TRADE4SD

Fostering the positive linkages between trade and sustainable development

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Structured review on the relationships between international agri-food trade and sustainability

Scoping exercise on possible linkages

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About TRADE4SD Project

Trade is a central factor in shaping not only global, but also regional and local development. Trade policy has an especially important part to play in achieving the UN Sustainable Development Goals (SDGs). The premise of the TRADE4SD project is that trade has the power to produce positive outcomes when the policies which define the rules of the game are framed and designed in a way to promote access to markets, fair prices and standards of living for farmers, as well as alleviating rural poverty and ensuring sustainable farming practices. Addressing the relation between trade and SDGs requires an integrated approach to policy-making and inclusive governance.

The main objective of the TRADE4SD project is to contribute to build new opportunities for fostering the positive sustainability impacts of trade supported by improved design and framing of trade policy at national, EU and global level, including WTO modernisation, increased policy coherence at different domains including agricultural, energy, climate, environmental and nutritional policies.

To meet this objective, the project will develop an integrated and systematic approach that combines quantitative models from different perspectives, and several qualitative methods recognising that SDGs and trade are highly context-related. On the one hand, a robust analysis of economic, social and environmental impacts is given by using diverse but integrated modelling techniques and qualitative case studies. On the other hand, a wide consultation process is implemented involving stakeholders both in the EU and in partner countries as well as those with a wide international scope of activity, providing opportunities for improved understanding, human capital building, knowledge transfer and dissemination of results. To this extent, the consortium involves, as co-producers of knowledge, a number of research and stakeholder participants with different backgrounds who will use their networks to facilitate the civil society dialogue and build consensus on the subject of gains from trade in view of sustainability.

Project Consortium

No.	Participant Organisation Name	Country
1	Corvinus University of Budapest (CORVINUS)	HU
2	University of Kent (UNIKENT)	UK
3	Consiglio per la Ricerca in Agricoltura e l'Analisi dell'Economia Agraria (CREA)	IT
4	Johann Heinrich von Thünen-Institut, Bundesforschungsinstitut für ländliche Räume, Wald und Fischerei (THUENEN)	DE
5	The University of Sussex (UOS)	UK
6	University of Ghana (UG)	GH
7	Luonnonvarakeskus (LUKE)	FI
8	Centrum Analiz Spoleczno-Ekonomicznych-Fundacja Naukowa (CASE)	PL
9	Food and Agriculture Organization of the United Nations (FAO)	IT
10	Institut national de recherche pour l'agriculture, l'alimentation et l'environnement (INRAE)	FR
11	Confederazione Generale Dell'Agricoltura Italiana (CONFAGRICOLTURA)	IT
12	Truong Dai Hoc Kinh Te Thanh Pho Ho Chi Minh (UEH)	VN
13	Luminaconsult Sprl (LUMINA)	BE

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1 Introduction

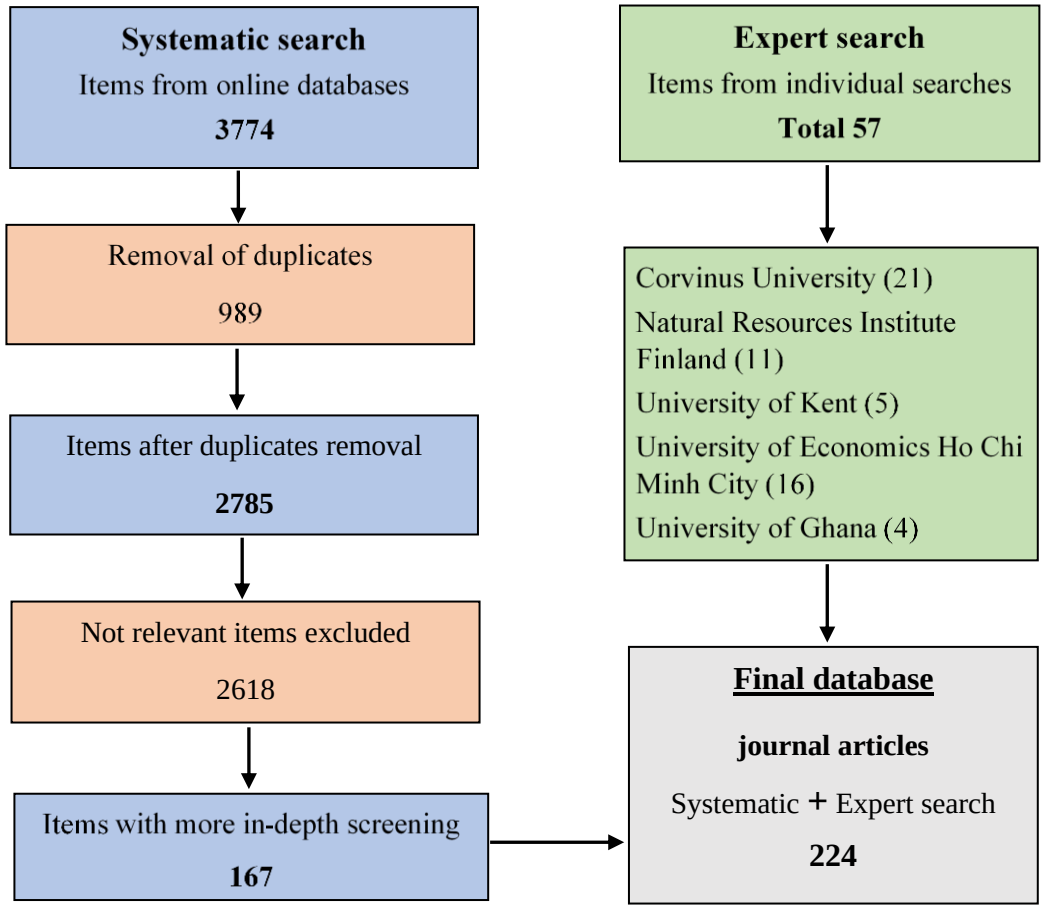
This is the first deliverable for Work Package 1 of the TRADE4SD project. The ambition of TRADE4SD is to explore and foster the positive linkages between trade and sustainable development and to provide policy recommendations for the creation of new opportunities for actors involved in the global, regional, and national agri-food value chains. *This deliverable, which lays the foundation for future TRADE4SD research, is to review previous studies concerning the interactions between trade and sustainability as well as to provide a narrative on the outcomes in academic research.* This will help to better understand how and in what ways agri-food trade is directly and indirectly related to the different Sustainable Development Goals (SDGs) and how these linkages differ by region or value chain, depending on the economic, social, and environmental contexts.

According to the United Nations (2021), which tracks global efforts to achieve the SDGs, the COVID-19 pandemic has caused a major disruption to people's lives and livelihoods. While progress to achieve the SDGs had been slow even before the pandemic struck, an additional 119-124 million people were pushed back into poverty in 2020. An equivalent of 255 million full-time jobs were lost, and the number of people suffering from hunger may have increased by 83-132 million. Furthermore, the pandemic has exposed and intensified inequalities within and among countries. Aggravated by the pandemic, the year 2020 marked one of the biggest recessions in global economic activity and world trade. During this period, the world economy contracted by more than 3% and global trade of products decreased by nearly USD 1.5 trillion compared to 2019. In contrast to the total trade, international trade of agri-food products increased by almost USD 28 billion. This is an indicator that global food trade is resilient, and international trade has played a crucial role in mitigating the devastating economic impact of the pandemic. Open global food trade makes food available and prevents dramatic food shortages in domestic food markets during a crisis. Despite the importance of agri-food trade, the number of studies exploring the nexus between agri-food trade and the SDGs has so far been limited. This study provides a structured review on the relationships between international agri-food trade and sustainability.

This literature review has been conducted to achieve a wide-ranging coverage of the relationship between trade and SDGs in academic research, following the principles set up by Tranfield et al. (2003). Two significant online scientific databases for academic literature have been used in the search: Scopus and Web of Science. The terms used in the search have been "Sustainable Development Goal*" and "trade*"and the requirement to select a source were that these words must be included in the article's title, abstract, or keywords. The search has been restricted to studies in English or with some information available in English. From the online databases, the initial search resulted in 3774 articles (Figure 1). The online software package Covidence has been used to exclude duplicates and only include relevant studies. After excluding 989 duplicates, 2785 articles remained as studies to be investigated in the systematic literature review. The initial screening conducted by the University of Corvinus team, based on the title and abstract, excluded 2618 articles as not relevant since they did not analyse the interlinkages between trade and SDGs. The remaining 167 articles are covering all the relevant journal articles published until the end of August 2021 (Figure 1).

Two parallel searches have been executed (Figure 1) in this study: the "systematic search" that resulted 167 articles and the "expert search" that resulted 57 articles selected by the different experts in the TRADE4SD consortium. The "expert search" has been based on the different disciplines and expertise of the experts in the TRADE4SD consortium and conducted with the search engine of Google and Google Scholar. Therefore, the "expert search" is a focused search to complement the "systematic search" with the purpose of including specific topics that are not captured by the broad "systematic search". The figures in this study are based on the database with 224 (167+57) articles relating to the overall international trade of products and services. The 224 journal articles have been screened in depth to classify them according to direct or indirect linkages between trade and SDGs along with positive or negative outcomes on the SDGs. The following chapter 2 will describe the direct and indirect linkages between trade and the SDGs, but given the focus of the TRADE4SD project, chapters 3 to 6 are concentrating on topics relating to agri-food, forestry, and fisheries.

Figure 1. Overview of the literature search and selection process.



2 Direct and indirect linkages between trade and SDGs

In 1987, the United Nations Brundtland Commission defined sustainability as meeting the needs of the present without compromising the ability of future generations to meet their own needs (United Nations, 1987). The definition seeks to pursue sustainability by creating and maintaining the conditions under which humans and nature can exist in productive harmony to support present and future generations. Sustainable development requires an integrated approach that takes into consideration environmental concerns along with economic and social development.

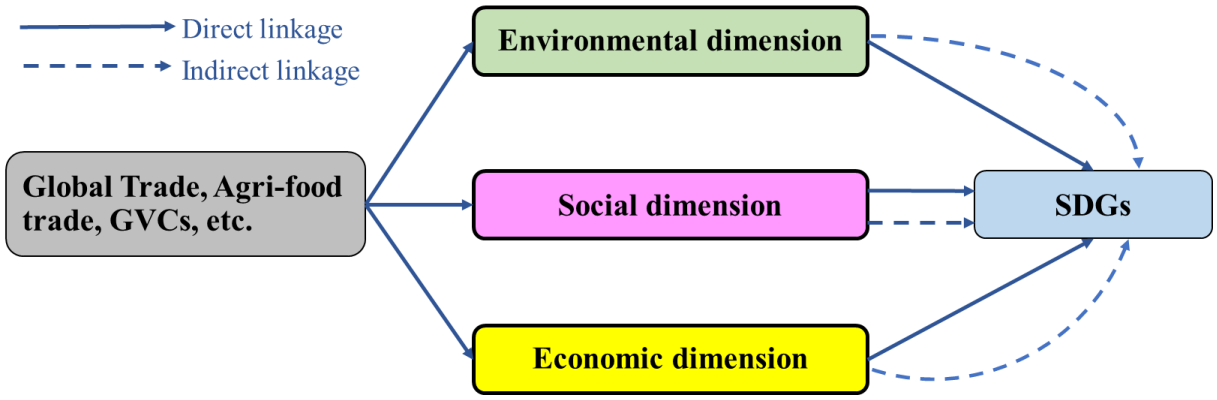
The 17 Sustainable Development Goals (SDGs) listed by the United Nations are an urgent call for action by all countries – developed and developing – in a global partnership. The SDGs acknowledge that ending poverty and other deprivations must be implemented at the same time with strategies that improve health and education, reduce inequality, and spur economic growth as well as tackling climate change and preserving our oceans and forests. In this chapter, the SDGs are classified into the three dimensions of sustainability (environmental, social, economic) according to the "planetary boundaries" concept and illustration below depicted by the Stockholm Resilience Centre **(**Figure 2). "Planetary boundaries" is a concept involving Earth system processes that contain environmental boundaries. This concept is defining a "safe operating space for humanity" for the international community, including governments at all levels, international organisations, civil society, the scientific community, and the private sector, as a precondition for sustainable development. This framework is based on scientific evidence that human actions since the Industrial Revolution have become the main driver of global environmental change. The illustration below implies that societies and economies are seen as embedded parts of the biosphere, thus implying that the environmental aspects are the most important followed by the social aspects in the middle and the economic aspects at the end, being embedded in society.

Figure 2. A new way of viewing the economic, social and ecological aspects of the SDGs.

Source: Stockholm Resilience Centre (2017).

In this structured review, the "direct" and "indirect" linkages between the 17 SDGs and international trade are analysed and classified into the environmental, social, and economic dimensions **(**Figure 3**)**. Overall, it is considered a *direct linkage* if a specific SDG is mentioned explicitly in an article; and it is considered an *indirect linkage* if a specific SDG is not mentioned explicitly in an article, but the keywords relating to the SDGs are mentioned in an article (e.g., growth, poverty, etc.). The linkages are considered as *positive outcomes* if agri-food trade facilitates the achievements of the SDGs; and the linkages are considered as *negative outcomes* if agri-food trade hinders the achievements of the SDGs. However, in exploring the nexus between global value chains and the SDGs, it is considered a direct linkage if a specific activity (e.g., palm oil production) is directly affecting the SDG with positive or negative outcomes; and it is considered an indirect linkage if a specific activity (e.g., deforestation due to land clearing for palm oil production) is indirectly affecting the SDG with positive or negative outcomes.

Figure 3. Overview of the direct and indirect linkages to the SDGs.

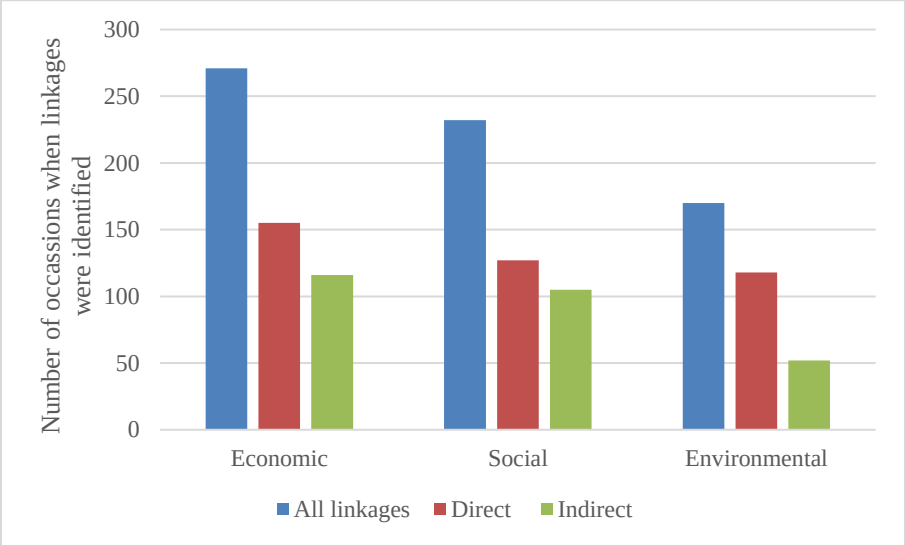


Source: own composition.

Economic sustainability has been predominant in the analyses according to the database of 224 journal articles relating to the overall international trade of products and services; 164 articles covered different aspects of economic sustainability **(**Figure 4**)**. The most researched topic concerned SDG 8 (Decent work and economic growth), analysed by 114 articles. Therefore, the literature review for the overall trade of product and services suggests that there are greater concerns in academia and society on "how the drive to sustainability" may affect economic growth and jobs, despite increasing needs for environmental sustainability and mitigating climate change. There are estimations showing that food systems contribute 19%–29% of global anthropogenic greenhouse gas (GHG) emissions, whereby agricultural production (including indirect emissions associated with land-cover change) contributes 80%–86% of total food system emissions (Vermeulen et al., 2012).

