially those related to agricultural production, so regional solutions are necessary. For example, the Congo Basin rainforest in Central Africa plays a role in regulating rainfall patterns across other parts of the continent. Rapid deforestation has destabilized weather patterns in the neighboring areas, for example, droughts have been increasing in Eastern Africa. This signals that while country-specific efforts are necessary; they are not sufficient. But regional trade liberalization efforts, such as the African Continental Free Trade Area (AfCFTA), can act as an institutional anchor to lock in some of the country-specific efforts that are aligned with fostering sustainable growth. Intra-AfCFTA trade will initially mainly involve agricultural goods and services. However, agriculture is highly vulnerable to climate change, as increases in temperature will result in reduced yields, higher prevalence of diseases, and extreme events such as drought and flooding. Agriculture also uses huge amounts of water, which is becoming scarcer. This requires that the AfCFTA include sustainable trade provisions in order to be effective, such that businesses can effectively adapt to climate change.

The role of trade and trade policies in global food security

International trade plays a critical role in global food security which will be increasingly important in a climate-impacted world. International trade reduces food insecurity and malnutrition during periods of domestic shortages by increasing access to food and attenuating price volatility.[23] More generally, countries that are structurally food deficient rely on trade to satisfy domestic demand.

[23] Trade is deemed a more efficient mechanism for stabilizing prices than domestic holdings of food stocks.

Global production tends to be less volatile than production at the country level and trade plays an important risk-sharing role in the face of domestic production fluctuations. Since climate change will increase the volatility of food production at the national level,[24] smoother flows of trade will gain even greater importance in reducing price volatility[25] and delivering supplies to food deficient countries (Smith and Glauber 2019). Without this trade expansion, more households in low-income countries will become food insecure as a result of climate change.

Figure 2 about here

Climate change will severely undermine progress on food security. Estimates from IFPRI suggest that by 2030, an additional 70 million people will be at risk of hunger because of climate change (Figure 2). This increase is concentrated in South Asia and SSA. Similarly, by 2050, the number of people at risk of hunger will be almost 20 percent higher by the same token. More than half of this predicted increase in hunger will occur in SSA. The IFPRI projections show that even though production grows faster in developing countries than in developed countries, as a result of the combined impacts of climate change, population growth, and increasing per capita consumption

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[24] By the second quarter of 2021, the UN FAO food price index had risen 34 percent, owing to droughts in key exporting countries as well as stockpiling by some governments and companies. https://www.ft.com/content/f7828907-32e5-4926-a0c7-6f1577c77d3f

[25] In addition to trade, other market-driven instruments such as futures and options markets and weather indexed insurance programs are complementary arrangements to open trade policies that—if implemented successfully—have the potential to mitigate food price risks given the limited amount of infrastructure they require, the low costs they impose on public resources, and the financial security they provide to vulnerable producers. Public provision of safety nets intended to maintain the purchasing power of vulnerable households and support for long-run productivity growth in agriculture through investment has also been advocated as has reliance on private storage as a means to address market shortages.

of food, developing countries as a group become larger net importers of food. Thus, trade will become increasingly important for food security.

This raises the issue of whether the policy environment for trade in agricultural products is conducive to such an increase in trade, or, on the other hand, trade restrictions and uncertainty over their use may hamper investments in food production. Trade policies continue to distort markets for agricultural outputs much more than for other products. Tariffs on agricultural products remain higher on average than those on non-agricultural goods with the global average tariff on agricultural products more than 12 per cent compared to around 8 percent for all other goods (See Figure 3). Tariffs on agricultural products tend to be higher in developing countries than developed countries, with the exceptions and low- and middle-income countries in East Asia and Europe.[26] Average tariffs on agricultural products remain over 20 percent in South Asia and the Middle East and North Africa (MENA). In some countries, tariffs on agricultural products remain relatively high. For example the average tariff on food products in Turkey is 50 percent, in India it is 33 percent, Morocco it is 29 percent and Kenya has an average tariff on agricultural products of 25 percent. However, some developing countries have been able to significantly reduce tariffs on food. In Peru, the average tariff is 2.3 percent, in Chile and Indonesia it is around 6 percent and close to 9 percent in South Africa.

Figure 3 about here

[26] A more nuanced picture emerges when support to farmers in the form of public expenditures – subsidies to output, inputs, or conditional on other variables- is considered. This shows, in general, minimal publicly funded support to farmers in low income countries, low levels of around 5 percent in middle income countries, but almost 15 percent on average in high income countries.

