



Clima-LoCa

Fostering low cadmium and climate-relevant innovations to enhance the resilience and inclusiveness of the growing cocoa sectors in Colombia, Ecuador, and Peru



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Briefing Note No. 4

Effects of the EU food safety regulation on cadmium on the cacao value chains of Colombia, Ecuador, and Peru

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Key messages



The effects of the EU food safety regulations on cadmium in cacao (EU 488/2014 – EU 2021/1323 of 10 of August 2021) vary markedly between and within countries due to differences in markets and value chain structures.



The regulation has caused severe localized impacts in specific cacao growing areas, nevertheless in general the impacts have been minor.



Farmgate prices have remained stable in the largest production areas, but farmers in highly affected areas such as Piura, Peru and Sucumbíos, Ecuador report Cd-related price reductions of 31% and 20%, respectively.



Exporting companies and cooperatives are facing operational cost increases of up to 20%, related to Cd mapping, blending of cacao beans, increased traceability demands, marketing efforts, and additional laboratory testing. They also experience

substantially lower prices and foregone incomes from changes in their clients. This has been critical for specialized cooperatives and producers in areas with high bean Cd.



Changes in export destination for cacao during the last 4 years cannot solely be attributed to the regulation, but these represent foregone incomes in 2020 of nearly USD 3.4 million in Peru and USD 1.6 million in Colombia, equivalent to 2.4% and 6% of the countries' cacao export value respectively.



In Colombia, other effects have been reported, such as reduced investments from companies and development donors in areas with high Cd, limiting the farmer's adaptation capacity.



Adoption of similar food safety regulations by other importing countries may further limit the adaptation capacity of exporters and cooperatives.

Introduction

Cacao is an important crop in Colombia, Ecuador, and Peru, as a traditional part of the diet and a driver of industrial development (Colombia), a key export crop and source of foreign revenue (Ecuador) or as flagship for alternative development and illicit

crop substitution (Colombia and Peru). Currently, around 260,000 farmers in the region are involved in the production of more than 548 thousand tons of cacao annually covering over 950 thousand hectares (Table 1).

Table 1. Cacao value chain indicators for Colombia, Ecuador and Peru in 2020.

Indicator	Colombia	Ecuador	Peru
Producers	52,000	120,000	90,000
Production (in t)	63,416	327,903	158,944
Sown area (in ha)	189,000	590,579	177,000
*Value chain exports (in USD millions)	110	1,030	266
Bean exports (in USD millions)	28.6	904	145
Bean exports (in t)	11,146	335,833	53,000
(Average export price FOB - in USD / kg)	2.53	2.69	2.71

*Includes cocoa beans, paste, butter, powder, chocolate, and other confectionary products.

** Average international cacao price 2020 = USD 2.47/kg.

Sources: MAG, 2022 [1]; SINAGAP, 2022 [2]; MIDAGRI, 2022 [3]; Fedecacao 2022 [4]; Agronet, 2022 [5]; Legiscomex, 2021 [6]

The three Andean countries are recognized for producing most of the world's Fine or Flavour cacao (FoF), which is sought after by speciality chocolate manufacturers [7]. ICCO states that 95% of Colombia's production, and 75% of that of Ecuador and Peru is considered FoF, and this has been one of the main marketing strategies to obtain higher prices¹. The three countries also share a common challenge: Some of the cacao produced has a relatively high cadmium (Cd) content compared to other producing areas in the world [9]. This has been attributed to the presence of cadmium in the soil, as well as that cacao appears to be a high Cd accumulator [10]. Cadmium can be a serious health risk when too much is present in the human diet, leading the European Commission to establish maximum levels in all foods including cacao-based consumer products such as chocolate and cocoa powder, which have been in force since January 2019 [10, 11]. While the limits do not refer to cacao beans, buyers in the European Union (EU) have established their own limits of Cd on the raw material, ranging from as low as 0.3 ppm to over 1.5 ppm, with most requesting between 0.5 and 1.0 ppm in fermented dried beans.

Over the past years, studies have investigated the sources of Cd in the three countries, the spatial distribution of Cd in soils and beans, and the possible mitigation strategies for reducing Cd accumulation in cacao [12, 13, 14, 15, 16, 17, 18, 19], but few have examined the effects of the regulation on the cacao value chains and their stakeholders. The Clima-LoCa project is generating a series of briefing notes to examine some of the commonly asked questions and misconceptions regarding cadmium and cacao, based on a scientific approach. This note aims to enrich these discussions by presenting a regional study of the different effects of the EU food safety regulation between, within and along the cacao value chains of the three countries.

This briefing note combines information from three country reports conducted between 2021 and 2022, as well as relevant findings from the available literature to examine the current state of knowledge of the spatial distribution of Cd content in cacao farms in the three countries, how the EU regulation has affected different stakeholders, and how they are managing the problem. With the information presented in this document, we also improve and update literature available to date.

1. It's important to note that the FoF denomination remains controversial, as there are no universally accepted criteria for classifying cacao as FoF [7]. There are positive differentials between these countries average export prices and the international cacao prices (Table 1), but these vary substantially between the countries, haven't been consistent throughout the years, and have not been widely accrued, as specialty markets are particularly small [8].