The literature review revealed that there are more direct linkages between overall international trade and the SDGs than indirect linkages **(**Figure 5**).** There are more indirect linkages only for two SDGs: SDG 1 (No poverty) and SDG 10 (Reduced inequalities).

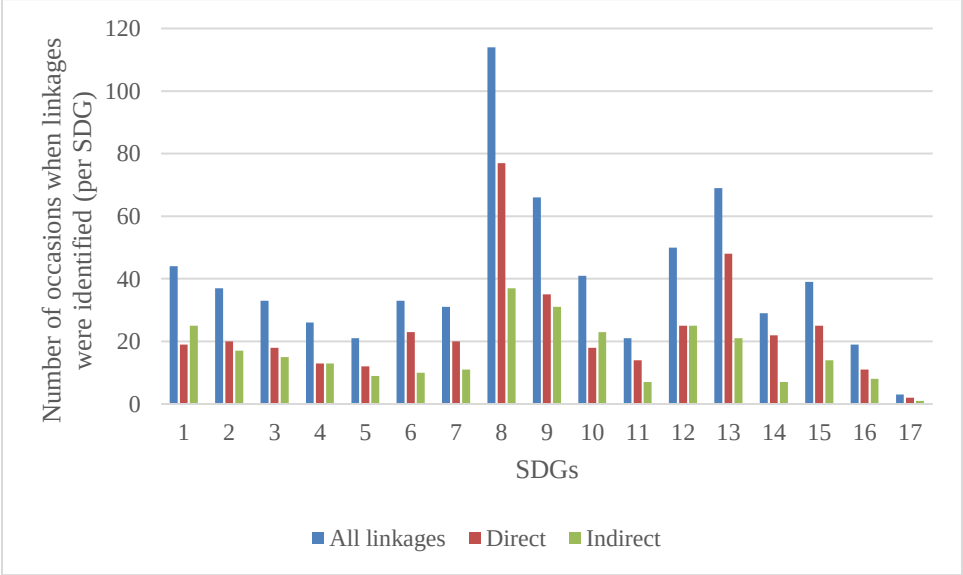
Figure 4. Direct and indirect linkages between overall international trade and the SDGs identified in the literature according to the different dimensions of sustainability.



Note: Where linkages are identified, the number of occasions is above the total number of articles in the database because the content of each article is analysed according to the SDGs covered; thus, if an academic work has identified linkages of trade to three different SDGs, it is counted three times.

Source: own composition.

Figure 5. Linkages identified per SDG.



Note: On the vertical axes (1) No Poverty, (2) Zero Hunger, (3) Good Health and Well-being, (4) Quality Education, (5) Gender Equality, (6) Clean Water and Sanitation, (7) Affordable and Clean Energy, (8) Decent Work and Economic Growth, (9) Industry, Innovation and Infrastructure, (10) Reduced Inequality, (11) Sustainable Cities and Communities, (12) Responsible Consumption and Production, (13) Climate Action, (14) Life Below Water, (15) Life On Land, (16) Peace, Justice, and Strong Institutions, (17) Partnerships for the Goals.

Source: own composition.

SDG 12 (Responsible Production and Consumption) which is strongly related to the agri-food sector and food value chains has received relatively little attention in the database (only 50 articles covered its direct and indirect linkages to trade). In the introductory presentation of SDG 12, the United Nations (UN) made reference to the estimation that one third of food produced (1.3 billion tonnes annually) is wasted, either by consumers, producers or intermediaries (United Nations, 2022). By cutting food waste, SDG 12 can contribute to SDG 1 and SDG 2 – No poverty and Zero hunger, respectively. UN also emphasised the economic benefits since reducing food loss and waste can contribute to lowering production costs and increasing the efficiency of food systems. Several regions in the world are lagging behind in the progress towards SDG 12. Therefore, further research could focus on this gap identified in the literature review.

Relatively few studies researched the linkages between trade and the SDGs in the social pillar. SDGs of central interest for the agri-food sector, SDG 1 (No poverty) was covered in 44 articles and SDG 2 (Zero hunger) in 37 articles. Another SDG where the progress in practice has been very limited is SDG 5 (Gender equality). The mentioned SDGs are important SDGs for in-depth studies.

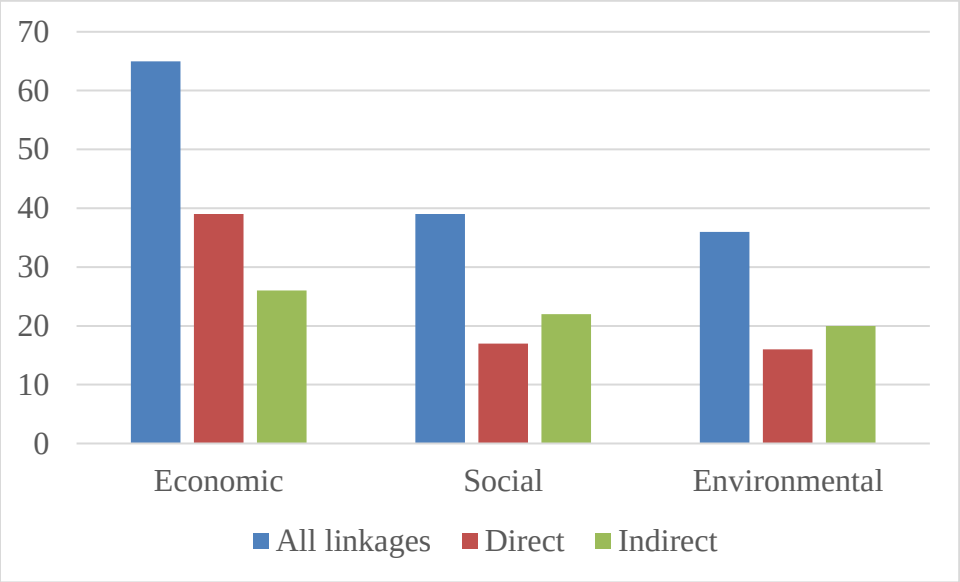
Concerning environmental sustainability, overall, 115 articles in the database analysed this dimension. One of the core SDG – 13 (Climate action) - has been relatively well-researched; 69 articles investigated its direct and indirect linkages to trade. However, the linkages between trade and the SDGs related to environmental sustainability have not been a primary focus in the academic literature. There is an important gap in research concerning the linkages between trade and several specific SDGs such at SDG 6 (Clean water and sanitation) and SDG 14 (Life below water). Further research should focus on how governance in trade policies, agricultural policies, and global value chains can help in achieving these specific SDGs.

Concerning the positive and negative interlinkages with the SDGs, van Zanten and van Tulder (2021) published a structured literature review with economic activities and not with trade. The authors extracted studies according to the economic sectors for analysis and used several criteria, including whether the article discusses intersections between an economic activity and aspects of sustainable development, and most importantly, according to the causality ranging from economic activities to aspects of sustainable development. Almost one fourth of the studies extracted for analysis were in agriculture, forestry, and fisheries. Most of the linkages with economic activities relating to social and environmental sustainability were negative with regard to sustainable production and consumption (SDG 12), life on land (SDG 15), climate action (SDG 13), good health and wellbeing (SDG 3).

The conducted literature review on overall international trade of products and services is showing that currently the economic aspects are the most important followed by the social aspects in the middle with the environmental aspects at the end. Due to the economic difficulties as a result of the COVID-19 pandemic, the significance of the economic aspects may increase. *Therefore, in relation to international trade, the present status of academic research is mainly focusing on the economic aspects, which is at the opposite of the "planetary boundaries" concept that is emphasising on the environmental aspects.*

The following chapters 3 to 6 are focusing on agri-food trade: it is also revealed that the economic aspects have attracted the most academic interest, followed by the social and environmental aspects respectively (Figure 6).

Figure 6. Focus on agri-food trade: direct and indirect linkages between agri-food trade and the SDGs identified in the literature according to the different dimensions of sustainability.



Source: own composition.

3 The three dimensions of sustainability covered by the SDGs

Trade can contribute to sustainability in many ways and this chapter aims to identify and analyse the relationships related to the three dimensions of sustainability. Although there is no specific trade-related SDG, there are references to trade-related objectives (Helble and Shepherd, 2017). International trade is considered as an important means for achieving sustainability. Although the policy implementation process is always intended to produce positive results, sometimes negative consequences (direct or indirect linkages) are also observed.

As evident from Figure 6, in the focused literature review on agri-food trade, *economic aspects are the most frequently mentioned and analysed dimension, followed by the social and environmental aspects.* Consequently, this chapter follows this logic and starts with the analysis of the linkages related to economic, social, and environmental dimensions, respectively. The possible linkages of agri-food trade with the SDGs are summarised in Table 1 to 9.

Based on word clouds and counting word appearance frequencies in the literature database (title, abstract, keywords), three dimensions of sustainability were identified with nine topics representing the most important avenues which agri-food trade and SDGs are interrelated.

3.1. Economic dimension

Since the very beginning of economic theories, trade has always been treated as an engine of economic development, giving birth to trade liberalisation theories (WTO, 2018). Trade liberalisation can directly and indirectly contribute to economic growth and can produce positive and negative outcomes, thereby giving a framework for our analysis. SDGs that are related to economic issues are SDG 8, SDG 9, SDG 10 & SDG 12.

3.1.1. Markets and value chains

One of the central issues analysed by the economic literature is related to markets and value chains, whereby agri-food trade has different impacts (Table 1) on all-related SDGs.

Table 1. Positive and negative linkages between agri-food trade and sustainability regarding markets and value chains.

Markets and value chains	SDG 8	SDG 9	SDG 10	SDG 12	SDG 17
Direct Linkages	X	X	X	X	X
Positive Outcomes	X	X	X	X	X
Negative Outcomes	X	X	X	X	X
Indirect Linkages	X	X	X	X	
Positive Outcomes	X	X	X	X	
Negative Outcomes					
Supporting literature	Alharthi and Hanif (2020), Ayompe et al. (2021), Borsellino et al. (2020), Chiputwa and Qaim (2016), Chiputwa et al. (2015), Downing et al. (2021), Feyaerts et al. (2020), González-Ramírez et al. (2020), Kaplinsky and Morris (2018), Lee et al. (2012), Lerner et al. (2021), Pietrzyck et al. (2021), Roy et al. (2021), Weersink et al. (2021)				

Source: own composition based on our literature review.

Trade can encourage economic growth through liberalisation and increased market access. Trade works for many countries because it increases economic growth by allowing each country to specialise in the production of goods and services it can produce more competitively. Alharthi and Hanif (2020), for instance, found that blue economy (fisheries production and fishing) played a direct and positive role in economic growth of the South Asian Association for Regional Cooperation (SAARC) countries. Borsellino et al. (2020) conducted an extensive literature review also found positive, although indirect, spill-over effects of agri-food trade on economic growth. Chiputwa and Qaim (2016) found similar indirectly positive effects of certified coffee trade on economic growth in Uganda. This argument is also strengthened by Lee et al. (2012) analysis on global value chains of agri-food products.

Trade-led economic development also has impacts on inequalities between countries and different groups of stakeholders. Over the past decades, accelerated economic growth of the developing countries has resulted in reduced inequalities between developing and developed countries as well as local groups of stakeholders. Hoang et al. (2021), for instance, showed that the milk value chain in Vietnam has developed in a way that farmers gained benefits and reduced inequalities in the long run. Kaplinsky and Morris (2018) also found direct and positive linkages between trade and reduced inequalities when analysing the role of regulations and standards in global value chains for various countries and products. Similar conclusions were drawn by Chiputwa et al. (2015) when analysing certified coffee trade in Uganda.

According to the literature review, trade can also produce economic gains by the transfer of technology, knowledge, and innovation. González-Ramírez et al. (2020), for instance, showed that technological development and knowledge transfer played a direct and positive role in the boom of Mexican fresh berries, traded through a coordinated global value chain. Better infrastructure, because of trade, was also found to be positively and directly linked to sustainability when analysing global coffee trade patterns (Lerner et al., 2021).

3.1.2. Economic development and growth

Trade-led economic growth enhances a country's income-generating capacity, which is one of the most important prerequisites for achieving sustainable development. Most of the articles addressing economic development and growth have a positive linkage (Table 2) with several SDGs (SDG 8, SDG 9, SDG 10, SDG 12, and SDG 17).

Table 2. Positive and negative linkages between agri-food trade and sustainability regarding economic development and growth.

Economic development and growth	**SDG 8**	**SDG 9**	**SDG 10**	**SDG 12**	**SDG 17**
Direct Linkages	X	X	X	X	X
Positive Outcomes	X	X	X	X	X
Negative Outcomes				X	
Indirect Linkages	X	X	X	X	X
Positive Outcomes	X	X	X	X	X
Negative Outcomes					X
Supporting literature	Adedoyin et al. (2021), Aldakhil et al. (2019), Alharthi and Hanif (2020), Ali et al. (2021), Alvarado et al. (2021), Aswani et al. (2021), Barrera (2020), Bhavsar et al. (2021), Charoenrat and Pholphirul (2020), Kumi et al. (2014), Machingura and Lally (2017), Meemken et al. (2017), Miglietta and Morrone (2018), Pérez Neira et al. (2014), Riekhof et al. (2019), Skerritt and Sumaila (2021), Sumaila et al. (2019), Tumaneng-Diete et al. (2005), Valdivia et al. (2017), Visbeck et al. (2014), Zhan and Santos-Paulino (2021)				

Source: own composition based on our literature review.

Trade can make a major contribution to support sustained economic growth. As evident from WTO (2018), the more open a country to trade is, the faster its economy grows. Among the various benefits of trade is that it improves the purchasing power of consumers and the competitiveness of domestic firms. According to Mizik (2021), a large section of the international agri-food literature has been dedicated to the linkages between agri-food trade and competitiveness, showing how comparative advantages contribute to specialisation and economic growth. By extending the size of operations for

domestic firms, at the other end, trade allows them to exploit economies of scale and become more productive, thereby also contributing economic growth (World Trade Organization, 2018).

Trade also has a significant impact on economic development through the transfer of technology, knowledge, and innovation. The free flow of goods and ideas, supported by advances in transport and telecommunication technologies, have created global agri-food value chains by changing the global flow of food products. Ali et al. (2021) concluded that trade liberalisation stimulated technology innovation in Asian countries and called for technology improvements to be combined with technology transfer through trade openness. According to Zhan and Santos-Paulino (2021), an affordable basic infrastructure is a prerequisite for trade-based sustainable development. Farm size, access to finance, and website availability were also found to be important factors influencing the export performance of firms in the Greater Mekong Subregion countries, contributing to economic growth and development (Charoenrat and Pholphirul, 2020).

3.1.3. Policies and governance

Mainstreaming trade requires a joint effort to integrate trade into the various dimensions of economic policy making. The premise of the TRADE4SD research project is that trade has the power to produce positive outcomes – for both the developed and developing world – when policies at international and domestic level are designed in a way to promote access to markets, fair prices, and standards of living for farmers and other agents along food chains, as well as alleviating rural poverty and ensuring sustainable use of natural resources. Many articles are dedicated, partly of fully, to tailoring economic policies and governance for sustainable development, suggesting that trade has a generally positive effect in this regard on all economic-related SDGs (Table 3).

Table 3. Positive and negative linkages between agri-food trade and sustainability regarding policies and governance.

Policies and governance	**SDG 8**	**SDG 9**	**SDG 10**	**SDG 12**	**SDG 17**
Direct Linkages	X	X	X	X	X
Positive Outcomes	X	X	X	X	X
Negative Outcomes	X		X	X	X
Indirect Linkages	X	X	X	X	X
Positive Outcomes	X	X	X	X	X
Negative Outcomes					X
Supporting literature	Adedoyin et al. (2021), Alharthi and Hanif (2020), Ali et al. (2021), Alvarado et al. (2021), Asmah et al. (2020), Barrera (2020), Booth et al. (2021), Galli et al. (2020), Ghislain (2021), Lamastra et al. (2017), Latka et al. (2021), Lewis et al. (2021), Matthews (2020), Monkelbaan (2017), Philippidis et al. (2020), Roy et al. (2021), Serrano and Valbuena (2021), Sumaila et al. (2019), (Verter, 2019)				

Source: own composition based on our literature review.

