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PERSPECTIVE

Scaling out agroforestry and forest conservation in West Africa requires more transformative policy interventions in cocoa supply chains

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Abstract

Tropical forests are vanishing at an unprecedented rate due to the expansion of commodity production, while climate change is putting increasing strain on food systems. Côte d'Ivoire and Ghana produce over half of the world's cocoa, a multi-billion-dollar industry, yet most cocoa producers in these two countries live below the poverty line, and economic vulnerability is further exacerbated by climate change and ongoing deforestation largely driven by cocoa expansion. Companies have recently begun implementing policies to promote forest restoration, halt deforestation, and improve farmers' livelihoods, but there is increasing evidence that these efforts are falling short in terms of both effectiveness and equity. This perspective article argues that several critical *design* flaws are central to the short-comings of these company policies that are likely to be exacerbated with the new EU deforestation regulation. The first problem is that they target a sub-optimal scale, focusing largely on individual suppliers or on landscape approaches that are only partially implemented, rather than on more manageable supply shed scales. The second flaw is that they focus on tree planting and agroforestry over conservation of remaining forests. We propose that cocoa firms and importing countries embrace more transformative policy approaches that target the correct scale and ambition to tackle structural issues influencing supply chain sustainability and achieve synergies between environmental and social outcomes. First, policies must be integrated in a mitigation and conservation hierarchy, focusing on conservation, not just tree planting. Second, companies must expand their approach beyond their individual *supply chains* to the broader *supply sheds* where they source.

1. Forest-focused supply chain policies (FSPs) in Côte d'Ivoire and Ghana

Tropical forests are disappearing faster than ever under pressure from commodity expansion (Curtis *et al* 2018, Pendrill *et al* 2019), while global warming is jeopardising tropical and global food systems (Vermeulen *et al* 2012), as well as the livelihood and food security of the people that depends on them (Fanzo *et al* 2018). This issue is of critical importance within the Guinean Forests ecoregion of West Africa where the majority of the world's cocoa is produced. Despite decades of sustainability investments in cocoa supply chains, cocoa farmers in Côte d'Ivoire and Ghana, the leading producing countries, are plagued by ongoing ecosystem degradation, deforestation, child labour, and poverty (van Vliet *et al* 2021, FAOSTAT 2023). In Côte d'Ivoire

alone, cocoa replaced 2.4 million hectares of forest between 2000 and 2019, and 848 000 ha in Ghana, accounting for about 45% and 57% of the total deforestation and degradation of the tropical moist forests in these countries respectively, making it the major direct driver of forest loss over this period (Renier *et al* 2023, 2025). Furthermore, increasing temperatures and intensifying droughts due to climate change may shrink the highly suitable areas for cocoa production in Côte d'Ivoire and Ghana by 57% and 41% respectively by 2050, potentially increasing the already high pressure on remaining forests in these and neighbouring countries such as Liberia (Schroth *et al* 2016, Nitidae 2021, Ruf 2021).

In the early 2000s, under pressure from consumers and civil society, as well as growing recognition of threats from climate change to cocoa yields, cocoa traders and manufacturers began committing themselves to halting deforestation, promoting restoration, and improving farmers' livelihoods. Subsequently in 2017, under continued pressure from civil society (see Higonnet *et al* 2017), 35 major cocoa companies signed the Cocoa and Forests Initiative (WCF 2023), thereby agreeing to a standardized set of goals and reporting indicators to achieve three objectives: (1) protect and restore forests; (2) improve farmers' livelihoods; and (3) promote social inclusion.

To achieve the first two objectives, companies have adopted a range of FSPs involving broadly similar approaches, which they have pursued through third-party certification schemes, their own internal programmes, or both. These approaches target both farmers' forest conservation behaviours, in terms of avoiding deforestation and restoring degraded areas, and their agricultural practices, by encouraging cocoa agroforestry—the intentional inclusion of multipurpose shade trees in cocoa farms (Nasser *et al* 2020, Parra-Paitan and Verburg 2022), and improved crop management.

The implementation of specific activities varies between companies, but under the CFI their sustainability objectives and theories of change are similar (Addoah *et al* 2025). To address deforestation, all companies' FSPs include a commitment not to purchase cocoa grown on recently cleared forest areas within legally protected zones. In terms of agroforestry interventions, most FSPs focus on distribution of few shade tree seedlings species, to be planted at varying density. More recently, performance payments for tree planting and survival have been introduced by a few buyers (Addoah *et al* 2025).

To date the effectiveness of these FSPs in promoting increased uptake of forest conservation and agroforestry practices is mostly unknown due to the low monitoring and disclosure by cocoa companies. The lack of public data about traceability and the deployment of FSP activities has impeded any systematic assessment of their impact on deforestation (Renier *et al* 2023). Their impacts on other outcomes—such as rural livelihoods, diversification, and poverty—are also unclear, and likely negative in the long term due to diminishing returns to land, increased total input costs, and reduced prices resulting from increased supply (Odijie 2018, Ruf 2021). Companies typically report financial investments in agroforestry and shade tree seedlings distributed, but not outcome measures such as planting and survival (CFI 2022b). A lack of disclosure on outcomes translates into a lack of impact evaluations.

