



Large gaps in voluntary sustainability commitments covering the global cocoa trade

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ABSTRACT

The production and trade of agricultural commodities, such as cocoa, have important impacts on farmer livelihoods and the environment, prompting a growing number of companies to adopt public commitments to address sustainability issues in their value chains. Though trading companies, who handle the procurement and export of these commodities, are key actors in corporate sustainability efforts, cross-country data on their identity, market share, and adoption of sustainability commitments is lacking. Here, we address this gap for the cocoa sector by compiling detailed shipping data from eight countries responsible for 80% of global cocoa exports, developing a typology of trader types, and assessing their adoption of sustainability commitments. We find that cocoa trading is a highly concentrated market: seven transnational companies handled 62% of the global cocoa trade, with even larger shares in individual cocoa producing countries. The remaining 38% of exports were handled by domestic trading companies and farmer cooperatives. Overall, the adoption of public sustainability commitments is low. We estimated that just over one quarter (26%) of cocoa is traded under some form of sustainability commitment, with gaps arising from their exclusion of indirect sourcing, low adoption rates by domestic traders, and commitment blind spots, notably on forest degradation and farmer incomes. Low rates of traceability and transparency pose a further barrier to the broadscale implementation and monitoring of these commitments: one-quarter of traders report being able to trace at least some of their cocoa back to farmer cooperatives and only half of them openly disclose the identity of their suppliers. We discuss the opportunities and limitations of voluntary sustainability commitments in a highly concentrated market and argue that, to realize visions of sustainable trade, the gaps in commitment coverage must be closed by extending current efforts to smaller traders and indirect suppliers. However, companies must support, coordinate and align with government efforts so that voluntary initiatives are ultimately rendered more transparent and accountable.

1. Introduction

Global value chains that connect geographically dispersed production activities have become the centerpiece of the world economy, with fundamental repercussions for societies, economies, and the environment (Kano et al., 2020; OECD, 2013; Ponte et al., 2019). In particular, agrifood value chains play a key role in global food security and the livelihoods of billions of rural laborers, while also being a driver of environmental degradation (Clapp, 2021).

Cocoa (*Theobroma cacao*) is one of the agrifood commodities raising sustainability concerns due to issues such as persistent poverty and child labor among cocoa farmers, and deforestation due to the expansion of cocoa farming (Abdullah et al., 2022; Fountain and Huetz-Adams, 2020; Sadhu et al., 2020). Cocoa, originating from the Amazon rainforest, is now planted across the tropics and its consumption, although still dominated by Europe and North America, is rapidly increasing in emerging economies of Asia, Latin America, and the Middle East (Fountain and Huetz-Adams, 2020; KPMG, 2014; Neilson et al., 2018).

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The global cocoa sector was worth 44 billion US dollars in 2019 and cocoa bean production has doubled in the last thirty years (Fortune Business Insights, 2019), which has contributed to making it one of the top ten deforestation-risk agricultural commodities globally (Goldman et al., 2020; Ordway et al., 2017; Pendrill et al., 2022).

In recent decades, the sustainability governance of commodity production, including cocoa, has shifted from being state-led to becoming polycentric, with an expansion of the influence of market actors. Governance efforts are increasingly oriented around global value chains, implemented through a combination of voluntary, self-regulatory, and market-led initiatives (Meemken et al., 2021; Ostrom, 2010; Thorlakson, 2018). These efforts include multi-stakeholder initiatives (e.g., the Cocoa and Forests Initiative-CFI) (Carodenuto and Buluran, 2021; Thorlakson, 2018; Vellema and Van Wijk, 2015; ICI, 2021; World Cocoa Foundation, 2017), third-party certification schemes (e.g., Fairtrade, Rainforest Alliance, UTZ, Organic) (Ingram et al., 2018b), own-firm sustainability standards (e.g., Forever Chocolate, Cocoa Compass) (Grabs and Carodenuto, 2021), and national publicly-led initiatives (e.g., Beyond Chocolate in Belgium, GISCO in Germany, DISCO in the Netherlands) (Wahba and Higonnet, 2020). In each of these governance structures, companies have taken a lead role in the definition and implementation of sustainability (Ponte, 2019; Thorlakson, 2018). Among companies, international traders, defined in this study as companies in charge of exporting cocoa from producing countries, are keystone actors who, because of their position in the value chain, often carry the responsibility of translating industry sustainability signals into ground-level action (Fig. 1) (Grabs and Carodenuto, 2021; Thorlakson, 2018). In addition to industry-led initiatives, legislative efforts are also expanding, such as the upcoming European Due Diligence legislation, which intends to hold trading companies legally accountable for impacts embedded in their value chains (European Commission, 2021).

In the frame of this article, we use the term 'value chain sustainability initiatives' to include both voluntary, publicly made corporate commitments (made either by individual companies or collectively by companies participating in multi-stakeholder initiatives) and third-party certification. Commitments notably differ from third-party certification in their self-reported nature and the lack of third-party verification or auditing mechanisms to guarantee implementation. We also differentiate between the adoption of commitments - the self-reported promise to implement a concrete sustainability action or program - and implementation, which is the concrete execution of such commitments. Further, there may be a gap between implementation and impact, the measurable change in the sustainability dimensions. Third-party certification can be used as an implementation mechanism of commitments, however, the information made available by companies does not allow to differentiate them from the commitments adopted.

Multiple studies have tried to understand why some companies adopt sustainability commitments and others do not. According to the global value chain theory, the organization of value chains has a fundamental impact on how sustainability is steered by a company (Gereffi, 2018;

Gereffi et al., 2006; LeBaron and Lister, 2021). Complementarily, the agency theory explains how principal actors (i.e., larger companies with more extended trade networks) utilize their power on agents (i.e., smaller companies or suppliers of principals) to lead the implementation of sustainability standards. The principal-agent relation seeks to ensure favorable agent behavior and it is modulated by power, information, and goal asymmetries between the two (Beal Partyka, 2022; Martinheikki et al., 2022). In the context of global value chains, power is understood as the capacity of actors to dictate or influence the behavior of other actors or strategic market factors, and it is often used to increase value, gain competitive advantage, and achieve desired market outcomes (Dallas et al., 2019). The agency theory also explains how principal actors foster collaborative initiatives with industry partners to improve their own performance and protect their own interests (Delbufalo, 2018; Mason, 2019). However, the asymmetric nature of the principal-agent relation can lead to opportunistic behavior and the failure of a sector to deliver sustainability outcomes (Wiese and Toporowski, 2013). Studies on various commodities have found that, due to the stronger pressure received from civil society, larger companies are more likely to adopt sustainability commitments than smaller ones (Bager and Lambin, 2020; Dauvergne and Lister, 2012; Garrett et al., 2019). In addition, the higher visibility of companies closer to the consumer end and the involvement of companies in other commodities facing similar sustainability issues, have been identified as factors contributing to higher adoption of commitments (Bager and Lambin, 2020; Grabs and Carodenuto, 2021).

Evidence also shows that companies utilize different implementation strategies and prioritize only certain sustainability issues. Over recent years, large companies have increasingly shifted from relying primarily on third-party certification labels towards developing their own in-house sustainability commitments, programs, and standards (Grabs and Carodenuto, 2021; Ingram et al., 2018b). In contrast, smaller companies typically lack the resources to develop such in-house schemes and continue to rely more on third-party certification (Bager and Lambin, 2020; Lambin et al., 2018; Thorlakson, 2018). Further, commitments are mostly framed around problems receiving high media attention, such as deforestation and child labor. These topics are not always aligned with the priorities identified in producing countries, such as poverty, living income, low market prices, or the need to favor domestic processing and export of processed products (such as cocoa butter and powder) instead of raw product exports (Carodenuto, 2019; Neilson, 2007; Oomes et al., 2016).

Recent studies have documented sustainability commitments in the cocoa sector (Carodenuto, 2019; Grabs and Carodenuto, 2021; Ingram et al., 2018b; Thorlakson, 2018). Others have studied the factors driving commitment implementation and have analyzed the factors influencing commitment effectiveness (Garrett et al., 2019; Gereffi and Lee, 2012; Ingram et al., 2017; Nelson and Phillips, 2018; Tayleur et al., 2017). Despite these research advances, four main knowledge gaps remain. First, most of the studies have focused essentially on large traders, which represent a large share of the cocoa volumes, but little is known about the non-negligible shares of cocoa traded by a myriad of smaller companies. Second, no study has yet analyzed the heterogeneity in the adoption of sustainability commitments between types of traders in the cocoa sector. Third, no study has properly analyzed whether these commitments cover the various sustainability issues. Fourth, no study has quantified the uptake of different implementation approaches for sustainability initiatives in the cocoa sector at a global scale.

