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Co-funded by the European Union

Federal Ministry for the Environment, Climate Action, Nature Conservation and Nuclear Safety

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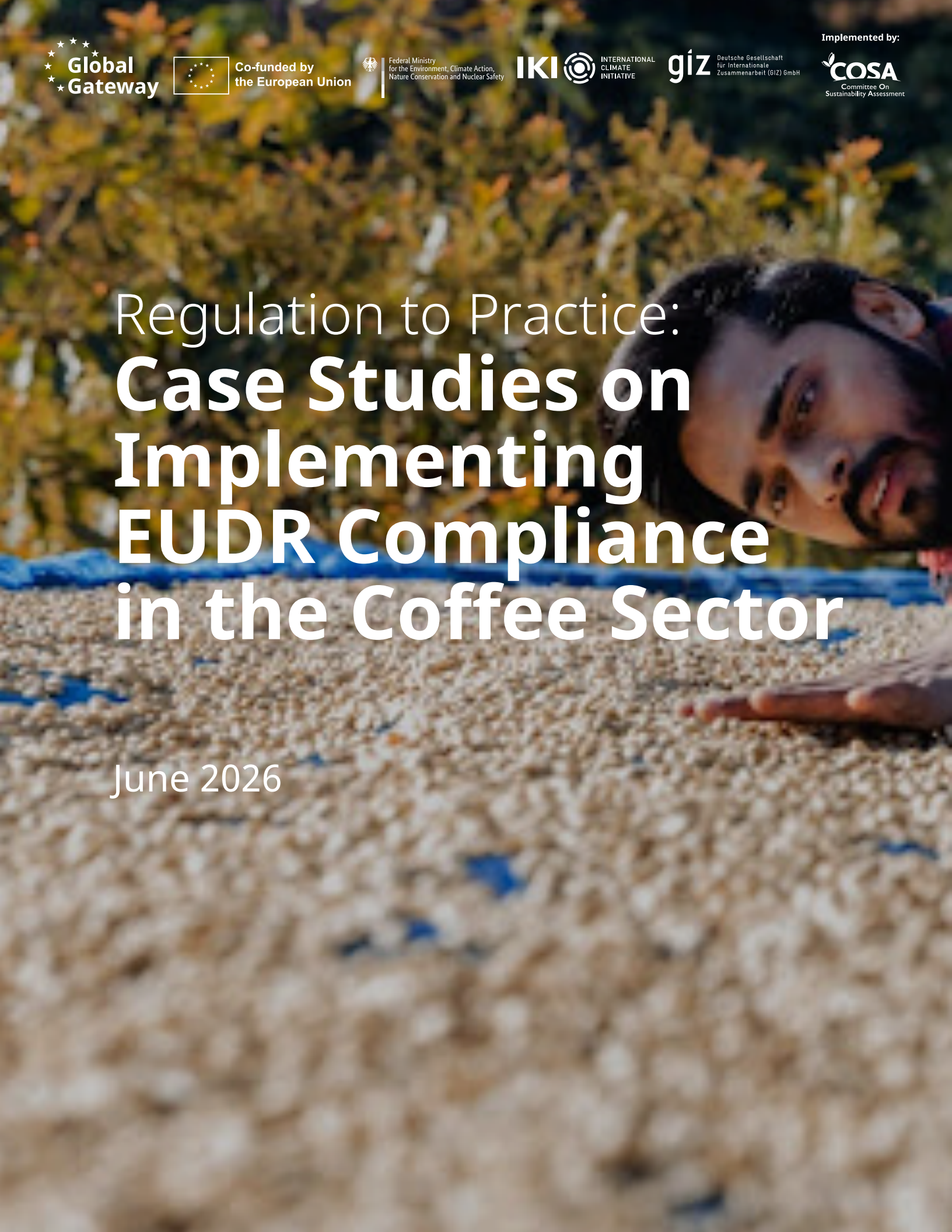
Implemented by:

COSA Committee On Sustainability Assessment



Regulation to Practice: Case Studies on Implementing EUDR Compliance in the Coffee Sector

June 2026

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Acknowledgements

This report was prepared by the Committee on Sustainability Assessment (COSA) with the financial support of the European Union and Germany (BMUKN-IKI), through GIZ, within the framework of the Greater Forests of Mesoamerica Programme and the Coffee and Forests Initiative.

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Interview List

Name	Organization
Luis Pineda	Asociación de Productores Cafetaleros de Occidente en Honduras (APROCAOH)
José Dario Enamorado	Beneficio Río Frío
José Manuel Calero Moraga	Becamo (Neumann Kaffee Gruppe)
Juan Galguero	Café Ventura
Federico Ceballos	Centro Internacional de Agricultura Tropical CIAT
Greg Sampson	Deforestation Free Trade Gateway DFTG
Alice Bisiaux	European Forest Institute EFI
Dolan Josué Castro Cortés	European Forest Institute EFI
Hannelore Beerlandt	International Coffee Organization ICO
Pascal Ripplinger	INATrace
Thomas Vaassen	Meridia
Christian Hennig	Permarobotics
Jonas Spekker	WHISP (WHat IS in that Plot) by FAO

Acronyms and Abbreviations

CIAT	International Center for Tropical Agriculture
COSA	Committee on Sustainability Assessment
DDS	Due Diligence Statement(s)
DinE	Declaration in Excess
EAIs	Early Action Initiatives
EFI	European Forest Institute
ERP	Enterprise Resource Planning (system)
EU	European Union
EUDR	European Union Deforestation Regulation
FAO	Food and Agriculture Organization
GIZ	German Agency for International Cooperation (Deutsche Gesellschaft für Internationale Zusammenarbeit)
IHCAFE	Instituto Hondureño del Café
ITC	International Trade Centre
QR (code)	Quick Response code

Executive Summary

The European Union Deforestation Regulation (EUDR) represents a major shift in environmental due diligence requirements for global commodity supply chains. For the coffee sector, the regulation introduces new obligations related to geolocation, traceability, deforestation risk assessment, and legality verification. While a growing ecosystem of digital tools and methodologies has emerged to support implementation, actors across the coffee supply chain continue to face significant operational, governance, and coordination challenges in translating regulatory requirements into workable systems under real-world conditions.

This report, commissioned by the Committee on Sustainability Assessment (COSA) within the framework of the Central America EUDR Learning Community, led by PROMECAFE and co-facilitated by COSA with the support of the German Agency for International Cooperation (Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH), analyzes five key implementation challenges associated with EUDR in the coffee sector. Drawing primarily on experiences in Honduras and broader regional initiatives, the report uses a case-based approach to examine how different supply-chain actors are operationalizing compliance in practice. Rather than presenting "best practices," the cases reveal emerging strategies, trade-offs, and unresolved tensions that characterize early implementation efforts.

A central finding across all cases is that EUDR implementation extends far beyond a technical traceability exercise. Instead, compliance is emerging as a chain-wide due diligence challenge requiring layered controls, governance mechanisms, interoperability across systems, and coordination among multiple actors. While plot mapping and deforestation screening are necessary foundations, they are insufficient on their own once coffee moves through fragmented and aggregated supply chains characterized by informal trade, infrastructure limitations, and physical mixing of volumes.

The first case study examines how transaction-level traceability systems such as TraceFoodChain and INAtrace are being used to strengthen first-mile traceability in aggregated smallholder coffee supply chains. The analysis shows that transaction-level controls, geolocation-linked producer records, plausibility checks, and digital documentation can significantly improve visibility and confidence in sourcing relationships, even in contexts with informal intermediaries and limited connectivity. However, the cases also demonstrate that digital systems alone are insufficient. Effective implementation

depends on complementary operational controls, warehouse management practices, documentary evidence, and external verification mechanisms.

The second case focuses on the challenge of managing mixing risk once coffee enters aggregated processing environments. Because full physical segregation is often economically or operationally unfeasible in smallholder-based systems, actors are increasingly relying on layered approaches combining digital traceability, "declaration in excess" (DInE), trust-based supplier relationships, and targeted verification processes. The case highlights how risk management under EUDR is evolving toward combinations of compensating controls rather than strict reliance on complete physical segregation. At the same time, uncertainty remains regarding how competent authorities will interpret these approaches and what level of residual risk will ultimately be considered acceptable.

The third case examines legality compliance under EUDR, one of the least clearly operationalized dimensions of the regulation. Experiences from Honduras demonstrate that legality assessment is not simply a documentation exercise, but a highly resource-intensive coordination challenge involving legal interpretation, risk prioritization, field-level verification, and potential remediation. The Honduran legality framework, developed through a multi-stakeholder process with methodological support from EFI and Preferred by Nature, illustrates how national-level coordination can reduce duplication, harmonize interpretations, and create shared reference points for exporters and buyers. However, substantial ambiguities remain regarding how legality should be assessed, what constitutes adequate mitigation, and how responsibilities should be distributed across actors.

