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# Mapping social impacts of agricultural commodity trade onto the sustainable development goals

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## Abstract

While international trade in agricultural commodities can spur economic development especially where governance is strong, there are also concerns about the local impacts of commodity production and their distribution on the environment and on people. The sustainable development goals (SDGs), though seeing trade as a means to support their achievement, recognise the need to address potential negative social and environmental impacts. It is therefore important to assess the contribution of international trade to the SDGs in commodity production areas. The environmental impacts of commodity production are widely acknowledged, but much less is known about its social impacts, and how this affects poverty reduction objectives across different dimensions. Impacts on human wellbeing and equity depend on a multitude of factors, including resources, systemic conditions and outputs of production. Through a broad literature review on soy, coffee, cocoa and palm oil, we show how studies

have addressed different aspects of these factors and their impacts. The paper demonstrates how efforts by actors in global supply chains are related to a large number of SDGs and their targets. We link the social impacts and factors to the SDGs and a list of potential indicators and variables to guide operationalisation of assessments in new empirical studies.

**KEYWORDS**
commodity production, global value chains, indicators, multidimensional wellbeing, sustainable development goals

## 1 | INTRODUCTION

International trade has historically been presented as a driver of development as it 'helps to strengthen peace, […] higher living standards and more rapid economic progress in all countries of the world' (UNCTAD, 1964). Yet, while participation in global value chains (GVCs) tends to increase economic growth and reduce poverty, trade gains and losses are not distributed equally across and within countries. While the inequities resulting from globalisation are felt both in the Global North and South, shrinking margins for producers are especially pronounced in low-income countries and agricultural GVCs (WB and WTO, 2015; World Bank, 2020). OECD countries continue to protect and subsidise their agricultural sector, with over 18% of gross farm receipts in OECD countries consisting of policy support, compared with 9% in emerging and developing countries (OECD, 2019). As a result, participation of low- and middle-income countries in GVCs is minimal (Hoekman, 2017). As key agricultural GVCs have become dominated by increasingly powerful multinational corporations (Folke et al., 2019), the share of benefits remaining in producer countries is low while their share in the associated social and environmental costs is high.

The environmental impacts of agricultural expansion are now widely acknowledged (Abman & Lundberg, 2020, World Bank, 2020, Bélanger & Pilling, 2019). For internationally traded commodities such as palm oil, cocoa, soy and coffee, these include deforestation, habitat degradation, biodiversity loss and climate change, soil erosion and degradation and water pollution (Ayompe et al., 2020; Folke et al., 2019; Pendrill et al., 2022). These impacts are increasingly being addressed through no-deforestation and other sustainability commitments, regulation and farmer support and recent technological developments enable increasingly accurate measuring, tracing and monitoring of these commitments (Green et al., 2019).

In comparison, much less is known about the social impacts of agricultural development and how to improve poverty reduction in producing areas in all dimensions of poverty (Terlau et al., 2019). Some assessments find positive impacts of agricultural trade (Garrett & Rausch, 2016; Lima et al., 2011; Weinhold et al., 2013). However, these are countered by reports of human rights violations, modern slavery (Stringer & Michailova, 2018), expropriation of (traditional) lands (Daniel, 2012; Greenpeace, 2019; Ioris, 2017), displacement of people (Amanor, 2012) and social violence on agricultural frontiers (Sauer, 2018). At the same time, improvements in human development are often not sustainable (Jain & Jain, 2020).

The international Agenda 2030 and the associated sustainable development goals (SDGs) posit international trade as a force for good, 'a means of implementation for the achievement of the SDGs'. The SDGs do recognise and seek to address some of the negative consequences of trade in SDG 17 Global Partnerships (targets 17.10–12 equitable trading system, increasing exports of low-income countries, realise market access and transparent preferential rules), SDG target 2.b: Trade restrictions and distortions, SDG target 8a: Aid-for-Trade support, SDG target 10a: special and differential treatment according to WTO agreements, SDG target 14.6: Prohibit certain forms of fisheries subsidies, and SDG target 15c: Combat poaching of protected species, with recognition of the need for SDG 16 Promote peaceful and inclusive societies, good governance and policy coherence (UNCTAD, 2016). Xu et al. (2020) have shown that international trade has improved SDG achievement in high-income countries, but found the opposite for low-income countries, with lower national-level scores for most evaluated SDGs (6: Water and sanitation, 7: Modern energy, 8: Inclusive and sustainable economic growth, 9: Infrastructure and innovation, 13: Climate change). Further evidence suggests that promoting agricultural production to achieve SDG2: Food security may lead to more trade-offs than synergies with SDGs 11: Sustainable cities and settlements, 12: Sustainable consumption and production, 13: Climate change, and 15: Life on Land (Pradhan et al., 2017). This raises the question to what extent agricultural commodity trade is really a force for good that will improve the lives of people in production areas and contribute to the achievement of the SDGs.

Tracking progress towards the SDGs through trade may help to promote actions towards the overall global ambition of 'achieving sustainable development in its three dimensions – economic, social and environmental' and 'leaving no one behind' (Biermann et al., 2022). The SDG set of targets and indicators makes it possible to monitor how public and private actions for international trade governance performs and hold policymakers and businesses accountable. However, the 17 SDGs do not include a specific goal related to international trade, making it difficult to monitor to what extent trade contributes to reaching the SDG targets. Some work exists on defining environmental targets and indicators for sustainable agriculture that can be linked to the SDGs (e.g. Streimikis & Baležentis, 2020). Yet, targets

