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TRADE AND SUSTAINABLE FOOD SYSTEMS

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ABSTRACT

Trade is an integral part of our food systems. It connects people at all stages of agricultural and food value chains, linking farmers with consumers across the world. It also links nations to each other and thus scales up from the domestic to global perspective. By moving food from surplus to deficit regions, trade promotes food security, the diversity of foods available, and can affect preferences and diets. Trade impacts food prices and the allocation of resources and thus is inherent with economic growth and interacts with the environment. At the same time, trade can create both winners and losers, resulting in inequality, and can generate negative social and environmental outcomes. This brief provides an overview of the current debate around trade in food and agriculture and illustrates the role that trade can play within food systems in balancing different dimensions of sustainability. While trade openness is generally conducive to food security and promotes economic growth, formulating trade policies to achieve multiple targets, including environmental, nutritional and social objectives, requires careful analysis. Trade policies may not be the best and most efficient instruments to achieve multiple objectives and they should be framed by complementary policies targeting specific aspects of sustainability. For example, in addressing climate change, one of today's most pressing challenges, a combination of food trade and domestic policy instruments can sharpen the adaptation and mitigation roles of trade and significantly contribute in providing incentives to promote climate-smart technologies. In order to effectively design such policies, a better understanding of both the complex linkages between trade and sustainability outcomes and the

simultaneous impacts of policy approaches on all parts of the food system will be necessary.

1. INTRODUCTION

Trade is an integral part of our food systems. It connects people at all stages of agricultural and food value chains, promotes food security, is inherent with economic growth, and interacts with society and environment. Since 1995, agricultural and food trade has more than doubled in value, quantity, calories, and land used for export (FAO, 2020b; Qiang *et al.*, 2020; Traverso and Schiavo, 2020). Today, about one third of agricultural and food exports in the world are traded within global value chains that encompass at least three countries (Figure 1; FAO, 2020b).

Agricultural and food trade links the food systems of countries and plays a crucial role in providing consumers worldwide with sufficient, safe and nutritious food, while generating income and employment for farmers, workers and traders in agriculture and food industry.

Trade is closely related to economic development. Developed countries make up more than 60 percent of agricultural and food trade. Emerging economies, such as Brazil and China, have been increasing their market shares since the early 2000s and play an increasingly important role in global agricultural and food markets (FAO, 2018a, 2020b).

At the same time, and as the interdependence between nations strengthens, the role of trade in society and income distribution becomes more important (FAO, 2020b). This, together with the emergence of new players in global markets, has induced lively debates on what economic, environmental and social outcomes trade and global markets generate. These debates have been intensified and broadened through significant concerns about inequality, growing environmental consciousness, changing lifestyles and diets that have been attributed to globalization and the related concerns about health risks associated with increasing shares of overweight and obese people (FAO, 2016, 2018b, 2020b).

The COVID-19 pandemic has fuelled fears about the functioning of global agricultural and food trade and the discussion about reshoring tendencies in manufactures and services and shortening global value chains has also reached food and agriculture.

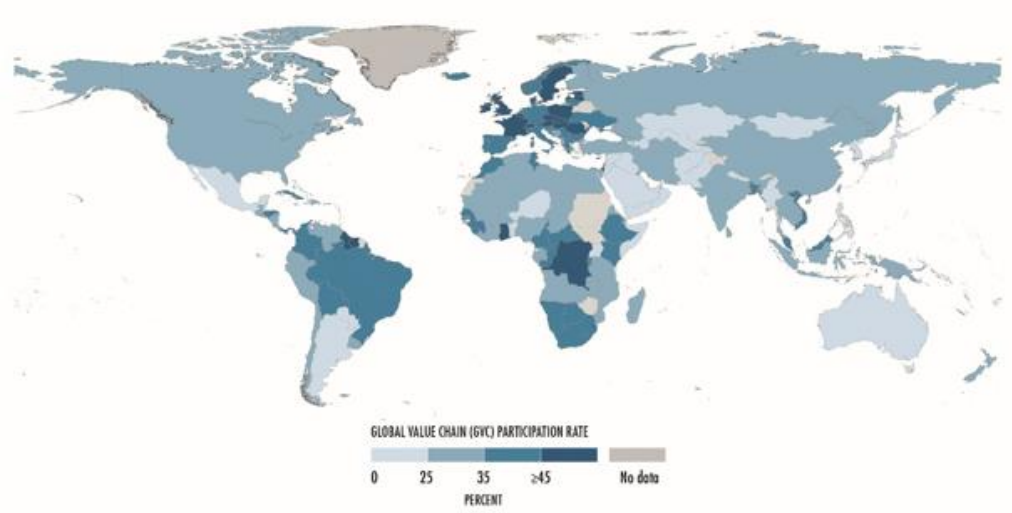
However, agricultural production strongly depends on specific natural resource endowments and environmental conditions, such as soil characteristics, altitude, water availability and climate. These are distributed unevenly across the world and, together with differences in technology, shape trade flows. This distinguishes agricultural and food trade from trade in manufactures and services. In fact, since the neolithic period, agricultural and food trade has evolved in line with the comparative advantage derived from these immutable characteristics (see for example, Smith *et al*., 2015).

At the same time, the demand for food is increasing fastest in regions where population and income growth are strongest, but which may not always be the most productive. These developments may reinforce the role of trade in ensuring food security and providing nutritious and healthy diets for all.

This brief highlights the role of agricultural and food trade in moving food globally from surplus to deficit regions, thus ensuring food security and serving a fundamental food systems function. It further addresses the interlinkages between trade and economic development, the environment and

societal shifts in food consumption. Ultimately, the brief illustrates the role that trade can play in balancing different aspects of sustainability from a global perspective and points out the scope for further research and novel policy approaches.

Figure 1. **Participation in global value chains in food and agriculture.**



Source: FAO (2020b).