To date, no independent assessment exists about company-led agroforestry FSPs' impact beyond business as usual on target farms (i.e. additionality) or on non-target farms (spillovers). Independent research on third-party certification schemes has found that UTZ, Rainforest Alliance and Organic have no impact on agroforestry adoption (Thompson *et al* 2022) and survival of distributed trees is likely very low (Sanial *et al* 2020, Ruf *et al* 2021, Kouassi *et al* 2023). At the regional level there is no indication that cocoa monocultures are transitioning to agroforestry (Becker *et al* 2024) despite considerable efforts by companies being reported (WCF 2023). While some of this effect is due to context specific and systemic challenges, such as unclear tree and land tenure (e.g. Ruf *et al* 2015, Sanial *et al* 2020, Garrett *et al* 2021, Kouassi *et al* 2021, Ruf 2021, Kpoviwanou *et al* 2024, Addoah *et al* 2025, Zabala *et al* 2025), we explore how it may be related to, and potentially remediated by, changes in FSPs design. Here we draw on recent fieldwork and emerging findings from new transparency data and policy reports to argue that many challenges underpinning the lack of success to date have to do with critical design flaws in the existing FSPs that are likely to be exacerbated under the EU Deforestation Regulation (EUDR) and similar regulations forthcoming in the UK and USA, which draw on mechanisms similar to FSPs (namely, the exclusion of production with illegal origins or sourced from areas deforested after 2020).

We advocate for a major shift in the design of these policies to improve cocoa sustainability governance. We embed this analysis within broader calls for transformative change to sustainability and land system challenges (Díaz *et al* 2019, Pascual *et al* 2022). Such calls centre on achieving more fundamental, system-wide reconfiguration of markets, knowledge, power, and rules to resolve tensions and achieve more co-beneficial outcomes across multiple sustainability dimensions. Policies embracing transformative approaches would seek to shift responsibility for current harms, developing new economic models for land, and empower marginalized and vulnerable groups in society (Kanger *et al* 2020, Garrett *et al* 2024). Transformative policy approaches therefore include greater prioritisation of justice alongside environmental effectiveness goals. We argue that achieving more transformative policies involves reconsidering the scale and

ambition of existing cocoa sustainability efforts to better tackle structural issues influencing agricultural practices and ecosystem health.

2. Challenges

2.1. Current FSPs enforce existing protections for legal reserves and protected areas, but ignore areas outside these zones

Most of the remaining forests in Ghana and Côte d'Ivoire are found in legally protected parks and forest reserves making it critical that FSPs cover these areas, especially since between 2000 and 2020 37.4% of protected forests in Côte d'Ivoire and 13.5% in Ghana were lost to cocoa (Kalischek *et al* 2023). FSP coverage is limited to protected areas, where a direct sourcing ban applies, while natural vegetation in the rural domain, commonly referred to as 'off-reserve', is not included in the scope of companies' FSPs, likely because there is no legal basis to protect it (see Ashiagbor *et al* 2022). FSPs often aspire to a stricter definition of forests based on the high conservation value (HCV) or high carbon stock (HCS) approaches which could include off-reserve forests (see Sassen *et al* 2022), but these are often namechecked in companies' FSPs and are rarely, if ever, implemented in the cocoa sector. The exclusion of off-reserve areas is problematic from a conservation perspective because 65% and 96% of the cocoa-driven deforestation identified in Côte d'Ivoire and Ghana between 2000–2019 occurred outside protected zones (Renier *et al* 2023, 2025). Although fragmented, this remaining natural vegetation outside protected areas fulfills fundamental ecological functions and its conservation is complementary to, not substitutable by, agroforestry or forest restoration (Schroth and Harvey 2007, Schroth *et al* 2011, Parra-Paitan and Verburg 2022). Additionally, the focus on suppliers' practices implies that existing FSPs only address deforestation driven by cocoa, rather than broader deforestation in cocoa villages. This may be encouraging cocoa farmers to clear forests in reserves for food crops while directing cocoa to areas outside reserves (Addoah *et al* 2023, 2025, Renier *et al* 2025).

2.2. Companies' FSPs implementation are mainly focused on productivity enhancement and agroforestry, and are usually not integrated in a clear mitigation and conservation hierarchy

Preserving ecosystems' functioning requires adopting a mitigation and conservation hierarchy that distinguishes and prioritizes avoiding damage over mitigation, remediation and restoration in turn (Arlidge *et al* 2018, Milner-Gulland *et al* 2021). Implementing agroforestry intervention outside of a conservation hierarchy results in greenwashing (Di Roberto *et al* 2023, Maron *et al* 2023), in which net gains are claimed through the planting of few shade tree species, while in the meantime more valuable native vegetation is removed and not accounted for. Such a mitigation and conservation hierarchy would include, but not be limited to, restoration of ecosystems through agroforestry. Yet, existing narratives around cocoa FSPs, whether deliberately or not, conflate and substitute forest conservation with agroforestry (Sanial *et al* 2020, Carodenuto and Buluran 2021, Di Roberto *et al* 2023). In the implementation of their FSPs, companies in the cocoa sector are largely focused on CO_2 sequestration, mostly through agroforestry. These activities elide explicit conservation goals that would allow companies to evaluate whether restoration and removal are sufficient to achieve no biodiversity losses or emissions (Cook-Patton *et al* 2021). Even though forest restoration and carbon removal are essential parts of a climate adaptation and mitigation plan, they cannot substitute for preventive action, namely the conservation of remaining forests on and off reserves (Sonter *et al* 2020), which are increasingly lost, despite growing intensification (Ruf 2021).

