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A REVIEW OF INITIATIVES AND THEIR EFFECTIVENESS

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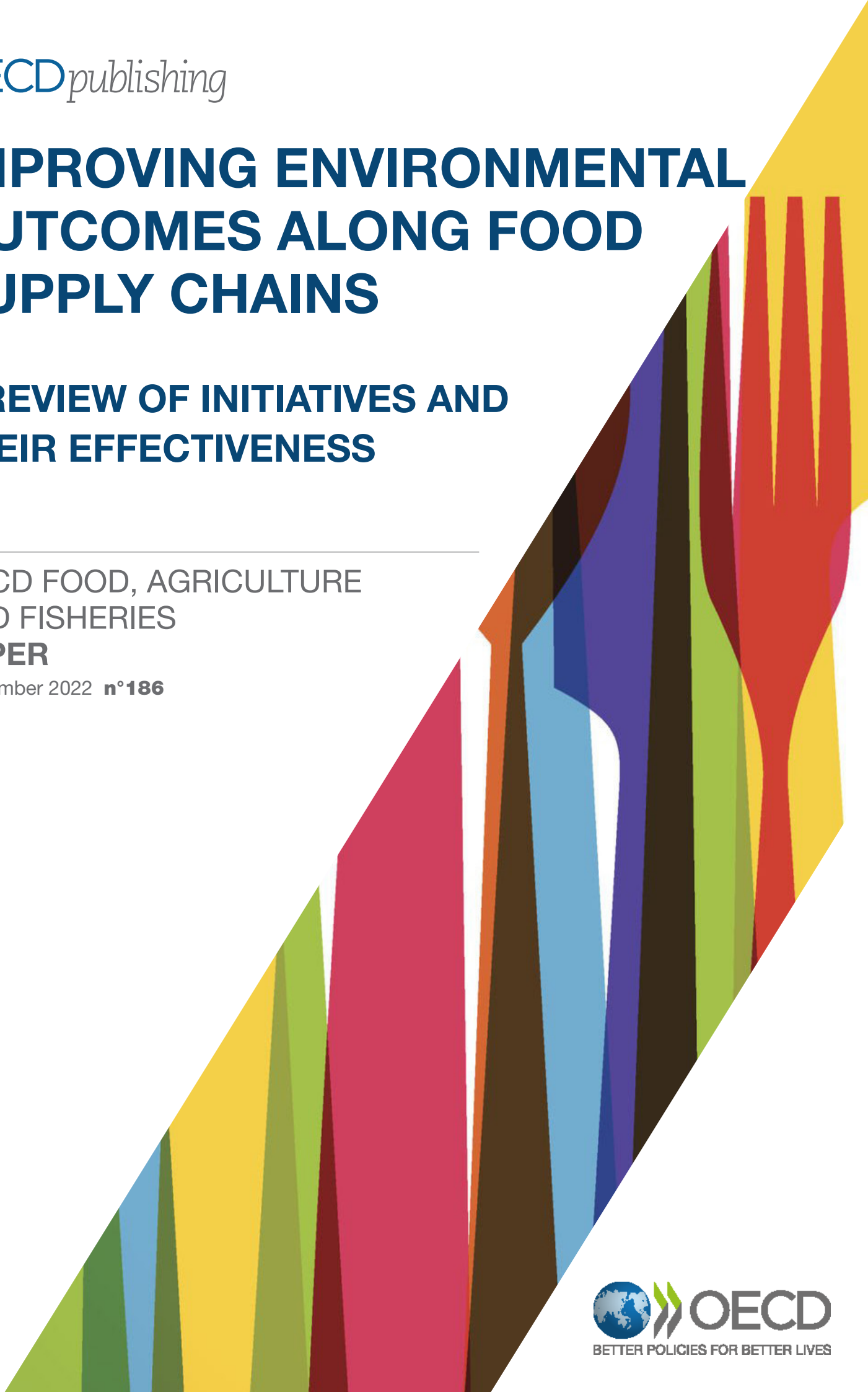

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Improving Environmental Outcomes Along Food Supply Chains: A Review of Initiatives and Their Effectiveness

Koen Deconinck and May Hobeika

This paper reviews initiatives which take a "supply chain lens" to improving environmental outcomes of food systems. Some focus on due diligence, or ask firms to disclose impacts of their supply chain. Others benchmark firms according to supply chain performance. Firms also increasingly make corporate pledges covering their supply chain. In addition to traditional voluntary sustainability standards and labels, new labels are emerging which communicate actual environmental impacts along the life cycle. Governments can also provide financial incentives linked to such impacts. This review demonstrates the strong growth and diversity of initiatives, bolstered by more clearly defined societal expectations and reporting standards, and leading to a greater availability of data and evidence and more universal reporting, reducing the scope for greenwashing. Despite their great promise, there remain coverage gaps. Evidence on effectiveness also remains relatively scarce, although there is a clear increase in the number of empirical studies.

This is one of four papers developing work on addressing evidence gaps on food systems in OECD countries (*OECD Food, Agriculture and Fisheries Papers 183 to 186*).

Key words: Sustainability, Due diligence, Disclosure, Supply chain initiatives, Life cycle assessment

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Key messages

- Recent years have seen many new initiatives taking a “supply chain lens” to reduce the environmental impacts of food systems. These include both voluntary and mandatory initiatives.
- Some initiatives focus on supply chain due diligence, or ask firms to disclose impacts of their entire supply chain. Firms are also increasingly benchmarked, and make corporate pledges, regarding their supply chain.
- Voluntary sustainability standards and labels have been around for some time, but are now joined by labels communicating actual environmental impacts, typically using a life-cycle approach.
- Governments can also provide financial incentives (through taxes or subsidies, or public procurement) linked to life-cycle impacts, again implying a supply chain lens.
- The growth in supply chain initiatives is underpinned by more clearly defined societal standards, reporting standards, and investments in life-cycle methodologies. This results in greater availability of data and evidence, as well as a growing emphasis on tracking actual impacts.
- There are still important “coverage gaps”, as many products, companies, or countries are not covered. Initiatives also tend to focus on global value chains, even though a large share of impacts is linked to domestic value chains.
- Evidence on the effectiveness of these initiatives remains relatively scarce, although there is a clear increase in the number of empirical studies using robust methodologies.

Executive Summary

Food systems account for a significant share of global environmental pressures such as greenhouse gas emissions, water pollution, and biodiversity loss. There is a growing recognition that addressing these pressures will require action not only by agricultural producers, but also by other supply chain actors, as well as consumers and policy makers. This paper reviews a variety of initiatives which take an explicit or implicit "supply chain lens" to improving environmental outcomes related to food systems. These include both voluntary and mandatory approaches. Where possible, evidence on the effectiveness of these initiatives is also provided.

This review uncovered a large and growing number of supply chain initiatives. These are moreover quite diverse. Some initiatives focus on supply chain due diligence, or ask firms to disclose impacts not only of their own operations but of their entire supply chain. Firms are increasingly benchmarked (e.g. by civil society actors) according to the performance of their supply chain, and firms also increasingly make corporate pledges covering their entire supply chain (e.g. Scope 3 greenhouse gas emissions). While many of these initiatives are new, voluntary sustainability standards and labels have a longer pedigree. A recent trend is the development of labels communicating not just adherence to standards, but actual environmental impacts. These typically use a life-cycle assessment, and hence implicitly take a supply chain lens as well. Finally, governments can also provide financial incentives: taxes or subsidies, or public procurement, can be linked to life-cycle impacts, again implying a supply chain lens.

The variety of approaches is a source of strength: given the complexity of food supply chains and their environmental impacts, it is unlikely that a single approach would be sufficient to address all issues. Rather, a mix of different approaches is needed, and this mix will also include other approaches which do not use a supply chain lens, such as agri-environmental policies.

The growth in supply chain initiatives is bolstered by the availability of clearly defined societal expectations (e.g. the OECD-FAO Guidance for Responsible Agricultural Supply Chains). This in turn facilitates benchmarking exercises, such as the World Benchmarking Alliance's Food and Agriculture Benchmark. Similarly, commonly accepted reporting standards such as the Greenhouse Gas Protocol facilitate the emergence of voluntary disclosure, while investments in the development of life-cycle methodologies were an important step in establishing the EU Product Environmental Footprint approach and related proposals for environmental impact labelling.

The result is a growing availability of data and evidence. New technologies and datasets (such as satellite data) also play an important role, as is the related trend of growing supply chain traceability. The greater availability of data and evidence can in turn be used to strengthen existing initiatives or can serve as the foundation for new approaches. One example of a new approach enabled by better data is the growing emphasis on measuring actual impacts, rather than (or in addition to) conformity with process-based standards. For example, companies are increasingly expected to report on outputs and impacts (e.g. GHG emissions), making it harder to engage in "greenwashing". Environmental impact labels similarly aim to communicate actual impacts rather than adherence to a set of practices.

Another trend is towards *universal* reporting and measurement, or at least a move beyond self-selection. For example, rating organisations would ideally like to have information on all publicly traded firms, while financial institutions similarly prefer having information on all firms in their portfolio. When retailers adopt environmental impact labelling, these generally also apply to all products. This greatly reduces the potential for companies to self-select whether and what to report or disclose.

Despite this trend towards more universal coverage, there are still important "coverage gaps", as the products, companies, or countries affected by existing initiatives are not always those where the greatest

environmental impacts of food supply chains occur. For voluntary sustainability standards, for example, standards typically apply to internationally traded tropical commodities which are easily identifiable by consumers (e.g. coffee, tea, cocoa), with much less coverage for other commodities such as soybeans. Implicitly, many initiatives also focus on consumption in high-income countries of products sourced from low- or middle-income countries. But as shown in a companion paper on environmental impacts along food supply chains (Deconinck and Toyama, 2022), a large share of environmental impacts is due to *domestic* consumption in the countries where these impacts take place. An implicit focus on *global* value chains is thus likely to be insufficient.

Tensions around facts, interests, and values are inherent in all food systems issues, and the same goes for food supply chain initiatives. The pilot projects to introduce environmental impact labelling in France provide a clear example, as these triggered debates not only on methodological issues but also on the relative weights assigned to different environmental outcomes. These discussions reflected differences over values as well as different industry interests.

Regarding effectiveness of different interventions, evidence remains relatively scarce, as is true for food systems more broadly (Deconinck et al., 2021). Yet there is a clear increase in the number of empirical studies attempting to assess effectiveness using robust methodologies. For sustainability standards in particular, there now exist several systematic reviews and meta-analyses, and the Evidensia.eco platform makes it possible to easily navigate the existing evidence base. Evidence on effectiveness is more limited for the other initiatives covered here, however. In addition, not all environmental impacts are well covered; for example, information on on-farm biodiversity and soil carbon appears to be lacking in commonly used life-cycle assessment databases. Many of the evidence gaps identified in the companion paper on environmental impacts along food supply chains (Deconinck and Toyama, 2022) thus affect the evaluation of supply chain initiatives as well.

1. Introduction

Food systems account for a significant share of global environmental pressures such as greenhouse gas (GHG) emissions, water pollution, and biodiversity loss (IPCC, 2019; IPBES, 2019; Poore and Nemecek, 2018). It is now widely recognised that addressing these environmental pressures will require action not only by agricultural producers, but also by other supply chain actors, consumers, and policy makers (Poore and Nemecek, 2018; Hodson et al., 2021).

This paper reviews a variety of initiatives which take an explicit or implicit "supply chain lens" to improving environmental outcomes related to food systems. These include both voluntary and mandatory approaches. Where possible, evidence on the effectiveness of these initiatives is also provided. A companion paper discusses what is known about environmental impacts along supply chains, as well as the strengths and weaknesses of different analytical approaches.[1]

Environmental impacts along food supply chains are affected by a wide range of actions by both private and public actors. Some of these affect food supply chains only indirectly: for example, a shift towards cleaner electricity will indirectly reduce environmental impacts of all sectors, including food supply chains. Others have a more direct impact, but involve only a specific stage of the food supply chain: for example, domestic agricultural and agri-environmental policies or individual efforts to reduce household food waste may improve the overall environmental sustainability of food systems, but neither of these necessarily require coordination with other supply chain actors.

By contrast, other initiatives involve actors across multiple stages of the food supply chain. This paper focuses on such supply chain initiatives, looking both at their extent and effectiveness; a large literature explores other policies and initiatives.[2] The goal here is not to provide an exhaustive overview, but to present the wide range of these practices, many of which have gained in importance in recent years.[3]

[1] The work in this paper forms part of broader OECD work assessing evidence gaps for food systems (Deconinck et al., 2021). This is one of four papers developing work on addressing evidence gaps on food systems in OECD countries (*OECD Food, Agriculture and Fisheries Papers 183 to 186*).

[2] On the environmental impact of agricultural policies, see Henderson and Lankoski (2019), DeBoe (2020a), Lankoski and Thiem (2020); and Laborde et al. (2021) on agricultural policies and climate change. On the role of environmental policies in agriculture, see DeBoe (2020b). Policy options for greenhouse gas mitigation in agriculture are reviewed in OECD (2019). For a review of the literature on agricultural trade and sustainability, see Baylis et al. (2021). Policy options for reducing food loss and waste are discussed in FAO (2019) and UNEP (2021).

[3] It is common to distinguish between private and public initiatives, or voluntary and mandatory ones. However, these distinctions are not necessarily the best way of classifying the initiatives covered here. Not all public initiatives are mandatory, and not all voluntary initiatives are private. For example, governments often provide financial incentives, regulatory frameworks, or organisational support for certain practices (e.g. organic labelling, or dissemination of the OECD Guidelines for Multinational Enterprises) without necessarily making these mandatory. Governments can typically choose to interact with initiatives in a variety of ways (e.g. no support at all; convening stakeholders; providing regulatory frameworks). As a result, it is more useful to focus on the initiatives themselves, although the discussion below does highlight areas where governments are supporting or mandating these.

2. Due diligence for responsible business conduct

Firms, and particularly multinational enterprises, face increasing societal expectations regarding responsible business conduct in their operations and supply chains. The OECD Guidelines for Multinational Enterprises, first published in 1976 and most recently revised in 2011, help clarify these societal expectations (OECD, 2011). They form the only multilaterally agreed and comprehensive code of responsible business conduct that governments have committed to promoting. Together with instruments developed by the United Nations and International Labour Organisation, they set the global expectations for responsible business conduct.[4]

To meet these expectations, firms are recommended to adopt a "risk-based due diligence" approach in order to identify, prevent, mitigate and account for actual and potential adverse impacts in their own operations, supply chains, and other business relationship. The OECD Due Diligence Guidance for Responsible Business Conduct (OECD, 2018b), together with related sector-specific guidance, provides an authoritative government-backed framework for due diligence and details the specific steps of the due diligence process. The Guidance defines the due diligence process in terms of six steps (Figure 1).

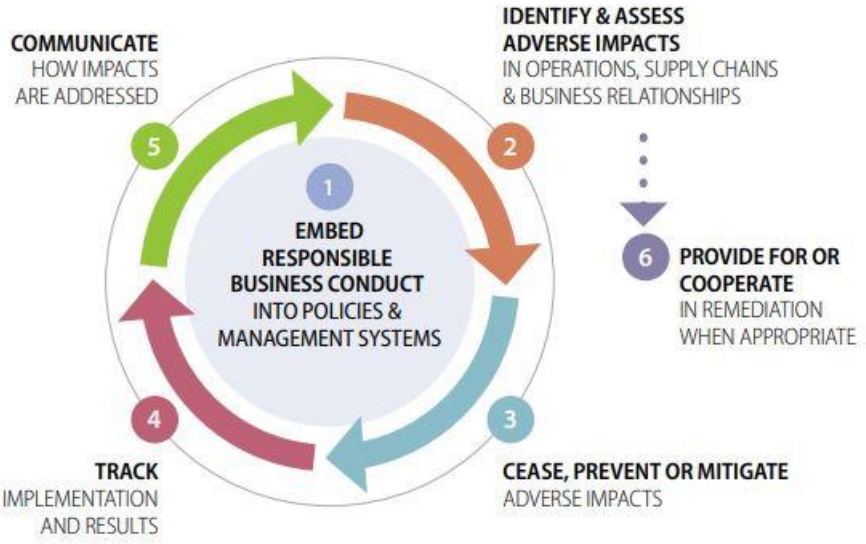
- First, firms should embed principles of responsible business conduct in their policies and management systems.
- Second, firms should identify actual or potential adverse impacts in terms of responsible business conduct associated with their operations, products or services.
- Third, firms should then cease, prevent, or mitigate these impacts.
- Fourth, firms should track implementation and results of their actions.
- Fifth, firms should communicate and publicly report on their due diligence activities, including on how they address impacts.
- Finally, where appropriate, firms should provide (or cooperate in) remediation.