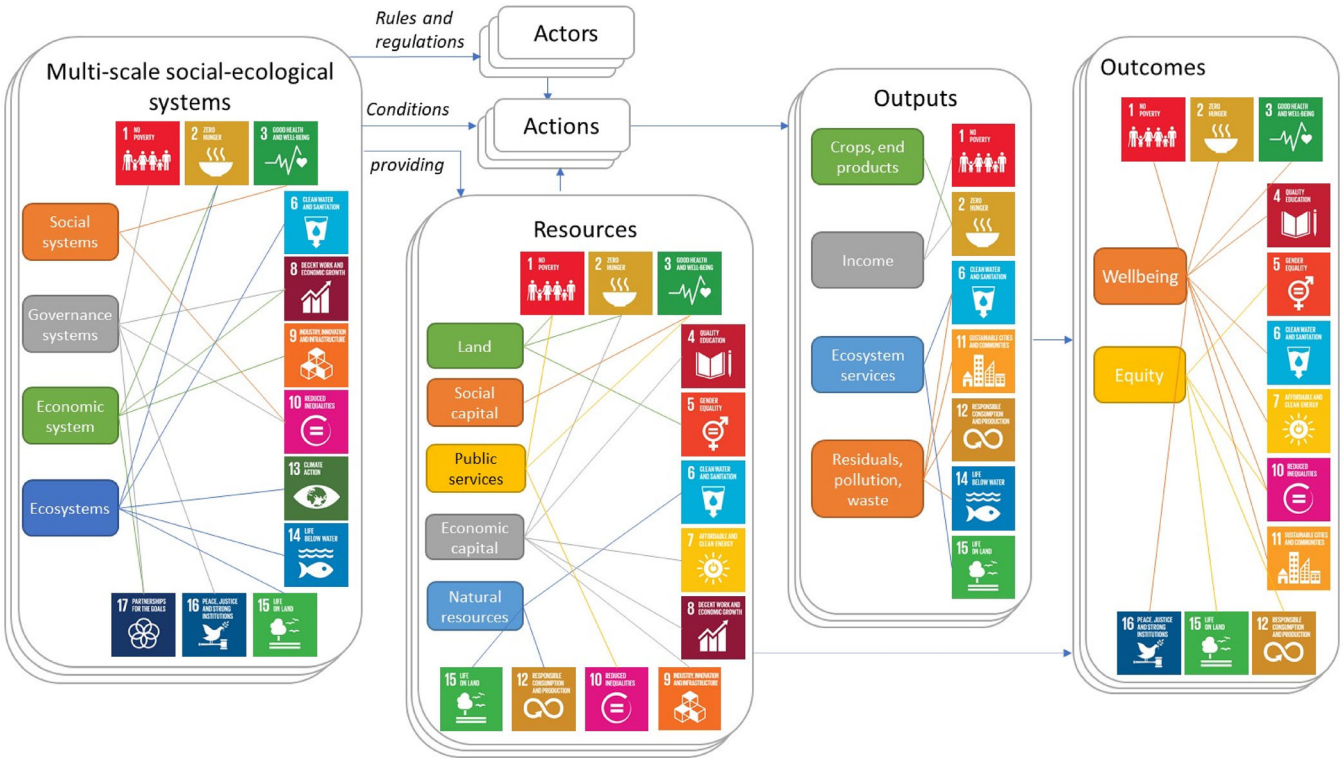


**FIGURE 1** SIAT Framework for understanding the multidimensional wellbeing and equity outcomes of commodity trade in social-ecological systems, with the results of the Sustainable Development Goal mapping exercise. *Source*: adapted from Schaafsma et al. (2022). [Colour figure can be viewed at wileyonlinelibrary.com]

and indicators are still missing to monitor how social aspects of sustainability are affected by trade in agricultural commodities and how this trade contributes to social SDGs. Some of the social impacts are considered under trade-related initiatives such as the UN Business and Human Rights and UN Global Compact, World Bank Operational Policies (OP 4.12, OP 4.10), ILO Agenda for decent work, sector-specific OECD guidelines and national-level legal initiatives such as the UK Modern Slavery Act (Arena, 2017). These foci are reflected in indicators that practitioners working in the commodity agricultural sector deem relevant to track (Rasmussen et al., 2017). However, these initiatives do not provide indicators that cover social impacts comprehensively and that can be readily linked to the SDGs.

The overarching goal of this article is to support the assessment of the social outcomes of agricultural commodity trade contributing to the achievement of the SDGs. To this end, we map the literature on impacts of agricultural commodity trade following the structure of the conceptual social impacts of agricultural trade (SIAT) framework, explained in Section 2, onto the SDG targets. We extracted a list of outcome indicators from the literature and compare these to the SDG indicators to highlight overlap and gaps. These social impacts and their indicators are primarily identified through a systematic literature review of impacts of agricultural commodity trade for four globally traded commodities (soy, cocoa, coffee, palm oil) that are associated with tropical deforestation (Garrett et al., 2021; Pendrill et al., 2022). Existing reviews on SDG impacts of agriculture have looked at economic interventions in general (van Zanten & van Tulder, 2021), certification (DeFries et al., 2017), land management (McElwee et al., 2020) or technological innovation (Herrero et al., 2021), but do not focus both on traded commodities and specific indicators for social impacts aligned with a conceptual framework as we do here. Moreover, there is a need to include interdependencies between SDGs in impact assessments (Nash et al., 2020) to start mapping out trajectories towards Agenda2030 goals in indicator studies (Hirai & Comim, 2022). This is the first systematic review that links the social impacts of traded agricultural commodities directly to the SDG indicators. We thereby aim to demonstrate how the SIAT framework can be used to conceptualise the links between trade-related actions and the SDGs, to structure research, to identify relevant indicators, and to measure and assess social impacts of agricultural commodity production for trade.

## 2 | SIAT FRAMEWORK FOR THE SOCIAL IMPACTS OF COMMODITY TRADE

Our SIAT framework was developed and documented in Schaafsma et al. (2022) (see Figure 1). This framework expands on existing conceptual frameworks for social-ecological systems, agricultural development, ecosystem services and international value chains. The links between concepts in the framework are supported by evidence on the social impacts of the production of agricultural commodities for international trade from peer-reviewed academic literature. We focus on the impacts

of cocoa, coffee, palm oil and soy production on the wellbeing of people (Ayompe et al., 2020; Dreoni et al., 2022; Watts et al., 2021).

The SIAT framework consists of four interlinked sections: *outcomes* result from the *outputs* of actions, for which actors use *resources*, and behave following rules and regulations and other conditions provided by the wider social-ecological-political *systems* at multiple levels. Trade occurs through interlinked multiscale *systems* of governance (including government, media, NGO organisations), social-cultural settings (demography, culture, history, social infrastructure), economy (markets, technologies, tax systems), policy, and climate and ecosystems (Figure 1). These systems are characterised by conditions and structures (settings). In this multiscale system, trade in commodities operates at multiple levels, from local demand to international markets back to processing countries connected to local production systems, and actions are taken in often highly spatially distant places.

In the SIAT framework, the main *outcomes* are the impacts on multidimensional wellbeing and (in)equity. Wellbeing is defined here as the ability to live a good life, with 10 dimensions from Schaafsma and Gross-Camp (2021).[1] The traded commodities are the focal *outputs*. Outputs furthermore include ecosystem services, together with pollution and waste, capturing the environmental impacts of trade. Income is also included under outputs as a means towards an end (Lyon et al., 2017).

Resources are used to generate traded goods and to engage in trade activities. Land is a key resource in the production of crops. Skills and knowledge are grouped under economic capital, together with (access to) financial capital and physical capital such as technologies and equipment. Social capital includes ability to influence decisions, and (access to) networks of actors, for example, for support or care or farmer associations or community groups, as well as trust, commitment and satisfaction as these enable good social relationships between actors. (Access to) Public services, such as infrastructure, education and health services are also included as capitals.

Actions include the various activities necessary from production to marketing, as well as those actions in the enabling environment to generate supporting knowledge, rules and regulations or provide access to resources. Rules and regulations determine access to these different capitals (Scoones, 2015), conditions for actions and therefore influence actors' behaviour, and ultimately the outputs and outcomes (Lenou Nkouedjo et al., 2020). Land tenure rules are an important area of research for understanding the social impacts of agricultural trade.

## 3 | METHODS

To map the social impacts onto the SIAT framework, we linked the wellbeing and equity outcomes in the framework to specific SDGs and their targets, providing references to empirical studies for each of these links.[2] We also identify these links with empirical studies for the other elements of the framework (outputs, resources, systems) to show how these can be related to the SDG goals and targets. The references demonstrate where empirical studies have tested the various arrows in the framework that specify conceptual (sometimes causal) relationships and allow evaluation of their link to specific SDGs. Most of the references in these tables were primarily taken from systematic literature reviews focused on impacts on wellbeing (outcomes) of soy (Dreoni et al., 2022), coffee (Watts et al., 2021), cocoa (Dreoni et al., 2021) and palm oil (Ayompe et al. 2021) production. In addition, we included literature from the evidence base of other commodities to fill in gaps related to the links between the resource and systems/settings concepts of the SIAT framework to relevant SDGs and their targets, as well as to demonstrate the wider applicability of the framework. The references in the tables in this section are not an exhaustive set but demonstrate how SDGs and their targets links to wellbeing outcomes and how these outcomes have been examined in the literature for our focal commodities. The results of this mapping exercise for the equity and wellbeing outcomes are presented in Section 4.1; Tables A1–A3 present the results for the outputs, resources and systems.