Trade policies not only affect production and consumption decisions between agricultural and non-agricultural products but also between different types of food. Figure 3 shows that, consistently across regions, tariffs on fruits and vegetables are higher than those on cereal crops. Hence, tariff policies in many countries conflict with the objective of providing access to a balanced and nutritious diet. The average tariff on fruit and vegetable imports in MENA countries, for example, is over 30 percent relative to the average tariff on cereals of 17.6 percent. For 56 out of 74 developing countries (excluding small-island economies) for whom data on tariffs is available for 2019, the average tariff on fruits and vegetables exceeded the average duty on cereals. Trade policy can also affect nutrition goals by influencing the relative demand for foods that are high in fat and high in sugar. Reducing tariffs on products high in fat or sugar can have adverse health outcome if appropriate health and information policies, such as domestic taxes related to the sugar content of drinks together with labels highlighting the risks, are not in place.

Amending tariff policies to remove bias against fruits and vegetables and plant-based sources of protein is a low hanging fruit that is relatively easy to implement. More generally, trade policies are an element of the overall policy environment affecting the amount of different food products that are produced and where they are produced. In comparison with the diet that nutritionists recommend, Kc et al. (2018) find that the global agricultural system overproduces grains, fats, and sugars and provides insufficient fruits and vegetables and protein for the nutritional needs of the current global population.

In general, high tariffs increase prices and reduce access of the poor to agricultural products. They also limit the size of the global market for agricultural products and hence reduce the incentive to invest in exporting such products. This is exacerbated by the fact that, in contrast to non-agricultural products, many developing countries have refrained from binding their agricultural tariffs at the WTO at rates close to applied rates, creating uncertainty over market access conditions. In making the global market thinner, such policies, amplify the impact of short-term changes in demand, due for example to climate related weather events, and hence the degree of price volatility.

One of the reasons why many developing countries are reticent to reduce tariffs on agricultural products is fear of dependence on an unreliable source of supply. Indeed, one of the biggest risks to food security in food-importing countries is the imposition of export restrictions by exporting countries that curtail global supply and increase prices. Some form of international agreement may be necessary, especially as climate change increasingly affects production and trade patterns, to provide food insecure countries with the degree of certainty they require to further open their markets to trade. [27]

Non-tariff trade measures can also be a major barrier to trade and influence trade and food purchasing decisions. Delays at borders and ports not only increase trade costs but also cause a significant amount of food to be wasted, contributing to the 1.3 billion tons of food, approximately

[27] A similar issue has recently come to the fore during the COVID-19 crisis regarding access of poor countries to medical products and vaccines, and the negative impact that export restrictions by producing countries have had on the large number of importing countries. Evenett and Winters (2020) identify the scope for a bargain at the global level whereby importing countries commit to reduce barriers to market access in return for commitments regarding the use of export restrictions.

30 percent of global production, that the FAO estimated is lost each year.[28] These costs and waste are likely to be more important for fruits and vegetables that have a shorter shelf life and are more vulnerable to high temperatures. This is particularly likely in developing countries where cold chain logistics services are not widely available and where poor border infrastructure entails little protection from high temperatures and rain for food products in transit or held at the border for inspection. Reducing food loss and waste would both lower GHG emissions, since the amount of food consumed could be produced with considerably less resources, and improve food security.

Implementation of standards for food is an essential element of food safety and nutritional policies and will likely become even more important as rising temperatures and changing precipitation increase risks related to pests and disease. However, the capacities to define appropriate sanitary and phytosanitary standards and for testing and conformity assessment are very weak in many developing countries. This often leads to barriers to trade and ineffectual policies. For example, Keyser and Sela (2020) show that current systems for the regulation of aflatoxins in grains in East Africa entails high costs that limit cross-border trade. Only large firms typically have the resources to comply with requirements such as obtaining a certificate of aflatoxin analysis from one of just three nationally recognized laboratories for each and every consignment. Smaller traders and other enterprises are forced to navigate around the regulatory system leaving countries with little

[28] Data on food wasted at borders and ports are generally lacking, however, an official UK estimate suggests that additional paperwork leading to border delays because of Brexit could result in 142,000 tons of food being wasted in the first six months of 2021 (https://www.independent.co.uk/news/uk/politics/brexit-border-food-waste-fish-seafood-meat-b1794364.html).

effective control over aflatoxins and limiting the ability of small farmers to benefit from trade opportunities.