In this study, our objective is to identify coverage and gaps in the adoption of sustainability commitments among cocoa traders and compare choices in implementation strategies and sustainability priorities. In contrast to previous studies, we address traders regardless of their market dominance. We address this through four questions:

1. How is the cocoa trading market structured? Following (Clapp, 2021), here our first hypothesis is that the downstream market

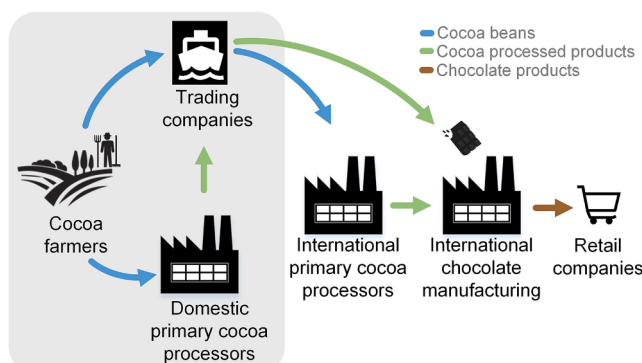


Fig. 1. Global cocoa value chain and boundaries of the study (in gray).

concentration extends also to cocoa trading. To test this, we described the market share, and the degree of vertical and horizontal integration of traders, both globally and within each country of production.

2. Which traders adopt sustainable sourcing commitments? Here, our second hypothesis is that larger, more vertically and horizontally integrated companies are likely to adopt more commitments. To test this, we compared the sustainability commitments made by cocoa traders with different market coverage and market integration profiles.
3. What are the gaps in commitment adoption coverage? Here, our third hypothesis is that gaps exist in the coverage of sustainability commitments due to the limited involvement of small traders, the selective application of commitments to direct suppliers, and the prioritization of specific sustainability topics. To test this, we analyzed the global coverage of commitments and the topics engaged with by traders.
4. What strategies do companies use to implement sustainable value chain initiatives? Here, our fourth hypothesis is that smaller companies prioritize externalizing sustainability action (i.e., third-party certification and ecolabels) while larger companies prioritize in-house sustainability programs (i.e., own schemes). To test this, we compared sustainability initiatives adopted by different traders.

To address these questions, we compiled shipping data of the eight largest cocoa exporting countries and documented the sustainability initiatives adopted by companies exporting cocoa from these countries. We used a combination of descriptive statistics and generalized linear models to evaluate our hypotheses. Following the literature on the effectiveness of voluntary sustainability commitments, we discussed the potential implications of the limited commitment coverage and the limited involvement of small companies in resolving sustainability issues in the global cocoa value chain. For this, we elaborated on the role of market coverage as a key enabling condition for the effectiveness of voluntary sustainability commitments, and as a key factor for mainstreaming market action and reducing opportunities for leakage (Garrett et al., 2019; Gollnow et al., 2022; Meemken et al., 2021). Here, we did not go so far as to evaluate the impact of these value chain sustainability initiatives, though we discuss the potential risks of sustainability agency concentration and the need to address known limitations of voluntary schemes to move from commitment to implementation and then impact. Using a key commodity as a case study, our research contributes to deepening the understanding of the role of private voluntary sustainability mechanisms in addressing sustainability issues in one of the largest sectors contributing to global environmental change, the agri-food business.

2. Methods

2.1. Data collection and classification

We compiled shipping data of exports of cocoa beans and cocoa derivatives (cocoa butter, paste, powder, and waste) from eight of the world's leading cocoa-producing countries (Côte d'Ivoire, Ghana, Cameroon, Indonesia, Ecuador, Peru, Colombia, and Brazil). We obtained this data from the Transparency for Sustainable Economies (Trase) initiative (www.trase.earth). This dataset contains information on the cocoa volumes traded per company, country of origin, country of destination, type of cocoa product traded (e.g., cocoa beans, butter, paste, or waste), and the free on-board price (FOB). This data covers 80% of global cocoa exports (ICCO, 2021). The data available corresponds to records for 2018 for all countries except Brazil, for which only the records of 2017 were available. We validated this data against the trade volumes reported by the United Nations International Trade Statistics Database and International Cocoa Organization (ICCO) (Supplementary Material Fig. S7). When aggregating volumes of different cocoa

products, we converted all products into 'cocoa bean equivalents' using standard conversion coefficients (Supplementary Material Table S1). We used data from the eight largest cocoa producers, though our data did not account for re-exports of cocoa that may be exported from one country (e.g., Ghana) and processed in another (e.g., Brazil, Malaysia) before re-export. In these cases, we may have double-counted cocoa if processing and re-export occurred within the same year, though three-quarters of global cocoa grinding takes place in Africa, Europe, or the United States and so this is unlikely to dramatically alter our results (ICCO, 2021).

Shipping records commonly refer to both the "exporter" and "importer" of a commodity. In this study, we focused on the "exporter" (henceforth the "trader"), except in Ghana, where we selected the importing company as the trader. We chose this because in Ghana the Cocoa Marketing Company (CMC) is listed as the only exporter of cocoa beans. The CMC is part of The Ghana Cocoa Board, the government-owned cocoa marketing institution that controls the Ghanaian cocoa market by setting prices and coordinating the purchase of all cocoa from farmers through licensed buying companies. The CMC is the institution responsible for mediating the trade between national producers and international traders (Bymolt et al., 2018). The CMC sells to trading companies such as Cargill or Olam, listed as the "importer" in customs records – hence the selection of the importer as the "trader" in Ghana for our analysis. This approach best captures the trade relations of Ghana with international cocoa markets in a manner consistent with our representation from other countries. However, we present how selecting the "exporter" data for Ghana would affect our analysis in the Supplementary material (Fig. S3).

We grouped together the records with different trader names corresponding to subsidiaries of the same company, as is often the case of transnational companies (Supplementary material Table S1). For these trader groups (to which we simply refer as "traders") we first recorded general company information, including ownership status (i.e., whether they are publicly listed or privately owned), their legal country address, horizontal integration (i.e., whether they trade other agricultural commodities as well), and vertical integration (i.e., the level of involvement in other cocoa business besides trading). We classified the degree of vertical integration through four binary variables, depending on whether companies reported being engaged in subnational sourcing (i.e., purchasing directly from farmers or farmer groups, rather than indirectly sourcing from intermediaries), primary cocoa processing (i.e., transformation of cocoa beans into butter, paste, powder, liquor, etc.), chocolate preprocessing (i.e., manufacturing of non-finished forms of chocolate), and chocolate manufacturing (i.e., production of finished chocolate products for direct consumption) (Table 1). Secondly, we recorded the sustainability initiatives self-reported by each company. These initiatives included: 1) sustainability commitments related to deforestation, forest degradation, child labor, poverty alleviation, climate change adaptation, agroforestry, traceability, and transparency; 2) third-party certification labels: UTZ, Rainforest Alliance, Fairtrade, and Organic. UTZ and Rainforest Alliance were kept separated because the documentation of initiatives was done when these labels were not yet operationally merged.

We recorded information on cooperative-level traceability and transparency since this is an important step in determining the origin and impact of cocoa. Traceability refers to the capacity of a company to trace a product to its origins and transparency refers to the public disclosure of this information (Gardner et al., 2018). We recorded all sustainability initiatives as binary variables, with 0 for lack of reported initiative, and 1 for a reported initiative. Because we focused on self-reported initiatives, lack of information was always recorded as zero (e.g., in case of lack of company website or lack of reported sustainability initiative).

These two types of company data collection followed an online search of official websites, official social media accounts, and official reports disclosed by companies or their partner organizations (e.g.,

Table 1

Information on general characteristics and sustainability initiatives recorded per traded company. All variables except “country name” were coded as binary variables. More information on definitions used and methods to record the information is in the Supplementary material.

Variable category	Description	Variables
General company characteristics		
Company origin	Country where the company is legally registered.	Country name
Cocoa quality traded	Whether the company trades fine-flavor or bulk cocoa beans or both. Fine-flavor cocoa comprises beans with special aromatic and flavor profiles that are sold at higher prices.	Cocoa bulk
		Cocoa fine-flavor
Ownership	Legal ownership of the company between publicly listed and privately owned.	Publicly listed
Vertical integration	Company involvement in different sourcing and industrial activities along the cocoa value chain.	Privately own
		Subnational sourcing
		Primary cocoa processing
Horizontal integration	Company involvement in the trade of other agricultural commodities (e.g., coffee, soybeans, oil palm, etc.).	Chocolate preprocessing
		Chocolate manufacturing
Sustainability initiatives		Horizontal integration
Traceability	Company traceability capacity to the cooperative or farm level. Interpreted as the maximum traceability level achieved by a company.	Traceability to cooperative
Transparency	Company transparent disclosure of cooperatives or farms supplying cocoa beans. Interpreted as the maximum transparency level achieved by a company.	Transparency to cooperative
Certification	Third-party certifications a company has adopted between UTZ, Rainforest Alliance, Fairtrade, and Organic.	UTZ
		Rainforest Alliance
CFI signatory	The company is a signatory of the Cocoa & Forest Initiative (CFI).	Fairtrade
Zero deforestation	Company commitment to zero deforestation.	Organic
Forest degradation	Company commitment to avoid forest degradation.	CFI
Climate change	Company commitment to support farmers in adapting to climate change by using climate smart agriculture.	Zero deforestation
Agroforestry	Company commitment to promote agroforestry systems.	Forest degradation
Living income	Company commitment to providing a fair price and living income to farmers.	Climate smart agriculture
Child labor	Company commitment to end child labor in cocoa farms. Child labor follows the International Labor Organization's definition: activities that harm or compromise the physical, mental, social, or moral integrity of children, and compromise schooling. Child labor, therefore, is differentiated from child work in this paper, and it can include child slavery as its worst form (Abdullah et al., 2022; ILO, 2020).	Agroforestry
CLMRS	Company implements a Child Labor Monitoring and Remediation System (CLMRS) in its cocoa value chain.	Living income
		Child labor
		CLMRS

NGOs or the World Cocoa Foundation). We assessed all traders covering the top 80% of exports from each country (67 companies), plus a random sample of 10% of the companies handling the remaining 20% in each country (another 80 companies). The complete list of traders in the full dataset comprises 968 traders and our final sample comprises 147 including 33 traders from Ecuador, 24 from Indonesia, 24 from Ghana, 23 from Peru, 19 from Côte d'Ivoire, 9 from Brazil, 8 from Cameroon, and 7 from Colombia. These numbers reflect the diversity in the number of small companies in each producing country.