The fourth case explores trusted data sharing and governance. Across interviews, stakeholders consistently identified the absence of trusted governance mechanisms—not the absence of technology—as one of the primary bottlenecks limiting scalability. Fragmented and duplicative mapping efforts, combined with concerns around competition, data ownership, and commercial sensitivity, continue to constrain collaboration. Emerging approaches such as "give-to-get" incentive models, shared data spaces, interoperability standards, and governance structures like CGIAR's Trust Framework illustrate possible pathways for enabling more coordinated and efficient systems. The analysis suggests that scaling EUDR implementation is fundamentally a collective action problem requiring alignment across incentives, trust, governance, assurance mechanisms, and technical interoperability.

The fifth case examines the growing need for modular and interoperable compliance "stacks." EUDR implementation requires multiple interconnected functions—including geolocation, risk analysis, legality assessment, traceability, reporting, and data exchange—which are rarely provided by a single system. Instead, actors are increasingly assembling combinations of proprietary and open-source tools. The report highlights the growing importance of interoperability, shared standards, and integration protocols to reduce fragmentation, lower compliance costs, and improve compatibility across supply-chain actors. Initiatives such as DIASCA and tools including DFTG, WHISP, TraceFoodChain, and INAtrace demonstrate a broader shift toward open and interoperable digital ecosystems rather than vertically integrated proprietary solutions.

Across all five cases, several cross-cutting insights emerge. First, compliance credibility is increasingly built through layered and compensating controls rather than through any single system or mechanism. Second, governance, trust, and coordination are as important as technology itself. Third, interoperability and data-sharing architectures are becoming critical for reducing duplication and enabling scalability. Finally, implementation remains deeply shaped by structural realities within producing countries, including infrastructure gaps, fragmented sourcing systems, and uneven technical capacity.

The report concludes that the long-term effectiveness and inclusiveness of EUDR implementation will depend not only on technical innovation, but also on governance arrangements that enable coordination across actors and systems. Whether EUDR ultimately strengthens supply chains or contributes to further concentration and exclusion will depend on how responsibilities, risks, costs, and incentives are distributed throughout the value chain. Early experiences from the coffee sector demonstrate that producing countries are actively developing practical and innovative approaches to implementation. Ensuring that these origin-led solutions are recognized and integrated into broader compliance frameworks will be critical for achieving effective, credible, and equitable implementation at scale.

1. Introduction and Purpose

1.1 Background: EUDR and the Coffee Sector

The European Union Deforestation Regulation (EUDR) represents a significant shift in how environmental due diligence is expected to be managed within global commodity supply chains. For coffee, the regulation introduces new obligations related to traceability, geolocation of production plots, and deforestation risk assessment, with implications for producers, producer organizations / primary aggregators, exporters, service providers, and buyers across the supply chain.

While technical guidance and digital tools for EUDR compliance are rapidly emerging, many actors continue to grapple with how to translate regulatory requirements into operational practices that are workable within existing coffee supply-chain realities. For example, segregation of coffees from compliant plots, with those of unknown plots might require separate hoppers and mills at washing stations, running separate batches in dryers or other processes, that either require additional physical infrastructure, or incur additional costs. This transition from regulation to implementation raises practical questions around data collection and quality, governance and data sharing, costs and timelines, and the allocation of roles and responsibilities among supply-chain actors.

In response to these shared challenges, PROMECAFE, the Committee on Sustainability Assessment (COSA), the German Agency for International Cooperation (GIZ), and the European Union have partnered to foster a learning community for Early Action Initiatives (EAIs)[1] engaged in EUDR implementation in Central America. The objective of this collaboration is not to promote specific solutions, but to create a space for collective learning around how different actors are navigating common constraints and trade-offs in practice. Within this framework, COSA was commissioned to examine a set of cases that illustrate how EUDR-related challenges are being addressed across the supply chain, and to analyze the emerging strategies, limitations, and implications of these approaches.

1 Early Action Initiatives (EAIs) are pilot, early-stage efforts by public, private, or multi-stakeholder actors to test and operationalize EUDR compliance approaches ahead of full enforcement. They explore different combinations of georeferencing, earth observation data, deforestation risk assessment, and traceability methods to assess cost, accuracy, scalability, and inclusion—particularly for smallholders.

1.2 Why a Case-Based Approach?

As EUDR implementation advances, a growing number of actors across the coffee sector are experimenting with different ways of addressing shared compliance challenges. These efforts offer valuable learning opportunities—not because they represent “best practice” or finalized solutions, but because they reveal how organizations are navigating common constraints, uncertainties, and decision points within existing supply-chain structures.

A case-based approach allows the analysis to move beyond abstract requirements and examine how EUDR-related challenges are encountered and addressed in practice. The cases highlight not only the strategies being tested, but also the limitations, trade-offs, and unresolved tensions that emerge as regulatory expectations are translated into operational systems.

By examining multiple cases side by side, the report identifies recurring challenges, patterns of response, and areas of divergence that are relevant beyond any single initiative. In this way, the cases serve as analytical lenses for understanding how different actors are grappling with the same underlying issues, not necessarily examples to be evaluated or precisely replicated.

1.3 Purpose, Audience, and Scope of the Report

The purpose of this report is to analyze five pre-eminent challenges associated with implementing EUDR in the coffee sector, and to examine how different supply-chain actors are responding to these challenges in practice. Through qualitative analysis, the report surfaces emerging strategies, implementation constraints, and practical trade-offs that characterize current efforts to operationalize EUDR requirements.

The report is intended for a broad set of stakeholders involved in production, trade, and sourcing of coffee or similar commodities. This includes:

- Farmers and producer organizations or primary aggregators, who are increasingly asked to provide geolocation, traceability, deforestation and legal compliance-related data;
- Exporters and other intermediaries in producing countries, who play a central role in coordinating compliance systems and managing data, costs, and risks; and

- International coffee buyers, who are responsible for ensuring due diligence under the EUDR.

This analysis is based on qualitative interviews with actors directly involved in EUDR implementation, complemented by a review of project documentation and publicly available materials. The selected cases reflect variation in supply-chain roles, geographic contexts, and operational conditions, and are used to examine how shared challenges are being addressed in practice.

By presenting a comparative analysis across cases, the report aims to support these actors in understanding how EUDR requirements are being interpreted and implemented, what constraints and trade-offs arise, and how responsibilities for compliance are being distributed across the supply chain.

The scope of the report is limited to qualitative analysis of selected experiences in Central America (mostly Honduras). These cases are not presented as best practices or endorsements of specific approaches, but as illustrative examples that shed light on diverse ways of addressing shared EUDR challenges. The report does not constitute a compliance manual, legal interpretation, or certification framework, nor does it assess or verify the compliance status of any actor. Instead, it is intended as a learning-oriented resource to inform dialogue, decision-making, and collaboration across the sector.

2. Analytical Cases

2.1 Case Study 1: First Mile Verification under EUDR: Transaction-Level Controls in Aggregated Coffee Supply Chains

Context and Challenge

EUDR requires operators placing coffee on the EU market to report the plots of production associated with each shipment. In practice, however, coffee moves through long, fragmented, and often informal supply chains before export. Plot-level data is collected upstream—by producers, producer organizations, intermediaries, or service providers—while downstream actors may process and blend these volumes into aggregated export lots. As a result, the reliability of traceability systems depends heavily on the accuracy of information captured at the first mile.

In countries such as Honduras, an estimated 80–90 percent of coffee is traded through informal or semi-formal intermediaries, often as fresh cherry or (wet) parchment. Transactions are time-sensitive, volumes are small, and commercial relationships rely largely on trust rather than formal documentation. Ensuring that actors consistently record origin information, maintain plot-level records, avoid mixing compliant and unknown volumes, and transfer accurate information downstream remains a significant challenge. Consequently, complete traceability from plot to export has historically been difficult to achieve.

The central challenge addressed in this case study is therefore: **how can confidence in first-mile traceability be established in aggregated, smallholder-based supply chains?**

Approach and Design

To examine this challenge, the case study analyzed how transaction-level traceability and control systems are being implemented within Honduran coffee supply chains, focusing specifically on the use of TraceFoodChain and INAtrace by different supply-chain actors, like

Beneficio Río Frío and Café Ventura. The analysis explored how information moves across producer organizations, intermediaries, exporters, and international buyers, and how digital systems are layered onto existing commercial relationships and sourcing structures.

Trace Food Chain

TraceFoodChain[2] is a transaction-level traceability system designed to empower informal buyers, to ensure a link between volumes purchased and the plots where they were produced.

TraceFoodChain captures transactions between every entity in the supply chain, beginning at the first mile and continuing through each subsequent transaction and transformation. By recording these exchanges step by step, the system creates a comprehensive transaction log that enables traceability across the entire value chain.

Before transactions can be initiated, plots need to be registered, and assigned a 'unique, universal identification' (UUID) generated by the Linux Foundation's Asset Registry. This UUID (a 64-digit string) can be shared with farmers via SMS/WhatsApp or printed as a QR code onto a physical card, simplifying identification of the plots during the farm-gate sale. Each plot is also assessed using WHISP to determine deforestation and other risks, to enable first buyers to segregate volumes from compliant farms with those of unknown status, even at the first mile.