Trade policy priorities for food security in an era of climate change-induced rising volatility

Talks on trade and agriculture at the global level through the WTO have been stalled for many years**,** but the need for progress in reducing barriers to trade in food products and the integration of agricultural trade and climate change objectives is only growing. The climate and food security crisis demand that countries revitalize negotiations on agriculture since there is huge potential for mutual benefits from a coordinated approach towards achieving global food security and addressing climate change. The following are issues that should be priorities for discussion.

At the global level:

- *Reducing barriers to market access for food products including tariffs and production distorting subsidies*. This should include commitments to reduce bias in these policies against access to nutritional foods essential for a balanced diet.
- *Apply measures to help protect food insecure countries from export restrictions imposed by key producing countries that limit access to critical food and other essential products in food production, such as seeds and fertilizers***:**
    - *Increase information and transparency and monitoring*. Fear of domestic shortages often drives short-term policy measures such as export bans. Moreover, politically well-connected domestic actors who benefit from export restrictions, such as food processors, often seek to stoke and exploit uncertainty over domestic supplies.

Hence, better information on global markets and greater transparency and information sharing can help limit panic-driven policy decisions and contribute to more informed and coordinated responses that avoid price surges. Information on global food stocks, for example, is crucial for policy makers trying to assess the risk of impending food shortages. Recent investments by the G20 countries in food information systems have increased the quality of information available to policy makers and may have tempered the use of export restrictions on food during the COVID pandemic.[29] Transparency and information sharing will only become more important as climate change induces greater variability in production and heightened uncertainty.

- *Increase cooperation on trade issues that are critical for health and food security*. In particular, explore a bargain whereby producing countries agree to limits on the use of export restrictions in return for tariff liberalization by importing countries. Such an agreement would reduce policy uncertainty and the risks associated with global markets in essential products and encourage greater investment in production and exports.

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[29] An Agricultural Market Information System (AMIS) was created in 2011 under which (i) G20 governments committed to instruct their statistical and other relevant agencies to provide timely and accurate data on food production, consumption, and stocks, and to invest in necessary mechanisms and institutions if they did not exist; (ii) international organizations committed to enhance global food security by monitoring, reporting, and analyzing market conditions and policies, and by introducing a global early warning system; (iii) a Rapid Response Forum would seek to promote policy coherence and coordination during crisis periods; and (iv) international organizations would support the improvement of national or regional monitoring systems in vulnerable developing countries and regions. http://www.amis-outlook.org/fileadmin/user_upload/amis/docs/reports/Improving_global_governance_for_food_security.pdf

    - *Link commitments by developing countries to reduce tariffs on agricultural products to capacities in implementing food safety and nutritional policies.* Hence, financial assistance should be provided for capacity building and technical assistance to those countries which currently have very weak capacities to implement and enforce food safety and nutrition policies at the border.

- *Ensure that developing countries can effectively participate in emerging private and government carbon abatement schemes that are applied to agricultural products*
    - *Support analysis that increases the applicability of methodologies used for carbon accounting to developing-country conditions.*
    - *Provide technical and financial support to allow developing countries to implement carbon accounting methodologies and to identify and exploit areas of carbon competitiveness.* This could include raising awareness of the applicability of block-chain technology in carbon accounting and develop the necessary physical and regulatory infrastructure to sustain it.

At the regional level:

In addition to a new determination to leverage global cooperation to address food and climate risks, efforts at the regional level can remove fragmented markets that limit access to key agricultural inputs that are essential for adaptation to climate change.

- *Enhance systems of standards and quality control to reduce barriers to regional input markets in Africa and elsewhere.* Two key issues must be addressed: (a) establishing a consistent and stable policy environment for regional trade in seeds, fertilizers and pesticides; and (b) investing in quality control institutions that reduce the transaction costs of coordination failures related to lack of information about agricultural products, the way they are produced and the risks to health they pose.