Importantly, businesses are expected to carry out due diligence in relation to the entire supply chain and business relationships, not merely their own operations.

Sector-specific due diligence guidance has been developed for institutional investors; extractive industries and minerals; garment and footwear; and agriculture. For agriculture, the relevant document is the OECD-FAO Guidance for Responsible Agricultural Supply Chains (OECD/FAO, 2016). In developing the Guidance, OECD and FAO worked with supply chain experts, business, civil society, unions, and policy makers. The Guidance also incorporates the UN Committee on World Food Security's Principles for Responsible Investment in Agriculture and Food Systems (CFS, 2014). The OECD-FAO Guidance is relevant for all enterprises across the entire agricultural supply chain, from the farm to the consumer, across food and non-food commodities, and covers a wide range of topics (human rights, labour rights, food security and nutrition, health and safety, tenure rights over and access to natural resources, animal welfare, governance, environmental protection and sustainable use of natural resources, and technology and innovation).

[4] Other initiatives exist which have a more specific sectoral or geographical focus, such as the EU Code of Conduct on Responsible Food Business and Marketing Practices (https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy/sustainable-food-processing/code-conduct_en, consulted 19 July 2021).

Figure 1. The Due Diligence Process



Source: OECD (2018b).

There have been increasing calls for governments to make due diligence mandatory, and several jurisdictions are indeed moving in this direction (OECD, 2021a).[5] The trend is most pronounced in Europe, where the European Commission in February 2022 adopted a proposal for a Directive on corporate sustainability due diligence.[6] This proposal would require all large firms in the European Union, as well as mid-sized firms in selected high-risk sectors, to carry out due diligence based on the six steps outlined in the OECD Guidance (Figure 1). Firms which do not comply with these requirements would be fined and in some cases subject to civil liability. Similar rules have already been in place in France since 2017 following introduction of the so-called "duty of care" (*devoir de vigilance*) law.[7] Due diligence requirements are also under discussion or already adopted in Switzerland, Germany, Norway, Spain, Belgium, the United Kingdom, the Netherlands, Japan, Canada, and the Democratic Republic of Congo, although legislation varies in terms of its objectives, scope, and degree of alignment with international standards.[8]

2.1. Effectiveness

By its nature, it is challenging to evaluate the effectiveness of the OECD-FAO Guidance for Responsible Agricultural Supply Chains (or similar guidance in other sectors) precisely, as it is not a discrete intervention but a set of recommendations which will be implemented differently by different firms. Moreover, prior to implementing the recommendations, firms may already have been engaged in similar activities to varying degrees, so that the "additionality" will also vary from company to company.

[5] See also https://mneguidelines.oecd.org/due-diligence-policy-hub.htm for updates on regulatory and policy developments regarding due diligence.

[6] See https://ec.europa.eu/commission/presscorner/detail/en/ip_22_1145 (accessed 19 April 2022).

[7] *LOI n° 2017-399 du 27 mars 2017 relative au devoir de vigilance des sociétés mères et des entreprises donneuses d'ordres*, *Journal Officiel de la République Française* JORF n°0074 du 28 mars 2017.

[8] See OECD (2021a) for a discussion of EU, French, Swiss, German, Dutch, and UK initiatives. For a discussion of proposals in Canada, see Raymer (2022).

There are no precise numbers available on how many firms have adopted the OECD-FAO Guidance for Responsible Agricultural Supply Chains. However, the Guidance enjoys widespread support by governments: in addition to the 38 OECD countries, five non-Members (Argentina, Brazil, Croatia, Kazakhstan and Uruguay) have committed to actively promote the Guidance. Moreover, several countries have integrated or referenced the Guidance in domestic laws, regulations, rules, procedures, guidance to comply with regulations, or other government issued guidance. There is also a growing interest globally in introducing mandatory due diligence requirements as noted above.

In the absence of precise numbers on adoption of the OECD-FAO Guidance, the World Benchmarking Alliance's Food and Agriculture benchmark (discussed in more detail below) provides indirect evidence of the use of due diligence approaches. The WBA found that among the 350 major food and agriculture enterprises it surveyed, 73% disclose a sustainable development strategy. However, only 11% have defined strategies on all the dimensions of the benchmark (which broadly correspond to the different dimensions of the OECD/FAO Guidance). Moreover, even firms with strong performance on these governance aspects did not necessarily score highly in other areas, indicating there is still much room for improvement.

Other insights on the potential role of due diligence can be gleaned from work evaluating the impact of the OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas (OECD, 2016) and related due diligence regulations. A recent study (OECD, 2022) on a global sample of companies producing, trading and sourcing minerals or metals found that the OECD Minerals Guidance plays a key role in an emerging global architecture for responsible business conduct in mineral supply chains: in 2018, more than half of global companies implemented some parts of the Minerals Guidance, up from 30% in 2014. While companies excel in disclosing their minerals sourcing policies, they generally disclosed much less regarding risk identification and mitigation. A working paper by Baik et al. (2022) found that conflict minerals disclosure compelled companies to move towards more responsible sourcing out of concerns for reputational costs. An earlier study by PRG, IPIS, SFR and Ulula (2020) found that due diligence programs for conflict minerals reduced military interference in the eastern Democratic Republic of Congo. While mineral supply chains obviously differ in many ways from agricultural supply chains, these studies do suggest that due diligence approaches can reduce adverse impacts even in challenging circumstances.

3. Disclosure

Firms are facing increasing pressures to disclose the environmental impacts not only of their own operations but also of their supply chain (KPMG, 2020). These pressures can come from buyers, as well as from "peer pressure" as other firms in the same sector disclose environmental impacts (Villena and Dhanorkar, 2020). Moreover, investors are also increasingly demanding greater transparency on firms' environmental, social, and governance (ESG) performance. In response, several organisations are now providing company ratings on ESG indicators, leading to a sometimes confusing landscape.[9]

The Global Reporting Initiative distinguishes between frameworks, standards, ratings, and rankings (GRI, 2022). A *framework* is relatively flexible and can be thought of as "shaping people's thoughts on how to think about a certain topic" (GRI, 2022), but without clearly defined rules on what and how to report. A (reporting) *standard* goes further and contains specific and detailed criteria of what should be reported on different topics, and how (e.g. which metrics, which calculation method). To the extent that firms are widely disclosing relevant information using similar reporting standards, specialised organisations can then

[9] On the broader landscape of ESG indicators and ESG investing, see OECD (2020b). OECD (2021b) discusses the potential role of financial markets in facilitating climate change mitigation, while Boffo et al. (2020) discuss shortcomings in current environmental scores used in ESG ratings.

provide *ratings* based on firms' disclosures, which can feed into *rankings* or benchmarking exercises. In addition to these more formalised approaches, civil society organisations have often conducted their own assessments and benchmarking exercises based on firms' environmental commitments and disclosures.

Many jurisdictions are also moving towards more stringent mandatory disclosure. Governments are increasingly requiring corporations and financial institutions to disclose information on non-financial issues; recent examples include the EU Directive on Sustainability-Related Disclosures in the Financial Services Sector (SFDR) and accompanying Taxonomy Regulation, the EU's forthcoming Corporate Sustainability Reporting Directive (CSRD) and the US Securities and Exchange Commission's proposed rules on climate-related disclosures for investors (see below).

This is a rapidly evolving landscape with a variety of initiatives and actors. The discussion here does not aim to be exhaustive, but focuses on a few key initiatives. This section discusses voluntary disclosure through the leading (non-sector-specific) environmental disclosure platform CDP as well as the trend towards mandatory disclosure. The next section covers benchmarking exercises by civil society actors, notably the World Benchmarking Alliance's Food and Agriculture Benchmark of 350 key global agri-food companies; and the Coller FAIRR Protein Producer Index, an in-depth assessment of firms active in animal protein. A similar benchmarking initiative, the Forest500 report by Global Canopy, is discussed later in the context of corporate commitments to zero deforestation targets.

3.1. Voluntary disclosure through CDP

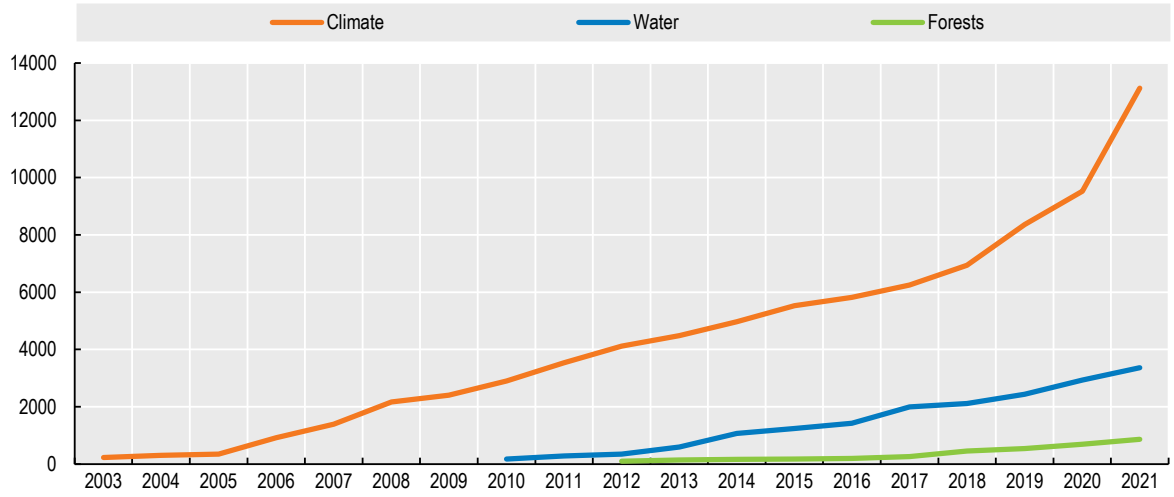
While different formats for voluntary disclosure are possible, an increasingly popular approach is for firms to use CDP, a not-for-profit platform where firms (as well as investors and governments) can disclose their environmental impacts. Originally, CDP focused on the disclosure of greenhouse gas emissions, but currently the platform also allows disclosure of impacts related to forests and water.[10]

Firms can disclose on their own initiative, but CDP also works with a growing number of investors and major purchasers to request firms to disclose their environmental impacts. CDP then awards firms a letter grade ranging from A to F reflecting the quality of the information disclosed and the level of ambition and commitment of the firm in reducing its environmental impacts. For greenhouse gas emissions, for example, a necessary condition for achieving the highest score is that the firm's emissions data are third-party verified and that ambitious reduction targets have been set. CDP is a co-founder of the Science-Based Targets Initiative (www.sciencebasedtargets.org), which helps firms formulate and commit to ambitious targets for reducing their greenhouse gas emissions, as discussed in more detail below. Firms committing to a science-based target receive a higher score in the CDP scoring system. The data reported to CDP can be accessed by companies to benchmark their own performance, as well as by banks, investors, and researchers.

The number of firms disclosing environmental impacts through CDP has grown strongly over time (Figure 2). In 2021, across all sectors, more than 13 000 firms reported climate impacts, nearly 3 400 firms reported water impacts, and more than 860 firms reported forest impacts. In parallel, investors and buyers are making increasing use of CDP data. At present, CDP reports that more than 680 investors with over USD 130 trillion in assets, and more than 200 large purchasers with over USD 5.5 trillion in procurement spending, are requesting companies to use CDP to disclose environmental data.

[10] CDP was originally known as the Carbon Disclosure Project ; the organisation now goes by the acronym to reflect its broader scope.

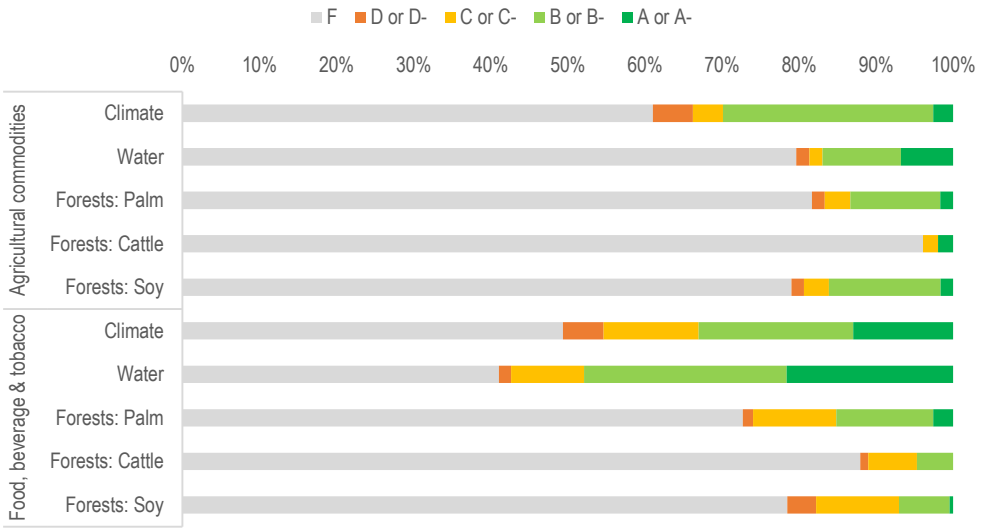
Figure 2. Number of firms disclosing climate, water, and forest impacts through CDP



Note: Number of firms (across all sectors) disclosing impacts through CDP.
Source: CDP, www.cdp.net (accessed 23 March 2022).

In 2021, 116 firms in the agricultural commodities sector and 565 firms in the food, tobacco and beverages sector disclosed environmental impacts to CDP in either the climate, water, or forests domain. Figure 3 summarises their scores. Across all domains, 40% or more of all firms received an F, indicating that insufficient data was provided to CDP to allow scoring. The remaining firms show a wide range of outcomes, from mere disclosure of impacts (a score of D or D-) to leadership (a score of A or A-). In general, firms in the food, beverage and tobacco sector appear more likely to disclose information than firms active in the more upstream agricultural commodities sectors. Reporting rates are lowest for forest impacts of agricultural commodities firms active in cattle products, and highest for water impacts of food, beverage and tobacco firms.

Figure 3. Agri-food firms' CDP scores



Note: An F indicates that companies were requested to disclose their data but failed to do so, or did so insufficiently; it does not necessarily indicate a failure in environmental stewardship. Percentages in each case refer to the relevant set of firms, which differs by domain (e.g. the number of firms reporting on water is smaller than that reporting on climate).
Source: CDP, www.cdp.net (accessed 23 March 2022).

These figures thus show there is much room for improvement in terms of agri-food firms' voluntary disclosure of impacts.