2.3. Current FSPs mostly target individual direct suppliers, rather than landscapes or supply sheds (SI 1)

Current FSPs forest protection measures de facto focus on companies' individual direct supply chains. They are enforced by requiring the exclusion of specific suppliers they identify as being located in protected areas. Below we elaborate three main limitations associated with this approach: (i) a lack of sufficient market coverage, (ii) a failure to acknowledge the diverse behavioural motivations of farmers, and (iii) a lack of convergence with ecological scale requirements.

Direct suppliers account for less than 40% of total exports in Cote d'Ivoire (Renier *et al* 2023, TRASE 2024) and likely even less in Ghana where cocoa purchases pass through the public Cocoa Marketing Company, subsidiary of COCOBOD. FSPs currently only cover a fraction of these direct suppliers, while the farm or cooperative origin of the rest of the cocoa is unknown to the companies themselves. Because they target a small fraction of the cocoa farming population, and because several buyers are usually competing at each location (Ollendorf and Ansah 2022), few farmers are typically receiving the policy in each village, the collective market share coverage of FSPs is low, and their requirements are unlikely to be met, because a buyer without requirements is always available (Garrett *et al* 2019), and the committed companies themselves keep sourcing from protected areas indirectly (Zu Ermgassen *et al* 2022). The high turnover of the supply base at every location (Ollendorf and Ansah 2022) makes also exposure to FSPs potentially short

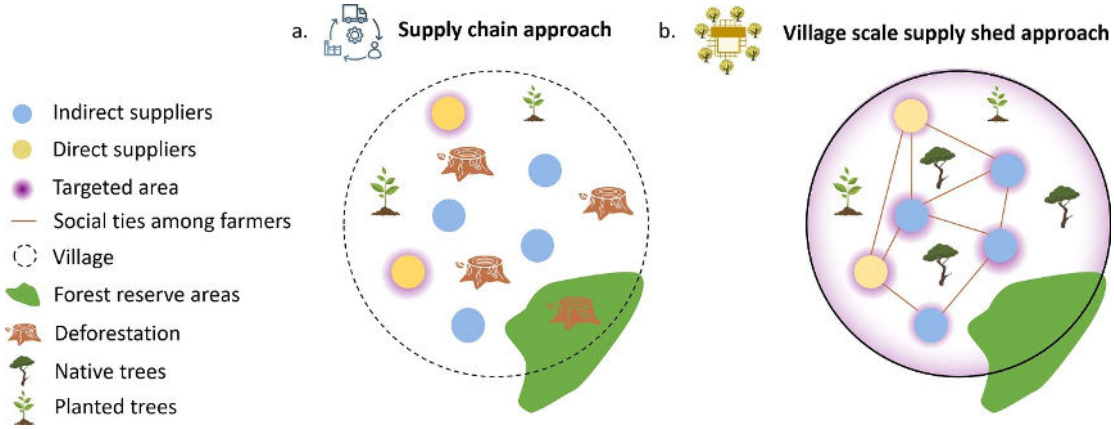

Figure 1. The supply chain and supply shed approaches differently impact the social and ecological processes underpinning adoption and conservation outcomes. Panel a. represents the status quo of a village targeted by FSPs—only a few direct supplier farmers are reached, and tree planting coexists with deforestation off-reserve - as most forest areas are outside of farms, and on reserve - via direct land use change and indirect sourcing. Panel b. is a normative representation of a village targeted by a supply shed FSP, where agroforestry and forest conservation goals are integrated. Farmers are engaged through their existing learning and institutional networks. Their interconnectedness increase the likelihood of adoption by both direct and indirect suppliers and enables landscape level adoption of agroforestry. The scale of implementation and the focus on social norms and values mitigate cross-supply chain and cross-crop leakage of deforestation.

lived. It is no wonder then that the effectiveness of supply chain-oriented approaches is in jeopardy, with non-compliant cocoa still entering the market via other intermediaries at any stage of the supply chain (Addoah *et al* 2025)—e.g. indirect sourcing accounts for 57% of EU imports and 65% of non-EU imports from Cote d'Ivoire (TRASE 2024), and with continuing direct and indirect cocoa-deforestation, where cocoa pushes other crops in protected areas (Addoah *et al* 2023, Renier *et al* 2023).