Cadmium presence and cacao volumes potentially affected in Ecuador and Peru

In this section we present the latest available information regarding Cd content in cacao beans in Ecuador and Peru. Based on the studies from Thomas et al. in Peru [14], and Argüello et al. in Ecuador [13], we estimated the number of families and production potentially impacted by the Cd regulation in the two countries. We employed 3 different thresholds for determining Cd risk exposure: 1) Low risk = less than 0.5 ppm, 2) Medium risk = between 0.5 and 1.0 ppm, and (3) High risk = above 1.0 ppm. While there is no publicly available information regarding Cd distribution in cacao beans for Colombia, a map of Cd distribution in soils was published by Bravo et al. [12] which reveals high risk areas in the departments of Santander, Arauca, Boyacá, Córdoba, and northwest of Antioquia. Similar estimations for Cd concentration in beans will be conducted for Colombia as part of the Clima-LoCa project when more information becomes available.

It is important to highlight that the information in this section must be used as indicative (potential impacts) considering that while some farmers may be located in high-risk areas, it doesn't necessarily mean that they are currently experiencing negative impacts from the regulation due to post harvest management such as blending, or exporting to non-EU countries or to non-speciality markets.

Based on the three risk categories and official sector statistics, we estimated that 19% of Ecuador's cacao production (61,031 t) falls under the high-risk category and 25.8% in medium-risk (81,971 t). Most of the production volume in the high-risk category is found in the provinces of Guayas (19,644 t), Manabí (12,326 t), Esmeraldas (9,791), and Los Ríos (6,918). It is important to note that these are the largest cacao producing provinces in the country, resulting in large volumes potentially affected, however, the provinces of El Oro, Sucumbíos, Orellana, and Azuay have the highest proportion of cacao with Cd contents above 1.0 ppm, ranging from 40% to 80% of the analyzed samples. (Fig. 1). These provinces add up 6.2% of the national production.

In Peru, we estimated that between 9% and 35% of the producers could potentially experience current or future barriers to exporting due to high Cd levels in their beans. The Cd problem is concentrated in the northern part of the country, particularly in Piura, Amazonas, and Tumbes where the shares of cacao at high risk are 83%, 56% and 41% respectively. At a national level it is estimated that around 3.6% of the total production could be classified at high risk (around 5,000 t), and 41% at medium risk (around 58,000 t).

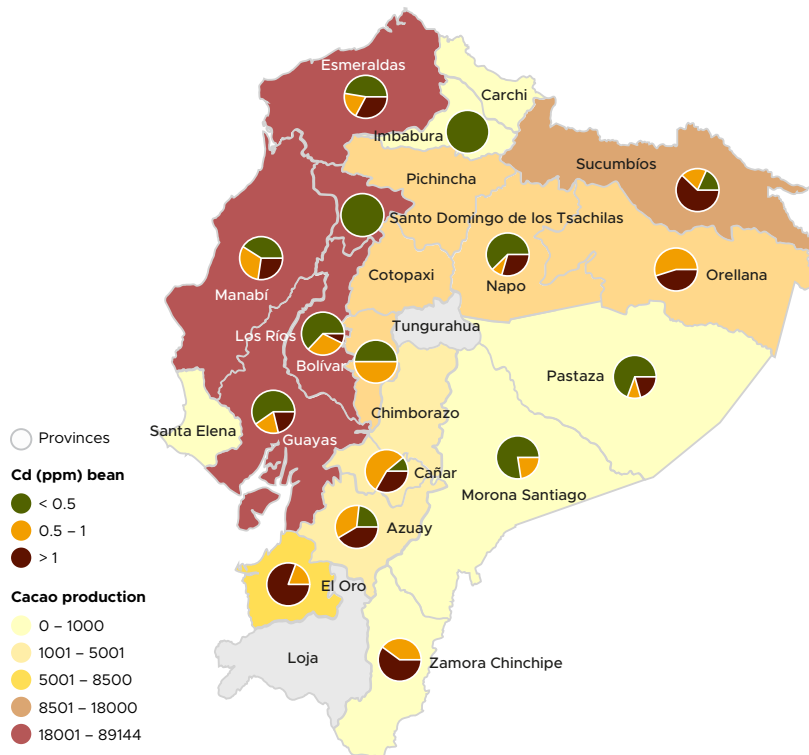


Figure 1. Regional differences in Cd concentration in cacao beans in Ecuador. Data from Argüello et al. 2022 [13]

