PBL Netherlands Environmental Assessment Agency

The outcomes of deforestation-free commodity value chain approaches

Background Report

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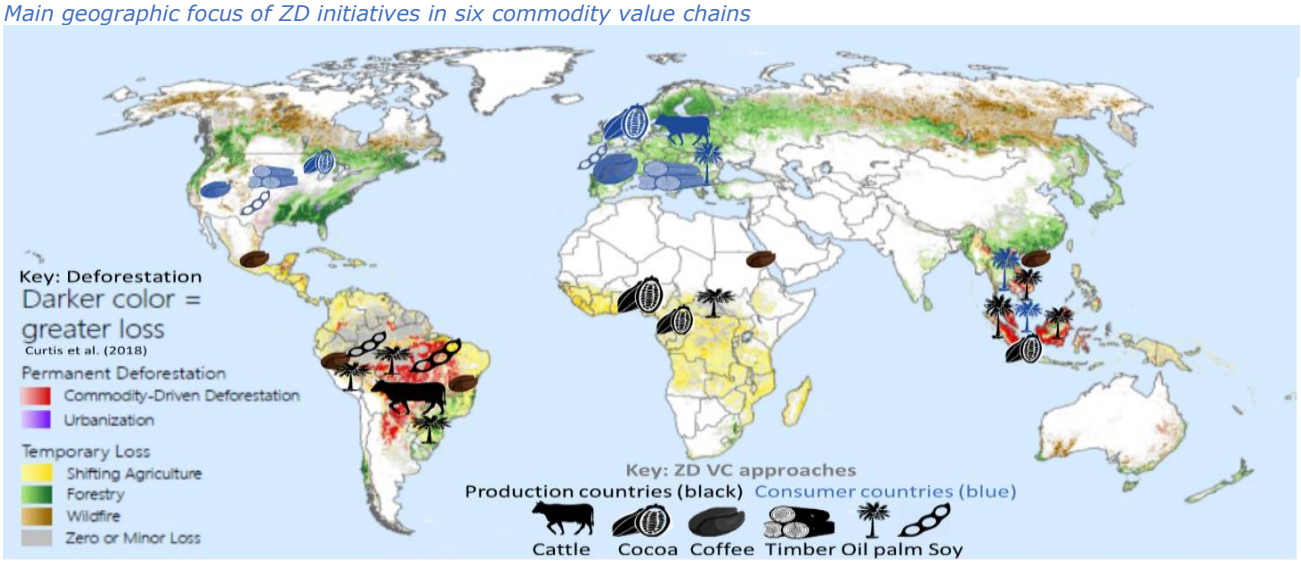
Summary

This **objective** of this study is to trace the impact of different approaches advocated to reach the objective of zero deforestation value chains (ZD-VC). The study uses the concepts of value chains+ geographic nexus to look at the impacts and success of different initiatives and approaches to reduce deforestation driven by high forest-risk commodities: cattle, coffee, cocoa, soy, palm oil and timber. Six approaches and their constructed theories-of-change (ToCs) were identified, that have evolved during the previous decades: regulatory approaches, voluntary sustainability standards – such as certification; landscape and jurisdictional approaches; corporate pledges – such as corporate social responsibility projects; public-private partnerships - which include platforms, networks, associations, partnerships and agreements between private sector and public sector, and often research and civil society; and due diligence mechanisms – including traceability mechanisms, third-party campaigns and investigations, voluntary disclosure and moratoriums. While in practice these approaches overlap and interlink, they are discussed separately to highlight the different emphasis given to interventions to reduce and halt deforestation.

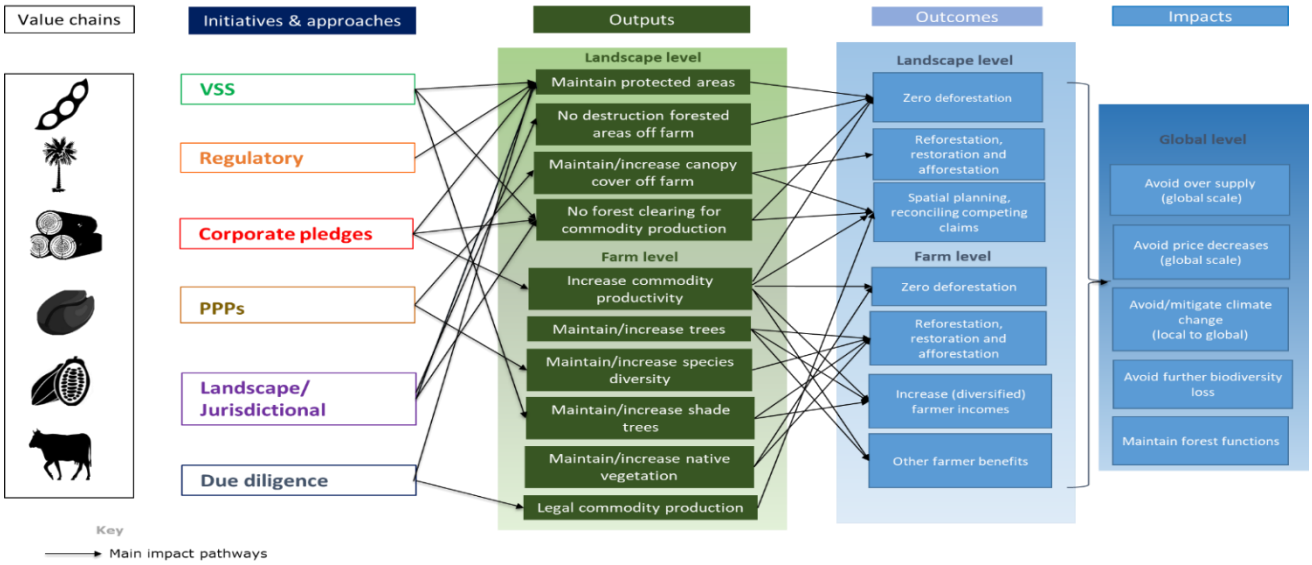
Based on a review of different approaches, the figure below shows that the main **geographic focus** of ZD-VC value chains approaches is on already-known, historically deforested hotspots. It also shows that a value chain approach is taken mainly by consumer countries with high and increasing levels of forest cover. Emerging hotspots of commodity driven deforestation (shown in red) on the edges of the Amazon basin and in Myanmar, Vietnam, Congo and East Africa do not currently have ZD-VC initiatives and some places e.g. Colombia, only very recently. Attention for tropical and temperate zone deforestation frontiers is lacking. Missing are actors in major consumer countries in such as China and India. A geographic refocus is needed to avoid the cycles of commodity led deforestation and leakage seen in the past.

Main geographic focus of ZD initiatives in six commodity value chains



We constructed the hypothetical ToCs – shown below- and explored the **evidence** on the outcomes and impacts of ZD approaches in the six chains. The first finding is that the effectiveness of most approaches - other than voluntary sustainability standards (VSS) and regulatory approaches - has not been well studied or reported upon. The evidence is not aggregated for major production regions, making the establishment of causal links between interventions and outcomes on avoided deforestation and preventing leakage tenuous. Where the effectiveness of an approach to reduce or avoid deforestation and/or degradation is positively established (based on a sufficient evidence base), it mostly relates to smallholder certification. These have not addressed the leakage of deforestation to other forested regions or spillover effects where other types of commodities or local market demands become drivers of deforestation. Second, there is a strong variation in the discourses about the drivers and solutions to deforestation, each making different causality claims and proposing different solutions. As such, the ToCs behind most ZD approaches are not clearly articulated and therefore less likely to be effective and robust. Third, a reason behind the lack of evidence is the recent timeline in the last decade when the majority of initiatives have been implemented, with different approaches favoured for different commodities. Learning across and between commodities and between regions has been limited.

Summarized ToC underlying ZD-VC approaches



Overview of the evidence and effectiveness of different approaches to commodity driven zero deforestation

Commodity	Zero Deforestation Value Chain Approach					
	VSS	Landscape/ Jurisdictional	PPP	Corporate pledges	DD	Regulatory
Cattle						
Cocoa						
Coffee						
Palm oil						
Soy						
Timber						
Summary						

Key:

Very effective	Partially effective	No effect	Not effective	No or little evidence

Lessons learned are:

- Commodities do drive deforestation 'at large'. The mechanisms by which a specific commodity drives deforestation differ per geographical region e.g. A cow in Ireland does not have the same impact on deforestation as a cow in Brazil, and has a different impact on deforestation than a cow on a neighbouring farm. Understanding such intricacies is necessary to design ZD approaches that can claim positive outcomes locally and prevent deforestation outside the borders of a farm, municipality or landscape.
- Voluntary Sustainability Standards - particularly coffee, cocoa and timber certification – have been partially effective in preventing local deforestation. Regulatory approaches have been effective for cattle and palm oil. Much less is at this moment known about landscape approaches, Public-Private Partnerships (PPPs), and corporate pledges, in part because of a lack of reporting mechanisms and their evolving, recent use. Due diligence mechanisms focus on regulatory and voluntary sustainability standards, and moratoria that are sometimes part of PPPs or corporate pledges. They have been successful in preventing deforestation in specific locations, but have also created leakage, which was evident only in retrospect. By adding traceability and monitoring to due diligence approaches, in theory their chance of success is higher and has a broader coverage. However, evidence on the effectiveness of these approaches is missing.
- A weakness of all ZD approaches to date has been the lack of attention to leakage and spillover effects. If local success does not contribute to large-scale impacts, the goal of zero deforestation is arguably not met. Most ZD approaches focus on regions with high historical deforestation rates and a long history of growing specific commodities e.g. cocoa in West Africa. A new focus on current deforestation hotspots, new frontiers, forested countries with high expansion rates in specific commodities and high-risk commodities is needed.
- A stronger evidence base can help develop robust theories of change that satisfy multiple political values currently expressed in political discourses and debates about zero deforestation and commodity value chains.
- When ZD-VC approaches have limited impact and are politically contested, these commodities are unlikely to gain a substantial share of the market. However, if market coverage is high and private sector or government stakeholders govern a significant proportion of the market, ZD-VC approaches may be more effective in halting forest loss. However, avoiding the unintended effects of leakage and spillover to other geographical areas may occur outside of a government's jurisdiction or sphere of influence, meaning a global approach is needed.

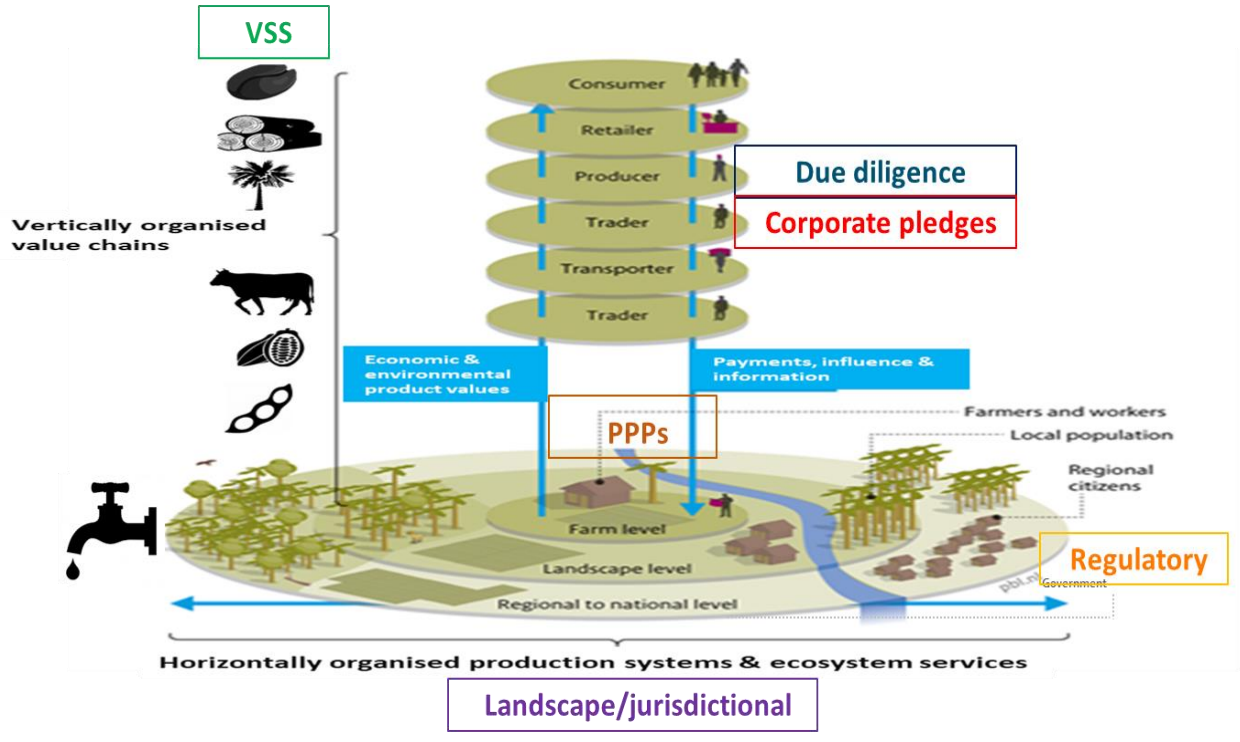
As no single approach seems to cover all issues, a combination of the best of the different approaches seems a plausible pathway to zero deforestation commodity VCs. This is concluded based on both the theories-of-change and the available - although limited - evidence. This means that there are different roles for individual VC actors. Therefore, this a clear multi-actor and multi-level governance approach to the wicked problem of deforestation and livelihoods is needed.

