

Zero Deforestation Agreements in Colombia: Outcomes in the Beef and Dairy, and Cocoa Supply Chains

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Executive Summary

This report assesses the outcomes of Zero Deforestation Agreements (ZDAs) in Colombia, voluntary and market-oriented public–private initiatives implemented since 2017 to reduce deforestation across key agricultural supply chains. It was elaborated under the CGIAR Climate Action Science Program. The analysis is situated in a post-conflict context characterized by accelerated deforestation driven by frontier expansion, land grabbing, and weak enforcement, which poses a challenging setting for voluntary sustainability initiatives. The study applies a mixed qualitative and institutional analysis grounded in a theory-of-change framework, drawing on stakeholder interviews, document review, and comparative sectoral analysis to examine governance, coordination, and behavioral outcomes of ZDAs in the beef and dairy and cocoa supply chains.

Results show that in high-risk and fragmented sectors such as beef and dairy, ZDAs have had limited capacity to generate direct and measurable reductions in forest loss. Their main contributions have been institutional, including improved coordination, information sharing, learning processes, and emerging norms around deforestation-free production. However, weak traceability, misaligned incentives, and strong frontier dynamics continue to constrain their effectiveness. In contrast, in the cocoa sector, characterized by high organizational coverage and agroforestry-compatible production systems, ZDAs have been more effective in consolidating low-deforestation pathways, reinforcing sustainable production models, and facilitating alignment with emerging international due diligence and traceability requirements. The conclusions highlight that ZDAs function best as governance instruments embedded within broader environmental and agricultural policy frameworks rather than as stand-alone solutions. Their effectiveness depends on complementary regulatory baselines, credible economic incentives, and long-term financial commitments. When matched to sector-specific realities, ZDAs can either remain limited to pilot impacts or consolidate sustainable, deforestation-free production trajectories.

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Acronyms and Abbreviations

CZDA	Cacao Zero Deforestation Agreement
EUDR	European Union Deforestation Regulation
FARC-EP	Revolutionary Armed Forces of Colombia – People’s Army
GAP	Good Agricultural Practices
GHGE	Greenhouse Gas Emissions
ICA	Colombian Agricultural Institute
IDH	The Sustainable Trade Initiative
NDC	Nationally Determined Contributions
REDD+	Reducing Emissions from Deforestation and Forest Degradation
TFA	Tropical Forest Alliance
WCF	World Cocoa Foundation
WRI	The World Resources Institute
ZDAs	Zero Deforestation Agreements

1 Introduction

Zero Deforestation Agreements (ZDAs) are market-oriented, voluntary, and non-legally binding initiatives to reduce deforestation from key agricultural supply chains in forested countries (Lister & Dauvergne, 2014). They involve agreements among private, public, and civil society actors that promote market opportunities for agricultural commodities while addressing deforestation. ZDAs offer reputation-based competitive advantages and market access for the private sector, while potentially contributing to tropical countries in meeting their climate commitments of decreasing deforestation (Furumo & Lambin, 2020). These agreements align with the global concerns arising from the Paris Agreement to reduce deforestation and forest degradation to curb greenhouse gas emissions associated with climate change (Rodríguez-de-Francisco, et al., 2021). In 2020, a wide range of actors came together globally under the Tropical Forest Alliance (TFA), established as an international public–private partnership with specific national chapters (Furumo & Lambin, 2020).

Colombia was the first Latin American country to join the TFA by establishing the Colombian TFA Alliance. Within this alliance, ZDAs have been signed since 2017 across the supply chains of oil palm, cacao, beef, dairy, coffee, and timber¹ (Cero Deforestación Colombia, 2025) and more recently, avocado. The ZDAs in these supply chains created public-private platforms where companies committed to reducing and eliminating deforestation from their supply chains, with support from the government and civil society organizations. These platforms aimed for the ambitious goal of achieving zero deforestation by 2030 within these supply chains (Rojas-Salazar L. , 2023).

However, the implementation of ZDAs in Colombia has unfolded within a particularly complex political and territorial context. Following the signing of the 2016 Peace Agreement between the Colombian government and the former guerrilla group FARC-EP, deforestation increased sharply, rising by approximately 44% in subsequent years (Rodríguez-de-Francisco, et al., 2021). This surge has been associated with the reconfiguration of armed actors from forest frontiers, weak state capacity, land grabbing dynamics, and speculative land-use change (Clerici, et al., 2020; Murillo-Sandoval, Van Dexter, Van Den Hoek, Wrathall, & Kennedy, 2020). At the same time, Colombia experienced an unprecedented expansion of international cooperation initiatives (e.g., REDD+, Visión Amazonía, the Joint Declaration of Intent), judicial rulings (e.g., STC 4360 of 2018), and public policies aimed at curbing deforestation. This post-conflict deforestation surge constitutes a challenging counterfactual for evaluating ZDAs, as these agreements operate primarily at the supply-chain level and were not designed to offset large-scale frontier expansion or illegal land appropriation processes.

While the dynamics of international cooperation, judicial action, and public policy responses to deforestation in Colombia have been extensively examined in the

¹ it was based on the 2009 Intersectoral Pact for Legal Timber (PIML)

literature (Rodríguez-de-Francisco, et al., 2021), considerably less empirical attention has been devoted to voluntary public–private initiatives targeting deforestation through agricultural supply chains, such as ZDAs. With few exceptions (Furumo & Lambin, 2020; Katz-Asprilla et al., 2024; Patiño & Zárate, 2024; Rojas-Salazar, 2023), systematic evidence on the outcomes of more than eight years of ZDAs implementation remains limited, particularly regarding how these agreements have influenced deforestation-related practices, supply-chain governance, and coordination between public and private actors.

This study was prepared under the CGIAR Climate Action Science Program (CASP), which will deliver the science, innovation, and collaboration necessary to transform food, land, and water (FLW) systems for a climate-resilient, net-zero, and more equitable future. With an overall ambition of climate action across agri-food systems, the Program’s research will support resilient, low-emission farms, landscapes, and aquatic resources of small-scale producers and value chain actors. The Program organizes its work through five interdependent areas: Prioritization and Coordination of Climate Action; Digital Advisories and Climate Risk Management; Locally Led Adaptation; Low-Emission Transitions; and Policy and Finance for Scaling Solutions. This study aligns with the Low-Emission Transitions work being done in Colombia, and the impact assessment component of the Program.

Specifically, the study’s objective is to evidence the outcomes of the ZDAs in Colombia from the perspective of the stakeholders involved, in the beef and dairy,² and cacao supply chains. These supply chains are critical for understanding the impacts of ZDAs in Colombia. On the one hand, cattle ranching is closely linked to deforestation dynamics in Amazonian frontier regions and to post-2016 land grabbing processes following the Peace Agreement (Mosquera, Sánchez, Gómez, & Ortiz, 2024). This supply chain poses significant challenges for reducing deforestation due to its heterogeneity, spatial dispersion, and outdated livestock traceability mechanisms (Furumo & Lambin, 2020). On the other hand, the cacao value chain is much less associated with deforestation (Castro-Núñez, Charry, Castro-Llanos, Sylvester, & Bax, 2020), and the Cacao Zero Deforestation Agreement ‘Cacao, Forest and Peace’ includes approximately 80% of producers nationwide, potentially allowing for greater influence over the sector’s sustainability in relation to forest conservation and the promotion of sustainable models for coca crop substitution (Furumo & Lambin, 2020).

Our main finding is that ZDAs in Colombia have had limited capacity to deliver immediate, measurable reductions in forest loss, but have generated significant governance, coordination, and learning outcomes. In high-risk supply chains such as beef and dairy, production is spatially dispersed, traceability remains weak, and powerful frontier dynamics (e.g., land speculation and limited enforcement) continue to shape land-use decisions, constraining the effectiveness of voluntary, non-binding commitments (Garrett, Levy, Gollnow, Hodel, & Rueda, 2021; Pendrill, Persson, Godar, & Kastner, 2019). By contrast, in cacao, a comparatively lower-risk chain more

² Given their close relation, we analyze the beef and dairy value chains as a single value chain.

compatible with agroforestry, high sectoral coverage and stronger organizational structures have enabled ZDAs to influence norms and practices around zero-deforestation production, reinforcing agroforestry pathways and facilitating alignment with emerging international due diligence and traceability requirements (Castro-Núñez, Charry, Castro-Llanos, Sylvester, & Bax, 2020; Furumo & Lambin, 2020; Lambin, et al., 2019).