An in-depth 2020 study by CDP on agri-food firms provides additional insight using CDP disclosures as of 2019 (CDP, 2020). For this analysis, CDP classified firms according to different stages of the food supply chain (production inputs such as fertilisers; primary producers; processors and wholesalers; retailers). This sample represents 11% of all submissions on climate change, but 17% of submissions for water security and 40% of submissions on forests. Moreover, firms in the food supply chain submitting information on all three domains account for 45% of all firms in the full CDP sample doing so. CDP's analysis showed that firms in the food supply chain are not adequately disclosing in important areas, including greenhouse gas emissions in their supply chain (Scope 3 emissions – see Box 1), their activities in water-stressed areas, and traceability of the commodities with which they are involved.[11]

Box 1. Three "scopes" of corporate greenhouse gas emissions

The Greenhouse Gas Protocol, which provides the world's most widely used GHG emissions accounting standards, differentiates between three "scopes" of corporate emissions:

- *Scope 1:* Direct emissions from owned or controlled sources, e.g. emissions from a firm's own manufacturing processes
- *Scope 2:* Indirect emissions from the generation of purchased electricity, steam, heating and cooling
- *Scope 3*: All other indirect emissions that occur in a company's value chain, both upstream and downstream. These include, for example, emissions embodied in purchased goods and services; emissions related to business travel or employee commuting; but also emissions related to transport and distribution upstream and downstream from the firm, as well as emissions related to the use of products sold by the firm and emissions related to waste disposal. For a company selling transportation fuels (e.g. gasoline), for example, Scope 3 would include emissions of customers' vehicles using the fuel.

Source: GHG Protocol (www.ghgprotocol.org); Carbon Trust (https://www.carbontrust.com/resources/briefing-what-are-scope-3-emissions)

3.2. Mandatory disclosure

Many jurisdictions are moving towards rules mandating disclosure of environmental impacts, especially GHG emissions. Mandatory disclosure of GHG emissions has been recommended by leading economists (Bolton et al., 2021; IGM, 2021). However, existing requirements usually do not take a supply chain perspective, focusing instead on the emissions from firms' own operations (Scope 1) and purchased energy (Scope 2).

In the European Union, the 2014 Non-Financial Reporting Directive (Directive 2014/95/EU) requires large companies to disclose information not only on environmental matters, but also on social matters and treatment of employees, respect for human rights, anti-corruption and bribery, and diversity on company

[11] Schulman et al. (2021) show that Scope 3 emissions for food and beverages firms often lack completeness and consistency.

boards.[12] This directive currently covers some 12 000 large companies in the EU. Non-binding guidelines by the European Commission suggest that firms should take a supply chain perspective where relevant.[13] A proposed new Corporate Sustainability Reporting Directive would introduce more detailed reporting requirements, as well as a requirement to report according to mandatory EU sustainability reporting standards (currently under development). The proposed Directive would also apply to a larger number of firms.[14]

Several countries have rules mandating disclosure of direct emissions; for example, in France any firm with more than 500 employees is required to disclose Scope 1 and Scope 2 emissions (Scope 3 is recommended, although not obligatory).[15] Similar legislation exists in the United Kingdom.[16]

While most existing requirements focus on Scope 1 and Scope 2 emissions, one major exception are rules proposed in March 2022 by the US Securities and Exchange Commission (SEC) around climate-related disclosures to investors.[17] The proposed rules would require firms whose securities (shares, bonds, etc.) are traded on US financial markets to disclose among other things their Scope 1 and Scope 2 emissions. Moreover, under the proposed rule firms would need to disclose their Scope 3 (upstream and downstream supply chain) emissions if these are large and/or if the firm has set an emissions reductions target or goal that includes Scope 3 emissions. If implemented, these rules would thus require many publicly traded firms in the United States to disclose GHG emissions on a supply chain basis.

Even where mandatory disclosure covers only Scope 1 and Scope 2 emissions (or other environmental impacts), these may be an important catalyst for greater disclosure and transparency along supply chains. Once firms along a supply chain have invested in internal reporting systems for their own impacts, this will lower the additional cost of (voluntary or mandatory) reporting on supply chain impacts. The growth of voluntary disclosure through, for example, CDP may also facilitate the introduction of mandatory rules, by demonstrating feasibility and by stimulating the development of reporting principles, methods, and tools.

3.3. Effectiveness

The literature on the effectiveness of voluntary or mandatory disclosure of environmental impacts is surprisingly limited. A systematic review by Velte et al. (2020) identified 73 peer-reviewed empirical studies on carbon performance and disclosure, covering mostly voluntary disclosure by firms. However, the bulk of the available studies investigate governance aspects or impacts on financial performance. Only nine studies focused on the link between disclosure and performance. Most of these asked whether firms with superior performance are more likely to voluntarily disclose (with a majority of studies concluding that this does indeed appear to be the case). Remarkably, only two studies investigated whether disclosure affects performance. Qian and Schaltegger (2017) find that among firms disclosing to CDP, an increase in

[12] See https://ec.europa.eu/info/business-economy-euro/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en (accessed 19 April 2022).

[13] See the European Commission Guidelines on non-financial reporting (2017/C 215/01) and its Supplement on reporting climate-related information (2019/C 209/01).

[14] See https://ec.europa.eu/info/publications/210421-sustainable-finance-communication_en#csrd (accessed 12 May 2022). In addition, the Directive on Sustainability-Related Disclosures in the Financial Services Sector (adopted in 2019) sets out sustainability-related disclosure requirements for financial market participants, financial advisers and financial products.

[15] See https://bilans-ges.ademe.fr/en/accueil/contenu/index/page/fr_art75/siGras/0 (accessed 19 April 2022).

[16] For an introduction to the UK requirements, see https://www.cdsb.net/what-we-do/reporting-policy/uk-mandatory-ghg-reporting-qa (accessed 19 April 2022).

[17] See https://www.sec.gov/news/press-release/2022-46 (accessed 19 April 2022).

disclosure is followed by improved emissions performance. By contrast, Hassan and Romilly (2018), using time-series methods, find no evidence that disclosure leads to improved emissions performance; rather, their findings suggest that improved performance is followed by greater disclosure.

Three recent studies quantify the impact of mandatory disclosure on greenhouse gas emissions. Bauckloh et al. (2022) study the effect of the US Greenhouse Gas Reporting Program, introduced in 2010. They find that firms affected by the new regulation reduced their carbon intensity (defined as Scope 1 emissions relative to a firm's total assets) more than other firms. However, absolute Scope 1 emissions were not affected. Two unpublished working papers (Downar et al., 2019; Jouvenot and Krueger, 2019) study the effect of mandatory disclosure rules implemented in the United Kingdom in 2013. Both studies obtain similar results, showing that mandatory disclosure led to a reduction in firms' global Scope 1 + 2 emissions by 16% (Jouvenot and Krueger, 2019) and a reduction in firms' installation-level Scope 1 emission by 18% (Downar et al., 2019).

4. Benchmarking

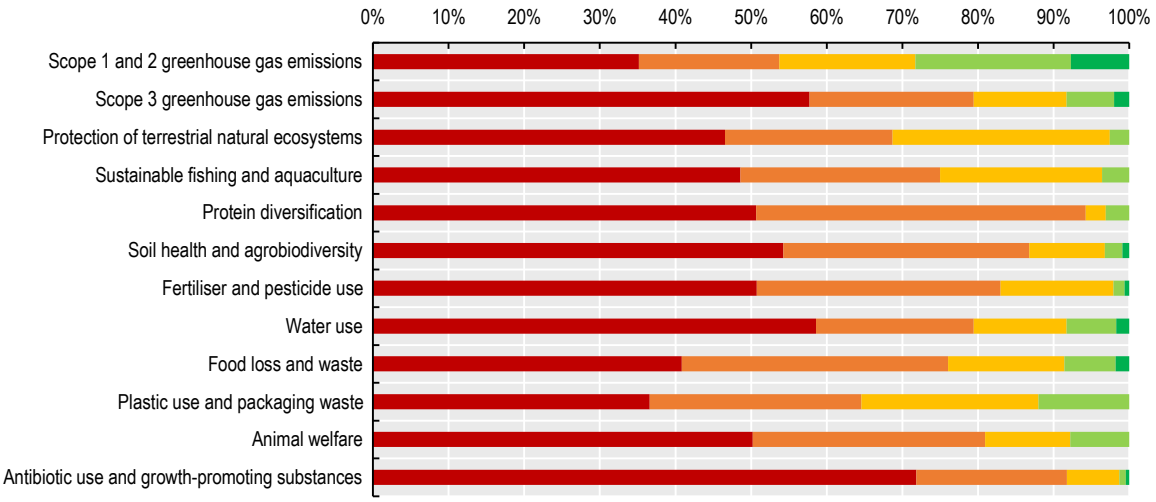
Closely related to disclosure is the practice of benchmarking, where companies are compared and ranked. Recent years have seen strong growth in such benchmarking exercises performed by civil society actors. Two examples relevant to food systems are discussed in this section; a third initiative (the Forest500 benchmark) is discussed later in the context of firms' commitments to zero deforestation.

4.1. World Benchmarking Alliance – Food and Agriculture

The World Benchmarking Alliance (www.worldbenchmarkingalliance.org) was launched in 2018 to measure companies' progress in contributing to the Sustainable Development Goals. The WBA has published benchmarks on social, gender, and human rights issues, on climate and energy, and on digital inclusion, among other topics. During the 2021 UN Food Systems Summit, WBA launched its first Food and Agriculture Benchmark covering 350 companies active in the agricultural input, agricultural products and commodities, animal protein, processing and manufacturing, and retail and food service segments. Together, these companies account for more than half of global food and agriculture sales. Companies were evaluated on four broad domains: governance and strategy, environment, nutrition, and social inclusion. For each domain, companies' public disclosures were used to score them on a more detailed list of criteria; for example, the environmental domain consists of 12 criteria.

Importantly, firms are not only evaluated on their own operations but also on performance elsewhere in their supply chains. For example, to achieve the maximum score on food loss and waste requires firms to provide evidence of collaboration with value chain partners to reduce food loss and waste, and similar criteria are used to award the maximum score for fertiliser and pesticide use, water use, plastic use and packaging waste, animal welfare, and antibiotic use and growth promoting substances. Achieving the maximum score for protection of terrestrial natural ecosystems requires firms to demonstrate 100% deforestation and conversion-free supply chains for all of its relevant high-risk commodities, while the maximum score for sustainable fishing and aquaculture requires firms to demonstrate that 100% of their portfolio comes from sustainable fisheries and aquaculture. The supply chain perspective is even more pronounced for greenhouse gas emissions, as efforts to reduce Scope 3 emissions form a separate criterion. Figure 4 below summarises firms' scores on these environmental criteria.

Figure 4. Distribution of firms' environmental scores in WBA Food and Agriculture Benchmark



Note: WBA assigns scores on a five-point scale: 0 (the lowest possible score, here shown in red), 0.5 (orange), 1 (yellow), 1.5 (light green), 2 (the highest possible score, shown here in dark green).
Source: WBA (2021).

In general, these results show that agri-food firms have considerable scope to improve the environmental performance of their own operations as well as in their supply chain. Across the twelve criteria, more than half of firms have a poor or very poor score. This share is particularly pronounced for the criterion on protein diversification (which asks whether firms active in animal protein have a strategy to develop alternative proteins) and for the criterion on antibiotic use and growth-promoting substances. For Scopes 1 and 2 greenhouse gas emissions, these figures mean that 188 firms (54% of the total) have not set any target at all, while only 26 firms (7%) have aligned their emissions reduction targets in line with 1.5°C of global warming.

Nevertheless, some firms do score relatively well, although even in these cases the data suggests strong performance in the firm's own operations but insufficient collaboration with supply chain partners to improve environmental impacts along the supply chain.

4.2. The Coller FAIRR Protein Producer Index

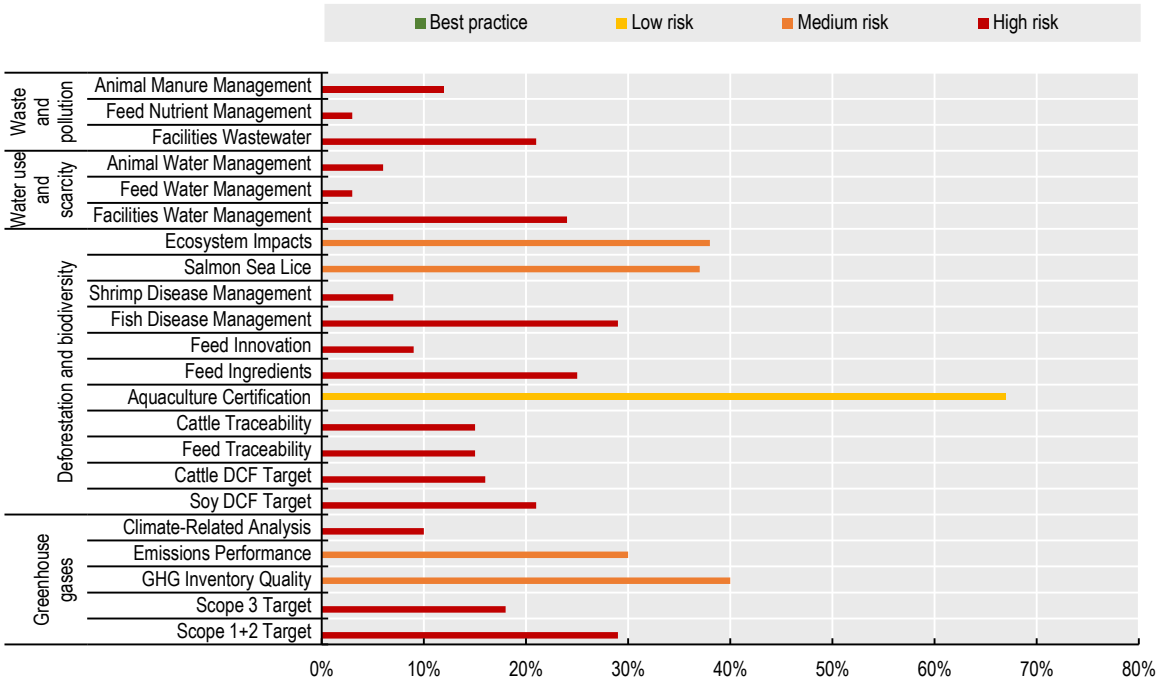
The FAIRR Initiative (www.fairr.org), established in 2016 by the Jeremy Coller Foundation, is a network of investors raising awareness of the environmental, social and governance (ESG) risks associated with animal protein production. Its 200+ members include major asset management firms such as Fidelity, Credit Suisse or HSBC Asset Management, representing an estimated USD 52 trillion of assets under management (at the time of writing). The FAIRR Initiative looks at the sustainability performance of the animal protein sector through the lens of investment risk. For example, firms involved in deforestation may face legal or regulatory risks, or may lose access to certain markets or buyers. To inform its members of these risks, the FAIRR Initiative conducts research and assesses firms' performance, including through its Protein Producer Index. FAIRR also engages on behalf of investors with companies on a range of issues from antibiotic policies, to climate disclosures and sustainable proteins.

The FAIRR Protein Producer Index evaluates 60 major global publicly traded firms active in breeding, processing, distribution and selling of meat, dairy and/or aquaculture products on nine risk factors (greenhouse gases; deforestation & biodiversity; water use & scarcity; waste & pollution; antibiotics; animal welfare; working conditions; food safety; governance) and one "opportunity factor" (investment in

alternative protein products). As with the WBA Food and Agriculture Benchmark, each of these factors is evaluated through a number of more detailed criteria, often using a supply chain view. For example, one of the criteria under the "waste and pollution" factor is whether firms require a nutrient management plan from their feed suppliers (to mitigate water quality risks). For each criterion, firms can be assessed as high risk, medium risk, low risk, or best practice; the latter typically requires that firms set strong targets with broad application, provide details of robust risk management strategies, and disclose key performance metrics showing improvement in performance over time.