Options for actions by different stakeholders in ZD-VCs include:

- **Consumer country governments** can combine regulatory and due diligence mechanisms, and speed up corporate compliance with voluntary standards by providing fiscal incentives, which later become statutory requirements. They can require traceability and legality for product value chains as part of transparency regulation, especially when sourcing from hot-spots of new deforestation; and support platforms and third party publicly available information and monitoring activities that enable consumers to understand where the source of products consumed and the externalities they create. Concerted action between consumer **governments on an EU level** with major consumer countries (notably China, Brazil, India and USA) may lead to more coherent, global policies to level the playing field (i.e. legally, fiscally and trade tariffs) and inhibit spillover and leakage of embodied deforestation commodities from one consumer region to another.
- Origin, **producer country governments** can lead on identifying hotspots and frontiers of direct and indirect commodity-based deforestation; strict enforcement of protected and HCV and HCS areas (also identifying these if not already done) and installing moratoria where needed; and convening multi-stakeholder platforms, landscape approaches and partnerships. Addressing the issue of customary and statutory tenure of lands subject to deforestation by commodities is difficult in countries where good governance practices are not present, but essential. The help provided for capacity building through EU VPAs and FLEGT for wood imports can serve as lessons for similar efforts to bridge value chains.
- **Financial institutions** can oblige clients to consistently and publicly report– and on their due diligence approach, and on the impacts – (using for instance commodity and sector standards, including certification) of both individual corporate and partnership interventions on annual time scales.
- **Business** needs to take responsibility for tracing their supply chains for all production (not just certified products) alongside coordinated sector and partnership interventions, and also on issues outside their direct sphere of sourcing influence (i.e. landscape level), addressing indirect drivers of deforestation and reforestation.
- **Business sector associations** can play a leading role in standard setting, baseline definitions, business guidelines for DD approaches, and coherent traceability and reporting systems. They are also important for mainstreaming actions chain-wide, for instance implementing sector-wide agreements.
- **Certification standards and their alliances** should engage actively with non-certified actors who are traditionally not involved in approaches - such as middlemen traders - so that the lessons learnt from voluntary sustainability standards can be translated to non-certified but organised farmers, for example through producer country government agencies and knowledge extension. Also, their standards could evolve for tackling broader ZD effects and include criteria on participation in local multi-stakeholder and landscape approaches.
- Research and conceptual work by **academic institutions** collaborating with NGOs and business partners is needed to establish shared assessment strategies for ZD-VCs going across commodity markets, approaches and regions, to create a systematic evidence-base supporting claims about the effectiveness of different ZD approaches. ZD approaches should be scrutinised for the societal and political values inherent in them and the theories of change they ascribe to. To do so, research to support evidence based policymaking is needed on: appropriate baseline-cut off dates; measuring deforestation and cycles of (in)direct drivers; identify mechanisms for the financial sector to influence ZD corporate, chain and sector interventions; and accounting for forest gain and loss.
- **Consumer organisations** can collaborate more with business and other partners to enable consumers to make informed choices – particularly the traceability of product ingredients, where products originate from, and the impacts of value chain interventions. This builds on publicly available and accessible information, provided by CSOs and NGOs.

Together, these options provide an example of a wicked problem where progress and success depends on a well-designed, interlinked approaches taking into account the multi-level and multiple-actor setting – shown in the figure below.

Interlinked multi-actor and multi-level concept to deforestation-free commodity value chain approaches



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Contents

Abbreviations

AFOLU	Agriculture, forestry and other land use
BEI	Banking Environment Initiative
CGF	Consumer Goods Forum
CIFOR	Centre for International Forest Research
CSR	Corporate Social Responsibility
DISCO	Declaration of Intent for Sustainable Cocoa
DNB	The Bank of the Netherlands/*De Nederlandsche Bank*
EUTR	European Union Timber Regulation
FAO	UN Food and Agriculture Organisation
FLEGT	Forest Law Enforcement, Governance and Trade
FPIC	Free Prior Informed Consent
GISCO	German Initiative for Sustainable Cocoa
GRSB	Global Roundtable for Sustainable Beef
GTPS	Brazilian Roundtable on Sustainable Livestock
HCS	High Carbon Stock
HCV	High Conservation Value
IDH	Sustainable Trade Initiative (*Initiatief voor duuzaam Handel*)
IMVO	International Socially Responsible Business/*Internationaal Maatschappelijk Verantwoord Ondernemen*
IPLC	Indigenous and local peoples
IRBC	Agreement on International Responsible Business Conduct
LNV	Ministry of Agriculture, Nature and Food Quality/ *Ministerie van Landbouw, Natuur en Voedselkwaliteit*
NYDF	New York Declaration of Forests
PBL	Netherlands Environmental Assessment Agency/ *Planbureau voor de Leefomgeving*
PPP	Public Private Partnership
RLRT	Responsible Leather Round Table
RSPO	Roundtable for Sustainable Palm Oil
RSPO	Roundtable for Sustainable Palm Oil
SNDI	French national strategy against imported deforestation
TPAS	Timber Procurement Assessment System
VPA	Voluntary Partnership Agreements
VSS	Voluntary Sustainability Standards
ZD-VC	Zero-deforestation value chains

Introduction

Why another study on zero deforestation value chains?

Over a quarter of global forest loss from 2001 to 2015 is permanent deforestation caused by commodity-driven agriculture, meaning these areas are likely not be forested again (Curtis et al. 2018). This has led to deforestation being addressed in global economic agendas, such as during the 2010 World Economic Forum (World Economic Forum 2019). In response, 400 companies comprising the Consumer Goods Forum committed in 2010 to achieve zero net deforestation within their supply chains by 2020 (Ludwig 2018). In the past decade deforestation has risen in prominence on the political agenda, leading in 2014 to the New York Declaration of Forests (NYDF), the 2015 Amsterdam Declaration on Deforestation signed by seven European governments, and a 2019 EU Action Plan and Communication on Stepping-up EU Action to Tackle Deforestation. These declarations encourage private-public partnerships and action to ultimately remove deforestation from supply chains[1] by 2020. A review of commitments made between 2015 and 2018 towards zero-net deforestation by companies and financial institutions which influence global forest-risk chains such as palm oil, cattle, soy, timber and paper showed increased engagement since the Amsterdam Declaration (Rogerson, 2019a).

It is vital to understand how specific interventions and commitments translate to avoided deforestation, as the rate of commodity-driven deforestation has not slowed despite private and public efforts (Curtis et al. 2018). Zero deforestation (ZD) commitments emphasize the role of the production and trade of commodities in deforestation, and the vital place of forests in global climate, biodiversity and inequality crises is becoming ever more apparent. There is a wealth of information on deforestation, the causes, awareness and urgency, and on the commitments made by companies, both globally and regionally, including third party certification. However, whether the targets and pledges in commitments are achieved, and whether current approaches deliver their stated objectives is mostly unclear (Lambin et al. 2018). The economic risks of commodity-driven deforestation for financial institutions have also become increasingly clear. These include public controversies and reputational damage caused by deforestation in commodity producing regions (World Economic Forum, 2019), and more stringent and legal forms of liability. Suppliers of financial capital, such as banks and credit organisations increasingly require a due diligence from companies they lend capital to, to reduce such risks, or carry out due diligence themselves (TFA, 2019).

To plan further activities and research on how to attain zero-deforestation value chains[1] (ZD-VC), the Netherlands Environmental Assessment Agency (*Planbureau voor de Leefomgeving, PBL*) requested the Forest and Nature Conservation Policy Group (FNP) at Wageningen University for an overview of current insights in approaches to ZD-VC and their results. PBL is conducting studies for the Ministry of Foreign Affairs on the use of certification as a policy tool, and with the Ministry of Agriculture, Nature and Food Quality (*Ministerie van Landbouw, Natuur en Voedselkwaliteit,* LNV) on deforestation free, sustainable agro-commodity value chains and natural capital (*Convenant Duurzame Agrosectoren*), given that the Netherlands are chairing the Amsterdam Declaration Partnership since June 2019 and are currently developing a forest strategy with national and international ambitions to pass on forests with their multiple functions to future generations (LNV 2020). This requires a policy that allows choices in the future and steers a long-term course. PBL is involved in a study on supply-chain risks and consequences for the financial sector together with The Dutch National Bank (*De Nederlandsche Bank*).

The aim of this study is thus to construct the mechanisms of change and learn from real world, field-based experience of what works to halt commodity-driven deforestation. This review also intends to inform financial institutions of the International Finance Sector Working Group (under the DNB) looking for ways to reduce deforestation risks in their investment portfolios, making explicit the role of the finance sector in theories of change[2].

[1] The term value chain is used in preference to supply chain. See Annex 1 for explanation and definitions.

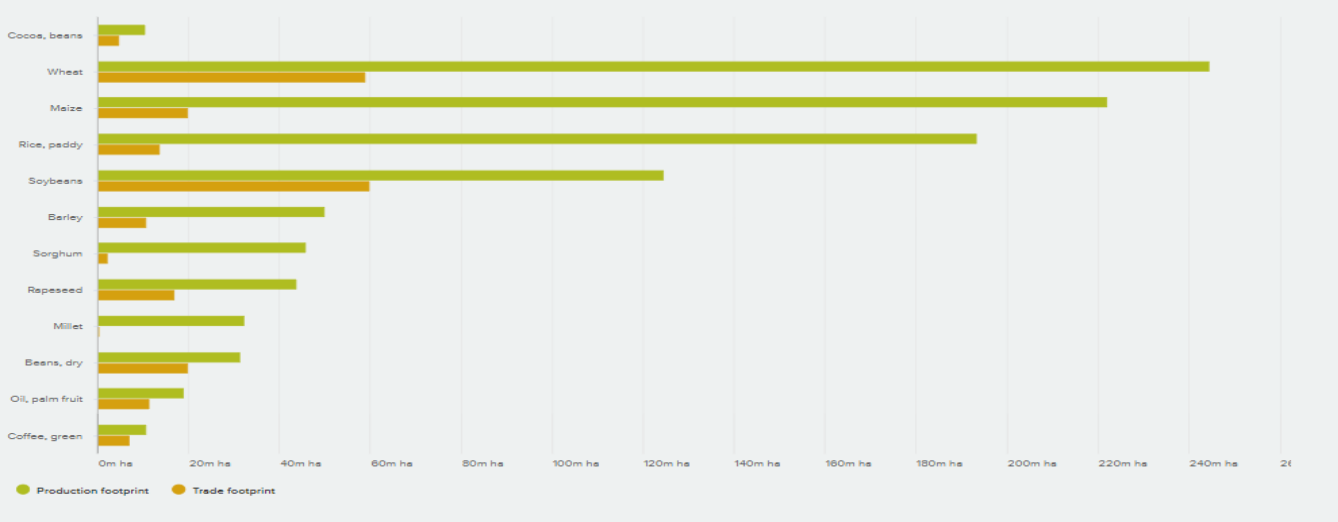
[2] De Nederlandsche Bank (DNB) leads working group exploring the role of financial sector in deforestation-free supply chains.

The context of zero deforestation commodity value chain commitments

This study builds on a PBL report on the emerging governance landscape around Zero Deforestation pledges (Ludwig 2018). It picks up on where this report left off by exploring how zero deforestation commitment translate to approaches that halt or slow deforestation. To do so, it describes general discourses on achieving zero-deforestation, private and public initiatives, theories of change (ToC) and checks how ToC translate into outcomes and practical results that determine ultimate impacts. The study focuses on six commodities that imply deforestation risk: cattle (meat and leather), coffee, cocoa, soy, palm oil, and timber. These are so-called 'forest risk commodities'.

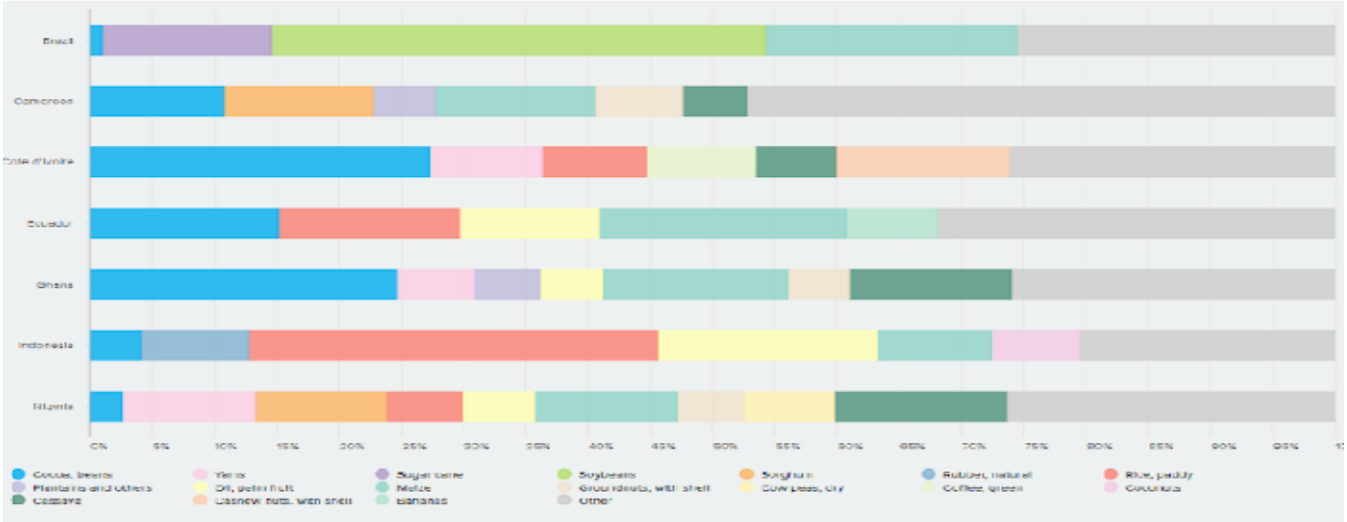
Commodity-driven deforestation in the tropics is an important concept to understand how zero-deforestation commitments translate to viable approaches. The spatial footprint of the global production volume of some of these commodities is small compared to staple crops produced worldwide like wheat, maize, rice and other grains (see figure 1 and 2). However, the geographic concentration of the production of cocoa, coffee, palm oil and soy in tropical "biodiversity hotspots makes their footprint significant nonetheless. Moreover, these globally traded commodities are often at the forefront of deforestation frontiers and more often implicated in new deforestation and recent land use change (Pendrill et al. 2019).

