



The private sector

Can zero deforestation commitments save tropical forests?

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Key messages

- There are three approaches to private sector commitments on zero deforestation: individual company or group-level adoption of voluntary standards; sector-wide supply chain-based interventions; and mixed supply chain and territorial initiatives at jurisdictional level.
- The main implementation challenges of these approaches are the limits of voluntary standards, traceability systems that are difficult to implement, selective actions that cannot deliver at scale, associated leakage effects, and persistence of segmented supply chains.
- Approaches have evolved to deal with such challenges, however progress requires committed companies to increase implementation efforts, other supply chain actors to adhere to commitments, and governments to harness the potential of jurisdictional approaches.

Private sector commitments in a nutshell



Deforestation due to commercial agriculture is a persistent problem in the tropics. It leads to biodiversity loss, contributes to climate change, and has other negative environmental and social effects.



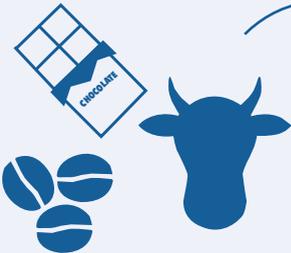
Private sector sustainability commitments seek to produce and source commodities in ways that reduce the risk to forests.



Zero deforestation pledges are promising, but have limits. Their implementation needs to be accelerated, transparently, to show real results and progress.



Improved supply-chain management measures and complementary initiatives at the territorial/jurisdictional level would enhance the effectiveness of commitments.



Approaches to support zero deforestation, and their implementation strategies, are generally commodity-specific.



Implementation of private sector commitments varies across products; palm oil is most advanced, followed by cocoa and soy. Coffee and beef lag behind, despite the fact that beef causes the most deforestation.



Governments, companies and NGOs agree that better management systems, partnerships and market deals are needed for more effective commitments.

13.1 Private sector commitments and approaches

Deforestation driven by commercial agriculture is a persistent problem in the tropics (Curtis *et al.* 2018), in spite of growing private sector efforts such as codes of conduct, certification, and individual and collective commitments to sustainability (Lambin *et al.* 2018). Company commitments to zero deforestation (ZD) hold significant potential, but have limited scope and coverage and relatively slow implementation, making it challenging to halt persistent deforestation with its multiple causes and actors (Geist and Lambin 2001; Busch and Ferretti-Gallon 2017). When forest is converted to agricultural land, the large income streams generated benefit both influential elites and significant numbers of local people and immigrants, who make a living from small-scale agriculture. Poor government capacity tends to lead to weak enforcement of land-use and environmental regulations; there is often also a lack of political support in jurisdictions where ZD actions are in place (Stickler *et al.* 2018).

Some segments of the private sector, notably consumer goods manufacturers (CGMs) and retailers, are committing to advance sustainable supply, specifically to address deforestation driven by agricultural commodities (Climate Focus 2016). The number of commitments to zero deforestation has grown rapidly in recent years (Box 13.1), although this is now beginning to plateau (Haupt *et al.* 2018). These commitments embrace different levels of ambition and ways to link with suppliers (Jopke and Schoneveld 2018). However, to date only 98 (21%) of all ZD-committed companies are working with suppliers and have clear, actionable goals to implement traceability systems (Forest Trends 2018).

This chapter provides reflections on the progress and challenges associated with ZD commitment implementation, with a focus on forest-risk commodities (i.e., palm

Box 13.1 Zero deforestation targets in the most relevant platforms

Consumers Goods Forum (CGF): Brings together consumer goods manufacturers and retailers in pursuit of business practices that enable industry-wide efficiency and positive change. It aims for zero net deforestation by 2020. www.theconsumergoodsforum.com

New York Declaration on Forests (NYDF): A non-legally binding political declaration that grew out of dialogue among governments, companies and civil society. It aims to halve natural forest loss by 2020 and end it by 2030. <http://forestdeclaration.org>