This study is structured as follows. In Section 2, we contextualize the ZDA Agreements in Colombia within the broader deforestation policies and the dynamics of forest degradation after the 2016 Colombian Peace Agreement. Additionally, we discuss to what extent beef-dairy and cacao supply chains are drivers of deforestation in Colombia. In Section 3, we delve into the evaluation methods and analytical approach of the study, along with the theory of change rationale for the ZDAs. In Section 4, we present the outcomes of the ZDA in the beef and dairy supply chains. In Section 5, we present the outcomes of the ZDAs in the cacao supply chain. In Section 6, we discuss our findings comparatively, examining how ZDAs are contributing (or not) to reducing deforestation, improving sustainable supply chain management, and strengthening public-private governance platforms. We end with conclusions in Section 7.

2 Dynamics of deforestation and deforestation policies in Colombia

2.1 Deforestation in Colombia

In 2016, the national government led by Juan Manuel Santos and the leftist FARC-EP guerrilla signed the Colombian Peace Agreement, aiming to end a 50-year armed conflict. This political milestone had lasting effects on the dynamics and policies of deforestation in the country in the years to come. With the Peace Agreement, the withdrawal of FARC-EP³ from forested regions like the Amazon led to an unprecedented surge in deforestation. In 2017, deforestation rates rose by 44%, resulting in the loss of 219,973 hectares of forest. This accounted for 65.5% of the national total in the Amazon, concentrated in the departments⁴ of the 'Colombian Deforestation Arc' (IDEAM 2017). This sharp rise reflects how the end of conflict opened spaces for new and entrenched actors to reshape land-use dynamics. Although "deforestation has decreased from annual levels of 170,000 ha in 2021 to 79,000 ha in 2022" (Rojas-Salazar L., 2023), this reduction is more attributable to the reconfiguration of the armed conflict and new environmental governance dynamics in the Amazon than to the effectiveness of deforestation policies (Mosquera, Sánchez, Gómez, & Ortiz, 2024).

³ Historically, the guerrilla was a central actor in controlling deforestation through environmental rules, either because they needed a dense jungle to protect themselves in the military confrontation with the state or to enforce community agreements to conserve specific natural resources (Clerici et al. 2020).

⁴ In Meta alone, 36,748 hectares were lost, which, along with Caquetá and Guaviare, accounted for 62% of the national deforestation (IDEAM et al. 2019).

Contemporary dynamics of deforestation in Colombia cannot be attributed to a single actor or factor. IDEAM et al. (2019) identify the direct causes of deforestation to human activities with immediate effects on forest: “these include factors operating at a local scale, different from initial structural or systemic conditions, originating in land use and affecting forest cover through the exploitation of arboreal resources or their removal for other uses” (IDEAM et al., 2019). On the one hand, direct causes of deforestation include the conversion of rainforests into new grasslands, which may be used for livestock farming, as well as illegal economic activities such as coca cultivation and mining (García & Wong, 2024). There are also underlying structural causes deeply embedded in political, economic, and armed-conflict factors (Rodríguez-de-Francisco, et al., 2021). They include dynamics of *praderización*⁵ and infrastructure building in the forest, including the construction of roads (*ibid.*). These drivers are linked to dynamics of land grabbing⁶ and land value speculation that are not mechanically associated with a particular agricultural supply chain (García & Wong, 2024; Mosquera, Sánchez, Gómez, & Ortiz, 2024; Hall, 2013). Additionally, the reconfiguration of the armed conflict in the Amazon have led emerging armed actors to intensified forest transformation through the expansion of illicit economies as a mean of both obtaining revenues and territorial control (Mosquera, Sánchez, Gómez, & Ortiz, 2024). These actors often encourage or finance large-scale forest clearing to establish land claims, open roads, or launder capital through cattle ranching.

Although ZDAs are based on the premise that agricultural supply chains, such as beef, dairy, palm oil, and cacao, drive forest loss, post-2016 dynamics reveal a more complex interplay between legal and illegal economies. Much of the recent deforestation is not directly tied to productive agricultural expansion but rather to speculative land appropriation, illegal economies, and the strategic behavior of armed groups with livestock farming often serving as a legitimizing cover for the occupation of deforested land and the concealment of land speculation. This raises important questions about the extent to which ZDAs, as voluntary public–private governance initiatives, can meaningfully contribute to reducing deforestation, and highlights the need to understand their outcomes beyond conventional assumptions about supply-chain causality.

⁵ “Praderización is described as the illegal deforestation of large portions of forest and the de-facto establishment of property rights over land in legal terms by fencing it and grazing cows on it to demonstrate productive use”) (Rodríguez et al., 2021: 1).

⁶ Land grabbing in some national natural parks, such as Chiribiquete and Macarena, is one of the leading causes of deforestation and is conducted to promote new colonization, facilitating land-use change that supports cattle ranching and coca crops (Sanchez 2024).

2.2 Characterization of the beef, dairy, and cocoa supply chains in Colombia

Beef

Cattle ranching has historically been associated with the dynamics of deforestation in Colombia, especially in the Amazon region. It plays a dual socioeconomic role: for smallholders, cattle serve as an asset for household security, herd accumulation, and diversification through dual-purpose systems (milk and beef), typically generating limited deforestation pressure. For large landholders, however, cattle ranching is frequently a mechanism for land speculation, territorial control, and capital accumulation through the strategic expansion of grasslands into newly deforested areas (Sanchez, 2024). Because forest-to-pasture conversion can legitimize informal land claims, cattle ranching becomes instrumental for actors seeking to consolidate access to land.

After the Peace Agreement, civil society investigations highlighted persistent linkages between beef supply chains and deforestation. The Environmental Investigation Agency documented cases where major supermarket retailers, including Grupo Éxito and Colsubsidio, purchased beef originating from deforested or illegally occupied areas inside national parks such as Chiribiquete (EIA, 2021). These findings exposed critical deficiencies in the national traceability system, particularly the prevalence of indirect cattle movements, animals passing through multiple farms before slaughter, which obscures the true origin of cattle entering formal markets. This lack of transparency has strengthened the argument for involving beef processors, supermarkets, and slaughterhouses in ZDAs, both to legitimize their commitments and to align supply-chain governance with broader deforestation control efforts.

Dairy

The dairy sector in Colombia differs markedly from the beef sector in both geography and governance. Milk production is concentrated in the Andean highlands, especially Cundinamarca, Boyacá, Nariño, Antioquia, and Córdoba, where more intensive and vertically coordinated systems dominate (DANE–SIPSA, 2025). Colombia produces roughly 7–8 billion liters of milk per year, with hundreds of thousands of small and medium producers integrated into regional collection networks. Unlike Amazonian beef, dairy supply chains are more spatially clustered and involve shorter cattle movements from farm to processor, which facilitates supplier monitoring and engagement by processing companies (USDA-FAS, 2024).

Although dairy is not a major driver of tropical deforestation, it exerts pressure on high-altitude páramo ecosystems, which are crucial for national water regulation. Pasture expansion and intensification in these zones contribute to grassland encroachment and degradation of fragile hydrological systems (Farfán, Forero, & Avellaneda-Torres, 2020; IDEAM, MADS, & Colombia., 2019). In this context, dairy processors that participate in Zero Deforestation Agreements have relatively strong leverage over their

suppliers through contracts, quality standards, and frequent milk-collection routes. This institutional structure makes dairy a promising sector for piloting traceability, environmental sourcing criteria, and sustainability standards (Sullivan, et al., 2025; Gardner, et al., 2019). Thus, the inclusion of dairy in ZDAs is less about direct Amazon deforestation and more about demonstrating feasible models of private-sector environmental governance and protecting sensitive high-mountain ecosystems.

Cocoa

In contrast to cattle production, the cacao sector in Colombia is associated with forest-compatible land-use systems rather than large-scale deforestation. Cacao is predominantly cultivated by smallholders, often on farms of fewer than five hectares, and is frequently embedded in agroforestry systems that combine shade trees, timber, fruit species, and remnant natural vegetation. Empirical studies show that cacao has not been a major direct driver of deforestation in the country; instead, it has increasingly been promoted as an alternative livelihood in former coca-growing and conflict-affected regions, with explicit links to peacebuilding and forest conservation (Castro-Núñez, Charry, Castro-Llanos, Sylvester, & Bax, 2020).