The majority of the studies analysed showed trade and related economic policies having a positive and direct linkage to economic development and growth. Roy et al. (2021) confirmed that aid to trade policy promoted sustainable economic growth in developing countries, but this development assistance was only effective for low and lower middle-income economies. The positive and significant effect of aid to trade policy promoted in upper middle-income countries was conditional to their level of political stability. Moreover, Ghislain (2021) highlights the need for mandatory labelling of agri-food production as another policy tool to steer producers towards favouring methods of production that are in line with achieving various SDGs. Furthermore, such a label would contribute to the level of the playing field on the EU market by imposing the same transparency rules to all sellers, including importers.

Some authors also highlight *the need for better targeted agri-food policies in Europe* in light of the fact that Europe is the leading agri-food exporter and importer globally, hence affecting agri-food markets worldwide. Galli et al. (2020) pointed out that food policy integration was needed for the transition to sustainable food systems in Europe and concluded that an effective food policy needed to be system-oriented and knowledge-integrated. In addition to this, Matthews (2020) points out the need to translate the relevant SDG targets into measurable, time-bound indicators by which progress can be evaluated, and potential incoherencies assessed. The proposed set of the EU Common Agricultural Policy's (CAP) Common Monitoring and Evaluation Framework indicators is inadequate for this purpose. Matthews (2020) suggests that the post-2020 CAP legislation should be revised to include an explicit reference that the policy is required to contribute to achieving the SDGs and calling for an indicator set to measure progress.

Multinational enterprises also have important roles to play through their SDG-related innovations such as energy-savings or emission reductions (van der Waal et al., 2021). Changes in research and development have immediate and long-term effects on public spending by governments, stimulating environmental innovation without limiting the expansion of production (Alvarado et al., 2021). Galli et al. (2020) state that many of the existing instruments are in line with sustainability objectives, but better coordination and streamlined governance involving new actors are needed. Existing instruments (e.g., food aid, public procurement schemes, food education) can be scaled up and better integrated with other instruments to help in achieving the SDGs.

3.2. Social dimension

Trade also plays a crucial role in addressing the social challenges of sustainability like hunger, food security, healthy lives, wellbeing, or employment. Both developed and developing countries benefit from trade and thanks to the trade gains, developing countries have experienced an unprecedented growth of the middle class despite the fact that their share in world trade is still low. At the other end, small and medium sized enterprises, as the largest global employers, had limited abilities to use the benefits of trade to a full extent (WTO, 2018). Society-related SDGs are SDG 1, SDG 2, SDG 3, SDG 4, SDG 5, SDG 7, SDG 11, SDG 16, and SDG 17. The trade impacts, like in the case of the environment, are again mixed as from the society's point of view, many trade-offs are observable.

3.2.1. Food and nutrition security

The ever-increasing population growth and the increased risk of epidemics pose new societal challenges, perhaps the most important of which is food and nutrition security. Food and nutrition security has the closest relationship with SDG1, SDG2, SDG3 and SDG 17 (Table 4).

Table 4. Positive and negative linkages between agri-food trade and sustainability regarding food and nutrition security.

Food and nutrition security	**SDG 1**	**SDG 2**	**SDG 3**	**SDG 4**	**SDG 5**	**SDG 7**	**SDG 11**	**SDG 16**	**SDG 17**
Direct Linkages	X	X	X		X				X
Positive Outcomes	X	X	X		X				X
Negative Outcomes	X	X	X						X
Indirect Linkages	X	X	X	X	X	X		X	X
Positive Outcomes	X	X	X	X	X	X		X	X
Negative Outcomes	X	X	X	X	X			X	X
Supporting literature	Ayompe et al. (2021), Bacon et al. (2008), Booth et al. (2021), Chiputwa and Qaim (2016), Downing et al. (2021), Feyaerts et al. (2020), Galli et al. (2020), Gema et al. (2018), Latka et al. (2021), Philippidis et al. (2020), Tian et al. (2021), Verter (2019), Wilkinson (2015), Asche et al. (2015) Bhavsar et al. (2021), Pietrzyck et al. (2021), Weersink et al. (2021), Whitfield (2017), Xiao et al. (2017), Yaro et al. (2017), Borsellino et al. (2020), Campi et al. (2021), Duarte et al. (2019), Ge et al. (2021), Mrdalj and El Bilali (2021), Sharma and Kumar (2020), Valdivia et al. (2017)								

Source: own composition based on our literature review.

Trade and food security are directly linked through food prices as even a slight rise in food prices caused by trade is also of particular concern to those living in vulnerable areas. Rising food prices are undermining the affordability dimension of food security, which affects the poorest, who spend a relatively larger share of their income on food than the rich. According to Philippidis et al. (2020), this increase in food prices could be caused by the food or fuel issue. It should be noted that in developed countries, the use of third- and fourth-generation biofuels does not significantly increase food prices or food insecurity. A similar case was observed by Sharma and Kumar (2020) since in developing states, the arable land is used entirely for the production of biofuel crops; thus, the shrinking supply of arable land raises the price of food. Ayompe et al. (2021) emphasised the importance of palm oil trade in terms of food and nutrition security. Growing demand for palm oil is helping developing countries to reduce the number of people living in food insecurity and poverty. Downing et al. (2021) came to a similar conclusion when examining the production and trade of palm oil in China.

Trade also has impacts on food and nutrition security through policy decisions. Ge et al. (2021) showed that an open, rules-based trading system and the creation of a transparent, undistorted production and investment environment are critical to improving food and nutrition security, especially in developing countries, which are exposed to food insecurity. According to Valdivia et al. (2017), the dynamics of the crop-livestock systems must be taken into account. They state that if

appropriate interventions continue to be implemented in Kenya, food insecurity and poverty could be reduced. Similarly, the openness of the agri-food trade may increase the incidence of malnutrition in some developing countries, such as Nigeria (Verter, 2019).

The relationship between fisheries subsidies, trade, and food security was explored by Asche et al. (2015). The general opinion is that fisheries subsidies have more negative effects than positive ones, which was also confirmed by Skerritt and Sumaila (2021). However, it must be recognised that some forms of subsidies can benefit fish stocks and thus the people who rely on them for their employment and nutrition. Instead of tax exemptions and fuel subsidies or the support of vessel construction, renewal or modernisation, fisheries subsidies may be provided directly and indirectly to supplement the income of fishermen and fishing workers. Only seven countries receive most of the world's fisheries subsidies (more than two-thirds), which countries and their enterprises operate on an industrial scale (Asche et al., 2015). Another problem with food and nutrition security is that there is a quality exchange in the world, which means that the volume of seafood exported from developing countries to developed countries (high-quality seafood) is close to the volume of seafood imported by developing countries from developed countries (lower-quality seafood).

Trade has direct and positive impacts on food security through participation in certification or standard schemes, increasing household caloric and micronutrient consumption (Bacon et al., 2008, Chiputwa and Qaim, 2016). Participation in such systems also has an impact on education (SDG4), gender equality (SDG5), and the institutional system (SDG16). The certificate increases household income and improves gender equality, for example, among smallholder coffee farmers in Uganda certified under Fairtrade, Organic, and UTZ. Both factors contribute to better nutrition. The partnership (SDG17) brings together governments, small producer organizations, civil society organizations, certification agencies and the speciality coffee industry in the case of Nicaragua, which helps reduce poverty and food insecurity.

However, as evident from the case of coffee smallholder farmers in Uganda, *sustainability standards can also cause a number of problems* (Chiputwa and Qaim, 2016): livelihood insecurities, including low incomes, high emigration, and food insecurity, persisted in lots of smallholder producers. Tools such as the use of certification can increase the protection of nature (e.g., forests, fish) but often exclude small producers with low production volumes, limited capacity, and low incomes, as their participation in such schemes is hampered.

Based on Bacon et al. (2008), despite the existence of sustainable coffee certifications in Uganda, the proportion of people living in food insecurity and poverty is still high. The possibilities of rural women to get the same work for the same compensation was also found to be highly limited despite the fact that jobs in export sectors tend to pay generally better. Chiputwa and Qaim (2016) also came to similar conclusions when examining sustainable standards. Agricultural commercialisation, as the authors suggest, often contributes to women losing control over agricultural production and incomes, which has a negative impact on household nutrition, as women tend to spend a greater share of their income on family nutrition and health than men.

3.2.2 Labour and employment

The right employment structure and the presence of a well-trained workforce are also important for achieving the SDGs as they provide an important basis for reaching many other goals. Although agricultural employment is relatively low compared to total employment in developed countries, agriculture remains the largest source of employment in many developing countries, having mixed impacts on the relationship between agri-food trade and the SDGs (Table 5). Labour and employment issues are most related to SDG1, SDG3, SDG4 & SDG5.

Table 5. Positive and negative linkages between agri-food trade and sustainability regarding labour and employment.

Labour and employment	**SDG 1**	**SDG 2**	**SDG 3**	**SDG 4**	**SDG 5**	**SDG 7**	**SDG 11**	**SDG 16**	**SDG 17**
Direct Linkages	X		X	X	X			X	X
Positive Outcomes	X		X	X	X			X	X
Negative Outcomes			X	X	X			X	X
Indirect Linkages	X	X	X	X	X				
Positive Outcomes	X	X		X	X				
Negative Outcomes	X	X	X		X				
Supporting literature	Ayompe et al. (2021), Bacon et al. (2008), Bhavsar et al. (2021), Downing et al. (2021), Feyaerts et al. (2020), Pietrzyck et al. (2021), Weersink et al. (2021), Whitfield (2017), Xiao et al. (2017), Yaro et al. (2017)								

Source: own composition based on our literature review.

Trade openness has a direct link to agricultural employment through the facilitation of job creation. According to Ayompe et al. (2021), the second most important positive effect of palm oil production and trade is job creation. The contribution of palm oil production and trade to employment has also been confirmed by Downing et al. (2021). Yameogo and Omojolaibi (2021) also explored the link between trade openness and employment and found a positive impact in sub-Saharan Africa. In response to campaigns by trade unions and NGOs to enforce labour standards, leading companies in the floricultural value chain in Kenya and Uganda have improved employment conditions, pointed out by Kaplinsky and Morris (2018). In these countries, job security increased as workers report better health and safety conditions and less sexual harassment on the farm.

Feyaerts et al. (2020) studied the African fruit and vegetable sector where some large export producers dominate the chains, and there is a high level of vertical coordination within agricultural companies employing a large number of workers. Here, the production and processing phase is labour intensive, which is limited to post-harvest treatment such as washing, sorting, and grading, which means the potential to reduce poverty through the employment of unskilled employees.

Trade-related proper training and education (SDG4) are also essential in employment as confirmed by Whitfield (2017). The Ghanaian government has begun investing in horticultural training at a state university and horticultural practice training centres to provide a skilled workforce to the growing agricultural industry. The importance of education and training was also highlighted by Hilal et al. (2021). Securing employment and encouraging further training are two keyways in which food quality schemes (FQS) contribute to the positive social outcomes of producers and communities. Through employment, FQS can offset the urban migration trend affecting rural regions and help maintain economic and social capital in the local region. Furthermore, based on the results of Charoenrat and Pholphirul (2020), we can conclude that the development of human resource skills and knowledge in the workforce is essential for countries to keep pace with today's rapidly changing technology. Participation in the economic integration of small and medium-sized enterprises in the Greater Mekong Subregion shows that skills development has a statistically significant impact on the ability of SMEs to participate in the value chain. International trade (exports) has and will also have a positive effect on women's employment (SDG5) in all countries.

According to Sharma et al. (2021), vocational training can have several benefits in terms of employment: on the one hand, it will ensure the supply of skilled labour, and on the other hand, by educating people, it will be easier to achieve environmental protection, as an educated society is expected to be more sensitive to environmental issues.

Trade and employment are also related through participation in global value chains. Feyaerts et al. (2020) have pointed out that global value chains can create jobs but note that the development and expansion of global value chains can compete with local value chains for labour (e.g., during harvest). In Ghana, based on Whitfield (2017), due to increasing international competition, a small number of agricultural enterprises have survived. Most people who quit farming look for work outside of agriculture, but their opportunities are limited due to low economic development and limited job opportunities. Most of the surviving smallholder farmers continue to struggle to stay on land, find suitable labour, or provide schooling for their child. Similar problems and the existence of gender discrimination (SDG5) have been reported by Yaro et al. (2017).

According to Malak-Rawlikowska et al. (2019), short food supply chains promote gender balance as women are more involved in logistics activities, in contrast to long chains where the role of women in distribution is rather limited. As it appears in Xiao et al. (2017) study, transnational companies looking for cheaper and cheaper labour have no interest in improving conditions and such companies often show gender discrimination (e.g., different wages).

3.2.3 Livelihoods and wellbeing

Many aspects of international trade can contribute to livelihood and wellbeing (Table 6), directly to SDG 3, or through reaching the targets of other SDGs (SDG1, 2, 4, 5, 7, 11 and 16). However, some negative impacts can also be detected (van Zanten and van Tulder, 2021). Trade-related social impacts are often difficult to quantify, mainly due to a lack of information (Ayompe et al., 2021).

Table 6. Positive and negative linkages between agri-food trade and sustainability regarding livelihoods and wellbeing.

Livelihoods and wellbeing	**SDG 1**	**SDG 2**	**SDG 3**	**SDG 4**	**SDG 5**	**SDG 7**	**SDG 11**	**SDG 16**	**SDG 17**
Direct Linkages	X	X	X	X	X	X	X	X	X
Positive Outcomes	X	X	X	X	X	X	X	X	X
Negative Outcomes	X	X	X	X		X	X	X	X
Indirect Linkages	X	X	X	X	X			X	X
Positive Outcomes	X	X	X	X	X			X	X
Negative Outcomes	X							X	
Supporting literature	Ayompe et al. (2021), Bellassen et al. (2021), Bhavsar et al. (2021), Booth et al. (2021), Chiputwa and Qaim (2016), Corrado et al. (2020), Downing et al. (2021), Govereha and Jayne (2003), Hoang et al. (2021), Lee et al. (2012), Meemken et al. (2017), Philippidis et al. (2020), Safaeimanesh and Jenkins (2021), Weersink et al. (2021), Whitfield (2017)								

Source: own composition based on our literature review.

Trade often has mixed results on livelihood and wellbeing. Ayompe et al. (2021) conducted a literature review on the positive and negative impacts of palm oil production and found that income generation (33%) had the highest positive impact. Kaplinsky and Morris (2018) also found direct and positive linkages between trade and income generation when analysing the role of regulations and standards play in the capacity of producers to participate in global value chains for various countries and products. However, it is clear that enhanced trade's welfare effects substantially contribute to developing exporters' health and education systems (Safaeimanesh and Jenkins, 2021).

Fair trade might guarantee higher purchase prices, resulting in enhanced education and wellbeing, together with sustained income in disruption prone working environments (Bhavsar et al., 2021, Chiputwa et al., 2015, Meemken et al., 2017). Production of food products and trade with European certified foods (e.g., organic or geographical indications) results in higher gender equality index (Bellassen et al., 2022). Others also found that foods with geographical indications positively impact (both direct and indirect) many of the SDGs, including the social ones (Barrera, 2020).

3.3 Environmental dimension

If economic growth continues on its current environmentally unsustainable path (Meadows et al., 1972), the world risks jeopardising future growth prospects and human well-being. Forests and wetlands make up 40% of the total wealth of countries. Trade undoubtedly impacts the environment through many channels starting from input use, production, processing, packaging, and transportation.