Besides the lack of market coverage, FSP designs targeting individual suppliers only are likely to fail because they ignore the social dimension of learning and technology adoption (figure 1). The main incentive transmitted through FSPs is an individual threat of exclusion from a specific supply chain or specific premium programs (or conversely enhanced access to a premium). This individualized approach ignores the more diverse behavioural motivations of farmers (Schill *et al* 2019). Changes in practice and the adoption of agricultural innovation, including agroforestry, are socially embedded processes which depend on social learning, norms and involvement of local institutions (Wood *et al* 2014, Taylor and Bhasme 2018). For instance, why should a few farmers targeted by FSPs in a large village change their behaviour if none of their neighbours and acquaintances do? Conversely, approaches that address whole villages and for longer time are more likely to reinforce social learning effects, because more farmers are targeted and local institutional barriers more easily overcome. For example, Dumas *et al* (2025) found that involving traditional chieftaincy would help clarifying land tenure and ownership of shade-tree benefits, while also improving how the risks and rewards of tree planting are communicated. This approach is also more likely to deliver effective and procedurally just FSPs, because more farmers will have a fair chance to receive FSP benefits and to be represented in decision making about change (Nasser *et al* 2020).

Finally, even assuming effectiveness of current FSPs on targeted farms, change in individual farm level behaviours are unlikely to trigger the desired ecological outcomes stated in FSPs. For instance, even if all targeted suppliers in a company's supply chain adopted agroforestry, this would at best create islands of cocoa fields with higher shade tree density amidst cocoa monoculture because FSPs are not delivered to all farmers in a village or landscape (figure 1). Overall, this is unlikely to activate the ecological processes underlying many of the benefits of agroforestry: agroforestry can certainly benefit individual farmers by providing shade for cocoa trees and fruit or timber production (Ramirez *et al* 2001, Obiri *et al* 2007, Blaser *et al* 2018, Niether *et al* 2020). However, the potential benefits are significantly larger and extend beyond the individual when the right species are chosen (Abdulai *et al* 2018), a critical mass is obtained that restores landscape connectivity (Asare *et al* 2014) and agroforestry and deforestation are addressed simultaneously (Schroth and Harvey 2007, Schroth *et al* 2011, Parra-Paitan and Verburg 2022). These benefits include increased biodiversity conservation (Felicitas *et al* 2018, Freeman *et al* 2019, Martin *et al* 2020, Jarrett *et al* 2021), pollinator abundance (Toledo-Hernández *et al* 2017), carbon sequestration (Asare *et al* 2014, Parra-Paitan and Verburg 2022) and climate resilience through microclimate buffering (Niether *et al* 2020) and rain preservation (Duku and Hein 2021). Rain preservation is particularly important in West Africa, where the majority of crops are rainfed, even small forest losses may reduce rainfall, and complete

deforestation could stop the monsoon altogether (Duku and Hein 2021). This means that FSPs targeting scattered individuals and disconnected from the surrounding land use are unlikely to activate the socio-ecological mechanisms that deliver benefits to ecosystems and farmers.

2.4. Landscape-level approaches could address these limitations but also face inherent challenges

Efforts have been made in both Ghana and Côte d'Ivoire to coordinate initiatives between companies and other actors at the landscape scale and beyond. This is particularly the case in Ghana where Hotspot Intervention Areas (HIAs) were initiated as part of the Ghana Cocoa Forest REDD+ Programme, which defines them as: 'An area designated on the basis of the presence of cocoa, and threatened forests with multiple stakeholders and actors' (NCRC 2016). The establishment of HIAs is rooted in a governance infrastructure based on community resource management areas (CREMAs)[6] and committees (CRMCs)[7] aimed at managing land use planning and forest conservation, while delivering agroforestry extension across districts under the framing of 'Climate Smart Cocoa' (Nasser *et al* 2020, NCRC 2020). These institutions theoretically give FSPs the potential to scale-up both inside and outside companies' individual supply bases (Meyer and Miller 2015). However, their top-down nature and dependence on external NGOs or companies' support may compromise their longevity, support from affected communities, and effectiveness at reducing deforestation and increasing agroforestry adoption (Adeyanju *et al* 2022). So far, all activities recorded in HIAs have been led by single companies (FCFP 2021), and the multi-stakeholder coalitions are yet to materialize. A multi-stakeholder governance initiative was started in the Asunafo-Asufiti HIA and the full implementation of activities was scheduled to start in 2023, but the level of implementation is still unknown (TFA 2022). Elsewhere, the sectoral landscape initiatives relying on these HIAs are yet to come.

In Côte d'Ivoire collaborative landscape interventions are more recent and are planned around the forest areas of Guemon, Cavally, Nawa, San Pedro and La Mé (CFI 2022a). The recently revised Ivorian Forest Code includes procedures aimed at fostering landscape interventions by enabling re-classifying and managing protected areas (Law n 2019–675). Two multi-sectoral projects were identified and are focused on monitoring and addressing systemic risk related to child labour and forest reserves encroachment: the level of implementation in the Nawa region is unclear, while the Cavally Landscape Project is the first potentially successful coalition of a private sector actor, civil society and state actors engaging both cocoa and rubber farmers to reduce deforestation risk around an existing forest reserve (Earthworm 2022, SPSC 2023, TFA *et al* 2023). The Goin-Débé and Nawa forest landscape projects appear to be the most promising avenues of community engagement beyond the supply chain by private sector actors, yet their scope is limited to the conservation of existing protected areas. This leaves existing FSPs in Côte d'Ivoire with little landscape governance infrastructure to build on.