- *Support capacity building for the regulation of key agricultural inputs.* Many countries have enacted new seed and fertilizer laws, but few have provided the resources to define and enforce regulations through standards and testing capacity. Reducing regulatory burdens on these key inputs and the consequent increase in their use would substantially raise yields and the ability to adapt to a changing climate.
- *Enhance the cross-border mobility of agricultural and environmental specialists.* Effective implementation of new technologies to adapt to climate change requires knowledge and guidance so expert mobility should be facilitated. Delivering such assistance to farmers is a major challenge in developing countries, where farmers are often heterogeneous and highly dispersed smallholders. There is considerable potential to increase access to the services of agricultural specialists through greater regional mobility of extension service providers. Steps that can be taken by regional communities to achieve this include creating and maintaining a regional database of agricultural specialists, streamlining the administrative procedures required to obtain a work permit, and mutual recognition of the qualifications of agricultural specialists (World Bank 2012). Environment engineers, such as those with skills related to water management, will also become an increasingly important resource in adaptation of agriculture to climate change.

<u>At the country level:</u>

- *Focus on trade facilitation of agricultural products and investments to improve transport* *and logistics procedures and infrastructure for food trade*. Reducing delays and waste, especially of highly perishable products will have the combined benefits of improving efficiency in agriculture, boosting trade in food products, increasing returns to farmers, lowering prices for consumers, *and* reducing carbon emissions from agriculture.

- *Remove domestic market distortions that reduce competitiveness and trade potential*. Domestic support to farmers has led to disappointing outcomes with regard to environmental sustainability and resilience of agri-food systems, raising farm incomes, reducing poverty, and improving food security and nutritional outcomes. In many countries such support has been regressive and highly distortionary and has favored particular products and practices. The resulting market distortions undermine private investment.

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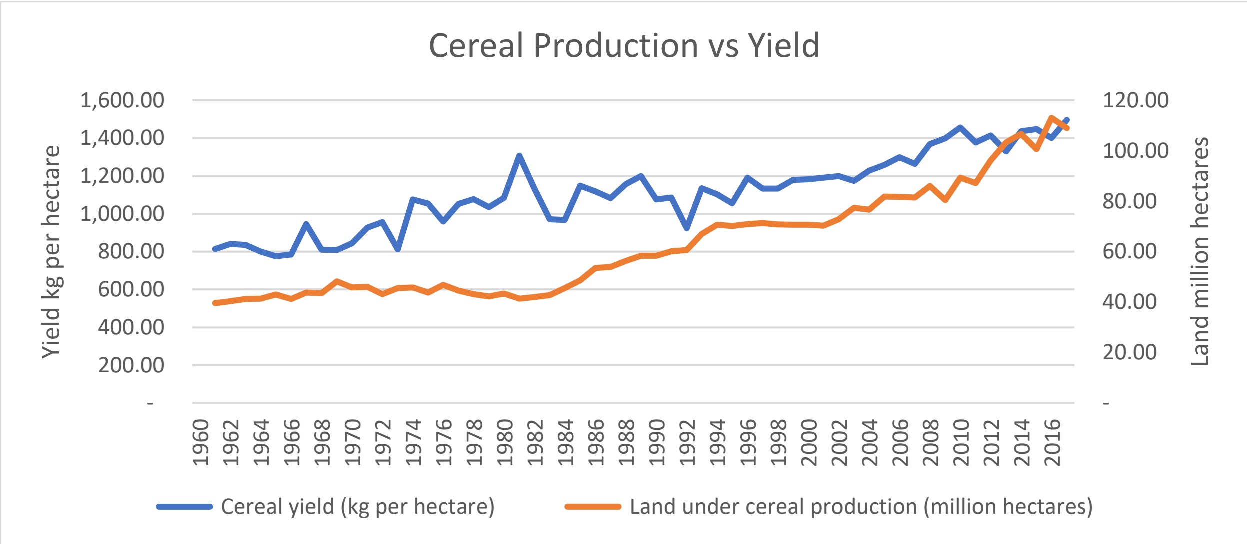
TABLE 1: CLIMATE CHANGE IMPACTS ON CROP YIELDS, ACCOUNTING FOR CO_2 FERTILIZATION (% CHANGE)

Region	Maize	Rice	Wheat	Other crops	All crops
Asia	15	4	-54	−13	−9
Commonwealth of Independent States	−10		−2	−2.0	−2
Europe	-15	52	-8	-12	-11
Latin America	3	-37	-35	-39	-35
Middle East and North Africa	116	-87	-26	-29	-23
North America	−16	9	−5	−18	−16
Oceania	21	−32	−40	−17	−20
Sub-Saharan Africa	0	−15	−76	−43	−39
World	2	3	−33	−17	−13