Next, we went one level deeper from SDG targets to SDG indicators. We extracted wellbeing and equity indicators employed by quantitative studies on soy, cocoa and coffee, which we classified according to the multidimensional wellbeing concepts described in Schaafsma and Gross-Camp (2021). We then compared the list of indicators used in quantitative empirical studies in the literature to the list of UN SDG indicators (updated September 2021)[3] to see if the evidence from these studies can directly feed into the SDG monitoring and reporting processes. The list of SDG indicators was developed by the UN member states and statistical offices to assess progress towards the SDGs at national level and allow for cross-country comparison. It includes 231 unique SDG indicators that were selected after a long process, according to the SDG framework. Their articulation involved choices regarding scales and units. Section 4.2 presents the results of this comparison, which aims to provide guidance on how studies can operationalise the assessment of social impacts of trade.

## 4 | RESULTS

### 4.1 | Linking trade to the SDGs

In Table 1, we link wellbeing and equity (outcomes) of the framework to the relevant SDGs and their targets. We found literature supporting the link between trade and equity as well as the different wellbeing dimensions—except for cultural values for which no SDG targets are specified. Fourteen of the seventeen SDGs are included in Table 1 and the SDGs cover almost all outcomes, which was expected as many of the SDGs are formulated in terms of ultimate societal goals. Our literature reviews showed that trade has both positive and negative effects on these SDGs; trade does not have a consistently positive or negative social impact. The direction of the impacts depends in most cases on the underlying efforts that interventions put towards the outputs, resources and structures/systems.

We undertook a similar exercise linking the SDG goals and targets to the outputs of the framework, which include agricultural crops, other end products, ecosystem (dis)services, and waste and pollution (see Table A1). The outputs also include income, as in our multidimensional wellbeing conceptualisation, income is seen as a means to an

**TABLE 1** Linking framework social wellbeing and equity outcomes to SDGs and SDG targets

| Outcomes & associated SDG(s) | SDG targets relevant to trade | References from commodity literature[a] |
|---|---|---|
| Wellbeing | | |
| SDG1 End Poverty in all forms | Target 1.2 Reduce poverty in all its dimensions | Brako et al. (2020), Dib et al. (2018), Muhammad et al. (2019), Puspitasari et al. (2019), Waarts et al. (2019) |
| | Target 1.4 Equal rights to economic resources, for example land | Hurtado et al. (2017), Ibnu et al. (2018), Tittor (2017) |
| Food/nutrition | | |
| SDG2 End hunger and achieve food security | Target 2.1 Ensure access to food/reduce undernourishment | Acosta and Dolores Curt (2019), de Jager et al. (2017), Dompreh et al. (2021), Hashmiu et al. (2022), Lima et al. (2011) |
| | Target 2.2 End all forms of malnutrition | Euler et al. (2017), Mekasha et al. (2022), Le et al. (2020), White (2012) |
| Health (physical) | | |
| SDG3 Ensure health and wellbeing | Target 3.1 Reduce maternal mortality | Bennett et al. (2018), Feintrenie et al. (2010) |
| | Target 3.2 End avoidable newborn and child deaths | Almberg et al. (2014), Santika, Wilson, Budiharta, et al. (2019) |
| | Target 3.4 Reduce non-communicable diseases, promote mental health and wellbeing | Adhvaryu et al. (2019), Chrisendo et al. (2022), Dallas (2020), Merriott (2016) |
| | Target 3.8 Achieve universal health care coverage | Eakin et al. (2006), Ruben and Fort (2012) |
| | Target 3.9 Reduce health problems linked to pollution | Almberg et al. (2014), Bernieri et al. (2019), Cardozo et al. (2016), Hutter et al. (2018), Mull and Kirkhorn (2005), Ruder et al. (2009), Sosan et al. (2008) |
| Education | | |
| SDG4 Ensure education for all | Target 4.1 Ensure primary and secondary education complete | Acosta and Dolores Curt (2019), Arnould et al. (2009), Austin (2017), Kamaruddin et al. (2018) |
| | Target 4.3 Ensure access to vocational and tertiary education | Ibnu et al. (2018), Jena and Grote (2017) |
| | Target 4.6 Ensure achievement of literacy and numeracy | Doherty (2018), Hirons et al. (2018) |
| Living standards | | |
| SDG1 End Poverty in all forms | Target 1.4 Equal rights to basic services | Ibnu et al. (2018), Marston (2016), McCarthy (2010) |
| SDG6 Ensure water and sanitation for all | Target 6.1 Ensure safe and affordable drinking water | Dib et al. (2018), Manggala et al. (2018), Miglietta et al. (2021), Liu (2012) |
| | Target 6.2 Ensure sanitation and hygiene | Hirons et al. (2018) |
| SDG7 Ensure modern energy for all | Target 7.1 Ensure universal access to energy services | Martinelli et al. (2017), Nelson et al. (2016), Phang and Lau (2017), Santika, Wilson, Meijaard, et al. (2019) |
| SDG11 Make cities and settlements sustainable | Target 11.1 Ensure access to housing and basic services | Ibnu et al. (2018), Manggala et al. (2018), Ruben and Fort (2012), Luskin et al. (2014) |
| Social relations | | |
| SDG10 Reduce inequality in and among countries | Target 10.3 Ensure equal opportunities and reduce inequalities | McCarthy and Moon (2018), Muhammad et al. (2019), Ragsdale et al. (2018) |
| Safety from other people | | |
| SDG8 Promote sustainable economic growth | Target 8.7 End modern slavery, trafficking and child labour | Ingram, van Rijn, Waarts, Dekkers, et al. (2018) |
| | Target 8.8 Protect labour rights and promote safe working environments | Foundjem-Tita, Degrande, et al. (2016) |
| SDG16 Promote peaceful and inclusive societies | Target 16.1 Reduce all forms of violence | Fair Labor Association (2012), Le Billon and Shykora (2020), Maher (2015), Smith et al. (2018) |
| | Target 16.2 End children's abuse, exploiting, violence | Mull and Kirkhorn (2005), Nkamleu and Kielland (2006) |

(Continues)