Across the risk and opportunity factors, the 60 firms included in the Protein Producer Index 2021 on average have either high or medium risk. The poorest scores are found for water use and scarcity, and waste and pollution. On water use and scarcity (covering water risks in facilities, feed farming and animal farming), 94% of companies are ranked as high risk, while no company is ranked as best practice. On greenhouse gases, more than half of companies have yet to set Scope 1 and 2 targets; and only 18% of companies have set a Scope 3 target, even though these account for the vast majority of total emissions in the sector. However, there are signs of progress: 28% of companies have set science-based targets for Scope 1 and 2 emissions, compared to only 18% in the 2020 edition of the index. Figure 5 shows average scores across the 60 companies on selected criteria.

Figure 5. Average environmental scores of companies in the FAIRR Protein Producer Index



Notes: Average scores across the 60 companies in the FAIRR Protein Producer Index 2021 on selected criteria. DCF refers to deforestation and conversion-free. For detailed description of each indicator, see https://www.fairr.org/index/methodology/. On average, firms did not achieve 'best practice' performance on any of the criteria shown.
Source: FAIRR (2021a).

4.3. Effectiveness

Since both the World Benchmarking Alliance and Coller FAIRR initiatives are recent, there is not yet sufficient empirical evidence available on the effects these benchmarks have on firms. However, FAIRR reports that its investor engagements with companies have improved their performance over time. For example, in 2016 FAIRR engaged with 20 major global restaurant chains on their antibiotics policy: at the time, only one of these had a policy on antimicrobial resistance, but by 2021, all companies had a policy in place. FAIRR also reports that its engagements with animal protein firms have led to a greater commitment among these companies to reduce emissions across their animal agriculture value chain (from 29% of firms in 2019 to 68% in 2021) (FAIRR, 2021b).[18]

Moreover, the broader literature on firm performance and benchmarking suggests that these initiatives could play an important role. Empirical research shows that differences in management practices have a large influence on the economic performance of companies (Bloom and Van Reenen, 2007; Bloom et al., 2019) while better managed firms are not only more productive but also have considerably lower energy intensity (Bloom et al., 2010). One factor influencing adoption of good management practices is the availability of information (Bloom and Van Reenen, 2010). For example, an experiment providing free consulting on management practices to randomly selected textile firms in India showed that simply providing this information improved firm productivity by 17% (Bloom et al., 2013). Benchmarking is widespread in the corporate sector, suggesting that managers themselves find benchmarks useful in improving performance (Adebanjo et al., 2010). Empirical evaluations of the effect of benchmarking are relatively scarce (Ghafoor et al., 2022), but the available evidence does suggest positive effects on firm performance (Adebanjo et al., 2010). Taken together, these findings suggest that management practices matter for both economic and environmental outcomes, and that management practices in turn can be influenced by providing information on good practices, including through benchmarking. While circumstantial, this suggests that recent benchmarking initiatives could indeed help improve environmental and other sustainability outcomes.

5. Corporate pledges

While firms can in theory make unilateral corporate commitments on a range of environmental impacts, such commitments are most common regarding the topic of greenhouse gas emissions (cfr. the Science-Based Targets mentioned earlier) and deforestation.[19]

5.1. Science-Based Targets

The Science-Based Targets Initiative (SBTi, https://sciencebasedtargets.org/) is a partnership between CDP, the United Nations Global Compact, the World Resources Institute and WWF. Firms joining the SBTi commit to develop a greenhouse gas emissions reduction target in line with SBTi guidelines. Once this target is validated by SBTi, firms are expected to disclose emissions annually, for example through the CDP disclosure platform discussed earlier. The emissions reduction targets of SBTi are defined in line with

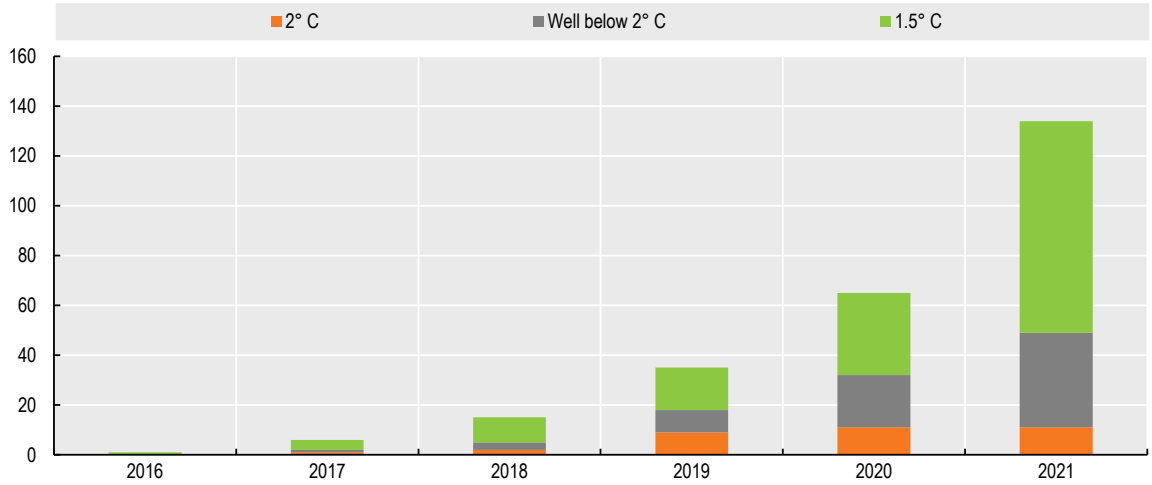
[18] Recent research by Barko et al. (2021) suggests that such activism by investors can indeed improve firms' environmental, social, and governance performance.

[19] Other voluntary commitments by firms include for example a commitment to using internal carbon or water pricing. CDP (2020) shows that among food supply chain firms reporting impacts to CDP, 20% is using internal water pricing while 11% uses internal carbon pricing in firm decision making. Another area of growing interest is regenerative agriculture, with several leading food companies (e.g. PepsiCo, Danone) setting up corporate programmes to promote, for example, better soil health among their suppliers.

the goals of the Paris Agreement, i.e. "limiting global warming to well below 2° C above pre-industrial levels and pursuing efforts to limit warming to 1.5°C" (SBTi, 2022).[20] SBTi reported that 94% of firms setting science-based targets also set targets for their value chain (Scope 3) emissions (SBTi, 2021).

Since its launch in 2015, more than 1 000 firms have set targets through SBTi, with growth accelerating over time. A similar pattern of strong growth over time is found for companies active in food supply chains (Figure 6). At the end of 2021, 134 agri-food firms had set targets, with 63% committing to a target consistent with 1.5° C of global warming.

Figure 6. Cumulative number of agri-food companies setting targets through SBTi



Source: Science-Based Targets Initiative, https://sciencebasedtargets.org/companies-taking-action#table (accessed 20 April 2022).

Building on the momentum of SBTi, the Science-Based Targets Network (https://sciencebasedtargetsnetwork.org/) is currently developing a similar approach covering a broader set of environmental impacts such as land use, water use, and pollution.

5.2. Collective aspirations to reduce deforestation

The Forest500 project, an initiative of the NGO Global Canopy, assesses the commitment to zero deforestation of 350 companies and 150 financial institutions judged to have the greatest exposure to tropical deforestation risk. Of the 350 companies, 298 are active in agri-food-related sectors, with the others focused exclusively on timber or paper and pulp production.

Among other indicators, the Forest500 survey inquires about firms' membership of voluntary initiatives (which Garrett et al. (2021) labelled 'collective aspirations') to reduce commodity-driven deforestation (Table 1). For both agri-food and other firms, about half is a member of at least one such initiative, with the UN Global Compact by far the most popular initiative.

[20] For a discussion in the scientific literature on the methodology behind science-based targets, see Bjørn et al. (2021), Chang et al. (2022) and Bjørn et al. (2022).

Table 1. Firms' membership of voluntary initiatives

Is the company a signatory to or member of voluntary initiatives seeking to end or reduce soft commodity driven deforestation?

	Number of firms		
Initiative	Ag/Food	Other	Total
UN Global Compact	109	24	133
Consumer Goods Forum Deforestation resolution	32	4	36
New York Declaration on Forests	26	1	27
Soy Moratorium	26	0	26
Cerrado Manifesto Statement of Support	25	0	25
Tropical Forest Alliance 2020 partner	21	1	22
WBCSD Forest Solutions Group	12	7	19
WWF Global Forest & Trade Network	10	8	18
Global Agribusiness Alliance	6	0	6
Palm Oil Innovation Group	6	0	6
Natural Capital Coalition	4	0	4
High Conservation Value Resource Network	1	1	2
G4 Cattle Agreement	1	0	1
Other	4	0	4
At least one of the above	142	28	170
None	156	24	180
Total firms included in the sample	298	52	350

Source: Forest500 (2022).

5.3. Company commitments to zero deforestation

Membership of collective aspirations does not of itself lead to a change in corporate practices. A first indication of whether such aspirations lead to action is whether companies also make corporate commitments to deforestation-free supply chains.[21] Data from the Forest500 project again provide useful evidence on how widespread such commitments were in 2021 (Table 2). Across both agri-food and other firms, a majority of the firms judged by Forest500 to have an important exposure to deforestation risk does not currently have any overarching deforestation commitment. Moreover, while 142 agri-food firms had signed up to at least one voluntary initiative seeking to reduce deforestation (Table 1), only 125 had any kind of corporate commitment.

Table 2. Company-wide commitments to zero deforestation

Does the company have a company-wide commitment to achieve deforestation-free and/or conversion-free production and/or procurement for all high risk commodity supply chains?

	Ag/food firms	%	Other sectors	
Conversion-free/zero-gross conversion/zero-net conversion commitment or a zero deforestation/deforestation-free commitment that explicitly includes all other natural ecosystems	13	4	1	2%
Zero deforestation/Deforestation-free commitment or, for timber, pulp & paper companies only, commitment to well implemented harvest and no deforestation of HCV & HCS areas	48	16	10	19%
Zero net deforestation or, for soy, palm oil, leather and beef companies only, no deforestation of HCV and HCS forests	9	3	2	4%
Commodity-specific commitment - commitment that does not apply to all of the commodities the company is exposed to	55	18	3	6%
No overarching deforestation commitment	173	58	36	69%
Total	**298**	100	**52**	100%

Note: "Other sectors" include "Pulp & Paper", "Timber", and "Pulp & Paper|Timber."
Source: Forest500 (2022).

[21] The terms « zero deforestation » and « deforestation-free » are typically used as synonyms.

Because of important differences between commodities, Forest500 also reports commitments for specific commodities. Table 3 shows these for the agri-food-related commodities covered by Forest500. For beef, leather, and soy, a majority of firms again reported no commitment. Firms in the palm oil sector, by contrast, are considerably more likely to have some form of commitment on zero deforestation or conversion. [22]

Table 3. Commodity-specific commitments

Does the company have a commitment to exclude production or procurement of products originating from natural forests, other natural ecosystems, and/or high conservation value areas, or a commitment to produce and/or procure sustainably produced commodities?

	Beef		Leather		Palm oil		Soy	
	No. of firms	%	No. of firms	%	No. of firms	%	No. of firms	%
Zero-gross conversion	5	6	1	1	20	10	19	10
Zero-net conversion	1	1	0	0	3	2	1	1
Zero-gross deforestation	17	20	14	18	75	38	37	20
Zero-net deforestation	1	1	0	0	3	2	0	0
Protects priority forests (including High Conservation Value)	2	2	6	8	5	3	3	2
Credible certification scheme	0	0	0	0	36	18	14	7
Sustainability commitment/other	7	8	9	12	6	3	15	8
No commitment	54	62	46	61	50	25	98	52
Total	87	100	76	100	198	100	187	100

Source: Forest500 (2022).

5.4. Effectiveness

According to data provided by SBTi, companies which have signed up to the initiative have collectively reduced their greenhouse gas emissions by 25% in the 2015-2019 period, while global emissions from energy and industrial processes increased by 3% over the same period (SBTi, 2021). These numbers cannot be directly interpreted as a causal effect, however, as firms are presumably more likely to sign up to SBTi targets if they expect to be able to reduce emissions. Giesekam et al. (2021) evaluate the performance of 81 "early adopters" of science-based targets. They found that the majority of targets were on track, but almost half of firms were falling behind on at least one target. Importantly, progress was particularly limited regarding Scope 3 emissions. The authors also found that company reporting practices were highly variable and often of poor quality. Further evidence on the role of emissions targets is provided by Dahlmann et al. (2019), who analyse data from 1 335 firms in 42 countries and 108 sectors reporting climate change targets to CDP. The authors find no general relationship between the presence of (self-defined) targets and improvements in environmental performance. However, where firms set more ambitious target, use a longer target time frame, and aim to reduce absolute emissions (rather than emissions intensity), there are indeed significant reductions in emissions. Moreover, Zhu et al. (2022) demonstrate that adopting voluntary internal carbon pricing reduces firms' emissions intensity (relative to revenues) by nearly 16%.

[22] Deforestation here refers to the loss of natural forest, while conversion refers to the change of a natural ecosystem to a different land use.

Several recent papers have studied voluntary corporate commitments and collective aspirations around deforestation.[23] Lambin et al. (2018) reviewed evidence on the effectiveness of various supply-chain initiatives (including corporate commitments and collective aspirations, but also sectoral standards) in reducing deforestation. Regarding collective aspirations, Lambin et al. (2018) note that companies signing up to these voluntary initiatives often lag considerably in translating this into more concrete commitments. As noted, the data from Forest500 suggests that a similar pattern still holds, as 142 agri-food firms have signed up to collective aspirations to reduce deforestation, but only 125 firms have any kind of company commitment. Lambin et al. (2018) note that one further step on the path from aspiration to action is the introduction of company codes of conduct, which translate commitments into specific guidelines for operations of the firm and its suppliers.[24]

Zu Ermgassen et al. (2020) use data from the Trase Earth project, discussed in detail in the companion paper (Deconinck and Toyama, 2022), to investigate the effectiveness of zero deforestation commitments for Brazilian soy. They identify four collective aspirations (the Soy Moratorium, the New York Declaration on Forests, the Amsterdam Declaration, and the Soft Commodities Forum) and six company commitments (by Cargill, Bunge, ADM, Amaggi, Louis Dreyfus, and Glencore) relevant to Brazilian soy. Of these, the Soy Moratorium applies only to the Amazon biome, but is independently audited using satellite data; the other commitments are global but lack independent auditing and monitoring. Combining data from Trase Earth on subnational supply chains, satellite data on deforestation, and information on firms' and countries' zero deforestation commitments, Zu Ermgassen et al. (2020) show that these commitments have reduced deforestation in the Amazon, but not in the Cerrado.

Garrett et al. (2019) develop criteria for effective zero-deforestation commitments. They apply these criteria to 52 zero-deforestation commitments by companies on the Forest500 list. Existing commitments fall short on several key criteria. First, these commitments currently only cover a small share of the market for deforestation-risk commodities, limiting their global impact. Second, implementation usually occurs through certification programs, which do not necessarily cover all suppliers in a region; and most commitments lack third-party near-real time monitoring of deforestation. Third, many commitments refer to zero *net* deforestation (which still allows some deforestation to take place as long as it is compensated elsewhere), and include future implementation deadlines (which means *promises* of future reforestation can be used to compensate for current forest loss). The authors conclude that the effectiveness of current schemes can be improved if firms adopt zero *gross* deforestation targets with immediate implementation deadlines and sanction-based implementation mechanisms in regions with high risk of deforestation.

[23] An older literature explored the use of "voluntary environmental programmes". Borck and Coglianese (2009) concluded that while voluntary initiatives have smaller effects than mandatory approaches, they may be effective alternatives if the goal is to achieve small environmental improvements at a relatively low cost. While research on this topic has continued, there do not appear to be any recent reviews of this literature.