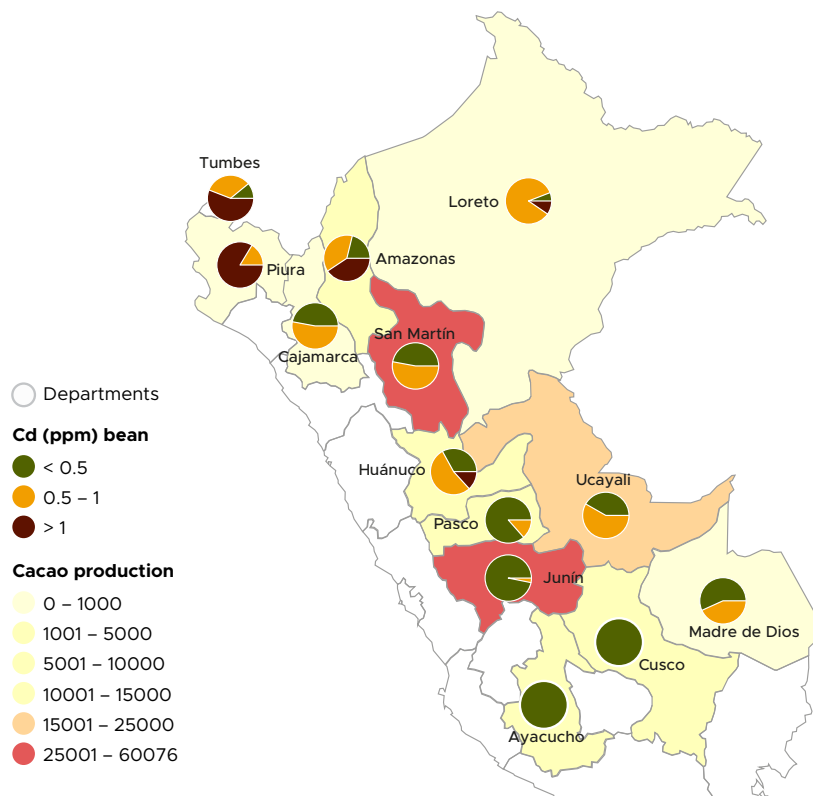


Figure 2. Regional differences in Cd concentration in cacao beans in Peru.
Data from: Thomas et al. (2022) [14]

Impacts and changes in practices reported by the value chain actors

We identified the impacts and changes in practices along the value chains in response to the regulation, based on semi-structured interviews with representatives of 145 organizations from the three countries who had either national or regional operations in the following departments/provinces:

- **Colombia:** Antioquia, Arauca, Cesar, Putumayo, Santander, and Tolima.
- **Ecuador:** Esmeraldas, Guayas, Manabí, Napo, and Sucumbíos.
- **Peru:** Amazonas, Huánuco, Piura, San Martín, and Ucayali.

Perspectives reported by companies and export cooperatives:

The larger buyers and exporters interviewed in the three countries have maintained their prices and buying areas. Nevertheless, some expressed reservations in buying from regions with high bean Cd and recommend avoiding establishment of new plantations in these areas until successful mitigation measures have been developed. To manage the

problem, companies have mapped Cd risk areas, identified new customers with lower demands for Cd, and are conducting regular Cd testing of samples. These actors sell mostly bulk cacao, semi-finished and finished products, enabling them to develop protocols for classifying and blending cacao beans according to their customers' requirements or adjusting their product formulae to comply with the regulation. Their capacity to adapt and diversify products and clients has allowed them to maintain prices regardless of Cd levels but they report increases in operational, logistical, and R&D costs of up to 20%. It is important to note that some costs, such as Cd mapping and R&D, have been partially covered by the public sector and international cooperation funding.

Exporting cooperatives and companies operating in high Cd areas that sell mostly certified or FoF cacao to specialized markets² reported that, on top of the additional costs, they had to reduce or stop buying in the most affected regions. Twelve organizations (out of 68 interviewed) report difficulties to various degrees, and 2 have even reduced their purchase prices. These organizations have attempted to mix

2. The most notorious case is in Piura, Perú where over 50% of the families report income losses and the cooperative NorAndino reports major reductions in purchases.

high Cd beans with lower Cd cacao while maintaining the flavor profiles, but this has proven difficult and, in many cases, unfeasible. Selling high Cd speciality cacao in conventional markets has represented an average reduction in prices between USD 500 and USD 700 per ton (between 21 to 29%).

Producers' perspectives:

Most of the producer representatives in the three countries expressed little knowledge about the regulation or health concerns related to Cd. They had also not experienced any economic impact. This is explained by a lack of changes experienced at a commercial level, as most producers reported that Cd levels are not a requirement from their buyers (whether they are large companies, intermediaries, or producer organizations).

Nevertheless, there are groups of producers located in regions where high levels of Cd in beans coincide with the production of speciality cacao that have been severely affected by the regulation. That is the case for over half of the producers of cacao “Blanco de Piura” in Peru, who cannot sell for export via the cooperative, and instead have to sell to the national bulk markets, losing price premiums of more than 30%. By August 2022, the price gap for farmers in the region between specialty and bulk cacao widened, with USD 2.44 / kg for low-cadmium organic “Blanco de Piura”, compared to the USD 1.78/kg paid by the bulk market. In Ecuador, one association in the province of Sucumbíos reported price decreases of 10% to producers located in areas with high Cd concentration in beans. In Colombia, no price decrease has been reported.



Perspectives from actors supporting the value chain³:

It is important to add that cacao producers in some affected regions have been affected in ways that have not been easily perceived by them. In Colombia, NGOs and companies reported a reduced investment interest among the private sector and some development agencies, who have redirected their resources to areas with lower Cd contents. This has diminished the already scarce resources available to support the most affected households in mitigating the economic impacts of the regulation.

Private and public sector representatives from the three countries along with international cooperation projects have engaged in building and advancing

agendas for the management and mitigation of the effects of the Cd regulation with different degrees of progress. Nevertheless, most of the actors in all countries suggest that greater efforts for cooperation and communication strategies are needed as they lack knowledge on the progress from other initiatives and have limited access to information.

While agricultural research centres, international cooperation agencies, cooperatives, companies, and technical assistants have proposed or are investigating the viability of a range of options to reduce Cd accumulation by cacao, so far, scientific evidence for their effectiveness under different soil conditions is still very limited [10], and these the practices and recommendations have not been implemented at scale.

3. This group includes public sector representatives, research institutions, NGO's and other service and support providers.