**TABLE 1** (Continued)

| Outcomes & associated SDG(s) | SDG targets relevant to trade | References from commodity literature[a] |
|---|---|---|
| | Target 16.3 Promote rule of law and equal access to justice | Busscher et al. (2020), Steward (2007) |
| | Target 16.10 Public access to information | Campbell et al. (2018), Godar and Gardner (2019), Lakkakula et al. (2020) |
| Environmental safety | | |
| SDG1 End poverty in all forms | Target 1.5 Build resilience to shocks and disasters | Andriesse (2018), Bacon et al. (2008), Blessley and Mudambi (2022), Hirons et al. (2018) |
| SDG13 Combat climate change | Target 13.1 Increase resilience and adaptive capacity | Kangogo et al. (2020), Linkov et al. (2020), Maguire-Rajpaul et al. (2020) |
| Cultural value | [No SDG] | Auer et al. (2017), Cardozo et al. (2016), Krapovickas et al. (2016) |
| Freedom of choice and action | | |
| SDG1 End poverty in all forms | Target 1.4 Equal rights to economic resources, for example land | Hurtado et al. (2017), Ibnu et al. (2018), Tittor (2017) |
| SDG16 Promote peaceful and inclusive societies | Target 16.10 Protect fundamental freedoms | Amfo et al. (2020) |
| Equity | | |
| SDG5 Achieve gender equality and empowerment | Target 5.1 End discrimination against women and girls | Kasente (2012), McCarthy (2015), Ragsdale et al. (2018) |
| | Target 5.2 Eliminate violence against all women and girls | Austin (2017), McCarthy et al. (2021) |
| | Target 5.5 Ensure women's participation and equal opportunities | Danso-Abbeam et al. (2020), LeBaron and Gore (2020), Lyon et al. (2010), Lyon et al. (2019) |
| | Target 5.a Share of women among owners or rights-bearers of agricultural land | Danso-Abbeam et al. (2020) |
| SDG10 Reduce inequality in and among countries | Target 10.1 Achieve income growth of lowest 40% | Hartmann et al. (2020), Hasudungan and Raeskyesa (2021), Mingorría et al. (2014), Lee et al. (2014) |
| | Target 10.2 Empower and promote inclusion of all | Ansah et al. (2020), Bacon et al. (2008), Choi and Kim (2016), Weinhold et al. (2013) |
| | Target 10.3 Ensure equal opportunities | Danso-Abbeam et al. (2020) |
| | Target 10.4 Adopt fiscal and social policies that promotes equality | Almberg et al. (2014), Weinhold et al. (2013) |
| SDG12 Responsible consumption and production | Target 12.4 Promote sustainable public procurement practices | Agyei et al. (2021), Ingram, Van Rijn, Waarts, and Gilhuis (2018), Neto (2020), O'Brien and Martin-Ortega (2020), Uehara (2020), |
| SDG15 Life on land | Target 15.6: promote fair and equitable sharing of resource benefit. | Camargo and Nhantumbo (2016), Grabs et al. (2021), Khatun et al. (2020), Meijaard and Sheil (2019), Wynberg (2017) |

[a]References can provide evidence for positive, negative or non-significant contributions of commodity production and trade to SDG target.

end. Traded commodities may be turned into income which can then be used to generate wellbeing, while farmers also produce non-traded commodities for domestic food and non-food needs. Studies assessing impacts on non-income dimensions of wellbeing are included in Table 1—outcomes, while income-related studies are included in Table A1—outputs (under Income).

The references for agricultural crops in the output Table A1 (SDG2, target 2.3) primarily include studies that assess total production and yield of traded crops. Compared with the outcomes, the outputs are related to fewer SDGs. The reviewed literature demonstrates that commodity trade activities are linked to outputs, with both positive (higher yields and incomes) and negative (more waste and lower ecosystem services production) effects, which in turn can be linked to positive and negative wellbeing outcomes, respectively.

Next, we linked the different types of resources that actors can employ to generate traded commodities or engage in other trading activities, to SDG targets (see Table A2). SDGs here relate primarily to targets for improving and sustainably managing these resources. Noticeable here is that the literature we reviewed allowed us to link commodity trade to many SDGs (12 out of 17), with more emphasis on technology (SDG8) and infrastructure (SDG9) as resources or inputs, compared with Table 1 focused on outcomes. Some of the targets, for example SDG 9.1, make explicit reference to wellbeing, whereas others do not; their impact on wellbeing can be traced by using the framework in Figure 1.

**TABLE 2** Wellbeing and equity outcome dimensions and associated SDGs with indicators used in the empirical literature on social impacts of commodity production and in the SDG framework

| Indicators in the empirical literature | Indicators in the SDG framework |
|---|---|
| Multi-dimensional poverty—SDG 1 (End poverty in all forms) | |
| Municipal development index (Human Development Index) | SDG 1.2.2: Proportion of men, women and children of all ages living in multidimensional poverty |
| Gender asset gap | SDG 1.4.2: Proportion of total adult population with secure tenure rights to land |
| Food/nutrition—SDG 2 (End hunger and achieve food security) | |
| Proportion of population whose food intake is below minimum dietary requirement<br>Perceived ability to meet basic nutrition needs | SDG 2.1.1: Prevalence of undernourishment |
| Food security index based on perceptions of food produced, periods of hunger and food access<br>Food insecurity experience index (FIE)<br>Household food insecurity access scale (HFIAS)<br>Perceived food insecurity and malnutrition<br>Frequency of food scarcity periods<br>Food consumption in last 7 days converted into calorie, nutrition and micronutrient values<br>Food expenditure<br>Adequate amount of food in the last year<br>Access to different food groups<br>Adequate variety of food in the last year<br>Satisfaction with nutrition | SDG 2.1.2: Prevalence of moderate or severe food insecurity in the population |
| Children's monthly and daily soybean consumption<br>Children's dietary diversity<br>Perceived food insecurity and malnutrition | SDG 2.2.1: Prevalence of stunting among children <5 |
| Health (physical)—SDG 3 (Ensure health and wellbeing) | |
| Subjective satisfaction with health status<br>Seeking healthcare | |
| Under-five mortality rate | SDG 3.2.1: Under-five mortality rate, by sex |
| Adverse birth indicators (proportion of low birth weight and preterm births) | SDG 3.2.2: Neonatal mortality rate |
| Presence of respiratory symptoms (e.g. cough)<br>Serum levels of thyroid function markers | SDG 3.4.1: Mortality rate attributed to cardiovascular disease, cancer, diabetes or chronic respiratory disease |
| Expenditure on health care<br>Perceived access to health care<br>Ability to afford health care | SDG 3.8.2: Proportion of population with large household expenditures on health as a share of total household expenditure or income |
| Presence of respiratory symptoms (e.g. cough)<br>Respiratory health symptoms | SDG 3.9.1: Age-standardised mortality rate attributed to household air pollution |
| Mean concentration of harmful chemicals<br>Duration of exposure to harmful chemicals | SDG 3.9.3: Mortality rate attributed to unintentional poisoning |
| Education—SDG 4 (Ensure education for all) | |
| Children's years of schooling completed<br>Ability to pay school fees<br>Perceived access to education<br>Satisfaction with education | SDG 4.1.1: Proportion of children and young people achieving a minimum proficiency level in reading and mathematics (%) |
| Household head literacy | SDG 4.1.2: School completion rate |
| Children's school attendance and duration<br>School attendance rates<br>Proportion of children enrolled in school<br>Children's likelihood to miss school in the last year | SDG 4.3.1: Participation of youth and adults in formal and non-formal education and training |
| Change in knowledge, skills and training about farming practices<br>Proportion of population educated above primary education | SDG 4.6.1: Proportion of population achieving at least a fixed level of proficiency in functional skills |
| Living standards—SDGs 1 (End poverty in all forms), 6 (Ensure water and sanitation for all), 7 (Ensure modern energy for all) and 11 (Make cities and settlements sustainable) | |

(Continues)