2. TRADE, FOOD SECURITY AND NUTRITION

Trade in food and agriculture can help balance food supply and demand globally by moving food from surplus to deficit areas. Higher food imports can increase the *availability* of calories and nutrients in a country. Through increased food supply, food prices would fall, thus improving *access* for net consumers. At the same time, decreasing food prices induced by import competition can also affect incomes and livelihoods of domestic farmers and food processors who are net producers. However, for a country, increased trade openness may also allow for better access to other countries' markets and promote exports of agricultural products to these markets, thereby creating and expanding employment opportunities and raising workers' incomes (Dithmer and Abdulai, 2017; FAO, 2016).

By moving food from surplus to deficit areas at times of shortages, which might, for example, be caused by natural disasters or seasonal growing patterns, trade can also contribute to more stable food supplies and prices and thus to the *stability* dimension of food security. The exchange of foods that are produced under specific climate, soil and other natural conditions, can contribute to the diversity of diets (Remans *et al*., 2014) and improved food *utilization* (FAO, 2016, 2018b).

Although the theoretical pathways of how trade can affect food security and nutrition are well established, the linkages between agricultural and food trade and food security and nutrition are complex and some of the impacts can offset each other. This makes the identification of the effects in empirical assessments difficult. In fact, there has so far been only little empirical evidence on these relationships (FAO, 2018b; Mary, 2019).

A relatively new strand of literature contrasts trade openness with direct nutritional outcomes such as undernourishment. At global level, it was

shown that agricultural trade openness has, on average, a positive net impact on food security measured as dietary energy supply adequacy. It also increased dietary diversity measured as the share of calories from non-staple foods and protein consumption (Dithmer and Abdulai, 2017). However, the exact mechanisms and impacts can vary by context and stage of development (FAO, 2016). For example, in a sample of 52 developing countries, food trade openness was associated with an increase in the prevalence of undernourishment. In fact, it was found that food supply increased as a result of increased trade openness, but, in net food-importing countries, the negative effect on agricultural producers and the food sector caused by import competition prevailed. This result could point to efficiency constraints in net importing countries with large agricultural sectors (Mary, 2019).

Besides trade openness, also the ease by which trade takes place matters. For example, poor trade facilitation with high bureaucratic requirements and lengthy export and import times can negatively affect various dimensions of food security, as shown in a study of 45 African countries observed between 2006 and 2015 (Bonuedi, Kamasa and Opoku, 2020).

Among the most-researched relations within the area of agricultural trade and food security are the linkages between trade and price volatility. Price volatility, which is described by episodes of large and unexpected price changes, can intensify and contribute to risks to food security (Kalkuhl, von Braun and Torero, 2016). In particular, the food price crisis of 2007/08 has triggered a plethora of studies on its causes. While a whole set of macroeconomic and sector-specific drivers for the price surges has been identified (Tadesse *et al.*, 2014), it is now well established that trade restrictions that were imposed by many countries in response to rising food prices exacerbated food price volatility.

Trade-restricting measures, such as high import tariffs and export bans, reduce the volume traded in international markets and thus constrain the exchange mechanism between surplus and deficit areas. This makes markets more vulnerable to shocks and increases price volatility at times of crisis (Anderson, 2012). To insulate from sudden food price surges, countries tend to impose new or heighten existing export restrictions and/or lower import barriers so that the domestic price would rise less than the world market price (Rapsomanikis, 2011), with the effect that world markets become even thinner, market uncertainty increases and international food prices become more volatile (Anderson and Nelgen, 2012; Anderson, Rausser and Swinnen, 2013; Martin and Anderson, 2012).

Export restrictions, especially when applied by major exporters, can significantly harm their trading partners, in particular, net food-importing developing countries. For example, export restrictions implemented by various countries between 2006 and 2011, increased international price volatility for wheat and rice. In fact, the contribution of export restrictions to price volatility appeared to be in the same order of magnitude as that from key macroeconomic variables (Rude and An, 2015).

At the same time, export restrictions affect also domestic markets (FAO, 2016). For example, export restrictions on wheat applied by the major wheat exporters during the 2007/08 food price crisis, did not only harm their trading partners, but decreased also prices for domestic producers and increased domestic market instability. The negative market effects discouraged private investors and prevented the countries which imposed the export restrictions from achieving their

production potential (Götz, Glauben and Brümmer, 2013).

Diet diversity is important for an adequate provision of nutrients and human health. As natural conditions do not allow to produce all foods everywhere, trade is an important means to help diversify diets. A number of studies investigate the relationship between trade and dietary diversity.

Since the beginning of the 1960s, trade in crops has expanded and diversified. This process has been identified as the main driver of globally diversifying supply of vegetable products (Aguiar *et al.*, 2020). In fact, the diversity of foods produced is a strong predictor of food supply diversity only in low-income countries, which are less integrated in international trade. In middle- and high-income countries, food supply diversity was shown to be independent of production diversity and other factors, including international trade, contributed more to a country's supply diversity (Remans *et al.*, 2014).

Although lower-income countries are often not well integrated in global markets, a study found that they still tend to improve their nutrient supply through trade, in particular, the supply of energy, protein, zinc, calcium, vitamin B12 and vitamin A (Wood *et al.*, 2018). However, in another study it was found that, while trade distributes substantial volumes of nutrients, its role in bridging the nutrient adequacy gap[1] was only marginal in low- and lower-middle income countries. International trade helped close the nutrient gap in most high- and upper-middle income countries, even where domestic production ensured only a very low nutrient adequacy (Geyik *et al.*, 2021).

Taken together, the evidence shows that trade is indispensable to ensure food security in all its dimensions. Without trade, the availability and accessibility of foods and nutrients would be more unevenly distributed, any form of domestic production disruptions would cause serious concern for food security, and diets would be less diverse.

However, increased competition through rising imports may be challenging for farmers in developing countries that are characterized by low efficiency and productivity constraints associated with poor physical infrastructure, weak institutions and low skills.