Effects on the export structure of cacao beans and cacao-based products

From the EU's perspective, the regulation has affected a relatively small group of chocolate makers, as the region only imports around 6.2% of its cacao beans from the three Andean countries and most of this volume is traded at commodity market prices (or slightly higher). However, individual niche chocolate makers have been seriously impacted, being unable to market single origin bars from certain regions. From the perspective of the Andean countries, the effects have been more pronounced but varying due to the differences between their value chain structures, trading partners and market segments.

Each country's value chains have developed to serve different market segments. Ecuador is by far the largest player in the region, specializing in the export of cacao beans for bulk markets, with some actors serving speciality markets; Colombia is the smallest producer of the three countries, but has a large and well-established national industry that serves domestic and international markets with chocolates and cacao semi-finished products for different segments. The country has relatively low bean exports, and most of the volume is currently destined to bulk markets. Peru presents a particularly diverse structure; it is the

world's second-largest producer of organic cacao [20], exports a large share of its cacao as beans to both bulk and speciality markets, and houses a growing industry exporting cocoa butter and powder.

Ecuador

Ecuador is the largest cacao producer in the region, with total value chain exports in 2020 surpassing US\$ 1 billion. Nearly 90% of the export value comes from beans (335.833 t in 2020), followed by cacao paste comprising around 7% of the total value [6]. While historically the EU has been an important trading partner for the country, the USA, Indonesia, and Malaysia have purchased over 60% of its cacao during the past 7 years.

Cacao bean exports from Ecuador to the EU declined from 89,000 t in 2017 to 73,000 t in 2020, whereas in the same period, exports to Indonesia and Malaysia, and USA increased by 39,000 t and 18,000 t respectively. While the export market shares have changed, the average export prices to the EU compared to USA, Indonesia and Malaysia are similar (sometimes even lower), therefore the regulation has not resulted in impacts to the cacao value chain income.

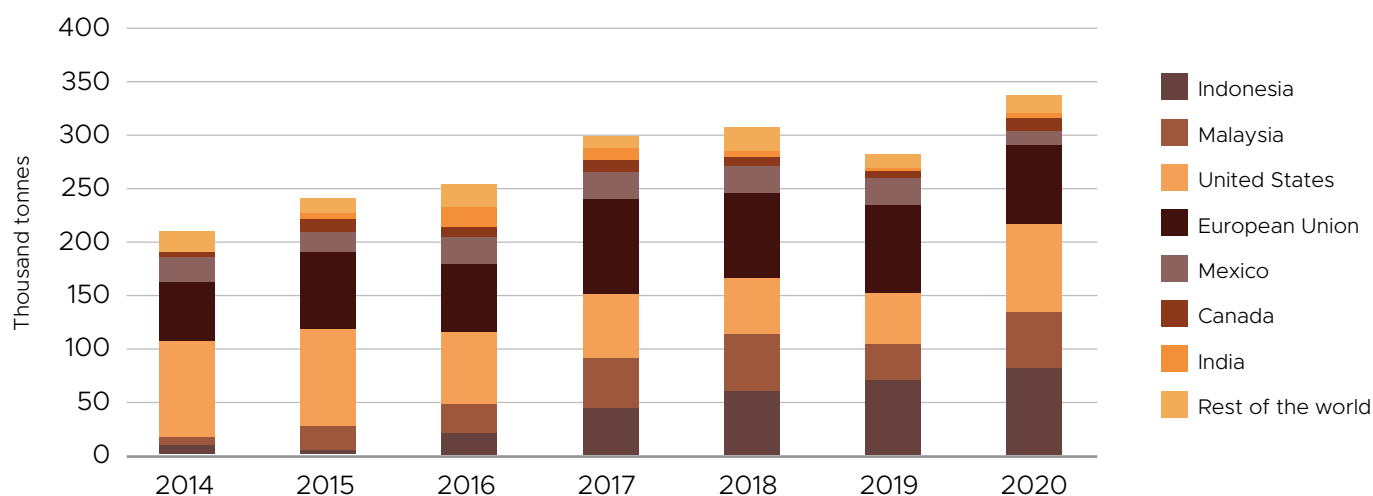


Figure 3. Annual cacao bean exports from Ecuador to its largest trading partners (in thousand t) between 2014 and 2020. Data from: Legiscomex, 2021 [6]

Peru

Peru produced nearly 160,000 t of cacao beans in 2020 [2]. Its value chain exports amounted to nearly USD 270 million, and while the main form of export is cacao beans (54% of the total value), processed products such as cacao butter, powder, and chocolates (to a lesser extent), have been gaining ground at an accelerated pace [6].

Regarding cacao beans, over 70% of the country's exports before 2016 were directed to the EU, but the destinations have changed substantially during the past years. Total bean exports decreased from 59,000 t in 2017 to 53,000 t in 2020. This reduction came mostly as the EU decreased its imports by 12,000 t, which was only partially compensated by the increase of 5,000 t going to Indonesia and

Malaysia. Unlike Ecuador, these changes have implications in the value chain income, as the prices paid by the EU for Peruvian cacao have been consistently greater than the country's average export prices [particularly compared to prices paid in Indonesia and Malaysia, which have been below that of the New York Exchange (NYE)]. This might be explained because a large share of the organic cacao was destined to EU, which garners a higher price than bulk cacao.

While the changes in export destinations cannot be fully attributed to the regulation, all surveyed actors with clients in the EU consistently declared a reduction in their exports to the region due to Cd restrictions. If the share of cacao bean exports to the EU had remained at the levels of 2013–2017 (i.e. 75%),

an additional 11,500 t would have been exported to this region in 2020, with an average price surplus of USD 300/t. This represents USD 3.4 million of foregone income for the exporters (2.4% of the bean export value).