Amsterdam Declaration (AD): The Amsterdam Group is a formation of seven European consumer countries. It aims to achieve a fully sustainable palm oil supply chain by 2020. www.idhsustainabletrade.com/uploaded/2016/06/declaration-palm-oil-amsterdam.pdf

Cocoa & Forests Initiative: Top cocoa-producing countries (Côte d'Ivoire, Ghana and Colombia) agreed on frameworks for action in 2017/2018; cocoa and chocolate companies are aiming for no further forest conversion for cocoa production, and for the elimination of illegal cocoa production in national parks. www.idhsustainabletrade.com/initiative/cocoa-and-forests

oil, cocoa, coffee, beef and soy). Limited research exists on ZD commitments and their impacts (Newton and Benzeev 2018). Both the type and scope of private sector commitments are linked to the commodity's characteristics and its supply chain configuration. For example, palm oil and its derivatives tend to be embedded in a final product; this makes attributes such as environmentally friendly production both less likely to gain attention and more difficult to trace, compared to single-ingredient products for direct consumption, like coffee. In turn, a proportionally larger number of smallholders are involved as primary suppliers in coffee and cocoa compared to oil palm and beef. This prompts differing motivations and interests in social standards and decent labour, linked to diverse end-consumer market pressures.

Three main approaches to support ZD supply in forest-risk commodities have been adopted by companies and backed up by multistakeholder platforms, NGOs and governments:

- an individual company or group-level approach, based on Voluntary Standard Systems (VSS) to demonstrate compliance with production or management practices, at household, smallholder group, plantation or concession level;
- a sectoral approach, with a focus on supply chain-based interventions, seeking to manage risks or mainstream environmental concerns along the entire supply chain from downstream buyers to upstream producers;
- a mixed supply-chain and territorial approach, labelled as a ZD jurisdictional approach, which relies on public-private partnerships to support sustainability actions, primarily orchestrated by NGOs or multistakeholder coalitions.

These three approaches are described in detail in Table 13.1. The extent to which these approaches are achieving impact against their own theories of change is in question. The first approach is challenged by the degree to which non-compliance with voluntary standards leads to restricted market access. The second, by whether CGM and retailer commitments can lead to whole market change, by forcing other players' adherence to voluntary standards, codes of conduct or specific policies. The third approach depends also on government action; this action is vital, both to reverse the institutional constraints that are limiting wider supplier uptake of sustainability practices, and to establish systems that link more sustainable jurisdictions with responsible buyers and end-consumers.

13.2 The scope of commitments across commodities

In the palm oil sector, implementation of private sector ZD commitments is relatively more advanced. Progress has been seen in cocoa and soy supply chains, however there has been less progress in coffee and beef, despite beef constituting the largest direct cause of deforestation. Differing levels of commitment to zero deforestation can be explained in part by when different certification systems were established (Forest Trends 2017), but consumer pressure also influences this, depending on

Table 13.1 Dominant approaches to zero deforestation in forest-risk commodities

	Individual company or group-focused approach based on adoption of VSS	Sectoral approach with focus on supply chain-based interventions	Mixed supply chain and territorial approach at jurisdictional level
Ultimate goal	To expand sustainable and third-party certified supply	To delink deforestation from commodity supply within a specific sector	To ensure sustainable jurisdictions and verified sourcing areas
Theory of change	A segregated supply from companies complying with sustainability standards contributes to secure access to markets and benefit from price premiums.	Companies in specific value chains sourcing from landscapes at risk from deforestation trace their supply to exclude non-performing farmers, and implement actions to ensure compliance with adopted ZD criteria.	Alignment of state regulations and private sector policies, supported by multistakeholder coalitions in specific jurisdictions, leads to a reconciling of production, environmental, conservation and social inclusion targets.
Implementation unit	Plantation, concession or management unit, involving individual farms and collective operations	The entire supply chain, linking upstream suppliers (small- and large-scale) to downstream end-buyers	Territorial units, which correspond to different jurisdictional boundaries, often at subnational level
Catalysers	Voluntary sustainability standards (e.g., FSC, PEFC, RSPO, RTRS, Rainforest Alliance and UTZ)	NYDF, Business platforms (e.g., GCF, TFA 2020), and government platforms (e.g., Amsterdam Declaration and Marrakesh Declaration)	Governors' Climate and Forests Task Force, BioCarbon Fund, IDH and WWF
Operational approach	Certification and verification of specific management units	Definitions, criteria and methods to set aside forest areas for conservation (e.g., HCS and HCV) accompanied by supply source traceability	Public policies, regulations and standards at territorial level, combined with private sector interventions to clean supply chains
Policy instruments/mechanisms	<ul style="list-style-type: none"> • Certification of management and production standards • Auditing/verification • Chain of custody assurance 	<ul style="list-style-type: none"> • Traceability of suppliers • Incentives to enhance suppliers' performance • Monitoring and verification 	<ul style="list-style-type: none"> • Land-use planning • Tenure arrangements • Extension services • Financing schemes