Efforts to understand these impacts are crucial in achieving sustainable development. In terms of policy solutions, clean and renewable energy, increasing energy and resource efficiency, reducing air pollution, reducing water and soil pollution, managing solid and hazardous waste, and monitoring environmental quality are the most well-known ones (World Trade Organization, 2018).

Environmental impacts of trade on SDGs are analysed here via SDG 6, SDG 13, SDG 14, and SDG 15. Based on the selected literature, three sub-topics could be identified: biodiversity; GHG emissions, pollution, and deforestation; and renewable energy.

3.3.1 Biodiversity

Agri-food trade has different impacts on biodiversity as evident from Table 7. In all related SDGs, both direct and indirect as well as positive and negative linkages were identified by the literature review. As evident from Table 7, most impacts are related to SDG14, 15 & 17.

Table 7. Positive and negative linkages between agri-food trade and sustainability regarding biodiversity.

Biodiversity	**SDG 6**	**SDG 13**	**SDG 14**	**SDG 15**	**SDG 17**
Direct Linkages			X	X	X
Positive Outcomes			X	X	X
Negative Outcomes			X	X	
Indirect Linkages	X	X	X	X	X
Positive Outcomes	X	X	X	X	X
Negative Outcomes				X	X
Supporting literature	Alharthi and Hanif (2020), Andrews et al. (2021), Ayompe et al. (2021), Corrado et al. (2020), Downing et al. (2021), Feyaerts et al. (2020), Galli et al. (2020), Kumar et al. (2019), Machingura and Lally (2017), Ortiz et al. (2021), Singh et al. (2018), Sumaila et al. (2019)				

Source: own composition based on our literature review.

Life in oceans, for instance, is particularly important for biodiversity. However, global trade of fish products contributes to ocean acidification, illegal and overfishing, thereby decreasing biodiversity (Singh et al., 2018), exaggerated by harmful fishing and fuel subsidies (Sumaila et al., 2019, Kumar et al., 2019). Another important issue related to the trade-biodiversity nexus is the negative impacts of the hydrocarbon industry on life in oceans. Heat gain from anthropogenic climate change coming largely from fossil fuels, and the resulting sea-level rise and ecosystem collapse, is an existential threat to biodiversity (Andrews et al., 2021). Andrews et al. (2021) also suggest that the transition to a more equitable and sustainable ocean economy requires collaboration between stakeholders and the integration of social and natural science tools, knowledge, and perspectives.

Trade can also have impacts on biodiversity through increased consumption. Corrado et al. (2020), for instance, analysed the environmental impacts caused by goods traded by the EU in the timeframe of 2000-2014 through an approach based on process-based life cycle assessment (LCA) of representative products. According to their results, EU consumption resulted to cause considerable biodiversity loss outside EU boundaries and impacts of imported goods are higher than those of exported products. Specifically, the environmental impacts of food imports were found to be higher than the one of food exports.

3.3.2 GHG emissions, pollution, and deforestation

Agri-food trade also have very different impacts on GHG emissions, pollution, and deforestation (Table 8) with all environmental-related SDGs highly related.

Table 8. Positive and negative linkages between agri-food trade and sustainability regarding GHG emissions, pollution, and deforestation.

GHG emissions, pollution and deforestation	**SDG 6**	**SDG 13**	**SDG 14**	**SDG 15**	**SDG 17**
Direct Linkages	X	X	X	X	X
Positive Outcomes		X	X	X	X
Negative Outcomes	X	X	X	X	X
Indirect Linkages	X	X	X	X	X
Positive Outcomes	X	X	X	X	X
Negative Outcomes	X	X		X	X
Supporting literature	Ali et al. (2021), Alvarado et al. (2021), Ayompe et al. (2021), Corrado et al. (2020), Downing et al. (2021), Duarte et al. (2019), Feyaerts et al. (2020), Galli et al. (2020), Gkatsikos and Mattas (2021), Kumar et al. (2019), Lamastra et al. (2017), Machingura and Lally (2017), (Malak-Rawlikowska et al., 2019), Miglietta and Morrone (2018), Ortiz et al. (2021), Santeramo et al. (2021), Serrano and Valbuena (2021), Shahbaz et al. (2019), Shao et al. (2020), Tumaneng-Diete et al. (2005), Verter (2019), Wu et al. (2021), Zhong et al. (2021), Duarte et al. (2014)				

Source: own composition based on our literature review.

In general, trade-facilitated economic growth results in higher GHG emissions (Ali et al., 2021). Ali et al. (2021) examines how trade openness affects CO_2 emissions via the scale and technique effects in the Asian region over the 1990–2015 period. According to the "gain from trade hypothesis", trade openness through technique effect facilitates technology transfer across countries promoting energy efficiency, while scale effect has direct linkage with the well-known "pollution haven hypothesis". The authors aim to alleviate the theoretical ambiguity on parallelly reporting positive and negative

impacts of trade on the environment due to endogenising trade for technology and found that trade-induced technology innovation reduced CO_2 emissions and the positive scale effect outweighed the negative technique effects. According to the results, the goals of environmental sustainability could be attained if the pace of national output growth was accompanied by environmental regulations and clean technology improvements when framing comprehensive trade policy.

Barrera (2020) argues that products with geographical indications have a lesser negative impact on the environment as geographical indications protect the global environmental asset as producers are seen as guardians of the ecosystem. This argument is extended by Drut et al. (2021), stating that food quality scheme products generally travel less, resulting in lower transport-related emissions. According to Bellassen et al. (2022), however, higher environmental performance of certified food products cannot be confirmed – hence, their trade may have either positive or negative impacts on the related SDGs. This is caused by the fact that lower input use is at least partly off-set by lower yields (Bellassen et al., 2021).

Effects of agri-food trade on deforestation are also controversial. When forest conservation is the major aim, economic or social impacts cannot be always fulfilled simultaneously, especially when production or trade is penalised (Tumaneng-Diete et al., 2005). Export bans to log products in the Philippines implemented since the 1970s, the authors suggest, have partially solved the problems of deforestation but increased poverty as the forestry sector was top ranked in creating export earnings. Similar conclusions were reached by Downing et al. (2021) when analysing the effects of reforestation programmes in China on countries supplying forest and agricultural commodities to China.

3.3.3 Renewable energy

Switching from non-renewable sources to renewable ones also result in mixed trade-related impacts (Table 9). Renewable energy was found to be only related to SDG13, SDG15, and SDG 17, according to the analysed literature.

Table 9. Positive and negative linkages between agri-food trade and sustainability regarding renewable energy.

Renewable energy	**SDG 6**	**SDG 13**	**SDG 14**	**SDG 15**	**SDG 17**
Direct Linkages		**X**		**X**	
Positive Outcomes		**X**			
Negative Outcomes		**X**		**X**	
Indirect Linkages		**X**		**X**	**X**
Positive Outcomes		**X**			**X**
Negative Outcomes		**X**		**X**	**X**
Supporting literature	Adedoyin et al. (2021), Machingura and Lally (2017), Shahbaz et al. (2019), Vrontisi et al. (2020)				

Source: own composition based on our literature review.

Foreign direct investment can help to promote low-carbon energy systems which include the promotion of renewable energy sources and more energy efficient processes; however, cleaner solutions are more expensive (Shahbaz et al., 2019). Lower CO_2 emissions directly helps to achieve SDG 13. This process requires a partnership between all the stakeholders (people, private and public sector) and includes actions such as energy-related policy measures, education, different incentives, as well as measures aiming to reduce the use of fossil resources (Shahbaz et al., 2021, Shahzad et al., 2020). For example, export diversification can be used to switch from fossil to renewable sources (Shahzad et al., 2021). Concerning India, it became obvious that the increase of per capita income and energy use increased CO_2 emissions, while higher oil price resulted in lower consumption and therefore lower CO_2 emissions (Shahbaz et al., 2021). Xiaoman et al. (2021) showed similar results by analysing the Middle East and North Africa economies. Based on correlations, both economic growth, trade openness, natural resources exploitation, economic globalisation, and urbanisation contributed to higher CO_2 emissions.

According to the Computable General Equilibrium model scenarios of Vrontisi et al. (2020), a clear drop in global trade activity based on fossil fuels is expected due to decreasing global demand of fossil fuels and the increasing need for clean energy goods. Furthermore, Adedoyin et al. (2021) show that there is a significant connection between gross domestic product (GDP), renewable energy (RE), non-renewable energy (NRE), natural resource rents, and CO_2 emissions. They revealed that while trade and income have a positive impact on emissions, renewable energy has a long-run negative significant impact on emissions.

However, some negative linkages can also be observed regarding the relationship between agri-food trade and biofuels. As evident from Fargione et al. (2008), carbon savings from biofuels depend on the way they are produced. Compared to biofuels made from biomass waste, for instance, converting

rainforests, peatlands, savannas or grasslands to produce biofuels create much more CO_2 emissions than the annual GHG reductions that these biofuels would provide in displacing fossil fuels.

3.4 Interlinkages between the SDGs

It is evident from the literature review that trade has different impacts on the SDGs, and there are many trade-offs between the different SDGs.

By network centrality measures, Swain and Ranganathan (2021) revealed and visualised synergies and trade-offs between the SDGs and they found more positive interactions than negative (similarly to Zhao et al. (2021). The examples shown by Ayompe et al. (2021) on the impacts of palm oil production and trade also showed how the different SDGs were interlinked and supported sustainable development. Kaplinsky and Morris (2018) as well as Chiputwa and Qaim (2016) also found these interlinkages in their papers by analysing the role of regulations and standards in global value chains as well as in certified coffee trade in Uganda. Ali et al. (2021) found that trade-induced technology innovation reduces CO_2 emissions, meanwhile trade-facilitated economic growth results in higher CO_2 emissions. Moreover, Kumi et al. (2014) underlined that the effects of neoliberal policy preferences on sustainable development have mixed impacts. They showed that the tenets of neoliberal economic agenda such as commodification, deregulation, privatisation, and cuts in government expenditure in some cases undermined the attainment of sustainable development by increasing poverty and inequality. Furthermore, achieving a given SDG can be a prerequisite for another SDG (interdependency) or provide co-benefits for achieving other SDGs that is particularly in the case of ocean related issues (Singh et al., 2018). In general, increasing income levels in developing countries have negative impacts on the environment due to the higher consumption and changing structure of consumption (Shahbaz et al., 2019).

Due to the above-mentioned trade-offs, the achievement of different SDGs requires a holistic framework. A one-size-fits-all trade policy does not exist to achieve the global sustainability agenda.

4 Global value chains and sustainable development

Global agri-food production, trade, and consumption have become ever more organised around global value chains (GVCs) that account for a growing share of international trade, global gross domestic product, and employment (Gereffi et al., 2005, Biurrun et al., 2021). Through global value chains, developing countries can integrate into the global trading system, which offers significant opportunities for industrial upgrading, economic development, employment creation, and poverty alleviation (Gereffi et al., 2005). The measurement of sustainability in global value chains requires a multidimensional assessment which includes environmental, social, and economic impacts. Since global value chains are highly competitive, and there is no guarantee that the benefits that accrue to developing countries will always be sustainable. There should be policies in place that can assist developing countries to integrate into global value chains and upgrade their domestic value chains. Value chain governance, standards, and certifications offer great opportunities for strengthening the economic, social, and environmental sustainability of global value chains, for example by fostering value adding, corporate social responsibility (CSR), and consumer awareness as well as more transparency in the global value chains, thus promoting sustainable production and consumption patterns along with achieving the global sustainability agenda. This chapter provides a structured review on the relationships between global food value chains and sustainability.

4.1 Linkages between global value chains and sustainable development goals

The possible linkages of global value chains with the SDGs are summarised in Table 10. In this chapter, the seventeen SDGs are assembled together into a single table and divided according to environmental sustainability, social sustainability, and economic sustainability along with partnerships to achieve the sixteen SDGs. Table 10 is not comprehensive; however, it does exemplify the negative and positive linkages revealed in the literature review between global value chains and the SDGs. The literature review shows that, in general, global value chains have direct linkages to fifteen SDGs with fourteen positive outcomes and nine negative outcomes. Global value chains also have indirect linkages to the eight SDGs with four positive outcomes and six negative outcomes.

Table 10. Global value chains and possible linkages between agri-food trade and the SDGs.

Global Value chains	Environmental Dimension				Social Dimension								Economic Dimension				Partner-ships
	SDG 6	SDG 13	SDG 14	SDG 15	SDG 1	SDG 2	SDG 3	SDG 4	SDG 5	SDG 7	SDG 11	SDG 16	SDG 8	SDG 9	SDG 10	SDG 12	SDG 17
Direct Linkages	X	X	X	X	X	X	X	X	X			X	X	X	X	X	X
Positive Outcomes	X	X	X	X	X	X	X	X	X				X	X	X	X	X
Negative Outcomes		X	X	X			X	X				X	X	X	X		
Indirect Linkages		X	X	X	X	X									X	X	X
Positive Outcomes					X	X										X	X
Negative Outcomes		X	X	X	X										X	X	
Supporting literature	Arampantzi and Minis (2017), Asche et al. (2015), Ayompe et al. (2021), Bacon et al. (2008), Bellassen et al. (2021), (Bellassen et al., 2022), Chiputwa and Qaim (2016), Chiputwa et al. (2015), Donati et al. (2021), D'Souza et al. (2020), Drut et al. (2021), Feyaerts et al. (2020), García-Alaminos et al. (2020), Gema et al. (2018), Govereha and Jayne (2003), (Hilal et al., 2021), Hoang (2021), Hoang (2014), Hoang (2020), Hoang and Tran (2019), Hoang et al. (2017), Kaplinsky and Morris (2018), Lee et al. (2012), (Malak-Rawlikowska et al., 2019), Meemken et al. (2017), Monier-Dilhan et al. (2021), Muller et al. (2021), Shumeta and D'Haese (2018), Tallontire et al. (2009), Van den Broeck et al. (2018), Yaro et al. (2017)															

Source: own composition based on our literature review.

4.1.1 Economic Dimension

In general, global value chains may help to achieve the economic goals and targets of sustainable development. Global value chains can create more jobs, increase labour productivity, bring higher wages, generate price premiums, and a higher value-added for producers (Bellassen et al., 2021, Hilal et al., 2021, Monier-Dilhan et al., 2021, Yanikkaya and Altun, 2020, Hoang and Nguyen, 2019, Urata and Baek, 2019). Global value chains exhibit a higher contribution to the local economy (SDG 8) than domestic value chains (Donati et al., 2021). Global value chains participation can largely improve the productivity of agri-food crops and food quality in developing countries (Urata and Baek, 2019). Participation in global value chains may result in technological progress (SDG 9), and technology can lower the cost of decreasing environmental pollution (Wang et al., 2021). Food waste occurs at all stages in the global food value chains; hence all actors in the value chain need to share responsibility, promote information, enhance partnership, and work together to reduce food loss and waste (SGD 12). Interventions at the production, transportation, storage, processing, and packaging stages of food products in global value chains can reduce food loss and waste (Nahman and de Lange, 2013), therefore efficiency gains can be achieve by reducing the costs of food loss and waste.

Alternatively, global value chains may contribute to unequal distribution of value-adding, income inequality, and exclusion of smallholders from the global markets (SDG 10) (De Fazio, 2016, Aguiar de Medeiros and Trebat, 2017, Schmitt et al., 2017). The increasing stringency of food safety standards and the emergence of voluntary certification systems in global value chains may lead to the displacement of smallholders from markets in developed countries, especially small agri-food producers in poor developing countries that cannot afford the costs of certification (Tran et al., 2013a).