Cocoa powder exports also experienced important changes. In 2020, Peru exported USD 20 million worth of cocoa powder, with USD 568,000 destined to the EU. This represents a large reduction from the nearly USD 1.5 million exported to the EU in 2017. EU clients have consistently paid higher prices for cocoa powder compared to clients in other regions. If the export market share had remained at levels of 2013–2017, the changes in destinations would amount to yearly forgone incomes for exporters between USD 200,000 and USD 450,000.

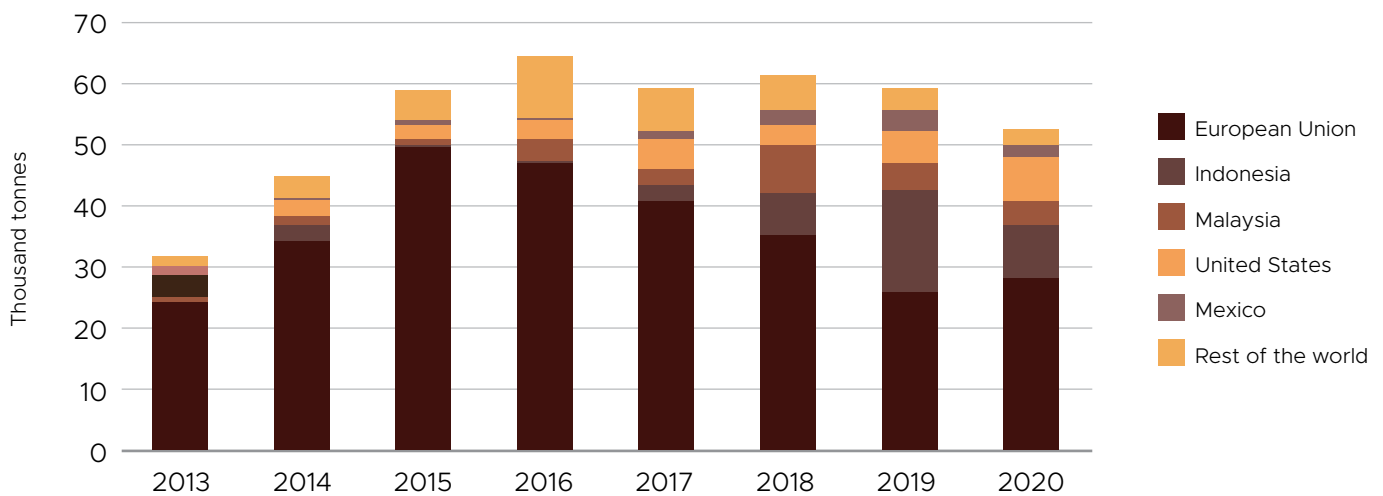


Figure 4. Cacao bean exports from Peru (in thousand t).
Data from: Legiscomex, 2021 [6]

Colombia

Colombia produced over 60,000 t of cacao beans in 2020, but only exported 11,000 t [6]. Nearly 80% of the production is absorbed by two national processors [8]; while these companies export beans, their main products for export are chocolates and other cacao semi-finished products. The largest trading partners for these companies are based in the Americas (USA, Latin America, and the Caribbean) with some exports to the EU, mainly in the form of cocoa butter and chocolates⁴.

Regarding bean exports, the EU was the country's largest trading partner before 2018 (with over 50% of the total share), but since then, the export structure has changed remarkably [6]. Unlike Peru and Ecuador, most of Colombia's bean exports during the last four years have been redirected towards Mexico, with a steep decrease in the volumes exported to every other region. By 2020, the ECOM office in Mexico

was the largest buyer of Colombian cacao beans, acquiring nearly 7,500 t, highlighting a strong export concentration. For the Colombian value chain, the EU regulation appears to have catalyzed changes in destinations by facilitating the concentration of cacao exports to fewer players through a reduction of competitiveness and increased transaction costs.

As in the case of Peru, the changes in export destination cannot be attributed solely to the regulation. Nevertheless, if the share of cacao bean exports to the EU had remained at the levels prior to 2018, an additional 4,200 t would have been exported to this region in 2020, with an average price surplus of US\$ 380/t. This amounts to USD 1.6 million in foregone income for the exporters (or 6% of the bean export value). For chocolates and other cacao subproducts, the EU has been a relatively small trading partner and no substantial changes were observed.

4. Cacao butter does not contain cadmium, as it is concentrated in its solids. To calculate the cadmium content of different chocolate formulations, visit <http://www.chocosafe.org>