Next, we designed a decision tree to classify our sample of traders based on the volume of cocoa beans traded, the number of sourcing countries, and the level of participation within national markets (for domestic traders) (Fig. 2). We did not include the number of destinations as a classification criterion because our dataset did not account for re-exports and, therefore, did not have information on final destinations. The type of consumer demands in different market destinations influences the pressure exerted on value chains so this might be an important factor to consider in future research. Due to the special role of farmer cooperatives in the cocoa market, we separated these into a specific category. We used this typology of traders as a reference for the subsequent analysis of sustainability initiatives.

2.2. Descriptive analysis of company types

We provide a descriptive analysis of the market shares of traders and traders' types at the global level and per producing country. We used the four-firm concentration ratio (CR4) as an indicator of market concentration per producing country (OECD, 2018). By summing the market shares of the four largest cocoa traders in each producing country, this indicator distinguishes markets as competitive (<50%), oligopolistic (≥50%), monopolistic (where a single company concentrates the

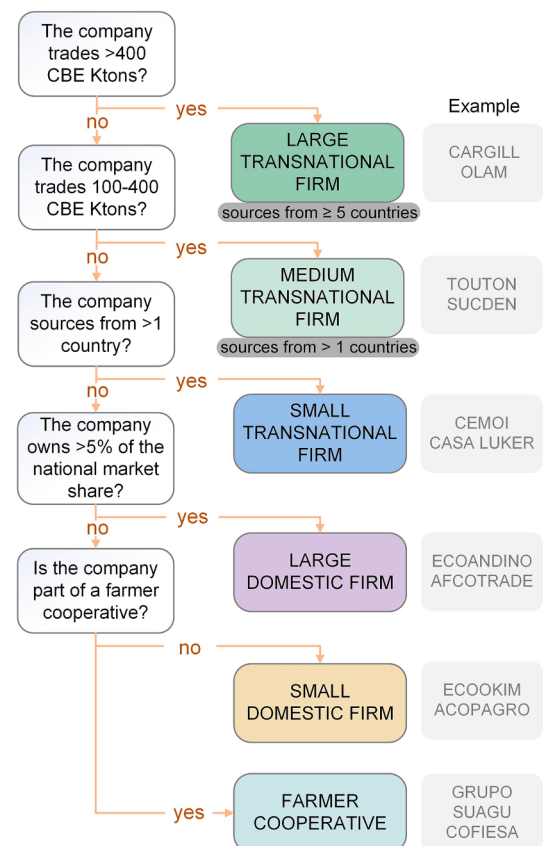


Fig. 2. Criteria used to classify cocoa traders. CBE stands for cocoa bean equivalent.

majority of the market share), and pure monopoly (a single company holds 100%). This index sheds light on potential market asymmetries and the responsibilities and opportunities of traders in moving the sustainability agenda forward (Folke et al., 2019). Next, we analyzed the involvement of traders in the subnational sourcing of cocoa beans, the levels of vertical integration, horizontal integration, and industrialization. Additionally, we characterized each type of trader in terms of the number of cocoa-origin countries and the number of destination countries, using the Shannon-Weaver diversity index, which balances the number of trading partners (i.e., “richness”) with the homogeneity of this exchange (i.e., “evenness”) (according to the volume traded with each partner) (Magurran, 2004). This index usually varies between 0 and 5 with lower values indicating little to no richness and evenness, and higher values indicating companies with richer and more even trade relations. We used trade data from 2017/2018 to describe these patterns, however, we acknowledge that sourcing can change year on year. Nevertheless, there is evidence that national-level sourcing is relatively consistent, as seen by small changes in sourcing reported by companies during the COVID-19 pandemic (Nestlé, 2021). Even so, we suggest future research to evaluate the stability of trade relationships over time if data is available (Reis et al., 2020).

2.3. Analysis of sustainability initiatives between company types

To understand how voluntary sustainability initiatives were adopted by different types of traders, we aggregated and compared the market shares of companies engaged in each of these initiatives. When reporting the coverage of sustainability initiatives of smaller traders, we extrapolated the data from our random sample of these smaller companies. For example, if for the traders handling the top 80% of cocoa exports in a country, they traded 90% of this under a sustainability initiative, and for the remaining 20% of exports, our sample of companies had 5% of their volume covered by an initiative, then the overall percentage was 73% (i.e., $80 \times 0.9 + 20 \times 0.05$). When a company reported a sustainability initiative, we assigned the market share linked to that initiative to the direct supply share managed by that company, as reported by Fountain and Huetz-Adams (2020). We calculated this by multiplying the direct value chain share of that company by its global market share. We did this because large traders source an important share of cocoa beans (between 30 and 100%) through indirect suppliers. In indirect sourcing, cocoa beans are bought from intermediate suppliers who operate independently from company policies, with companies therefore lacking oversight or leverage on the production conditions (Fountain and Huetz-Adams, 2020; zu Ermgassen et al., 2022). As a result, most of the initiatives of these companies are exclusively targeted to their direct suppliers. In the Supplementary material (Fig. S4) we provide results using the full market shares of companies as this represents, in principle, the market share over which they can be considered accountable. We documented sustainability initiatives as reported by companies in 2021 (the time of collection of these data), while our trade data is from 2017 to 2018. Given the growing awareness of sustainability, our results may over-report the share of cocoa that was traded with initiatives in 2017/2018. However, given the limited transparency and verification systems, this is the best available information (Thorlakson, 2018). We based our search on digital material, which has the risk of underreporting the initiatives of, often smaller, companies that do not have websites or do not update them regularly. Nevertheless, we make explicit our focus on “openly reported” initiatives. In addition, there might be some noise in our numbers for market share and sustainable initiative coverage, caused by transactions between traders. For example, in Côte d’Ivoire, transnational companies are required to source 20% of their cocoa through local traders (Reuters, 2021) - it is ambiguous whether this exchange is recorded within the country (i.e., contributing to their indirect sourcing), or whether it is recorded after export, with transnational traders acting as ‘importers’ - in the latter case, our estimates of transnationals’ market share would be lower than if we were analyzing

import data.

To test whether the level of adoption of sustainability initiatives was influenced by the type of trading company, we built generalized linear models (GLM) with the adoption of sustainability initiatives as response variables, and company types and company characteristics as explanatory variables. We first assessed the correlations among variables to guide the final selection of variables and minimize the risk of collinearity in the models, using the Spearman correlation index (Crawley, 2013). If two variables showed a strong correlation (< -0.8 or > 0.8), we included the variable with the most important theoretical meaning in the statistical models. The explanatory variables comprised all the types of companies as dummy variables, and the following company characteristics that were not captured by the typology: number of destination countries, company ownership, horizontal integration, subnational sourcing, and level of vertical integration. The response variables were of two types: i) summary variables describing the overall level of engagement of a company, i.e., the number of initiatives (commitments and third-party certifications) adopted, and ii) binary variables on specific initiatives. Because of the different nature of explanatory variables, we used two types of regression models. GLM with Poisson errors was used for the cases with count data as response variables (number of commitments and certifications). Our models showed little overdispersion, justifying the selection of GLMs with Poisson errors instead of Negative Binomial errors. GLM with binomial errors (logistic regression) was used for the remaining binary response variables. We included the same set of explanatory variables in each initial model, except for variables causing perfect separation in the model. We then automatized the simplification and selection of the best-fitted model by using stepwise deletion based on the Akaike’s information criterion (AIC). To facilitate interpretation, we report the odds ratios (OR) for the logistic regression models (Table S5) and 95% confidence intervals (CI). Odds ratios represent the odds of an outcome (dependent variable) occurring in the presence of a particular condition (independent variable), if all other conditions remain constant, compared to the odds of the outcome occurring in the absence of that condition. To correct for multiple comparisons, we used the false discovery rate (Benjamini-Hochberg method) to calculate adjusted p-values (Crawley, 2013).