The “Cacao, Bosques y Paz” Zero Deforestation Agreement brings together a broad coalition of private companies, producer organizations, and public agencies, and is estimated to cover close to 80% of national cacao production (Grupo Técnico Cacao, 2018). This unusually high level of sectoral coverage gives the cacao ZDA considerable potential to shape norms and practices across the value chain. While the direct deforestation risk of cacao is relatively low compared to beef and oil palm, the agreement plays a strategic role in locking in low-deforestation production pathways, strengthening producer organizations, and signaling to domestic and international buyers that Colombian cacao is aligned with sustainability and climate objectives (Furumo & Lambin, 2020; Byerlee & Rueda, 2015; Rueda, Thomas, & Lambin, 2015)

Cacao’s main contribution to deforestation governance, therefore, lies less in curbing ongoing large-scale forest loss and more in preventing future conversion, consolidating agroforestry-based production models, and supporting rural development strategies in post-conflict landscapes (Castro-Núñez, Charry, Castro-Llanos, Sylvester, & Bax, 2020; Castro-Núñez, Villarino, Bax, Ganzenmüller, & Francesconi, 2021). By anchoring cacao within a zero-deforestation narrative, the ZDA helps align market incentives, donor interventions, and public policies around a vision of cacao as both a peace crop and a forest-compatible commodity (Dávalos, Sanchez, & Armenteras, 2016; Palacios Bucheli, Cárcamo Mallen, Álvarez Macías, Coral, & Bokelmann, 2021), complementing efforts to address high-deforestation sectors such as beef and dairy through supply-chain commitments and broader forest governance reforms (Sullivan, et al., 2025).

2.3 Policies aimed at reducing deforestation

Following the Peace Agreement, a surge of policies emerged to address deforestation in a context characterized by increasing deforestation rates, the international climate change mitigation and adaptation agenda, and efforts to build peace in regions affected by the armed conflict. Within this framework, a diverse array of measures has been implemented to control and reduce deforestation through various mechanisms, including international cooperation projects (Rodríguez-de-Francisco, et al., 2021), public policies that utilize both incentives and coercive measures, and public-private partnerships such as the ZDAs (Furumo & Lambin, 2020).

To address the diversity of policies, programs, and projects tackling deforestation and climate change, it is useful to adapt the typology proposed by Jan Börner et al. (2020) for classifying deforestation policies into three categories: enabling, incentive-based, and disincentive-based.

Enabling policies are those that, while not directly reducing deforestation, create institutional conditions and governance mechanisms that support its reduction. These policies pertain to land property formalization, rural development programs, and conditional access rights over forest reserve areas. The policies stipulated in the Colombian Peace Agreement serve as an example of enabling policies, as they are linked to agrarian reform, the closure of the agricultural frontier, and participatory environmental zoning. As we will present in the results, the cacao ZDA is closely tied to the enabling policies of the Peace Agreement.

Incentive-based policies encompass agreements between communities and institutions, both individually and collectively, aimed at generating additional income through conservation activities. These activities include payments for environmental services, participatory ecological restoration, and other productive alternatives that seek to harmonize conservation with agricultural economic activities by providing direct benefits. In the realm of international cooperation, Vision Amazonia (Rodríguez-de-Francisco et al., 2021) exemplifies such policies, with its program proposing the national strategy REDD+ as a model of incentive-based approaches. As a matter of fact, the funding for Vision Amazonia was provided by international donors from Norway, Germany, and the United Kingdom through the Joint Declaration of Intent, which pledged over 300 million USD to reduce deforestation in the Amazon. These funds also supported the implementation of ZDAs initiatives (Furumo & Lambin, 2020, p. 10).

Disincentive-based policies aim to reduce deforestation by restricting land use by designating protected areas with stringent regulations, alongside sanction-based measures such as fines, imprisonment, asset confiscation, penalties, and the use of force to maintain institutional control over deforestation. In Colombia, these policies are executed through anti-deforestation initiatives like Environmental Bubbles, Operation Artemis, and other interventions that have employed force to enforce environmental management (Corredor-García & López Vega, 2024; Lévy, 2025).

Disincentive-based policies as coercive measure measures intensified after the Supreme Court issued Sentence 4380 of 2018 to safeguard the “rights of the Amazon” (Richardson & Bustos, 2023; Gómez-Betancur, 2020). This ruling enabled the criminalization and judicialization of smallholder farmers, arguing that such coercive measures were necessary to curb and stop deforestation. Consequently, these measures, implemented without considering the deforestation chain, affect vulnerable populations. However, Sentence 4380 also prompted the Minister of Agriculture to take more decisive action against deforestation, marking a significant milestone in the effort to further public support to ZDAs (RM-11).

The Colombian ZDAs are integrated into and interact with the broad spectrum of deforestation policies in the country, including enabling, incentive-based, and disincentive-based strategies. Although this may have created “synergies and scaling up impacts,” we identified early challenges, including agenda setting, implementation, and monitoring/enforcement⁷ (Furumo & Lambin 2020: 1). In the following sections, we explore how the beef, dairy, and cacao ZDAs addressed these challenges and present the outcomes from the stakeholders' perspective.

3 Data, Methods and Analytical Framework

3.1 Data collection and sample

Between October and December 2025, we conducted 21 semi-structured interviews with stakeholders directly involved in Colombia's ZDAs across the beef, dairy and cacao supply chains (Annex 1 and Annex 2). The sample included representatives from private enterprises, civil society organizations/NGOs, and public institutions. All participants were anonymized to protect their identities. In terms of supply-chain scope, interviews covered actors working specifically in beef (n=5), dairy (n=3), and cacao (n=4), both beef and dairy (n=4), and the three supply chains (n=5).

Interviewees were identified in collaboration with staff from the Alliance of Bioversity International and CIAT supporting the ZDAs, complemented in a few cases through snowball sampling to reach additional actors with relevant implementation or coordination roles. All interviews were conducted and audio-recorded after obtaining informed consent and following the procedures outlined in an ethics information letter.

Interviews were selectively transcribed and coded in MS Excel using a structured analytical grid. Codes were defined from the interview protocol and refined iteratively

⁷ “(1) agenda setting—narrow or unambitious commitments lack time-bound measurable impacts and consistency in the way definitions of “forest” and “zero deforestation” (i.e., net vs gross) are applied by actors; (2) implementation—a lack of public-private coordination and absent actors fail to address the drivers of deforestation and miss opportunities for leveraging finance to scale up impacts; and (3) monitoring/ enforcement—supply chain traceability challenges and lack of a consistent accountability framework” (Furumo & Lambing, 2020: 2).

during analysis, covering organizational trajectories, motivations and roles in ZDAs, perceived outcomes, and challenges and policy-relevant recommendations. We then compared patterns across high-risk (beef/dairy) and lower-risk (cacao, agroforestry-based) supply chains to assess how sectoral conditions shape ZDAs outcomes.

3.2 Analytical framework

The evaluation methodology followed a qualitative “Outcome Evaluation” approach to assess the effects of ZDA in Colombia. This qualitative evaluation framework recognizes that the results of an intervention or public policy are not linear causal processes but rather emerge from “uncertain and evolving” dynamics resulting from complex interactions among systems of actors, institutions, and knowledge (Douthwaite B. , Mayne, McDougall, & Paz-Ybarnegaray, 2017). In this context, outcomes are defined as intended or unintended changes in knowledge, attitudes, skills, and practices resulting from the use of research outputs (Blundo-Canto, Läderach, Waldock, & Camacho, 2017). Based on this methodology, we designed a semi-structured interview guide comprising four modules to gather information on: (I) the trajectories of actors and their institutions in relation to deforestation and sustainability; (II) their participation in the zero deforestation agreements; (III) their perspectives on the impacts resulting from these agreements (such as changes in practices and/or association); and (IV) the actors’ views on the future of the zero deforestation agreements and recommendations for their improvement. .

Although some tools have been developed to follow up and monitor commitments under ZDAs (Cabezas, Borda, & Vasquez Molano, 2025), these efforts tend to focus on tracking compliance related to the formulation and adoption of responsible zero-deforestation sourcing policies. In contrast, rather than estimating impacts on deforestation outcomes or outputs directly attributable to ZDAs, our approach focuses on identifying intermediate enabling factors—such as governance arrangements, coordination processes, and behavioral changes—that emerge from complex, voluntary, and multi-actor interventions (Douthwaite B. , Mayne, McDougall, & Paz-Ybarnegaray, 2017; Blundo-Canto, Läderach, Waldock, & Camacho, 2017). This methodological choice was justified by three features of ZDAs. First, ZDAs are non-binding and voluntary, lacking enforceable sanctions and clearly defined counterfactuals. Second, they operate through indirect mechanisms, such as norm-setting, learning, and coordination, whose effects are unlikely to translate into short-term, observable changes in deforestation rates, particularly in frontier contexts shaped by structural drivers beyond the scope of supply-chain initiatives. Third, ZDAs are embedded in highly heterogeneous value chains, where attribution of outcomes to a single intervention or policy is analytically infeasible.