**TABLE 2** (Continued)

| Indicators in the empirical literature | Indicators in the SDG framework |
|---|---|
| Ability to acquire basic household goods | SDG 1.4.1: Proportion of population with access to basic services |
| Access to improved sanitation<br>Access to toilet | SDG 6.2.1: Proportion of population using safe hand-washing facilities and sanitation |
| Access to electricity | SDG 7.1.1: Proportion of population with access to electricity |
| Presence of electricity | SDG 7.1.2: Proportion of population with primary reliance on clean fuels and technology |
| House ownership<br>House construction material<br>Access to housing | SDG 11.1.1: Proportion of urban population living in slums, informal settlements or inadequate housing |
| Social relations—SDG10 (Reduce inequality in and among countries) | |
| *not quantitatively assessed* | SDG 10.3.1: Proportion of population reporting having felt discriminated against or harassed (also 16.b.1) |
| Safety from other people—SDG 5 (Achieve gender equality and empowerment), 8 (Promote sustainable economic growth), 16 (Promote peaceful and inclusive societies) | |
| Participation rate of children in hazardous tasks<br>Knowledge of child labour rights (e.g. minimum age) | SDG 8.7.1: Proportion of children engaged in child labour |
| Satisfaction with health and safety (e.g. provided with PPE) | SDG 8.8.1: Fatal and non-fatal occupational injuries |
| Environmental safety—SDG 1 (End poverty in all forms), 13 (Combat climate change) | |
| Diversification of farm income | |
| Feelings of anxiety (climate change) | SDG 1.5.1: Number of deaths, missing persons and directly affected persons attributed to disasters (also SDG 11.5.1 and SDG 13.1.1) |
| Cultural value | |
| *not quantitatively assessed* | *no SDG* |
| Freedom of choice and action—SDG 1 (End poverty in all forms), 16 (Promote peaceful and inclusive societies) | |
| Subjective satisfaction with freedom of choice | |
| Decision-making power over natural resource use<br>Land tenure security | SDG 1.4.2: Proportion of people with legally recognised documentation of their rights to land, and with secure tenure rights to land |
| Equity—SDG 4 (Ensure education for all), 5 (Achieve gender equality and empowerment), 10 (Reduce inequality in and among countries), 16 (Promote peaceful and inclusive societies) | |
| Composite indicator (gender empowerment) | |
| Satisfaction about female participation in decision-making and cocoa production<br>Participation and leadership roles (women) in collective actions (e.g. farming cooperatives) | SDG 5.5.1 Proportion of seats held by women in national parliaments and local government<br>SDG 5.5.2: Proportion of women in managerial positions |
| Gender asset gap<br>Decision-making power over income | SDG 5.a.1: Proportion of population with ownership or secure rights over agricultural land, by sex; and share of women among owners or rights-bearers of agricultural land, by type of tenure |
| Theil index<br>Gini index | SDG 10.4.2: Redistributive impact of fiscal policy, Gini index |

Finally, we linked the systems and contextual settings to the SDGs and related targets. Here, we included rules and regulations generated by these systems following McGinnis and Ostrom (2014) (see Table A3). In this exercise, the role of SDG16 (peaceful and inclusive societies) and SDG17 (global partnerships) is more prominent than in the other elements of the framework, as socio-economic stability and safety is fundamental to trade.

## 4.2 | Metrics and indicators for wellbeing outcomes

Table 2 shows the most common indicators employed by quantitative empirical studies on soy, cocoa and coffee, and their SDG counterparts. We find that the indicators of the empirical studies on soy, cocoa and coffee (first column in Table 2) do not necessarily match

with the indicators proposed in the SDG indicator list (second column in Table 2). For dimensions such as food security and education, the empirical studies use a diverse set of indicators whereas the SDG framework only includes a single indicator. This incompatibility may imply that the current literature does not provide immediate evidence for the contribution of trade to social development. Furthermore, we find that the empirical studies do not quantitatively assess the dimensions of social relations and cultural values, whereas the SDGs do not include cultural values.

## 5 | DISCUSSION

Based on a literature review of the social impacts of trade in agricultural commodities, focused on soy, palm oil, cocoa and coffee, we have mapped these impacts onto the SDG targets to identify the contribution of trade to the Agenda2030. We structured this mapping exercise using the SIAT framework (Schaafsma et al., 2022), demonstrating the conceptualisation of links between trade-related actions and SDG indicators. We identified how the impacts identified in the literature related to specific SDG targets indicators. This provides an important resource for researchers, policy-makers and those that monitor social development in relation to agricultural commodity trade.

Our mapping of SDGs onto the framework in Section 4.1, while not intended to be comprehensive, shows that not all wellbeing dimensions on which trade has an empirically assessed impact are included in the SDG framework. Most notably, we did not find an explicit SDG targets and indicators to monitor the link between trade and cultural values as mentioned in the literature (e.g. Auer et al., 2017; Bacon, 2005; Cardozo et al., 2016; Hausermann, 2014).

The list of empirical indicators from commodity studies presented in Section 4.2 demonstrates how different disciplines have assessed various wellbeing aspects. We expected to find evidence for a larger number of SDG targets. But mapping SDG targets onto empirical studies, which often use very different indicators than the SDG system, is not straightforward. This is especially true for localised, context-specific assessments of trade impacts; national level studies are easier to match with SDG indicators and targets, as similar statistics are used. Empirical studies with a specific thematic focus may use more detailed indicators, focus on various different target groups, use different units or scales, or develop new composite indicators (e.g. on food insecurity, Kuma et al., 2019). Such studies often provide a more detailed measurement of the contribution of trade to wellbeing in comparison to more general SDG targets. Small-scale studies can also include a diversity of context-specific indicators relevant to local wellbeing and equity dimensions. In SDG reporting, translation of such local impact assessments to official SDG indicators, or flexibility in indicator choice in measuring progress, may be necessary to link impacts to SDGs. Alternatively, small-scale studies could consider using SDG indicators—or modify these slightly—to inform monitoring processes at higher levels of governance, while discussing the limitations for specific areas. Such discussions could in turn inform UN statistics process to potentially revise their indicator selection and match empirical work.

Neither the SDG indicator list nor the empirical indicator list is complete or comprehensive. The list of indicators from the empirical literature draws attention to specific aspects of SDG themes that are influenced by commodity production; whether these effects would be observed if only SDG indicators were used in impact assessments remains a relevant knowledge gap in existing research. Moreover, the list of SDG indicators that are focused on outcome dimensions identified in the SIAT framework contains several indicators that have not been used in the empirical literature to assess the impact of the production of traded commodities. Whether there are measurable impacts of traded commodity production on these indicators remains another important knowledge gap in existing research. At the same time, the qualitative empirical literature suggests, for example, that the impact of trade on social relationships tends to be negative (e.g. Auer et al., 2017), but we were unable to identify empirical studies that quantified this impact. In Table A4, we included indicators where we believe there may be links to commodity production and trade which future studies could explore.

Our mapping exercise was primarily looking into the social impacts of agricultural commodity production that are associated with tropical deforestation. This meant that we did not include links between sustainable consumption patterns and social impacts on consumers, as the social impacts of such links were not covered by our literature review. Future studies may extend the literature selection to modelling exercises that cover this topic. We also did not cover other key commodities (maize, rice and rubber) and pasture that significantly affect tropical deforestation.

## 6 | CONCLUSION

Trade in commodities has a myriad of impacts on the SDGs. The contribution of this article is twofold. First, we systematically reviewed the literature on impacts of trade in agricultural commodities (primarily soy, coffee, cocoa and palm oil) on human wellbeing and equity outcomes that we organised conceptually using the SIAT framework to show the complex impact pathways towards the Agenda2030. Second, we mapped the study indicators onto the SDG target indicators and thereby demonstrated not only how efforts by actors in global supply chains are related to most if not all SDGs and their targets, but also identified gaps on assessing social impacts of trade in both the current impact assessments and the SDG indicator list.