3. TRADE, GROWTH AND INEQUALITY

The global trade regime – as it is reflected by the WTO rules and a multitude of trade agreements – has contributed to increasing trade significantly since the last decades of the 20th century. Population growth and urbanization, rising incomes and improvements in transport and communication technology have colluded with lower policy-induced trade barriers to fuel trade (FAO, 2020b).

Most economists would agree that openness to international trade promotes economic growth (Irwin, 2019). Trade results in efficiency gains as resources are allocated in line with comparative advantage – that is shaped by differences in technology and relative factor endowments. In agriculture, where differences in land and water endowments and climate are significant across countries, gains from openness and market integration can be large (Martin, 2018). These gains can add to the rate of growth of the economy but are difficult to estimate.

Isolating the impacts of trade openness, whether this comes from a reduction in trade costs or trade policy

[1] The nutrient adequacy gap describes the difference between nutrient requirements and actual availability referring to six essential nutrients (protein, iron, zinc, vitamin A, vitamin B12 and folate) (Geyik *et al.*, 2021).

reforms is challenging, given the myriad of factors that affect economic growth. In addition, focusing the analysis on single sectors, such as food and agriculture, can be complex. Using structural models to test counterfactual scenarios is the analysts' preferred method to untangle the role of trade and trade policy in economic growth. For example, a study looking at the effect of market integration across US counties between 1880 and 1997 suggests that such gains are substantial as agricultural production is allocated according to comparative advantage (Costinot and Donaldson, 2016).

In addition to the effect of efficiency gains, trade facilitates technology and knowledge spillovers across countries which promotes growth by improving the production process, increasing product quality and resulting in new products (Grossman and Helpman, 1991). Indeed, since 1995, the growth in food and agricultural trade has taken place together with increases in agricultural productivity per capita, particularly in emerging and developing economies (FAO, 2018a).

This conventional wisdom on the effects of trade openness on growth and productivity is being questioned by many practitioners. Gains from trade are asymmetrically distributed. Trade openness affects the prices of goods and those of production factors, including labour, and thus can result in winners and losers. In agriculture, a major concern relates to the ability of smallholder farmers from developing countries to compete effectively in open markets.

A handful of studies focus on the impact of trade openness on agricultural productivity – the underlying hypothesis being that trade facilitates the diffusion of technology and knowledge spillovers. Focusing on how agricultural productivity in 44 countries – both developed and developing – converges at higher levels, a study finds that openness to trade increases labour productivity growth rates in agriculture within an analytical framework that also takes into account the costs of technology diffusion and adaptation (Gutierrez, 2002).

Additional evidence suggests that trade openness can have a short-run negative impact on agriculture's efficiency (Hart, Miljkovic and Shaik, 2015). However, in the long run, it is found to increase efficiency in agriculture, reflecting the ability of the sector to adapt to global markets and increased competition through technology adoption, but also through the exit of inefficient farms from the sector. In Chile – a country that liberalized trade in the 1990s after a period of import-substitution policies – an analysis of 70,000 farms suggests that trade openness is positively related to farm yields (Fleming and Abler, 2013).

Downstream, a study of more than 20,000 food firms in Italy and France suggests that import penetration in both final food products and intermediate inputs systematically contributes to firm-level productivity growth (Olper, Curzi and Raimondi, 2017). Participation in agricultural and food global value chains, either through imports of inputs or exports of intermediate products, is also found to promote agricultural labour productivity (FAO, 2020b; Montalbano and Nenci, 2020). The main mechanism for this lies on how value chains unbundle the production process, allowing farms and firms to leverage their comparative advantage in global markets and facilitating the transmission of improved technology, leading to better farm practices and improved labour productivity.

These linkages between trade openness and technology are unwrapped by a micro-level data study of the impact of trade in agricultural inputs on the productivity of 1.1 million fields across 65

countries. Since the 1980s, trade openness in agricultural inputs was found to result in significant shifts from traditional farm technologies to modern ones, thus having distributional implications for productivity and welfare across the world (Farrokhi and Pellegrina, 2020).

In addition to the efficiency gains from better resource allocation in agriculture and the dynamic effects on agricultural productivity through the transmission of technology and knowledge, trade openness in food and agriculture can generate significant effects on the broader economy by facilitating structural transformation. Trade in food, especially imports, can help meet domestic food requirements and allows labour to be allocated to non-agricultural sectors, thus promoting economic growth and development (Tombe, 2015). Analyzing the process of structural transformation in the UK in the 19th century and, more recently, in South Korea, a study finds that agricultural imports played a crucial role in the transformation process of both economies (Teignier, 2018).

Trade openness, either by intensifying competition or through fuelling the structural transformation process, can promote growth but can also affect income distribution and inequality. A recent analysis of the impacts of eliminating tariffs on agricultural products across low- and middle-income countries pointed to increases in both income and inequality (Artuc, Porto and Rijkers, 2019). The results suggest that, on average, liberalizing agricultural trade would increase household incomes. At the same time, eliminating import tariffs was found to have highly heterogeneous impacts across countries, and within countries across households. In most countries, the top 20 percent of the richest households would gain more from liberalization than the bottom 20 percent, thus exacerbating inequality.

In the context of food systems, trade openness highlights the trade-offs between promoting economic efficiency and generating positive social outcomes. Integrating smallholder farmers in global markets is challenging. Policies that promote trade openness often tend to underplay market failures and the need for complementary actions to address inequality are necessary. Inclusive business models, such as contract farming, can address the constraints farmers in developing countries face in entering markets and global value chains (FAO, 2020b). But a range of public policies and investments, such as carefully designed input subsidies targeted to smallholder farmers, skills upgrade and education, removing labour market rigidities, as well as improvements in infrastructure and regulation, can complement the market mechanism and promote a fair structural transformation.

4. TRADE, ENVIRONMENT AND CLIMATE CHANGE

Agriculture builds one complex with the environment. Natural resources and climate are inputs to agricultural production and a part of the human impact on the environment is transmitted through this production process.