First-mile transactions are then recorded using this plot UUID and can be captured, using offline-first apps available for iOS, Android, or via web app. Each subsequent transaction or transformation along the supply chain is recorded in the same system, creating a continuous and traceable record of product movement (aka a "digital twin"). Volumes can be mixed at any step, including the first mile, so long as volumes from compliant plots are not mixed with those of non-compliant plots.

For each transaction, both parties (i.e. producer and first buyer) must verify the details, creating a chain of dual-party verified transactions that are stored in an immutable ledger[3].

[2] https://tracefoodchain.org/

[3] Initially first mile transactions could not be verified by farmers, who had physical cards with their plot UUID printed as a QR code. To address this, TraceFoodChain has developed a system for farmers who have semi-smart phones to verify the transaction. Since these transactions often occur in areas without the internet, the transaction details are communicated from the buyer's phone via a QR code generated in the app, that the seller

This verification mechanism strengthens transparency and accountability throughout the supply chain. In addition, by recording the volumes sourced from each plot, the system enables volume-based plausibility checks[4] that compare reported volumes with expected production levels. These checks draw on factors such as plot size, expected yields, historical delivery patterns, and the distance between the plot and the first buyer.

Taken together, these mechanisms provide a robust method for identifying potential inconsistencies in the supply chain, including leakage, where volumes are attributed to a plot that did not actually produce them. By combining traceability, dual-party verification, and volume-based plausibility checks, the system strengthens the integrity and reliability of supply chain data while helping to detect irregularities early in the chain.

INAtrace

INAtrace is a modular, open-source traceability system implemented and stewarded by the Sustainable Agricultural Supply Chains Initiative (SASI) at GIZ to support transparency and transaction-level documentation across agricultural supply chains. In Honduras, interviewed actors described the platform as primarily being used to digitalize sourcing, purchasing, and traceability processes across relationships between producer organizations, exporters, and international buyers. While the system was not initially adopted specifically for EUDR compliance, additional functionalities and integrations—including geolocation tools, WHISP integration, and risk-assessment capabilities—have made it increasingly compatible with EUDR due diligence requirements over time.

In the case of Café Ventura, a Honduran family-owned exporter, implementation was initiated through collaboration with the Canadian importer RGC Coffee and supported by GIZ. The system operated through a three-level coordination structure involving producer organizations, the exporter, and the importer. This structure enabled traceability systems to be layered onto existing sourcing relationships rather than replacing them.

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can scan. Once the seller verifies the transaction, another QR code is generated in the app, that the buyer can scan to record mutual verification.

[4] **Plausibility checks** are validation steps used to assess whether reported data (e.g., volumes, yields, timelines, and flows) are realistic and internally consistent, helping identify potential errors, mixing, or fraud in traceability systems (e.g., production volumes exceeding farm capacity, out-of-season sales, or mismatches between reported and mapped farm areas).

Within this workflow, producer organizations received coffee deliveries from individual producers, recorded sourcing transactions and delivery information, maintained production estimates, and assembled export lots in response to purchase requests originating downstream from the importer and exporter. Purchase requests generated by the importer were transferred to the exporter, which then allocated sourcing requests to participating cooperatives and associations according to predefined specifications such as volume, quality, and certification requirements. Producer organizations subsequently assembled export lots by linking individual producer deliveries to the requested lot.

Producers were associated with unique producer identifiers and linked geolocation records, while delivery information, payment records, processing documents, and lot composition histories were entered into the system by cooperative staff. Interviewed actors explained that many producer organizations already possessed geolocation data and production records prior to implementation but lacked a centralized digital platform through which to organize and share this information. Integrations with WHISP later enabled the upload and management of polygon data and GeoIDs associated with individual plots. Production estimates and expected yield ranges were also incorporated to support plausibility assessments aimed at reducing the risk of duplicate sales or the introduction of volumes inconsistent with expected production levels.

At the same time, interviewed actors emphasized that producers themselves generally did not directly interact with the platform or digitally verify transactions. Traceability therefore remained institutionally mediated through cooperatives and exporters rather than being directly farmer managed.

Actors also stressed that traceability within INAtrace extended beyond digital transaction records alone. The platform was used to document warehouse segregation, transfer records, quality controls, storage locations, machinery cleaning logs, processing documentation, and lot histories associated with export shipments. These records served as supporting evidence intended to strengthen confidence in the relationship between digital traceability records and physical coffee flows. However, as INAtrace itself does not enforce physical segregation, interviewed actors described the system as most effective when combined with organizational controls, documentary evidence, and external verification mechanisms.

What the Approach Demonstrated

Implementation experience from the TraceFoodChain Early Action Initiative and INAtrace implementation in Honduras indicates that transaction-level traceability systems can function even in contexts where first-mile transactions frequently occur between smallholders, cooperatives, and informal or semi-formal intermediaries operating in areas with limited connectivity. Interviewed actors described these systems not as replacements for existing sourcing relationships, but as mechanisms for making sourcing transactions, lot composition, and supporting documentation more visible and verifiable across the supply chain.

Actors reported that the systems were operational and adopted by key intermediaries, cooperatives, mills, and exporters. In the case of Café Ventura, traceability systems were integrated into existing sourcing structures involving autonomous producer organizations, export coordination, and downstream buyer requirements. Producer organizations were able to link producer deliveries, geolocation information, and production estimates to export lots, while exporters used the systems to monitor lot assembly, segregation, and processing documentation associated with export shipments.

Interviewed actors also emphasized that confidence in traceability did not rely solely on digital transaction records. Systems such as INAtrace were combined with warehouse segregation practices, transfer documentation, quality records, machinery cleaning logs, and third-party verification processes intended to strengthen alignment between digital records and physical coffee flows. These experiences suggest that emerging EUDR implementation models in aggregated supply chains are evolving into hybrid assurance systems that combine digital traceability, operational controls, documentary evidence, and external verification mechanisms.

Importantly, the pilot established workable practices and institutional precedents around first-mile data capture and interoperability. Actors such as Beneficio Río Frío and Becamo described transaction-level controls as a practical improvement over previous sourcing practices, particularly for non-certified coffee where geolocation and transaction data had previously been limited or absent. Even without generating immediate price premiums, the pilot demonstrated that transaction-level controls can contribute meaningfully to EUDR due diligence under real supply-chain conditions, particularly in smallholder-based systems characterized by aggregation and informal trade.

Structural Constraints

While the pilot demonstrated meaningful operational improvements, it also clarified which constraints remain structural and extend beyond the scope of any single digital tool.

Physical segregation remains economically prohibitive in many smallholder-based systems. Intermediaries and mills noted that running equipment multiple times for small compliant lots significantly increases costs. Digital systems can document transactions and segregation practices, but they cannot fundamentally alter underlying infrastructure realities. We will discuss this further in Case Study 2.

Data governance concerns also surfaced. Actors expressed hesitation about sharing sensitive producer and commercial data without clear access rules. Positioning public institutions such as Instituto Hondureño del Café (IHCAFE) as neutral data-space hosts was viewed as enabling, though not sufficient on its own. Case Study 4 provides a more detailed discussion on trust frameworks for shared data governance models.

Actors also emphasized that transaction-level traceability systems alone were not necessarily viewed as sufficient to establish commercial confidence. In practice, digital traceability systems were often combined with existing trust relationships, documentary controls, physical segregation practices, and third-party verification mechanisms. For example, Becamo valued the fact that Beneficio Rio Frio used TraceFoodChain, despite not relying directly on the batch-level traceability it provided and instead adopted a 'declaration in excess' approach—whereby all plots supplying Beneficio Rio Frio are assumed to contribute to every outgoing lot (refer to Case Study 2). In this context, transaction-level controls were viewed as a meaningful contribution to first mile traceability and EUDR documentation requirements, while still functioning alongside broader institutional and commercial trust mechanisms.

Additional assurance layers also emerged around third-party verification systems. Café Ventura described participation in RGC Coffee's "3E" verification scheme, implemented through independent auditors, which included periodic verification of warehouse segregation practices, labor conditions, storage documentation, and consistency between digital records and physical inventories. These experiences suggest that EUDR implementation in aggregated smallholder supply chains may increasingly rely on layered

governance approaches that combine digital traceability tools with external verification, operational controls, and buyer-driven assurance mechanisms.

Key Insights from Case Study 1

- TraceFoodChain and INAtrace demonstrated a model that can function to capture traceability back to the plot, even when the first-mile transactions take place between small-holders and informal buyers and without network connectivity.
- First-mile transactions facilitate assessment of deforestation and other on-farm risks, which is particularly important for non-certified coffee.
- Volume-based plausibility checks enhance risk detection and documentation, even where full physical segregation is not feasible.
- Digital systems can enhance transparency and traceability, but credibility does not rely on a single tool. It depends on how different controls and systems work together, alongside physical infrastructure, trust-based commercial dynamics, and clear governance and data-sharing frameworks.
- While stronger traceability systems may create future opportunities for differentiated market access or pricing, interviewed actors did not report immediate price premiums associated with implementation during the pilot period.