Our overview of studies and indicators may help to monitor the contribution of agricultural commodity trade and related value chain activities to the SDGs. Ideally, this would happen at a much larger scale through a concerted effort rather than through the various scattered studies that we summarised. However, similar to monitoring tropical deforestation associated with agricultural commodity production (Pendrill et al., 2022), there are important data gaps when it comes to monitoring these social impacts. For one, there is no consistent cross-continental monitoring of social impacts of trade in

agricultural commodities, making it complicated to evaluate the real contribution of trade to development in all its dimensions. We highlight relevant SDGs, but simply monitoring these to assess trade impacts is not enough: changes have to be attributed to the relevant commodities and the interventions. Moreover, such attribution will require improvements in the spatial and temporal granularity of both the survey or census data that inform SDG monitoring, and the commodity production data.

Importantly, our framework and mapping exercise shows that all SDGs are relevant if trade wants to deliver on the SDGs through improving social impacts. Achieving positive social impacts is complex and requires paying attention to the complex interplay of systemic conditions, rules and regulations, resources, and outputs. The framework helps to structure such impact pathways. For informing national policies, our overview shows how a large range of activities towards achieving the SDGs is required in order to achieve the ultimate goal of Agenda 2030 of 'leaving no one behind' through eradicating poverty in all its dimensions. This policy agenda therefore stresses the importance of extending assessments of trade impacts beyond income towards including multidimensional wellbeing. For private sector actors, as well as NGOs and CSOs that engage with GVCs, our review shows that multiple conditions need to be in place for people in producing areas to benefit from trade in the commodities they produce. Providing such conditions should be the focus of new policy design. Our review did not find conclusive evidence on the effectiveness in achieving social impacts of specific policy instruments or measures related to the commodities. Instead, transformational change towards sustainable commodity trade is likely to require policy mixes or bundles that include redressing governance and economic systems, building and transferring knowledge, addressing social norms and values, and fostering sustainable natural resource management (see the SIAT framework in Figure 1, Barrett et al., 2020).

Given the complexity of trade systems, achieving positive outcomes for people in producing countries through trade is not guaranteed. As such, sustainable futures may well be built on trade activities in some places, but in others alternative pathways with more localised supply–demand systems for agricultural products may be more appropriate, complemented by international cooperation efforts towards other dimensions of wellbeing and social change (Delabre & Okereke, 2020; Laumann et al., 2021).

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## ENDNOTES

[1] These categories include: food & nutrition, health (physical), education, living standards, social relations, security & safety from other people, living in safety from risk inflicted by nature in a clean and healthy environment, cultural value and freedom from choice and action.

[2] We used https://unstats.un.org/sdgs/indicators/database/ for the SDG targets.

[3] We used https://unstats.un.org/sdgs/indicators/indicators-list/ for the SDG indicators.

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## APPENDIX A

**TABLE A1** Linking framework outputs to SDGs and SDG targets

| Outputs & associated SDGS | SDG targets relevant to trade | References from commodity literature |
|---|---|---|
| Agricultural crops and end products | | |
| SDG2 End hunger and achieve food security | Target 2.3 Enhance agricultural productivity | Darré et al. (2019), Foong et al. (2019), Mitchell et al. (2014), Paul et al. (2015), Purba (2019), Rhebergen et al. (2018), Syswerda and Robertson (2014) |
| Income | | |
| SDG1 End poverty in all forms | Target 1.1 Eradicate extreme poverty | Alwarritzi et al. (2016), Castiblanco et al. (2015), Choi and Kim (2016), Jena et al. (2012), Vanderhaegen et al. (2018), Weinhold et al. (2013) |
| | Target 1.2 Reduce poverty in all its dimensions | Manggala et al. (2018), Mitiku et al. (2017), Puspitasari et al. (2019) |
| SDG2 End hunger and achieve food security | Target 2.3 Enhance agricultural productivity and incomes | Arnould et al. (2009), Azhar et al. (2017), Dib et al. (2018), Santika, Wilson, Budiharta, et al. (2019) |
| Ecosystem services | | |
| SDG6 Ensure water and sanitation for all | Target 6.4 Increase water use efficiency | Galli and Sottas (2021), Galli and Vousvouras (2020), Merten et al. (2017), Ridoutt and Pfister (2010) |
| SDG15 Life on land | Target 15.1 Ensure conservation and sustainable use of terrestrial ecosystems and freshwater (eco-)systems | Baumann et al. (2017), Keil et al. (2007), Krapovickas et al. (2016), Malkamäki et al. (2016), Mann et al. (2012), Saraiva Farinha et al. (2019) |
| Waste, pollution, residuals | | |
| SDG6 Ensure water and sanitation for all | Target 6.3 Improve water quality | Acosta and Dolores Curt (2019), Darré et al. (2019), Kemper and Partzsch (2018), Lima et al. (2011), Maydana et al. (2020), Obidzinski et al. (2012), Suttayakul et al. (2016), Syswerda and Robertson (2014) |
| SDG11 Make settlements sustainable | Target 11.6 Improve air quality and waste management | Anankware et al. (2015), Heimpel et al. (2013), Manggala et al. (2018), Phang and Lau (2017), Santika, Wilson, Budiharta, et al. (2019), Santika, Wilson, Meijaard, et al. (2019), Savolainen et al. (2020), Suttayakul et al. (2016), Tittor (2017) |
| SDG12 Ensure sustainable consumption and production | Target 12.2 Ensure efficient use of resources | Attipoe et al. (2020), Hes et al. (2017), Mekonnen et al. (2015), Pérez-Neira et al. (2020) |
| | Target 12.3 Reduce food waste and food losses | de Araújo Veloso et al. (2020), Fauzianto (2014), Murthy et al. (2019), Okiyama et al. (2017), Priadi et al. (2020), Ye et al. (2013) |
| | Target 12.4 Achieve sound chemical and waste management | Halimah et al. (2010), Izah et al. (2016), Maydana et al. (2020) |
| SDG14 Life below water | Target 14.1 Reduce marine pollution | Joni et al. (2021), Mgbolu and Amah (2020) |

**TABLE A2** Linking framework resources to SDGs and SDG targets

| Resources & associated SDGs | SDGs targets relevant to trade | References from commodity literature |
|---|---|---|
| Land | | |
| SDG1 End poverty in all forms | Target 1.4 Promote equal rights to economic resources | Akrofi-Atitianti et al. (2018), Dib et al. (2018), Edwards (2019), Euler et al. (2017), Foundjem-Tita, Degrande, et al. (2016), Foundjem-Tita, Donovan, et al. (2016), Hernández-Núñez et al. (2020), Kelley (2020), Miyamoto (2020), Morel et al. (2019) |
| SDG2 End hunger and achieve food security | Target 2.4 Increase area under sustainable agriculture | Kaba et al. (2020), Sabas et al. (2020), Sandström et al. (2018), Schneider et al. (2017) |
| SDG5 Achieve gender equality and empowerment | Target 5a Give women equal rights to economic resources | Akrofi-Atitianti et al. (2018), Etuah et al. (2020), Lai (2011), Laroche et al. (2012), Muhammad et al. (2019), White (2012) |

(Continues)