Notes: FSC = Forest Stewardship Council, GCF = Green Climate Fund, GCF = Governors' Climate and Forests Task Force, HCS = High Carbon Stock, HCV = High Conservation Value, IDH = Sustainable Trade Initiative, NYDF = New York Declaration on Forests, PEFC = Programme for the Endorsement of Forest Certification, RSPO = Roundtable on Responsible Palm Oil, RTRS = Roundtable on Responsible Soy, TFA 2020 = Tropical Forest Alliance 2020, UTZ = the label and program for sustainable farming, WWF = World Wildlife Fund / World Wide Fund for Nature.

the vicinity of production to forest areas, impacts of production expansion on iconic species, and business operation size. Palm oil sourcing companies, for example, have faced more reputational risks due to media criticism for their involvement in deforestation that affects orangutan habitat (CDP 2017), while chocolate companies are facing financial risks due to the decreasing productivity of cocoa trees (Camargo *et al.* 2018). Although the Soy Moratorium was labelled as the first zero deforestation agreement in the tropics (Gibbs *et al.* 2015), it failed to cover the Cerrado biome, the most active frontier of large-scale soy expansion (Trase 2018).

Specific interventions depend on supply chain configuration, specific consumer pressures and the regulatory environment; this has led key players across different commodities to adopt different types of commitments to clean their supply chains and reduce their exposure to risk. The scope and type of commitments across key forest-risk commodities are explained in Table 13.2.

2020 is a popular deadline for targets – 33% of companies tracked by Supply Change have at least one commitment targeting 2020 (155 out of 473). Overall, about a third have reported significant progress towards their goals: 32% (49 out of 155) of companies with at least one commitment targeting 2020 are 75% of the way towards their commitment(s), with a minority of companies (15%, 23 out of 155 companies) reporting no progress towards their 2020 commitment(s) (Forest Trends 2018).

13.2.1 Palm oil

Palm oil is the focus of the majority of commitments (59%) made by companies tracked by Supply Change (Forest Trends 2018). However, these commitments only involve key sector players in the sector, i.e., CGMs, traders, and major palm oil corporate groups that produce, process and trade palm oil, and that have adopted No Deforestation, No Peat, No Exploitation (NDPE) policies. A small number of food companies (8 of the 16 more influential groups), including Unilever, Mars and Nestlé, are releasing data on all of their sourcing mills (Greenpeace 2018). A major issue is that an unknown number of independent mills and third-party suppliers have still not adhered to such commitments. The governments of main producer countries Indonesia and Malaysia have made clear that national regulations must be followed (Pirard *et al.* 2017), rather than corporate sector policies (Pacheco *et al.* 2018). National sustainability standards in Malaysia and Indonesia have also been issued to counteract Roundtable on Sustainable Palm Oil (RSPO) standards (Hospes 2014). Traceability is challenging, as a significant portion of oil palm (40% in Indonesia) is planted by smallholders. Illegal tenure, disconnected incentives, a lack of tailored finance and poor regulatory enforcement constitute the main challenges of the sector (Pacheco *et al.* 2017). Mainly at subnational level, different initiatives have emerged to support wider uptake of improved practices, such as jurisdictional certification pilots under RSPO in Central Kalimantan and Sabah (Luttrell *et al.* 2018).