2.2 Case Study 2: Managing Mixing Risk under EUDR Through Declaration in Excess and Trust-Based Controls

Context and Challenge

While Case Study 1 focuses on establishing confidence in first-mile traceability, this case examines a distinct challenge: how to maintain that integrity once coffee moves beyond the first mile into aggregated processing systems where physical mixing occurs.

Beyond first-mile traceability, EUDR does not allow mass balance and requires that volumes from compliant plots must remain segregated from non-compliant or unknown-origin volumes throughout processing, storage, and aggregation.

In the Honduran coffee sector, this requirement collides with entrenched operational realities. Coffee is routinely mixed by farmgate buyers, wet mills, dry mills and other intermediaries. Mixing by these various actors is motivated by several factors including:

- **Limited infrastructure:** For example, there may only be a single wet mill, and so all fresh cherries received on a given day must be processed together.
- **Efficient use of time:** While a farm-gate buyer may be able to segregate batches from farmers using burlap sacks, this would require considerable time effort.
- **Efficient utilization of physical resources:** For example, smaller segregated batches may not fill a dryer, so unless multiple batches are mixed, the dryer will need to be run more times adding cost.
- **Lack of systems:** Implementing segregation at each step—and accurately recording these processes—requires clear protocols, trained personnel, and reliable systems (whether analog or digital) to capture each stage.

Traceability tools like TraceFoodChain and INAtrace track segregation digitally, but they cannot guarantee real-world execution. Plausibility checks that compare volumes against area of production along with dual-party verification[5] provide mechanisms for verifying first

[5] **Dual-party verification** is a validation approach where two independent actors (e.g., farmer and buyer, or producer organization / primary aggregator and exporter) confirm the same data or transaction, helping ensure accuracy and reduce the risk of errors or misreporting (e.g., matching reported volumes, prices, or delivery records between parties).

mile and subsequent downstream transactions; these mechanisms have limited ability to verify physical segregation once coffee is in the custody of single actors such as producer organizations or mills. In these contexts, digital records may not fully reflect physical reality, as volumes reported as segregated may in practice have been mixed. Indeed, the traceability tool recently launched by the European Forest Institute, called WHIMO, assumes that all volumes will essentially be mixed at each node in the supply chain.

Without credible control mechanisms, compliant volumes may be mixed with unknown-origin coffee, creating uncertainty around the integrity of Due Diligence Statements (DDS). In response, some European buyers have opted to simply shift their procurement to exclude certain mills where segregation is perceived to be unreliable. While this reduces perceived compliance risk, it may exclude suppliers who happen to be upstream of those mills, even if they are compliant.

The central question addressed in this case is therefore: **how can mixing be managed that ensures compliant coffee remains separate from non-compliant, particularly where physical segregation is constrained?**

Approach and Design

To address the limitations for verifying segregation while in the custody of a single entity, digital tools may need to be paired with a trust established with their supplier chain partners and/or an approach known as “declaration in excess” (DInE). Trust in suppliers is especially important when an entity is handling both compliant and non-compliant volumes, to help build confidence that the digital segregation reflects reality. DInE may obviate the need for segregation altogether, provided that suppliers handle only volumes from compliant plots.

Becamo emphasized the importance of the trust it had in Beneficio Rio Frio, which had been established over several years working together, through which Becamo felt confident in the processes and credibility of the organization to accurately record traceability. This trust was further enhanced through Rio Frio’s adoption of traceability tools like TraceFoodChain, as was noted in Case Study #1.

However, trust between two supply chain actors may not be sufficient for actors further downstream who do not share the direct relationships. Hence a “trust but verify” approach, in which a small number of unannounced audits are conducted to ensure that the digital twin reflects reality, can demonstrate greater due diligence. Such audits might, for example,

check in close to real time that volumes that were reported as being segregated are physically segregated and clearly marked.

By independently assessing the compliance of all of Rio Frio's suppliers, Becamo was also able to use DInE. Under this model, rather than tracking the specific plots contributing to a given lot, an entity assesses whether all its suppliers are compliant and, if so, lists them in the Due Diligence Report. So long as a buyer has sufficient trust that their supplier's sub-suppliers are compliant, internal mixing becomes immaterial from a due diligence perspective, as all incoming volumes are already considered eligible.

While DInE is not permitted at the country level and the regulation requires maintaining the highest possible level of traceability, FAQ 1.18 indicates its accepted use within entities to address challenges of segregation:

Operators may declare "in excess" only in situations where a bulk commodity is fully traced to the plot of land and is not subject to mixing with commodities of unknown origin or non-compliant commodities. When such bulk commodity is mixed up along the logistical or production process, for instance in silos for storage, during the transport or in the production process, and as long as they are not being subject to mixing with commodities of unknown origin or non-compliant commodities, the operator can resort to a declaration in excess. In these situations, operators are required to obtain traceability data that is as granular as possible, identifying all plots of land from which the specific batch of products could have originated.

A key risk of the DInE approach is that if any supplying plot is found to be non-compliant, all volumes it has been mixed with become ineligible under EUDR. This makes early verification of plot compliance critical. By assigning unique identifiers (e.g., UUIDs or QR codes) and assessing deforestation risk through tools such as WHISP, first-mile buyers can screen sourcing at the point of entry. Solutions like INATrace, TraceFoodChain, and WHIMO support this process by enabling early-stage validation.

What the Approach Demonstrated

Experience from Honduras suggests that combining DInE with digital documentation, trust and verification can meaningfully reduce mixing-related uncertainty. At the processing level, volume reconciliation and digital documentation allow exporters to align sourced and sold volumes, creating structured evidence to support DDS submissions. Río Frío and Becamo reported that this layered approach, with checks at multiple steps along the value

chain, increased buyer confidence while preserving existing supply chains, despite their inability to provide segregation.

More importantly, this model has allowed continued market access for producers delivering into mixed facilities, reducing the need for blanket exclusion - where entire groups of producers are excluded from supply chains due to a lack of full segregation and help maintain trade continuity under EUDR constraints.

Applications of INATrace in other contexts, including Ecuador and Cameroon, suggest that similar models may be transferable, though outcomes depend heavily on local institutional capacity.

Structural Constraints

Digital twins generally cannot replace a lack of physical infrastructure: because Rio Frio does not have multiple processing lines or separate drying patios, physical segregation is unfeasible without substantial investment. However, the case study of Beneficio Rio Frio underscores how trust and DInE can be leveraged to overcome these challenges, and how tools like TraceFoodChain, INATrace and WHIMO can increase that trust, and provide the necessary assurance around plot compliance necessary for DInE.

Since Becamo had verified that all the suppliers were deforestation free, they were able to rely on DInE. However, if Beneficio Rio Frio were handling volume from both compliant and non-compliant plots, Becamo would have needed to mitigate the risk of mixing. It might have achieved this using a “trust but verify” approach. Verifications could include independent verification—through document triangulation, plausibility checks, and targeted sampling—specifically targeted to ensure that the digital records accurately reflected segregation through each step.

Open questions remain regarding how competent authorities will interpret layered compliance architectures and how much residual risk will be deemed acceptable under EUDR.

Key Insights from Case Study 2

- Managing mixing risk in smallholder-based systems requires combined risk-management strategies - including physical controls, documentation, and verification- rather than strict physical segregation.
- Traceability tools like TraceFoodChain, INATrace and WHIMO are essential where intermediaries are handling both compliant and non-compliant volumes, to demonstrate their proper segregation. However, trust in supply chain partners, supported by spot audits ("trust but verify"), are still needed to ensure that the digital records reflect actual segregation, and to support acceptance by downstream entities (including operators and competent authorities).
- Localized DInE offers a pragmatic pathway where segregation infrastructure is limited. Traceability tools like TraceFoodChain, INATrace and WHIMO can still play an important role in DInE systems, by providing the first-mile traceability necessary to identify plots and ensuring that volumes from non-compliant plots are identified before they are mixed into the broader system.
- Conservative buyer responses- such as avoiding entire mills or regions where segregation is uncertain—can reduce perceived compliance risk, but, if not paired with proportionate, risk-based assessment, may lead to the exclusion of compliant producers operating within aggregated or mixed systems.

2.3 Case Study 3: Addressing EUDR Legality Through Collective Assessment at the National Level

Context and Challenge

In addition to requiring that commodities be deforestation-free, EUDR mandates that products originate from plots that comply with all relevant legislation in force in the country of production. While deforestation risk has been widely discussed, legality introduces a distinct layer of interpretative ambiguity, resource intensity, and governance coordination. Interviews indicate that competent authorities increasingly view legality as equally important as deforestation risk. However, legality remains one of the least clearly operationalized components of the regulation.