3.3 Theory of Change

Zero Deforestation Agreements (ZDAs) are grounded in a theory of change that differs fundamentally from command-and-control environmental regulation. Rather than relying on legal enforcement, ZDAs operate as voluntary governance mechanisms that seek to influence deforestation risk by aligning incentives, norms, and coordination among actors within agricultural supply chains (Lambin, et al., 2019; Garrett, Levy, Gollnow, Hodel, & Rueda, 2021).

In practice, ZDAs convene public agencies, private firms, and civil society organizations to establish shared commitments and operationalize them through a range of instruments, including traceability and monitoring systems, supplier sustainability requirements, and, in some cases, conservation or restoration agreements with producers. These activities are expected to generate immediate outcomes such as increased awareness of deforestation risks, improved access to information, enhanced coordination across actors, and greater legitimacy to introduce sustainability criteria along the value chain (Furumo & Lambin, 2020).

Over time, these early changes are expected to translate into intermediate outcomes, including adjustments in organizational practices, more systematic supplier engagement strategies, and the consolidation of norms around deforestation-free production. At this stage, ZDAs may also contribute to strengthening institutional capacity for traceability, verification of commitments, and collective action, which are widely recognized as preconditions for effective supply-chain governance (Garrett et al., 2019; Lambin et al., 2018).

If these intermediate outcomes materialize in favorable contexts, particularly where supply chains are relatively organized, traceable, and compatible with forest conservation, ZDAs can support the consolidation of low-deforestation production pathways and facilitate alignment with emerging international sustainability and due-diligence requirements, including zero-deforestation regulations in consumer markets (Pendrill, Persson, Godar, & Kastner, 2019; Furumo & Lambin, 2020).

This theory of change is conditional. The literature shows that voluntary zero-deforestation commitments are unlikely to generate substantial land-use change in supply chains characterized by high fragmentation, informality, and strong frontier dynamics, where structural drivers of deforestation dominate and monitoring costs are high (Garrett, Levy, Gollnow, Hodel, & Rueda, 2021; Pendrill, Persson, Godar, & Kastner, 2019). In contrast, in agroforestry-based and more centralized supply chains, such as cacao in Colombia, ZDAs are more likely to produce meaningful governance and learning outcomes that can reinforce existing sustainability trajectories, even in the absence of immediate reductions in observed deforestation (Castro-Núñez, Charry, Castro-Llanos, Sylvester, & Bax, 2020).

4 Zero Deforestation Agreements in the beef and dairy supply chains

The ZDAs in the beef and dairy supply chains constitute a public-private partnership in which the signatories seek to carry out coordinated actions in production, processing, marketing, and consumption to discourage deforestation and associated greenhouse gas emissions (GHGE). To this end, participating actors commit to promoting product traceability from origin, monitoring deforestation, establishing sustainability requirements for their suppliers, and entering into conservation and restoration agreements with their producers, among other measures (Minambiente, 2019).

Eight years after their implementation, interviewees acknowledged that, despite persistent challenges in achieving zero-deforestation objectives, the agreements have also generated a range of outcomes that point to a positive trajectory and provide grounds for optimism regarding the future of the initiative. Drawing on in-depth interviews with key public, private, and civil society actors, we explored how these outcomes and challenges are experienced and interpreted by those directly involved in the agreement.

4.1 Stakeholders' trajectories in relation to deforestation and sustainable supply chain management

The interviewees possess relevant expertise for contributing to the sustainability of the beef and dairy supply chain. Ten out of 16 interviewed actors are experts in animal science and forestry (focusing on production systems and ecosystem conservation), environmental engineering (assessing regulatory and impact frameworks), or geography and geomatics (analyzing land-use dynamics and satellite-based monitoring mechanisms).

Regardless of actor type, interviewees reported having participated in previous sustainable initiatives before they engaged in the beef and dairy ZDAs. For instance, organizations have promoted Good Agricultural Practices (GAP)⁸ workshops such as a dairy company that said, *“What we do is teach farmers how they can replace their traditional fences with living fences, reduce the use of chemical fertilizers and use organic fertilizers or fertilizers produced by themselves (compost, worm farms) —all these kinds of practices that reduce pressure not only on the ecosystem as such but also on the soil”* (RM-01); while a social civil actor mentioned reforestation activities: *“We support several aspects of environmental policy related to deforestation control, including reforestation agreements with farmers”* (RM-02).

⁸ Good Agricultural Practices (GAP) refer to a set of technical, environmental, and managerial measures implemented at the farm level to ensure sustainable agricultural production, food safety, environmental protection, and the well-being of producers and workers (ICA, 2021).

4.2 Background of the beef and dairy Zero Deforestation Agreements

Dual-purpose livestock farming generates different types of economic incentives depending on the scale of production. For small producers, it represents a strategy to diversify household income, whereas for large producers it has often been associated with land speculation, territorial control, and capital accumulation (Sanchez, 2024). In relation to the latter, deforestation may be understood as a colonial practice that has persisted across generations in which clearing forests continues to be associated with economic improvement (Murillo-Sandoval, et al., 2023), or as an interviewee explained *“100 years ago, forest clearing, deforestation, and grass planting were seen as improvements and could be quantified monetarily, and people could apply for loans” (RM-13).*

Additionally, it was mentioned that deforestation may also stem from adverse incentives historically promoted by the state, whereby populations were encouraged to clear inhospitable areas and introduce cattle to obtain land tenure, *“50 or 60 years ago, the Colombian government itself told the population -look, go out there, bring in cattle, and you can obtain title to that land” (RM-09).*

Consequently, livestock farming has historically been intertwined with deforestation in Colombia, contributing to long-standing tensions and polarization between producers and environmental groups. In this context, producers and local communities increasingly seek to legitimize their productive activities as deforestation-free. As one interviewee stated, *“Amazonian communities have stated that they want to disassociate their activities and legitimize their productive activities, free from any environmental stigma that may arise” (RM-15).*

In this context, the Beef and Dairy Zero Deforestation Agreements (ZDAs) were adopted in 2019 to promote forest conservation. The Dairy ZDA was the first commitment of its kind, while the Beef ZDA was the second, following Brazil’s pioneering agreement (Sullivan, et al., 2025). These agreements rely on commitments by signatory actors to coordinate actions across the beef value chain to achieve zero gross deforestation. Key actions include promoting practices that reduce environmental impacts, facilitating conservation agreements with producers, ensuring transparent information sharing, designing and implementing monitoring and verification protocols, collaborating to design economic and policy instruments, and exploring market mechanisms such as labels or seals to distinguish zero-deforestation beef (Ministerio de Ambiente y Desarrollo Sostenible, 2019).

In addition, the dairy sector agreement also seeks to foster cooperation between the Government and stakeholders to prevent transformation of *páramos* ecosystems⁹ linked to dairy production in Colombia (Ministerio de Ambiente y Desarrollo Sostenible, 2019).

⁹ Páramos area is a key factor for conservation of endemic species (e.g. plants and birds) and land conservation given its role in hydrological cycling (Sarmiento, Cadena, Sarmiento, & León, 2013).

4.3 Interests, motivations, and roles of the ZDA participants

Most participants were already engaged in zero-deforestation activities before the ZDAs, since their organization's missions are related to sustainability issues. In that sense, the ZDAs were also aligned with their mission, which motivated around 75% of the interviewees to take part in them.

“Sustainability has been part of this company's DNA. When the whole issue of deforestation in Colombia began, with livestock farming being the main driver of deforestation, this company knew that it had a large milk supply chain and that we were in active areas of deforestation” (RM-03).

Additionally, some interviewees mentioned value-driven environmental responsibility as a motivation to engage in zero-deforestation initiatives, and economic or market-oriented incentives were also consistently referenced—either directly or indirectly—as reasons to participate in the agreements. Motivations such as keeping the “business afloat”, maintaining market positioning and managing reputational risk were mentioned by 62% of the actors.

Example of keeping the “business afloat” motivation: *“There is a long-term business vision of how I guarantee the resource in the long term. We have done all the research and verification, and farms that are adopting these measures, which have less pressure on ecosystems, are much more resilient to events such as droughts or heavy rains, so it can above all stabilize milk production” (RM-01).*

Example of maintaining market positioning: *“... joining this agreement also allows us to show ourselves to customers and other actors as a sustainable company, which is also important because we are gaining recognition” (RM-04).*

Example of managing reputational risk: *“In the south of Meta, they see us as nature's greatest predators, demonizing extensive livestock farming... If we were to export meat, they would suddenly punish us with prices or they would not be sold commercially in the best way” (RM-05).*

Once actors were motivated to participate in the ZDAs, their involvement could be as either implementing-oriented or learning-oriented actors. The former refers to a leadership role, mentioned only by NGOs or public actors who were responsible for improving the agreements, while the latter refers to private actors who positioned themselves as followers of the first group.