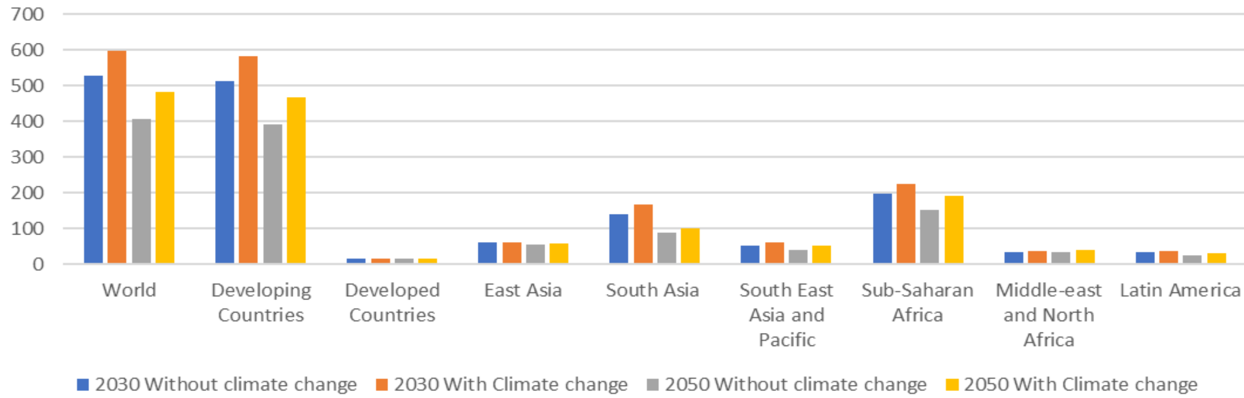
Source: GAEZ project (IIASA/FAO, 2012), as presented in Gouel and Laborde (2018).

FIGURE 1: CEREAL PRODUCTION VS YIELD ON HARVESTED LAND IN SUB-SAHARAN AFRICA

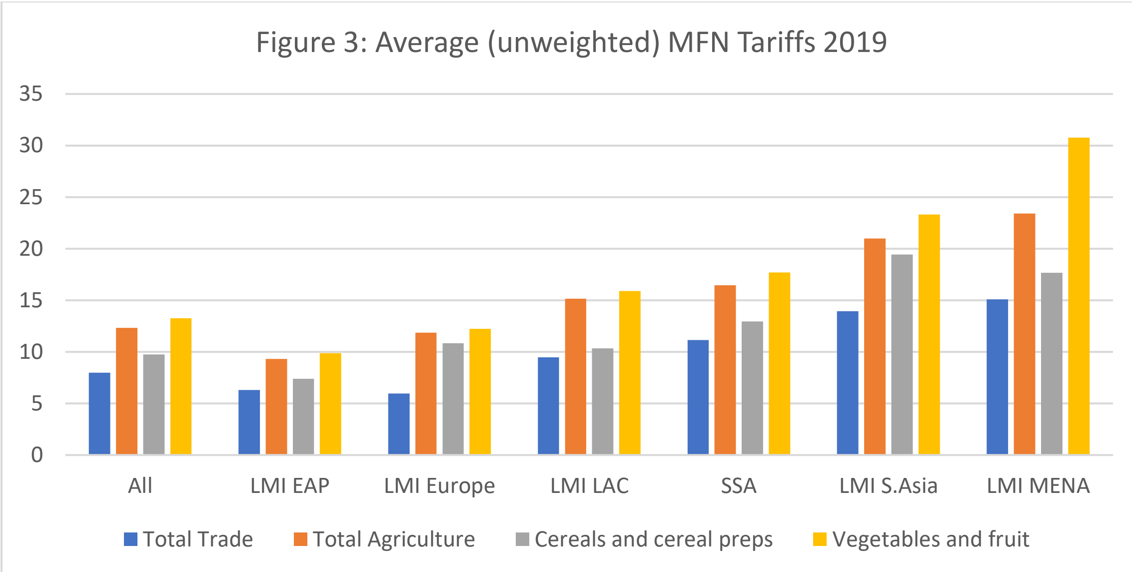


Source: Data from FAOSTAT (Food and Agriculture Organization Corporate Statistical Database).

FIGURE 2: CLIMATE CHANGE AND HUNGER (MILLIONS OF PEOPLE AT RISK)



Source: IFPRI (2019)



Source: TRAINS database accessed through WITS