**TABLE A2** (Continued)

| Resources & associated SDGs | SDGs targets relevant to trade | References from commodity literature |
|---|---|---|
| Natural resources | | |
| SDG6 Ensure water and sanitation for all | Target 6.3 Improve water quality | Acosta and Dolores Curt (2019), Bitzer et al. (2013), Darré et al. (2019), Maydana et al. (2020), Mekonnen et al. (2015), Obidzinski et al. (2012), Othman et al. (2014), Suttayakul et al. (2016) |
| SDG12 Ensure sustainable consumption and production | Target 12.2 Sustainable production and resource use | Bitzer et al. (2013), Chaudhary and Kastner (2016), Uehara (2020) |
| SDG15 Life on land | Target 15.2 Promote sustainable forest management | Bitzer et al. (2013), Hoare et al. (2020), Mosnier et al. (2017) |
| | Target 15.3 combat desertification and restore degraded land | Kissinger et al. (2014), Sileshi et al. (2020) |
| | Target 15.6 Promote fair and equitable sharing of resource benefits | Amfo and Ali (2020), Kelley (2020), Li (2018), Martinelli et al. (2017), Nasser et al. (2020), Taherzadeh and Caro (2019) |
| Social capital | | |
| SDG3 Ensure health and wellbeing | Target 3.8 Achieve universal health coverage | COSA (2013), Eakin et al. (2006), Le et al. (2020), Mauthofer et al. (2018) |
| Economic capital (incl. financial and physical capital) | | |
| SDG2 End hunger and achieve food security | Target 2.3 Enhance agricultural productivity | Basiron and Weng (2004), Brako et al. (2020), Gonzalez-Perez and Gutierrez-Viana (2012), Neilson and Shonk (2014), Parrish et al. (2005), Sirdey and Lallau (2020), Valkila and Nygren (2010), Vicol et al. (2018) |
| | Target 2.3 Enhance agricultural productivity | Nelson et al. (2016), Valkila and Nygren (2010) |
| SDG4 Ensure education for all | Target 4.3 Ensure access to vocational and tertiary education | Bray and Neilson (2018), Mojo et al. (2015), Pineda et al. (2019), Sirdey and Lallau (2020) |
| | Target 4.4 Increase number of youth and adults with technical and vocational skills | Bitzer et al. (2013), Bray and Neilson (2018), Calkins and Ngo (2010), Gockowski et al. (2006) |
| SDG7 Ensure modern energy for all | Target 7.3 Improve energy efficiency | Awafo and Owusu (2022), Pérez-Neira et al. (2020) |
| SDG8 Promote sustainable economic growth | Target 8.1 Sustain per capita economic growth | Bacon et al. (2008), Ferreira and Harrison (2012), Gebreselassie and Ludi (2007) |
| | Target 8.2 Improve productivity through diversification, technological upgrading and innovation | Gehl Sampath and Vallejo (2018), Permani (2011) |
| | Target 8.3 Promote development oriented policies (employment) | Adeogun (2015), Barzola et al. (2019), COSA (2013), Jena and Grote (2017), Ude (2020) |
| | Target 8.4 Improve resource efficiency | Maydana et al. (2020), Taherzadeh and Caro (2019) |
| | Target 8.10 Expand access to banking | Attipoe et al. (2020), Bicudo Da Silva et al. (2020), Bitzer et al. (2013), Lima et al. (2011), Pramudya et al. (2017), Steward (2007) |
| SDG9 Build resilient infrastructure and foster innovation | Target 9.1 Develop infrastructure | Acosta and Dolores Curt (2019), Bennett et al. (2018), Cramb and Sujang (2012), Dib et al. (2018), Feintrenie et al. (2010), Kari et al. (2016), Manggala et al. (2018), Santika, Wilson, Budiharta, et al. (2019), Santika, Wilson, Meijaard, et al. (2019) |
| | Target 9.3 Increase access of SMEs to financial services | Gitter and Barham (2007), Mendez et al. (2010), Piao et al. (2019), Rueda and Lambin (2013) |
| Public services | | |
| *Health care*<br>SDG3 Ensure health and wellbeing | Target 3.8 Achieve universal access to essential health services | COSA (2013), Ebong et al. (1999), Morgans et al. (2018), Mukherjee and Mitra (2009) |
| *Social benefit systems*<br>SDG1 End poverty in all forms | Target 1.3 Implement social protection systems and measures | Ingram, van Rijn, Waarts, Dekkers, et al. (2018), Isaac (2017), Tennhardt et al. (2022), Tirivayi et al. (2016) |
| SDG10 Reduce inequality in and among countries | Target 10.4 Promote fiscal, wage and social protection policies | Falconer et al. (2015), Lee et al. (2014), Nurfatriani et al. (2019) |

**TABLE A3** Linking framework systems and setting to SDGs and SDG targets

| Systems/ settings & associated SDGs | SDG targets relevant to trade | References to commodity literature |
|---|---|---|
| Governance | | |
| *Property right systems*<br>SDG1 End Poverty in all forms | Target 1.4.2 Ensure equal rights to resources, services, ownership and control over land and property, natural resources, inheritance, technology and financial services. | Bennett et al. (2018), Busscher et al. (2020), Cardozo et al. (2016), García-López and Arizpe (2010), Lima et al. (2011), Steward (2007) |
| *Political stability*<br>SDG16 Promote peaceful and inclusive societies | Target 16.2 Child trafficking and violence against children | Busquet et al. (2021), Cartier (2021), Gottwald (2018) |
| | Target 16.3 Promote peaceful and inclusive societies | Attrree and Möller-Loswick (2015) |
| | Target 16.5 Reduce corruption and bribery | Amankwah-Amoah et al. (2018), Auriol et al. (2016), Eldeeb et al. (2015) |
| | Target 16.6 Develop institutions | Hoare et al. (2020) |
| *Good governance*<br>SDG16 Promote peaceful and inclusive societies | Target 16.7 Ensure participation in decision-making | Delabre and Okereke (2020), Hoare et al. (2020) |
| | Target 16.8 Broaden and strengthen participation of developing countries. | Teoh (2010) |
| | Target 16a non-discriminatory laws and policies | Li (2018) |
| SDG17 Strengthen global partnerships | Target 17.14 Enhance policy coherence | Mercure et al. (2019), Sari et al. (2021) |
| *Rules & regulations*<br>SDG 8 Promote sustainable economic growth | Target 8.7 Eradicate forced and child labour, modern slavery | Deam (2020), LeBaron (2021), Mull and Kirkhorn (2005), Nkamleu and Kielland (2006), Rifin (2020) |
| | Target 8.8 Protect labour rights and promote safe jobs | Aidenvironment (2016), Amfo et al. (2020), Foundjem-Tita, Donovan, et al. (2016), Myzabella et al. (2019) |
| SDG16 Promote peaceful and inclusive societies | Target 16.9 Provide legal identity | Hambloch (2018), Pramudya et al. (2018) |
| | Target 16.10 Protect fundamental freedoms and provide access to information | Rissman et al. (2017), Wu and Wu (2020) |
| *International cooperation*<br>SDG 10 Reduce inequality in and among countries | Target 10.6 Ensure enhanced representation of developing countries | Teoh (2010) |
| *Relevant (trade) organisations and arrangements*<br>SDG17 Strengthen global partnerships | 17.10 Promote multilateral trading system | Anderson and Martin (2006), Giordani et al. (2016) |
| | 17.12 Market access for all LDCs | Flentø and Ponte (2017), Freund and Rocha (2011), Gray (2013) |
| Ecosystem | | |
| *Climate*<br>SDG13 Combat climate change | 13.2 Integrate climate change measures into national policies | Arene and Nwachukwu (2013), Friedman et al. (2019) |
| *Genetic diversity*<br>SDG2 End hunger and achieve food security | Target 2.5 Maintain genetic diversity and promote access and equitable benefit sharing | Hayati et al. (2004) |
| *Healthy ecosystems*<br>SDG6 Ensure water and sanitation for all | Target 6.6 Protect and restore water-related ecosystems | Chavalparit et al. (2006) |
| SDG14 Life below water | Target 14.5 Conserve at least 10% of coastal and marine areas | Gevaña et al. (2018), Tulloch et al. (2016) |
| SDG15 Life on Land | Target 15.1 Ensure conservation, restoration and sustainable use of terrestrial and inland freshwater systems | Ordway et al. (2017) |
| | Target 15.7 End poaching and trafficking of protected species | Lenzen et al. (2012) |
| | Target 15.9 Integrate ecosystem and biodiversity values in policies | Morgans et al. (2018), Mumbunan et al. (2021) |
| Social system | | |
| *Health status, health systems and population trends* | Target 3.2. End all preventable deaths under 5 years of age | Almberg et al. (2014), Santika, Wilson, Budiharta, et al. (2019) |