Figure 1 Global land footprint of major commodities for both total production and production for export, 2014



Source: FAOSTAT data (Resourcetrade Earth 2017)

Figure 2 Land footprint of major tropical commodities in main producing countries, 2014

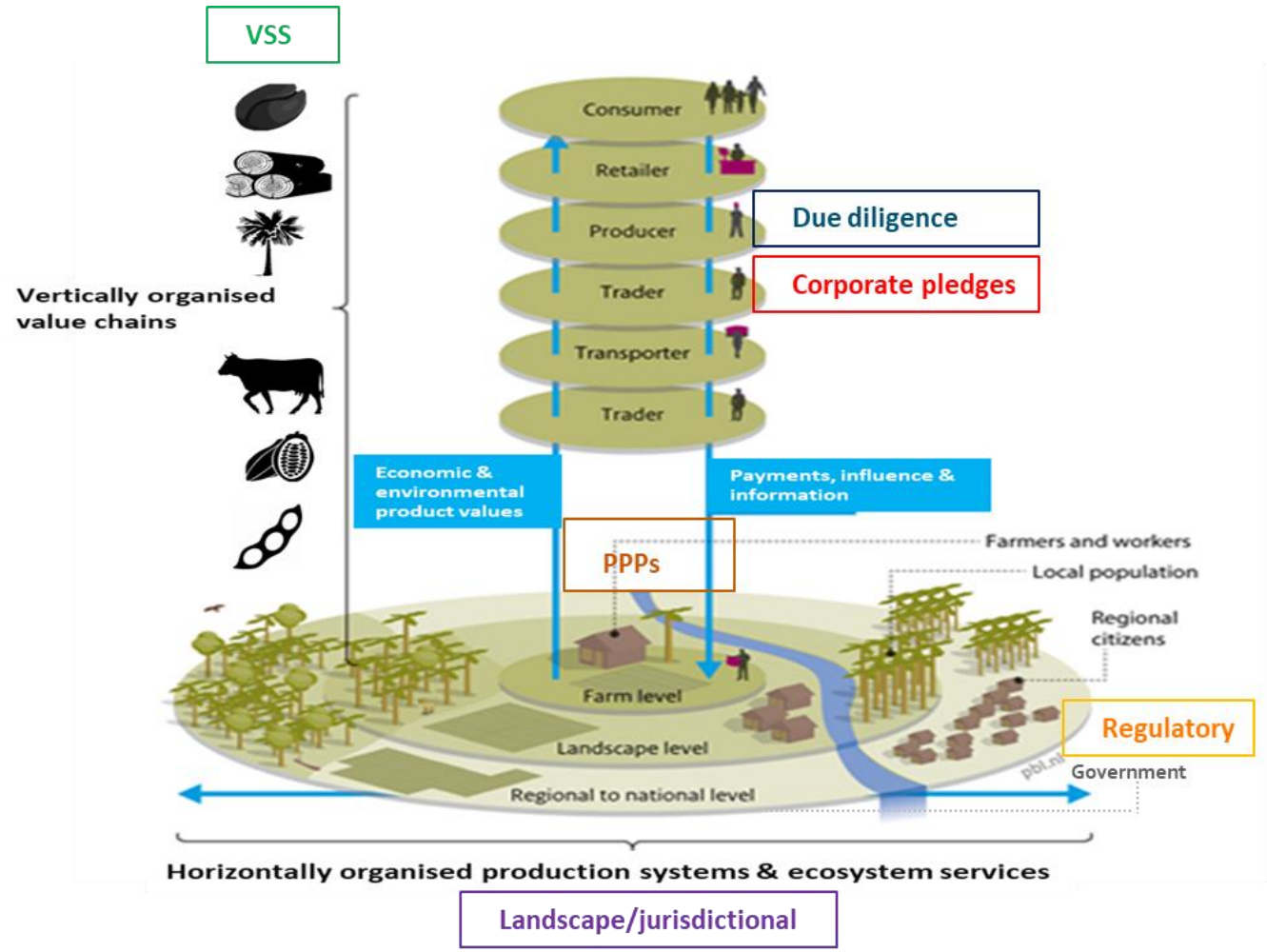


Source: FAOSTAT data (Resourcetrade Earth 2017)

The consumption and trade of commodities in the Netherlands, and elsewhere, is linked via 'telecouplings' (Liu et al. 2013) to deforestation across the globe. These telecouplings driving deforestation are direct and indirect[3]: at each step in a value chain from farm to raw product processing, transport, manufacturing and retail economic and social value is added to the commodity but also the traceability to deforestation caused by the production system may become harder to identify. Using the value chain concept implies tracing these commodity value chains to establish a link between the impacts of producing the commodity, such a cocoa, and the final product, for example chocolate, made from that commodity. The impacts of deforestation include greenhouse gas emissions contributing to climate change, biodiversity loss, human rights violations, as well as financial impacts, such as corporate reputational and operational sourcing risks. Deforestation may be direct – as forest is felled and replaced immediately by a commodity, or indirect, where forest is gradually degraded for example by shifting cultivation and timber extraction, infrastructure development and habitation, and eventually replaced by commodity cash crops. Land-use change is thus dynamic and typical replacement patterns are associated with different business models, types of landowners, regions and commodities.

Superimposed on the vertical value chain is a horizontal geographic focus which highlights the production system where the commodity value chain originates – and how this production system is scaled from farm, to landscape to regional and national level – shown in Figure 3. Leakage or spillover - where unsustainable production activities are transferred from one region to another or from one type of producer to another – telecouples different landscapes, which maybe in the same or different region, country or continents.

Figure 3 The forest-risk commodity value chain and geographic nexus concept



Inspired by: van Oorschot et al (2016), Ruijs and Egmond (2017)

[3] See Annex 1 for glossary of definitions.

Tracing the zero deforestation approaches in value chains

This objective of this study is to trace the outcomes and impacts of approaches advocated to reach the objective of Zero Deforestation value Chains (ZD-VC). It uses a value chain and geographic nexus concept to look at the impacts and success of initiatives, classified into approaches used to reduce deforestation driven by forest-risk commodities. Six approaches were identified: voluntary sustainability standards, public-private partnerships, corporate pledges, landscape and jurisdictional, and due diligence mechanisms. While in practice, these approaches overlap and interlink, we discuss them in this report separately to highlight how they emphasise specific interventions which are predicted to lead (or not) to outcomes and impact. To guide the study, the following questions were asked:

1. What role do commodities have in driving deforestation (distinguishing between large scale such as soy, timber, cattle, palm oil) and smallholder commodities (cocoa, coffee)?
2. What are the discourses around these approaches, who is driving and using these discourses to what ends and at what governance level?
3. What theories of change do they embody with a focus on six commodities strongly associated with deforestation (soy, palm oil, cacao, coffee, timber and cattle)?
4. What kind of initiatives (including geographic focus and scale) are taken by public and private, direct and indirect[4] value chain stakeholders towards zero deforestation in the six commodity value chains?
5. What are the outcomes and impacts of these initiatives on the ground?. Do outcomes/impacts differ according to approach, actor and commodity?
6. Which approaches appear most successful in tackling commodity-related deforestation?
7. What future research is needed to address current concerns?

[4] See Annex 1 for definitions and explanation of the key terms.

Methods

This study was conducted based on a review of evidence in literature (peer reviewed, grey literature and websites), databases (e.g. Accountability Framework and Forest Trends Supply Change and trade and production data such as FAOStat), which were analysed using three approaches:

Discourse analysis: Discourses on zero deforestation in literature - including written communications and debates, media and websites - were investigated for how they present the logic or theories of change (ToC) of zero deforestation interventions, how they do or do not establish causality across the value chain, and what they present as major themes in achieving ZD-VC for the six commodities in different localities and the main approaches used and by which stakeholders. The most common discourses are presented.

Evidence analysis: Literature and databases were reviewed for evidence on how commodities drive deforestation, definitions and terms used, the outcomes and impacts of different ZD initiatives and lessons learnt. Details of 46 initiatives implemented in the six commodity chains were entered into a database, detailing the organisations involved, activities, timing and scale of intervention, criteria and indicators of success, monitoring frameworks and data sources, claimed attribution and causality, and reported outcomes and impacts of these initiatives. The **initiatives** were classified into **approaches,** drawing on Newton et al.'s (2013) typology of interventions enhancing the sustainability of commodity chains and Cashore's (2002) framework of non-state market driven governance systems. The reviewed interventions and evidence on different ZD approaches generally from literature and websites were evaluated for their the effectiveness in meeting the objective of zero deforestation value chains, based on criteria developed by Garret et al. (2019), and detailed by other scholars (c.f. Nolte et al., 2013, Vuohelainen et al., 2012, van der Ven et al., 2018, Fung et al., 2007; van Oorschot et al. 2018; Mol, 2010) – see section below. A five point scale from "very effective", to "no effect" and "not effective" was used to evaluate against ten criteria. Where there was no or little evidence, this was also indicated.

Theories of Change (ToC): When the logic behind the specific initiatives and approaches were not explicitly documented, a ToC (see Annex 2 for explanation of the terms including definitions of initiatives, approach, intervention, outcome and impact), was constructed by inspecting the literature on the selected value chain initiatives, including (where available) the interventions, outcomes and impacts, with at least two initiatives investigated per approach and per commodity. These were analysed and mapped into aggregated impact logics per commodity value chain and approach. Qualitative expert judgement by the research team members was used to develop the summary tables and figures.

Criteria for evaluating the success of zero-deforestation commitments

An assessment of the success of approaches to tackle commodity-driven deforestation depends on the definition of the term "success". It mostly relates to the impacts – both intended implicitly and/or stated explicitly by approach owners and users. As there are diverse approaches with different targets, focus points, methodologies and tools, their comparison is challenging. The different discourses on deforestation have led to diverse definitions and interpretations of these key terms, leading to a long list of terms (see Annex 1 for definitions). Based on the literature review and particularly Garret et al., (2019), the following criteria for measuring the success of ZD initiatives were developed and used to assess effectiveness on a five point scale from "very effective", to "no effect" and "not effective", and where there was no or little evidence, this was also indicated.

1. **Baselines and (de)forestation definitions are provided** to assess since when deforestation and forest degradation have been prevented, and when restoration, afforestation and/or reforestation[5] have been implemented, making it also possible to distinguish past deforestation from current deforestation. Collective agreement on the definition of forests and deforestation, and a fixed baseline or relative year after which no deforestation should occur and from which products are classed as entering a deforestation free value chain is important. Although the baseline year needs to be agreed globally, it should also be sensitive to local realities. Initiatives benefitting from "low-hanging fruit" and in already deforested land with decreasing rates of deforestation cannot be considered successful in stopping further deforestation, making "deforestation free" claims difficult to verify.
2. **Deforestation and degradation of high conservation value forests is prevented**, starting from a set baseline year, even if compensation or reforestation is promised locally or elsewhere. Native and old-growth forests with a high conservation and/or carbon value, are important resources for climate change mitigation and regulation, biodiversity conservation, water circulation and carbon sinks. Native and old-growth forests cannot be fully recompensed by reforestation, creating a carbon and biodiversity gap in time.
3. **Governance arrangements** which aim to prevent deforestation operate at both the level of **production systems** and **value chains** (Nolte et al., 2013, Vuohelainen et al., 2012, Van der Ven et al., 2018)
4. **Collective action is part of the approach** – As eliminating deforestation from value chains is a complex process it requires the involvement of diverse, multiple actors at different levels. Meaningful participation and collaboration between public institutions, businesses and financers is important, as global trade is not changed by a single actor.
5. **Market benefits are created** - A successful approach links sustainable production with markets and consumers to deliver value for producers and incentivize them to continue producing sustainably and deforestation free. Even when price premiums are not offered to producers as an incentive, interventions need to discourage free-riding and unfair competition in markets created by those who produce unsustainably and continue feeding markets with cheap products with embedded, embodied environmental externalities, making it more profitable to deforest than to keep forests standing in most the tropical countries.
6. **Smallholder support and fair distribution of benefits is in place** – A successful approach encourages smallholder participation, invests in their progress, provides capacity building, is sensitive towards fair benefit and responsibility sharing around deforestation free production.
7. **No leakage mechanism in place** – A successful approach has conditions in place to avoid leakage such that pressure to abandon unsustainable practices lead buyers to change suppliers to address deforestation.
8. **Free, Prior and Informed Consent (FPIC) is achieved** – a successful approach involves indigenous peoples, local communities (IPLC) and other relevant local stakeholders in the process and achieves their free, prior and informed consent before implementation.
9. **Transparency, monitoring and accountability in place** – are key conditions of environmental governance (Fung et al., 2007; van Oorschot et al. 2018; Mol, 2010). A successful approach is based on regular reporting, civil society engagement and accountability. Transparency, monitoring and accountability is relevant in relation to corporate power and business operations and associated socio-environmental impacts.
10. **Effectiveness, efficiency** and **equity principles are implemented** – which implies that value chain actors are sensitive to environmental and social criteria and that producers are willing to work to these extrinsic criteria to supply them (Garrett et al. 2019– see Figure 12). Efficiency implies that companies (alone or in collaboration) invest in tracing value chains to farm level production systems to manage the risk of sourcing from "recently" deforested land (unless sourced from areas with no deforestation at all). Equity refers to the management of the distribution of the risks and costs of deforestation, certain producers may be eliminated from a chain and others rewarded (i.e. producers who deforested early, which disadvantages forest-rich areas that came late to an initiative). If the government is involved, a jurisdictional scale can provide a condition for effectiveness and entry point for dealing with land-use conflicts, including those stemming from illegal land conversion in the past.