Table 13.2 Scope and type of key commodity commitments to zero deforestation

	Oil palm	Cocoa	Coffee	Beef	Soy
Ultimate goal	Goals differ, but a large proportion commit to NDPE, in part by protecting high conservation value (HCV) and high carbon stock (HCS) forests.	Goals differ, but a large proportion commit to eliminating deforestation, and sourcing sustainable or certified cocoa.	Goals differ, but most embrace avoiding negative impacts on protected areas and areas of high conservation value, assuring 'no recent' deforestation.	TAC aims to eliminate illegal deforestation; G4 aims to achieve zero deforestation from both direct and indirect beef suppliers. Food companies down the supply chain have also committed to zero deforestation.	The goal is to eliminate any deforestation from the soy supply chain.
Private sector initiatives	These include individual VSS approaches (RSPO), individual and sector-based supply-chain approaches (NDPE policy), and mixed supply chain and territorial approaches, mainly through jurisdictional certification and sourcing.	These include individual VSS approaches (e.g., Fairtrade, UTZ and Rainforest Alliance), individual supply chain approaches through sustainability programmes, ^e and emerging territorial approaches under the Cocoa & Forests Initiative. ^f	These include individual VSS approaches (e.g., UTZ, Rainforest Alliance, organic and Fairtrade) and a few supply chain approaches linked to specific company initiatives, but no territorial initiatives.	These include sectoral supply chain approaches covering only a segment of companies through a public agreement (TAC) and a private bilateral agreement (G4 Agreement). Downstream food companies have embraced ZD commitments, and work through individual company approaches and sectoral approaches.	There are individual VSS approaches (RTRS) and combined territorial and supply chain approaches (Soy Moratorium), but these are limited to the Brazilian Amazon.
Major corporate groups committing	285 companies including producers, processors, traders, manufacturers and traders. ^a All major corporate groups in Malaysia and Indonesia.	19 companies, 3 traders and 1 inputs industry.	<ul style="list-style-type: none"> All large roasters and retailers work with VSS. 3 out of 8 of main companies, roasters and retailers have biodiversity and ZD commitments. 1 out of 5 major global traders commits to biodiversity conservation. 	<ul style="list-style-type: none"> TAC, comprising of 56 meatpackers in 3 states (Pará, Mato Grosso and Rondônia). G4 Agreement, 3 biggest meatpackers. 	<ul style="list-style-type: none"> Main traders linked to the Soy Moratorium. At least 91 companies, including producers, processors, traders, manufacturers and traders, have ZD commitments.^a

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Table 13.2 Continued

	Oil palm	Cocoa	Coffee	Beef	Soy
Regulatory frameworks	National standards, such as Indonesian Sustainable Palm Oil (ISPO), and Malaysian Sustainable Palm Oil (MSPO). Others on land allocation and moratorium.	Regulations differ, yet emphasise supporting productivity, reversing degradation, enhancing sustainable land uses, protecting biodiversity and halting deforestation.	Regulations differ, yet emphasise assuring adherence to national law, increasing productivity, reversing degradation and protecting biodiversity.	Both agreements have incorporated legal framework aspects (e.g., Registry and holding an environmental license).	Sector compliance with the Forest Code, which aims for a deforestation-free supply chain in the Brazilian Amazon.
% of supply covered by commitments	<ul style="list-style-type: none"> • 21% of global supply under RSPO certification in 2016.^b • 65% covered under some commitment in 2017, but this only accounts for a third of the planted area in Malaysia and Indonesia.^c • 74% of Indonesia and Malaysia's palm oil refining capacity covered by NDP policies.^d 	About 2/3 of global supply. ^g	% of global supply: <ul style="list-style-type: none"> • 6% Rainforest Alliance • 4% organic • 6% Fairtrade • 9% UTZ • 25% 4C.^h 	<ul style="list-style-type: none"> • 11% of global supply covered under some commitment in 2017.^c • G4 Agreement and TAC agreement involve only direct suppliers in the Brazilian Amazon. 	<ul style="list-style-type: none"> • 11% of global supply covered under some commitment in 2017.^c • 42% of all Brazilian soy exports, including soy trader commitments and Soy Moratorium.ⁱ
Operational challenges	Traceability, unclear tenure, finance and weak regulatory enforcement.	Tenure, finance, extension services, child labour and low yields.	Monitoring and enforcement, slow degradation of coffee landscapes.	Traceability of indirect suppliers, dependence on government actions, transparency regarding law offenders.	Leakage, differing criteria in land-use frameworks across regions.