(Continues)

**TABLE A3** (Continued)

| Systems/ settings & associated SDGs | SDG targets relevant to trade | References to commodity literature |
|---|---|---|
| SDG3 Ensure health and wellbeing | Target 3.7 Universal access to sexual and reproductive care, family planning and education | McFall et al. (2017) |
| | Target 3.8 Achieve universal health coverage | COSA (2013), Mauthofer et al. (2018) |
| | Target 3c Increase health financing and support health workforce | CIHE (2010) |
| *Migration*<br>SDG10 Reduce inequality in and among countries | Target 10.7 Facilitate migration and mobility | Budidarsono et al. (2013) |
| *Social norms* | [No SDG] | Auer et al., 2017 |
| Economic system (market, trade) | | |
| *Economic development*<br>SDG2 End hunger and achieve food security | Target 2a Increase investment in agriculture | De Schutter (2011), Santos-Paulino (2017), Ssozi et al. (2017), Webb and Block (2012) |
| | Target 2b Eliminate agricultural export subsidies | Anderson (2016), Buffie and Atolia (2012) |
| | Target 2.4 Sustainable food production systems and resilient practices | Tan et al. (2009) |
| SDG8 Promote sustainable economic growth | Target 8.1 Sustain economic growth (7% GDP per annum in LDCs) | Okyere and Jilu (2020), Permani (2011) |
| | Target 8.3 Promote employment | Dib et al. (2018), Kowo et al. (2019) |
| SDG9 Build resilient infrastructure and foster innovation | Target 9.1 Develop infrastructure | Jayne et al. (2010), Llanto (2012) |
| SDG17 Strengthen global partnerships | Target 17.11 Increase agricultural exports of low-income countries | Béné et al. (2010), Christiaensen et al. (2011) |
| *Prices, price volatility*<br>SDG2 End hunger and achieve food security | Target 2 (2c) Price anomalies/distortions | Abdullah (2011), Distefano et al. (2018), Nsabimana and Amuakwa-Mensah (2018), Salami and Haron (2018), Tokgoz et al. (2020) |
| *Technological development*<br>SDG8 Promote sustainable economic growth | Target 8.2 Achieve higher economic productive through diversification and innovation | Bicudo Da Silva et al. (2020), Permani (2011) |
| *Employment*<br>SDG8 Promote sustainable economic growth | Target 8.5 Achieve full employment, decent work and equal pay | Foundjem-Tita, Degrande, et al. (2016), Foundjem-Tita, Donovan, et al. (2016), Ingram, Van Rijn, Waarts, and Gilhuis (2018), Obidzinski et al. (2014) |
| | Target 8.6 Reduce youth unemployment | Nkamleu and Kielland (2006), Ohimain et al. (2014) |

**TABLE A4** Set of SDG indicators which are deemed relevant but have not been quantitatively assessed in the empirical literature we reviewed

| |
|---|
| Food/nutrition—SDG 2 (End hunger and achieve food security) |
| SDG 2.2.2: Proportion of children moderately or severely wasted or overweight (%)[a] |
| SDG 2.2.3: Proportion of women aged 15–49 years with anaemia (%)[a] |
| Health (physical)—SDG 3 (Ensure health and wellbeing) |
| SDG 3.1.1: Maternal mortality ratio[a] |
| SDG 3.3.1/2/3/4: HIV/Tuberculosis/Malaria/hepatitis B incidence by sex and age |
| SDG 3.4.2: Suicide mortality rate, by sex |
| SDG 3.5.2: Alcohol per capita consumption |
| SDG 3.6.1: Death rate due to road traffic injuries |
| SDG 3.9.2: Mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene[a] |
| Education—SDG 4 (Ensure education for all) |
| SDG 4.2.1: Proportion of children aged 36–59 months who are developmentally on track in literacy-numeracy, physical development, social–emotional development, and learning |
| SDG 4.4.1: Proportion of youth and adults with information and communications technology (ICT) skills |
| Living standards—SDG 17 |
| SDG 6.1.1: Proportion of population using safe drinking water services[a] |
| SDG 17.8.1: Proportion of individuals using the internet |
| Safety from other people—SDGs 5 (Achieve gender equality and empowerment), 8 (Promote sustainable economic growth), 16 (Promote peaceful and inclusive societies) |
| SDG 5.2.1: Proportion of partnered women and girls subjected to violence by partner |
| SDG 5.2.2: Proportion of women and girls subjected to violence by persons other than partner (also 16.2.3)[a] |
| SDG 11.7.2 & 16.1.3: Proportion of population subjected to physical violence, psychological violence or sexual violence[a] |
| SDG 16.1.1: Number of victims of intentional homicide[a] |
| SDG 16.1.2: Conflict related deaths[a] |
| SDG 16.1.4: Proportion of population that feel safe walking alone around the area they live[a] |
| SDG 16.2.1: Proportion of children who experienced punishment or aggression by caregivers[a] |
| SDG 16.2.2: Number of victims of human trafficking[a] |
| SDG 16.3.1: Proportion of victims of violence who reported their victimisation to authorities[a] |
| Freedom of choice and action—SDG 16 (Promote peaceful and inclusive societies) |
| SDG 16.9.1: Proportion of children under 5 years of age whose births have been registered with a civil authority |
| Equity—SDGs 4 (Ensure education for all), 5 (Achieve gender equality and empowerment), 10 (Reduce inequality in and among countries), 16 (Promote peaceful and inclusive societies) |
| SDG 4.5.1: Parity indices for education |
| SDG 4.6.1: Proportion of population in a given age group achieving minimum literacy and numeracy skills |
| SDG 5.3.1: Proportion of women aged 20–24 years who were married or in a union before age 18 |
| SDG 5.4.1: Proportion of time spent on unpaid domestic chores/care |
| SDG 5.6.1: Proportion of women who make their own informed decisions regarding sexual relations, contraceptive use and reproductive health care |
| SDG 5.b.1: Proportion of individuals who own a mobile telephone, by sex |
| SDG 10.1.1: Growth rate of income per capital among the bottom 40%[a] |
| SDG 10.2.1: Proportion of people living below 50% of median income[a] |
| SDG 16.7.1: Proportion of population in national and local institutions, by gender, age, disabilities and population groups |

[a]Indicates that a link to the related SDG target is supported by the empirical literature that we reviewed (see Table 1), but the studies did not quantify this link.