While expected changes in climatic and environmental conditions over the coming decades will affect food security and nutrition, short-term shocks, such as natural hazards, pests, diseases and extreme weather events, already lead to harvest losses and supply chain disruptions. In regions with limited access to international markets and where food production and consumption are tightly coupled, these shocks can more readily

translate into local shortages of (specific) foods (Davis, Downs and Gephart, 2021).

At the same time, changes in trade flows are associated with changes in agricultural production, which can influence greenhouse gas (GHG) emissions, land and water use and biodiversity through positive and negative externalities. Because of the spatial heterogeneity of resource availability, resource productivity, and farming practices, the environmental impact of producing food is localized and highly dependent on its origin. Depending on whether the environmental impact of agricultural production is greater or smaller in the exporting region than in alternative production sites, agricultural and food trade can therefore either increase or reduce the aggregate impact of agriculture on the environment globally (Dalin and Rodríguez-Iturbe, 2016).

By contributing to a better allocation of production across countries, trade can improve the utilization of natural resources in agriculture at the global level, which, in aggregate, can be beneficial to the environment (Roux *et al.*, 2021). Without trade, some countries would have to produce a wider range and larger quantities of foods, even if their natural endowment was not compatible with such an expansion, placing an additional pressure on their ecosystems.

For example, increased agricultural production in net food-importing countries in the Middle East and North Africa would likely be at the expense of further water depletion in an already water scarce region (Biewald *et al.*, 2014).

However, greater import demand and demand for specific products in some regions of the world can also lead to the depletion of natural resources and/or increased pollution in exporting countries.

In particular, if comparative advantage is derived from differences in environmental regulation, production might shift to countries with relatively laxer regulation, leading to worse environmental outcomes on the aggregate (Grossman and Krueger, 1991).

Moreover, trade can induce technological change, including through transfer of technology and best practices between trading partners, and leading to increased productivity and more efficient resource use (Grossman and Krueger, 1991). For example, greater agricultural output per hectare may release some agricultural land from production (land sparing) which thus becomes available for natural habitats and species, contributing to wildlife biodiversity (Phalan *et al.*, 2011).

In order to analyse the impact of trade on resource use and pollution, a growing literature expresses trade flows in terms of the resource inputs and emission content they carry (virtual resource trade, carbon/land/water footprint). In fact, while trade was found not to be a major topic in ecosystem research based on a survey of ecological journals published in 2017 (Pace and Gephart, 2017), the literature on interactions between trade and the environment has been rapidly expanding. The analysis of impacts of agricultural trade on the environment mainly centres on climate change and the use of water and land, covering also deforestation (Balogh and Jámbor, 2020).

4.1. Climate change

Agricultural trade can play a role in both adjusting to the effects of climate change (adaptation) and reducing GHG emissions from agriculture (mitigation).

Trade as adaptation mechanism

Climate change may lead to significant trade disruptions in the short term (through extreme weather events) and long-term changes in trade patterns

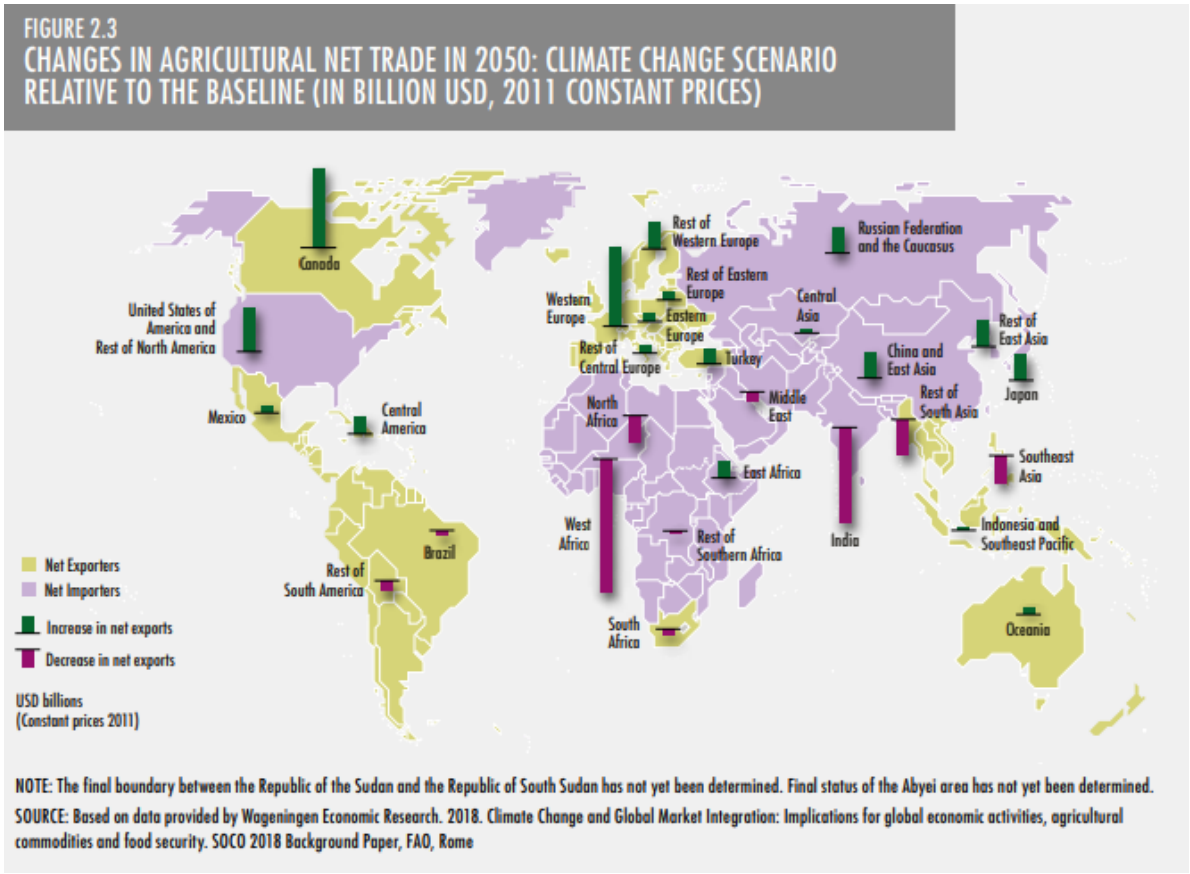
through altering countries' comparative advantage. Trade could help countries adapt to short-term supply disruptions and long-term changes in comparative advantage triggered by climate change (FAO, 2018a).