Notes: (a) Supply Change <http://supply-change.org/>; (b) RSPO (2016); (c) Haupt et al. (2018) <https://www.tfa2020.org/wp-content/uploads/2018/06/Progress-on-Corporate-Commitments-and-their-Implementation.pdf>; (d) Steinweg et al. (2017); (e) Camargo and Nhandumbo (2016); (f) Cocoa & Forests Initiative <https://www.idhsustainabletrade.com/initiative/cocoa-and-forests/>; (g) World Cocoa Foundation Press Release <http://www.worldcocoafoundation.org/two-thirds-of-global-cocoa-supply-agree/>; (h) Estimates based on Panhuysen and Pierrot (2018); (i) Estimates from Trase (2018) <http://yearbook2018.trase.earth/>

13.2.2 Cocoa

About 80% of global production originates from smallholder farmers, who struggle with basic social and technical needs, leading to low yields. Corporate commitments in the cocoa sector historically addressed social issues such as child labour and poverty (International Cocoa Agreements, Dutch Letter of Intent), but now increasingly focus on deforestation (Camargo *et al.* 2018). Although some companies made pledges towards addressing deforestation after the New York Declaration on Forests, and the World Cocoa Foundation (WCF) emphasised environmental issues in its 2014 CocoaAction programme, it was not until 2017 that leading chocolate and cocoa companies joined with cocoa-producing countries Côte d'Ivoire, Ghana and Colombia to collaborate on halting deforestation and restoring forests. Such initiatives are addressing productivity gaps and inefficient land use, by providing smallholders with training and improved access to agricultural inputs, and by supporting agroforestry (Kroeger *et al.* 2017). However not all supply chain companies are committed to tackling deforestation and reducing GHG emissions. Other actors (e.g., input providers, packaging and transportation) are not targeted by campaigns, despite contributing to negative social and environmental externalities (other than deforestation) that can also lead to GHG emissions (Camargo and Nhantumbo 2016).

13.2.3 Coffee

Globally, coffee production varies in scale, from large estates to smallholder systems with few coffee trees. The sector has many well-established VSS, and is characterised by intensive collaboration between VSS and coffee companies, roasters and retailers (Mithöfer *et al.* 2017). Environmental organisations such as Conservation International have pushed commitments towards forest conservation and restoration via the Sustainable Coffee Challenge. In 2016/17, 55% of global coffee production was certified to sustainability standards (Panhuysen and Pierrot 2018). Roasters and VSS frequently partner with each other, with coffee companies increasingly complementing such partnerships with company-own initiatives that focus on technical assistance (Panhuysen and Pierrot 2018). The main VSS narratives focus on 'conserving biodiversity' rather than zero deforestation; for example, the Common Code for the Coffee Community (the 4C Association) - which has the largest coverage of all VSS - does not commit to zero deforestation, and other VSS address zero deforestation indirectly, as only plots not recently converted from forest can be certified. Close to 50% of VSS-certified coffee is produced under 'no recent deforestation' criteria. Only Nestlé and Starbucks have public deforestation positions on their company websites.