There are four broad steps involved in assessing legality for EUDR:

Included in EFI Framework & Partners

Step 1: Determining the laws that are relevant to the commodity and reinforced
Step 2: Assessing which of these laws represent actual risk

Step 2: Assessing risk in specific supply chain(s) based on available data sources and collected data
Step 4: Remediation/mitigation of identified risks

Generally implemented by Supply Chain & Partners

This multi-step process aligns with the best practices for human rights and environmental due diligence (HREDD) as outlined in the recent publication Applied Due Diligence; Lessons learned through the Due Diligence Fund[6], which explains that:

Desk-based scoping studies serve as a cost-efficient starting point for HREDD improvements. As outlined in the OECD Guidelines (OECD, 2018), desk-based studies can efficiently inform risk prioritization and identify existing information and data on specific risks within a geographic context. This is a useful first step in avoiding duplication [as indicated in step #2 above. However,

[6]https://www.sustainable-supply-chains.org/funds-projects/due-diligence-fund/translate-to-en-report-lessons-learned

as per step #3, above] Regional risks must be verified within the specific supply chain context; a high regional risk does not automatically equate to a high company risk, and conversely, a low -regional average may mask acute adverse impacts at the operational level. Therefore, to perform effective due diligence, a company needs to understand the conditions of its own operations and supply chains as opposed to relying on general regional knowledge.

Each of these steps may involve multiple experts, including local legal specialists to interpret regulations (step 1), as well as researchers and field actors to identify where risks of non-compliance pose real threats (step 2). Additional expertise is required to determine what data is available—such as public records and geospatial tools—and to design and deploy effective field audits where necessary (step 3). Ultimately remediating or mitigating any compliance risks that were identified. These steps represent a challenging, and resource-intensive process that is likely beyond the resource capacities of most entities to execute credibly in a single origin. The challenge for entities becomes entirely infeasible for many actors that may operate across multiple countries, as is the case for many operators sourcing one or more affected ingredients from multiple geographies.

Furthermore, ambiguities about how to interpret EUDR further complicate the process. For example, interviewees highlighted uncertainty regarding what constitutes "legislation in force," how to treat laws that exist on paper but lack implementing decrees.

While well-resourced buyers and trade associations have independently hired legal experts to map relevant legislation in sourcing countries—these efforts are rarely harmonized, yielding the risk for varying degrees of quality and a patchwork of different interpretations of the same laws that value chain actors would need to contend with for different buyers.

Beyond the interpretation of local laws, there are procedural ambiguities. For example, where additional information must be gathered through field audits or other data collection, several tactical decisions are unclear:

- Do they need to be conducted by third-party auditors, or can local partners implement them? Should audits be unannounced?
- What is an appropriate sample size? Should issues be assessed at the level of individual farmers or can be interpreted at broader systemic or regional levels?
- Some competent authorities have signaled expectations of per-farmer legality verification, significantly increasing compliance burdens in smallholder-dominated supply chains.

Lastly, there is lingering uncertainty around what risk mitigation constitutes in the context of EUDR. Initially, many had interpreted risk mitigation to include remediation of known non-compliances. However, more recently this interpretation is giving way to a stricter, zero-tolerance interpretation, akin to that for deforestation. There may even be diverging interpretations across competent authorities, further compounding this lack of clarity.

Legality under EUDR therefore presents not only a documentation requirement, but a coordination challenge that requires alignment on legal interpretation, risk prioritization, and assessment approaches across multiple actors.

Approach and Design

Most of the actors interviewed in Honduras have adopted a risk-based, regionally grounded interpretation of EUDR as a practical response to the challenges of operationalizing legality in complex smallholder systems. Interviewees consistently emphasized that universal verification of every producer would be both impractical and disproportionate. Instead, the approach begins with macro-level risk identification—assessing which legal categories are most material at the national level (step 1), where risks are geographically concentrated (step 2), and how enforcement functions in practice—so that due diligence efforts can be focused where they matter most (step 3).

This framing is closely linked to the realities of how legality is experienced on the ground. Compliance with specific legal requirements at the plot level is not always clear-cut. For example, environmental permits may take years to obtain; a producer may have applied and be in the process of regularization but not yet hold formal approval. In such cases, compliance status remains ambiguous despite active efforts to meet legal requirements. By distinguishing between material and likely risks versus those that are less probable or structurally unresolved, the Honduran Due Diligence Tool provides a way to prioritize verification and mitigation efforts in a manner that is both risk-based and operationally feasible.

At the same time, this approach is designed to create alignment across the supply chain rather than replace individual responsibility. It offers a shared national reference that helps harmonize interpretations of legality, improve consistency among actors sourcing from Honduras, offer sources of key data (e.g. land titles) or how to document sufficiently when

data is not available. In some instances, the review has helped identify legal challenges such that the governments can address them by providing additional information or updating the regulations.

The Honduran Legality Framework in Practice

This case examines the Honduran legality assessment process—developed with methodological support from the European Forest Institute (EFI) in cooperation with Preferred by Nature (PbN)—as a lens to explore one of the most complex EUDR challenges: how to operationalize legality in practice. The legality due diligence methodology was published in Honduras in December 2025 as part of EUDR implementation. It emerged from a multi-stakeholder process led by the Government of Honduras, with technical support from EFI/PbN through its Technical Facility on Deforestation-free Value Chains, as well as NIRAS, and was financed by the European Union.[7]

The Honduran Legality Due Diligence Tool was developed using EFI's methodological framework and hosted on its Legality Due Diligence Navigator platform. Rather than producing a prescriptive audit checklist, the tool consolidates relevant national legislation linked to coffee production areas and identifies where risks are most material. It integrates formal legal analysis with practical field-level risk patterns, such as labor vulnerabilities in border regions or land-tenure complexities affecting smallholder farmers.

The tool suggests possible data sources to monitor risk, such as geospatial tools to check infringement on protected areas, indigenous territories, and zoning regulations. However, many legality risks—particularly those related to labor rights or documentation—require field-level assessment.

What the Approach Demonstrated

The Honduran legality tool, finalized in late 2025 following extensive consultations, represents a structured attempt to operationalize EUDR legality at a national level. Interviewees emphasized that the process itself was a significant achievement. By convening government agencies, private sector actors, and civil society, the framework

[7] https://legalitynavigator.efi.int/honduras-legality-due-diligence-tool-coffee/

created shared ownership of legality interpretation and assessment of risks. The publication of the guide provides exporters and buyers with a consistent interpretation, increasing alignment and predictability.

Structural Constraints

The methodological framework is resource-intensive, typically requiring months of technical analysis and coordination and hence assessments have been completed for only a handful of countries. Furthermore, many legality issues—such as land-tenure regularization or environmental permitting—extend beyond the control of most value chain partners and hence often require further government coordination.

The EFI process stops short of making recommendations for field-level assessment or remediation (addressing steps 1 and 2, not 3 and 4 above). Where such field assessments are necessary, entities are left to design and implement them on their own. Efforts to provide pragmatic, credible and ideally open source, assessment content, and guidelines for conducting assessments, is a critical need that organizations like EFI, COSA, Verite, ISEAL, FairTrade, Rainforest and others could collaborate to provide.

Investment by supply chain actors to remediate non-compliances based on legality requirements have been relatively limited to date. There are many reasons for this, including the relative nascency of understanding of the legal requirements under EUDR and data to identify those issues, as well as lack of clarity around who is ultimately responsible for such remediation. This is especially true for seemingly intractable challenges that may arise from multiple factors, such as child labor. Collective action by multiple supply chain actors, may be one solution as we will explore in case study 4.

Despite these constraints, the Honduran experience clearly demonstrates that legality under EUDR may be more feasible when approached as a national, multi-stakeholder governance exercise rather than as fragmented firm-by-firm compliance.

Key Insights from Case Study 3

- Legality under EUDR requires coordination across multiple actors to align legal interpretation and credibly identify relative risks at a regional level.
- Assessing the relevant laws and their risks requires substantial resources, institutional capacity, and political will. However, tackling these efforts through a national, multi-stakeholder process reduces duplication of effort and aligns interpretation across supply-chain actors.
- Risk-based prioritization enables proportionality in how legality is assessed, without lowering standards.
- Significant ambiguities remain in how legality requirements under EUDR are interpreted in practice.
- While the EFI process provides a protocol for a more unified interpretation of relevant laws, and their respective risks (steps 1 and 2), supply chain actors and their partners generally are responsible for assessing the specific risks in their supply chain (step 3), and remediating any risks identified (step 4). Execution of these latter two steps could be made simpler, more credible and impactful with assessment and remediation guidance. A number of NGOs and other actors should collaborate to develop this guidance.
- Investments in remediation around legal risks, especially for more complex issues, has been limited and will likely remain so without efforts to coordinate collective action by multiple parties including various value chain actors, government bodies and philanthropies

2.4 Case Study 4: Enabling Trusted Data Sharing at Scale Under EUDR.

Context and Challenge

This case examines a structural bottleneck that cuts across many EUDR and similar implementation efforts: the extent to which distrust, commercial competition, and the absence of trusted data-sharing mechanisms constrain collaboration across supply chains. While plot mapping, deforestation screening, and legality assessments are advancing rapidly, implementation efforts often remain highly fragmented and duplicative. In many cases, multiple traders and buyers independently geolocate and assess the same producers, resulting in inefficient use of resources that could otherwise be directed toward underserved regions and producers not yet covered by compliance systems. This duplication can also create assessment fatigue among repeatedly surveyed farmers, while further marginalizing less-connected producers who remain outside formal traceability networks.