As climate change is expected to have an uneven effect across regions, trade can be an important avenue in ensuring food security. In studies on climate change impacts on agriculture in the time period 2050 to 2100, low-latitude regions such as the Near East, North Africa, sub-Saharan Africa and South Asia are often projected to be adversely affected, whereas high-latitude regions such as North America, parts of South America (e.g. Chile), Central Asia and Eastern Europe are expected to experience largely positive impacts on agricultural production (FAO, 2018a; Reilly, 1995; Wheeler and von Braun, 2013).

Under deteriorating conditions for agricultural production due to climate change, food imports by relatively more adversely affected (often developing) countries will have to come from those countries (often developed) that are relatively less adversely affected.

In fact, most studies integrating biophysical and economic models project a stronger role for trade as a result of climate change at the global level (Ahammad *et al.*, 2015; Baldos and Hertel, 2015; FAO, 2018a; Havlík *et al.*, 2015; Janssens *et al.*, 2020; von Lampe *et al.*, 2014, 2014; Nelson *et al.*, 2014; OECD, 2015; Schmidhuber and Tubiello, 2007; Figure 2).

Figure 2. **Projected changes in agricultural net trade in 2050: climate change scenario relative to a no-climate change baseline (in billion USD, 2011 constant prices).**



Source: Cui et al. (2018); FAO (2018a).

However, the adaptive role of trade in ensuring food security, could be constrained by trade restrictions and structural barriers to adjustment.

While a substantial part in mitigating adverse effects from climate change in agriculture would come from endogenous production adjustments, such as shifts in production patterns, in line with evolving comparative advantage (Costinot, Donaldson and Smith, 2016; Gouel and Laborde, 2021), freer trade could indeed offset part of the welfare losses from climate change (Costinot, Donaldson and Smith, 2016; Gouel and Laborde, 2021; Stevanović *et al.*, 2016; Wiebe *et al.*, 2015). Open markets could also contribute towards food security, especially in adversely affected regions that are already characterized by a high prevalence of undernourishment (Baldos and Hertel, 2015; Janssens *et al.*, 2020).

The aggregate patterns of climate change effects at global and regional level can mask differences in the distribution of gains and losses within countries and regions. Through the balancing mechanism of international trade, agricultural and food prices in adversely affected regions would be relatively lower under free trade compared to a scenario in which trade is restricted. This would benefit net food consumers, while agricultural producers could lose. At the same time, farmers in less affected or even benefitting regions could gain from relatively higher prices under free trade, while consumers would face welfare losses (Stevanović *et al.*, 2016).

As labour productivity in agriculture would be more affected by higher average temperatures than in other sectors of the economy, affected countries could adapt to climate change by importing food and shifting labour towards nonagricultural sectors. However, under limited market integration, subsistence food requirements in many developing countries could drive specialization even towards, rather than away from, agriculture, thus exacerbating losses from climate change (Nath, 2020).

Trade in climate change mitigation

Foresight analyses suggest that between 2012 and 2050 agricultural production will have to increase by 50 percent in order to provide food for a growing and progressively more wealthy population (FAO, 2018c). Such increases in production could also result in increases in global GHG emissions unless food systems become 'emissions efficient' and produce lower emissions per unit of output. As trade will expand to contribute to climate change adaptation, increased transport will also add to the emissions (FAO, 2018a; Pendrill *et al.*, 2019; Schmitz *et al.*, 2012, 2015). The ultimate impact on global emissions depends on whether imports are sourced from systems that operate at lower emissions efficiency or from ones that operate at higher emissions efficiency (Table 1).

***Table 1*. Impacts of emissions leakage through trade**

Relative emissions efficiency (between imports that displace domestic products)	Impact on global emissions	Result of emissions leakage
Imports are produced in systems with **lower emissions efficiency** (higher emissions per unit of output)	**Increase** in global emissions	**Emissions misallocation**
Imports are produced in systems with **higher emissions efficiency** (lower emissions per unit of output)	**Decrease** in global emissions	**Emissions reallocation**

Source: FAO (2018a).

Several policy incentives can help improve emissions efficiency and lower GHG emissions. For example, taxing GHG emissions is a way to 'internalize' their full cost to the society and can provide incentives to farmers to adopt technologies and practices that promote climate change mitigation (FAO, 2018a).

However, mitigation policies implemented through a uniform global carbon price would curb emissions but also reduce agricultural production, raise agricultural commodity prices, and impact food security. Underlining the trade-offs between food security, nutrition and emission reduction targets, especially for developing countries, the most significant reduction in consumption as a result of global carbon taxes has been projected for livestock products in sub-Saharan Africa (FAO, 2018a; Havlík *et al.*, 2015).

If instead carbon taxes were imposed unilaterally, countries that try to internalize the cost of GHGs may inadvertently confer a competitive advantage on others that do not impose a similar measure, potentially leading to emissions leakage and misallocation. This would imply the risk of increasing production and exports from countries without mitigation policies resulting in emissions leakage. In this case, the impact of this leakage on global emissions may be positive (emissions reallocation) or negative (emissions misallocation) depending on the relative emissions efficiency of domestic production vis-à-vis imports (Table 1). Specific trade policies can contribute towards addressing the trade-off between food security and emission reduction targets. To even out disparities between domestic and international levels of carbon taxes, border measures, such as border tax adjustments based on food products' carbon footprints, could be implemented (FAO, 2018a).

Instead of, or in addition to taxing GHG emissions, labelling of final products with respect to GHGs emitted during their production can be a way of shaping consumer preferences towards less-emitting production practices.