[24] Companies may also introduce company-specific standards on other environmental aspects; these are discussed in the next section on sustainability standards. While important, evidence on these standards is limited. One exception is Thorlakson et al. (2018), who find positive effects of a retailer standard on farm environmental performance in South Africa.

6. Voluntary sustainability standards and labels[25]

Voluntary sustainability standards require products to meet specific economic, social, or environmental criteria, whether in terms of product attributes or in terms of production and processing methods (UNCTAD, 2020). Such standards can be established by governments, private firms, NGOs, or multi-stakeholder initiatives. Labels and other information systems can be used to communicate conformity with the requirements of these standards to customers and other interested parties (Gruère, 2013), but not all standards are accompanied by labels.[26]

Hundreds of voluntary sustainability standards and labels exist, many of which relate to agri-food products.[27] However, evidence on market shares or adoption rates by farmers is only available for a handful of major standards. The main source of information on the use of voluntary sustainability standards is the *State of Sustainable Markets* report by ITC, FiBL, and IISD, covering twelve major voluntary sustainability standards related to agriculture and food.[28] (Rainforest Alliance and UTZ merged in 2018 but are still treated as distinct standards here). As Traldi (2021) shows, all of these standards typically include not only an environmental focus, but a social and an economic focus as well, although standards differ strongly in terms of the relative importance and stringency of these dimensions, as well as in their commodity focus. Figure 7 shows key indicators for these standards.

In terms of the number of certified producers worldwide, the most popular standards are various organic standards (which differ by country), as well as the Fairtrade, Better Cotton Initiative, and Rainforest Alliance standards. In terms of certified area, organic standards clearly dominate. Expressed as a share of the global production area, certification is most significant for cocoa, cotton, coffee, and tea. By contrast, certification plays a smaller role for other commodities, notably soybeans.

Between 2008 and 2019, strong growth was seen in the certified area of cotton (which grew by a factor of 56x), sugarcane (47x), oil palm (25x), and cocoa (18x). Growth was more muted for soybeans, although even here total certified area expanded by about 37% over this period. In recent years, growth has slowed for most commodities.

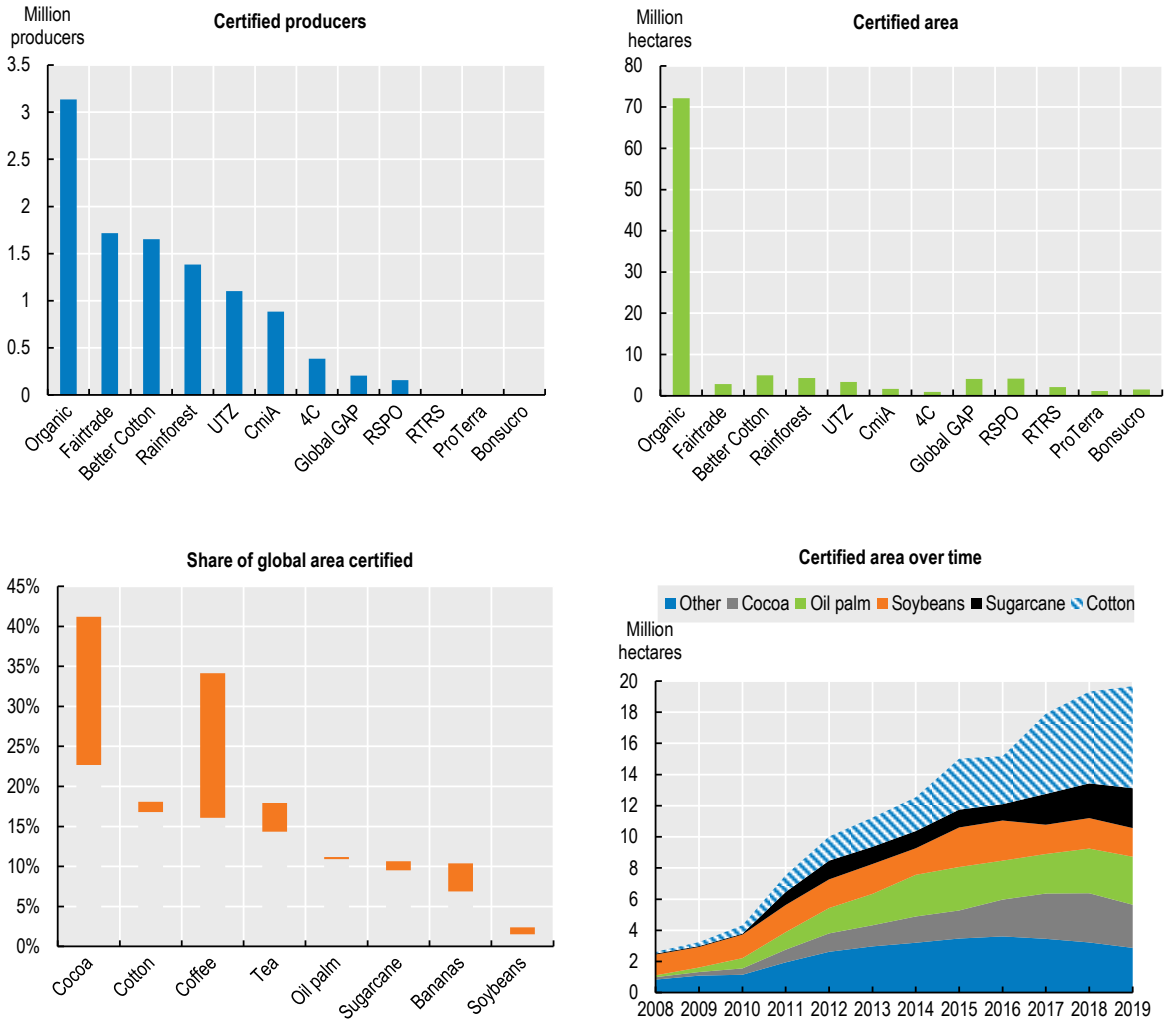
[25] The role of voluntary sustainability standards and labels is explored in more detail in ongoing OECD work on which this section is based.

[26] A confusing array of terms are often used to describe these concepts. The term “standards” as used here refers to technical specifications, criteria, and guidelines, and is distinct from “certification”, a procedure by which a third party assures that a product, process or service is in conformity with a standard. The term “standards” is typically reserved for requirements which are not a legal obligation; when requirements are mandatory, the term “technical regulations” is used (Rousset et al., 2015). The term “assurance schemes” is sometimes used to denote the overall system of requirements (such as voluntary sustainability standards), confirmity assessment, and communication of that conformity (e.g. through a label).

[27] A number of databases contain information on standards and assurance schemes. The Ecolabel Index (www.ecolabelindex.com) covers 455 labels and standards across a range of sectors. Another source of information is the ITC StandardsMap database, which contains detailed information on 318 standards across various sectors. An earlier information source is data collected by Gruère (2013), who reviewed 544 environmental labelling and information schemes covering 197 countries. Other data sources include the Global Ecolabelling Network (www.globalecolabelling.net) and the Sustainability Compass (*Kompass Nachhaltigkeit,* www.kompass-nachhaltigkeit.de), although the latter does not cover food and agriculture. These databases typically focus on requirements, ownership, the standard-setting process, and the type of verification used (e.g. third-party accredited), but rarely include data on market shares, number of certified producers, etc.

[28] In addition, the publication covers two forestry-related standards (FSC and PEFC), which are not discussed here.

Figure 7. Key indicators for major sustainability standards in agriculture and food



Note: "Organic" refers to various organic standards around the world. Better Cotton refers to the Better Cotton Initiative; Rainforest refers to the Rainforest Alliance; CmiA is Cotton Made in Africa; RSPO is Roundtable on Sustainable Palm Oil; RTRS is Round Table on Responsible Soy. As the same farm may be certified by several standards, the bottom left panel shows the range between the minimum area (assuming full overlap) and the maximum area (assuming minimal overlap). The bottom right panel shows the evolution of the minimum area.
Source: Based on Meemken et al. (2021), updated using ITC/FiBL/IISD (2021).

6.1. Effectiveness

Evidence on the effectiveness of sustainability standards (and several other supply chain approaches) can be accessed through the Evidensia platform (Box 2).

In theory, two conditions need to be fulfilled for voluntary sustainability standards to improve the environmental performance of food systems. First, sustainability standards should indeed improve environmental practices and outcomes on the supply side. Second, there must be a demand for products produced using these standards. While firms may adhere to voluntary standards in part out of a concern

with overall reputation, an important factor is whether sustainability standards indeed convince consumers.[29]

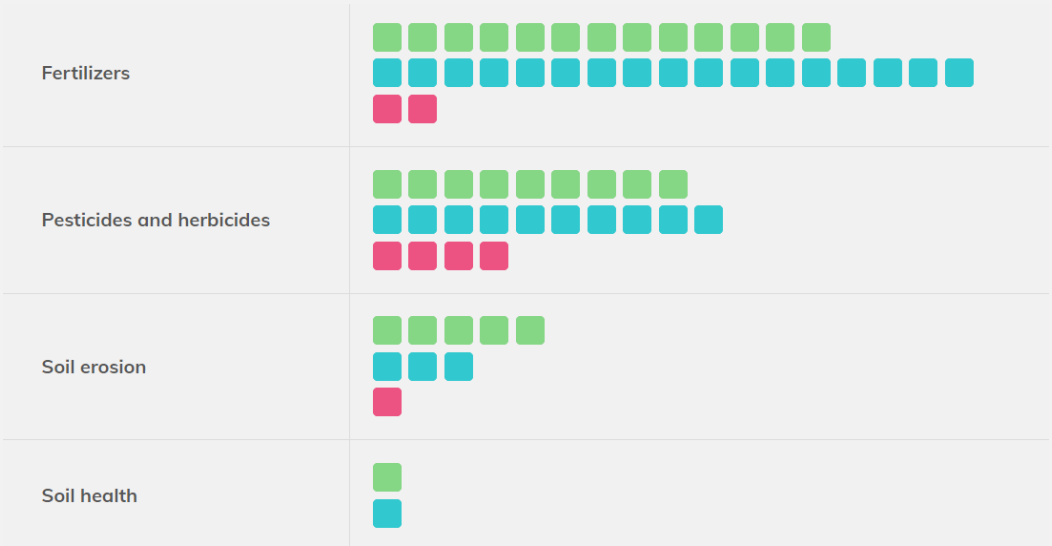
Box 2. The Evidensia platform

The Evidensia platform (www.evidensia.eco) brings together research on the sustainability impacts and effectiveness of various supply chain initiatives and tools. It was founded in 2019 as a partnership between ISEAL Alliance, Rainforest Alliance, and WWF, with support of the Global Environment Facility. The Evidensia database currently covers more than 1 000 resources, ranging from opinion pieces to peer-reviewed systematic reviews with meta-analysis, and covering a wide range of sectors and supply chain initiatives (including, but not limited to, voluntary sustainability standards).

The online interface makes it possible to see at a glance whether most studies find positive, negative, or no effects. It is also possible to create cross-tabulations to see which combinations of supply chain initiatives, outcomes, and sectors/products have been studied extensively and where there are evidence gaps: most studies to date have focused on voluntary sustainability standards and looked at economic outcomes, while other topics (including e.g. climate change) have received less attention. Among the environmental impacts, the most commonly studied topics are forests and other ecosystems, and pesticides, fertilizers and soils.

The Evidensia platform also presents visual summaries of available evidence. For example, Figure 8 shows a summary of studies on supply chain initiatives' impacts on agrochemical use, soil erosion, and soil health (across all supply chain initiatives), where each square is one study, and green denotes a positive effect, blue denotes no effect, and red denotes a negative effect.

Figure 8. Visual evidence summary of impacts of supply chain initiatives



Note: Only showing impacts on agrochemical use, soil erosion, and soil health. Each square denotes one study. Green denotes a positive effect; blue denotes no effect; red denotes a negative effect (i.e. farms using the supply chain initiative performed worse than a control group). Studies included here all relied on either experimental methods (e.g. randomised control trials) or quasi-experimental methods (e.g. matching).
Source: Evidensia.eco (accessed 8 March 2022).

[29] A more extensive discussion of the evidence will be included in forthcoming work by the OECD.

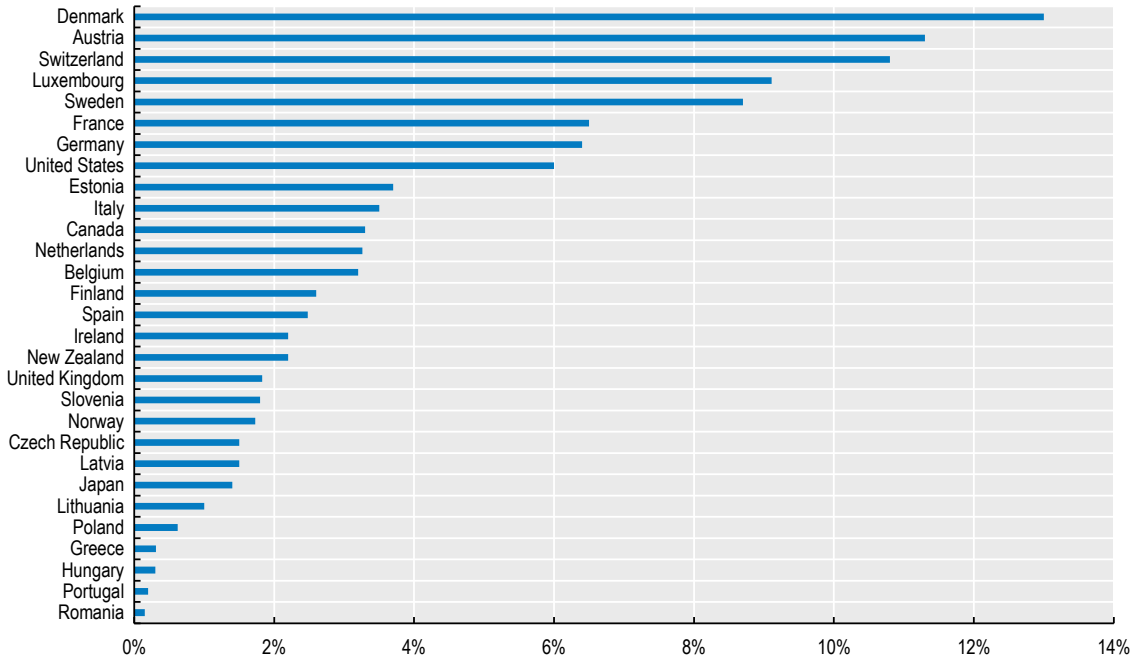
Demand-side effects

In opinion surveys across countries, consumers routinely indicate that sustainability issues are important to them (Arreza, 2020; Capterra, 2021; BEUC, 2020; EY, 2021; Fabric, 2021; Lusk and Polzin, 2022; PwC, 2019). Moreover, consumers typically also say they are willing to pay more for products that have been produced sustainably (Lusk, 2018), and experimental evidence typically finds positive effects of sustainability labels on consumers' shopping behaviour (Potter et al., 2021).

However, these stated intentions and experimental findings do not translate into major changes in consumer behaviour, and market shares of products with sustainability labels typically remain low.

One indication is the generally low market share of organic products. As shown in Figure 9, retail market shares of organic products in 2020 rarely exceeded 10%. While the relative environmental merits of organic agriculture are debated (as noted below), organic agriculture is by far the most widely used voluntary sustainability standard (cfr. Figure 7). Market shares of other sustainability standards are likely to be smaller still: for example, Lernoud and Willer (2017) report that the retail market share of FairTrade products in 2015 was considerably below that of organic agriculture in almost all countries for which data was available.[30]

Figure 9. Market share of organic products in 2020



Note: Chart shows the organic market share of retail sales (by value) for 2020.
Source: FiBL Statistics, https://statistics.fibl.org/index.html (accessed 28 April 2022).