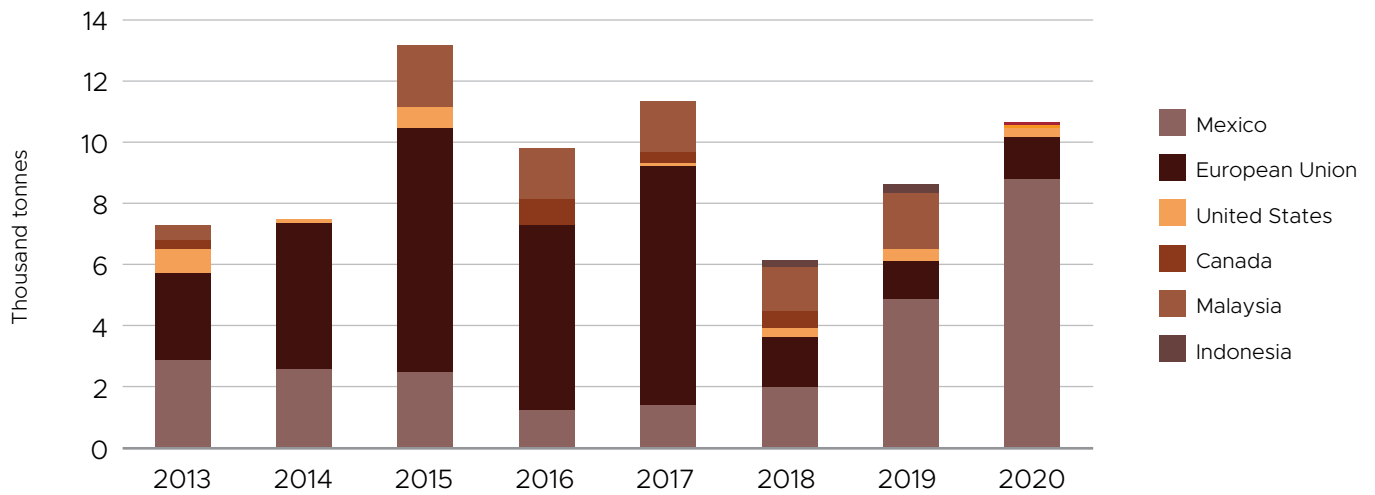


Figure 5. Cacao bean exports from Colombia to its largest trading partners (in thousand t).
Data from: Legiscomex, 2021 [6]

Effects of the EU regulation on national prices

To study effects of the regulation on internal cacao prices we analyzed price data for the period between 2016 and 2022 for the three countries as well as the international prices. No major tipping points are visible around the time of the regulation. Additional econometric tests showed no evidence of significant breaking points that could be attributed to the regulation⁵ and Granger causality tests between NY

prices and each of the three countries confirmed that most of the internal price dynamics in the countries are explained by international price changes, with no noticeable differences prior or after the regulation came into force. This result corroborates the discussion above that the regulation has not affected the actors involved in bulk cacao markets, and highlights the difficulties of identifying specific effects on small volume markets of speciality cacao using public statistics.

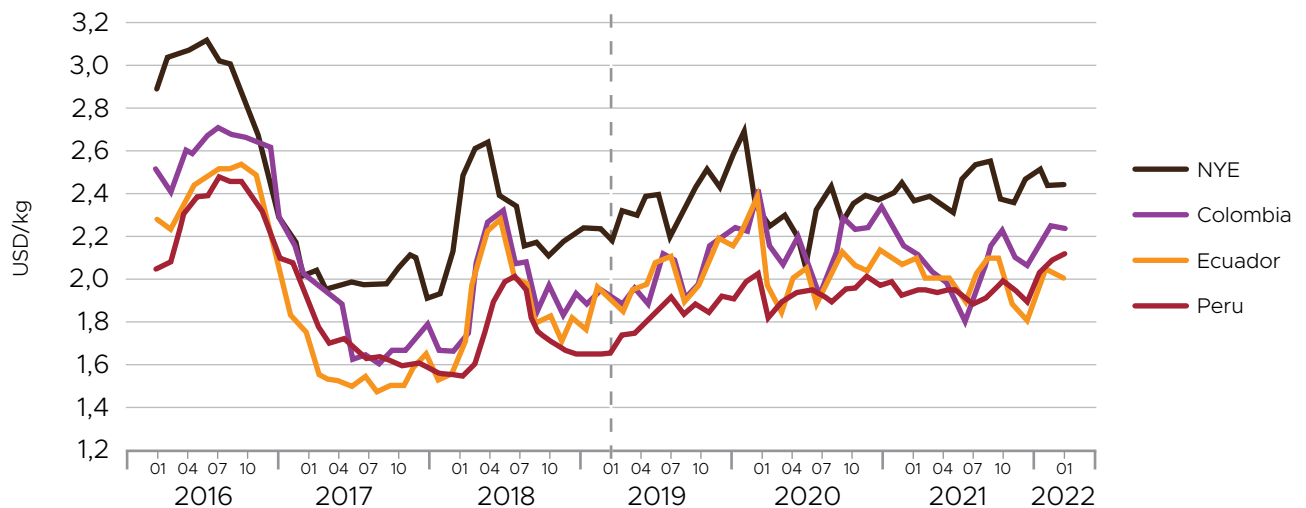


Figure 6. Internal purchase prices of cacao in Colombia, Ecuador and Peru vs NYE prices (in USD/Kg).

* Colombian prices correspond to the average price in national purchase centers. The price received by the producer may be lower depending on the distance and ease of access.

* Ecuadorian prices correspond to the interprovince average local purchase prices of dry cacao beans.

* Peruvian prices correspond to average farm gate prices.

* The vertical line marks January 2019, the beginning of the enforcement of the regulation.

Sources: SINAGAP, 2022 [2]; MIDAGRI, 2022 [3]; Agronet, 2022 [5]; ICCO, 2021 [21]

5. We calculated a set of Wald statistics to identify every possible breaking point in the time series, employed the CUSUM (cumulative sum test for parameter stability) methodology, and evaluated breaking points at three moments using the Bai and Perron algorithm.

Discussion of conclusions from previous studies

During the course of this work, we identified 5 related studies regarding the economic effects of the EU regulation on the cacao value chains of the three Andean countries. These were conducted before or during the first years of the enforcement of the regulation and present opposing conclusions both to each other and to the work presented here.