4.1.2 Social Dimension

Global value chains can be linked to various social aspects of sustainable development. The labour to product ratio, income of smallholders, employee wage, and educational attainment in global value chains are higher than those of local value chains (Hilal et al., 2021, Hoang and Nguyen, 2019). In other words, global value chains can provide more employment, increase the income of smallholders and employee wage, improve education and training in enterprises. Participation in global value chains can reduce hunger and poverty (SDG 1, SDG 2) by contributing to an increase in productivity and production (Yanikkaya and Altun, 2020, Urata and Baek, 2019). Schmitt et al. (2017) showed that globally traded food products have advantages in attributes such as affordability (lower prices) and food safety (higher quality). Ayompe et al. (2021) reviewed the positive impacts of global value chains which can include income generation, employment, credit facilities, improved housing condition, landscaping, market infrastructure, religious centres, rural development, and urbanisation (SDG 1-5). Global value chains may perform better than domestic value chains in the distribution of bargaining power and adaptation capacity (Muller et al., 2021).

However, the extension of global value chains and the growing number of intermediaries may decrease the share of value-added for the farmers, increase income inequality and unfair benefit distribution as well as exclude smallholders from the global markets, thus causing a negative impact

on rural areas such as unemployment and depopulation due to migration (De Fazio, 2016, Biurrun et al., 2021). Ayompe et al. (2021) also showed other negative linkages such as conflicts, housing conditions, land grabbing, harassment, inequality, job quality, security, social equity, and solidarity (SDG 16).

4.1.3 Environmental Dimension

In global food value chains and markets, there are recently growing social and consumer requirements for reassurance on how products are being made, where they are sourced from, what the environmental consequences are, and how the products are disposed at the end of their life cycle (Humphrey and Schmitz, 2001, Morris and Dunne, 2004). These requirements are shown by public and private standards. Certified products in global value chains can reduce soil degradation, water and coastal pollution, zero water exchange, and greenhouse gas (GHG) emissions (SDG 6, SDG 13, SDG 14, SDG 15) due to the technical specifications for production methods, for example, limiting the use of synthetic fertilisers and pesticides (Bellassen et al., 2021, Drut et al., 2021, Hoang and Nguyen, 2019). Participation in global value chains forces and motivates actors to sustainably exploit and conserve seafood sources, as well as reduce marine pollution (SDG 14). There are studies (Nguyen and Jolly, 2020, Schmitt et al., 2017) showing that global value chains present substantial advantages in terms of climate change mitigation and GHG emission reduction (SDG 13) due to the efficient use of transport in global value chains by moving products in bulk quantities and shorter delivery times. Since GHG emission from farming is more significant than transport (Kastner et al., 2011), global value chains could decrease worldwide agricultural land use and GHG emissions due to yield differences at the production level; production can shift to countries that have comparative advantage in producing certain agricultural products (Kastner et al., 2014). Ayompe et al. (2021) indicated the positive impacts of global value chain for palm oil on provision of raw materials, erosion prevention, and food provision. Firms and suppliers in global forest value chains need to satisfy international private standards (retailers and consumers) and government regulations on the sustainability of their products, thus global value chains can assure the usage of sustainable and traceable timber sources, efficient utilization of energy and materials, and recycling wastes (Morris and Dunne, 2004, Eden, 2009).

On the other hand, the excessive number of participants, more intensive farming, and the increase in transport distance in global value chains may have negative environmental impacts (De Fazio, 2016). Ayompe et al. (2021) showed the negative environmental impacts were concerning soil erosion, carbon sequestration and storage, climate regulation, and habitat provision. Several crops of global value chains consume relatively high amounts of irrigation water, even from groundwater resources and in desert conditions (Schwarz et al., 2015). There are food losses and waste in the processing and consumption of food products under the global value chains, thus the production of these lost food crops and wasted food can lead to the waste of freshwater resources, cropland area, and fertiliser (Kummu et al., 2012, Nahman and de Lange, 2013). Global value chains seem to have relative

disadvantages in biodiversity, animal welfare, water and energy use, and resilience in comparison with the local value chains (Schmitt et al., 2017).

Therefore, targets that include different dimensions of sustainability and various aspects of trade, finance, technology, along with capacity building can be achieved under global value chains through partnerships (SDG 17). A key measure to enhance partnerships under global value chains is through micro-level cooperation (e.g., contract farming, cooperative, industrial association) and macro-level coordination (e.g., multi-national corporations, regional trade agreements, multilateral trade agreement under the WTO).

4.2 Characteristics of global value chains

Issues concerning governance, standards, and sustainability are central to global food value chains and may prominently affect the global sustainability agenda. Value chain governance and standards in global food value chains have significantly developed over time. Value chain governance can be classified into private governance (e.g., firm codes of conduct and monitoring), public governance (government policies), and social governance (civil society pressure on business). Private governance has various forms such as standards for the environment, labour, health, and product safety; codes of conduct by corporations, associations, and non-governmental organizations; labels for green and fair-trade; and self-regulation by firms with corporate social responsibility. Public governance involves formal rules and regulations set by governments at local, national, and global levels that facilitate social and economic upgrading. Private and public governance may hold comparative strengths and weaknesses that make them complementary. Social governance is driven by civil society actors and includes codes of conduct for regulating workers' rights and conditions (Gereffi et al., 2005). Therefore, value chain governance in the form of standards is represented in the requirements for reassurance on how the food products are being made, where they are sourced from, and what are the environmental and social consequences.

There is a debate on the positive and negative impacts of food standards and certifications on farmers' welfare and sustainable development, especially for smallholders in developing countries. The main concern on standards is whether they will act as a barrier for smallholders and hinder poverty reduction in developing countries and may lead producers to be displaced from export markets, especially in developed countries. However, scholars (Tran et al., 2013b, Maertens and Swinnen, 2009, Lee et al., 2012) have proved that, rather than acting as barriers, higher food standards and certifications in developed markets may be a strong motivation for fostering sustainable production and trade. Complying with higher standards provides an incentive to producers and governments in developing countries to learn and invest in their capacity to satisfy the diverse standards.

Higher standards can provide smallholders with various benefits, i.e., higher-ability labour, higher-quality products, better-quality living environment, and more stable income, thus increasing smallholders' welfare in the long term (Maertens and Swinnen, 2009). In addition, standards are

supposed to help overcome market failures, communicate information about products and consumers' demand, transfer of technology and knowledge, promote sustainable use of environmental resources, and reduce consumer uncertainty on food quality and safety. Therefore, standards can increase demand and reduce food-borne diseases by safeguarding public health as well as facilitate developing countries to integrate into global value chains. Standards can also enhance developing countries' capacities to meet developed countries' stringent demand, therefore creating more trade, employment, and economic growth via new forms of competitive advantage (Keiichiro et al., 2015).

Food standard is a condition and key determinant of contract farming and global value chains (Guo et al., 2007). Contract farming is defined as contractual arrangements between farmers and firms specifying conditions of production and marketing of agri-food products. Contract farming is widely used in global value chains for high-value and certified products. Contract farming is likely to appear when uncertainty is high, such as in the trade of products that are perishable, difficult to store and transport, and heterogeneous in quality (Hoang, 2021). Contract farming is identified as an intermediary form of vertical coordination between farmers and firms in global value chains that shape production decisions through contractually specifying market obligations such as value, volume, quality, and price; provide specific inputs; and exercise some control at the point of production in response to consumers' growing demand for product quality and safety as well as farmers' production constraints from market imperfections (Swinnen and Maertens, 2007). The significant benefits of contract farming are to stabilize prices, enrich food quality and safety, enhance market access, improve traceability for food retailers, lower trade barriers, and increase farmers' income, especially for smallholders (Hoang, 2021, Guo et al., 2007).

4.3 Characteristics of agri-food products and value chains

According to Gereffi et al. (2005), three major variables determine how a global value chain (GVC) is governed, they are (1) complexity of transactions, (2) ability to codify the transactions, and (3) capabilities in the supply base. These variables will affect the governance and implementation of standards, both public and private, thus having an impact on the interactions between global value chains and sustainable development. Production characteristics, product features, and value chain characteristics of agri-food products may have different linkages to sustainable development. Table 11 has divided the characteristics and value chains of agri-food products in developing countries to fresh fruit and vegetables, tropical commodities, and cereals according to Feyaerts et al. (2020) classifications, along with seafood according to further study conducted in this chapter.

Both the production of fresh fruit & vegetables and tropical commodities in developing countries are labour-intensive. This feature can provide more employment and increase the income of smallholder farmers as well as improve employee wage and training on farms via agro-industrial companies. Furthermore, Ayompe et al. (2021) showed that in addition to employment and income generation, there are positive impacts such as credit facilities, improved housing condition, landscaping, market

infrastructure, religious centres, rural development, and urbanisation (SDG 1-5). Meanwhile, tropical commodities and cereals are land-intensive, therefore certified products in global value chains can reduce soil degradation, water and coastal pollution, and GHG emissions (SDG 6, SDG 13, SDG 15) due to the technical specifications for production methods, for example, limiting the use of synthetic fertilisers and pesticides (Bellassen et al., 2022, Drut et al., 2021, Hoang and Nguyen, 2019).

Fresh fruit & vegetables and seafood have high values, but these food products have low storability. Therefore, these products may have higher production costs due to special infrastructural needs such as facilities to store, preserve, and transport. Vertical coordination through contract-farming schemes is widely used in the production of these food products. Contract farming is used because uncertainty is high, products are perishable, difficult to store and transport, and heterogeneous in quality (Hoang et al., 2021). Contract farming between farmers and agro-industrial companies will influence production decisions through agreements by specifying market obligations such as value, volume, quality, and price as well as provide specific inputs to farmers, thus reducing farmers' production constraints from market imperfections (Swinnen and Maertens, 2007); therefore, increasing farmers' income, stabilising prices, enhancing market access, enriching food quality and safety, and improving traceability for food retailers (Guo et al., 2007, Hoang et al., 2021).

Fresh fruit & vegetables and seafood are under strict regulation through both public and private standards. Strict food standards and certifications in developed markets may be a strong motivation for fostering sustainable production and trade (SDG 12), rather than acting as barriers (Maertens and Swinnen, 2009, Lee et al., 2012, Tran et al., 2013b). Governments and producers in developing countries are encouraged to invest in their capacity to satisfy the different standards. These food products have strong product and quality differentiation via higher standards that can provide smallholders with various benefits, i.e., higher-quality products, more stable income, better-quality living environment, and higher-ability labour; therefore, increasing smallholders' welfare (SDG 1, SDG 2, SDG 8) in the long term (Maertens and Swinnen, 2009). Certification and stringent governance in global value chains forces and motivates seafood producers to sustainably exploit and conserve seafood sources as well as reduce marine pollution (SDG 14).

Fresh fruit & vegetables and tropical commodities have widespread foreign direct investments that have significant impact on economic development through the transfer of technology, knowledge, and innovation (SDG 9). The flow of knowledge and innovation via global agri-food value chains to developing countries are changing the global flow of food products supported by advances in transport and telecommunication technologies. There are studies (Nguyen and Jolly, 2020, Schmitt et al., 2017) showing that global value chains present substantial advantages in terms of climate change mitigation and GHG emission reduction (SDG 13) due to the efficient use of transport in global value chains by moving products in bulk quantities and shorter delivery times.

There is strong consolidation throughout the value chains for fresh fruit & vegetables, meanwhile tropical commodities and seafood have consolidation in the processing and exporting of the food products. In general, fresh fruit & vegetables, tropical commodities, and seafood have a high degree of coordination via vertical integration in agro-industrial companies, contract farming, out-grower schemes, and horizontal coordination among producers in cooperatives. These structures will give rise to the opportunity to reduce food loss and waste in all stages of the global food value chains; subsequently, all actors in the value chain can share responsibility, promote information, enhance partnership, and work together to reduce food loss and waste (SGD 12).

Regarding governance and state involvement, fresh fruit & vegetables are liberalised and privatised while tropical commodities and seafood are partially liberalised with various regulatory intervention by governments, depending on the countries. However, cereals (e.g., rice) can have a high degree of state intervention and tariff protection as well as subsidies due to national agricultural policies to promote self-sufficiency in food production and food security. Through global value chains, there is the possibility to lower trade barriers and enhance market access in highly protected markets as well as to improve traceability of food products along with augmenting food quality and safety in liberalised markets.

Table 11. The characteristics of agri-food products and value chains in developing countries.

	Fresh fruit & vegetables*	**Tropical commodities***	**Cereals***	**Seafood****
Crop & production characteristics				
Type of crop or harvesting	Annual crops (*most vegetables*) and perennial crops (*most fruits*)	Perennial crops (*coffee, cocoa, tea, oil palm*) grown as annual crops (*cotton, tobacco, sugarcane*)	Annual crops	Annual harvesting (*most seafood*)
Labour intensity	High	High	Low	Medium
Land intensity	Low	High	High	Low
Type of producers	Mainly agro-industrial companies; some smallholder farmers	Smallholder producers *(cocoa, coffee, tobacco, cotton*); small- and large-scale producers *(tea, sugarcane, palm oil*)	Large, medium, and small producers	Large, medium, and small producers
Product features				
Value of product	High	Medium *(depending on the crop and level of processing)*	Low	High *(depending on the species and level of processing)*
Storability of product	Low	Strongly depends on the level of processing	High	Low
Value chain characteristics				
Governance and state involvement	Liberalised and privatised	Partially liberalised with remains of state intervention *(depending on the subregion)*	High degree of state intervention *(depending on the subregion)*	Partially liberalised with regulatory interventions
Private and foreign direct investment	Widespread private sector and foreign direct investment	Widespread private sector and foreign direct investment	Emerging private sector investment	Widespread private sector investment
Regulation through standards	Strict regulation through both public and private standards	Less strict regulation; private sustainability standards are important	Limited regulation through standards	Strict regulation through both public and private standards
Degree of consolidation	Strong consolidation throughout the supply chain	Consolidation in processing and exporting	Large number of producers and traders, differentiated by size	Consolidation in processing and exporting with many producers
Degree of coordination	Vertical integration in agro-industrial companies; vertical coordination through contract-farming schemes	Horizontal coordination among farmers; vertical coordination through out-grower and contract-farming schemes	Low levels of coordination; prevalence of spot market transactions	Vertical coordination by contract-farming in GVC; low levels of coordination in local value chain
Product and quality differentiation	Strong product and quality differentiation; strong differentiation between GVC and local value chain	Quality differentiation; mainly export chains	Limited product and quality differentiation; limited differentiation between GVC and local value chain	Strong product and quality differentiation between GVC and local value chain

Source: Feyaerts et al. (2020) and further study conducted in this chapter***

5 Spatial characteristics of the interlinkages between trade and the SDGs

This chapter aims to examine the relationship between international agri-food trade and sustainability at the global, regional, and local levels (Table 12). The traded agri-food products are classified into the different groups along with the specific products and aligned to the product categories under Table 11 in Chapter 4. In the literature review, papers at the global level emphasised the implication of agricultural trade and sustainability for all countries in the world, meanwhile the regional papers focused mainly on regional blocs including Europe, Africa, Asia, North America and Latin America. The local level papers are basically country papers.

Table 12. Spatial distribution of traded agri-food products and SDG linkages.