[5] See Annex 1 for definitions.

Results and discussion

This section presents the results, ordered according to six research questions.

Commodities drive deforestation directly and indirectly

The first step to trace the impact of various approaches to zero deforestation is to establish the role **commodities play in driving deforestation** for the six commodities, by describing the most important geographical contexts where production systems occur and discussing the nature of their markets and trade.

Cattle

Cattle ranching is an economic activity that is in many cases economically viable directly after forest clearance. Cattle ranching has directly caused an 'arc of deforestation' on the border between the Amazon rainforest in Brazil, Peru and Bolivia and the Cerrado savannah biome, and the Gran Chaco woodlands in Argentina, Paraguay and Bolivia (Walker et al., 2013; Fontes et al., 2017; Baumann et al., 2017). Cattle production has increased also India, USA, and China (Newton et al. 2013). The relation between cattle pasture expansion and deforestation in the Amazon and Cerrado biomes is well documented (Kaimowitz *et al.*, 2004; Rudel *et al.*, 2009; Gibbs *et al.*, 2010; Hosonuma *et al.*, 2012; Pereira *et al.*, 2016; Barreto *et al.*, 2017). As a country that has the biggest share of the Amazon biome, Brazil is the main beef producer among Latin American countries (OECD, 2018). In 2010, the export value of beef and leather products from Brazil was over 5 billion US dollars, while the domestic market is even bigger (Walker et al., 2013). Despite an implementation gap and continuous attempts to weaken the provisions, Brazil is considered to have the most robust environmental and forest protection laws among South American countries (Bauch et al, 2009; McDermott et al.,2015). In addition to federal laws and regulations on forest conservation in public and private lands, there have been numerous attempts through public-private and individual supply chain interventions with the aim to decouple cattle production from ongoing deforestation.

While deforestation in the Amazon has been on the rise again in recent years, the expansion of cattle ranching is not necessarily a direct driver of deforestation. From 2007 to 2012, Gollnow and Lakes (2014) did not find a correlation between loss of forest cover and cattle expansion, implying an increase of animals per hectare instead. Cattle ranching is also not a direct driver of deforestation in other types of biomes, in Brazil and elsewhere. This may be because land has historically already been deforested (e.g. Ireland, the Netherlands), or because cattle ranching is carried out in naturally un-forested biomes (e.g. pampas grassland biome in Argentinian, Uruguay). Cattle ranching in temperate regions and grassland biome is also more efficient per hectare as soils tend to be richer compared to the relatively poor Amazonian soils.

Coffee

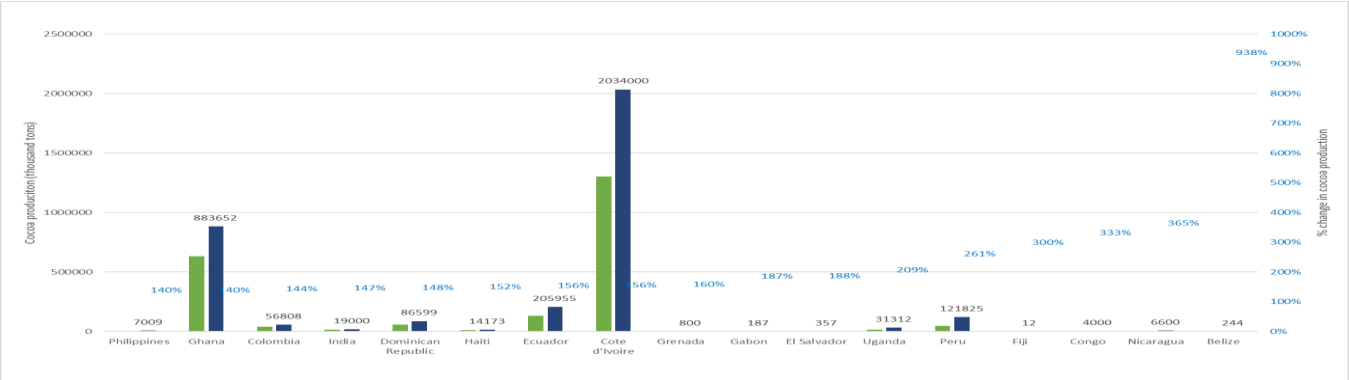
The expansion of coffee production in Ethiopia, Indonesia, Vietnam, Brazil and Mexico has led to direct and indirect deforestation (Gaveau et al 2009, Priess et al. 2007, Meyfroidt et al 2013, Hylander et al 2013, Brannstrom 2000, Blackman et al. 2005) and has been coupled with significant social impacts. This experience suggests that forest loss is likely to continue with the increasing global demand and expansion of coffee (Magrach & Ghazoul, 2015). Coffee production systems range from technified and intensified shade production, to agroforestry (Grabs & Zurich, 2019). Shaded coffee plantations however can also generate ecosystem services such as increased biodiversity, carbon sequestration and soil protection (Pham et al. 2019). Whilst shaded coffee production systems can slow down the conversion of forest to annual-crop agriculture, there is a risk that intensification threatens forest biodiversity, including the genetic diversity of wild coffee in Ethiopia (Hylander et al., 2013). As coffee is sensitive to temperature shifts, climate change is projected to lead to future forest losses due to shifts in coffee cultivation sites (Magrach & Ghazoul, 2015; Pham et al., 2019). Under current market conditions, producers have shifted towards intensified shade and technified production which are seen as more commercially viable. Most individual producers do not have an influence on prices; thus a seemingly rational economic choice is made to maximise output on the production surface (Grabs & Zurich, 2019).

The coffee trade is worth 15 billion US dollars a year (Magrach & Ghazoul, 2015), the second most traded commodity after petroleum oil (Davis et al. 2012). Globally around 99% of coffee produced is Arabica (*Coffea arabica*) and Robusta (*Coffea canephora*) (Jayakumar et al., 2017), grown in over sixty tropical countries by over 25 million farmers, the majority of whom are smallholders (70% in Africa, the Americas and Asia where for many coffee is their primary source of income) (Jayakumar et al. 2017). Coffee provides significant social and economic contributions to the livelihoods of over 120 million people (TCI, 2016). World production of coffee in 2018/19 increased by 5.4% compared to 2017/18, although it is expected to decrease over the coffee year 2019/ 2020 (ICO, 2019b). The EU is the largest importer of coffee, followed by the USA and Japan (ICO, 2019a). Within the EU, the Netherlands is the sixth largest importer of green coffee beans (share is 6%) (CBI, 2019). Brazil produces approximately 36% of the coffee, Vietnam about 17%, followed by Colombia (8%) and Indonesia (6%) (Pham et al., 2019). Global coffee production rose over the coffee year 2017/18 to 2018/19, and although it is expected to decrease slightly over the coffee year 2019/20 (ICO, 2019b), consumption is expected to increase. The EU is the largest importer of coffee, accounting for 40% of global consumption (TRANS SUSTAIN, 2018), followed by the USA and Japan (ICO, 2019a). Within the EU, the Netherlands is the sixth largest importer of green coffee beans (share is 6%) (CBI, 2019).

Cocoa

An estimated 2 to 3 million hectares of forest have been converted due to cocoa production globally in the period 1988-2008 (Kroeger et al 2017). Cocoa production has increased, particularly in Ghana and Ivory Coast since the mid-1940s, largely as a pioneer crop by occupying fertile, converted forested land (Ruf and Varlet, 2017, Ruf 2007). Similar cocoa expansion through deforestation has occurred in Asia, particularly in Indonesia since the 1980s (Ruf 2007), and to a lesser extent in the Amazon where shade systems are more common (Kroeger et al 2017, Mihofer et al. 2018). Between 2010 and 2017, cocoa production grew in Ivory Coast by 156% and in Ghana by 140%, however, forest cover in the two main West African production countries is now very limited with 8% land in Ghana covered by primary forest and Ivory Coast 2%, and a 83% decrease relative to the estimated forest extent in 1900 (FAO 2018, Aleman et al 2018, Ruf and Varlet, 2017). In the countries shown in Figure 4 where significant (over 140%) growth in cocoa production has occurred since 2010 and which still have high forest cover, the current deforestation risk is much higher (Feintrenie 2014, Tothmihaly et al. 2017, De Beule et al. 2014). Cocoa production also increased by 75% between 1990 and 2020 in Nigeria (Newton et al. 2013). Traditional, shaded cocoa forests however also generate ecosystem services and can support high levels of plant and animal biodiversity, carbon sequestration and soil protection – on a level to similar to secondary forests (Sonwa et al. 2007, Scroth and Harvey 2007).

Figure 4 Countries with increases in cocoa production of over 140% from 2010 (green) to 2017 (blue)

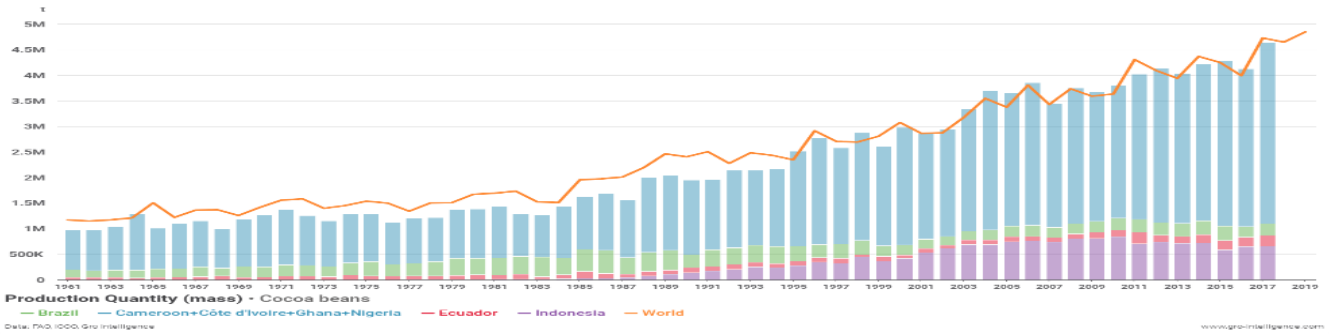


Source: FAOSTAT 2019

The seeds – known as beans – of the *Theobroma cacao* tree are a tropical, perennial cash crop and non-staple food, used to make cocoa powder, butter and liquor: the main constitutes of chocolate. Whilst trade in cocoa started in the sixteenth century, the first global boom in the cocoa–chocolate sector occurred in the late nineteenth century, with world production of cocoa beans steadily increasing since 1870s when cocoa was introduced to Ghana, and rising particularly since the 1960s, shown in Figure 4. Around 4,849,000 tons of cocoa

beans were produced in 2017/2018 (ICCO 2019), with the global trade[6] of cocoa beans in 2017 worth 19,209,996 US$ and of chocolate products 55,876,471 US$ (FAO 2019).

Figure 5 World cocoa production 1960 to 2017



Although cocoa originates in the Amazon Basin, an estimated 17% of global cocoa production originated from Latin America in 2018/2019, with the majority (76%) produced in Africa, led by Ivory Coast (17% global production and Ghana 17%). Indonesia is the third largest production country, with an estimated 5% of global production (ICCO 2019). The main cocoa consuming countries are the USA, Germany, France, UK and Brazil. Europe consumes 43% of cocoa globally, followed by the Americas (32%), Asia and Oceania (18%) and Africa (4%). Belgium, Switzerland and Germany lead consumption of cocoa per capita, with 5.8, 5.5 and 4.3kg per capita (ICCO 2017).

Soy

Soy was a direct driver of deforestation in the Amazon until 2004, with soy plantations established in previously forested areas, replacing an estimated 14% of forests in Brazil, Argentina, Paraguay, Uruguay and Bolivia (IDH and IUCN 2019). Soy production increased between 1990 and 2020 by 72% in the USA, 244% in Brazil, 394% in Argentina, 37% in China and 277% in India (Newton et al. 2013). Since then, an increase in production per hectare and a soy moratorium have halted soy being a direct driver of land use change (Macedo et al., 2012; Nepstad et al., 2014). Gollnow and Lakes (2014) observe a decoupling of the causal direct link between increased soy production and deforestation, while accounting for the effects of leakage. Before 2005, soy farming in the Amazon was responsible for approximately 10% of total deforestation, with cattle ranching approximately 75% (Rudel et al. 2009). However, soy is also an indirect driver of deforestation as it often replaces cattle pasture, driving the transition from forest to pasture deeper into the Amazon region. While these leakage effects are known, they are not well quantified and usually not part of zero deforestation interventions such as moratoria. For other countries with high soy expansion rates since 2008 – India, Ukraine, Russia, Canada – no evidence for a link between soy cultivation and direct deforestation has been found (European Commission 2019a)

Soybean or soya bean (*Glycine max*) are legumes native to East Asia, widely grown for its edible bean, and meal and oil produced from the bean, which has numerous uses, in food products, as a protein source in animal feed, biofuels and for technical uses. Mainly grown industrially in temperate countries, a rising share of soybeans is now produced in Brazil due to improved varieties, both increasing productivity and area (IDH & IUCN NL 2019). The main soy producers in 2019 were the US, Brazil, Argentina, China, Paraguay, Canada and India (IDH & IUCN NL 2019). The main 10 countries importing soy from the Cerrado are Asian, European, and North American (Green et al. 2019). In 2017, the EU+ countries consumed around 34.4 million tonnes of soybeans, soymeal and soybean oil, approximately 12% of global soybean production. Production systems range in scale from large industrial farming operations in South America of over 100,000 hectares, to small farmers with 1 and 50 hectares. Growing areas are found both on former tropical forested lands as on former savannah ecotypes.