Three of these studies examined the potential effects of the EU regulation on the Peruvian cacao value chain (Alianza Cacao Perú (ACP) [22, 23] and Conseil Santé [24]). The ACP studies highlight the major changes in export destinations of Peruvian cacao beans from Europe to Southeast Asia and estimated that nearly 44% of the total cacao production (around 60,000 t) could have Cd concentrations above 0.3 ppm, which would result in price reductions ranging from USD 100 to 200 per ton due to a weakened bargaining power of the exporters. They predicted critical impacts for the cocoa powder industry, foreseeing its closure due to increased costs and reduced market prices. The study by Conseil Santé estimated that producers with cacao with high levels of cadmium could see income reductions from 24% to 61% and predicted a reduction in production of up to 7,000 t due to plantation abandonment in the most affected regions. These studies evaluated different scenarios

and responses from the value chain actors, but as the data presented here shows, they may have underestimated the ability of the actors to adapt to the new regulation.

ICCO carried out two studies [25, 26] that recognize the structural shifts in the export destinations of the three countries but conclude that it is not possible to attribute these changes to the regulation. Their conclusions are based on two premises: i) the increased volume of grinding in Indonesia and Malaysia significantly explains a large share of the changes in export destinations from Peru and Ecuador, and ii) Colombia's changes in export destinations are blurred and inconsistent with their hypothesized effects of the regulation.

As discussed in this document, while the change in export destinations from the Andean countries could be due to several factors, the explicit direct effects of the regulation for producers and exporters in some regions cannot be attributed to the growing processing market in Southeast Asia. As for Colombia, the redirection of exports from Europe to lower value markets has been linked by large and small exporters to the difficulties derived from the regulation.



Implications and policy recommendations

As identified in this document, the EU regulation is having severe and highly localized effects in regions that produce speciality cacao and have high Cd levels. Both producers and cooperatives in these areas are facing dramatic challenges for their continuity in the sector, and rapid measures should be taken to protect the livelihoods of the already vulnerable families. In this study we identified producer groups in Piura and Amazonas (Peru) Sucumbíos, Esmeraldas and Guayas (Ecuador), who have reported economic losses ranging from low to critical. The effects have been particularly dire in Piura and major efforts are being made to manage the problem and allow the continuity of their fine flavour profile.

For bulk cacao, most of the value chain actors in the three countries have managed to adapt to the regulation and continue their operations with minor disruption. The effects on exporting producer organizations and companies include customer changes, foregone incomes, and increased R&D and operational costs. With the help of national and international cooperation funds, these organizations have absorbed most of the costs. Moreover, since most of the producers in the three countries are linked to bulk value chains, national farm gate prices of cacao have remained consistent.

While measures for reducing Cd accumulation by the tree are still limited, interventions with farmers in areas with high bean cadmium are focusing on increasing yields and other ways to complement/diversify their income to compensate for income losses. In areas with exceptionally high Cd levels, transitioning to other crops or land uses is also an option. The suitability and cost-efficiency of any strategy will depend on the characteristics of each farm and respective Cd levels, for which -site/context-specific diagnostics and interventions are necessary.

While the negative impacts of the Cd regulation remain concentrated in specific geographical areas and market segments, existing and upcoming food safety regulations for Cd in other importing countries and crops constrain the adaptive capacity of exporters and processors in the future, as well as the value chain's potential for developing specialty cacao profiles⁶. The joint FAO/WHO Expert Committee on Food Additives (JECFA) considered the EU limits to have disproportionate effects, and together with the Codex Alimentarius committee, have expressed that a less strict limit would be sufficient for safeguarding consumers health and minimizing impacts in producer countries [27]. A working group on cadmium and cacao from the



Codex Alimentarius committee has reviewed and approved new limits for the different cacao-based products, with considerably less strict values (limits for cocoa powder are still in review)⁷. This will not be likely to affect the EU limits but is expected to inform all other Codex signatories. While less strict limits may represent a solution for stakeholders in bulk markets, it is likely that producers with significant Cd levels in specialized regions remain affected, needing additional long-term strategies if they are expected to continue in the market. Any program promoting the establishment of cacao as illicit crop substitution or development alternatives for rural communities in the three countries should include a Cd risk assessment as part of their selection criteria, as it this can severely hinder their future market potential.