Implementing-oriented	Learning-oriented
<i>"We have been promoting the agreements. We were technical secretaries of the palm oil agreement. We have been leaders of the monitoring and information group for the meat and milk agreements. We supported monitoring, traceability, and information tools" (RM-06).</i>	<i>"We attend and we listen what had been done, then we continue working ourselves fulfilling the commitment we have made. The purpose is not how I present myself in the agreements but how I apply the agreements" (RM-07).</i>

Regarding the private sector participation in the beef and dairy ZDAs, it has been difficult not only to involve new actors in the agreements, but also to maintain the commitment of already linked actors over time. According to one interviewee from a NGO (RM-13), at the beginning only 3 out of 10 actors participating were from the private sector. Enrolling in new private actors has been difficult because of two facts:

- I. **Lack of economic incentives.** Regarding the cattle supply chain, most interviewees agreed that it is a disjointed value chain in which those who perceive the benefits of sustainable practices are not the same actors who bear the costs of implementing such practices or providing trustable evidence of this implementation (e.g., traceability). This is linked to the informality of the sector, which makes it difficult to trace the product and to implement fair trade.

"Companies are still unable to trace the entire value chain when they purchase from indirect suppliers or intermediaries (due to excess demand), and they do not know how that intermediary monitors deforestation" (RM-09).

- II. **Weak legitimacy to demand sustainable practices.** Most of the interviewees emphasized the need for stronger legitimacy—from national regulation or government institutions—to require producers to adopt practices/processes aligned with the ZDAs. Without such institutional support, actors feel they lack the authority to make demands, and producers often perceive these recommendations as additional burdens.

"When we give recommendations to our providers to encourage them to adopt certain alternative practices to what they have always used, what they say is, -You come with a new requirement, telling us what we MUST do.- So, if we bother the producer too much, he will sell elsewhere where there are fewer requirements" (RM-01).

There has been a heterogeneous engagement across the private sector actors that participate in the agreements with not only *"companies that seek to improve or want to align their activities to gain a competitive edge in the market"* (RM-02), but also *"there are companies that may have signed up for public relations reasons, but without fully*

understanding what they are committing to, which is a long-term commitment that does involve changes and demands at the organizational level” (RM-08). Consequently, private actors, especially powerful (i.e., large enterprises) ones, describe an uneven pace of progress across actors that disincentive participation of enrolled actors.

“We are talking about X [name large companies] that can move extremely quickly and want to comply with the whole zero deforestation issue, but on the other hand there are small companies that lack incentives, knowledge, tools and resources to meet basic requirements. Additionally, the public sector has different timelines because professionals rotate frequently, which slows down the process” (RM-06).

4.4 Outcomes and perceived impacts

Informants identified four main outcomes indicating multiple types of changes. First, political changes are observed, as there is growing awareness of the importance of agreements and a deeper understanding of the deforestation problem, which fosters greater institutional commitment. Second, collaborative changes emerge through the creation of spaces for the exchange of knowledge and practices among different actors, strengthening coordination and collective action. Third, technological and technical changes are evident, as monitoring platforms have been developed and the adoption of improved agronomic practices is actively happening. Finally, additional political changes are identified in the form of institutional endorsement and momentum that facilitate the development and implementation of new norms and regulatory frameworks.

- I. **Increased awareness.** Close to three out of four interviewees mentioned both a broader dissemination of the importance of ZDAs within society and increased understanding of the problem, along with stronger commitments from cattle- ranchers and suppliers across the supply chain.

“One result is the knowledge that companies have acquired regarding deforestation, traceability and monitoring issues. For them, it is no longer a mystery to talk about these issues”. “Although enrolled companies are already committed with the agreements, they have also reached territories where one would not have expected them to join, such as Caquetá, but there has been a real commitment, and they have seen the importance of forest conservation” (RM-06).

- II. **Creation of collaborative networks.** Approximately two out of three interviewees highlighted the emergence of collaborative networks as a key change resulting from the agreements. While five private-sector actors mentioned increased mutual support among themselves and noted that larger companies have led by example, six NGO and public-sector representatives pointed to various forms of collaboration developed to

deploy tools, draft new legislation, identify funding opportunities, and carry out related initiatives.

“Something that has helped us is having contacts who can tell you, -Look, if you do it this way, get involved with these people, they can help you understand the farm's polygons better, among others” (RM-10).

“It [an NGO] was the connector that began to engage in dialogue with ranchers’ associations and companies and sought to join forces to manage resources and build capacity in countries” (RM-11).

- III. **Use of tools and technologies.** As noted previously, actors involved in the agreements exhibit different roles. The implemented-oriented actors have been more encouraged to develop solutions or lead the agreements based on their experiences, and then promoting platforms and developing technologies aligned to the agreements’ goals. For example, a NGO actor mentioned *“Tools that have been developed, such as Ganabosques, Visiprast, and many other alliances, such as Global Forest Watch and other sources of information, the MRV protocol...” (RM-06)*. These Tools play an essential role in supporting zero deforestation agreements by enhancing the *monitoring, reporting and verification (MRV)* capacities necessary for implementing and tracking commitments under zero deforestation agreements.

In contrast, the learning-oriented actors have been committed to implementing those technologies to fulfill their obligations with the agreements, as an actor mentioned, *“Many companies have carried out a self-assessment exercise, which was one of the first commitments that companies had to make...and carry out that initial assessment to find out if there was any deforestation or risk at that time” (RM-11).*

- IV. **Adoption of Good Agronomic Practices (GAP).** This reported change must be interpreted with caution, as enrolled actors were already implementing good agronomic practices prior to joining the agreements. As one interviewee mentioned, *“Livestock farming practices have been promoted by the agreements, but more than by the agreements themselves, it is by the projects that have been immersed within this” (RM-06)*. In this sense, ZDAs have influenced GAP indirectly through two mechanisms: (i) the involvement of NGOs or related initiatives that are also committed to reducing deforestation or promoting sustainable agricultural practices, and (ii) the legitimization of these processes through the participation of the public sector, which encourages new producers to adopt technologies in order to remain competitive. As one interviewee explained, *“Producers are realizing that having a label could determine whether or not they enter a*

market, so the sectors have begun to generate better information and work more closely with producers on the practices they are implementing” (RM-11).

4.5 Future perspectives: recognizing challenges and opportunities

While the agreements have generated positive changes, all interviewees noted that there have also been challenges and barriers that can compromise their future. We classified these challenges into four interrelated groups: traceability and monitoring capacity constraints, implementation and coordination challenges, financial and resource dependence constraints, and regulatory and market governance challenges.

Traceability and Monitoring capacity constrains: Actors reported that it has not been possible to establish joint work on traceability with the Colombian Agricultural Institute (ICA for its acronym in Spanish), which has hindered supply. In addition, companies lack the technical and human capacity to monitor the farms of their suppliers, further complicating compliance efforts.

“It has been a challenge for companies to provide information, and I believe this has taken much longer than expected. Perhaps at the beginning we thought that companies would have greater control or authority to request information from their suppliers, but it seems that this is not necessarily the case, that there are many parts of the chain that are very fragmented, or also fear of sharing this information, which limits the ability to carry out supplier analyses” (RM-02).

Implementation and Coordination challenges: There are significant heterogeneities among companies participating in the agreements. For example, some operate under their own brand and therefore control all stages of their production chain, or they have greater installed capacity to meet the requirements of the agreements. As a result, companies progress at different rate, and because the agreements must adapt to the pace of the least advanced actor, those who have made greater progress may perceive the process as too slow and become discouraged from continuing. As it was mentioned by an advanced actor *“The agreements require follow-up, I’ll call it that, as a basic requirement since companies can comply with, but no further steps are required, even if it is voluntary, for example, voluntary companies that want to demonstrate a greater degree of belonging or affiliation to the agreements could demonstrate this with a specific result, such as a percentage increase in vegetation cover or a percentage reduction in deforestation among certain producers who have been at risk of deforestation” (RM-01).*

In addition, some actors also emphasized that their staff have limited time, meaning they must carve out space among their multiple responsibilities to participate in the meetings. Therefore, time becomes a valuable and constrained resource for these actors.

“Plenary sessions are very important, but when something concrete happens, then, for example, we are in the plenary sessions, and I have participated in several because I try to connect as much as I can, but also, many times, due to time constraints, it has not been easy, and when you don't see much progress, you get a little discouraged” (RM-10)

To compound this, interviewees consider it important that projects who support stakeholders to comply with the agreement's requirements should coordinate more effectively among themselves, as they are saturating actors within the value chains and may be reducing the overall efficiency of the agreements. This highlights that time is a constraint not only to actors directly participating in the ZDAs, but also stakeholders who need to learn and implement the recommended actions.