Common to all of these policies is that they would require an accurate and complete assessment of the costs incurred to the society by the GHGs emitted during agricultural and food production, or, as usually done in practice, a reliable estimate of the direct emissions involved in the production process of different foods - the carbon footprint.

However, already the consistent accounting of GHG emissions in agriculture implies several challenges, including methodological issues and excessive data requirements. Carbon footprints need to be quantified encompassing the emissions generated in the production and supply of inputs used by farmers, direct and indirect emissions generated in agricultural production processes, and subsequent emissions associated with transportation, processing, storage, and delivery of products to consumers (FAO, 2018a;

Rosenzweig *et al.*, 2020). In particular, agricultural production involves many different sources of emissions that need to be covered. Moreover, these sources of emissions are often diffuse, difficult to monitor and can vary by location (Escobar *et al.*, 2020). For example, fertilizer use is a major source of nitrous oxide emissions, but measuring the emissions from a given area of land is complicated, since it depends on factors other than the amount of fertilizer applied, many of which are site-specific (e.g. management practices, soil types, and weather) (FAO, 2018a).

In addition to overcoming technical challenges in determining carbon footprints in agriculture and possible trade-offs with food security through certain mitigation policies, the carbon accounting mechanisms would also need to be agreed upon internationally to avoid any trade disputes (FAO, 2018a).

Alternative policy approaches to reduce GHG emissions from agriculture centre on domestic measures to incentivize climate-smart agricultural practices. These can be indirectly related to trade by altering traded volumes and market signals (FAO, 2018a).

4.2. Land, water, biodiversity

Besides GHG emissions, agricultural production can affect natural resources, such as land and water, and biodiversity. Through trade, these external effects can occur in countries far away from the final point of consumption. In the case of water, these externalities are mainly positive (Dalin and Rodríguez-Iturbe, 2016). By importing products and services from countries with abundant water resources, water-deficient countries can alleviate the pressure on their own water supply (Deng *et al.*, 2021; Pastor *et al.*, 2019).

With increasing agricultural trade, also the total land use embodied in agricultural trade more than doubled (almost tripled) between 1986 and 2016. As in the case of water, countries with absolute or relative abundance of land, such as the United States, Brazil and Argentina, are net exporters of 'virtual' agricultural land. Countries with relatively less land per capita, such as Japan, the Netherlands and mainland China, are among the net importers of 'virtual' land. Countries with relatively little arable land but high yields, such as European and some Asian countries, tend to export high-value agricultural products, such as fruits, vegetables and animal-based foods (Qiang *et al.*, 2020).

However, due to trade-offs with other resource uses, trade may not always allocate production to the regions with the most efficient land use (Roux *et al.*, 2021). For example, a globally optimal allocation of water use might imply an expansion of land use into natural areas and forests (Pastor *et al.*, 2019).

By specializing agricultural production away from certain products that are increasingly imported, land use changes can occur also in importing countries. For example, increased nitrogen pollution was observed in countries that shifted from domestic soybean production to increased soybean imports. In these cases, farmland that was originally used for cultivating soybeans, which can fix nitrogen and require significantly less fertilizer, was converted to grow crops such as wheat, corn, rice, and vegetables, which are more prone to overfertilization (Sun *et al.*, 2018).

Land use affects also biodiversity. On the one hand, some farming systems can be beneficial to biodiversity and many ecosystems depend directly on agricultural land use (Henle *et al.*, 2008; Tscharntke *et al.*, 2012). On the other hand, the conversion of natural habitats to farmland can lead to displacement or eradication of wildlife (Rockström *et al.*, 2009), and

biodiversity in existing agricultural systems can be affected by an overuse of agrochemicals and certain forms of land management.

By distinguishing between biodiversity loss from agricultural land used for exports and domestic consumption, increasing import demand from developed countries is sometimes found to be the main driver for biodiversity loss in exporting countries (Chaudhary and Brooks, 2019; Chaudhary and Kastner, 2016; Lenzen *et al.*, 2012; Moran and Kanemoto, 2017). However, more systematic research covering multiple disciplines, various dimensions/indicators of biodiversity and counterfactuals is needed to provide comprehensive assessments of biodiversity footprints (de Chazal and Rounsevell, 2009; Marquardt *et al.*, 2019; Ortiz *et al.*, 2021).

Overall, the evidence on the effects of extreme weather events, natural hazards, pests and diseases on food systems is concentrated on the main staple crops (maize, rice and wheat) and relatively few types of shocks (Davis, Downs and Gephart, 2021). Similarly, also the analysis of the impact of trade on the environment tends to focus on aggregated trade or on trade in staple food crops. Only very recently, studies consider the impacts of a broader range of specific products, such as trade in cash crops (Sporchia, Taherzadeh and Caro, 2021).

Ensuring food security and satisfying dietary needs for a growing number of people, especially in already food-deficit regions, may not be possible without exploiting the relative comparative advantage in other regions of the world.

5. GLOBALIZATION OF FOOD: TRADE, SOCIAL AND HEALTH IMPACTS

Improvements in productivity and the expansion of international trade have increased the availability of food, lowered food prices and contributed to overall declining rates of undernutrition in the world. At the same time, together with higher incomes and a more sedentary lifestyle, trade is also associated with increasing rates of overweight and obesity worldwide (FAO, 2018b, 2020b).

The liberalization of trade and investment have sometimes been identified as being among the key mechanisms through which globalization impacts health (Cowling, Thow and Pollack Porter, 2018; Mary and Stoler, 2021). Overall, the empirical literature appears to point to a broad association between trade liberalization, improved dietary quality and reduced undernutrition (Cuevas García-Dorado *et al.*, 2019).

However, subject to context and method of analysis, the body of empirical work investigating the relationship between globalization, trade in food and agriculture and health outcomes finds mixed results (Cowling, Thow and Pollack Porter, 2018; Cuevas García-Dorado *et al.*, 2019; Mary and Stoler, 2021).