[6] Imports and exports

Palm oil

Palm oil production has driven direct and indirect deforestation, particularly the increase of oil palm prices and its profitability in the 1980s encouraged a shift from other crops to oil palm in Southeast Asia, notably in Indonesia and Malaysia (Byerlee et al., 2014), although here deforestation peaked in the 1970s, and was already decreasing before palm oil production increased in the 1980s, such that palm plantations mostly replaced other agricultural land uses. Palm plantations are estimated as responsible for around 3% of global recent/historical? deforestation (Roda, 2019). In Southeast Asia, 45% oil palm plantations were in areas forested prior to 1989, and 31% in South America (Ecuador, Peru, and Brazil). In Mesoamerica and Africa (particularly Cameroon and Republic of Congo) only 2% and 7% of oil palm plantations were in areas that were forests in 1989 (Vijay et al 2016).

The oil-rich seeds of the oil palm (*Elaeis guineensis*) are used in many food and non-food products, such as cooking oils, soaps and detergents, cosmetics, lubricants, oleo-chemicals, animal feed and biodiesel. Several stages of processing are required before palm oil reaches the consumer. In under a century, oil palm has changed from a minor subsistence crop in West and Central Africa to a major global agricultural commodity. Production increased from 1.4 million tons in 1961, to 14 million tons in 1994 and 55.2 million tons in 2014 (FAO 2019). On average (1994-2017) 86% of palm oil is produced in Asia, with Indonesia (13 million tons) and Malaysia (13.4 million tons) the main production countries. This growth is predicted to slow, tied to a deceleration in area expansion and modest yield prospects in Indonesia and Malaysia (FAO/OECD 2019).

Although oil palm is native to West Africa, in 2017 only 6.5% of global production originated from Africa (FAO 2019). A major production increase in Africa, due to larger scale production, occurred since around 2006 (Carrere 2010). Oil palm in West Africa is grown in forest fallows and small mixed farming systems, and increasingly in larger scale, industrial mono-crop plantations (Carrere 2010, Feintrenie 2014, Sayer et al. 2012). In Asia, the tree is grown in a mixture of independent smallholder plantations (32% in Indonesia and 16% in Malaysia), by smallholders on contracts to mills (known as plasma schemes 8% in Indonesia and 22.5% in Malaysia), in medium to large scale mono-crop plantations generally over 25 hectares (53% in Indonesia, 61% in Malaysia), and on larger state owned plantations (6% in Indonesia) (Varkkey et al 2018). Oil palms produce 5 to 8 times more oil per hectare than other vegetable oil crops, with soybean, sunflower and rapeseed requiring 5 to 8 times more land than oil palm trees to produce one tonne of oil (Roda 2019).

Timber

Wood products are a major driver of tropical deforestation (Curtis et al., 2018; Garret et al., 2019) and further degradation of remaining forests is attributed to selective logging used for timber, paper and pulp (Garrett, et al., 2019). An increasing amount of timber comes from plantations and mono-cultures of local and exotic species, which maybe or not be defined as a forest, but may have led to the disappearing of natural forests. The increasing demand for wood products is partially driven by an increasing global population, accompanied changing consumer preferences, and governmental bio-energy policies. The conversion of forests and logging for agricultural expansion (also burning due to an absence of infrastructure to process cut wood) and unsustainable timber production have been linked to negative social and environmental impacts such as land conflicts, increased rural income inequality, greenhouse gas emissions, biodiversity loss, and hydrological changes (Garret et al., 2019).

The chains of timber products and tropical timber are complex and highly fragmented. Small and medium enterprises with relatively minor market shares dominate the industry (Global Canopy, 2018). A high proportion of timber in tropical regions is informally logged for local and national use and often illegal, with an estimated 15%-30% of tropical forestry consisting of illegal logging, worth approximately US$30-100 billion globally (Global Canopy, 2018). National and international production data therefore fails to capture significant amounts of produced timber production (ibid.).

The top five producers of timber products (Brazil, Canada, China, Russia and the USA) are also the top five consumers globally, including tropical timber (FAO, 2016). Wood-pulp production has continued to increase in

South America; 15% of global wood pulp production comes from Brazil, Chile and Uruguay. These also account for 33% of the exports (FAO, 2016). Currently, the EU imports most of its tropical timber from Africa (56%), Asia (25%) with Latin America at 19% (IDH, 2019). The market for tropical timber has grown but remains significantly lower than its peak prior to the global financial crisis in 2008-9. Many producers have stopped regarding Europe as their main export market, and shifted towards growing domestic and regional markets, and new markets in Asia (IDH, 2019). It is estimated that if the main tropical timber-importing countries in Europe (Belgium, Germany, France, the UK, Netherlands, Italy, and Spain – combined representing approximately 90% of the EU28 primary tropical timber product import) sourced sustainable natural tropical timber, an "additional 12.5 million ha of tropical forests can be positively impacted" (IDH, 2019: 13).

Five key discourses on zero deforestation value chains

This section presents the results for question two on the **shared, public discourses** around these zero deforestation value chain approaches in the six commodity value chains. It discusses how these discourses present theories of change, how they do (or do not) establish causality across the value chains, and what they present as key solutions to consider for approaches to realise zero-deforestation commitments. The main discourses are described, along with which types of actors are driving and using them, to what ends and what type of governance.

Five discourses were identified from literature and are described below. These discourses dominate public debates and discussions on the six ZD-VC approaches for the six commodities described in the previous sections. These discourses are found in public media, in statements by government and private actors, and in reports and documents on zero deforestation commitment. The reflect the variety of worldviews, the focus and often implicit theories of change behind specific interventions that politicians, policymakers, and private actors hold (Mammadova et al., 2020a). By doing so they set the framework for how outcomes of ZD approaches and ZD indicators are conceptualized.

Neoliberal market discourse

Imbedded in discourses of ecological modernization and sustainable development, a core assumption within this discourse is that development and nature protection are compatible and can co-exist. The indirect driver of deforestation is the failure of markets to mitigate negative impacts and to manage the unintended side-effects of modernisation and globalisation. The best approach to zero deforestation is therefore contented to be found in technical innovation and societal reflection. Technical innovation is expected to reduce trade-offs between forest and agricultural land use, for example via agricultural intensification, productivity increases and reduced impact logging (land sparing) (c.f. Edwards et al 2014). Societal reflection on the unintended consequences of deforestation should lead to insights into which commodities are causing deforestation where, and the social, institutional and technological innovations (including agroforestry as a reforestation mechanism and form of land sharing) to prevent this. This discourse sees the current economic system as inherently benign and establishes a causal link between unintended side-effects, market failure to adequately value forests, lack of technical means, and absence of innovative practices as the main drivers of deforestation.

The neoliberal discourse exhibits confidence in the role of markets to find solutions to environmental problems. It strongly favours market mechanisms such as PES schemes, voluntary REDD+ at a national and international scale, emissions trading and carbon caps, voluntary mechanisms such as VSS, and individual business operations. The discourse is characterized by being "techno-optimist" in proposing technical solutions to environmental and social problems (Arts et al., 2010): i.e. blockchain technology, traceability solutions, transparency tools, etc. as solutions by improving information to consumers and creating innovation opportunities. It seeks to reach the "win-win" scenarios: i.e. cattle intensification for satisfying global demand for beef while reducing the need for more deforested lands. The discourse proposes zero net deforestation (stable amount of hectares of forest cover globally) as a goal by defining zero gross deforestation (no new deforested lands) as unrealistic.

The neoliberal discourse is implicitly and explicitly embraced by many "moderate" NGOs (WWF, IUCN, etc.), the private sector, and liberal governments (Weber et al., 2018). It is supported by a broad variety of actors i.e. Roundtable for Sustainable Palm Oil (RSPO) (Schouten & Glasbergen 2011) and Responsible Leather Round Table (RLRT), including those where governments are deliberately absent. This discourse is increasingly questioned by social movements and commentators on forest governance such as FAO and CIFOR.

Legality and responsibility discourse

This discourse centres on legality and demands a stronger (corporate) value chain responsibility for market actors in the developed world. While it shares a similar problem definition with the neoliberal market discourse that sees modernisation and economic growth as causing deforestation, in the legality discourse these negative impacts are seen as the result of negligence and/or ignorance, rather than unintended consequences. The

causal drivers of deforestation are thus a lack of information flows on the sourcing commodity productions and the lack of active attention to deforestation caused by their activities by companies and other actors in the value chains.

The solutions proposed in this discourse are legality: ensuring rule of law (i.e. no deforestation of protected areas) and carrying out proper and careful management of the risks inherent in sourcing and procurement practices (i.e. due diligence) to reduce the impacts of commodity production and trade. Due diligence implies the need for traceability mechanisms and methods to be established for individual commodities. Within the legality and due diligence discourse confidence is shown in the interaction between legal frameworks, corporate responsibility and an active civil society. Legal frameworks - such as the UN Declaration on Human Rights, International Tropical Timber Organization (ITTO) principles or the EU FLEGT policy on timber - set the boundaries for what is acceptable in terms of negative impacts and what not. Legal frameworks may thus allow deforestation, under strict conditions and/or circumstances. A focus of the EU Action Plan on Deforestation and EU-wide Due Diligence Regulation as a more adequate policy response of the EU to address its deforestation footprint (FERN, 2018 & 2019). Market parties are required to follow such frameworks and demonstrate adherence to legal frameworks by their subcontractors and suppliers in a value chain. The role of civil society is to ensure accountability of these market actors via monitoring and transparency mechanisms. NGOs, such as Greenpeace, have called for a new EU regulation on forest-and-ecosystem-risk commodities, of the opinion that "It has become clear that relying only on corporate, voluntary market-based initiatives won't put an end to the destruction driven by our consumption. New and more comprehensive action is needed by the EU and national governments" (Greenpeace 2020). Due Diligence is also part of the instrument mix for transparency regulation, and as such, also related to the neoliberal market discourse with a large role for finance to implement ESG principles.

Supporters of this discourse include governments, the EU (for commodities such as timber but not yet other commodities), many NGOs who focus on corporate transparency (such as Transparency International), and financial organisations. There are increasing calls for this discourse to become the mainstream way of thinking about zero deforestation and to be expanded to other commodities, not just timber. Despite this, little success has been achieved so far: there are only few businesses that have made commitments and even fewer that actually implement and report on those commitments (NYFD, 2019). Discussion in the Netherlands is ongoing on the voluntary or obligatory nature of due diligence, in the context of the evaluation of the international Corporate Social Responsibility (CSR) agreements.

Limits to growth or zero gross deforestation discourse

The central claim of this discourse is that decoupling deforestation from economic growth and commodity production is not possible within the current system of global neoliberal capitalism. Unless zero gross deforestation is taken as a definition and the world's forests are conserved, the demand for commodity production for a growing world population will always drive deforestation. Taking a macro-scale, political economy perspective, it causally relates global economic growth with continuing (and increasing) global rates of deforestation. The more detailed problematic argues that price premiums, certification, FPIC and other mechanisms within existing market tools do not guarantee deforestation-free production, due to the continuous demand for commodities, leakage, whitewashing, and corruption – none of which cannot be fixed via technical means and market instruments. Even when intensification of the production of some commodities can temporary satisfy growing demands, at some point there will be a need for more cleared land, as many global scenario studies also indicate. Growing consumption and the need for economic growth to maintain the current economic system thus are direct drivers of deforestation and threaten the carrying capacity of the planet (Meadows et al. 1972; Steffen et al. 2011).

The limits to growth discourse argues for a variety of solutions. Rather than market solutions, it calls for a strong government and regulatory approaches to set boundaries to the expanding economy, to transformative change in consumption and production patterns (?) and to the behaviour of private individuals and companies. To curb global demand for commodities, it argues for changes in consumer consumption patterns, for example

by sourcing food locally or by choosing a vegetarian or vegan diet and lifestyle. It also argues against privileging traditional market players in giving out land right and licenses and in favour of protecting and strengthening the rights of IPLC. Indigenous and traditional communities are "guardians" of the forests and their traditional knowledge and agricultural practices as an example of how humans can co-exist with nature. Closer to urban environments, one discourse argues for "convivial conservation" (Büscher & Fletcher 2019), where alternative urban and spatial planning can allow more overlap between human land use and nature. This discourse embraces efforts for global burden sharing, and fair and equitable shares in global consumption. Calculating and reducing global footprint is an example of an awareness raising and activation approach within this discourse (Lucas and Wilting 2019), with solutions to limit footprints addressing both supply and demand side measures.

Proponents of this discourse include "conscience keeping" NGOs (Yamin, 2001), local movements, indigenous associations and part of the scientific community. Agroecological and peasant movements (Holt-Giménez & Altieri, 2013), climate activists, youth activists, and the slow food movement appear to come together in this discourse to challenge existing power and market structures.