Agri-food Products	**Global Level**		**Regional Level**		**Local Level**	
	Direct linkage	Indirect linkage	Direct linkage	Indirect linkage	Direct linkage	Indirect linkage
Seafood & fisheries						
Seafood	8	1, 8, 10, 12, 14				
Fisheries	1, 2, 8, 14	1, 8, 9, 10, 12				
Small-scale fisheries			9, 11, 14	3, 8		
Fresh fruit & vegetables						
Pomelo					8, 10	1, 9
Pineapple						1, 8, 9
Tropical commodities						
Coffee			1, 9, 16	8, 10		1, 2, 4, 8, 9
Sugar					8, 9, 11, 16	3, 4
Coconut					8	9, 10
Palm oil	15	1, 4, 5, 6, 7, 11, 12, 16			1, 8, 11, 15	13, 16
Cereals						
Rice	13	15			1, 2	
Oilseeds						
Soybean	8, 12, 15	2, 6, 13,				
Rapeseed					7, 13	9
Others						
Cotton						2, 8
Milk					8, 10	1, 2
Agricultural goods			1, 2, 3, 6, 12	8, 9, 13		
Crop-livestock systems					1, 8	2, 6, 10, 12, 15

Supporting literature	Asche et al. (2015), Cisneros-Montemayor et al. (2020), Cisneros-Montemayor and Sumaila (2019), Corrado et al. (2020), Costello et al. (2021), Downing et al. (2021), Kumar et al. (2019), Montanía et al. (2021), Skerritt and Sumaila (2021), Sumaila et al. (2019), Wu et al. (2021)	Corrado et al. (2020), Ezirigwe et al. (2021), Lerner et al. (2021), Penca et al. (2021), Weersink et al. (2021)	Ayompe et al. (2021), Bacon et al. (2008), Chiputwa and Qaim (2016), Chiputwa et al. (2015), Doliente and Samsatli (2021), Hoang (2014), Hoang et al. (2021), Hoang and Tran (2019), Meemken et al. (2017), Nhlengethwa et al. (2021), Shumeta and D'Haese (2018), Tian et al. (2021), Tran et al. (2013b), Valdivia et al. (2017), Whitfield (2017)

Note: The numbers represent Sustainable Development Goals (SDGs)

Source: own composition.

Studies at the global level have discussed various aspects of international agricultural trade and sustainability in the areas of economic growth and development (Downing et al., 2021, Montanía et al., 2021), economic policies and governance issues (Skerritt and Sumaila, 2021, Sumaila et al., 2019), livelihood and wellbeing (Downing et al., 2021, Skerritt and Sumaila, 2021), biodiversity of products (Wu et al., 2021, Skerritt and Sumaila, 2021, Sumaila et al., 2019), emissions and pollution (Downing et al., 2021) as well as food and nutrition security (Sumaila et al., 2019). The papers reviewed had direct links to SDG 1 (No poverty), SDG 8 (Decent work and economic growth), SDG 13 (Climate action), SDG 14 (Life below water) and SDG 15 (Life on land).

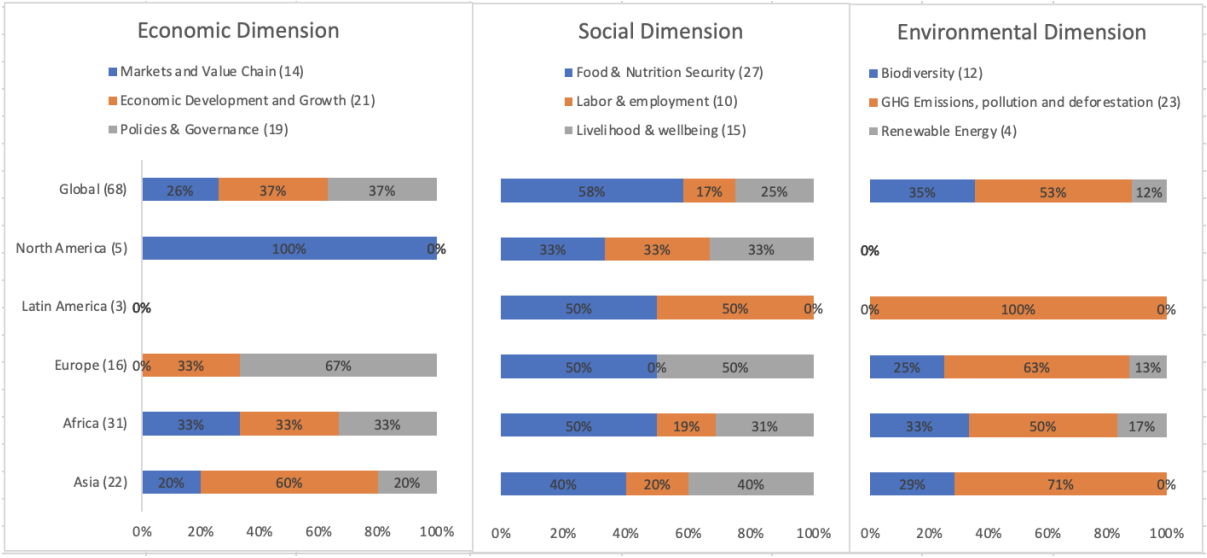
The issues reviewed at the regional level are not very different from those of the global level, although the studies reviewed were mostly about the European Union, Africa, and the Mediterranean. The issues studied relate to markets and value chain (Ezirigwe et al., 2021), economic development and growth (Lerner et al., 2021), trade-related economic policies and governance (Lerner et al., 2021, Corrado et al., 2020), food and nutrition security (Ezirigwe et al., 2021), livelihood and wellbeing (Corrado et al., 2020, Penca et al., 2021), biodiversity (Penca et al., 2021) as well as emissions and pollution (Corrado et al., 2020). The papers reviewed had direct links to SDG 1 (No poverty), SDG 2 (Zero hunger), SDG 3 (Good health and wellbeing), SDG 6 (Clean water and sanitation), SDG 9 (Industry, innovation, and infrastructure), SDG 12 (Responsible consumption and production), and SDG 16 (Peace, justice, and strong institutions).

Studies at the local level tend to be more specific to certain agricultural products (soybean, sugar, palm oil, coffee, coconut, cotton, milk, pineapple, pomelo and rapeseed) and relate to economic development and growth (Ayompe et al., 2021, Nhlengethwa et al., 2021, Valdivia et al., 2017), economic policies and governance (Nhlengethwa et al., 2021, Valdivia et al., 2017, Bacon et al., 2008), livelihood and wellbeing (Nhlengethwa et al., 2021, Valdivia et al.,

2017, Bacon et al., 2008, Ayompe et al., 2021), biodiversity (Valdivia et al., 2017) and emissions and pollution (Ayompe et al., 2021). These papers are directly linked to SDG 1 (No poverty), SDG 2 (Zero hunger), SDG 4 (Quality education), SDG 8 (Decent work and economic growth), SDG 11 (Sustainable cities and communities), and SDG 15 (Life on land). The following subsections present these discussions in detail.

Figure 7 shows the grouping of papers linking trade with sustainability. The categorisation comprises: i) Economic Dimension (markets & value chains, economic development & growth, and policies & governance); ii) Social Dimension (food & nutrition security, labour & employment, and livelihood & wellbeing); and iii) Environmental Dimension (biodiversity, GHG emissions, pollution, & deforestation, and renewable energy). The economic dimension has the highest number of papers, followed by the social dimension, and then the environmental dimension. For each of these three dimensions, the papers identified focus on the Global level, Africa, Asia, and Europe. Fewer studies are related to North America and Latin America.

Figure 7. Spatial analysis of agri-food trade in the different dimensions of sustainability.



Source: own composition.

Most of the studies under the environmental dimension focus on GHG emissions, pollution, and deforestation, followed by biodiversity and renewable energy, respectively. These studies are primarily related to the Global level and Asia. Under the social dimension, the studies reviewed focus largely on food and nutrition security, followed by livelihood and wellbeing, and labour and employment, accordingly. The economic dimension, despite having the highest number of studies, has an even spread of papers across its components and was predominantly focused on the global level with minimal emphasis on Asia, Africa, and Europe.

In summary, most of the reviewed studies have a global perspective. In the case of those focusing on Africa, emphasis is mostly on the social dimension and more specifically on food and nutrition security. Concerning Asia and Europe, papers on the environmental dimension dominate and especially on GHG emissions, pollution, and deforestation. North America and Latin America have relatively few studies linking trade with sustainability. North America has

papers in the economic and social dimensions whereas Latin America has papers in the social and environmental dimensions.

5.1 Global level

The papers exploring the economic development and growth issues include the papers by (Downing et al., 2021, Montanía et al., 2021). Downing et al. (2021) focused on the trade in rubber and palm oil production in Southeast Asian countries, soy production in Brazil and logging in South Pacific Island states to explore the cross-sector effects of production for trade with China. They showed the extent to which trade in these products affected economic growth and development in these countries, using a telecoupling framework that tracks spill-over effects to other sectors as well as other scale effects. This study (linked to SDG 15 – Life on land) further emphasised that existing social and environmental regulations are insufficient towards growing demand for the production of such food crops. Thus, more efficient regulations, policies, or laws are required to manage their production, distribution, and transnational equality issues. Montanía et al. (2021) focused on soybeans and showed how its exports boosted the economies of major exporting countries like Brazil and minor exporting countries like Ukraine, Paraguay, and Canada. In relating its production to the pressure on natural resources (mostly, land use), Montanía et al. (2021) argued that government involvement was required in the development of strategies that would enhance soybean exports while promoting decent work and economic growth (SDG 8) and responsible consumption and production (SDG 12).

With regards to the papers discussing economic policies and governance issues at the global level, Skerritt and Sumaila (2021) focused on addressing the issue of why the mandate of the World Trade Organization (WTO) in developing a multi-lateral agreement on the elimination of harmful fisheries subsidies remains elusive. They showed that the lack of a clear metric for measuring potential scale effects was a huge stumbling block. Sumaila et al. (2019) explored a similar issue by providing estimates in the scope, amount, and level of subsidisation in the fisheries sector. They showed that while the increase in fisheries subsidies has halted (compared to previous decades), the bulk of harmful 'capacity-enhancing' subsidies, particularly those for fossil fuels, have increased as a proportion of total subsidies. Thus, for the benefit of marine ecosystems, and current and future generations of people, the WTO must be supported to reach a meaningful agreement to discipline subsidies that lead to overcapacity and overfishing.

Downing et al. (2021) and Skerritt and Sumaila (2021) also explored some livelihood and wellbeing issues. Downing et al. (2021), in their discussion on who must be included (or excluded) in the development of international trade policies, emphasised that previous strategies were limited to a few beneficiaries and that there is the need to emphasise on large-scale effects. Skerritt and Sumaila (2021) also discussed the extent to which harmful fisheries subsidies, through their effects on overfishing, can lead to the non-attainment of SDG targets

related to reducing poverty, providing nutritious foods, and securing livelihoods. It is critical to note that most of these effects are not direct outcomes of the paper reviewed respectively.

On the issue of biodiversity, various studies have sought to understand the effect of international trade on the sustainability of food production (Skerritt and Sumaila, 2021, Sumaila et al., 2019, Wu et al., 2021, Costello et al., 2021, Cisneros-Montemayor and Sumaila, 2019, Asche et al., 2015). Wu et al. (2021) showed how global trade response to climate actions can differently affect rice production (increasing in India and reducing in China, Bangladesh, and Myanmar). Cisneros-Montemayor and Sumaila (2019) showed how fisheries subsidies are ineffective at competing with large fishing nations and could worsen poverty. Costello et al. (2021) showed how the WTO was at a better position to deliver on SDG 14 (Life below water) by reforming global fisheries subsidies to enhance fisheries biodiversity. Asche et al. (2015) showed how the trade in seafood is helping countries to improve societal welfare via its trade.

5.2 Regional level

Ezirigwe et al. (2021) discussed trade in general agricultural goods (within the context of the COVID-19 pandemic) in navigating the realities of food security in African markets and in addressing SDG 1 (No poverty), SDG 2 (Zero hunger), SDG 3 (Good health and well-being), and SDG 12 (Responsible consumption and production). They showed that while the pandemic provides an opportunity for governments to strengthen their commitments, it raises questions on the ambitious global efforts to deliver the SDGs by 2030. They recommended that African governments needed to maximize intra-African trade with investments in agricultural biotechnological infrastructure to close the gap between the targets and the realities.

Lerner et al. (2021) related unfair trade practices in coffee production in affecting its value chain, growth, and governance in coffee-producing countries. More specifically, they sought to understand the drivers of the differences between farm-gate and free-on-board prices in Arabica coffee. Their findings showed that heterogeneity in infrastructure and institutions are key explanatory factors. They further indicated that these differences lead to the introduction of intermediaries in the coffee supply chain, and the generation of some transaction costs which reduces the margin that coffee farmers receive generally. Thus, actions aimed at reducing these inefficiencies needed to be introduced to bring more transparency, lower transaction costs, thereby directly contributing to SDG 1 (No poverty), SDG 9 (Industry, innovation, and infrastructure) and SDG 16 (Peace, justice, and strong institutions).

Penca et al. (2021) analysed the fish market in the Mediterranean region to map the drivers and feedback loops that keep fisheries in an unsustainable trajectory as well as review the key innovations in support of sustainable small-scale fishing sector. They sought to understand how the biodiversity of fisheries can be sustained and how the negative effects of the current market structure on the livelihood of small-scale fishers can be mitigated. On the issue of addressing the negative effects of the existing market structures on small-scale fishers, they discussed

various governance interventions including the shortening of the value chain, innovation in the distribution channel, diversification in the type of product offered, promotion and education regarding small-scale fisheries products, label and brand development and the empowerment of small-scale fisheries communities through improved leadership, ownership, cooperation and coordination. These discussions are the focus of SDG 9 (Industry, innovation, and infrastructure), SDG 11 (Sustainable cities and communities), SDG 14 (Life below water).

Weersink et al. (2021) studied the agri-food supply chains in North America and observed its rapid rebound during the recent global pandemic following some years of initial disruption. They also discussed the extent to which a continuation of the pandemic could push the supply chain toward greater consolidation of firms and diversification of products. They discussed some other structural changes that will be felt through input markets, most notably labour, as the trend toward greater automation continues to accelerate as a response to meeting concerns about a consistent supply of healthy and productive workers. They further argued that the recent COVID-19 pandemic will have minimal effects on North American agriculture through food prices that are likely going to be stable because of the existence of such supply chains that require minimal physical contact. Their discussion emphasized the role of agri-food supply chains in enhancing decent work and economic growth (SDG 8) as well as improving the infrastructure, the agri-food supply chain and innovation (SDG 9).

5.3 Local level

The local level papers focused on a variety of agricultural products (e.g., palm oil, sugar, coffee, pineapple, pomelo, and coconut). Ayompe et al. (2021) explored the sustainability of palm oil trade by focusing on the social impact, rather than the environmental impact that appears to be predominant in the literature. The results, concerning Malaysia and Indonesia, showed several positive (income generation and employment) and negative impacts (in terms of conflicts, land grabbing, housing conditions). Ayompe et al. (2021) concluded that palm oil trade can be made sustainable not just by addressing the environmental impacts, but also the negative social impacts need to be addressed.

Nhlengethwa et al. (2021) showed that infrastructural investment is a precondition for developing countries to sustain the pace of development and achieve the SDGs. They explored how agricultural water infrastructure development affected sugar production in Eswatini. They showed that previous economic growth and sugar export values are the two critical determinants of agricultural water infrastructure investments in Eswatini. They also argued that it can be safely construed that higher incomes as well as terms of trade for sugar, can improve spending on agriculture water investments, and this is important because an increase in investments in water infrastructure may then help spur economic growth. More generally, infrastructure investment (including water, electricity, information & communication technology, and transport) can be directly linked to SDG 8 (Decent work and economic growth), SDG 9 (Industry, innovation, and infrastructure), SDG 11 (Sustainable cities and

communities) and SDG 16 (Strong institutions). Such investments in infrastructure can promote economic growth and improve the depth of infrastructure.

Bacon et al. (2008) relied on data from Nicaragua to find out whether sustainable coffee certifications are enough to secure farmer livelihood and promote fair trade. Their findings suggest that households that were connected to 'Fair Trade' cooperatives experienced several positive impacts in education, infrastructure investment, and monetary savings. However, several important livelihoods insecurities (including low incomes, high emigration, and food insecurity) persist among all small-scale producers. Thus, implementing sustainable coffee certification, through livelihood and fair-trade improvement, is likely to indirectly contribute to reducing poverty (SDG 1), zero hunger (SDG 2), quality education (SDG 4), gender equality (SDG 5), improving decent work and economic growth (SDG 8), and improving industry, innovation, and infrastructure (SDG 9).