A review of companies' reports complemented by interviews with their representatives showed that overall companies landscape level involvement has been low or insufficient: insofar when companies did not directly lead a landscape, they were mere signatory of a landscape or were not involved in landscapes at all (Addoah *et al* 2025).

3. Two steps to transform cocoa agroforestry and forest conservation FSPs from promise to performance

We propose two adjustments to boost the potential of cocoa FSPs to achieve their promised benefits. First, cocoa sector policies must address the root causes of ecosystem degradation and social harm by prioritising forest conservation and community protections alongside more incremental agroforestry approaches. This means that policies must embrace the Mitigation and Conservation Hierarchy, explained in further detail below. Second, current FSPs that are not yet part of a landscape approach should be operationalized at the supply shed (at least village) level, rather than exclusively with farmers in companies' direct supply chains, to mitigate the risk of greenwashing and reach the scales required to achieve targeted social and ecological outcomes.

3.1. Agroforestry and conservation initiatives should be integrated in a Mitigation and Conservation Hierarchy and result in explicit and measurable ecological goals

Forests provide vital ecosystem services, and their conservation is complementary to (and not substitutable by) agroforests within a landscape. A landscape is the geographical space in which natural resource governance and ecosystems are completely expressed and functioning (see Sayer *et al* 2013, SI1). To balance trade-offs and optimize benefit flows across all relevant biophysical, social, political, psychological and

[6] CREMAs—Community Resource Management Areas. A sub-component of HIAs.

[7] CRMCs—Community Resources Management Committees. A sub-component of CREMAs.

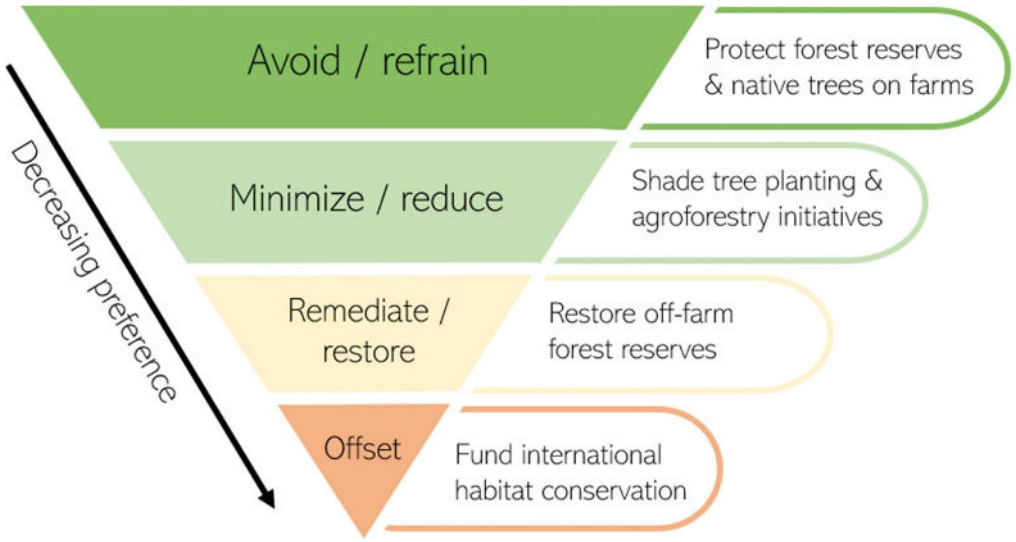

Figure 2. A Mitigation and Conservation Hierarchy to integrate agroforestry and conservation initiatives. These are not mutually exclusive efforts, but the actions at the bottom should be prioritized above actions at the top of the pyramid to avoid harm.

institutional attributes, it is necessary to intervene at the landscape scale and to integrate agroforestry restoration and forest conservation goals (Mansourian *et al* 2020). Even if agroforestry were sufficient to reinforce landscape connectivity on its own (Asare *et al* 2014), its benefits at the landscape level for carbon and biodiversity would still be crucially dependent on land use changes beyond the farm level (Schroth and Harvey 2007, Schroth *et al* 2011, Parra-Paitan and Verburg 2022). These changes are usually neglected in FSP design. Such landscape restoration should therefore be approached as a deliberate, participatory, planned and holistic process, rather than a collection of isolated projects in supply chains that may (or not) manage to cover large areas over time (Lamb *et al* 2012).