Some studies explore the relationship between globalization indices and average body mass index (BMI: kg/m^2) in a country. In low-income countries, increasing mean BMIs can indicate a reduction in undernutrition, while high mean BMIs can also indicate a greater prevalence of overweight in a country.

Economic globalization, measured as an index of trade and foreign direct investment (FDI) flows and restrictions[2]

[2] Several studies distinguish between the impact of economic, political and social globalization based on the KOF index (Dreher, 2006). According to this index, economic integration refers to actual trade and foreign direct investment (FDI) flows and restrictions. Political integration is composed of a country's international engagement with other countries and

was found to be positively related to increases in mean BMI (Vogli *et al.*, 2014). The relationship between economic freedom[3] and BMI was found to be very weak overall. Only in the case of men living in developing countries an increase in economic freedom was associated with slightly higher BMIs (Lawson, Murphy and Williamson, 2016).

Several studies consider indicators different from BMI, such as the prevalence of obesity and/or overweight. The economic integration (or economic globalization; see above) between countries is often shown to have no or a decreasing effect on the prevalence of overweight (Costa-Font and Mas, 2016; Goryakin *et al.*, 2015; de Soysa and de Soysa, 2018).

Globalization can also manifest in shifts in socio-cultural norms, which, in turn, affect consumer preferences, diets and nutritional outcomes. A closer social integration, measured as an index of personal international contacts, international information flows and cultural proximity (Dreher, 2006), is sometimes found to be positively associated with obesity (Costa-Font and Mas, 2016; Goryakin *et al.*, 2015).

However, socio-cultural aspects of globalization and access to information and communication technology were found to lower the share of overweight and obese young people aged between 15 and 19, suggesting that increased international interconnectivity in this age group might help spread knowledge about healthier eating and lifestyle habits (Knutson and de Soysa, 2019).

Recent studies also explore the relationship between (general) trade openness and obesity rates. For example, an increase in trade openness was associated with increasing overweight and obesity rates in Brazil (Miljkovic *et al.*, 2018) and at global level (An *et al.*, 2019). This relationship appeared to be stronger in developing countries with high economic growth rates, while no relationship between trade openness and obesity prevalence was identified among high-income countries (An *et al.*, 2019).

In a study on the effects of social globalization and trade openness on average BMI and different indicators of diet quality, increasing social globalization was associated with higher mean BMI, animal protein and sugar supply. These results seem to be driven by specific components of social globalization such as information flows through television and internet. Trade openness did not reveal any effect on dietary outcomes or health (Oberlander, Disdier and Etilé, 2017).

A critical review of methodological approaches used in quantitative analyses of the impacts of global trade and investment on non-communicable diseases and risk factors, encourages future studies, *inter alia*, to clearly define the exposure of interest and, in particular, not to conflate trade and investment; explore the mechanisms of broader relationships that might steer the results; adjust for reverse causality; increase the use of individual-level data; and, consider sector-specific rather than economy-wide trade and investment indicators (Cowling, Thow and Pollack Porter, 2018).

Empirical evidence on the interlinkages between trade in food and agriculture and nutritional outcomes is still scarce and, so far, only a few studies have

international organizations and social integration measures personal international contacts, international information flows and cultural proximity.

[3] Economic freedom was measured with the Economic Freedom of the World index. The index assesses the degree to which policies and institutions of countries are supportive of economic freedom. It measures economic freedom in five broad areas: size of government; legal systems and property rights; sound money; freedom to trade internationally; and regulation (Gwartney, Lawson and Hall, 2013).

explored these linkages more systematically (FAO, 2020b). Agricultural and food trade constitutes an important means to ensure diet diversity. However, as trade improves the availability and accessibility of both foods necessary for a healthy diet and foods high in fat, sugar, salt and calories, the effects on nutritional outcomes can be mixed (FAO, 2018b, 2020b; Krivonos and Kuhn, 2019).

In fact, trade has helped overcome the constraints the uneven distribution of natural resource endowments poses on the supply of foods and nutrients across countries. A study suggests that trade resulted in food and nutrients being more equally distributed in 2010 than in 1970 (Bell, Lividini and Masters, 2021).

Agricultural trade openness has also been associated with increasing overweight and obesity prevalence in developing countries (Mary and Stoler, 2021); rising imports of sugar and processed foods were found to be correlated with slightly higher average BMIs (Lin, Teymourian and Tursini, 2018); and the exposure to food imports from the United States of America was found to explain part of the rise in obesity prevalence among Mexican women between 1988 and 2012 (Giuntella, Rieger and Rotunno, 2020).

6. THE TRADE POLICY ENVIRONMENT

International trade negotiations in the General Agreement on Tariffs and Trade (GATT), and subsequently under the WTO, have contributed to opening global markets and barriers on agricultural and food trade have declined since the Uruguay Round of the GATT and the WTO Agreement on Agriculture in 1995.

Since the beginning of the 1990s, also the number of regional trade agreements that have been notified to the WTO has risen, from less than 5 in 1990 to 339 being in force in 2021. Currently, European countries are the main partners in regional trade agreements, followed by countries in East Asia (WTO, 2021).

Considerable attention has been paid to prospects for development from the African Continental Free Trade Area (AfCFTA). The AfCFTA covers 54 of the 55 African Union (AU) Member States and entered into force in May 2019, with trade commencing in January 2021 (FAO and AUC, 2021). The AfCFTA is expected to significantly increase intra-African trade of agricultural and food products, with estimates ranging between 20 and 30 percent increase in 2040 compared to a scenario without the AfCFTA (United Nations Economic Commission for Africa, 2018; United Nations Economic Commission for Africa and TradeMark East Africa, 2020).

In contrast to multilateral trade agreements, regional trade agreements grant concessions only to a few trade partners, discriminating against others. The proliferation of regional trade agreements is sometimes seen as “building blocks” towards multilateral trade liberalization, but could also hinder further integration (Bhagwati, 1991, 1993). This discussion is of particular relevance in the agricultural sector (Sheldon, Chow and McGuire, 2018), for which also the depth of many regional trade agreements and thus their actual potential to impact members’ trade has been called into question (Grant, 2013).