A systematic review of 60 studies similarly concluded that sustainability labels may increase awareness and (stated) willingness to pay, but that the link with actual behaviour is much smaller or non-existent (Onwezen et al., 2021). Although there is no widely accepted explanation for this gap between (stated) intentions and actual shopping behaviour, one possible factor is "social acceptability bias" in how people

[30] It could be argued that the *sum* of the market shares of the many sustainability standards might add up to a more significant number. However, many products tend to have multiple certifications; hence, adding up for example market shares for organic and FairTrade products would in fact overstate their actual market share.

respond to survey questions (Lusk, 2018). It seems likely that in actual shopping contexts, factors such as price, taste, and (perceived) health tend to dominate consumer decision-making (Lusk and Briggeman, 2009; Lusk, 2011).

Taken together, these findings suggest that whatever their effects on the supply side, the overall effectiveness of voluntary sustainability standards and labels may be limited by their uptake by consumers. However, research also indicates that various design choices can improve the effectiveness of labels (Onwezen et al., 2021).

Supply-side effects

A number of papers have systematically reviewed the literature on the effects of voluntary sustainability standards on "supply-side" outcomes such as on-farm environmental impacts or farmer livelihoods (DeFries et al., 2017; Oya et al., 2018; Meemken, 2020; Traldi, 2021).[31] The most recent of these reviews, by Traldi (2021), covers 45 peer-reviewed studies, including studies covered by earlier reviews.

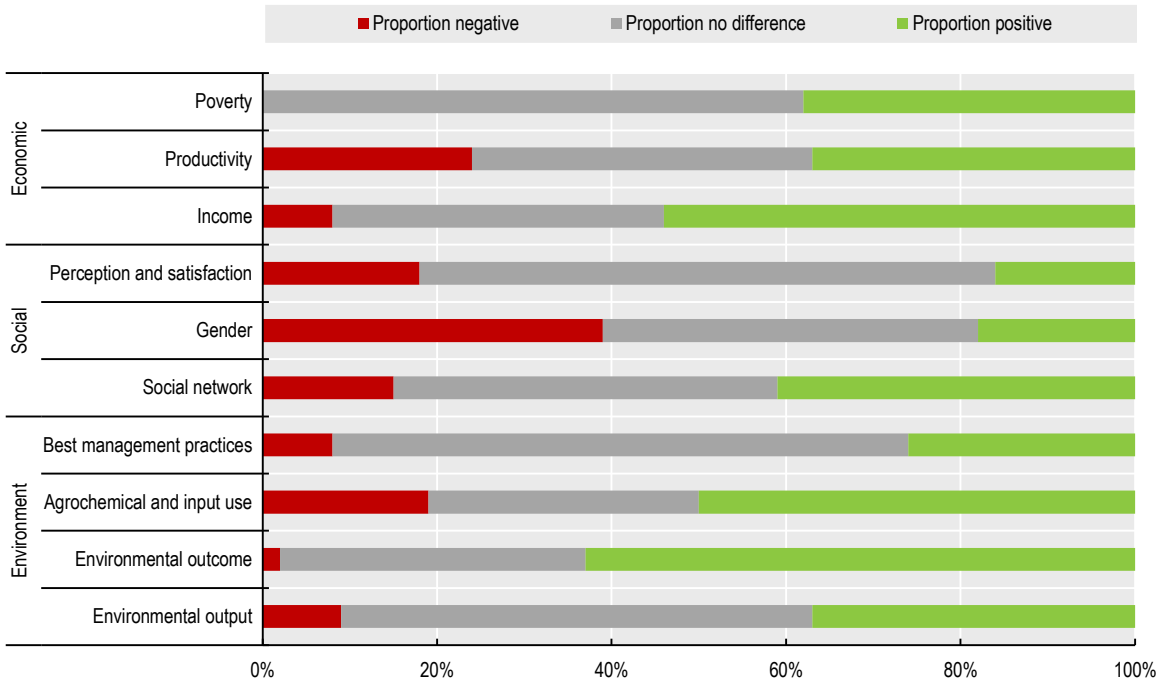
Traldi (2021) first shows that there is a mismatch between what is certified and what is studied, in the sense that some crops, standards, and countries are overrepresented in the literature relative to the importance of certified production, while others are underrepresented. In particular, 75% of the available literature focuses on coffee, which constitutes only 11% of the area of all certified crops globally (among the major sustainability standards). Cotton, by contrast, accounts for 22% of the area of all certified crops, but was only covered by a single study (1.5% of the total), while sugar (8.5% of the area of all certified crops) and soybeans (7.8%) were not studied at all.

A similar mismatch exists for the types of standards. The available literature has disproportionately studied Fairtrade and UTZ/Rainforest Alliance, while some other standards have not been studied at all. Relative to its large share (72%) of the total certified area, organic standards also appear understudied (at 21% of the study coverage). Geographically, most studies covered Africa (51%) or Latin America (34%), while none of the studies identified by Traldi (2021) studied schemes in North America or Australia. Brazil, Indonesia, Ivory Coast and several other countries with widespread certification are also under-represented.

Most of the studies reviewed by Traldi (2021) look at economic outcomes (84%), with less frequent analysis of social (43%) or environmental (43%) outcomes, and only 20% of studies looking at all three dimensions together. Across all dimensions, the published literature tends to mostly find positive or zero effects of sustainability standards on economic, social, or environmental outcomes. Figure 10 provides more detail for selected indicators, broadly confirming the overall conclusion that studies tend to find more positive than negative effects, with the notable exception of gender issues. For the environmental indicators in particular, the available evidence suggests that positive effects outweigh negative effects, although a significant share of studies do not find any measurable impact. One challenge with measuring environmental indicators is that studies often focus more on practices than on actual outcomes: Traldi (2021) notes that 38% of the studies looked at environmental indicators, but only 22% explicitly considered environmental outcomes.

[31] A related review by Garrett et al. (2021) looks at a broader range of food supply chain policies, but a narrower set of impacts (forest conservation and livelihoods).

Figure 10. Effects of sustainability standards on specific sustainability indicators



Note: Chart shows the proportion of study results showing negative, positive, or no clear effects (using conventional statistical significance levels) of voluntary sustainability standards on different sustainability indicators. "Environmental output" here refers to practices (e.g. use of compost) while "environmental outcome" refers to actual results (e.g. species abundance, soil carbon stocks).
Source: Adapted from Traldi (2021).

As Traldi (2021) notes, a proper evaluation of the effectiveness of voluntary sustainability standards should look at possible trade-offs or synergies between the outcomes depicted in Figure 10. Historically, studies tended to focus on only one dimension of sustainability (e.g. only on farm income), making it impossible to assess possible trade-offs or synergies. More recently, however, researchers have started to systematically look at a broader set of impacts, and results do suggest trade-offs may exist, in particular between environmental and economic outcomes; see, for example, Vanderhaeghen et al. (2018).

Organic agriculture standards occupy a prominent position among voluntary sustainability standards. Seufert and Ramankutty (2017) and Meemken and Qaim (2018) review the substantial literature on the impacts of organic agriculture, and come to similar conclusions: broadly speaking, organic agriculture tends to have better environmental performance *per unit of land*, but due to lower yields (generally 20% smaller than conventional yields), the environmental performance of organic agriculture *per unit of product* is not necessarily superior. Moreover, for a given production volume, organic agriculture would require greater land use. Expansion of agricultural land at the expense of natural ecosystems is a major driver of greenhouse gas emissions and biodiversity loss, yet such indirect land use effects are generally not included in empirical studies comparing organic versus conventional agriculture.

However, both reviews emphasise that the actual performance of organic agriculture is highly context dependent. Seufert and Ramankutty (2017) highlight that organic agriculture performs relatively well when it comes to yields of forage crops such as hay, but worse when it comes to cereals. Similarly, organic agriculture performs better for biodiversity of plants and pollinators in arable systems and simple landscapes, but less well for biodiversity of birds in pastures and extensive agricultural regions. The evidence also suggests that organic agriculture has benefits for livelihoods of farmers who participate in alternative food networks and who are located in regions with low labour costs, but not for farmers without access to premium prices. Meemken and Qaim (2018) similarly emphasise that organic methods can be

useful in specific situations. Both reviews also highlight that the available evidence on organic agriculture is mostly concentrated in high-income countries, leading to important evidence gaps for low- and middle-income countries.

7. Communicating environmental impacts of products[32]

Labels on food products usually certify that a product or its producer adheres to specific *practices* codified in sustainability standards, as discussed above. However, another approach is to communicate environmental *impacts* directly. The ISO 14025 standard defines criteria for such environmental declarations.[33] In particular, the standard foresees that these should be based on independently verified life cycle assessment (LCA) data, or similar data sources.[34] Environmental declarations have often been used in a business-to-business context, and may involve detailed overviews of environmental impacts. However, simplified consumer-oriented communication tools can also be developed on the basis of the more detailed declarations.

7.1. Environmental product declarations

Environmental product declarations (EPD) are a specific kind of environmental declaration developed by the International EPD System (www.environdec.com), originally founded by the Swedish Environmental Protection Agency and Swedish industry. An EPD is a document registered in the International EPD system communicating the life-cycle impacts of a specific product on the basis of an independently verified life-cycle assessment (LCA). (LCA methods and findings for food products are discussed in detail in the companion paper (Deconinck and Toyama, 2022). All EPDs are freely available on the website of the International EPD system, including many EPDs for food and beverage products. Figure 11 shows selected information from an EPD for one particular brand of soft bread.

To ensure consistency, Product Category Rules provide a "cookbook" explaining how life-cycle assessments should be conducted for various products in the context of an EPD. The International EPD System provides several sets of Product Category Rules for agri-food items, such as bakery products, fish and fish products, poultry meat, or virgin olive oil. PCRs also exist for products which are intermediate steps in the agro-food supply chain, e.g. arable and vegetable crops, or preparations used in animal feeding for food-producing animals.[35] In March 2022, the International EPD System announced the

[32] Initiatives to communicate environmental impacts to consumers are explored in more detail in forthcoming OECD work on which this section is based.

[33] ISO distinguishes between Type I Environmental Labelling for eco-labelling schemes where there are clearly defined criteria for products, Type II Self-Declared Environmental Claims (for products and services where there are neither criteria nor labelling schemes), and Type III Environmental Declarations based on a life-cycle approach. This classification is widely used but does not fully capture the diversity of environmental labelling and information schemes. For example, most of the labels reviewed earlier (such as organic labels) do not fit into any of these categories as they do not take a full life-cycle approach. See Gruère (2013) for a more comprehensive overview.

[34] More precisely, the ISO 14025 standard states that Type III Environmental Declarations should be "based on independently verified life cycle assessment (LCA) data, life cycle inventory analysis (LCI) data or information modules in accordance with the ISO 14040 series of standards." (The ISO 14040 series of standards governs life cycle assessment.)

[35] See https://www.environdec.com/pcr-library (accessed 6 April 2022).

development of a main PCR for food and beverage products, which can be complemented by further product-specific PCRs.[36]

Figure 11. Environmental Product Declaration example

POTENTIAL ENVIRONMENTAL IMPACTS data referred to 1 kg of product		UPSTREAM		CORE	DOWNSTREAM		TOTAL
		Raw material production	Packaging and auxiliary materials production	Production	Distribution up to shelf	Primary packaging end of life	
GLOBAL WARMING POTENTIAL - GWP ($g\ CO_2$ eq)	Fossil	7,79E+02	1,61E+02	2,94E+02	7,65E+01	9,31E+00	**1,32E+03**
	Biogenic	5,39E-01	3,65E-01	8,19E-01	5,12E+00	1,83E-01	**7,03E+00**
	Land use and land transformation	4,44E+01	2,45E+00	1,94E-03	7,04E-04	2,54E-05	**4,69E+01**
	Total	**8,24E+02**	**1,64E+02**	**2,95E+02**	**8,16E+01**	**9,49E+00**	**1,37E+03**
Acidification Potential - g SO_2 eq.		1,20E+01	6,78E-01	4,86E-01	4,03E-01	1,32E-03	**1,36E+01**
Eutrophication Potential - g PO_4^{---} eq.		8,03E+00	1,54E-01	6,94E-02	6,34E-02	5,36E-04	**8,32E+00**
Photochemical Oxidant Formation Potential - gNMVOC eq		2,01E+00	5,48E-01	5,61E-01	5,14E-01	1,92E-03	**3,63E+00**
Abiotic Depletion Potential - Elements g Sb eq.		1,15E-03	2,36E-05	5,16E-06	3,32E-06	3,25E-08	**1,18E-03**
Abiotic Depletion Potential - Fossil fuels - MJ, net calorific value		6,94E+00	3,28E+00	4,40E+00	1,07E+00	1,19E-03	**1,57E+01**
Water scarcity potential, m3 eq.		1,28E+00	6,40E-01	2,42E-01	-1,20E-04	2,23E-05	**2,16E+00**

WASTE PRODUCTION* data referred to 1 kg of product	UPSTREAM		CORE	DOWNSTREAM		TOTAL
	Raw material production	Packaging and auxiliary materials production	Production	Distribution up to shelf	Primary packaging end of life	
Hazardous waste disposed (g)	6,39E-04	1,52E+00	0,00E+00	0,00E+00	0,00E+00	**1,5E+00**
Non-Hazardous waste disposed (g)	7,69E+00	1,99E+01	0,00E+00	0,00E+00	0,00E+00	**2,8E+01**
Radioactive waste disposed (g)	1,60E+00	3,70E-01	9,64E-02	3,50E-02	4,67E-05	**2,1E+00**

Note: Figure shows an excerpt of the Environmental Product Declaration for "Harry's 100% Mie Nature" soft bread produced by Barilla for sale in the French market. This EPD is registered in the International EPD System as S-P-00487. See the full EPD for additional context and data.
Source: International EPD System (www.envirodec.com), accessed 6 April 2022.

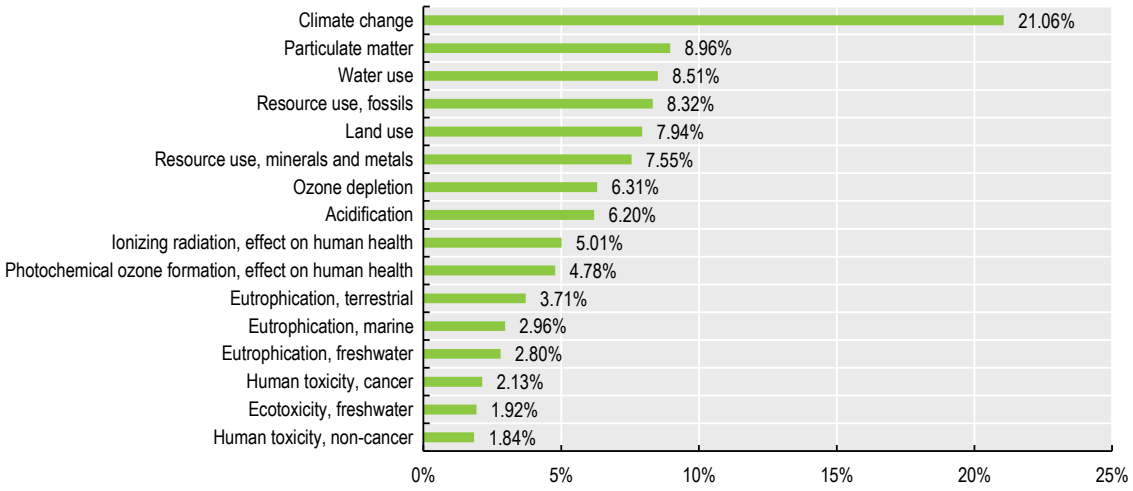
7.2. Product Environmental Footprint

There are long-standing efforts by the European Commission to develop so-called Product Environmental Footprint (PEF) methods based on life-cycle assessment (European Commission, 2021a).[37] As with environmental product declarations, these define methods for measuring and communicating potential environmental impacts of products using a life-cycle approach. The Product Environmental Footprint considers sixteen impact categories (Figure 12). The results in each category are normalised, i.e. divided by a reference value based on per capita impacts of an average person globally. This results in sixteen dimensionless scores, which are then weighted and aggregated into a final score using the weights shown in Figure 12.