Financial and resource dependence constraints: some actors noted that fulfilling the commitments established in the agreements requires financial and human resources that are not always available. For example, supporting the inclusion of small suppliers or gathering information from their farms often demand human and financial resources that actors lack.

“Companies do not have the resources, or at least small and medium-sized companies do not have the resources or personnel to comply with everything that the agreements require, so they will need ongoing support and guidance to ensure that this is incorporated into their operations and that they can finance the monitoring of deforestation and make decisions” (RM-09).

Although certain initiatives or projects provide funding, activities become dependent on these external resources, and in many cases, once a project leaves the territory or ends, progress comes to a halt. This could be mitigated through long-term financial commitments from key actors, like the government or large donors, among others.

“All these activities are contingent on the availability of resources, but the country should be politically committed to zero deforestation as part of its roadmap so that, with political will, the resources to support these initiatives are guaranteed” (RM-12).

Regulatory and market governance challenges: Although as of November 2025, a legislative initiative for sustainable and deforestation-free livestock had passed several debates in the Senate and moved on to the House of Representatives, placing it only a few steps away from becoming national law, several interviewees emphasized the need to advance toward the implementation of regulations that would make the agreements mandatory. They argued that such regulation could help address the current problem of informality in product marketing and make the benefits for producers committed to sustainable and zero-deforestation practices more visible. As one interviewed actor explained, *“It is a challenge that a ZDA signatory company has to compete in a market with informal companies that buy from anyone—including suppliers who have deforested— so it is a major challenge because formal actors require support and incentives for formality” (RM-09).*

Most interviewees from public and NGO sectors consider as a relevant change the legislative initiative for sustainable and deforestation-free livestock. As of November 2025, this initiative had passed several debates in the Senate and moved on to the House of Representatives, placing it only a few steps away from becoming national law. However, although the initiative is relevant and aligned with the objectives of the agreements, none of the actors manifested this change directly to the agreements themselves.

Further, some actors stressed that agreements, although non-mandatory, should be communicated to suppliers in a more supportive and non-coercive manner to avoid resistance. Overall, interviewees called not only for a fair-trade market but also for inclusive public policies that address structural fragmentation within the value chain. As one actor noted, *“At the national level, we have a completely fragmented chain where no one reports to anyone else, and where, as a producer, I have no incentive to share information with intermediaries, as I fear they will place additional burdens on me, while small producers are the ones facing the lowest margins in the business”* (RM-14).

Based on these challenges, most interviewees trust in the ZDA future but a conditioned one, therefore they provided recommendations to strengthen them. These recommendations are converged into five key areas. First, they recommended the promotion of a fair-trade framework for sustainable production that reduces competitive disadvantages faced by formal and compliant actors. Second, they recommended that the policies should adopt a supportive rather than punitive approach toward producers, particularly smallholders, to foster trust and long-term engagement¹⁰. Third, interviewees recommend strengthening government leadership and increasing political commitment, including clearer regulatory alignment with zero-deforestation objectives. Rather than applying broad national measures, they recommended prioritizing interventions in municipalities with high deforestation rates, where impacts could be more effectively targeted. Fourth, several actors recommended differentiated support mechanisms that consider heterogeneity in actors’ capacities, levels of progress, and resource constraints. Finally, respondents emphasized the importance of integrating reforestation and restoration efforts alongside zero-deforestation goals, improving coordination among existing initiatives, aligning national policies with zero-deforestation strategies, and strengthening communication and education efforts to raise awareness and facilitate implementation across the value chain.

¹⁰ Although agreements are voluntary, many actors interpret them as enforcement-oriented or policing mechanisms. This perception shifts the agreements from being seen as supportive tools for environmental sustainability to instruments associated with control, surveillance, and potential sanctions.

5 Zero Deforestation Agreements in the cocoa supply chain

Although cacao production in Colombia, unlike other commodities of the ZDAs, is not directly linked to deforestation (Castro-Nuñez, Charry, Castro-Llanos, Sylvester, & Bax, 2020), a Cacao Zero Deforestation Agreement (henceforth CZDA) provides significant opportunities for the sector. CZDA known as ‘Cacao, Forest, & Peace’ enabled the Colombia cacao supply chain to expand into new markets, given the momentum of peacebuilding, international cooperation, and crop substitution initiatives. Rather than serving as a tool to reduce deforestation, the CZDA was envisioned as a strategy to strengthen the position of the Colombian cacao sector and implementing the Colombia Peace Agreement. This characteristic distinguishes cacao from other sectors, such as beef and dairy supply chains, which have a more direct impact on deforestation. Rather than serving as a tool to reduce deforestation, the CZDA was envisioned as a strategy to strengthen the position of the Colombian cacao sector and implementing the Colombia Peace Agreement. This characteristic distinguishes cacao from other sectors, such as beef and dairy supply chains, which have a more direct impact on deforestation.

5.1 Stakeholders’ trajectories in relation to deforestation and sustainable supply chain management

The interviewees involved in the CZDA have extensive experience in cacao and sustainability. This includes the sustainable management of the cacao supply chain (RM-17; RM-19), environmental issues (RM-18), and the transfer of sustainable cacao farming technologies (RM-16). They currently hold managerial and executive roles within their organizations. Furthermore, those interviewees from civil society organizations have implemented projects promoting cacao cultivation and rural development, funded by public and international cooperation resources (RM-18; RM-19)—including project associated with the implementation of the Colombian Peace Agreement.

The interviewees acknowledged that their organizations have engaged in sustainability initiatives of the cacao supply chains previously or independently from the CZDA. One interviewee highlighted the inherent sustainable characteristics of cacao cultivation in Colombia: *“families already implement sustainability criteria due to the very nature of cacao cultivation, which is cultivated in agroforestry systems”* (RM-19). The interviewees from civil society organizations noted that their organizations have been working for over 15 years to integrate the cacao supply chain with climate change mitigation strategies, forest preservation, environmental governance and policies, and sustainable businesses (e.g., bioeconomy and regenerative businesses) (RM-18; RM-19). Finally, one interviewee from a cacao company noted their comprehensive internal regulation—independent from CZDA’s guidelines. This internal regulation incorporates traceability mechanisms to prevent purchasing cacao linked to deforestation, and includes initiatives focused on the sustainability of cacao producers, encompassing economic, environmental, and social dimensions:

“From the economic perspective, we aim to diversify producers’ income through agroforestry systems; from the social perspective, we offer educational and employability programs; and from an environmental perspective, we seek to raise awareness about protecting forests, water, and biodiversity” (RM-17).

Overall, the trajectories of the organizations involved in the CZDA demonstrate that the sustainability and zero deforestation approach within the cacao supply chain did not originate with the CZDA, as there are significant pre-existing initiatives.

5.2 Background of the cacao Zero Deforestation Agreements

The CZDA emerged from a specific political and policy context in Colombia, shaped by the implementation of the 2016 Peace Agreement. This context is also linked to a surge in international cooperation aimed at supporting the Peace Agreement, with a particular focus on environmental issues in regions affected by the armed conflict, such as the Amazon. This backdrop is more crucial for understanding the creation of CZDA than the mere objective of reducing deforestation associated with the cacao supply chain. In fact, two interviewees acknowledged that the Colombian cacao supply chain is not a significant driver of deforestation in the country (RM-18; RM-19). Instead, within the framework of the Peace Agreement, cacao farming was seen as an economic strategy for advancing rural development, environmental conservation, and the substitution of coca crops.

One interviewee—who served both as a government advisor for the environmental aspects of the Peace Agreement and as the leader of the technical secretariat of the CZDA—emphasized how cacao farming had the potential to contribute to the implementation of the Peace Agreement, including: *“closure of the agricultural frontier, protection of strategic ecosystems, participatory environmental zoning, and implementation of PDET productive projects”* (RM-18). Furthermore, in the context of rising deforestation in Amazonian departments following the Peace Agreement (e.g., Caquetá, Putumayo, and Guaviare), *“cacao cultivation was considered a buffer”* against deforestation (RM-19). Overall, the context surrounding the Colombian Peace Agreement was pivotal in defining the scope and objectives of CZDA.