Local livelihoods discourse

The central claim within this discourse is that the livelihoods of local farmer producers are central to addressing the issue of deforestation. The problematic it expresses is that conservation NGOs and global food and commodity markets represent global discourses that ignore and/or neglect the needs of local populations and farmers. With its roots in the peasant movement, this discourse points to neo-colonial conservation and claims that similar to the way that the establishment of protected areas in developing countries discriminated against local producers and affected their livelihoods in the past, zero deforestation requirements manifest as a new way of asserting international power on producers and depriving them of livelihoods without offering alternative or support for improvement (Risso & Lim, 2010; Hinkes, 2019). Historical injustices and the monopolisation of production systems by global markets, makes traditional practices unattractive and feeds dependence on agricultural or extractive industry, which asserts its power through diverse conditions and limitations. Insecure land rights and bureaucratic challenges linked to obtaining land titles incentivize more deforestation, profit maximization in a short period, unwillingness to invest in long term sustainable management and unfair competition. The discourse thus posits a causal link between structural relation of power over prices for primary resources and extraction and deforestation. In other words, neo-colonialism and globalisation limits the possibilities for local farmers and smallholders to produce and reach acceptable living incomes without deforesting lands. Solutions posed in this discourse include measures that improve livelihoods and living wages, including some VSS (such as Fairtrade): certification and price premiums, payments for ecosystem or environmental services, capacity and skills building training on individual and collective level such as cooperatives.

To counter pressures on smallholders to deforest their lands and/or to prevent land use change of their lands that results from global trade relations, the livelihoods discourse arguments for recognising land use practices in forested areas and government support for markets for local farmer and communities to provide local livelihoods. Land tenure is seen as an important condition for producing deforestation free commodities (Barbier & Burgess, 2001; Newton & Benzeev, 2018). PES schemes such as REDD+, legal protection of farmers, and agricultural extension services are proposed solutions to halt or reduce further deforestation in forest risk areas. As economically vulnerable actors, smallholders often carry the burden of zero deforestation requirements in terms of transaction costs and potential exclusion from markets (Mol & Oosterveer, 2015), mechanisms for equitable cost-benefit and responsibility sharing among value chain actors are seen as needed and sustainable and low-impact ecosystem use is promoted.

The livelihoods discourse is relatively weakly used at an international level and mostly expressed at a local level by farmers and communities, and development focused organisations. It is reflected in the discourses of many certification schemes with a livelihoods element (i.e. living incomes, focus on social-economic benefits and duties in certification). It is actively supported by states such as Indonesia and Brazil, at times in conjunction

with the neoliberal markets discourse. This discourse is however qualitatively different from the neoliberal discourse as it locates the solution of deforestation not with global markets but with local producers.

New colonialism discourse

The central tenet within this discourse is that zero deforestation requirements are an unfair limiting factor to the development of tropical countries (Chang, 2002). Zero deforestation moreover undermines the sovereignty of developing countries. The problematic posed in this discourse is that developed countries have already deforested the majority of their land surface in the past and are thus able to claim 'zero deforestation' for the commodities they produce on pasture and agricultural lands, whereas tropical, developing countries are still 'climbing the ladder' of development. Calls for zero deforestation are thus an undesirable and ill-intentioned interference in the sovereignty of developing countries to determine the use of their land. For example, labels such as "palm oil-free" used by some retailers in Europe is unfair, unlawful and spreads misinformation, as palm oil is the most versatile and land and water use efficient vegetable oil among other alternatives (Baron et al., 2017). This has led to significant push back and efforts to regain sovereignty, notably in the Indonesian and Malaysian palm oil chains, evidenced by the ISPO and MSPO national standards (Hospes 2014, Dermawan & Hospes 2018). A causal link thus exists between stage of development of a country and the level of deforestation, whereas still developing countries should be allowed to deforest their lands.

Within this new colonialism, commodity production is a development engine (Pye 2019). For example, during the economic crisis in Brazil, the agribusiness sector was the only one maintaining the positive balance and the agriculture frontier states of Mato Grosso, Para, etc. were the ones that supported the national economy (Miranda, 2018). Palm oil production in Indonesia and Malaysia is also essential for economic development, employment, and smallholder livelihoods. (Rival and Levang 2014, Pirard et al., 2015). Banning palm oil from global markets thus means "crop apartheid" and deprival of livelihoods (Reuters, 2018). Solutions proposed in this discourse are consumer behavioural change through information and awareness, regulations and, economic compensation. The logic behind this is that if tropical forests are seen are valuable for developed nations and they prefer them to be conserved they need to pay the lost opportunity cost – for example through development aid, technology transfer, payments for ecosystem services and/or REDD+. For example, palm oil plantations are important carbon sinks (MPOC 2018), and rural environmental reserves within private properties in Brazil provide important ecosystem services that need to be compensated through the above-mentioned mechanisms.

The new colonialism discourse is used by countries such as Brazil, Indonesia, and India, and by actors such as palm oil producers and global meat producers. While adopting a similar anti-colonial theme as the limits to growth discourse, the new colonialism discourse is directed towards the opposite economic goal of growth and accordingly is supported by actors from the other side of the political spectrum.

How discourses influence and shape theories of change

The causal relations that are established and/or emphasised in each discourse show a strong connection to sets of preferred interventions. For a theory of change (see Annex 2 for explanation), this means that the support for a certain discourse by certain actors can strongly steer preferences for ZD interventions, shown in *Table 1*. Regulatory as well as landscape and jurisdictional approaches are clearly favoured by a legality and due diligence discourse, as well as by the limits to growth discourse. While these discourses share very different objectives (sustainable growth vs de-growth), they favour similar types of interventions. Voluntary sustainability standards, corporate pledges, and public-private partnerships fit better with the neoliberal market discourse, but voluntary standards also have an appeal with the livelihoods discourse when certification supports local communities and smallholders. Due diligence mechanisms are not explicitly mentioned in most discourses except as a solution in the legality discourse. But due diligence mechanisms do address multiple types of causalities expressed in those discourses, including market failure, the relationship between land tenure and sustainable land use, and how global markets effect the land use options of smallholders. They may therefore garner broad support rapidly, even if they are currently not at the forefront of most discussed ZD interventions.

Table 1 Overview of discourses, causalities, solutions, and theories of change

Discourse	*Cause of deforestation*	*Proposed Solutions*	*Theory of Change*
Neoliberal markets	Failure to mitigate unintended side-effects of modernisation (externalities), market failure to account for deforestation	Payment for Ecosystem Services (to companies); Voluntary standards, Carbon credits, true prices, Voluntary market-based value chain governance; technological innovations	Voluntary market interventions lead to less pressure on protected areas and on maintaining forest cover on and off farm. This leads to zero deforestation on the farm scale
Legality and responsibility	Negligence and lack of intent to account for deforestation as aside-effect commodity production	Combination of legal frameworks, landscape approaches, certification and increased traceability and monitoring	Regulatory interventions and private sector taking more responsibility (a risk based approach) can prevent deforestation in a chain and lead to zero deforestation. Due diligence in supply chains, capacity building for good governance.
Limits to growth	Economic growth cannot be decoupled from commodity production, so consumption drives deforestation.	De-growth and limiting consumption, together with strong regulatory approaches that protect forest and respect planetary boundaries and support land rights of indigenous populations	Regulatory interventions and limiting of global trade can prevent deforestation on the global scale. Sustainable use and rethinking welfare and "living with nature" also contribute to human wellbeing
Local livelihoods	Global market practices, volatile prices and insecurity of land tenure drive smallholders to deforestation	Price premiums, Payment for Ecosystem Services (to smallholders), subsidies for …., sustainable use and security of land tenure and land rights	Supportive regulatory interventions and private support for sustainable use practices and a sufficient living income will prevent deforestation at the farm level and lead to increased farmer incomes
New colonialism	The attention for deforestation as a result of commodity production is misguided and constitutes an attempt to limit development in the global South	Payment for Ecosystem Services (to states), recognition of regulatory approaches and voluntary standards for sustainable development of economies in place	Regulatory approaches and Voluntary standards for responsible development may be supplemented by financial support of developed nations. This will lead to sustainable use at the landscape scale.

As discourses place attention on specific levels and units of intervention, depending on causality, the emphasis within a ToC on outputs in terms of protected areas and maintaining of original vegetation and tree cover is especially prominent in the legality (i.e. no deforestation of protected areas) and limits to growth discourses. These discourses moreover favour impacts in terms of net zero deforestation on both the farm and the landscape level. Both neoliberal and livelihoods discourses instead tend to emphasize outputs on the agricultural lands, including sustainable intensification, on-farm tree cover, and other sustainable use practices. These are associated with both impact of avoided or net zero deforestation on the farm level and reforestation elsewhere, usually on the landscape level. The new colonialism discourse illustrates that ToC are not self-evident and that ZD-VC commitments may also be rejected to favour business-as-usual scenarios, as a counter-reaction on a discourse that sets limits to growth that limits the prospects of developing economies. Moreover, certain discourses are likely to support ToC that are more transformative of the economic system than others. For example, while the neoliberal and livelihood discourses support similar types of interventions and impacts, the livelihood discourses makes more transformative demands on the global markets than the neoliberal discourse does. In this sense, it is good to explore how public discourse so not only steer the direction and impacts of interventions, but also their scale and intensity.

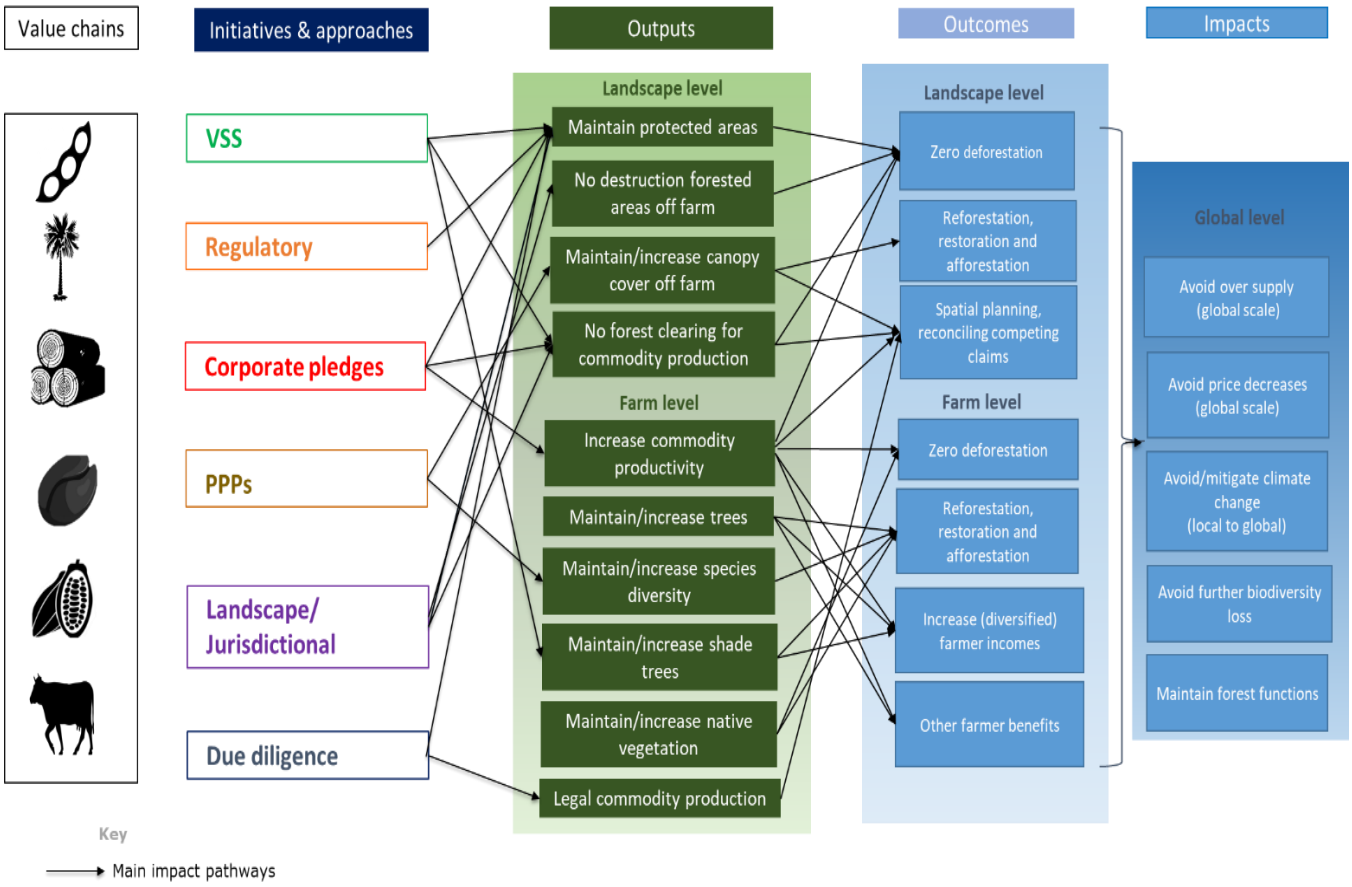
The theories of change of six commodity zero deforestation commitments

This section replies to question three by focusing on the **theories of change in ZD-VC commitments** for the six commodities strongly associated with deforestation. The aim of identifying the theories of change (i.e. the logic models of thinking and intervention philosophies – explained and defined in Annex 2) in interventions and approaches to counter deforestation is to help understand the pathways by which they aim to be effective. First the theories of change were identified for different approaches (certification, corporate pledges, joint public-private agreements, landscape/jurisdictional approaches, due diligence mechanisms) in each commodity value chain. These were then aggregated into a theory of change for each commodity value chain – shown in Annex 4 in Figure 14 to

Figure 19, and an summarised theory of change for all commodities in Figure 6.