To address the issue of uneven coverage—and to support national-level plausibility assessments based on plot sizes, expected yields, and other variables—many governments are seeking to establish centralized repositories of aggregate geolocation data. However, regardless of whether participation in these systems is voluntary or mandatory, private-sector actors are often reluctant to contribute data in the absence of sufficient trust guarantees, clear governance frameworks, data protection mechanisms, and appropriate incentives for sharing commercially sensitive information.

Across interviews, stakeholders consistently identified four core categories of data that must be shared and maintained for EUDR systems to function effectively at scale:

- Plot georeferences
- Traceability data linking physical volumes back to plots
- Deforestation-risk assessments associated with those plots
- Legality information

Without coordination across these categories, EUDR implementation risks remaining fragmented, inefficient, and uneven across actors and regions.

Approach and Design

Interviews consistently indicated that the primary bottleneck is not the absence of mapping or traceability tools, but rather the absence of a governance architecture capable of enabling data exchange among actors operating in competitive environments. Scaling data sharing therefore requires alignment across several interdependent dimensions, particularly incentives, trust, and governance.

1. Incentive Alignment

Geolocation and traceability data are often perceived as competitive assets. In the absence of reciprocal value, sharing such information can appear economically irrational to private actors. As a result, several initiatives are exploring "give-to-get" models, in which governments or neutral institutions provide access to services—such as polygon cleaning, deduplication, risk analysis, or access to georeferences contributed by other users—in exchange for data sharing. These mechanisms help shift cooperation from voluntary goodwill toward mutually beneficial participation.

Another important incentive for data sharing is the facilitation of collective action. By identifying which supply-chain actors' source from the same plots or regions, shared systems can create opportunities to jointly commission additional data collection, coordinate monitoring efforts, and invest collectively in remediation activities. These are actions that individual actors would often have little incentive to undertake independently.

2. Data governance and trust

At the same time, interviews highlighted that concerns over who controls the data, who can access it, and how it may ultimately be used remain among the main barriers to participation. In response, emerging initiatives are focusing on governance frameworks designed to enable data sharing while safeguarding the interests of participating actors.

One example is the "Trust Framework," a methodology developed by the International Center for Tropical Agriculture (CIAT)/CGIAR to build governance structures from the ground up. Since 2023, this approach has been applied in Honduras through a bottom-up

process beginning with supply-chain actor mapping and initial agreements, and evolving through pilots, iterative coordination, and continued stakeholder engagement. Over time, the process has contributed to a broader institutional mandate, including support for the development of digital infrastructure for the coffee sector in collaboration with government actors. Interviewees emphasized that this process has been complex and non-linear, requiring continuous trust-building among stakeholders with diverse and sometimes competing interests.

The approach is now expanding to additional countries, including Kenya, Guatemala, and Costa Rica, across both EUDR-related and broader sustainability initiatives, demonstrating its relevance in diverse contexts. Importantly, the framework is not limited to EUDR compliance. Rather, it is designed to support multiple objectives depending on how governance arrangements are defined.

The architecture is also intended to function within an open ecosystem, where different tools and platforms—such as INAtrace, TraceFoodChain, and the Deforestation-Free Trade Gateway (DFTG)—can connect and contribute as interoperable data sources within a broader digital public infrastructure. No single platform is intended to be exclusive or mandatory. Instead, the Trust Framework, supported by shared methodologies and implementation guidance, provides the governance structure through which data is generated, validated, exchanged, and managed. This reinforces a central lesson emerging across cases: credibility depends not on any single tool, but on the strength of the governance framework within which tools operate.

3. Assurance Mechanisms

Shared data must be credible to be usable. Independent (i.e. third party) verification layers, including triangulation based on multiple sources of the same data, and targeted audits strengthen confidence without requiring full-scale inspection. Indeed, the certain types of verification, such as volume plausibility checks, are most accurate when conducted in such a shared data space, as individual entities would not be aware of volumes being purchased from a given plot beyond their supply chain. Neutral “data space” architectures can separate governance of access from commercial control, preserving data sovereignty while enabling controlled exchange. The Instituto Hondureño del Café (IHCAFE) has launched such a shared data space for Honduras.

4. Interoperability Infrastructure

The ability to efficiently exchange data between systems is a critical enabler of interoperability. This requires both **syntactic** and **semantic interoperability**. Syntactic interoperability refers to the format in which data is exchanged—such as JSON, XML, or CSV—ensuring that systems can technically transmit and receive information. Semantic interoperability, by contrast, refers to a shared understanding of the meaning of that data.

Without semantic alignment, even technically compatible systems can produce inconsistent or misleading results. For example, one system may measure compliance on a scale from 1 to 5, while another uses a simple binary classification (yes/no), making direct comparison difficult. Similarly, the use of common identifiers is essential to ensure that the same entity—such as a specific farm plot—is consistently recognized across different systems.

These dimensions are mutually reinforcing.

- Incentives without trust will not generate participation.
- Trust without interoperability limits usability.
- Interoperability without reciprocal value fails to motivate contribution.

Weakness in any one-dimension risks undermining the entire architecture.

What The Approach Demonstrated

Although still at an early stage, interviews indicate increasing convergence around the need for reciprocal data-sharing models and independent assurance layers.

Several major buyers were reported to be open to sharing high-quality remote sensing outputs—such as Airbus-derived analyses—if assured of the reliability of underlying geolocation data. These examples suggest that cooperative dynamics may emerge where value exchange is clear and governance frameworks provide sufficient trust, transparency, and assurance for participating actors.

While sophisticated organizations may exchange data via direct system-to-system integration, most supply chain participants require a dedicated intermediary platform to facilitate these transitions. To address this need, the International Trade Centre developed

the Deforestation-Free Trade Gateway (DFTG), a no-cost digital infrastructure designed to standardize and streamline data flows.

The DFTG enables supply chain actors to upload geographic plot data—either their own or those of their suppliers—to a centralized environment. Once integrated, users can access geospatial analytics from WHISP to verify land-use history. Furthermore, the platform acts as a secure conduit, allowing for the direct transfer of validated plot data to downstream partners, thereby supporting transparency throughout the value chain.

Structural Constraints

Despite conceptual alignment, significant obstacles remain. Competitive asymmetries persist. Actors that have invested heavily in mapping may resist sharing unless reciprocal arrangements clearly outweigh perceived losses.

Trust asymmetries between governments and private actors remain unresolved in some contexts. Firms may question public-sector neutrality or data security, while governments may doubt the completeness of private datasets.

Institutional capacity varies widely across producing countries. Long-term data hosting, maintenance responsibilities, legal ownership, and data protection frameworks require clarification before large-scale sharing can occur.

These challenges suggest that scaling EUDR compliance is fundamentally a collective action problem under competitive conditions, requiring governance design that aligns incentives, safeguards trust, enables technical exchange simultaneously and clearly demonstrates shared value.

Key Insights from Case Study 4

- Facilitating the exchange of EUDR and other data presents many benefits, including avoiding duplication of effort, broader coverage, opportunities to cross-check data, and validation such as holistic plausibility checks.
- Several hurdles prevent greater data sharing, including competition, distrust and technical barriers to data exchange.
- Incentive alignment—such as “give-to-get” models—can shift data sharing from voluntary to economically rational participation.
- Trusted governance arrangements and independent assurance layers build trust in the veracity of data and streamline data exchange.
- Tools for data sharing, like the DFTG facilitate data exchange between value chain partners without requiring full centralization.

2.5 Case Study 5: Building an Integrated EUDR Compliance Stack Across Tools and Actors

Context and Challenge

This case examines a cross-cutting implementation challenge emerging across supply chains: how to assemble and coordinate multiple digital tools and systems into a coherent EUDR compliance architecture.

Fulfilling EUDR due-diligence and reporting requirements involves multiple interconnected steps, including:

- Plot geolocation
- Assessing deforestation risk
- Assessing legality compliance
- Tracing volumes to specific plots and demonstrating downstream segregation between compliant and non-compliant volumes
- Data storage and analysis
- Data sharing with partners, including creating Due Diligence Statements

While a few tools aim to provide more comprehensive solutions, these tend to be commercial solutions whose cost is unmanageable for producer organizations, exporters and other small and medium enterprises in the global south. There is a growing ecosystem of free and open-source tools, including many that have been developed by Team Europe Initiative (TEI) partners (including GIZ, ITC, EFI and FAO)

However, most of these tools address only one or a subset of these functions, requiring actors to assemble and coordinate a "stack" of complementary tools to meet EUDR requirements. Building such a stack introduces the need to exchange data between various tools; e.g. plot geolocated in one system, may be referenced in transactions, which are tracked in another.