To achieve this more holistic planned approach, companies in the cocoa sector should follow a mitigation and conservation hierarchy following a framework such as that proposed by Milner-Gulland *et al* (2021; figure 2). This would involve, first, the identification and investments in the protection of on- and off-reserve forests (i.e. avoid/refrain), second, the roll-out of large scale and sound agroforestry support measures and awareness-raising programs including conservation of native trees on farms (i.e. minimize/reduce), third, the implementation of off-farm restoration activities (i.e. remediate/restore) and, lastly, as an example, the funding of international habitat conservation initiatives (i.e. offset/renew). This would increase forest cover in the landscape faster and with more tree diversity, increasing carbon storage and biodiversity (including pollinators) while maintaining the microclimate, preserving rainfall and increasing drought resilience. Ideally, such an approach would include: 1. the definition and monitoring of target ecological and socioeconomic outcomes; 2. an explicit process to identify areas at different stage of degradation or deforestation risk, taking into account natural and socioeconomic factors, such as geology, soil type, slope, land use and deforestation dynamics, forest fragment types, productivity potential and protected areas; and 3. the process linking each area to the target social and ecological functioning through a management plan (de Mendonça *et al* 2022, 2023, Sassen *et al* 2022, Brancalion *et al* 2025).

The first component of such a mitigation and conservation hierarchy should focus on avoidance ('refrain'), for instance by applying the HCV and HCS approaches to identify natural vegetation requiring conservation outside protected areas (SI 2). A participatory, adapted HCV/HCS approach for smallholders is also already recommended by the CFI (CFI 2022b) and has also been piloted in Ghana (Lindt&Sprüngli 2020). However, the HCSA Steering Group's official Simplified Smallholder Toolkit remains in development and a draft has only been piloted in Indonesia (HCSA-Secretariat 2023). Steps must also be taken to integrate the principles from the simplified HCV/HCS approaches for smallholders—zero gross conversion requirements—into a mitigation and conservation hierarchy that contemplates unavoidable losses and restoration (SI 2). Far wider uptake and engagement is required by companies in such initiatives to address deforestation outside legally protected areas.

Further, considering ecological goals at the landscape level has implications for farm level agroforestry management (Brancalion *et al* 2025). For instance, agroforestry FSPs would need to recognize the

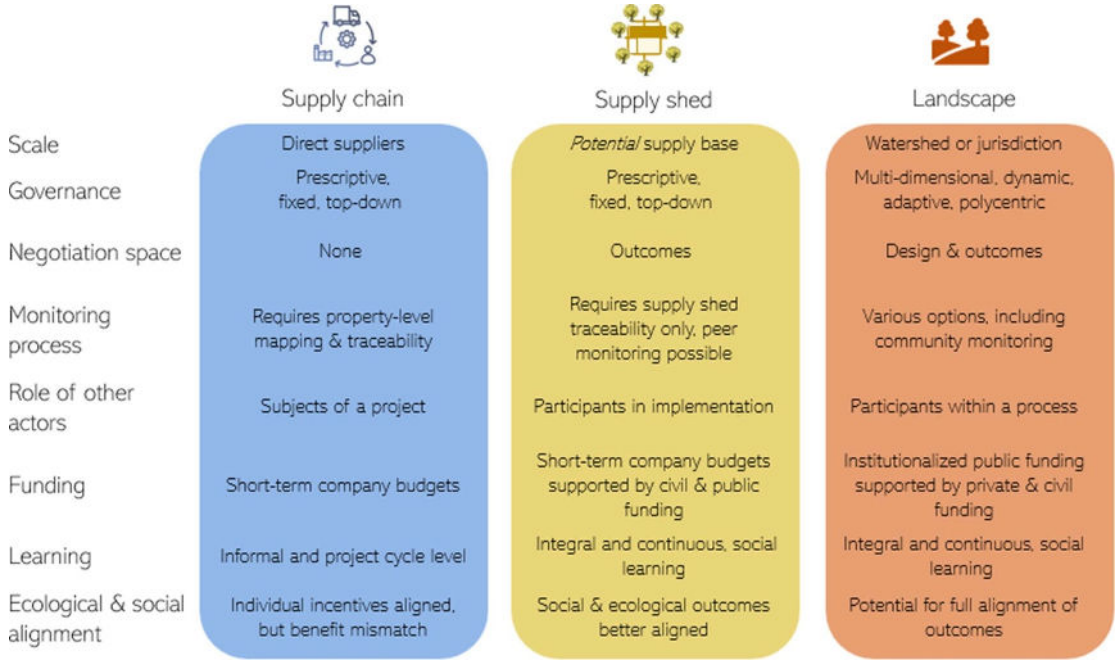

Figure 3. The supply shed is a middle-ground between supply chain and landscape approaches to FSPs implementation.

importance of preserving naturally occurring trees, assisted regeneration and transplantation of wild seedlings ('wildlings') rather than the current approach of mere distribution of seedlings. They would then need to build on the strengths of each of these approaches to ensure landscape-level carbon sequestration and biodiversity conservation and to avoid unintended effects, such as a reduction in tree diversity due to substitution of native trees with only few planted species (Sanial *et al* 2020, 2022, Kouassi *et al* 2023).