The overall theory of change for commodity value chains approaches in Figure 6 shows that multiple, parallel approaches are used in deforestation-risk value chains, with often deliberate associations between different interventions. For example VSS certification plus corporate pledges plus PPPs are common in coffee, cocoa and palm oil chains, reflecting the neoliberal market discourse. VSS, pledges and landscape approaches all commonly use several different pathways to attain impact. The regulatory approach is less prominent, and is mostly seen in the timber, soy and cattle chains. It is associated with issues of legality, in terms of land use conversion, the legality of commodity trade, and is context specific given the legal systems governing commodity trade and land use in origin countries and consumer markets. This legal approach flows from the legality and new colonialism discourse as it acknowledges the sovereignty of countries to determine the rules of allowed and illegal deforestation on their own territory. There are no impact logics that correspond to the limits to growth discourse i.e. changing behavioural consumption patterns. Increasing agriculture productivity (i.e. closing yield gaps) and sustainable intensification are part of the discourse interventions, recognizing the claim for development in the new colonialism discourse. The outputs focus mainly at farm level, whereas potential impacts range from farm, to landscape and global level.

Figure 6 General summary theory of change for ZD approaches in forest-risk commodity value chains



Some reporting of outputs has been stimulated by due diligence reputational risk-based approach. This has been led by civil society "name and shame" actions (part of legality and neoliberal market discourses) and is mirrored in the focus on livelihood outputs in terms of improved local benefits? / productivity (livelihoods discourses) and reducing the need to deforest by productivity increases. Where increased efficiency and increased productivity (i.e. higher yields on the same land space) is assumed to lead to less deforestation, reflecting the land-sparing and sharing discourse. A divergent potential impact is that improved productivity, and higher prices and premiums due to for example certification premiums or payments for environmental services, may increase the motivation of farmers to produce specific commodities and lead to increased production area (Abman and Carney 2020, Angelsen 2010, Angelsen and Kaimowitz 2001, Shively and Pagiola

2004, Ehui and Hertel 1989, Tomich et al. 2001). Whether the expansion is onto forested land, is often not made explicit in the assumptions. Most outputs concern interventions at farm level, productivity approaches (landscaping/sharing discourse) and monitoring deforestation. There are recent attempts to work at landscape level, but this is proving time-consuming to develop and implement and reports on outcomes and impacts are very scarce.

Reforestation, restoration and afforestation[7] interventions are not common within the different approaches. Even when they are used (for example in Cocoa & Forests Initiative in West Africa) they are hardly measured at farm scale, and also not at landscape scale. Although huge advances have been made by trading companies in collecting spatial data and mapping production at producer farm level, on-farm restoration and especially off-farm reforestation, restoration and afforestation measures were little reported upon outcomes. This is also despite rapidly evolving tools, maps and databases that make this both possible and enable historical comparisons. Also little included in the ToCs are tools to prevent deforestation, which provide localised vulnerability/risk assessment and early warning systems for commodities in vulnerable forested areas (e.g. palm oil in Indonesia).

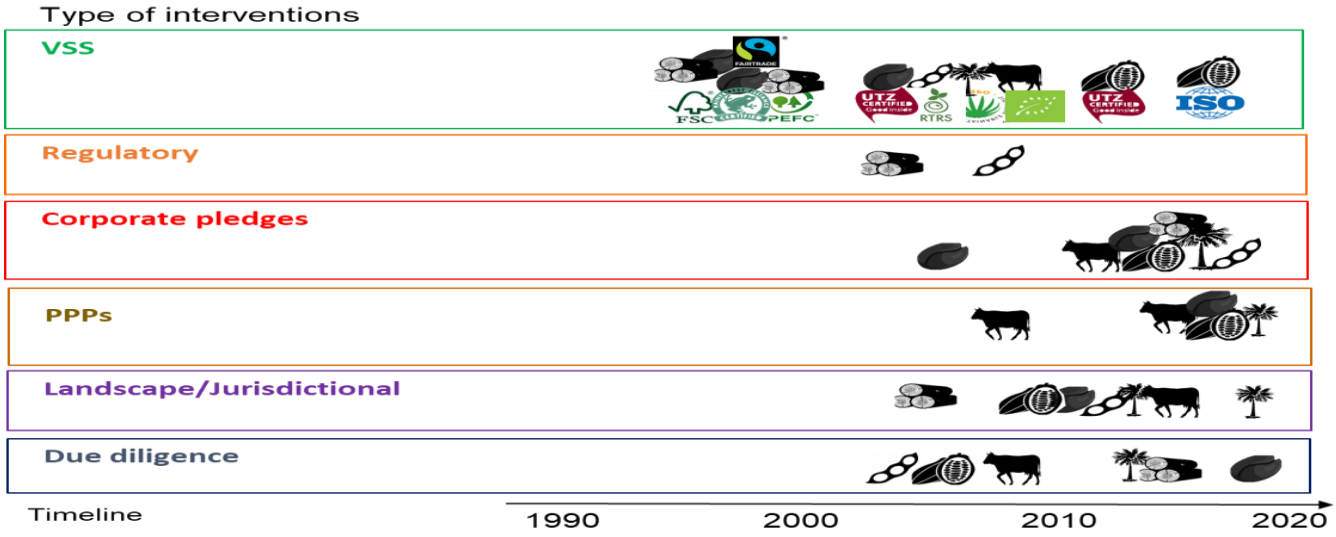
Many outcomes and impacts foreseen in all the approaches, are not reported on. Notably the outcomes and impacts of corporate pledges are sketchy with huge variations apparent between the disclosure and transparency by companies who have public consumers (as opposed to Business-to Business companies) seeking to minimise risks. Exceptions include cocoa and oil palm large commodity traders and manufacturers. Due diligence mechanisms, particularly third-party investigations and transparency initiatives, can be seen as interventions rather than outcomes and are common ways to disclose information on companies, their supply chain actors, and interventions (or lack of) and pressure companies and other value chain actors into "voluntary" disclosure about these. Few due diligence mechanisms however make explicit the impact logic of how deforestation will subsequently be reduced following third-party investigations, traceability mechanisms and voluntary disclosure initiatives.

[7] See Annex 1 for definitions.

Six zero-deforestation value chain approaches currently used

This section responds to question four by presenting the **six main approaches used to address zero deforestation caused by commodity value chains**. These approaches were identified by evaluating the main intervention mechanisms, outputs and (groups of) actors involved, and are implemented in different locations in the value chain and landscape nexus (c.f. Figure 3). Each approach is illustrated with examples from the different commodity chains. The timeline of when the majority of interventions have been implemented is shown in Figure 7, illustrating not only that most approaches emerged in the last decade starting tentatively with different commodities adopting different approaches, but also that voluntary sustainability standards have had the longest history since taking off in the mid-1990s and have since been adopted in all the commodity value chains with a proliferation of different standards used in most chains.

Figure 7 Timeline of approaches used in the six commodity value chains



Regulatory approaches

Regulatory approaches include state regulations and government policies (both a demand and supply side) governing commodity value chains and seeking to govern the landscapes which the commodities originate from, as well as the value chains. The focus and location of authority and legitimacy is with the state, who is the main actor. Regulatory approaches apply legal mechanisms on land use and commodity trade to prevent and/or limit deforestation. Regulatory approaches are powerful in demarcating lands – for example as protected area - but also in guiding management and production practices of commodities, ranging from cattle to timber. They include legal instruments such as moratoria on deforestation in specific sourcing areas and set quality standards for commodity production that include but are not limited to deforestation, such as establishing norms for legal traceability of a commodity to a sourcing location.

In Brazil, the forest law is the most important approach to stop cattle-driven deforestation. It forbids more than a deforestation beyond 20% of private land area in the Amazon region. in 2009, the Federal Public Prosecution Service (*Ministério Público Federal*, MPF) of the state of Pará and the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA) sued ranchers and slaughterhouses that deforested illegally a higher share of their lands and threatened to sue big retailers and supermarket chains that bought from them. The slaughterhouses signed Terms of Adjustment of Conduct (TAC) agreements with the MPF in July 2009 committing to avoid purchases from properties with illegal deforestation (Gibbs et al., 2016; Barreto et al., 2017). MPF and IBAMA effectively force market actors to sign an agreement to develop traceability systems and report regularly. In consumer markets, establishing legal and regulatory measures for beef imports is being discussed in Europe as a follow-up to the EC communication "Stepping up EU Action to Protect and Restore the World's Forests" (European Commission 2019), including the feasibility and effectiveness of creating a FLEGT like system for other forest risk commodities in addition to timber: the current focus is on palm oil.

For timber, the lack of information on forest management and commodity flows is an obstacle for sustainable production, and one of the drivers of corruption, conflicts and illegal activities (EU FLEGT & REDD facilities, 2017). The FLEGT action plan was set up in 2003 to combat illegal logging "by strengthening sustainable and legal forest management, improving governance and promoting trade in legally produced timber" (EU FLEGT, 2019). The FLEGT Action Plan has two main elements: the EU Timber Regulation (EUTR) and Voluntary Partnership Agreements (VPAs), which are bilateral trade treaties between the EU importing and the timber-exporting countries. Through the action plan, timber producing and consuming countries can engage in VPAs with the EU. Through the VPAS, the countries commit to forestry policies and actions that are aimed at reducing the consumption and trade of illegally harvested timber. In return, these countries get access to the EU market, developmental aid, and capacity building. Ultimately, forest governance should be improved and the supply and demand for timber from responsibly managed forests will increase. However, out of the total EU imports of natural tropical timber, only 11% is FLEGT licenced but 35% can be marketed as 'FLEGT-proof', and 28% of imports are certified (FSC and PEFC) which also meet legality criteria (IDH, 2019). This illustrates that although a shift towards procuring sustainable tropical timber is visible, there remains much room for improvement.

The Dutch Timber Procurement Assessment System (TPAS) aims to ensure that globally procured timber is sustainably sourced, and if that is not possible, that is at least legally sourced. Legality is thus the main criterion by which to stop deforestation, even when legal deforestation is of course possible. TPAS includes transparent and clear Timber Procurement Criteria for the Chain of Custody (CoC) and for Sustainable Forest Management, and a framework which highlights requirements and procedures to verify the source of the timber (Benthem & Tiemensma, 2011; TPAC, 2010). The Netherlands follows two main legality verification systems: the Timber Legality and Traceability Verification (TLTV) and timber with FLEGT licenses.

Voluntary sustainability standards

Voluntary Sustainability Standards (VSS) are broadly defined as "standards to which producers voluntarily adhere, requiring them to improve their production practices across a variety of sustainability indicators. In return, producers become certified – helping them gain access to niche markets and higher prices for their products" (TRANS SUSTAIN, 2018) where monitoring of these standards is done by third-party certification. VSS have a programmatic nature, and consist of different interlocking mechanisms of which the most important are standards (codes of conduct), internal management system requirements to allow for group certification, traceability requirements and systems, independent verification, and consumer facing labels. In some VSS, producers receive a price premium for their commodity. Retailers, commodity product manufacturers, traders and processors have all adopted VSS, which is the main force driving the adoption by producers (Ingram et al. 2018). The focus and location of authority is with private sector companies (the organisations being certified) who are key actors. The legitimacy of VSS certification standards is provided by the audit and compliance verification enterprises and from NGOs supporting standards and governments that accept these VSS as the basis for commodity procurement. This broad acceptance also leads to a certain level of consumer trust and support. VSS have grown over the last twenty five years as a tool for private sector to address various social, economic and environmental challenges within global commodity chains. VSSs have been developed and owned by the private sector, governments, NGOs and/or as multi-stakeholder initiatives, often as a response to pressure from consumer groups (FAO, 2017). VSS are used in all stages of commodity chains.

VSS often have a explicitly stated theory of change (ToC), where the grouping and training of farmers coupled with certification is expected to improve farmer knowledge and implement more sustainable farming practices, which will lead to field-level outcomes that can be related to zero-deforestation pathways/mechanisms (e.g. biodiversity and natural resource conservation, farmer well-being, and increased farm productivity and profitability). When these outcomes take place over a large number of farms, and include support from others stakeholders, they play a role in achieving the programme's intended broader impact (e.g. sustainable and resilient rural landscapes). In addition to field-based activities, the TOCs often include other activities concerning other stakeholders and consumers, as well as providing a framework for the monitoring and evaluation processes (Newsom & Milder, 2018).

There are many different certification schemes each with their own strategies that have been adopted globally with sector-wide schemes and labels and company-based labels (Ruben & Hoebink, 2015: 28). For example, deforestation and degradation of protected areas and/or high conservation value (HCV) are unacceptable in most VSS except for the organic standard. The protection of biodiversity is interpreted differently, as the protection of native animals from hunting, in water protection zones and in set aside natural forest areas. Agroforestry practices and the use of shade trees are included in some VSS for cocoa and coffee.