13.2.4 Beef

Over the last 40 years, the beef industry has been the main direct driver of deforestation in the Brazilian Amazon. Since 2009, NGOs and public authorities

have pressured meatpackers to change their practices, with federal prosecutors threatening to sue meatpackers due to their co-responsibility in deforestation. This has led to two cattle agreements: (i) the Agreement for the Adjustment of Conduct (Termo de Ajuste de Conduta, TAC), which applies to more than 50 meatpackers in the Brazilian Amazon; and (ii) the G4 Agreement, signed by Greenpeace and the three largest meatpacking companies (JBS, Marfrig and Minerva). The agreements differ only in that G4 aims for zero deforestation while TAC demands the removal of illegal deforestation from the supply chain. The agreements have increased control over the beef supply chain, resulting in 83% traceability. This can be partially attributed to food safety issues in beef consumption (Forest Trends 2016). However both agreements face limitations; enabling control only over direct suppliers has led to indirect supplier practices like cattle laundering of unregistered herds (Gibbs *et al.* 2016). Likewise, the enforcement of minimal legal obligations in order to meet the 2012 Brazilian Forest Code meant there were no obligations to change farm-level management.

13.2.5 Soy

Major soybean traders, by endorsing Brazil's Soy Moratorium, agreed not to purchase soy grown on Brazilian Amazon lands deforested after July 2008. In 2016, after several extensions of the moratorium, soy traders decided to maintain the agreement indefinitely. Farms violating the moratorium are identified using satellite monitoring, and noncompliant farmers are blacklisted. Monitoring data and audits confirm high compliance. The moratorium involved traders of around 90% of all Brazilian Amazon sourced soy (Gibbs *et al.* 2015). Yet, this level of control has likely exacerbated the expansion of soy production in other regions, like the Cerrado, where environmental laws are less stringent. The supply chain transparency platform Trase (2018) indicates that four major soy traders – jointly responsible for almost half of Brazilian soy exports between 2006 and 2016 – have made ZD commitments encompassing their entire supply chain. In 2018, the Cerrado Working Group, coordinated by WWF and the Brazilian Association of Vegetable Oil Industries (Associação Brasileira das Indústrias de Óleos Vegetais, ABIOVE), was established to negotiate a new agreement to reduce soy's conversion of natural vegetation in the Cerrado. Efforts were also made to establish programmes with a jurisdictional approach (e.g., the Produce, Conserve and Include strategy in Mato Grosso) to tackle problems associated with leakage (Nepstad *et al.* 2018). Much of the current expansion is taking place in the Matopiba region, which stretches across four states, making jurisdictional coordination more difficult.

13.3 Implementation challenges across approaches

There are several challenges with private sector ZD commitments (see Taylor and Streck 2018). Here we discuss those faced by the three approaches discussed,

linked to their underpinning theories of change and operational frameworks for implementation, which have both potential and limitations.

The individual company or group-level approach, which focuses on adoption of VSS, faces challenges due to addressing zero deforestation through certification. While certification can stimulate the adoption of good practices, it is not designed to have impact outside certified land and thus cannot achieve impacts at scale (Forest Trends 2017; van der Ven *et al.* 2018). Likewise, not all VSS include zero deforestation targets, meaning companies committing to VSS-certified supply are not automatically addressing deforestation. Some systems like RSPO NEXT have proposed more stringent criteria, but just a few companies with higher targets have adopted these (RSPO 2017). Critically, certification has not penetrated the market enough to bear out its theory of change. For it to be effective, buyers need to demand certified supply, with criteria that explicitly include zero deforestation.