In terms of coffee, Chiputwa and Qaim (2016) investigated smallholder coffee farmers in Uganda – certified under Fairtrade, Organic, and UTZ – to analyse the effects of certification on food security and dietary quality. They showed that certification increased calorie and micronutrient consumption mainly through higher incomes and improved gender equity, increased women's control of coffee production, and monetary revenues from sales. The authors conclude that certified households in Uganda tend to be better off compared to noncertified households in terms of farm size, income levels, and infrastructure conditions. Chiputwa et al. (2015) compared the impacts of three sustainability-oriented standards – Fairtrade, Organic, and UTZ – on the livelihoods of smallholder coffee farmers in Uganda. They showed that Fairtrade increases per capita consumption expenditures by 30% and reduces the likelihood of being poor by 50%, guarantees a minimum support price, which increases the average price received by farmers and reduces downside risk. They further showed that Fairtrade cooperatives receive a premium, which they use for investments in infrastructure and training programs. Meemken et al. (2017) also found Organic and Fairtrade to have positive effects on total consumption expenditures, education, nutrition, and gender equality in Uganda. Shumeta and D'Haese (2018) investigated how coffee cooperative membership affected food security among coffee farm households in Southwest Ethiopia. Their results revealed that cooperative membership has a positive and significant effect on staple food production (maize and teff) and facilitated technological transformation via increased utilization of fertilizer and improved seeds. Nonetheless, the effect on food expenditure and income could not be confirmed. Certification and cooperative membership can promote the attainment of SDG 1 (No poverty), SDG 9 (Industry, innovation, and infrastructure), SDG 16 (Peace, justice, and strong institutions).

Whitfield (2017) explored new pathways to agricultural production drawing evidence from fresh pineapple exports in Ghana. The author argued that this category of exporters represents a path to capitalist agricultural production that can be conceptualized as capitalism from outside: where capital flows to the countryside rather than accumulation occurring from above

or below the agrarian economy. The new pathways identified include attempts by farmers to upgrade their production activities by introducing new products, diversifying markets to reduce risk, and relying on a portfolio of related products that include not necessarily higher-value products but a large range of products with different specifications and of different values, including lower-value products. These reforms, accompanied by institutional support, can enhance the attainment of SDG 1 (No poverty), SDG 8 (Decent work and economic growth), and SDG 9 (Industry, innovation, and infrastructure).

Govereha and Jayne (2003) explore synergies between cash crops and food crops in Zimbabwe; and show that intensive household engagement in cotton production produced higher yields compared to yields from non-cotton and marginal cotton production. The authors argue that the potential spill-over benefits for food crops through participation in cash crop programs are important for developing strategies to intensify food crop production in Africa. Their findings questioned the assertions that cash crop production comes at the expense of household food security. It is clear, therefore, that intensifying cotton production could promote SDG 2 (No poverty) and SDG 8 (Decent work and economic growth).

For livestock, Valdivia et al. (2017) explored the policies required to enhance semi-subsistent crop-livestock systems in Kenya. They relied on the case of a public intervention meant to improve crop-livestock systems and was part of interventions meant to attain the SDGs. They showed that a strategy that stimulates rural development, increases farm size to a sustainable level, and reduces distortions and inefficiencies in input and output markets could lead to a sustainable development pathway and achieve the SDGs for rural household's dependent on crop-livestock systems. Improving semi-subsistent crop-livestock system can be argued to contribute directly to reducing poverty (SDG 1) and hunger (SDG 2) and improving work conditions and growth (SDG 8).

Doliente and Samsatli (2021) showed that the lengthening of rice value chains, due to shifting patterns of global trade and booming economies of major rice-producing nations, hampers cost-effective and efficient rice supply. The authors advocate for the need to operate value chains that can eliminate hunger through affordable food production and accommodate co-production of high-value commodities while maintaining sustainable ecosystems. The model, used in the study, appeared to be potentially useful to many rice-producing countries (e.g., in Sub-Saharan Africa and Latin America) seeking to be self-sufficient in rice production but are constrained with food insecurity, biodiversity loss and climate change. Streamlining value chains could contribute to attaining SDG 1 (No poverty) and SDG 2 (Zero hunger).

Hoang et al. (2021) studied the milk value chain in Vietnam to explore the issues of governance and fairness as well as regulatory interventions and how they have affected activities along its value chain. They showed that reforms in the food sector have generally enhanced activities in the milk value chain, although various dairy products were significantly affected by the fairness

of the reforms. Thus, improving regulatory interventions to promote fairness can promote decent work and economic growth (SDG 8) and reduce inequality (SDG 10).

In terms of products such as pomelo and rapeseed, Hoang (2014) and Tian et al. (2021) showed that pomelo and rapeseed production in Vietnam and China, respectively, provide substantial financial benefits. The continuous production of such crops could lead to the attainment of SDG 8 (Decent work and economic growth) and SDG 12 (Responsible production).

Tran et al. (2013a) and Hoang and Tran (2019) respectively estimated the financial benefits from the coconut value chain and the comparative advantage of coconut (against rice and pomelo) in Vietnam. They reported that strengthening the coconut value chains is likely to increase sales revenue and profits from coconut production. Improving the competitiveness of coconut production would enhance its economic benefits by improving decent work and growth (SDG 8), reducing inequalities (SDG 10), and promoting responsible production and consumption (SDG 12).

Africa: The interactions between trade agreements and the SDGs

The underlying motivation of trade agreements is to facilitate trade and, in this review, trade in agri-food, fisheries, and forestry. Trade, in agri-food, fisheries, and forestry in developing countries have the potential to enhance economic, social, and environmental sustainability. For instance, through employment creation, commodity trade serves as a channel to reduce all forms of poverty given that within the developing world, poverty is endemic amongst rural people where agriculture is the backbone of production.

According to UNCTAD (2019) report, Africa's poor trade performance can be attributed to high dependence on the exportation of primary goods, weak regional production networks, and poor infrastructure. The Continental Free Trade Area for Africa (AfCFTA) agreement has the potential to increase intra-regional trade amongst the members of the trade agreement, which is expected to lead to increased economic growth and development within the sub-region. There is, however, evidence to show that increased trade might have negative implications for environmental sustainability and invariably sustainable development efforts within the sub-region. Opoku-Mensah et al. (2021) investigated the causal relationship between the trade impact of the agreement and CO_2 emissions using data from 25 out of the 35 countries that had ratified the AfCFTA agreement. The study found trade openness (compared to urbanization and economic activities) as the most significant long-term driver of CO_2 emissions within the 25 AfCFTA ratified countries, and CO_2 emissions will increase by 17% relative to the emission levels in 2015 if no measures are undertaken. One of the suggested measures to reduce CO_2 emissions is the need for policymakers in AfCFTA countries to partner with advanced countries to obtain knowledge spill-overs from clean technologies in developed countries to Africa.

Regional trade agreements promote food security. In the absence of non-tariff barriers and distortions, the principle of comparative advantage will ensure the efficient allocation, distribution, and production of crops in a free market for agricultural products. According to Maasdorp (1998), trade within the Southern African Development Community (SADC) region has the potential to enhance food security. Regional trade agreement such as SADC and the Economic Community of West African States (ECOWAS) in Sub Saharan Africa that seek to promote food security have direct linkages to SDG 1 (No poverty) and SDG 2 (Zero hunger).

In conclusion, the spatial analysis concerning trade agreements in Africa shows that through trade in primary commodities (including agri-foods, fishing, and forestry), trade agreements have impacted on economic (improved economic growth), social (food and nutrition security, employment, and well-being) and environmental sustainability (GHG emissions). The trade agreements that promote agricultural trade have both positive and negative indirect linkages to SDG 1 (end poverty in all forms), SDG 2 (end hunger), SDG 3 (good health and well-being), SDG 7 (affordable clean energy), SDG 8 (decent work and economic growth), and SDG 9 (industry, innovation, and infrastructure). In addition, the trade agreements have indirectly impacted on efforts at attaining SDG 10 (reduced inequalities), SDG 12 (responsible consumption and production), SDG 13 (climate action) and SDG 17 (revitalize the global partnership for sustainable development using trade).

6 Positive and negative outcomes of the interlinkages between trade and the SDGs

Previous chapters analysed a range of aspects pertaining to the potential linkages between international trade and sustainability. This chapter provides a summary picture of:

- the political, economic, and social circumstances which may bring about a greater likelihood of positive linkages and reduce the likelihood of potential negative linkages between trade and sustainable development, hence promoting conditions that foster more positive outcomes.
- the positive and negative outcomes of the linkages between trade and the SDGs with context specific examples.
- aligning national agricultural policies to achieve the SDGs.

Trade has been given a prominent place is several SDGs. Trade has been mentioned directly in 5 SDGs (see Table 13). The main preoccupation concerning trade has been to improve market access and remove discriminatory barriers to exports from developing countries, especially the least developed countries (LDCs). What lies behind are the potential negative spill-over effects of domestic policies in industrialised countries, e.g., fishery subsidies and policy distortions in agricultural markets created by export subsidies and other trade distorting measures with similar effect. In essence, texts in SDGs call for fairer trade between developed and developing countries.

Table 13. SDGs directly mentioning trade.

SDG	Reference to trade
SDG 2 (No hunger)	Calls to correct and prevent trade distortions in world agricultural markets
SDG 8 (Decent work and economic growth)	Calls to improve Aid for trade support for developing countries
SDG 10 (reduced inequalities)	Emphasises the importance of Special and Differential Treatment of developing countries
SDG 14 (life below water)	Calls for discipline on rich countries fishery subsidies
SDG 17 (partnerships for the goals)	Calls for: - a universal, rules-based, open, non-discriminatory, and equitable multilateral trading system under the WTO; - significantly increasing developing countries' exports; - timely implementation of duty free and quota free market access on a lasting basis for all LDCs; - enhancing policy coherence for sustainable development; - respecting each country's policy space and leadership to establish and implement policies for poverty eradication and sustainable development

Source: Helble and Shepherd (2017)

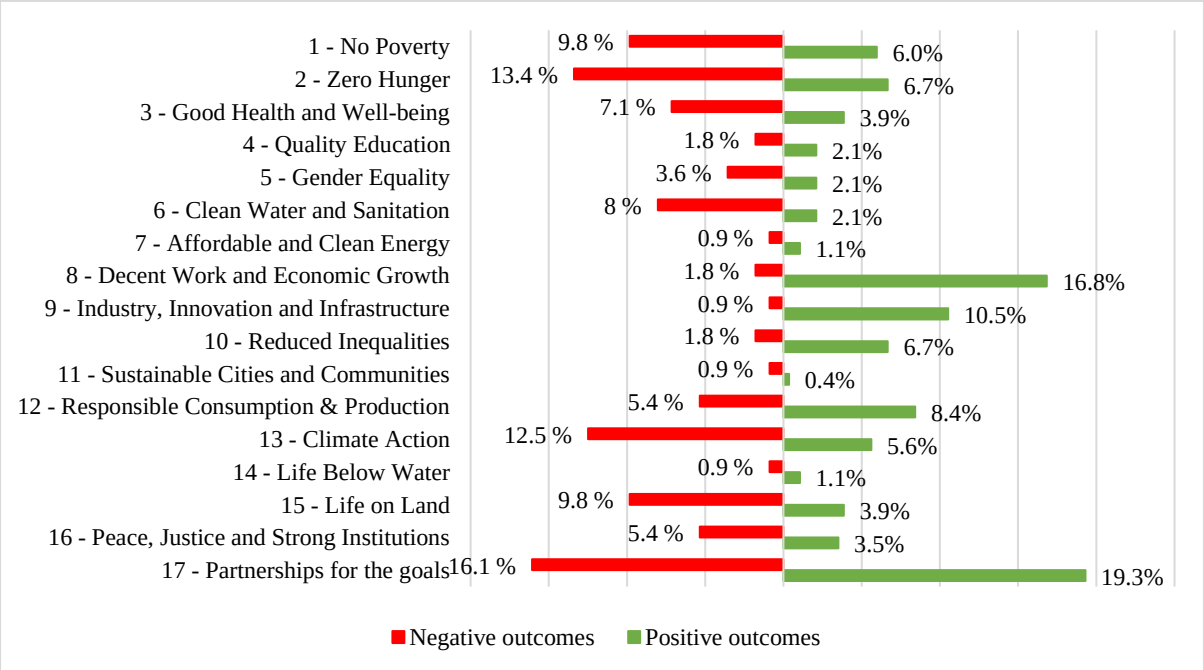
6.1 The positive and negative outcomes of the linkages between trade and SDGs

A summary of the analysis of the database reveals more positive than negative outcomes of the interactions between trade and the SDGs. Most of the positive outcomes are related to SDG 8 and SDG 17. It is likely that the number of articles claiming that the contribution of trade to jobs and growth is positive has been influenced by the large number of sources in the database which have analysed SDG 8 (see Figure 5**)**.

Figure 8 presents the share of each SDG in the positive and negative outcomes of the linkages between trade and the SDGs (the overall number of positive outcomes revealed in the database has been treated as 100%; the same applies to the negative outcomes). Figure 8 shows that most of the positive outcomes benefit SDGs in economic dimension of sustainability. SDGs in environmental and social dimension have much smaller shares of the positive outcomes. However, looking at the left side of the figure, important for TRADE4SD research agenda, social SDGs such as SDG 1 (No poverty), SDG 2 (Zero hunger), and SDG 3 (Good health and well-being) and environmental SDGs such as SDG 13 (Climate action), absorb a large share of negative outcomes along with SDG 17 (Partnership for the goals).

However, these outcomes are often based on sources which do not demonstrate causality and, therefore, in many cases only association has been established. For example, increased economic growth may be a result of other policies and act as a cause for increased trade and not the other way around.

Figure 8. Positive and negative outcomes of trade on the SDGs: shares of different SDGs in positive and negative outcomes (%).



Source: own composition.

There are economic, institutional and governance conditions which may increase the likelihood of positive or which minimise the potentially negative outcomes of the interactions between trade and SDGs. Table 14 depicts the conditions for enabling positive outcomes and preventing the conditions for negative outcomes that can be created through market oriented economic structure (liberalised economy with overwhelming private sector), good governance, and policies aligned to the SDGs. Since this requires broad societal consensus, a wide stakeholders' involvement is necessary to achieve the SDGs in the environmental and social sustainability pillars. Table 15 presents several examples of the possible positive and negative outcomes, emphasised in the literature review.

Table 14. Conditions increasing the likelihood of positive or negative outcomes of the linkages between trade and SDGs.

Conditions increasing the likelihood of positive outcomes
* Liberalised and privatised sector * Reduction of tariff and non-tariff barriers * Enforced both public and private standards * Strong foreign direct investments * Vertical integration (wide use of contract farming, especially involving smallholders) * Policy integration for sustainable food and nutrition (integration of agriculture, health, and environmental policies) * Aligning national agricultural policies (e.g., EU CAP) with the SDGs * Increased information, knowledge, and technology transfer * Stakeholders' involvement in assessment & implementation of agricultural & trade policies * Strong governance and institutions * A universal, rules-based, open, non-discriminatory, and equitable multilateral trading system under the WTO
Conditions increasing the likelihood of negative outcomes
* Wide state intervention, unpredictable policy changes (e.g., export bans) * Limited standard enforcement * Rudimentary private investment * Weak coordination along food value chain * Weak institutions * Monopolised domestic market and exclusion of small agricultural producers * Lack of price transmission from international to domestic markets and from domestic markets to households * Lack of adequate agricultural policy reform and strong implicit taxation of agricultural producers * Economic growth is not accompanied by environmental regulations and clean technology improvements

Source: own composition.

Table 15. Potential "positive" and "negative" outcomes of agri-food trade on the SDGs.

Positive outcomes
* Export-led growth * Economic diversification * Vertical integration along the food value chain * Efficient resource allocation * Technological innovation * Income growth and poverty alleviation * Improved food supply and access to food * Improved production standards * Improved quality of internationally traded food products
Negative outcomes
* Decreased social protection (increased workers exploitation; long hours of work; decreased safety at work) * Deforestation in developing countries * Increased use of fossil-based inputs in developing countries * Exclusion of small and remote producers from the market * Increased pollution and greenhouse gas emissions * Decreased environmental protection[1] * Increased antimicrobial resistance due to trade with meat and other food with countries with lower standards

[1] Export demand for soy, beef and palm oil is responsible for nearly 80% of tropical deforestation

Source: own composition.