The challenge of exchanging data between tools within an organization, are compounded by the challenge of exchanging data between organizations.

This fragmentation increases compliance costs and risks reinforcing inequalities between actors with advanced digital infrastructure and those operating with limited resources. As a result, the ability to assemble and maintain an effective compliance "stack" becomes unevenly distributed across actors.

Rather than focusing on a single initiative, this case analyzes the practical challenge of tool integration, data exchange, and standards alignment across supply-chain actors who often rely on different platforms, vendors, or internal systems. It explores how open-source tools, shared data standards, and interoperability protocols may reduce duplication, lower costs, and improve consistency in EUDR-related reporting.

Approach and Design

Across interviews and documentation, a clear pattern is emerging: rather than relying on proprietary, vertically integrated systems, actors are moving toward **modular compliance architectures** built from combinations of:

- Free and open-source tools that fulfill one or more functions
- Interoperability protocols that facilitate combining tools into a comprehensive solution (or "stack")
- Shared data standards, to facilitate exchange of data between actors

In this modular approach, different tools serve complementary functions—such as data collection, traceability, or risk assessment—while remaining connected through common standards.

At the core of this approach is **data interoperability**. There are two key types of interoperability that are necessary to ensure systems can exchange data effectively:

- *Semantic* interoperability: ensuring common definitions of data. A classic example is harmonizing date formats between US systems (Month-Day-Year, MDY) and international/European systems (Day-Month-Year, DMY) to ensure a single, accurate interpretation of the date 04/05/2026 as May 4th, rather than April 5th.
- *Syntactic* interoperability: the structural elements of how data is exchanged, such as the format in which data is exchanged (XLS vs GeoJSON), data exchange protocols, etc.

The Digital Innovations in Agricultural Supply Chains Alliance (DIASCA), a project led by GIZ, continues to align industry partners around common understandings of both semantic and syntactic interoperability. Aligning around common field definitions, shared identifiers, and exchange protocols facilitate a modular approach, even allowing the adoption of both free and open-source tools along with proprietary systems. Actors may continue using different internal tools, but data can still be exchanged in consistent, structured formats. This shifts the challenge from selecting a single "correct" tool to designing a modular ecosystem in which multiple tools can reliably work together both within and across organizations. Ultimately the goal is that an exporter using free and open-source tools can send data to an importer who is using a proprietary solution, just as easily as someone using a mac can send an email using Gmail to someone on a PC using MS outlook.

What the Approach Demonstrated

integrating tools often requires some technical expertise, which could include clunky manual processes of exporting data from one system and importing into another, or more technical processes such as configuration of custom APIs (Application Programming Interface, which allow systems to exchange data directly).

To reduce both the manual and technical burden for users some tools are beginning to embed integration more directly. For example, TraceFoodChain (TFC) integrates with FAO's WHISP for deforestation-risk assessment and with Asset Registry systems for traceability and entity identification. Similarly, INATrace combines farm-level data collection, traceability, and risk assessment functionalities, including integration with FAO´s WHISP tool for deforestation screening and the AgStack Asset Registry for the generation and management of GeoIDs associated with production plots. The Deforestation-Free Trade Gateway (DFTG) reflects this trend by aggregating deforestation-risk data (e.g., WHISP, Global Forest Watch) into a shared access platform. COSA, in partnership with the Gates Foundations, also configured open-source integrations between Kobo, Baserow, WHISP, and DFTG for the Ethiopian Coffee Association, which are now being piloted by several other partners.

Together, these developments point to a gradual shift toward more interoperable ecosystems, where integration is increasingly built into system design, standardized workflows and shared protocols rather than being left entirely to end users.

Structural Constraints

Despite increasing awareness of the need for interoperability, several changes persist. First, commercial incentives may favor closed ecosystems. Vendors offering vertically integrated solutions may prioritize platform lock-in over interoperability, creating tensions between ease of use within a single system and the broader need for cross-system compatibility. Second, standards continue to evolve, creating a moving target. As additional EUDR implementation guidance is issued and new regulations evolve, data requirements and reporting formats may change, requiring ongoing adaptation.

These factors suggest that reducing compliance fragmentation will require not only better tools, but clearer standards, technical assistance, and coordinated sectoral alignment of tools, methodologies, data models, specialized survey and metric content and analytical capabilities. Without such comprehensive solutions, smaller actors may struggle to configure and maintain the necessary multi-layered systems without external support.

Practical Implications for Implementation

For actors assembling or refining their EUDR compliance stack, several practical considerations emerge:

- Consider their technical capacity to configure and maintain tools and their integrations when selecting which tools to use
- Evaluate whether open-source components can reduce entry costs for upstream partners while remaining compatible with commercial systems. Also consider the cost of paying for proprietary tools versus maintaining free and open-source tools
- Regardless of what tools are chosen, avoid excessive “lock-in” by selecting tools that adhere to **common data standards and agreed field definitions** so that data can be ported to new systems, as well as to supply chain partners
- Map internal data flows before investing in new systems, identifying where manual re-entry, duplication, or inconsistencies occur.
- Consider what data needs to be collected and from what entities. Clarify responsibility for data validation, transformation, and transmission at each supply-chain interface.

Rather than seeking a single comprehensive solution, organizations may benefit from deliberately designing and managing a modular compliance “stack” that allows incremental adaptation as regulatory expectations evolve.

Key Insights from Case Study 5

- EUDR compliance requires multiple steps. There are many proprietary tools as well as a growing cadre of free and open-source tools are also available. Many tools, especially free and open source developed by TEI and other partners, address only part of the compliance process, but can be integrated into holistic “stacks”
- The capacity to build and manage an effective compliance stack is unevenly distributed, creating barriers for smaller actors and risk reinforcing inequalities.
- Modular architectures built on shared standards enable flexibility while preserving compatibility.
- Interoperability, not tool uniformity, is the critical design principle.
- Emerging tool integrations (e.g., TFC, INATrace, DFTG) demonstrate a shift toward more connected systems, though integration challenges remain.

3. Cross-Case Insights

This chapter synthesizes cross-cutting insights emerging from the five analytical cases. Rather than comparing initiatives as "solutions," the synthesis focuses on recurring implementation challenges, the strategies actors are adopting in response, and what these experiences suggest about how EUDR is being operationalized.

3.1 EUDR compliance is a Chain-Wide Due Diligence Challenge

Across cases, EUDR implementation emerges less as a purely technical traceability exercise and more as a multi-layered due diligence challenge spanning the entire supply chain. While plot mapping and deforestation screening provide essential foundations, they are insufficient to generate the necessary confidence in compliance once coffee moves through intermediaries, mills, exporters, and buyers without additional mechanisms in place.

Case 1 demonstrates how confidence in first-mile traceability can be strengthened through transaction-level recording, dual-party verification, and plausibility checks. Case 2 shows the additional challenges of this approach once coffee enters aggregated processing systems, where physical mixing can occur. In these contexts, while digital systems and trust-based relationships are valuable tools, they cannot compensate for inadequate physical systems, e.g. segregation. Together, these cases shift the focus of compliance away from single solutions toward the combination of complementary mechanisms, across different stages of the supply chain, such as the physical processes and their digital twins.

Building on this, Case 3 introduces a further layer of complexity by highlighting that EUDR compliance also depends on how national laws are interpreted and assessed in the country of production—adding coordination, resource, and capacity challenges that go beyond traceability and deforestation risk.

Case 4 touches on the dynamics between value chain actors including incentives for data sharing and systems that promote trust in data veracity. Case 5, discusses the challenge of bringing all of these elements together within a single organization, including multiple tools, processes and content, as well as the technical challenges of exchanging data across various platforms and between different entities.

3.2 First-Mile Controls Are Necessary but Not Sufficient

The cases reveal a clear asymmetry: the first mile is where risk is most detectable and feasible to document, but downstream physical infrastructure ultimately determines how far that confidence can travel. Transaction-level systems can strengthen visibility and enable plausibility checks in smallholder-based contexts. However, once volumes enter aggregated processing environments, digital documentation cannot substitute for the absence of segregation infrastructure or guarantee physical practices that cannot be continuously verified. This highlights a structural gap between visibility and control as coffee moves beyond the first mile.

Across cases, a consistent finding reinforces this dynamic: digital tools are effective in strengthening documentation, anomaly detection, and internal oversight, but their impact is bounded by broader system constraints. These include physical infrastructure, the cost and feasibility of segregation and verification, and the realities of legacy trading systems—long-established aggregation and bulk trading practices designed for efficiency rather than traceability. In this sense, digital solutions are not standalone fixes, but components within a wider compliance architecture shaped by both technical and structural conditions.