3.2. Companies' agroforestry FSPs in the cocoa sector that are not yet nested in a landscape approach should be operationalized at the supply shed (at least the village) level

A supply shed approach at the village level means pursuing bilateral engagement between a company and its supply chain partners (such as cooperatives in Côte d'Ivoire or Licensed Buying Companies in Ghana), and village-level institutions, rather than individual suppliers alone (S1, box 1). The supply-shed approach aims to reconcile FSP activities with the social processes underlying adoption and behavioural change, and the scale of the ecological processes linking adoption and changes in behaviour to targeted social and environmental outcomes. Considering the large size of many Ivorian and Ghanaian cocoa villages, supply shed interventions have the potential to cover sufficiently large areas to contribute to the preservation of key ecosystem services, such as pollinator diversity, carbon storage, and climate resilience. A supply shed approach can also deliver more procedurally just FSPs and mitigate adverse distributional outcomes if it empowers all farmer groups in the supply shed—including, but not limited to all ethnicities, women and youth (Nasser *et al* 2020).

The supply-shed approach is a middle ground between a multilateral landscape approach, which is complex and takes at best five years to build (TFA, Proforest, CDP 2023) and a supply chain approach which lacks the scale and social engagement needed to be effective (figure 3, SI1). While FSPs targeting whole supply-sheds may not achieve all the results of a landscape approach—and are therefore not substitutes—they are more readily implementable and pragmatic. Supply shed approaches may also help to support landscape approaches, while strengthening landscape-level institutions such as HIAs and CREMAs. Hence, approaches based at the supply shed scale can build upon, but do not necessarily require new governance infrastructure (box 1, SI 1). Like landscape approaches, the sustainability investments of one company could potentially affect other companies' suppliers, creating potential for pre-competitive collaboration. The business case for supply shed sustainability investments comes from considering the high turnover in the supply base and the higher chances to realize the gains from agroforestry, off-farm restoration and forest conservation.

The supply shed approach should be a complement and not a substitute for supply chain-level incentives, traceability, and reporting. The supply shed provides a more effective scale for FSPs implementation than the supply chain, such as training on agroforestry or conservation and forest conservation, which would benefit

buyers by reducing environmental risks and promoting security of supply in their sourcing areas. However, individual suppliers' traceability and incentives through commercial relations (e.g. premiums for certifications, market exclusion after deforestation) should not be eliminated. If farmers' motivations for activities including tree planting and forest conservation stem at least in part from premiums or market exclusion, diluting or eliminating supply-chain incentives risk hindering such motivations. On the other hand, a well-designed supply-shed policy could reinforce incentives through long-term engagement that is currently lacking in supply chain policies (Ingram *et al* 2018), fostering structural change and mobilizing intrinsic values, norms and local institutions (Addoah *et al* 2025). For instance, customary institutions, often sidelined in FSPs, could play a stronger role in shaping the implementation of corporate interventions and improving local accountability and legitimacy (Dumas *et al* 2025). Ultimately, the supply-shed approach has the potential to enhance coordination, reduce duplication of efforts, and better align interventions with the social and ecological processes necessary for tackling deforestation, restoration, and agroforestry adoption. This potential, however, is highly dependent on the evolving regulatory environment, as discussed in the next section.

Box 1. Case studies of actual and potential supply shed approaches

ETH Zürich and Cambridge University's 'Agriculture for the future' program is a supply shed intervention aimed at leveraging pro-environmental social norms and values to promote forest conservation and agroforestry adoption in Ivorian cocoa-producing villages. The initiative was implemented in 2024 and 2025 by the Universities and a partner cocoa trading Company in a segment of its potential supply base, i.e. all the cocoa farmers in villages from which cooperatives are sourcing on behalf of the company. The project was carried out in villages where the village level customary government was ready to endorse the activities and where volunteers were found to support the project and the continuous engagement in the village. Monitoring was carried out both via remote sensing and through a farmer-led and incentive compatible data collection procedure. Monitoring results were returned to villages twice a year and formed the basis for an inter-village competition for sustainability, fostering cooperation for change at the village level. Even though only a simple set of indicators were monitored and reported, producers were encouraged in workshops to choose autonomously the vision and the actions they want to undertake for themselves and the village in order to improve those indicators. This approach is at odds to the standard supply chain scale of FSP implementation, where initiatives target only few suppliers per village and involve little or no cooperation with the local customary government.

Musim Mas' Smallholders' Hub program in Indonesia provided improved training to government-employed agricultural extension agents called village extension officers (VEOs), who trained smallholder oil palm farmers on good agricultural practices, financial literacy, and 'No Deforestation, no Peat, no Exploitation' principles within a district from which Musim Mas was sourcing. The first hub was established in Aceh Tamiang regency in Sumatra and was nested in a larger landscape approach, with the stated aim to reach as many independent smallholders as possible and to create a verified sourcing area (IDH 2018). Since the first hub, five more were created in other regencies in Sumatra and Kalimantan, with 460 VEOs and over 6700 smallholder farmers were trained (MusimMas 2023). Supply shed approaches are a common and cost-effective way to implement FSPs in the palm oil sector, because farm level traceability is hard to establish in a supply chain with many intermediaries and a high turnover in the supply base. This case study shows how supply shed approaches can be devised as a transition to or a component of landscape interventions.