3. Results

3.1. The market coverage of cocoa trader types

At the global level, transnational traders handled 62% of the cocoa bean trade, with 40%, 18%, and 4% being handled by large, medium, and small transnational traders, respectively (Fig. 3). Among large transnational traders, Olam had the highest share, handling 17% of the cocoa trade, followed by Cargill with 12%, and Barry Callebaut with 11% (Fig. 4). Medium transnational companies included Ecom, which had 5% of the global market share, Touton with 6%, Sucden with 4%, and Guan Chong Bhd with 3%. The remaining 38% of the global cocoa market was handled by domestic traders, from which 27% was handled by small domestic traders, 8% by large domestic traders, and 2% by farmer cooperatives (Fig. 3). Almost all medium and large transnational traders are headquartered in high-income countries: Olam in Singapore, Cargill in the USA, Barry Callebaut and Ecom in Switzerland, and Touton and Sucden in France, with one headquartered in a middle-income country (Guan Chong Bhd in Malaysia).

Even though cocoa production has expanded to many countries and most of them are increasing production volumes, the global market remains strongly dependent on Ivorian and Ghanaian bulk cocoa supplies (Fig. 3). Over 60% of the supply of the six largest cocoa trading companies depended on Côte d’Ivoire and Ghana, with the three largest companies (Olam, Cargill, and Barry Callebaut) also sourcing importantly from Indonesia and Brazil. The CR4 indicated that cocoa bean export markets are oligopolies in all countries, except Côte d’Ivoire and Ecuador (Fig. 4). These results support our first hypothesis on the high

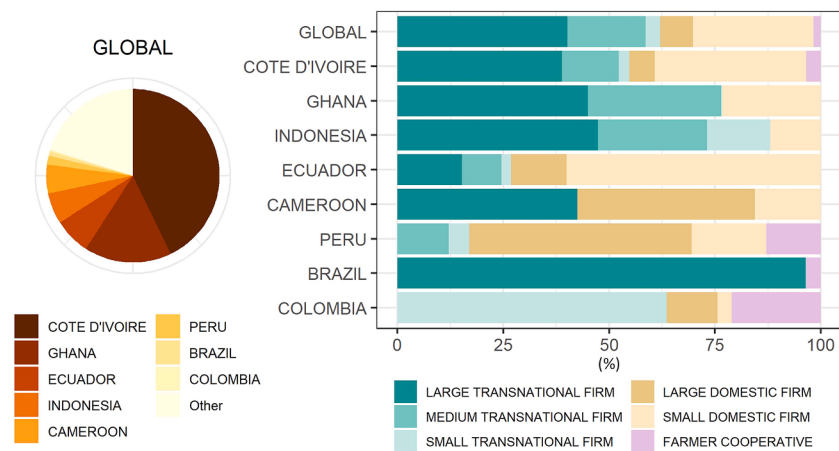


Fig. 3. Market coverage per country (left panel), and per type of trader within each producing country (right panel).

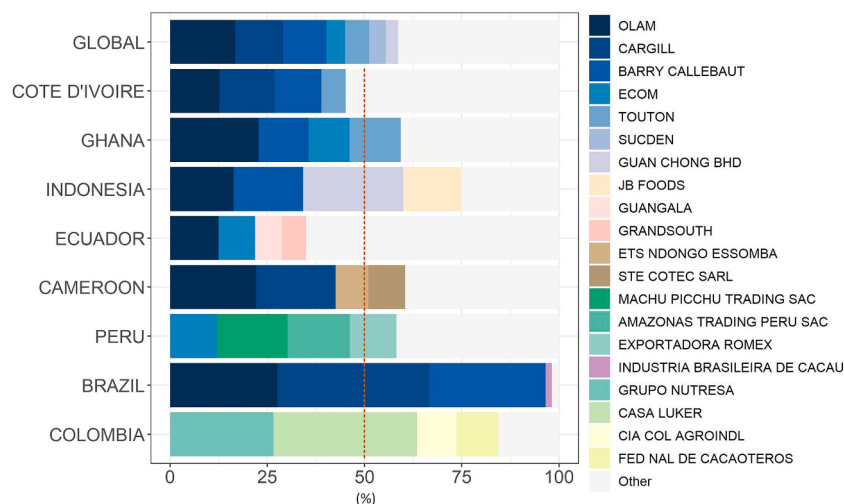


Fig. 4. Market shares of the four largest traders in each producing country, except in "Global" where the seven largest traders are displayed. The dashed line indicates where the market concentration is 50%, depicting a threshold between competitive markets and oligopolies.

market concentration extended to traders, however, it provides important nuance on the context-specific occurrence of market concentration, as it does not apply to all top exporters or globally. Most countries with oligopolies had a market dominated by the three largest transnational companies: Olam, Cargill, and Barry Callebaut. Countries where these companies did not dominate the market (Ecuador, Peru, and Colombia) had a more balanced competition between transnational and domestic traders. Transnational companies handled between 59 and 97% of the market in most cocoa-producing countries except Ecuador, Peru, and Cameroon, where domestic traders handled more than 50% of exports (Fig. 3). A special case is Colombia, where 64% of the exports were handled by the small transnational companies "Casa Luker" and "Grupo Nutresa", which are domestic traders that have expanded into other Latin-American countries in the last decade. Additionally, farmer cooperatives had a particularly strong presence in Colombia and Peru (21% and 13% of the market share, respectively). The presence of domestic traders was among the lowest in the two main global cocoa suppliers Côte d'Ivoire and Ghana (with 42% and 23% of the market shares, respectively).

3.2. Market differentiation between types of traders

Overall, transnational traders were more commonly engaged in subnational sourcing, cocoa processing, and export of other non-cocoa

commodities (i.e., horizontal integration), than in downstream activities (i.e., chocolate pre-processing and manufacture), but with

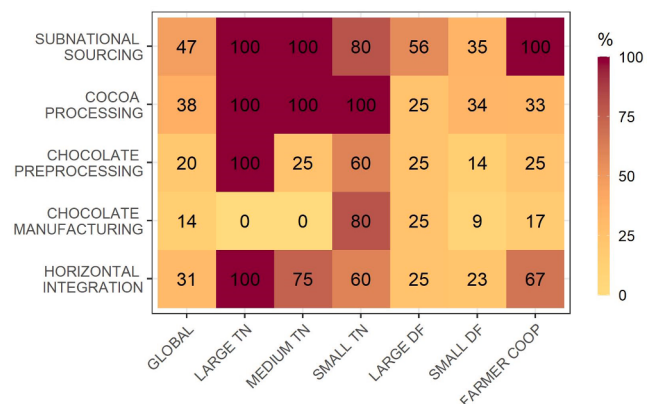


Fig. 5. Percentage of companies vertically and horizontally integrated per trader type. Because each company can do multiple activities, each row has to be interpreted independently, e.g., 60% of small transnational traders are involved in chocolate manufacturing and 60% in horizontal integration, yet these might be the same or a different set of companies. COOP = cooperative, DF = domestic firm, TN = transnational company.

important variations (Fig. 5). For example, the only transnational traders involved in chocolate manufacturing were the Colombian small transnational traders Grupo Nutresa and Casa Luker, which also produce non-chocolate finished food products. Domestic traders and farmer cooperatives mainly exported untransformed cocoa beans, with about a third involved in cocoa processing and less than a quarter in further cocoa industrial transformation. All farmer cooperatives and medium-to-large transnational traders were involved in subnational sourcing activities, while only half of domestic traders reported doing so. Horizontal integration into other agricultural commodities was the highest among farmer cooperatives and transnational traders, while domestic traders tended to focus exclusively on cocoa beans.

The diversity of countries that each trader sourced from and sold to varied greatly among types of traders (Fig. 6). Large transnational traders had a more diverse country portfolio and evenly distributed volume (higher diversity index), followed by medium and small transnational companies. Guan Chong Bhd is the only transnational firm with a low diversity because it sources almost entirely from Indonesia. The number of destination countries showed less differentiation between types of traders (Figs. 6 and 7). Large transnational traders exported to more than 45 countries while other companies exported to ~30 or fewer countries. The diversity index of export countries for large transnational companies was lowered by Cargill whose exports are unevenly targeted

to the Netherlands, which is both a major hub for re-exports and the site of four of their processing plants (Cargill, 2022). Domestic traders and cooperatives supplied cocoa to multiple international markets, either evenly or strongly focusing on a few countries, which explains the high dispersion of diversity index values (Fig. 6a).

3.3. Sustainability commitments

In line with our second hypothesis, public sustainability commitments were more commonly adopted by large traders (transnationals). Of the reviewed cocoa trading companies, only 14% made one or more public sustainability commitment. Half of these public commitments were made by transnational traders, a quarter by large domestic traders, and the other quarter by farmer cooperatives. Though domestic traders and farmer cooperatives handled 38% of the global market share, they rarely made public sustainability commitments. Only two large domestic traders publicly committed to addressing child labor and most farmer cooperatives had no commitments or focused only on one particular topic (with climate change and CLMRS rarely included). In general, companies adopting public commitments tended to adopt more than one (see Supplementary Material Fig. S5), while transnational companies were likely to adopt most of them.