[36] See https://www.environdec.com/product-category-rules-pcr/get-involved-in-pcr-development#pcrsunderdevelopment (accessed 6 April 2022).

[37] In parallel with the Product Environmental Footprint work, the European Commission also developed methods for Organizational Environmental Footprints.

Figure 12. Weighting of impact categories in the Product Environmental Footprint



Note: Figure shows the weights of the impact categories used in the Product Environmental Footprint methodology.
Source: https://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml (accessed 13 April 2022), based on Sala et al. (2018).

At the time of writing, the European Commission was preparing new initiatives around substantiating green claims, with the purpose of reducing the proliferation of different environmental claims and the prevalence of 'greenwashing'. The PEF is expected to play a central role in these initiatives.[38]

Since PEF uses a life-cycle approach, analyses can generate a wealth of data, which may be difficult to communicate to consumers in a retail setting. For this reason, pilot projects and further research have been conducted to assess different options for communicating PEF results to consumers. This research demonstrated that consumers prefer the use of graphics, bars, and colour scales, such as a "traffic light" or "letter grade" (A to E) label, similar to simplified front-of-pack labels used to convey nutritional information. De Bauw et al. (2022) discuss several proposed schemes, and draw parallels with nutritional front-of-pack labels.[39] Interestingly, surveys in stores showed that even though only a small portion of consumers consult detailed information, half of those surveyed prefer to have this detailed information available, e.g. through an app or website (Lupiáñez-Villanueva et al., 2018).

7.3. Foundation Earth

The UK-based non-profit Foundation Earth (www.foundation-earth.org) was created with the goal of issuing environmental front-of-pack labels for food products based on life-cycle assessment. Foundation

[38] See https://ec.europa.eu/environment/eussd/smgp/initiative_on_green_claims.htm (accessed 6 April 2022). While the PEF may help to harmonise approaches and reduce confusion, some practitioners and researchers have voiced concerns. Finkbeiner (2014) argued that rather than harmonising existing standards, the PEF introduces new standards which are at times in conflict with the existing ISO 14044 standard, and may therefore end up contributing to "confusion, proliferation, and mistrust" rather than harmonisation; see Galatola and Pant (2014) for a defense of the PEF approach against this critique. Also see Lehmann et al. (2016) and Bach et al. (2018) for further discussion of possible weaknesses. From a different angle, advocates of organic agriculture have argued that the PEF approach is not appropriate for agri-food products as it does not fully capture biodiversity impacts, pesticide use, or animal welfare issues (IFOAM, 2022).

[39] Simplified front-of-pack labels for nutritional information were explored in detail during the 14th meeting of the OECD Food Chain Analysis Network meeting in January 2022; see https://www.oecd.org/agriculture/topics/food-chain-analysis-network/ (accessed 6 April 2022).

Earth explicitly aims to develop an approach whereby two products in the same product category can be compared based on their actual impact (measured through a life cycle analysis), as opposed to using secondary data on the environmental impact of an entire product category. The organisation sees individual impact measurement as essential to create the correct incentives for innovation in the food supply chain. Impacts considered are greenhouse gas emissions (with a weight of 49%), and water usage, water pollution, and biodiversity loss (each with a weight of 17%). The final score is then translated into a letter-based grade from A+ to G. In addition to a front of pack label, Foundation Earth also provides more detailed information online. The Foundation Earth initiative is backed by major food supply chain actors such as Nestlé, Unilever, Starbucks, Danone, and PepsiCo, as well as retailers such as Aldi, Lidl, Tesco, Coop, Sainsbury's, and Marks and Spencer.

7.4. Eco-score

The French Eco-score initiative (https://docs.score-environnemental.com/) similarly develops a front of pack label summarising environmental impacts of food products into a letter grade (from A to E) (Figure 13).[40] The Eco-score was launched as part of several trial projects in the context of French policy developments towards mandatory labelling, discussed below.[41]

Figure 13. The Eco-score label

Source: https://docs.score-environnemental.com/ (accessed 12 April 2022)

The Eco-score label starts from a life-cycle assessment on the sixteen impact categories included in the EU Product Environmental Footprint methodology. The underlying data comes from the French Agribalyse database (https://agribalyse.ademe.fr/), jointly developed by the French Environment and Energy Management Agency (ADEME) and INRAE.[42] In each impact category, impacts are expressed as 'points', where one point corresponds to the average environmental impact of a European citizen in 2010. These scores are then weighted using the same weights as in the Product Environmental Footprint methodology (see above). This is not the only factor determining the Eco-score rating, however, as the score can be adjusted upward or downward depending on five additional criteria:

[40] The Eco-score initiative is a collaboration between the French organisations Yuka, Eco2 Initiative, ScanUp, OpenFoodFacts, Etiquettable, FrigoMagic, La Fourche, FoodChéri, Marmiton, and Seazon. Many of these are active in online food sales, either as vendors (Seazon and FoodChéri are food-delivery services) or information providers (Yuka, ScanUp, OpenFoodFacts, and Etiquettable are apps/websites providing information about health and sustainability of food products).

[41] One of the alternatives to Eco-score is Planet-score, discussed in more detail in ongoing OECD work on assurance schemes [OECD internal report], on which this section is based.

[42] A major limitation of the current version of the Eco-score methodology is that it assigns the same life-cycle assessment estimate to every product in the same product category (i.e. it is not yet possible for producers to show that their own product performs better than similar products by competitors). An extension of the methodology to allow for product-specific life cycle assessments is foreseen. See https://docs.score-environnemental.com/more/evolutions-a-venir#integration-dacv-individualisees (accessed 12 April 2022).

- *Labels and certifications:* Products can receive a bonus of up to 20 points if they have certain certifications (e.g. organic, FairTrade, UTZ/Rainforest Alliance, MSC, Label Rouge).

- *Transport*: Product scores can be adjusted by up to 15 points based on the imputed carbon intensity of transport (depending on the country of origin and typical transport modes).

- *Environmental performance in the country of origin:* Product scores are adjusted by -5 to +5 points depending on how the country of origin scores on the Yale Environmental Performance Index (https://epi.yale.edu).

- *Packaging:* Product scores can be reduced by up to 10 points depending on the environmental sustainability of packaging materials used.

- *Endangered species:* If a product includes an endangered fish species, the product automatically receives the lowest possible Eco-score regardless of other criteria. Moreover, all products containing palm oil have their scores lowered by 10 points, with the exception of palm oil with a RSPO Segregated or RSPO Identity Preserved certification.

The final score is then translated into a letter grade (A to E) where A corresponds to a score between 100 and 80, B to a score between 80 and 60, and so on.

Major European retailers such as Carrefour, Lidl, and Colruyt are currently testing the Eco-score label. Consumers can also consult Eco-score labels for a wide variety of products through the Open Food Facts app and website (https://fr.openfoodfacts.org/eco-score). The Open Food Facts project manages an open-source, crowd-sourced database of food products, and is one of the founding partners of the Eco-score project. Among the close to 900 000 products included in the database, two-thirds currently do not yet have an Eco-score. Among the rated products, the highest score of A appears rare, while scores among the other letter grades (B to E) are spread more equally.

7.5. Towards mandatory environmental impact labelling in France

The French “climate and resilience” law of 2021 specifies that, following a period of experimentation, environmental impact labelling should become mandatory in France for a list of goods and services.[43] In the short run, and taking into account the EU regulation on the provision of food information to consumers, the decision to display an environmental impact label on products will remain voluntary for companies. However, the environmental labelling scheme used will have to fit the mandatory regulatory framework established by decree. The law requires that such labels will express environmental impacts using a life-cycle approach, and should take into account greenhouse gas emissions, biodiversity impacts, and consumption of water and other natural resources. They must also take into account the environmental externalities of the production systems of the products considered, which have been scientifically evaluated, in particular for agricultural, forestry, and food products. An experimentation period of up to five years is foreseen to develop suitable labelling schemes. Earlier legislation had already initiated pilot projects to experiment with different labelling schemes.[44] The French government organised an open call for proposals, which led to 18 trial projects organised by private sector and/or civil society organisations,

[43] See Article 2 of *LOI n° 2021-1104 du 22 août 2021 portant lutte contre le dérèglement climatique et renforcement de la résilience face à ses effets*, Journal Officiel de la République Française (JORF) n°0196 du 24 août 2021.

[44] See Article 15 in *LOI n° 2020-105 du 10 février 2020 relative à la lutte contre le gaspillage et à l'économie circulaire*, Journal Officiel de la République Française (JORF) n°0035 du 11 février 2020.

including the Eco-score. These were complemented by additional experimental research, contributions by stakeholders, and a review by a scientific council.

In January 2022, the government submitted its findings to Parliament, concluding that an environmental label for food products is feasible and desirable, although some further analytical and operational refinements are needed (Gouvernement de la République française, 2022). This report also announces the government's goal of deploying a first version of an environmental labelling scheme in early 2023, assuming that a satisfactory methodology can be developed in time. Based on the trial projects, the government concluded that any labelling scheme should cover all food products for sale in France (including imported and processed foods), must allow comparisons of food products not only across but also within product categories, and should be based on a life-cycle approach aligned with the EU Product Environmental Footprint, as well as semi-specific and, if possible, specific data, describing more precisely the characteristics of a given product. The government also noted that the calculation method must have a robust scientific basis, while at the same time be sufficiently easy and low-cost so that the scheme can be implemented by all actors for nearly all products.

7.6. Effectiveness

To date, environmental impact labels have not yet been widely used, so robust evidence on their real-world effectiveness is relatively scarce. Yet some early evidence from France suggests that the Ecoscore environmental impact label indeed affects consumer behaviour. The organic online grocer La Fourche introduced the Ecoscore and reported that the market share of products labelled A increased by three percentage points to almost 24% (Ecovadis, 2022). Further insights can be obtained from studies on e.g. carbon footprint labels, as well as experiments conducted as part of the development of the EU Product Environmental Footprint and of the French environmental impact-labelling scheme.

Soler et al. (2021) review studies on earlier environmental impact labels such as carbon footprint labels. Experimental evidence suggests that these labels induce changes in consumers' choices, and that simple "traffic light" labels are more effective than providing quantitative information. Research conducted by the European Commission to support the development of the Product Environmental Footprint similarly shows that providing consumers with environmental impact information can indeed affect their behaviour (European Commission, 2019). In online choice experiments, the fraction of consumers choosing a product with a better-than-average environmental impact increased from 24% to 36% when a label indicating a product's environmental impact was present. Moreover, the presence of other labels (e.g. organic) did not increase or decrease the effectiveness of the environmental impact label.

Consumer choice experiments conducted in France on environmental impact labels also found that these labels led to a reduction in the overall environmental impact of food choices, while lowering costs and generally improving the nutritional quality (Soler et al., 2021).

However, De Bauw et al. (2021) provide experimental evidence on consumer choices when both environmental (Eco-score) and nutritional (NutriScore) front-of-pack labels are present, and find that the presence of both labels improves the nutritional quality of food choices, but not the environmental impact. These findings suggest that when environmental impact labels are used in conjunction with nutritional labels, they may not be as effective as the results of earlier experiments suggest.

8. Financial incentives by governments

Governments have several options to interact with the practices discussed above. Most obviously, governments could decide to make certain practices mandatory (e.g. mandatory disclosure, mandatory due diligence), but other possibilities exist as well. For example, governments could provide regulatory frameworks to make voluntary practices more effective or more credible (e.g. harmonising voluntary

standards, rules on product labelling). In other cases, governments might leverage existing practices to achieve regulatory aims, e.g. building on voluntary standards or codes of conduct in developing new regulations, or accepting compliance with a voluntary scheme as an option to comply with regulatory requirements (Rousset et al., 2015). Governments can also play a convening role (bringing together stakeholders) and can signal their support for voluntary practices.

Another important lever for governments is to provide financial incentives, e.g. through taxes, subsidies, trade policy instruments, or procurement policies. This section highlights two possible ways in which governments could provide financial incentives for improving the environmental impact of food supply chains: through taxes or subsidies based on life-cycle impacts, and through public procurement. Some of the existing proposals on linking taxes or subsidies to life-cycle impacts have the additional feature that they may provide a mechanism for reducing evidence gaps on these impacts, by providing incentives to firms to disclose these impacts.

8.1. Taxes or subsidies based on life-cycle impacts

As noted by Rajagopal et al. (2017), policies to reduce environmental impacts along the life cycle do not necessarily need to take an explicit life cycle *approach*. For example, if GHG emissions were priced in all sectors and countries, this would automatically reduce emissions along the entire supply chain, reducing the need for a separate policy linked to life-cycle assessments of GHG emissions. However, there are good reasons why governments may still want to target life-cycle impacts. First, not all countries have similar environmental policies in place, creating a risk of leakage or unfair competition. Second, because of transaction costs it may be easier to use a life-cycle approach, e.g. by holding key importers or retailers accountable for environmental impacts which occur upstream in their supply chains (Rajagopal et al., 2017).[45]

Some authors have proposed introducing consumption taxes based on life-cycle impacts of products (McAusland and Najjar 2015; Timmermans and Achten 2018), while other proposals suggest differentiating tax rates based on e.g. sustainability certifications (Heine et al., 2021). These proposals are closely related to discussions on carbon border adjustment, which would similarly require some form of life-cycle assessment of imported goods (Rajagopal et al., 2017).[46]

To date, schemes linking taxes or subsidies to life-cycle assessments are not yet widely adopted. However, the growing popularity of life-cycle assessment and the trend towards more ambitious climate action may spur their development in future. Moreover, some of the proposals suggest innovative implementation details which could help reduce evidence gaps. Taxing or subsidising products based on their life-cycle environmental impact requires highly accurate and verifiable evidence, for both fairness and efficiency reasons. For example, if broad averages are used rather than product-specific information, firms selling products with a better-than-average environmental impact could reasonably complain that it is unfair to be lumped together with worse-than-average products. Such imprecise estimates would also undermine incentives to invest in improving environmental impacts along the supply chain. Having product-specific, verifiable evidence is clearly preferable, but raises the question of transaction costs of gathering and verifying the data. However, smart institutional design may help overcome these obstacles (McAusland and Najjar, 2015). For example, governments could decide to rely on generic data (for example, assuming that all products have the same impact as the average product in a category) unless firms can provide evidence that their products perform better than the benchmark provided by the generic data. If governments find it difficult to apply a differentiated tax treatment directly (e.g. because of administrative or technical constraints), an equivalent mechanism is to first apply a tax using the generic benchmark data

[45] Rajagopal et al. (2017) also mention the usefulness of life-cycle assessments in guiding innovation policies and in providing information to consumers.

[46] For a review of the possible role of carbon border adjustment mechanisms, see OECD (2020c).

and subsequently provide rebates to firms based on demonstrated superior performance (Heine et al., 2021). Both approaches greatly reduce the need for governments to collect data, and give firms the choice between being taxed based on generic data or investing in more accurate life-cycle assessments. The shortcomings of generic datasets would in turn become less of an issue if firms are allowed to provide their own, more precise estimates, and these estimates in turn can lead to improvements over time in the generic data. However, there may still be a possible credibility problem if firms are themselves paying for life-cycle assessments.