3.3 Compliance Credibility is Built Through Layered and Compensating Controls

Across cases, compliance does not hinge on a single control or the ability to fully segregate compliant and non-compliant volumes. Instead, actors are converging on layered compliance strategies that combine multiple, complementary controls across the supply chain. Recurring mechanisms include:

- Limiting EU-bound sourcing to suppliers that have been mapped and screened
- Volume reconciliation and plausibility checks, ideally implemented at the national level
- Verification layers based on document triangulation and targeted follow-up

Where full physical segregation is not feasible, actors apply compensating controls to manage residual risk. While these mechanisms do not eliminate uncertainty, they enable actors to establish defensible due diligence positions under real operational constraints.

Across cases, credibility does not stem from any single tool or intervention, but from combinations of controls that reinforce one another across different stages of the chain. In this sense, compliance is less about proving absolute certainty and more about assembling sufficient, coherent evidence to demonstrate that risks have been identified, assessed, and mitigated.

Importantly, this pattern reflects adaptation rather than failure. Rather than waiting for ideal infrastructure, actors are actively constructing workable compliance architectures within existing systems, balancing regulatory expectations with on-the-ground realities.

3.4 Coordination, Governance, and System-Level Feasibility

Across cases, technological capability alone does not determine feasibility. EUDR implementation emerges primarily as a coordination challenge, shaped by governance, incentives, and how responsibilities are distributed across the supply chain.
Governance conditions—such as who controls data, who is trusted to host it, and what incentives support participation—shape outcomes as much as the tools themselves. Concerns around data ownership, competition, and trust recur throughout the cases. Without clear governance and a shared value proposition, data sharing remains uneven, fragmented, and often duplicative.

At the same time, no single actor or system can ensure compliance in isolation. Traceability tools, remote sensing, and verification processes each address part of the problem, but none provide a complete solution on their own. Effective implementation depends on how these elements are combined and coordinated across actors and systems.

This interdependence creates practical coordination challenges. Systems must be able to exchange information in consistent formats, and actors need aligned incentives to participate in shared approaches. Without interoperability and participation, compliance efforts remain fragmented and difficult to scale.

Across cases, implementation is uneven but evolving. There is clear progress: first-mile systems are functioning in some contexts; layered controls are being applied where segregation is not feasible; legality requirements are being interpreted; and new tools and infrastructures are emerging.

However, important gaps remain. Differences in technical capacity, infrastructure, and resources risk widening the divide between well-resourced actors and those operating in more fragmented or under-digitized environments.

Ultimately, whether EUDR strengthens supply chains or contributes to further consolidation will depend on how governance, interoperability, and incentives evolve. In this sense, EUDR implementation is as much an institutional and coordination challenge as it is a technical one.

3.5 What the cases suggest about EUDR implementation in practice

Across the five cases, several cross-cutting observations emerge:

- EUDR compliance involves multiple actors across the supply chain and functions as a risk-management process, rather than a single traceability system.
- Plot mapping and deforestation screening are necessary foundations, but additional challenges arise once coffee moves through aggregation, processing, and governance systems.
- Digital tools improve visibility and help detect inconsistencies but cannot replace the infrastructure needed to physically separate compliant and non-compliant coffee.
- Where physical segregation is not feasible, actors combine different control measures (such as declaration in excess, volume checks and sourcing restrictions) to manage risk and support due diligence.
- Governance, incentives, and interoperability are key conditions for scaling implementation.
- Current approaches show adaptation and learning but also highlight risks of

4. Implications for EUDR Implementation and Sector Governance

4.1 Core Implementation Principles Emerging from Practice

Across diverse supply-chain contexts, early EUDR implementation points to four practical principles.

1. Risk Management is the Core of Implementation

In many coffee supply chains—especially where volumes are aggregated—full traceability and physical separation at every stage is not feasible. As a result, the most effective approaches do not aim for perfect control, but for credible, well-documented risk management systems.

This involves:

- Identifying where risks are most material (e.g., sourcing, mixing during processing, legality requirements)
- Matching those risks with proportionate control measures (such as sourcing restrictions, volume reconciliation, or targeted verification)
- Aligning across supply-chain actors on what constitutes a reasonable and defensible level of risk management.

The key shift is from asking *"Can we eliminate all risk?"* to *"Are our controls clear, credible, and consistently applied?"*

2. Controls Must Reflect How Coffee Actually Moves

The need for a risk-based approach is driven by the physical and operational realities of coffee supply chains. While plot mapping and deforestation checks are essential starting points, they do not ensure confidence once coffee moves through aggregation and processing.

Most coffee systems over the last several decades have evolved to favor efficiency and volume aggregation—not for strict lot-by-lot segregation. As a result:

- First-mile traceability often faces challenges related to fragmented sourcing structures, high number of transactions, dispersed producers, and the informality of some actors.
- Downstream traceability and segregation become increasing difficult as aggregation and processing systems are designed to maximize efficiency and handle mixed volumes. Digital tools can improve visibility and documentation across different stages of the supply chain, but they cannot replace missing infrastructure or fundamentally alter how coffee systems are physically organized.

In this context, designing controls that reflect how coffee actually moves is critical. Where segregation is not feasible, combining multiple control mechanisms has proven more practical than attempting to enforce models that cannot operate at scale.

3. Governance and Trust are as important as Technology

Compliance depends not only on tools, but on how systems are governed.

Key elements include:
- Clear rules on who can access and use data
- Trusted arrangements for storing and managing data
- Verification processes that strengthen credibility without requiring constant audits
- Recognition of existing relationships and roles in the supply chain

Traceability systems work best when governance is built in from the beginning—not added later.

4. Scaling Requires Coordination Across Systems and Actors

EUDR compliance involves multiple functions: mapping, risk analysis, transaction tracking, legality checks, and reporting. These are usually handled by different systems and actors.

Scaling depends on:
- Systems being able to exchange information
- Shared definitions and data formats

- Incentives for actors to collaborate and share data
- Collective approaches for shared challenges (such as legality)

Without coordination:
- Efforts become fragmented
- Costs increase
- Smaller actors are disadvantaged

Well-coordinated systems reduce duplication and make participation more feasible.

4.2 Structural Implications for the Coffee Sector

Beyond implementation, the cases reveal broader sector dynamics. EUDR is interacting with existing differences in infrastructure, resources, and technical capacity across producing regions. In many contexts, investments in traceability and certification have already been made over the past decades. However, limited margins and price volatility constrain the ability of actors to invest further in segregation infrastructure, legal compliance, or advanced digital systems.

As a result, gaps in compliance are often driven by structural constraints rather than a lack of willingness.

There is also a risk that stricter or more conservative interpretations of compliance—particularly around mixing or legality—may favor already well-equipped supply chains. This could lead to:
- Greater concentration of sourcing
- Exclusion of producers in more fragmented or less digitized regions

At the same time, the cases demonstrate strong innovation at origin. Examples include:
- Transaction-level traceability systems
- National approaches to legality
- Modular integration of tools and data systems

These developments show that producing countries are actively designing workable solutions under real constraints. Ensuring that such approaches are recognized and

incorporated into compliance frameworks will be critical for achieving fair and realistic implementation.

4.3 Looking Ahead: Areas Requiring Continued Attention

As implementation evolves, several areas require continued attention:

First, producer inclusion and incentive design will be critical. Whether EUDR strengthens shared accountability or leads to further consolidation at origin will depend on how incentives are structured, whether interoperability reduces the cost of participation, and how downstream actors engage with suppliers across different tiers of the supply chain.

Second, there is a need to recognize and integrate solutions emerging from producing countries. Approaches such as collective legality frameworks and transaction-level controls offer practical pathways for compliance under real-world conditions. Their inclusion in broader regulatory and market discussions will shape long-term feasibility.

Third, the allocation of responsibility remains a key issue. While legal responsibility sits with EU operators, operational compliance is distributed across multiple actors in the supply chain. How responsibilities, costs, and risks are shared will influence whether EUDR supports collaboration or leads to risk shifting and exclusion.

Finally, institutional innovation will play an important role. The long-term effectiveness of EUDR may depend less on new technologies and more on governance approaches that enable coordination among actors, particularly in areas such as legality interpretation and data sharing.

5. What Will Matter Most Going Forward

Early experience in the coffee sector shows that EUDR compliance is fundamentally a coordination and governance challenge. Technical tools are essential, but not sufficient on their own.

Looking ahead, three factors will be particularly important:

- **Alignment of systems**
  Shared data standards and interoperability mechanisms, and governance arrangements that allow actors and tools to work together across fragmented supply chains.
- **Recognition of origin-led solutions**
  Greater recognition and integration of approaches developed in producing countries - including transaction-level controls, collective legality frameworks, and interoperable systems- within broader compliance frameworks.
- **Clear distribution of responsibilities and costs**
  Practical and equitable allocation of responsibilities, costs and risks across the different actors in the supply chain.

Ultimately, the effectiveness of EUDR will depend on whether coordination improves alongside technical development—and whether implementation remains inclusive of diverse producing contexts.