We also find large gaps in the market coverage and imbalanced engagement on certain sustainability topics, in line with our third hypothesis. In terms of traded volumes, only 26% of global cocoa was traded under any commitment (Fig. 8). Yet, if commitments would also cover the indirect sourcing shares of companies, more than 60% of the whole cocoa value chain would be reached by sustainability commitments (Supplementary material Fig. S4). A key mechanism through which commitments were adopted is membership of the CFI, to which all transnational companies are signatories. The CFI sets targets for deforestation, forest restoration, agroforestry, and income diversification, but has been criticized for excluding forest degradation from corporate action plans - a notable blind spot (Carodenuto and Buluran, 2021; World Cocoa Foundation, 2017). Only three companies, covering 10% of the traded volume, committed to addressing forest degradation: Nestlé, Touton, Guan Chong Bhd, as well as the Peruvian cooperative Cooperativa Agraria Naranjillo. In contrast with other commitments, fewer transnational companies adopted child labor, CLMRS, and living income commitments.

3.4. Third-party certification labels

In line with our fourth hypothesis, we found that small companies were more likely to trade third-party certified cocoa than to adopt sustainability commitments (Fig. 8). We found, however, that although large transnational traders adopted mostly their own sustainability commitments, they also continued to trade cocoa certified under multiple labels. An important nuance is that our findings only refer to the number of initiatives of traders and not to the volume traded, since the data did not allow us to make this distinction. Overall, transnational companies and farmer cooperatives were the largest users of certification labels; 75–100% of transnational traders and 25–67% of farmer cooperatives traded cocoa with at least one certification (favoring UTZ and Organic, respectively). However, this does not mean that all of these companies' exports were certified: in Côte d'Ivoire, for example, it is estimated that <40% of exports by Cargill, Barry Callebaut, and Olam come from certified cooperatives (Renier et al., 2023). <40% of large domestic traders traded some certified cocoa, most of which had more than one certification, especially UTZ. The larger market penetration of UTZ is generally explained by its relatively lower requirements compared to other standards (Krauss and Barrientos, 2021). Domestic traders and farmer cooperatives adopting certifications were mostly based in Latin America (mainly Peru and Ecuador) and favored organic labels probably due to the larger government support to organic farmers in this region (Meemken et al., 2021; Reynolds, 2004).

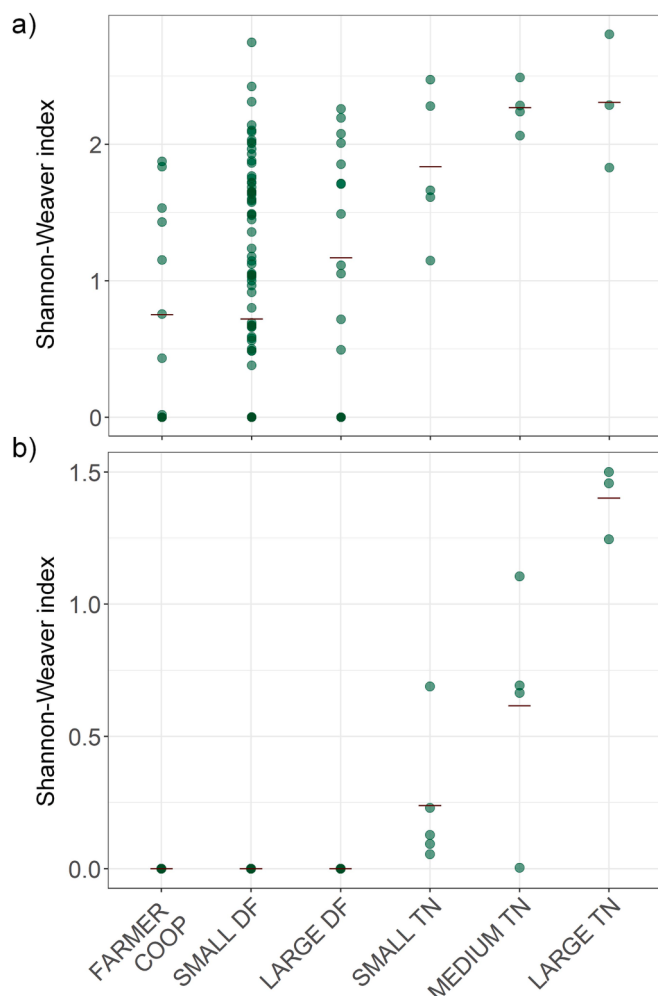


Fig. 6. Diversity and evenness of trade relations per type of trader as calculated with the Shannon-Weaver diversity index for a) destination countries and b) sourcing countries. Horizontal lines indicate mean values. Higher values indicate higher diversity in sourcing or destination countries. See numeric values in the Supplementary Material (Table S3).

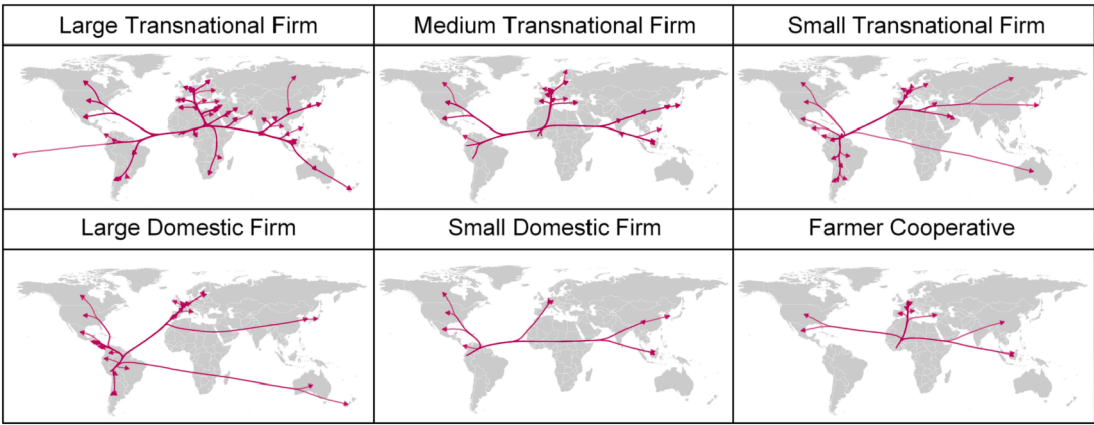


Fig. 7. Example of trade networks for each type of trader. Edges connect sourcing and destination countries. Selected companies are depicted as examples for each trader type: Olam (large transnational firm), Ecom (medium transnational firm), Casa Luker (small transnational firm), Machu Picchu Trading (big domestic firm), Sanchez Group (small domestic firm), and Ecookim (farmer cooperative).

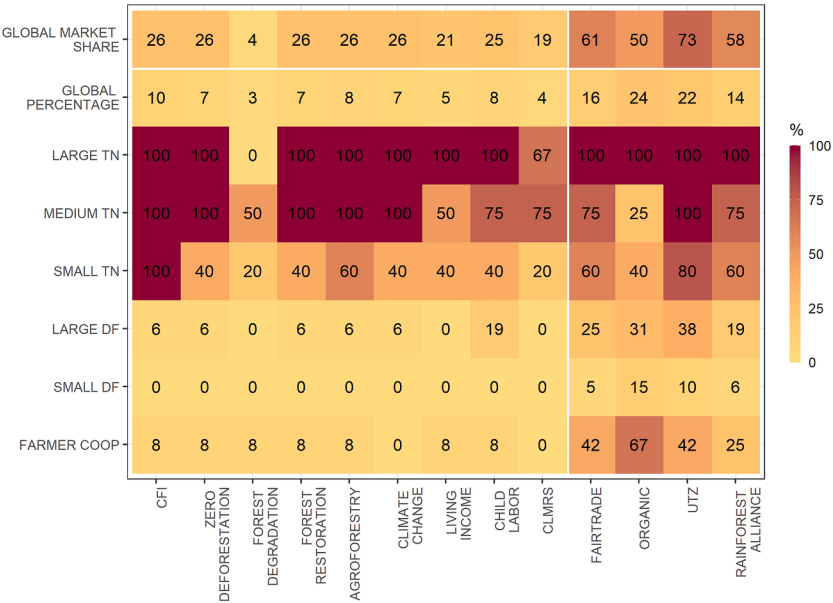


Fig. 8. Percentage of companies (bottom seven rows) and share of cocoa traded (top row) by companies adopting sustainability commitments (first nine columns) and by companies trading cocoa under certification labels (last four columns).