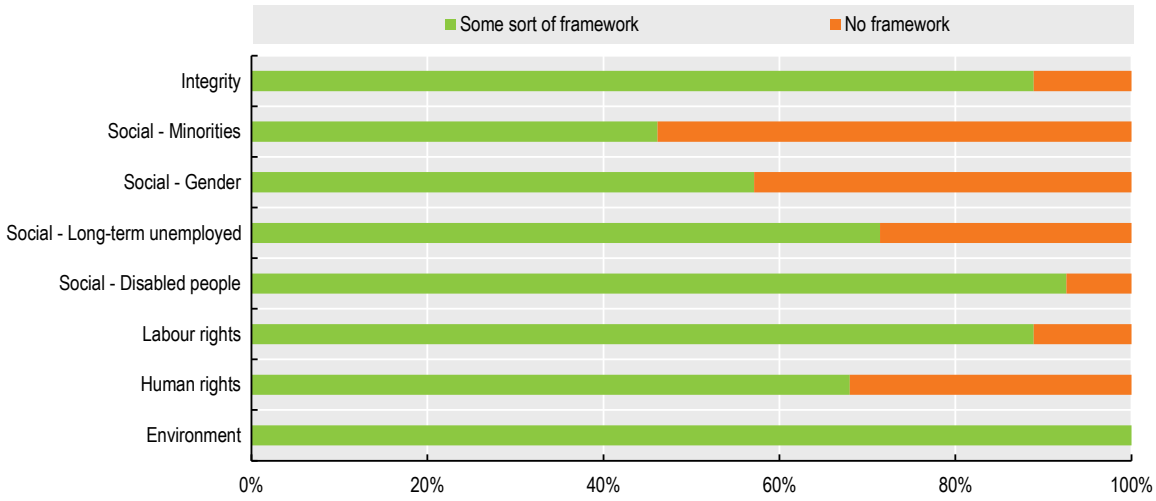
Concerns exist regarding the compatibility of proposed schemes with international trade rules. Governments may be inclined to use financial incentives based on a life-cycle approach precisely to overcome problems of leakage and unfair competition caused by goods imported from countries with less stringent environmental regulation (Rajagopal et al., 2017). Under pressure from domestic interest groups, there is a risk that such schemes may be used as a protectionist tool; but even in the absence of protectionist motives, there may be adverse effects, e.g. on developing country exporters (as discussed below). Whether or not such a system would be consistent with trade rules is currently unclear but would most likely depend on specific design features (Dominioni, 2021).

8.2. Public procurement

OECD countries spend on average 12% of GDP on public procurement. This makes public procurement potentially a powerful tool for achieving social, environmental or other policy objectives (OECD, 2020a).

A 2020 OECD survey on responsible business conduct and public procurement found that of the 27 surveyed countries, all had some framework in place to ensure that public procurement would support environmental objectives (Figure 14).

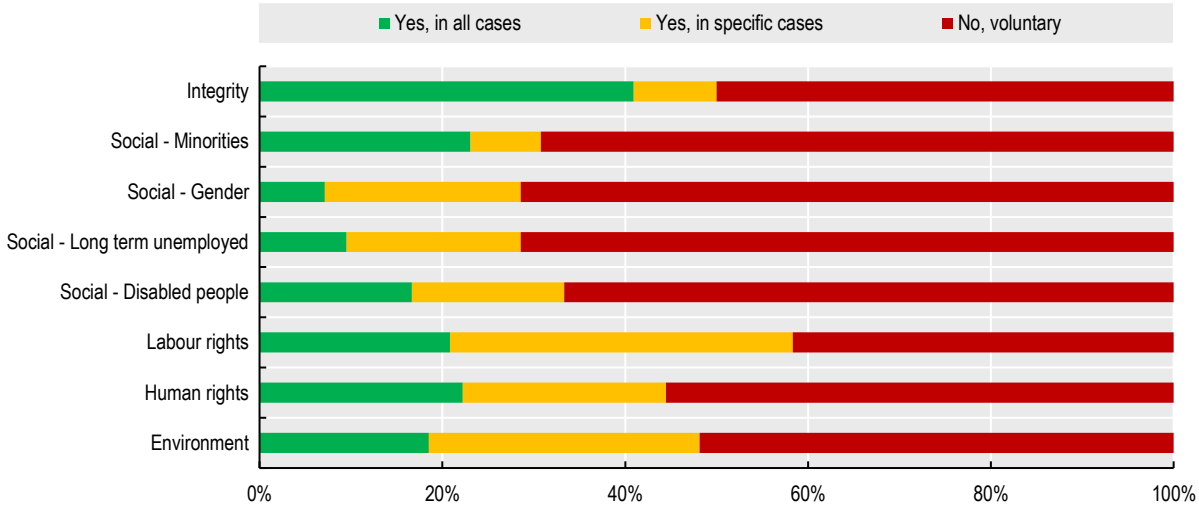
Figure 14. Share of countries with a procurement framework to support Responsible Business Conduct



Note: Based on data from 27 countries. “Framework” refers to either a regulatory or a strategic framework.
Source: OECD Survey on Leveraging Responsible Business Conduct through Public Procurement (OECD, 2020a).

Moreover, in about half of countries these frameworks applied to the entire supply chain (Figure 15). The OECD survey also found that more than 80% of countries monitor whether environmental conditions are respected. However, only a limited number of central purchasing bodies currently require their suppliers to conduct supply chain due diligence.

Figure 15. Countries where procurement frameworks apply to the supply chain



Note: Based on data from 27 countries. "Framework" refers to either a regulatory or a strategic framework.
Source: OECD Survey on Leveraging Responsible Business Conduct through Public Procurement (OECD, 2020a)

8.3. Effectiveness

Taxes or subsidies linked to life cycle impacts for a broad range of products and covering a wide range of environmental impacts are currently not yet in place. However, given similarities with proposals for border carbon adjustment mechanisms, simulation results for such proposals can shed some light on likely effects. Böhringer et al. (2022) review the relevant literature. A common finding is that border carbon adjustments can indeed reduce leakage, create a more level playing field, and can improve global cost effectiveness of emissions reductions. However, effectiveness is generally reduced because of the possibility of reshuffling: exporters may redirect products with the lowest carbon footprint to markets where a carbon border adjustment exists, while selling products with a higher carbon footprint in other markets. As a result, total emissions reductions may be less than expected. Importantly, carbon border adjustments by high-income countries may lead to a loss of export revenues for lower-income countries, thus shifting part of the burden of emissions reductions to poorer countries. These considerations are also likely to be relevant for proposals to tax a wider range of environmental impacts.

The literature on the effectiveness of green public procurement is currently limited, and consists mostly of case studies. Rietbergen and Blok (2013) found that the introduction of a CO_2 certification scheme as part of public procurement in the Netherlands was associated with substantial reductions in emissions. By contrast, Lundberg et al. (2015), in a study of Swedish cleaning services procurement, found at best only a weak effect of environmental standards on supplier behaviour. Two studies looked at public food procurement. Cerutti et al. (2016) studied public procurement of fruits and vegetables for school catering in Turin (Italy). Using a detailed life-cycle assessment to calculate the carbon footprint, the authors found that a shift to organic fruits and vegetables reduced carbon footprints by 15-20%, while more local provisioning reduced carbon footprints by 5-8%. A more recent paper by Lindström et al. (2020) found that Swedish public sector purchases of organic food led to an increase of agricultural land under organic agriculture. Finally, one important channel through which green public procurement could affect environmental impacts is by stimulating innovation of more environmentally friendly products. Orsatti et al. (2020) and Krieger and Zipperer (2022) both find evidence of such a link (although their findings are not specific to agri-food sectors).

9. Conclusion

A great many initiatives affect the environmental impact of food supply chains. The review here does not claim to be exhaustive, but does capture the variety of approaches taking an explicit or implicit "supply chain lens". This variety is a source of strength: given the complexity of food supply chains and their environmental impacts, it is unlikely that a single approach would be sufficient to address all issues. Rather, a mix of different approaches is probably needed, as is true for food systems more broadly (OECD, 2021c). This mix will include other approaches which are not necessarily using a supply chain lens, such as agri-environmental policies.

Looking across the various initiatives surveyed here, a number of trends appear.

A first trend is the growing availability of data and evidence. For example, there has been strong growth in disclosure initiatives such as CDP. New benchmarks (the World Benchmarking Alliance, the Coller FAIRR Protein Producer Index, Forest500) also provide greater transparency of corporate commitments. Similarly, environmental impact labelling provides consumers with much more data than can be communicated using traditional sustainability labels. New technologies and datasets (such as satellite data) play an important role, as is the related trend of growing supply chain traceability.

A second trend is the importance of clearly defined expectations for food supply chain stakeholders, and accepted methodologies and reporting standards. The OECD Guidelines for Multinational Enterprises provide an internationally agreed formulation of societal expectations for major firms. The more recent development of due diligence guidance (in particular the OECD-FAO Guidance for Responsible Agricultural Supply Chains) translates these guidelines into concrete behaviours expected of companies in agri-food supply chains. Clarity on these expectations in turn facilitates benchmarking exercises, such as the World Benchmarking Alliance's Food and Agriculture Benchmark. Similarly, the development of greenhouse gas reporting protocols facilitated the emergence of voluntary disclosure, while investments in the development of life-cycle methodologies were an important step in establishing the EU Product Environmental Footprint approach and related proposals for environmental impact labelling.

The greater availability of data and evidence can in turn be used to strengthen existing initiatives or can serve as the foundation for new approaches. For example, the Trase Earth approach has been used to evaluate the effectiveness of corporate zero-deforestation commitments, while detailed life-cycle assessment data might enable taxes or subsidies based on life-cycle impacts of products.

A third trend is that initiatives are increasingly adopting a supply-chain perspective. This is by definition the case for approaches based on life-cycle assessment, but it is equally true for example for the OECD Due Diligence Guidance; the strong suggestion for companies to report their Scope 3 (i.e. upstream and downstream supply chain) emissions in CDP; and proposed mandatory Scope 3 emissions disclosure rules by the US Securities and Exchange Commission. Similarly, the World Benchmarking Alliance takes an explicit supply chain lens in evaluating corporate commitments to the Sustainable Development Goals. This contrasts with more traditional sustainability standards (e.g. organic), which typically focus on the farm level.

A fourth trend is a growing emphasis on measuring actual impacts and effectiveness. For example, environmental impact labelling is qualitatively different from labels signifying conformity with voluntary sustainability standards, as the latter typically focus on processes rather than impacts. Similarly, companies are increasingly expected to report on outputs and impacts (e.g. GHG emissions), making it harder to engage in "greenwashing". Regarding effectiveness of different interventions, evidence remains relatively scarce, as is true for food systems more broadly (Deconinck et al., 2021). Yet there is a clear increase in the number of empirical studies attempting to assess effectiveness using robust methodologies. For sustainability standards in particular, there now exist several systematic reviews and meta-analyses, and the Evidensia.eco platform makes it possible to easily navigate the existing evidence base. Evidence on effectiveness is more limited for the other initiatives covered here, however.

A fifth trend is towards *universal* reporting and measurement, or at least a move beyond self-selection. For example, rating organisations would ideally like to have information on all publicly traded firms, while financial institutions similarly prefer having information on all firms in their portfolio. When retailers adopt environmental impact labelling, these generally also apply to all products; in France, legislation foresees that environmental impact labelling will eventually become mandatory for all food products. Initiatives such as the World Benchmarking Alliance, FAIRR, Forest500, or Trase similarly collect information on all firms they deem relevant. Governments may also mandate disclosure of all firms (potentially above a certain size threshold). New technologies also make it possible to provide more universal measurement: for example, the Climate TRACE initiative (https://www.climatetrace.org/) aims to use satellites and other technologies to provide detailed real-time data on GHG emissions worldwide, and a similar approach recently led to the first satellite-based measurement of methane emissions from dairy cows (GHGSat, 2022). Taken together, these developments greatly reduce the potential for companies to self-select whether and what to report or disclose, and may herald, in the words of the Climate TRACE initiative, "an era of radical transparency".

Despite these encouraging developments, this review also uncovered important gaps and shortcomings, both substantively and in terms of the evidence.

Many initiatives suffer from what might be called a "coverage gap": despite the trend towards more universal coverage, the products, companies, or countries affected by existing initiatives are not always those where the greatest environmental impacts of food supply chains occur. For voluntary sustainability standards, for example, it is clear that standards typically apply to internationally traded tropical commodities which are easily identifiable by consumers (e.g. coffee, tea, cocoa). While initiatives exist for other commodities such as soybeans, these have a much smaller coverage of the global production area.[47]

The relative importance of global versus domestic value chains discussed in the companion paper on environmental impacts along food supply chains (Deconinck and Toyama, 2022), is again of importance here. Implicitly, many initiatives focus on consumption in high-income countries of products sourced from low- or middle-income countries. But one finding of trade-based methods to assess environmental impacts of food supply chains is that a large share of global environmental impacts is due to *domestic* consumption in the countries where these impacts take place. This does not necessarily mean that approaches focusing on global value chains are ineffective. As Zu Ermgassen et al. (2020) demonstrate in their study of Brazilian beef supply chains, major exporting firms are also important players in the domestic market, and export market requirements have historically led to improvements in the domestic sector as well (e.g. for sanitary standards). Nonetheless, policy makers should keep in mind that improving environmental impacts of food systems will also require other approaches (e.g. technical assistance, capacity-building).

Tensions around facts, interests, and values are inherent in all food systems issues, and hence also in methodologies and initiatives on environmental impacts of food supply chains. Nowhere was this clearer than in the discussions around environmental impact labelling in France. The pilot projects to introduce such labels led to questions around the reliability of the data and methodologies used in life-cycle assessments (e.g. the use of product averages rather than specific data; the absence of information on on-farm biodiversity), but also touched on the relative weights assigned to different environmental outcomes. These discussions involved differences over values, but equally involved interests, as industry players expressed preferences for some proposals over others. Possible trade effects seem to have received less attention so far, but the issue is likely to gain prominence as France moves towards mandatory labelling.

[47] In the US context, Waldman and Kerr (2014) concluded that it would be challenging to use voluntary sustainability standards as a tool to improve environmental performance of soy and corn, in part because most of these commodities end up as part of processed food products and are hence not easily identifiable by consumers.

Several important evidence gaps emerge from this review. Echoing the findings from the companion paper on environmental impacts along food supply chains (Deconinck and Toyama, 2022), as well as the findings regarding the "coverage gap", evidence on the *effectiveness* of initiatives does not cover all important initiatives, or all relevant commodities and countries (Traldi, 2021). Similarly, evidence on effectiveness does not cover all-important environmental impacts. The discussion around environmental impact labelling in France demonstrated that information on on-farm biodiversity and soil carbon appears to be lacking in commonly used life-cycle assessment databases. Third, the distinction between attributional approaches (which provide a snapshot) and consequential approaches (which model what the consequences would be of an intervention) discusses in the companion paper is again relevant here. Land use change is one of the most important drivers of environmental impacts in food systems, but accounting for indirect land use change is difficult, and typically not included in life-cycle assessments.[48]

In surveying the wide range and large number of initiatives, additional questions emerge around the proper role of public policy. Governments can interact in many different ways with the initiatives described here (Rousset et al., 2015). Among the possibilities are, for example, a pure *laissez-faire* approach; an approach focused on creating a sound regulatory framework to allow different initiatives to thrive; an approach focused on harmonising existing initiatives; or incentivising or even mandating certain actions. Historically, for example, governments have often intervened to harmonise organic standards in order to prevent consumer confusion due to a proliferation of similar-sounding schemes (Rousset et al., 2015). Similar questions have emerged in the context of ESG schemes (OECD, 2020b). A related question is how the different initiatives strengthen each other. These topics, as well as the other evidence gaps identified here on the effectiveness of various approaches, are fruitful areas for further research.

[48] The possibility of "reshuffling" in response to carbon border adjustment taxes is another example of how environmental impacts might improve in an attributional sense without necessarily leading to any actual improvement in the consequential sense.

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