Another milestone for the CZDA establishment occurred on the international stage. In 2017, during the UN Climate Change COP 23, the “Cacao & Forest Initiative Framework Actions” was signed, which involved the governments of Côte d’Ivoire and Ghana, along with major cacao companies in these countries. The initiative “established the groundwork for the public-private partnership platform by outlining commitments to drive sector-wide progress toward zero deforestation as well as alignment to ensure common definitions, data, and regulations.” (WCF, 2025). The Cacao & Forest Initiative was an internationally influential policy in forming public-private partnerships aimed at reducing deforestation in the cacao supply chain,

particularly in the context of increasing deforestation in West Africa linked to cacao production. This backdrop was also a milestone in the launching of the Global Initiative Cacao & Forest led by the World Cacao Foundation (WCF), and with Colombia being the first Latin American country to join. Within this framework, Colombian stakeholders promoting the cacao supply chain saw an opportunity to position Colombian cacao on the international stage, given that cacao cultivation in the country was already deforestation-free (RM-18). Both international and national policy dynamics shaped the conditions for the signing of CZDA.

In 2018, the CZDA was signed by the Colombian Government (Ministries of Agriculture and Environment), the Colombian Federation of Cacao Producers, the cacao enterprise Casa Luker, and civil society organizations including The World Resources Institute (WRI), the Sustainable Trade Initiative (IDH) and WCF. This agreement stated the common objective of “ending deforestation and promoting the protection and restoration of forests in the cacao supply chain in Colombia” (Cacao Bosques & Paz en Colombia, 2018: 2). It established three strategic priorities closely aligned with the Colombia Peace Agreement and its environmental objectives: 1) Protecting and restoring forests through sustainable cacao production, taking into account the Peace Agreement’s environmental zoning and the definition of the agricultural frontier; 2) ensuring sustainable livelihoods for cacao producers by incorporating sustainable intensification and economic diversification to increase yield and income, while reducing pressure on the forest; and 3) fostering community participation and social inclusion in cacao production, particularly in areas prioritized for post-conflict development (Cacao, 2018)

5.3 Interests, motivations, and roles of the participants

The signatories of the CZDA acknowledged various motivations and expectations for joining the Agreement. One interviewee from a cacao enterprise identified in the Agreement an opportunity to align their internal sustainability policies with the broader cacao sector in Colombia (RM-17). Another interviewee recognized the Agreement's potential to benefit the Colombian cacao sector and cacao producers by disseminating new *“knowledge and capacities”* associated with sustainability (RM-16). For another interviewee, CZDA was primarily a chance to position the Colombian cacao supply chain internationally and open new markets: *“We clearly had the intention of positioning ourselves and being able to say that Colombia is committed to cacao that is zero deforestation and supports small producers in areas of Peace Agreement implementation”* (RM-18). Similarly, another interviewee framed CZDA as a strategy to gain a competitive advantage in the international market compared to West African cacao:

“It emerged as a possibility to position cacao in Colombia by showing that it does not cause deforestation; it is farmed within agroforestry, it is sustainable. It is not a driver of deforestation; it does not involve child

labor; it supports the transition from illicit to legal economies. It generates economic development and is cultivated in many areas that have been affected by violence and need to be consolidated as zones of peace” (RM-19).

The high centralization of the cacao supply chain in Colombia among few key actors was an opportunity to facilitate participation and synergy among the signatories of the CZDA (RM-18). In its first two years, participants introduced a strategy known as the “Action Plan Cacao, Forest and Peace 2020-2030.” This strategy outlined five strategic outcomes to be achieved by 2030: 1) Zero-deforestation cacao production models; 2) Financial instruments to support zero-deforestation cacao models; 3) A system for monitoring, verification, and traceability; 4) Strengthening cacao sector institutions for forests and peace; and 5) A communication and transparency strategy (Colombia, 2019).

The interviewees acknowledged that in the last two years (2024, 2025), participation and coordination in the CZDA have diminished, and even one of them stated that: *“I feel like the agreement has kind of disappeared, I mean, I don't know how long it's been [...] for over a year and a half or two years the agreement hasn't published, hasn't met, hasn't promoted anything, hasn't communicated”* (RM-19). Likewise, another interviewee recognized that the *“CZDA worked well at first, but that started to wear off; people began to get tired because these are very long-term results, and the participation is voluntary”* (RM-18).

5.4 Outcomes and perceived impacts

The interviewees reported six outcomes and perceived impacts of the CZDA. These outcomes extend beyond merely reducing deforestation. They are related to international recognition of the sustainability of cacao production and potential access to global markets for the Colombian cacao supply chain, the leveraging of international cooperation funding for the implementation of the Peace Agreements, and multi-stakeholder coordination in the traceability and monitoring of zero-deforestation cocoa. Despite these positive outcomes from the stakeholders' perspective, other outcomes revealed tensions and disagreements among them, including the predominant concentration of the CZDA in the Amazon region and the prioritization of environmental conservation over economic productivity in the cacao sector.

- I. International recognition:** the CZDA elevated the Colombian cocoa at the global level with international organizations. However, this international recognition was not necessarily linked to an increase in cocoa exports, but rather to recognition of Colombian cocoa sustainability by non-profit organizations, such as the WCF.

“Colombia was non-existent in the global cocoa chain because we exported very little. The Cacao, Forests, and Peace Agreement

catapulted us forward, and we began to appear on all global stages of the cacao value chain through the WCF. We were there presenting the agreement and the progress made. Since then, Colombia has begun to appear differently in the global cocoa chain” (RM-18)

- II. Access to new international markets:** This Agreement facilitated access to new international markets by positioning the Colombian cocoa supply chain's environmental sustainability approach and the emergent recognition of zero deforestation within the global supply chain. However, as reported by Interviewees, this international access was not immediately harnessed, as the Colombian cocoa supply chain was kept predominantly oriented toward meeting internal demand.

“Our intention was to open up new markets for cocoa exports. However, after six or eight years, Colombia has not taken advantage of this. With the Agreement, the conditions were created, but there has still been no significant promotion or growth in international markets” (RM-18)

- III. New platforms for coordination and information sharing:** the CZDA integrated a traceability committee within the cacao supply chain known as the National Cacao Traceability Roundtable, serving as a multi-stakeholder platform where actors coordinate activities and exchange information related to verifying the deforestation-free origin of cacao beans and monitoring of environmental conservation. However, the interviewees reported contrasting views on this outcome, with some linking it directly to the Agreement and others viewing it as an independent initiative.

“This traceability committee anticipates the regulation of European Union Regulation on Deforestation-free products (EUDR) and was a direct result of CZDA” (RM-18).

“This initiative is as a parallel and independent— currently more dynamic— platform, known as the National Cacao Traceability Roundtable, that emerged to comply with the EUDR” (RM-19).

- IV. Access to new financial resources:** the CZDA facilitated channeling of international cooperation resources to implement the Peace Agreement through cacao projects with an environmental approach, offering an alternative to *“restore and protect important ecosystems, such the Amazon”* (RM-18). However, according to an interviewee, the overreliance on

international cooperation limited CZDA's potential to extend beyond the Amazon to cover all regions where cacao is produced (RM-17).

V. Regional Positioning of the Amazon: the CZDA succeeded in positioning the cacao produced in the Amazon within the Colombian cocoa supply-chain as an environmentally sustainable and peace-building oriented alternative in areas experiencing high deforestation rates (RM-18). However, this was not free of tension. Two interviewees (RM-17; RM-19) pointed out that the CZDA's regional focus on the Amazon (e.g., departments of Guaviare, Caquetá, and Putumayo) was problematic, as it responded to areas prioritized for the implementation of the Peace Agreement and the environmental agenda of international cooperation, rather than the demands of the cacao sector. Therefore, this regional focus was fraught with tensions among the signatories, including the national government and some enterprises (RM-18), which may have felt underrepresented in the CZDA.

VI. Environmental Conservation over Economic Productivity: The regional positioning of the Amazon and the zero-deforestation approach within the CZDA led to a perceived prioritization of environmental matters over economic productivity. According to one interviewee, this perception undermined CZDA credibility among stakeholders worried about the sector's productivity challenges, such as the low yields of cacao beans. It noted that:

"We engaged in discussions about the agroforestry model, which suggested that we should have more than 200 tree species. However, I felt that we were shifting from producing cacao to cultivating forests. [...] I believe we are overly concentrating on conservation. We still face productivity issues, producing the same 400 kg of cacao per hectare as we did 30 years ago. [...] The agreement could not materialize a concept of sustainable and productive cacao, which is crucial for increasing farmers' incomes" (RM-19).

5.5 Future perspectives: recognizing challenges and opportunities

CZDA stands at a crossroads, with participants weighing various strategies to either continue with the Agreement or transition to existing or new cacao platforms to be able to address new challenges and policies faced by the cacao sector.

Changing Policy Priorities: The policy priorities that initially shaped the CZDA are evolving due to a shift in focus towards international cooperation on climate change and the waning momentum of the Colombia Peace Agreement (RM-19). However, the CZDA still has potential to enhance national climate policies by linking the sustainability of the cacao supply chain to the of the Paris Agreement's NDC (Nationally Determined

Contributions) (RM-19). Nonetheless, a significant challenge for CZDA continuity is renewing participants' interest through a new strategic plan *"adapted to the new realities and contexts"* (RM-18).