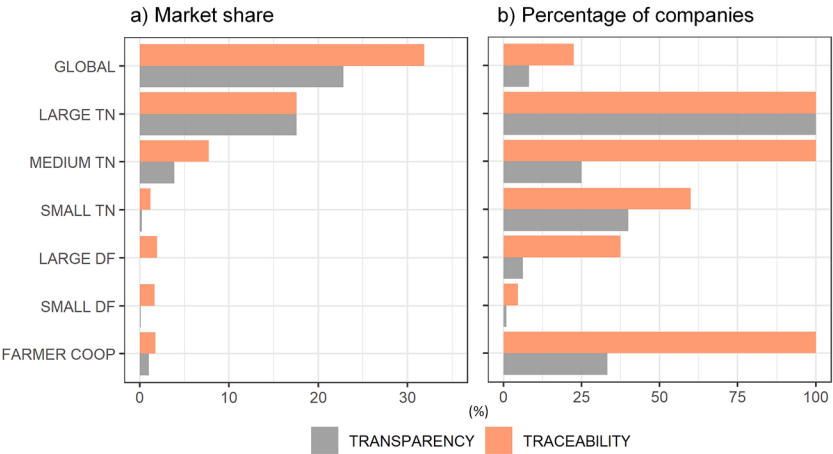


Fig. 9. Percentage of traded cocoa (a) and percentage of companies (b) having traceability and transparency systems up to the cooperative level for at least part of the cocoa traded.

3.5. Traceability and transparency

Only 22% of all companies, handling 32% of cocoa exports, reported being able to trace their cocoa back to farmer cooperatives, and only 8% of companies (handling 23% of cocoa exports) were transparent about the identity or location of their direct suppliers (Fig. 9). The information disclosed varied, but most companies disclosed either the jurisdiction of origin and/or name of farmer cooperatives, with some also including the number of farmers, certifications adopted, and volumes traded. All medium and large transnational traders traced at least part of the cocoa they source back to the cooperative level. Among medium transnational companies, only one in four, Touton, openly disclosed this information. Only 60% of small transnational companies, 38% of large domestic companies, and 5% of small domestic companies reported tracing part of the cocoa traded back to the cooperative level - in line with their lower engagement in subnational sourcing. It is important to clarify that traceability to the cooperative level does not necessarily imply full traceability to the farm level, not even for farmer cooperatives. Currently disclosed information is scattered, not constantly updated, and does not allow to verify whether traceability to farm-level is achieved by any company (Renier et al., 2023).

3.6. Correlates of sustainability initiatives' adoption

Our statistical modeling confirmed the above-mentioned results and hypothesis (Table 2). In general, the adoption of sustainability commitments was low. Transnational companies adopted significantly more sustainability commitments ($\beta > 2.1$, $p < 0.01$), and small domestic traders significantly fewer ($\beta = -3.96$, $p < 0.01$). Small domestic traders were also significantly less likely to report traceability information (OR 0.20, $p < 0.01$) or be transparent about their sourcing (OR 9E-03, $p < 0.01$) (Supplementary material, Table S4). Companies engaging in subnational sourcing acquired a significantly higher number of certification labels ($\beta = 1.74$, $p < 0.01$) and were more likely to report sourcing traceable cocoa (OR 31, $p < 0.01$). Large domestic traders were more likely to adopt child labor commitments (OR 17, $p < 0.05$). Publicly listed companies were significantly more likely to adopt deforestation (OR 18.5, $p < 0.01$) or child labor commitments (OR 19.4, $p < 0.05$). Vertically integrated companies were more likely to adopt traceability commitments (OR 2.2, $p < 0.1$) and horizontally integrated companies were more likely to adopt transparency commitments (OR 5.4, $p < 0.1$), which may reflect a “spillover” from transparency commitments set for other agricultural commodities. We also found that traders involved in cocoa processing that are horizontally integrated adopted ten times as many commitments as traders engaged in chocolate manufacturing

Table 2

Results of statistical modeling indicating regression coefficients (β). 95% confidence intervals are shown in brackets for logistic models. “-” indicates variables that were not included in the initial model due to perfect separation or collinearity; “~” indicates variables that were included in the initial model but were not retained in the final model due to stepwise model selection based on AIC values.

Explanatory variables	N° Commitments	N° Certifications	Traceability	Transparency	Zero deforestation	Agroforestry	Child labor
Large TN	2.84** (2, 3.8)	-1.03 (-2.1, 0)	-	-	-	-	-
Medium TN	2.44** (1.8, 3.1)	~	-	-1.78 (-5.1, 0.9)	-	-	~
Small TN	2.19** (1.4, 3.2)	~	-2.11 (-5.03, 0.9)	-	~	3.32* (0.6, 6.6)	3.03 (-0.1, 6.8)
Large DF	~	~	-	-2.68 (-5.9, 0.33)	~	-	2.85* (0.6, 5.7)
Small DF	-3.96** (-6.9, -2.4)	-0.65** (-1.1, -0.2)	-4.17** (-6.1, -2.7)	-4.64** (-7.8, -2.4)	-	-	-
Farmer cooperative	~	~	-	-1.22 (-3.4, 0.7)	2.34 (-0.9, 5.2)	~	~
Public company	~	~	-	~	2.92** (1.1, 5.1)	~	2.24* (0.3, 4.5)
N° country destinations	~	0.04** (0, 0.1)	~	~	0.17** (0.1, 0.3)	0.21* (0.1, 0.4)	0.24* (0.1, 0.5)
Subnational sourcing	~	1.74** (1.1, 2.5)	3.44** (1.6, 6.6)	~	~	2.13 (-0.4, 6)	2.03 (-0.4, 5.5)
Vertical integration	0.2 (-0.3, 0.6)	~	0.78 * (0.1, 1.6)	~	~	-0.85 (-2.2, 0.1)	-1.96* (-3.8, -0.6)
Horizontal integration	1.47** (0.6, 2.4)	0.35 (0, 0.8)	~	1.69 (0, 3.8)	~	2.4* (0.6, 4.8)	1.89 (-0.2, 4.6)
Vertical integration: Horizontal integration	-0.75** (-1.2, -0.2)	~	-	-	-	-	-
Intercept	-1.18 (-2.1, -0.4)	-1.76** (-2.6, -1)	-2.16 (-5.1, 0.5)	-0.72 (-3, 1.3)	-5.76** (-8.8, 4)	-7.45** (-12.6, -4.6)	-7.93** (13.9, -4.7)
Akaike Inf. Crit. (AIC)	141.73	271.43	67.77	57.32	44.97	46.36	48.48

* $p < 0.05$; ** $p < 0.01$.

(Fig. S6).

4. Discussion

In the following sections, we discuss the importance of market concentration in the prevalence, distribution, focus, and potential effectiveness of value chain sustainability commitments; the factors that may explain such market concentration in the cocoa sector; the current gaps in sustainability commitments and topics; and end with broader implications for commitment implementation, effectiveness, and accountability for addressing global environmental challenges.

4.1. Market concentration - a double-edged sword

Previous studies have demonstrated that cocoa processing and chocolate manufacturing are concentrated in the hands of a few transnational companies (Oomes et al., 2016). Here, we show that this concentration also extends to cocoa trading in which transnational traders handle around two-thirds of global cocoa exports. Often presented as an opportunity for sustainability (Folke et al., 2019; Ponte, 2019), market concentration presents a double-edged sword.

On the one hand, high market coverage can be seen as a prerequisite for corporate sustainability initiatives to be effective (Garrett et al., 2019). It has been argued that sustainability upgrading is more likely in value chains where power is exercised by a group of (concentrated) lead firms than in value chains with a more balanced power distribution (Ponte, 2019). Similarly, the “hourglass” theory of change posits that market concentration offers an opportunity for sustainability impact, as the actions of a small number of companies active in the middle of value chains can improve sustainability outcomes across large sourcing regions (Folke et al., 2019; Gollnow et al., 2022; Grabs et al., 2021; Lyons-White and Knight, 2018). For this reason, and their position as suppliers to global brands, traders have been identified as key actors in sustainable global value chains (Grabs and Carodenuto, 2021; zu Ermgassen et al., 2022). In line with agency theory, the leadership of large companies in sustainability commitments could, therefore, be advantageous if the accumulated agency of these actors is used as an opportunity to create leverage points for sustainability initiatives in the entire sector (Folke et al., 2019). This opportunity could apply to transnational traders that are horizontally integrated into trading other agricultural commodities that face similar social and environmental challenges (e.g., Cargill, Olam, and Ecom). These companies adopt similar commitments across different commodities, which is facilitated by the lower costs of expanding commitment portfolios to commodities with similar strategic requirements (Fountain and Huetz-Adams, 2017; KPMG, 2014; Oomes et al., 2016).

On the other hand, market concentration allows leading companies (principals) to exert uneven pressure on less powerful actors (agents) to obtain strategic market advantage and sustainability outcomes (Dallas et al., 2019). Concentration, for instance, increases the agency of larger companies in the priority-setting of policy agendas and can exacerbate the unequal representation of smaller actors in sustainability governance structures. Arguably, the greater focus that transnational companies and multi-stakeholder initiatives like the CFI place on forests, rather than poverty or living income, partially reflects this power over agenda-setting (Clapp, 2021; Schneider et al., 2020). Larger traders have more resources to set up commitments and can attract more investment from sustainability-oriented downstream companies. Therefore, voluntary sustainability markets indirectly provide an unequal competitive advantage to large traders, which creates a self-reinforcing process of ever-deepening market concentration (Mcdermott et al., 2022; Smith et al., 2019). Lead companies also push sustainability costs and risks upstream onto less powerful actors, the local traders or farmers supplying multinational traders, thus raising the entry barrier and leading to their own consolidation (Ponte, 2020, 2019). Despite achieving some improvements, claimed sustainability solutions might be reinforcing the

underlying drivers of sustainability issues while providing a false sense of security to consumers (LeBaron and Lister, 2021). In addition, market concentration can lead to a softening or delay of government sustainability agendas by generating a deterring effect on policy makers who fear that more stringent regulation would incentivize divestment or, even worse, the relocation of trade (Clapp, 2021). This can be of particular concern when private companies are part of multistakeholder partnerships with governments, in which the efforts to implement more stringent policy regulations are at risk to be delayed or weakened (Ponte, 2019).