4. Implications for the EUDR and sustainability reporting standards

The EUDR and similar trade and due diligence regulations and policies, as currently written, stand poised to further solidify incremental policy approaches that create tensions between environmental effectiveness and social justice concerns, and will fail to address the root causes of ecological and social harm (Verhaeghe and Ramcilovic-Suominen 2024). The EUDR will be significantly more transformative and just, if it instead supports supply chain actors to better prioritize and address the avoidance of harm by strengthening protections for remaining native ecosystems and supply shed implementation of FSPs, rather than further entrenching supply chain traceability and exclusion practices focused on individual cocoa farmers (see Ruf and Galo 2024). First, the EUDR should strengthen landscape and supply shed initiatives by making specific

provisions to promote pre-competitive collaboration between companies and with other stakeholders in a target area. Although the article 30 of the regulation calls for coordinated action at the landscape or jurisdictional level to improve forest and biodiversity conservation, its implementation remains uncertain (FERN 2023, Zu Ermgassen *et al* 2023) while the existing focus on supply chain traceability may drive attention and investments away from supply shed and landscape activities, especially in high forested areas such as Liberia (Nitidae 2021). To counter this, as an example, landscape or supply shed-level efforts could be considered as part of the European Union's risk benchmarking, which will be used to determine the level of checks on imports from those regions (Zu Ermgassen *et al* 2023).

Second, the EUDR should be complemented by other policy instruments to incentivize the other steps of the conservation hierarchy, including agroforestry and other restoration activities. The EUDR contributes to the highest level of this hierarchy by aiming at the avoidance of on- and off-reserve deforestation. Yet, especially in Côte d'Ivoire and Ghana where large stretches of forests were lost to cocoa, the geographical scope of the policy could be too narrow and incentivize companies to invest in supply chain traceability and source away from forests, rather than investing in change including large-scale transition to agroforestry systems and other restoration activities. To this purpose the EUDR should provide reassurance that agroforestry and risk of forest loss will not be conflated (see van Noordwijk *et al* 2025). Further, it could tie benchmarking to a continuous improvement approach that includes agroforestry transition and other restoration activities in post-forest landscapes, while maintaining separate evaluation for (and avoid conflating) each of the different levels of the hierarchy.

Emerging reporting standards will also affect companies' ability and incentives to take action beyond their supply chains. This challenge is shared equally by both supply shed and landscape approaches. Current reporting standards—such as those established by the accountability framework initiative and the Science-Based Targets Initiative's Forest, Land, and Agriculture (SBTi FLAG) framework—focus on supply chain-level traceability and impact attribution. These requirements are further reinforced by regulations such as the EUDR. As a result, companies cannot easily report outcomes achieved at the supply shed or landscape level against supply chain-level key performance indicators. Further, implementing activities at a higher scale than the scale of reporting may create an incentive to scale back sustainability investments with a high marginal costs component to the suppliers only (e.g. shade tree seedlings distribution), undermining the credibility of supply shed and landscape commitments. Reporting at higher levels, such as supply sheds or landscapes, may also generate overlapping claims among several companies. Although double-counting is prohibited by reporting frameworks such as the CFI, SBTN, and the Accountability Framework, the risk of overlapping claims in supply sheds could still incentivize free-riding and dilute individual accountability. Emerging frameworks like LandScale and SourceUp address this by operating at the landscape level without allowing direct attribution to individual companies, thereby avoiding double-counting. However, because they provide limited direct incentives for corporate participation, they are unlikely to replace supply chain-level reporting—especially for carbon accounting or regulatory compliance.

A potential solution is to conduct traceability and reporting at multiple levels. Companies should continue reporting at the supply chain level to comply with CFI commitments and the EUDR, while also reporting on the supply sheds where they operate. This would allow them to evaluate the return on their sustainability investments in terms of land use change and conservation outcomes that meaningfully de-risk their supply base—capturing both direct and indirect land use change, and enabling more effective biodiversity measurement (Brancalion *et al* 2025). However, because outcomes measured at the supply chain, supply shed, and landscape levels measure distinct issues, they may appear contradictory (see Zu Ermgassen *et al* 2023) and should not be conflated.

5. Conclusion

This perspective highlighted how critical design flaws in current efforts to implement FSPs in the cocoa sector make them unlikely to achieve their stated goals of sectoral transformation. Specific problems include FSPs' narrow focus on direct suppliers and farm-level adoption, and their limited reliance on integration with landscape level governance initiatives, which are themselves currently weak. Supply chain and farm level implementation of FSPs cannot deliver on their promise because they are mismatched with the social and ecological processes they aim to activate. While supply chain level traceability and accountability is essential, an improved approach to FSPs implementation would focus on the supply shed, rather than the supply chain, to target all producers and empower diverse actors within cocoa-farming communities. It would also integrate agroforestry, forest conservation and off-farm restoration in a conservation hierarchy. Such a reformed approach would transform FSPs' potential to deliver faster, cost-effective, and equitable impacts for farmers' livelihoods, biodiversity, and climate while more holistic landscape governance initiatives are developed and strengthened.

Data availability statement

No data were created or analysed in this study.

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Conflict of interests

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