From Voluntary to Mandatory Zero Deforestation Regulations: Within the framework of complying with EUDR regulations, some CZDA stipulations may transition from voluntary to mandatory for enterprises aiming to export cocoa to the European Union. In this context, the mandatory EUDR zero-deforestation requirements for accessing European markets may take precedence over the voluntary, non-legally binding initiatives of the CZDA. In fact, some cocoa stakeholders are already coordinating to meet the demands of the EUDR.

"There is a relatively new coordination space, created within the framework of the EUDR implementation. The limited timeframe to comply with the regulations forced cacao stakeholders to come together, discuss, and coordinate" (RM-19).

Coordination Through New Stakeholder Platforms: A potential scenario for the CZDA would be its integration into emerging or existing cacao platforms, such as the National Council of Cacao Producers or the National Cacao Traceability Roundtable. Stakeholders might also choose to coordinate through these platforms, potentially replacing the CZDA as the main coordination platform in the Colombian cacao supply chain.

" [In the new cacao platform] The same actors are present as in the Agreements, but they find a framework for dialogue around something that really interests them [exporting cacao to the EU]. We are talking about deforestation, we are talking about how to measure it, how to quantify it, but we are talking about deforestation associated with the market as an enabling requirement" (RM-19).

6 Discussion

The findings reveal that Colombian ZDAs operate through highly differentiated pathways across the beef, dairy, and cacao supply chains, confirming that sectoral context is a determinant of their effectiveness. Rather than generating uniform and measurable deforestation outcomes, ZDAs interact with pre-existing institutional arrangements and deforestation policies, production systems, and market structures, resulting in uneven and conditional effects.

In the beef and dairy sectors, ZDAs have produced limited direct effects on observed deforestation. While interviewees reported gains in awareness, information sharing, and the development of traceability and monitoring tools, these advances remain insufficient to counteract structural drivers of deforestation such as fragmented supply chains, weak enforcement capacity, land grabbing and speculation, and expansion of

the agrarian frontier. This aligns with the literature showing that voluntary sustainability initiatives rarely alter land-use behavior in high-risk contexts without regulatory backing, credible sanctions, or strong market exclusion mechanisms (Lambin, et al., 2019; Garrett, Levy, Gollnow, Hodel, & Rueda, 2021; Rodríguez-de-Francisco, et al., 2021).

In contrast, the cacao ZDA was not designed to reverse active deforestation caused by cacao cultivation but rather to prevent future forest conversion and consolidate low-deforestation production systems, while positioning Colombian cacao at the international stage. Given cacaos' agroforestry base and relatively low deforestation footprint in Colombia, the agreement's contribution lies in reinforcing existing sustainable pathways and signaling alignment with international zero-deforestation expectations and the implementation of Colombia Peace Agreement (Furumo & Lambin, 2020).

Differences across supply chains management are more pronounced. In beef and dairy, sustainability practices remain regionally uneven and heavily dependent on external projects, reflecting misaligned incentives in fragmented value chains. Without mechanisms to redistribute costs and benefits or reward compliance, sustainable practices struggle to scale beyond pilots, as documented in the broader certification and standards literature (Garrett, Levy, Gollnow, Hodel, & Rueda, 2021).

By contrast, cacao's higher sectoral concentration, stronger organizational capacity, and pre-existing sustainability practices enabled the cacao ZDA to function as a coordination and market-positioning platform. Outcomes such as strengthened traceability governance and early alignment with the EU Deforestation Regulation (EUDR) illustrate how ZDAs can support sustainable supply-chain management even in the absence of binding enforcement. However, tensions around productivity and overreliance on international cooperation highlight the need to better integrate conservation objectives with income and yield improvements (Giller, et al., 2021).

Finally, ZDAs have functioned as public–private governance platforms with mixed results. In beef and dairy, they facilitated dialogue and learning but lacked the authority to demand compliance, underscoring the limits of voluntary governance in high-risk contexts (Bernstein & Cashore, 2012). In cacao, the ZDA initially provided strategic coordination around peacebuilding and sustainability but has lost momentum as policy priorities and market requirements have evolved.

Overall, the evidence suggests that ZDAs are understood as adaptive governance instruments rather than direct deforestation-control tools. Their primary contribution lies in shaping coordination, learning, and expectations, necessary but insufficient conditions for zero-deforestation outcomes, highlighting the importance of combining voluntary agreements with regulatory frameworks and market incentives tailored to sector-specific realities.

7 Conclusions

This study shows that ZDAs in Colombia should be understood as governance instruments whose effectiveness depend on how they are embedded within the broader deforestation policy frameworks, rather than as stand-alone solutions. Their primary contribution lie in enabling reputation-based competitive advantages and market access shaping, multi-actor coordination, information flows, and management of expectations along supply chains, but translating these gains into durable deforestation outcomes requires targeted public action that addresses sector-specific constraints.

In high-risk and fragmented sectors such as beef and dairy, policy efforts should prioritize correcting incentive misalignments that currently undermine voluntary commitments. This implies moving toward mandatory, minimum traceability requirements that extend beyond first-tier suppliers and are interoperable with land-use planning, cadastral, and environmental monitoring systems. Linking ZDAs to such regulatory baselines would help level the playing field between compliant and non-compliant actors, reducing the risk that firms engaging in zero-deforestation commitments face.

Complementarily, ZDAs in these sectors should be coupled with economic incentives that reward compliance and offset adjustment costs, particularly for small and medium producers. Preferential access to credit, technical assistance, and public procurement programs conditioned on deforestation-free production can strengthen the credibility of ZDAs and enhance producer buy-in. Without these incentives, voluntary agreements are likely to remain confined to pilot initiatives, unable to counteract land-use pressures driven by land grabbing, speculation and frontier expansion.

In the cacao sector, where agroforestry-based production is compatible with forest conservation, the evidence suggests that ZDAs can help consolidate low-deforestation pathways when they are embedded in long-term sector strategies rather than short-term projects with limited regional focus. Public policy should therefore integrate the cacao ZDA into permanent sector institutions and align it with national climate commitments and emerging due diligence regulations, while ensuring continuity beyond international cooperation cycles. Sustaining participation requires linking zero-deforestation and environmental objectives to clear productivity and income gains. Therefore, policies should support yield-enhancing technologies within agroforestry systems, promote income diversification, and facilitate access to stable markets so that sustainability requirements are perceived as economically viable rather than as additional burdens.

The policy implication is that ZDAs should be treated as adaptive instruments that need to be matched to sector realities and embedded within broader environmental and agricultural policies. Where deforestation risk is high, and supply chains are fragmented, ZDAs require regulatory scaffolding and credible economic incentives to move beyond pilots and voluntary uptake; where risk is lower and organization is

stronger, they can help lock in sustainable trajectories and facilitate compliance with emerging due-diligence expectations. To be successful, the Agreements also require long-term financial commitments to allow stakeholders to comply with the requirements. Future research should test these conditional pathways more explicitly by linking governance and behavioral outcomes to spatially explicit measures of land-use change over longer horizons, and by identifying which combinations of traceability systems, enforcement arrangements, and incentive structures can make voluntary agreements consequential in frontier settings.

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9 Annexes

Annex 1. Respondents by supply chain and type

Supply chain	Private actor	Public actor	NGO/civil society	Total
Beef	5			5
Dairy	3			3
Beef/Dairy			4	4
Cacao	2		2	4
Cacao/beef/diary		2	3	5
TOTAL	10	2	9	21

Annex 2. Respondents ID

Respondent ID	Type	Supply chain
RM-01	Private actor	Dairy
RM-02	NGO/civil society	Dairy/beef
RM-03	Private actor	Dairy
RM-04	Private actor	Beef
RM-05	Private actor	Dairy
RM-06	NGO/civil society	Dairy/beef
<i>RM-08</i>	NGO/civil society	Dairy/beef
<i>RM-09</i>	NGO/civil society	Dairy/beef
RM-10	Private actor	Beef
RM-11	Public actor	Dairy/beef/cacao
RM-12	Private actor	Beef
RM-13	Private actor	Beef
RM-14	Private actor	Beef
RM-15	Public actor	Dairy/beef/cacao
RM-16	Private actor	Cacao
RM-17	Private actor	Cacao
RM-18	NGO/civil society	Cacao
RM-19	NGO/civil society	Cacao
RM-20	NGO/civil society	Dairy/beef/cacao
RM-21	NGO/civil society	Dairy/beef/cacao



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