4.2. Factors explaining market concentration

Concentration is partly driven by efforts to benefit from economies of scale, of particular concern in low-margin businesses, as agricultural commodity trading is typically characterized (Bonfiglioli et al., 2021; Oomes et al., 2016). It is estimated that traders only capture 3–5% of the net margins associated with a typical chocolate bar (FAO and BASIC, 2020). Market concentration between cocoa traders has occurred through a series of company mergers (Oomes et al., 2016). In Côte d'Ivoire for example, the USA trader Archer Daniels Midland exited the cocoa sector in 2013, citing low margins (Reuters, 2013). Its cocoa branch was then purchased by its transnational rival Cargill (Cargill, 2015).

The pattern of market concentration differs between producer countries. Transnational companies handle the majority of exports in Côte d'Ivoire, Ghana, Indonesia, Brazil, and Colombia, but not in Peru, Colombia, and Ecuador. The latter markets are major producers of fine-flavor cocoa (ICCO, 2020), which has a more heterogeneous and complex aromatic and flavor profile and is rarely traded in bulk volumes typical of transnational companies (Leissle, 2013; Daniels et al., 2012; ICCO, 2021; Oomes et al., 2016). The high market penetration of domestic traders in these countries is also a consequence of longstanding national incentives to national entrepreneurs (Meliciani and Savona, 2015; Neilson et al., 2020; Purcell, 2018; Scott et al., 2015). The apparent market differentiation between fine and bulk cocoa might dissipate in the future, however, as with the growth of the market for fine flavor cocoa, transnational traders are increasingly investing in in-house fine-cocoa trading divisions (Confectionery News, 2021a, 2021b).

In addition, farmer cooperatives buffered market concentration in Brazil and Peru, which are countries with long-term technical support, infrastructure, and financial assistance for rural community enterprises through government and NGO programs (Donovan et al., 2008; Neilson, 2007; Scott et al., 2015). In West Africa, cooperatives had important but lesser participation, having been supported by private companies seeking high-quality products and stable and predictable supplies in return (Donovan et al., 2017, 2008). Other countries, such as Indonesia, have given more emphasis to trade and taxation policies and have discouraged the organization of cooperatives as they gathered agency and were seen as politicized institutions (Neilson, 2007). Varying degrees of market concentration thus stem from factors related to the cocoa value chain itself (e.g., the focus of some countries on fine flavor versus bulk cocoa) as well as factors related to countries' socio-political contexts.

4.3. Gaps in sustainability commitments

Despite the existing market concentration and the leadership of large companies in commitment setting, we identified large gaps in sustainability commitments - through the partial adoption of commitments, non-signatory traders, and commitment blind spots. First, our estimate that only 26% of cocoa is traded under some form of sustainability commitment accounts for the fact that traders only apply commitments to their so-called ‘direct’ value chains, where they purchase cocoa directly from known farmer groups or cooperatives. The inclusion of indirect sourcing through intermediary local traders in sustainability

monitoring and reporting is essential to the success of corporate sustainability efforts (zu Ermgassen et al., 2022). If transnational traders were to apply commitments to volumes sourced through local intermediaries and through international spot markets, the coverage of sustainability commitments would more than double, to cover 60% of global trade.

Second, the exclusion of smaller traders is also an important contributor to gaps in sustainability commitments. Domestic traders and farmer cooperatives represent an important 'missing link' in sustainable cocoa initiatives. These companies were responsible for 38% of global trade, with only 7% of these adopting at least one sustainability commitment, and just 28% using certification labels. One positive step would be for multi-stakeholder initiatives, such as the CFI, to bring domestic traders into the fold. However, these companies would still face important challenges in implementing sustainable procurement initiatives due to the high entry barriers favored by the existing power asymmetry. Domestic companies inevitably have less agency and fewer financial resources than their larger transnational rivals to establish, for instance, costly traceability, child-labor monitoring and remediation systems, and satellite-based deforestation monitoring systems (Carodenuto, 2019; Fountain and Huetz-Adams, 2020). This is one reason why they more commonly rely on certification labels than setting up their own independent commitments. Further, traceability is a very important requirement for commitment implementation, and we found that domestic traders have a business model that limits the visibility of the value chain and complicates traceability even more. Domestic traders were less likely to engage in subnational sourcing: rather than buying cocoa from specific farmer groups, they were more likely to source through local aggregators and intermediaries (Grabs and Carodenuto, 2021; zu Ermgassen et al., 2022).

Third, in terms of sustainability topic gaps and alignment, the type of information disclosed in commitments reports focused on only a few issues, was variable, and rarely aligned with reporting norms such as the Accountability Framework Initiative (AFI, 2019). Even among transnational trading companies, some issues received more attention than others without acknowledging that the range of sustainability issues in the cocoa sector encompasses many additional dimensions, such as forest degradation, biodiversity loss, soil degradation, climate vulnerability, etc. (Tennhardt et al., 2022). Agency seems to be used to adopt commitments on factors driving reputation gains and increased value creation rather than addressing systemic issues. We found that traders more commonly adopted forest-related commitments than they adopted commitments to ensure a living income, or address child labor through the implementation of CLMRS systems. This focus also is a missed opportunity, as deforestation cannot be addressed without addressing poverty and farmer incomes as underlying drivers (Pendrill et al., 2022; Southworth, 2009; Meyfroidt et al., 2022). Even so, only three traders made explicit commitments to address forest degradation, which can rival deforestation as a source of carbon emissions and biodiversity loss and can contribute to the expansion of the cocoa frontier (Barlow et al., 2016; Matricardi et al., 2020; Renier et al., 2023). Agroforestry was actively promoted as a 'win-win' option for combining cocoa production with biodiversity protection and carbon storage. However, in most cases, companies did not provide definitions of the actual practices promoted. In addition, there is a lack of recognition that the benefits of agroforestry systems are likely to be context specific due to land use dynamics and potential leakage effects across producing landscapes (Meyfroidt et al., 2014). Where it replaces sun-grown cocoa, agroforestry can indeed benefit biodiversity, carbon storage, and soil fertility (Blaser et al., 2018; Martin and Raveloaritiana, 2022; Parra-Paitan and Verburg, 2022). But where shade-grown cocoa encroaches into old-growth forests, it is likely to erode these services too, which is a process that is not actively detected and acknowledged by sustainability initiatives (Renier et al., 2023; Wurz et al., 2022). Therefore, corporate efforts to promote agroforestry should be guided by land use planning to navigate these trade-offs (Parra-Paitan and Verburg, 2022).

In addition, by having narrow geographic units of intervention (i.e., some farmers in some areas) commitments and certification labels fail to address the systemic problems that emerge at the landscape level due to the telecoupled nature of land-based dynamics (Meyfroidt et al., 2020). The competing interests that arise at larger scales need to be addressed to avoid leakage and compromising other environmental and development agendas. Therefore, sustainable value chain initiatives can be more effective if they are aligned to and complement efforts addressing issues at wider scales and dimensions (Mcdermott et al., 2022; Pendrill et al., 2022; Smith et al., 2019).

Overall, the imbalanced distribution of commitments' scope and coverage can lead to the abandonment of important sustainability dimensions and to the displacement of negative practices into smaller non-committed companies, other locations and sectors (LeBaron and Lister, 2021). This can lead to market bifurcation where companies trading with high-demanding consumer markets prefer sourcing from cocoa origins with less social and environmental challenges, while companies trading with less-demanding markets source from countries with more challenges and less stringent regulations (Lambin et al., 2018; Meyfroidt et al., 2020). To avoid leakage and scale up the impact of own-company sustainability commitments, government interventions at multiple levels are needed to create a legally-binding level playing field where all companies are requested to fulfill sustainability criteria (Gollnow et al., 2022; Grabs and Carodenuto, 2021; Mayer and Gereffi, 2010). Yet, to avoid further marginalization of smaller traders, it is necessary to also support the bottom-up inclusion of all types of traders in the sustainability market, notwithstanding their market share, in all parts of the value chain (direct and indirect) (Gardner et al., 2018; Lambin et al., 2018; Pedersen et al., 2021).