Table 15 is not comprehensive; however, it does exemplify several of the positive and negative outcomes revealed in the literature review. It should be noted that the positive or negative outcomes are context specific. In different countries and regions, positive and negative outcomes appear to depend on factors such as the level of economic development and political stability, market effect of trade liberalisation, factor endowment to mention a few examples. One example analysed in literature concerns the interlinkage of "aid to trade" policy with SDG 8, in particular target 1 of SDG 8 (Sustain per capita economic growth in accordance with national circumstances). The quantitative analysis of 50 developing countries reveals a strong and statistically significant positive effect of "aid to trade" policy on low and low-middle income countries. However, for upper middle-income countries, the outcome depends on their political stability – only under a stable political environment the interlinkages are positive (Roy et al., 2021). The specific context is also related to the outcome of agricultural markets liberalisation. Two contrasting examples of the outcome from market liberalisation are Zambia and Zimbabwe (Winters, 2002). Concerning Zambia, the government abolished the purchasing monopsony of maize, and the market became dominated by two large firms which excluded small and remote producers. Thus, market liberalisation had a negative effect on SDG 1 (No poverty) and SDG 2 (Zero hunger). On the other hand, the removal of government regulation in the cotton market in Zimbabwe brought about more competition in cotton purchasing, which was beneficial for producers' incomes. For countries which have a wide pool of unskilled labour, trade liberalisation results in an increase in the wages of unskilled workers and thus brings out a positive outcome on SDG 10. This was in the case of Thailand regarding the

liberalisation of its agricultural sector where the poor with low wages have been mostly employed (Sudsawasd et al., 2020).

The following Table 16 and 17, exemplifying a few recent articles which reveal the positive and negative outcomes, show it is difficult to say something authoritative when studies use different methodologies, cover different countries and regions with different socio-economic contexts. This calls for more rigorous research on the outcomes to determine that causality flows from trade to the SDGs because the positive or negative outcomes of the linkages between trade and SDGs are context specific. In different countries and regions, positive and negative outcomes appear to depend on factors such as the model of the food value chain implemented, its governance, the level of economic development and political stability, legal and cultural institutions as well as other factors.

Currently, the COVID-19 pandemic has created challenges to achieve the positive outcomes and overturned the progress in attaining the SDGs.

UNCTAD (2021) announced that in 2020 due to COVID-19 the pandemic, international SDGs investment to developing and transition economies decreased by about one third. They emphasised that investment flows decreased sharply across all SDGs activities. Foreign direct investments (FDI), and especially greenfield investment and project finance, have been lacklustre in SDGs related sectors, partly because of stagnant global outward investment trends and partly because of regulatory and absorptive capacity constraints in many host countries. The value of greenfield projects in agriculture, water and sanitation, health and education were between one and two thirds lower in 2020 in comparison to 2019. The drop in international projects targeted at SDGs has been steeper in developing regions and particularly in the least developed countries. Since the adoption of the SDGs in 2015, the negative effects of the COVID-19 pandemic have reversed the progress made in achieving the SDGs.

Table 16. The positive outcomes of the linkages between trade and SDGs with context specific examples.

Methodology	Findings	Conditions	Positive Outcomes
Workshop, expert opinions (Singh et al., 2018)	Two targets in SDG (ending overfishing and increasing economic benefits to Small Island Developing States) are associated with positive effect on many SDG targets	A universal, rules-based, open, non-discriminatory, and equitable multilateral trading system under the WTO; Strong foreign direct investments	Income growth and poverty alleviation (SDG 1, SDG 2); Economic diversification (SDG 8, SDG 9)
Panel data analysis (Adedoyin et al., 2021)	Sustainable and alternative energy sources to decrease pollutant emissions	Increased information, knowledge, and technology transfer	Technological innovation (SDG 17)
Survey of 208 businesses, consisting of 186 farms and 22 fishmongers (Malak-Rawlikowska et al., 2019)	Economic: beneficial for producers to capture a large proportion of the margin; Social: significant differences across food chains	Vertical integration (wide use of contract farming, especially involving smallholders); Strong governance and institutions	Vertical integration along the food value chain (SDG 10)
Econometric estimations based on formal models (Chiputwa et al., 2015)	Fairtrade increases living standards by 30% and reduces the prevalence and depth of poverty	Enforced both public and private standards	Income growth and poverty alleviation (SDG 1, SDG 2)
Endogenous growth framework and panel data analysis (Roy et al., 2021)	"Aid to trade" policy promotes sustainable economic growth in low and lower middle-income countries	Increased information, knowledge, and technology transfer; Reduction of tariff and non-tariff barriers	Export-led growth (SDG 8), Economic diversification (SDG 9)
Agent-based global trade model linked to a comprehensive nutrition formula (Ge et al., 2021)	Global trade improves the food and nutrition security of countries in Africa, Asia, and Latin America	Reduction of tariff and non-tariff barriers; A universal, rules-based, open, non-discriminatory, and equitable multilateral trading system under the WTO	Improved food supply and access to food (SDG 2)

Source: own composition.

Table 17. The negative outcomes of the linkages between trade and SDGs with context specific examples.

Methodology	Findings	Conditions	Negative Outcomes
Telecoupling framework to track cross-border effects of a national sustainability initiatives (Downing et al., 2021)	Reforestation programmes have positive impact in China but through trade, there are negative environmental impact on deforestation and environmental degradation in countries exporting to China	Limited standard enforcement; Weak institutions	Deforestation in developing countries (SDG 15)
Structured literature review (Ortiz et al., 2021)	Changes in demand and the resulting dislocation of production and consumption lead to biodiversity impacts (e.g., consumption of internationally traded goods drives 25% of bird species losses); introduction of invasive species	Weak institutions; Limited standard enforcement; Weak coordination along food value chain	Decreased environmental protection (SDG 15)
Life cycle assessment using environment footprint methods (Corrado et al., 2020)	Consumption in the EU results in negative environmental impacts outside EU; trade impact mostly associated with those having a high impact intensity on land use	Limited standard enforcement; Weak coordination along food value chain; Weak institutions	Increased pollution and GHG emissions (SDG 13); Decreased environmental protection (SDG 15)
Stochastic Impact by Regression on Population, Affluence and Technology model framework; panel data analysis (Ali et al., 2021)	Trade openness increases CO_2 emissions in the long run due to the scale effect; trade-facilitated economic growth results in higher CO_2 emissions	Economic growth is not accompanied by environmental regulations and clean technology improvements	Increased pollution and GHG emissions (SDG 13);
Structured literature review (Ayompe et al., 2021)	Palm oil trade has negative impacts on human wellbeing and environmental sustainability (the direct impacts on social and financial costs and the indirect impacts on ecosystem services, deforestation, and carbon sequestration & storage).	Weak institutions; Limited standard enforcement; Weak coordination along food value chain	Decreased social protection (SDG 8 & SDG 12); Deforestation in developing countries (SDG 13 & SDG 15)

Source: own composition.

6.2 Aligning national agricultural policies to achieve the SDGs

It is important to stress that the lack of alignment of domestic agricultural and trade policies to SDGs limits the opportunities of positive outcomes. In this section, the example focuses on the EU Common Agricultural Policy (CAP) due to its effects on international agri-food trade, which is at the core of TRADE4SD, however this applies to all other countries including the development trade partners.

In the past, CAP has been heavily criticised due to its distortionary effects globally on international agri-food trade, as well as on particular agricultural markets (see e.g., Alston, 1986, Borrell and Hubbard, 2000, Baffes and de Gorter, 2005). Despite the fact that recent reforms to the CAP have removed to a greater extent, some of the most trade distorting instruments (e.g., price support, coupled direct payments, export subsidies), which coupled with "Everything but Arms" provisions have resulted in improved market access for the Least Developed Countries, this policy still has implications for trade and sustainability. Below are examples of the current effects on developing countries:

- reintroduced use of coupled payments under the form of voluntary coupled support in sectors undergoing difficulties together with border measures make some developing countries' export less competitive (European Parliament, 2018);
- some erosion of preferences granted to developing countries due to the greater trade openness of the EU (European Parliament, 2018);
- support to livestock in the EU has boosted the import demand of protein rich feed which was satisfied by developing countries often at the price of deforestation and displacement of small farmers (European Parliament, 2018). Between 1990-2014 EU forests expanded by 9% whilst in trade partners around 11 million hectares were deforested to produce export crops for livestock feed use in the EU (Fuchs, Brown and Rounsevell, 2020).
- carbon leakage - increased reliance of the EU on imports allows to farm less intensively in Europe at the expense of more intensive farming in exporting countries which usually have less strict environmental laws. Europe's trading partners use more than twice as much fertilizer on soya beans on average (34 kilograms per tonne of soya bean compared with 13 kg in the EU). Pesticide use has also risen in eight of the EU's top ten trading partners to the detriment of pollinators (Fuchs et al., 2020).

Due to this, one of the main challenges concerning sustainability in the EU agri-food trade is to align the CAP with the SDGs. Matthews (2020) emphasised that there are gaps in the alignment of the CAP with SDGs, and in particular, a lack of a measurable framework to assess the degree of alignment. Based on Matthews (2020), Table 18 summarises different assessments by the European Commission and other experts ranging from rather pessimistic, indicating very limited CAP alignment to SDGs (e.g., contribution to only 2 SDGs), to a wider mapping of SDGs against CAP operational objectives.

Table 18. Studies on the alignment of EU Common Agricultural Policy to the SDGs.

Methodology	Results
Expert opinion (Pe'er et al., 2019)	Potentially CAP can contribute to nine SDGs but in reality, it contributes to only two – SDG 1 & SDG 2
Mapped the indicators from CAP Common Monitoring and Evaluation Framework against 100 SDGs target indicators selected by Eurostat as policy relevant for the EU (Scown and Nicholas, 2020)	29 CAP indicators map to SDG indicators; however, there are several relevant SDG indicators for which CAP indicators do not exist
Assessed 169 targets associated with all SDGs according to their relevance to agriculture (Schwoob et al., 2018)	Identified 47 targets covering SDGs 1-15 as relevant to the CAP. Suggested indicators that can operationalise 21 of these 47 targets
Impact assessment of reform options for the CAP post -2020; employed multi-criteria analysis and covered thirteen SDGs (European Commission, 2018)	Operational objectives of the 'new' CAP could be mapped directly to ten SDGs (1, 2, 3, 6, 7, 8, 9, 10, 13, 15) and indirectly to SDG 4, SDG 5. For SDG 12 and SDG 17, the Commission argued that they are overarching and thus linked to all objectives

Source: own composition.

7 Conclusions

Despite the importance of agri-food trade, the number of studies exploring the nexus between agri-food trade and the SDGs has so far been limited. This study provides a structured review on the relationships between international agri-food trade and sustainability. It will help to better understand how and in what ways agri-food trade is directly and indirectly related to the different SDGs and how these linkages differ by region or value chain, depending on the economic, social, and environmental contexts.

Concerning the overall international trade, the academic research has been until now mainly focused on the economic aspects of sustainability, which is at the opposite of the "planetary boundaries" concept that is emphasising the environmental aspects. In the literature review that is concentrating on agri-food trade, in particular, it is revealed that the economic aspects have attracted the most academic interest, followed by the social and environmental aspects respectively.

International trade is considered as an important means for achieving sustainability in its different dimensions: economic, social, and environmental. It is evident from the literature review that trade has different impacts on the SDGs, and there are many trade-offs between the different SDGs. Achieving a given SDG can also be a prerequisite for another SDG (interdependency) or provide co-benefits for achieving other SDGs. Due to the trade-offs or co-benefits, the achievement of different SDGs requires a holistic framework. A one-size-fits-all trade policy does not exist to achieve the global sustainability agenda.

Therefore, *targets that include different dimensions of sustainability and various aspects of trade, finance, technology, along with capacity building can be achieved under global value chains through partnerships* (SDG 17). A key measure to enhance partnerships under global value chains is through micro-level cooperation (e.g., contract farming, cooperative, industrial association) and macro-level coordination (e.g., multi-national corporations, regional trade agreements, multilateral trade agreement under the WTO).

Trade, in agri-food, fisheries, and forestry in developing countries have the potential to enhance economic, social, and environmental sustainability. For instance, through employment creation, commodity trade serves as a channel to reduce all forms of poverty given that within the developing world, poverty is endemic amongst rural people where agriculture is the backbone of production. Regional trade agreements in Sub Saharan Africa that seek to promote food security have direct linkages to SDG 1 (No poverty) and SDG 2 (Zero hunger). However, the COVID-19 pandemic has reversed the progress towards achieving the SDGs since their adoption in 2015.

One of the important lessons from previous studies is that the outcomes of interactions between trade and SDGs are context specific. The positive or negative outcomes depend on the economic development and political stability in different countries and regions, the types of global value chains, governance and institutions as well as policy induced market distortions. Liberalised and privatised agri-food sector along with good governance and institutions, liberalisation of international trade under the WTO, private and foreign direct investments,

enforced public and private standards together with economic growth that is accompanied by environmental regulations and clean technology improvements are among the conditions conducive to positive outcomes. The correct political, economic, and social circumstances are needed to reduce the likelihood of potential negative linkages between trade and sustainable development in order to promote conditions that foster more positive outcomes. The ambition of TRADE4SD is to explore and foster the positive linkages between trade and sustainable development and to provide policy recommendations for the creation of new opportunities for actors involved in the global, regional, and national agri-food value chains.

Below is the list of knowledge gaps found from the literature review:

- An important methodological problem in the literature dealing with interactions between trade and SDGS is that often the studies are based on association without proving the causality in these interactions. For example, increased economic growth may be a result of other policies and act as a cause for increased trade and not the other way around. This is a gap in the literature which may require further research.
- Impacts are rarely quantified and even if the impacts are measured, they are measured with different methods; therefore, the results cannot be compared.
- There are very few studies that have empirical evidence on trade-related impacts upon the SDGs at the agri-food product level or value chain level.
- Relatively few studies researched the linkages between trade and SDGs in the social pillar. SDGs of central interest for the agri-food sector are SDG 1 (No poverty) and SDG 2 (Zero hunger). There is also limited literature discussing the role of international trade in promoting gender equality (SDG 5). The case of agri-food trade is even more unique because there are substantial heterogeneities in how the gains can be shared – in terms of wages, consumption, and welfare as well as the quality of jobs available. Particularly for agri-food trade, these issues are murky due to the dynamics of land (and asset) ownership rights and the level of female participation in agriculture. These SDGs are important for in-depth studies.
- SDG – 13 (Climate action) - has been relatively well-researched; however, the linkages between trade and environmental sustainability have not been a primary focus in the academic literature. There is an important gap in research concerning the linkages between trade and several specific SDGs such at SDG 6 (Clean water and sanitation) and SDG 14 (Life below water). Further research should focus on how governance in trade policies, agricultural policies, and global value chains can help in achieving these specific SDGs.
- None of the studies identified explored the role of international trade in promoting stronger partnerships and cooperation between countries (SDG 17). More specifically, how agri-food trade can promote North-South or South-South partnerships.
- There are very few "modelling studies" focusing on nexus between "reducing food waste", and the "impact on trade" as well as the "impact on SDGs". For example, a proposal to further study SDG 12 by cutting food loss and waste. Reducing food waste has been widely studied with the life cycle assessment (LCA) method, but not many studies are utilising the partial equilibrium and general equilibrium models. Kummu et al. (2012) did a thorough study on food waste, but only through statistics from the FAO and other relevant studies. TRADE4SD can contribute by modelling the reduction of food loss and waste in agri-food trade and the impacts on SDGs with partial equilibrium and general equilibrium models.

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