The sectoral approach to ZD, which focuses on wider supply chain-based interventions, faces three related challenges. First, it is complex in practice to trace the production of all suppliers - including independent smallholders with their unclear tenure rights and informal access to finance and inputs (Pirard *et al.* 2017) - and differentiate between legal, standard-compliant suppliers and those who are not (Nepstad *et al.* 2017). Second, segmentation of the supply chain and market is problematic. Companies source across the same landscape from diverse types of farmers, with varying capacities and incentives to comply with company-imposed standards and regulatory frameworks (Gibbs *et al.* 2016); in addition, some farmers operate through shadow companies (Chain Reaction Research 2018). While certain companies are trying to address deforestation, others are not, and in the absence of sector-wide commitments, such companies can benefit from spurious market advantages. The third challenge is that of additionality from companies adopting ZD commitments. As better-performing companies tend to embrace more ambitious commitments (Haupt *et al.* 2018), upgrading costs become higher, further reinforcing market segmentation for companies lagging behind.

As the jurisdictional supply-chain and territorial ZD approach builds upon the previous two approaches, it faces both previously mentioned challenges and additional ones. One such challenge is a lack of incentive or reward mechanism to improve the performance of suppliers, particularly smallholders. Partnerships and collaborative action are needed, both with financial institutions, so as to mobilise finance, and with private service providers and government agencies, so as to facilitate the adoption of improved practices (Bronkhorst *et al.* 2017). Ensuring that institutional conditions support ZD actions will require state agencies to deal with territorial zoning, land regularisation, extension services and environmental conservation. Verifying progress independently and transparently is critical, as is making that information useful for monitoring progress and enhancing

accountability. This will support co-learning on cost-effective actions that contribute to compliance, maximise ZD commitment benefits and minimise trade-offs. Finally, beyond the jurisdiction, a significant challenge is that of potential leakage across locations, as companies applying more rigorous commitments can displace lack of compliance to places where it is easier to circumvent regulations, or less likely to capture attention.

13.4 The way forward

It is highly unlikely that the 2020 targets set by individual companies and initiatives under the New York Declaration on Forests and Consumer Goods Forum will be met. Removing deforestation using the three approaches outlined in Section 13.1 requires addressing existing gaps amongst them. This means committed companies must increase their implementation efforts, additional supply chain actors must adopt commitments, and outside actors must become involved – particularly domestic companies in emerging consumer markets such as China and India. This will require committed companies to enhance their monitoring, accountability and transparency in order to improve their impact and make it visible to society. This should lead civil society organisations and financial institutions to further support these companies, as it is unlikely that more companies will come on board if those trying to improve their performance are exposed to intense criticism due to lack of progress.

The challenges identified here can be tackled in diverse ways. To ensure zero deforestation, VSS must incorporate explicit criteria and methods for companies or producer groups to assess and report compliance with ZD targets, as seen in palm oil and coffee standards. Such improvements must come alongside efforts to expand the uptake of certification across larger territories, as proposed by the jurisdictional certification approach.

The sectoral supply chain-based approach has attempted to deal with the limitations of VSS in halting deforestation. To overcome the remaining challenges this approach faces requires increased investment in traceability systems, and making use of emerging methods and technologies, such as those using fine resolution remote sensing data and blockchain technologies. To overcome segmentation within supply chains and markets, performance gaps between suppliers must be resolved (Pacheco *et al.* 2018). This requires co-investment schemes involving all supply chain actors, including providers of inputs, packaging and transportation (Camargo *et al.* 2018).

The mixed supply chain and territorial approach arose to tackle major challenges like market segmentation and differentiated performance amongst suppliers, along with the need for improved public and private partnerships, particularly at subnational level, so as to foster common goals in specific jurisdictions.

Jurisdictional sourcing offers additional incentives for companies and investors trying to reduce their risk exposure to deforestation. But that alone is insufficient unless companies are committed; additionally, NGOs and governments must initiate co-investment schemes to improve local production systems, delivery of finance, inputs and services, and market deals, so that ZD commitments are more effective for all supply chain actors. Strengthening public governance structures - particularly in areas recipient to leakage - is also vital to reach ZD goals.

Ultimately, for subnational initiatives to be effective, they should align with both national government regulatory frameworks (e.g., environmental law and fiscal incentives) and with wider corporate sustainability policies and consumer country government regulations that support sustainable sourcing of forest-risk commodities. This alignment is essential to scale up the impacts of ZD commitments.