4.4. Commitment implementation, effectiveness, and accountability

So far, we have discussed what sustainability commitments trading companies preach, which are not necessarily the same as what they practice. Though corporate sustainability commitments have been shown to improve sustainability outcomes in several commodity contexts (Chen et al., 2019; Gollnow et al., 2022; Heilmayr et al., 2020; Heilmayr and Lambin, 2016), there are also many examples of companies not living up to their sustainability ideals (Hofmeister et al., 2022; Ponte, 2020; Mighty Earth, 2022). Specifically in the cocoa sector, child labor (Krauss and Barrientos, 2021; Sadhu et al., 2020), poverty (DeFries et al., 2017; Guzmán and Chire Fajardo, 2019), deforestation (Goldman et al., 2020; Oomes et al., 2016; van der Ven et al., 2018), and environmental degradation (Barnett et al., 2021; Clapp, 2021) persist despite the proliferation of sustainability commitments.

The factors that make voluntary sustainability governance arrangements attractive for participating companies are arguably also those that potentially limits their impact. When sustainability is voluntary, it can be used strategically for product differentiation and value capture by lead firms – sometimes referred to as 'green capital accumulation' (Ponte, 2019). Besides new market opportunities, voluntary commitments offer companies flexibility in goal-setting and progress reporting, with low bureaucratic costs and no legal risks when targets are not met. As a result, voluntary sustainability commitments are not enforceable and generally lack external auditing, reporting and verification mechanisms, cross-sectoral benchmarks, and standardized definitions around sustainability issues (e.g., of deforestation, risk, agroforestry) (Clapp, 2021; Garrett et al., 2019; Meemken et al., 2021; Tayleur et al., 2017). Though some companies issue annual reports documenting the implementation of their commitments, such as the Cocoa Compass from Olam, Cocoa Promise report from Cargill, and Cocoa Horizons report from Barry Callebaut, the statements contained are not third-party verified and often do not allow distinguishing the contribution of certification labels and voluntary commitments. Altogether, the incentive for sustainability value creation, the lack of minimum standards, transparency, accountability, and the risk of softened regulation create an enabling

environment for potential corporate greenwashing (Wu et al., 2020; Ponte, 2019).

Though certification schemes are third-party audited, which in principle provides them higher accountability than voluntary sustainability commitments, the capacity of auditing bodies is questioned (Greenpeace, 2021; Ruf et al., 2019) and even certification shows limited evidence of efficacy, with heterogeneous impacts on farm worker incomes and deforestation (Dietz and Grabs, 2021; Meemken et al., 2021; Oberlack et al., 2023; Tayleur et al., 2018). Moreover, certifications focus on an even narrower set of sustainability topics than commitments, and their benefits have been reported to not match with the implementation costs (Ingram et al., 2018a; Mcdermott et al., 2022; Thorlakson, 2018; van der Ven et al., 2018). Other bottom-up initiatives complementary to certification can help navigate these challenges by enhancing the agency and representativeness of farmer organizations in global value chains. Some studies have documented positive outcomes of solidarity economy, inclusive business, and participatory guarantee schemes in sustainability outcomes and inclusive value creation. These bottom-up schemes use participatory tools to build trust-based schemes for the definition, measurement, and assessment of sustainability (Loconto and Hatanaka, 2018; Oberlack et al., 2023).

A prerequisite for the implementation of sustainability commitments, however, is knowing where the products come from. It is therefore concerning that only 32% of cocoa trading was handled by traders who reported being able to trace cocoa back to specific farmer cooperatives or groups. Ultimately, accountability and monitoring of the impact of corporate sustainability efforts requires that companies are transparent about their sourcing practices and publish independent audits of their sustainability activities. Despite annual reporting under initiatives such as the CFI, few companies (cumulatively handling 23% of cocoa trade) disclose information about the identity and location of their suppliers according to the Accountability Framework Initiative (AFI, 2019). Traceability and transparency often require costly up-front investments for GPS farm mapping, digitalization, and online transparency portals that are less available to smaller traders (Carodenuto, 2019). The need for traceability will become even more acute with proposed due-diligence legislation from the European Union and other importing markets. These laws require trading companies to geolocate the origin of deforestation-risk products, including cocoa, and provide evidence that products do not originate from recently deforested land nor are associated with human rights abuses.

Multi-level initiatives are needed to balance competition in the sustainability market and create an enabling environment for achieving sustainability upgrading (Furumo and Lambin, 2021). In addition to the bottom-up initiatives cited above, national and subnational governments can play a variety of 'orchestrating roles' to address the shortfalls of sustainable value chain initiatives and deliver improved sustainability outcomes (Ponte, 2019). Governments in producer countries can facilitate traceability for all companies regardless of their financial resources (zu Ermgassen et al., 2022). The governments of Côte d'Ivoire and Ghana, for instance, are setting up farm-level traceability systems to support sustainability accountability efforts. Similarly, governments can set minimum standards, reporting norms, or transparency requirements - arguably, the European Union's proposed due-diligence legislation is an effort to provide this for the European market, though side-effects of such policies are also likely (Sellare et al., 2022). At subnational level, jurisdictional sourcing approaches are initiatives that can help addressing the lack of oversight in indirect sourcing volumes, in which actors (e.g., companies, local governments, and civil society organizations) operating in a common jurisdiction or landscape establish targets for production, incomes, and conservation through a multi-stakeholder process (Boshoven et al., 2021; zu Ermgassen et al., 2022). Recent studies have documented the potential holistic benefits of this approach (Torralba et al., 2023) and the CFI has started to implement it by identifying a number of priority landscapes in Ghana and Côte d'Ivoire (WCF, 2023), though these remain in pilot stage. In order to make

sustainability standards enforceable, governments can move to internalize market-led or multi-stakeholder standards into regulation (Ponte, 2019). For example, in the Brazilian cattle sector, more than 100 slaughterhouses in the Amazon have voluntarily entered into legally binding sustainable procurement commitments, coordinated by the Federal Public Prosecutor's Office (Amigos da Terra, 2020). It is important to stress, however, that for improved sustainability outcomes in polycentric governance arrangements, it is not simply a case of governments creating an enabling environment for market-led initiatives, but it is also necessary for companies to support government initiatives.

5. Conclusion

The current paradigm of market-led governance arguably emerged as a response to weak national and international regulation of environmental and social issues arising in value chains (Bernstein and Cashore, 2007; Ponte, 2019). Now, more than two decades since the emergence of these initiatives, there is growing frustration at the perceived lack of progress on sustainability goals, and even their unintended consequences (LeBaron and Lister, 2021; Ponte, 2020). For the case of global cocoa trading, this study found high levels of market concentration among traders and an imbalanced representation of large companies in the adoption of sustainability commitments. Only seven companies traded most of the cocoa volumes and had the largest adoption of sustainability commitments. Despite this dominance, we identified large gaps in the adoption, framing, and implementation of these commitments which conspire to undermine their potential effectiveness: <30% of cocoa is traded under some form of sustainability commitment due to the selective focus of these commitments on direct cocoa supplies. Smaller companies, domestic traders, and farm cooperatives hold an important market share (38%) but rarely adopt commitments. The agency derived from market concentration could support sustainability efforts only if it creates leverage points for upgrading the entire sector. However, the power asymmetry from concentrated markets also creates high entry barriers to smaller traders in the sustainability market. Government interventions can help level the playing field by promoting the representation of smaller traders in sustainability agenda-setting, leading cross-sectoral initiatives to set up standards, and providing the infrastructure for traceability and transparency systems.

Further, commitment does not equal implementation or impact, and voluntary sustainability initiatives have known limitations regarding these. Voluntary mechanisms can improve certain sustainability outcomes but are insufficient to fully address sustainability issues in global value chains, as they often lack external verification, follow non-standardized definitions, cover only some sustainability topics, have limited coverage, are not enforceable, and do not address the root causes of sustainability issues that include poverty, inequality, tenure insecurity, lack of regulation enforcement, and power asymmetries. Several other interventions are needed. Jurisdictional approaches and spatial policies can support addressing the lack of commitments covering indirect sourcing, bottom-up initiatives can enhance the agency and representativeness of farmer organizations, and national and international initiatives can help minimizing spillovers across locations and sectors. Coordinated corporate and government efforts to make sustainable supply chain initiatives transparent, monitorable, and enforceable are needed to make the cocoa sector succeed in closing the gap between sustainability rhetoric and reality.

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CRediT authorship contribution statement

Claudia Parra-Paitan: Conceptualization, Methodology, Validation, Software, Formal analysis, Investigation, Resources, Visualization, Data curation, Writing – original draft, Writing – review & editing. **Erasmus K.H.J. zu Ermgassen:** Conceptualization, Methodology, Data curation, Supervision, Writing – review & editing. **Patrick Meyfroidt:** Conceptualization, Methodology, Supervision, Funding acquisition, Writing – review & editing. **Peter H. Verburg:** Funding acquisition, Writing – review & editing.

Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

- Claudia Parra Paitan currently works for Olam Food Ingredients, her engagement with Olam started after the completion of this research article and Olam had no influence over the content of this work.
- Erasmus zu Ermgassen: no competing interests
- Patrick Meyfroidt: no competing interests
- Peter Verburg: no competing interests

Data availability

The data and code used to obtain the figures and statistical results reported in this article are available in DataverseNL (<https://doi.org/10.34894/XO5E7I>).

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.gloenvcha.2023.102696>.

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