More recently, the use of environmental provisions in trade agreements has increased considerably, a trend that is particularly strong in agreements between industrialized and developing countries (Morin, Dür and Lechner, 2018). Moreover, the consideration of nutritional objectives in trade agreements has also emerged (Thow and Nisbett, 2019), with the discussion in

multilateral fora focusing on issues related to nutrition labelling (Thow *et al.*, 2018).

While the strong focus on environmental and nutrition aspects in trade policy is relatively new, non-tariff measures, especially food safety standards and their international harmonization, continue to be a major point of discussion in agricultural trade (FAO, 2020a; Santeramo and Lamonaca, 2019; Wieck, 2018).

These discussions on environmental provisions and nutritional issues in the context of trade trace the multiple trade-offs between economic, environmental and social objectives within food systems. They also highlight that, in general, the market mechanism cannot guarantee the provision of a range of social and environmental benefits that are central to sustainable development. Food and agricultural trade may result in negative environmental outcomes or may fail to address social objectives, such as reducing inequality.

In food and agriculture, trade policy measures address a broad array of mainly economic objectives. For example, tariffs are commonly used to protect local producers from international competition and can contribute towards maintaining a level of farm income that keeps pace with income in other economic sectors. Tariffs are also used to reduce import dependence and promote self-sufficiency in staple foods. Export restrictions can lower the domestic price of food and contribute towards food security in the short term. Both tariffs and export taxes provide an important source of government revenue. Other measures, such as non-tariff barriers, aim at improving the safety and quality of food. All these policy instruments should address their objectives as sustainably as possible but can also entail positive or negative external effects to society and the environment.

Within a food systems approach to trade, policy formulation based on tariffs or export restrictions to address environmental and social objectives, such as the preservation of biodiversity, better nutrition or equity, might be very costly and not sufficient to achieve all sustainability targets.

Externalities or non-economic objectives, such as those considered in this brief, are best addressed by policies that act directly on the relevant margin, as for example, by domestic policy instruments, such as taxes and subsidies, rather than introducing trade distortions. Formulating policies at the margin implies a 'targeting principle' that allows to rank different policy instruments in line with their effectiveness in addressing externalities or noneconomic objectives (Bhagwati and Ramaswami, 1963; Dixit, 1985; Rodrik, 1987). Trade policies may not be the best and most efficient way to address externalities and achieve environmental objectives. For example, a domestic carbon tax acts on the margin, providing incentives to farmers to reduce emissions and adopt climate-smart farming technologies.

In some cases, policy objectives can be independent of each other. For example, the prevalence of overweight and obesity can be addressed by taxes on the sugar or fat content of food or raising awareness on healthy diets, rather than trade policies. A basic principle of effective policy-making – the Tinbergen rule – indeed suggests that to achieve a number of independent policy targets at least the same number of independent policy instruments are required (Tinbergen, 1952).

Political economy considerations suggest that trade policies can also be endogenous in the sense that they have been created by pressure groups, such as producer organizations, exerting influence on the policy-making process. In this case, the 'targeting principle' may not apply. For

this reason, it is important to understand the process by which policies are formulated and to consider context-specific policy approaches instead of broad principles (Rodrik, 1987).

While open markets and free trade are conducive to global food security and promote economic growth, liberalization processes can create winners and losers and thus should be framed and supported by complementary policies that address market failures, externalities and system-inherent distortions. For example, addressing inequality can be achieved by redistributing gains from liberalization and facilitating mobility across sectors.

In order to effectively design such policies, a better understanding of their simultaneous impacts on all parts of the food system will be necessary. Evolving food systems research will require both strong disciplinary approaches and analytical tools integrating several dimensions and multi-level perspectives (van Ittersum *et al.*, 2008). It will also require effective communication of "plurality and conditionality of complex, dynamic systems research" (Zurek *et al.*, 2018) to non-expert audiences and policy-makers.

Key policy issues to be considered on the Food Systems Summit agenda:

Recognize the role of trade in promoting food security, economic growth and better natural resource use and management

Trade openness contributes towards global food security and better nutrition, a better allocation of food production, and a more efficient and sustainable use of natural resources across countries. For a country, participation in global markets and value chains facilitates the diffusion of technology and knowledge and leads to increased productivity and more efficient resource use. To allow trade to flow smoothly and fulfill these functions, unjustified trade distortions and barriers should be avoided. Enhancing market transparency through improved information, cutting red tape and simplifying trade procedures through digitalization can significantly facilitate trade.

Implement complementary policies to address the trade-offs between economic and social objectives in the context of open markets

Open markets lie at the heart of the development process. In developing countries, a range of public policies and investments can help farmers overcome constraints to market access and create an enabling environment for a prospering economy for all. These include skills upgrade and education, removal of labour market rigidities, and improvements in infrastructure, institutions and regulation. Social protection mechanisms and redistribution of economic gains of trade openness to vulnerable population groups can improve inclusion and reduce inequalities.

Strengthen the role of trade in climate change adaptation and mitigation

As climate change is expected to have an uneven effect across regions, trade openness can be an important avenue in ensuring food security in countries which are more adversely affected by global warming and extreme weather shocks. But the mitigating role of trade is equally important. Internalizing the cost of climate change in the food price across countries can help trade reallocate agricultural production to regions where emissions per unit of output is lowest. This can address the dual challenge of meeting food demand growth in the future and reducing greenhouse gas emissions.

Maximize the gains from trade for all countries

Both regional agreements and multilateral mechanisms can support trade and economic growth. Nevertheless, as food surplus and deficit areas may be located in different world regions and specific products may be most efficiently produced in other parts of the world, gains from agricultural and food trade can be maximized through multilateral mechanisms. Multilateral mechanisms can also help guide an optimal policy mix in addressing trade-offs between economic, health and environmental objectives, such as the harmonization of food safety standards and the development of a common understanding on sustainability certification.

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