6. Such as proposition 65 in California, USA.

7. Especially for cacao powder, with 2.0 ppm compared to 0.6 ppm in the EU regulation.

References

1. MAG. 2022. Cifras agroproductivas. Sistema de Información Pública Agropecuaria. <https://bit.ly/3otlpFz>
2. SINAGAP. 2022. Sistema de información pública agropecuaria [Database]. <http://bit.ly/3ZbDmGz>
3. MIDAGRI. 2022. Sistema Integrado de Estadística Agraria [Base de datos]. https://siea.midagri.gob.pe/portal/siea_bi/index.html
4. Fedecacao. 2022. Estadísticas nacionales. <https://www.fedecacao.co/>
5. Agronet. 2021. Estadísticas sectoriales. [Database]. <http://bit.ly/3lwd2Jz>
6. Legiscomex. 2021. Cacao and derivatives export data – Colombia, Ecuador and Peru. [Database].
7. ICCO. N.d. Fine or Flavour Cocoa <https://www.icco.org/fine-or-flavor-cocoa>
8. Abbott PC; Benjamin TJ; Burniske GR; Croft MM; Fenton M; Kelly CR; Wilcox Jr MD. 2018. Analysis of the cocoa production chain in Colombia. Analysis of the cocoa production chain in Colombia.
9. Meter A; Atkinson RJ; Laliberte B. 2019. Cadmium in cacao from latin America and the Caribbean. A review of research and potential mitigation solutions. Caracas: CAF. Retrieved from <http://scioteca.caf.com/handle/123456789/1506>
10. Vanderschueren R; Pulleman M. 2021. Cadmium in cacao: what we know about mitigation practices. Clima-LoCa Briefing Note No. 2. International Center for Tropical Agriculture (CIAT). Cali, Colombia. 10 p.
11. European Union. 2014. COMMISSION REGULATION (EU) No 488/2014 of 12 May 2014 amending Regulation (EC) No 1881/2006 as regards maximum levels of cadmium in foodstuffs. <https://bit.ly/40d6Q87>
12. Bravo D; León-Moreno C; Martínez CA; Varón-Ramírez VM; Araujo-Carrillo GA; Vargas R; Rodríguez EAG. 2021. The first national survey of cadmium in cacao farm soil in Colombia. *Agronomy* 11(4):761.
13. Argüello D; Chavez E; Laurysen F; Vanderschueren R; Smolders E; Montalvo D. 2019. Soil properties and agronomic factors affecting cadmium concentrations in cacao beans: A nationwide survey in Ecuador. *Science of the total environment* 649:120–127.
14. Thomas E; Atkinson R; Yovera F; Lastra S; Arango K; Pezo A; Zavaleta D; Ladd B; Duran Y; Alguilar J; Tames M; Ramos A; Rodríguez C; Cruz W; Cosme R; Chavez CR; Espinoza E; Remigio J; Garcia S; La Torre B; Alegre J; Mendoza L; Schubert J; Murrieta E; Palma H; Andrade AM. 2022. The distribution of cadmium in soil and cacao beans in Peru. The Alliance of Bioversity and CIAT, Lima, Peru. available at www.cacaodiversity.org
15. Bravo D; Santander M; Rodríguez J; Escobar S; Ramtahal G; Atkinson R. 2022. 'From soil to chocolate bar': identifying critical steps in the journey of cadmium in a Colombian cacao plantation. *Food Additives & Contaminants: Part A*, 1–15.
16. Albarracín HSR; Contreras AED; Henao MC. 2019. Spatial regression modeling of soils with high cadmium content in a cocoa producing area of Central Colombia. *Geoderma Regional* 16:e00214.
17. Zug KLM; Huamaní Yupanqui HA; Meyberg F; Cierjacks JS; Cierjacks A. 2019. Cadmium accumulation in Peruvian cacao (*Theobroma cacao* L.) and opportunities for mitigation. *Water, Air, & Soil Pollution* 230(3):1–18.
18. Ramtahal G; Umaharan P; Hanuman A; Davis C; Ali L. 2019. The effectiveness of soil amendments, biochar and lime, in mitigating cadmium bioaccumulation in *Theobroma cacao* L. *Science of the Total Environment* 693:133563.
19. Vanderschueren R; Argüello D; Blommaert H; Montalvo D; Barraza F; Maurice L; Smolders E. 2021. Mitigating the level of cadmium in cacao products: Reviewing the transfer of cadmium from soil to chocolate bar. *Science of the Total Environment* 781:146779.
20. MIDAGRI. 2021. Plan Nacional de Desarrollo de la Cadena de Valor de Cacao-Chocolate al 2030
21. ICCO. 2021. Statistics. Cocoa daily prices [Database]. <https://www.icco.org/statistics/>
22. Alianza Cacao Peru & USAID. 2019. Posibles impactos sobre Peru de la nueva regulación de la Unión Europea sobre cadmio en chocolate. Impactos sobre la demanda y los precios de exportación del cacao peruano destinado a la elaboración de chocolate, manteca y polvo de cacao [Presentation].
23. Alianza Cacao Peru & USAID. 2020. Planteamiento para la PCE en la OMC. Elementos para la discusión acerca de la posición peruana frente al Reglamento 488/2014 de la UE respecto al cadmio en derivados del cacao y chocolate [Presentation]
24. Conseil Santé; Development Poles GIP; SOFRECO; JCI. 2019. Impacto de la aplicación del reglamento (UE) No. 488/2014 sobre la competitividad del cacao peruano Informe Final. Lima.
25. ICCO. 2021a. Analysis on the shift of Latin America's cocoa export destinations, from Europe to Southeast Asia.
26. ICCO. 2021b. Technical report on the recent trade patterns of Colombia, Ecuador and Peru.
27. Wiersma W. 2021, November 8. Disruptive EU Politics on Chocolate. <https://bit.ly/3LJsHjI>

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Additional reports describing the national and sub-national value chains, with more detailed information in selected provinces/departments can be found at:

- Colombia: <https://cgspace.cgiar.org/handle/10568/114702>
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This project addresses important challenges related to the resilience, competitiveness, and inclusiveness of the growing cacao sector. Here, resilience refers to the capacity of smallholder producers, and other value chain actors, to mitigate the negative impacts of new EU food safety regulations on cadmium in cacao, and of climate change. The project builds on the premise that agricultural innovations require engagement of diverse end users to co-develop context-relevant production systems and practices based on strong interdisciplinary science, while creating an enabling environment for their adoption and scaling.

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