In coffee, *organic* (IFOAM) has no requirement concerning the destruction of primary forest, protected areas or HCVs. The transition to fully organic input sources is a binding criterion. "Use of all chemical pesticides or plant protection products that are not specifically authorized under the respective (national or private) legislation is prohibited (critical)". *FLO (Fairtrade)* "prohibits negative impacts on protected areas and HCV areas from the beginning of the certification period," refers to agroforestry but not a requirement. The *Rainforest Alliance (2017) standard*: "Forbids the destruction of HCV from 2005 and the conversion of other forests from 2014 onward." "With the newest 2017 revision, the shade requirement has moved to being evaluated after 6 years at the earliest; moved to a less stringent category (only 50% of level 'A' criteria are required for continued certification, rather than the 80% of the old standard); no longer includes the specification of two or more tree strata; measures foliage cover when it is most dense (as opposed to requiring 40% cover 'at all times'); and allows for the substitution of shade canopy if 15% of the total farm or farm group area is covered by native vegetation" (Grabs & Zurich, 2019). Company-based labels include Certifica Minas, Starbucks *C.A.F.E. Practices* which prohibits the conversion of all-natural forest from 2004 onward (zero tolerance). This includes a definition of adequate shade cover (but it is not a critical requirement for compliance). *Nespresso AAA* "focuses on HCV areas and prohibits cutting forest to prepare land from 2005 onward." This includes a definition of adequate shade cover, but this is not a critical requirement. The *4C* program refers to primary forest and protected areas, uses 2006 as its cut-off date. Refers to agroforestry but not a requirement. *UTZ Certified* "limits itself to primary forest, cut-off date is 2008." 'Adequate' amount of shade trees planted by year 3 of certification is needed, but producers can decide what the adequate number should be. The *Smithsonian Bird Friendly Coffee* standard is the only mainstream private sustainability standard that ensures coffee was produced under shade cover. The label "has the most stringent criteria regarding multi-strata, native and diverse forest cover. All farms have to be certified organic, as well as undergo additional certification to showcase that their production methods are in line with agroforestry principles and ensure the protection of bird habitats and tropical ecosystems on an ongoing basis. Bird Friendly certified farms are likely to show high levels of environmental conservation contributions as well as climate change resilience" (Grabs & Zurich, 2019: 15). Coffee buyers have increasingly started using VSS to demonstrate their corporate social responsibility. In 2008, 7% of the global coffee exports complied with VSS, this number increased to 23% in 2015, "while the considerable oversupply of certified coffee meant that an estimated 40-53% of coffee produced (depending on the amount of double and triple certification) adhered to one of these schemes (Dietz et al., 2018: 74). However, there are multiple coffee-related VSS that exist in parallel and all strive towards (environmental, social, and/ or economic) sustainability although there are significant differences in their individual regulations. This leads to confusion of what each label represents and what their impacts are on the ground (TRANS SUSTAIN, 2018.). In response to this ambiguity, TRANS SUSTAIN developed the Voluntary Coffee Standards Index (VOCSI) to assess the strengths and weaknesses of the different VSS's within the coffee sector. They conclude that "multi-stakeholder VSS developed with NGO participation, such as UTZ, Rainforest Alliance, and Fairtrade USA, consistently out-rank industry-led VSS" (TRANS SUSTAIN, 2018).

Three VSS (*UTZ-Rainforest Alliance* with the highest coverage, followed by *Fairtrade* and *Organic*) have been adopted by cocoa traders, chocolate manufacturing and retail companies from 1987 onwards. Given the aggregated nature of the cocoa value chain, whilst the majority of trader-grinder-exporters and the six multinational manufacturer-processors who dominate the chain can be seen to have adopted certification, less than 50% of global production is certified (shown in Table 2).

Table 2 Global cocoa certification rates

Certification	Thousand tons certified [1]	% global production [2] 4651 thousand tons 2017/2018
UTZ	1449 (2017)	31%
Rainforest Alliance	458(2017)	10%
Fairtrade	291 (2016)	6%
Organic		
Total		47%

Sources: Voice Network 2018, ICCO 2018

Rainforest Alliance complies with the Sustainable Agriculture Network (SAN) 2017 standard which requires that "All existing natural ecosystems, both aquatic and terrestrial, must be identified, protected and restored through a conservation program. From the date of application for certification onwards, the farm must not destroy any natural ecosystem. No HCV's destroyed after November 1, 2005, and for natural ecosystems destroyed by farm activities prior, farm must implement analysis and mitigations". Also that "farmers protect and restore natural ecosystems, maintain adequate shade cover, tree species diversity, and connectivity in crop areas (2.1-2.9)'', and that "No destroyed forests, PAs or other natural terrestrial ecosystems subsequent to 2014 or last 5 years (5.1)". *UTZ* Chain of Custody Certification (2014) states in that "no deforestation or degradation of primary forest since 2008 and deforestation of secondary forest is allowed only with proper permits and titles. (ID.113), No production/ processing in/ within 2 km of protected areas unless allowed (ID.114)" and it "promotes ecological diversity by protecting & enhancing on-farm &/or neighbouring habitats and ecosystems (ID.117)". The UTZ Core Code of Conduct promotes soil fertility, ecological diversity by protecting habitats and ecosystems and addressing climate change risks, through cocoa agroforestry i.e. planting at least 12 shade trees per hectare. UTZ merged with Rainforest Alliance in 2017, and data on the combined standard is not yet available. *Fairtrade International* and Fair Trade USA share common requirements for small producer organizations that "members must avoid negative impacts on protected areas and in areas with high conservation value within or outside the farm or production areas from the date of application for certification" and must report on activities to protect and enhance biodiversity (Fair Trade International Standard for Small Producer Organizations 3.2.33 and FairTrade USA Guidelines ES-BD 1). In 2018 Fairtrade USA developed a PUR project with companies to regenerate ecosystems, via community-driven agroforestry projects within Fair Trade supply chains in Ivory Coast. *Organic certification* varies from country to country. The International Federation of Organic Agriculture Movements (IFOAM) is the global umbrella for organic farming, providing a reference and benchmark for organic certification standards globally. It says "Clearing or destruction of High Conservation Value Areas is prohibited. Farming areas installed on land that has been obtained by clearing of High Conservation Value Areas in the preceding 5 years shall not be considered compliant with this standard." (2.1.2 IFOAM Norms).

The *Roundtable for Sustainable Palm Oil (RSPO)* Principles and Criteria for Sustainable Palm Oil Production was developed as a result of multi-stakeholder discussions between environmental NGOs, palm oil processors and traders, food producers, retailers, financial institutions in 2002 (RSPO 2002), as global guidelines for producing palm oil sustainably. RSPO aims to ensure that fundamental rights of previous land owners, local communities, plantation workers, small farmers and their families are respected and fully taken into account, that no new primary forests or high conservation value areas are cleared for palm oil production since November 2005, and that mills and plantation owners minimize their environmental impact. This developed into the RSPO certification system in 2007 which is related to plantation establishment and management and subsequent chain transparency, aims to ensure that palm oil is produced sustainably and ensure the integrity of the trade in sustainable palm oil. RSPO recognizes four supply chain certificates with different levels of traceability (c.q. identity guarantees) which differ in their potential to influence deforestation (certificate trading does not directly induce real change on practices on the ground). The 2013 RSPO global standard recognised different High Conservation Value areas (HCV's) defined according to their levels of species diversity; landscape-level ecosystems and mosaics; rare, threatened, or endangered ecosystems; provisions of ecosystem services in critical situations; community needs and cultural values. The principles and criteria prohibited clearing of primary, or virgin, forest for palm plantations, but allowed cutting secondary forests and peat forests with a peat layer less than 3 meters deep. Following lobbying by NGOs, negative press coverage and much discussion among members, in[VI1] November 2018 RSPO members agreed on a total ban on deforestation so that future

land clearing doesn't cause deforestation or damage areas rich in carbon, including peatlands and high carbon stock (HCS) forests, and not allowing planting oil palm in peat of any depth. This was enshrined in RSPO's Principles and Criteria (RSPO 2018), which member companies must comply with for their product to be certified "sustainable." RSPO has a cut-off date of November 2007, after which new palm oil plantings should not replace primary forest or HCV areas. Areas cleared after this are unable to become certified unless an RSPO-approved compensation plan is developed. Major global traders and processors and manufacturers, such as Unilever have obtained RSPO certification, most opting for Segregated and Mass Balance certification. Around 20% of global palm oil production was certified by RSPO in 2017 (Carlson et al 2017). Indonesia has become the world's leading producer of RSPO-certified sustainable palm oil (RSPO 2019).

The *Round Table for Sustainable Soy (RTRS)* is used in the Amsterdam Declaration Partnership on soy as the basis for deforestation-free value-chains. Along with *Proterra* these two standards cover an estimated 2% of globally traded soy. Like for beef, the uptake of certification in soy production and trade has been low.

Forest certification is a commonly used tool by companies and governments to determine responsible forest management, whereas chain-of-custody certification is used to locate the origin of the wood. Certification is a market-driven mechanism and within forestry and timber production, the aim is to create incentives for sustainable forest management by creating benefits for timber producers. Hence, producers are required to comply with certain production criteria if they want to receive the certification. Certification in producing countries can be a method for forest and biodiversity conservation whilst providing benefits for local communities, the workforce and companies (IDH, 2019). Forest certification schemes for natural forests have not been designed to monitor or guarantee zero deforestation, but to provide sustainable forest management of specified status and quality, and concerns HCVS and HCS. Thus they can be seen to contribute to meet targets that are linked to deforestation-free supply chains but do not guarantee zero deforestation (Lambin et al., 2018). Especially relevant for wood produced on (mon-culture) plantations. Special criterion for the establishment (with cut-off date). Although Europe takes a significant share of procuring sustainable timber and demanding certified wood, the EU is currently not on track for the goal of certifying 50% of consumed tropical timber by 2020 with 28.5% of the EU market share of primary natural tropical timber products (roundwood, sawn wood, plywood and veneer) is verified sustainable in 2018 (IDH, 2019). Legality is also taken into account (see next sub-section), for example through FLEGT licensing. The certification systems the Dutch government accepts for its timber procurement have to meet the *Dutch Timber Procurement Criteria* include *Forest Stewardship Council (FSC), Programme for the Endorsement of Certification Systems* (*PEFC), MTCS (PEFC Malays*ia) and *Keurhout* (only Chain of Custody) (TPAC, 2019). In addition, certification systems endorsed by the PEFC (e.g. The Canadian Standards Association (CSA) and the North American Sustainable Forestry Initiative (SFI)) are automatically accepted as they meet the Dutch Timber Procurement criteria (Benthem & Tiemensma, 2011). Wood originating from converted areas is not accepted (with the exception of justified exceptional circumstances). Acceptable wood comes from "plantations established before 1997, and if at least 5% of the plantation is allowed to re-grow as natural forests", preferably consisting of native species (TPAC, 2019). Currently, certification via FSC and PEFC are the most used ways to guarantee sustainable forest management and legality (IDH, 2019). *Forest Stewardship Council (FSC)* is an independent, non-governmental membership organisation that aims to bring together social, environmental and economic interests. This is done through its certification and standard setting for forest management, and by actively supporting the Sustainable Development Goals (SDGs). FSC works towards Target 15.2 ("by 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation[8] globally") and other targets concerning conservation and restoration of forest ecosystems (15.1), afforestation degraded lands and soils (15.3) etc. (FSC, 2019).

[8] See Annex 1 for definitions.

Landscape and jurisdictional approaches

Landscapes and jurisdictions are defined by spatial boundaries. A jurisdictional initiative takes place at a scale that matches the administrative boundaries of local, regional, sub-national or national governments. Such approaches have been civil society, government and private sector led and focus on resource rich regions adopting sustainable production landscape approaches (TFA 2019, WWF 2016). The focus and location of authority and legitimacy may be shared between these different actors or be dominated by a leading actor. Landscape approaches are regularly used in conservation, natural resource management and REDD+ projects. They are characterised by inter- and multidisciplinary approaches, a defined place with stakeholder and cross-sector engagement, and a focus on reconciling multi-functional and competing land use objectives at different scales (WWF, 2016, Arts et al 2018). They offer practical frameworks to reconcile competing social, economic, and environmental objectives, through integration at different levels (Wolosin, 2016). Many landscape approaches have specific ToC (e.g. IDH). Landscape initiatives thus focus on reducing deforestation at a landscape level by combining private sector action along agricultural supply chains with public sector planning and efforts to integrate smallholders (Kroeger, Koenig, Thomson, & Streck, 2017). The jurisdictional approach is often synonymous with a landscape approach but cover a larger area, with jurisdictions used to scale up impact across a larger geographic area beyond single companies or community development projects while involving multiple sectors and stakeholders in an integrated fashion (Wolosin, 2016). These approaches tend to cover different stages of one commodity chain, with producers being most widely represented numerically.

In the top producing coffee regions, 20% of coffee production is in jurisdictional approaches (which means 80% does not have active jurisdictional approaches) (TFA, 2019) and by volume of production, 15% is in areas with jurisdictional approaches. Hence, it is important to enhance private sector engagement in those regions and increase their participation and engage relevant civil society parties to develop jurisdictional approaches in regions that lack active jurisdictional approaches (TFA, 2019). An example of a jurisdictional approach in coffee producing regions includes the launch of the National Sustainability Curriculum (NSC) in coffee producing regions including Indonesia, Brazil, Uganda, Vietnam and Tanzania (IDH, 2015). Developed through a multi-stakeholder approach with governments, private sector players (e.g. roasters, farmer associations), and sector stakeholders (e.g. experts, research institutions, civil society organisations) - it aimed to address "real sustainability issues in the national context of coffee production, while also taking into account national legislation and relevant requirements of (inter)nationally renowned standards and schemes" (SCP, n.d.). NSC provides training to farmers and facilitates possible certification and verification processes for different standards and schemes. Apart from addressing good agricultural practices, broader sustainability topics include climate adaptation, establishing farmer groups and family business management practices. Other examples include the Jambi Sustainable Landscape Management Project (J-SLMP) in Indonesia and the Nespresso AAA Sustainable Quality Program in Ethiopia (IFSL, 2019).

The IDH Landscape and Verified Sourcing Areas (VSA) programmes work with four stakeholder groups – companies, governments, smallholder farmers and impact investors/ finance sector – in tropical regions producing commodities such as coffee, soy, timber, palm oil, beef and tea. IDH and partners do this through a three-pronged approach – production, protection and inclusion –aiming for sustainable natural management, prevention of deforestation, improvement of the livelihoods of smallholders and communities, and ensuring supply security for the private sector. The landscape program is also a PPP approach which "aims to transform finance and business in such a way that they will sustain land-use practices in which the production of agro-commodities contributes to the protection of forests and the inclusion of smallholders and forest communities in the economy" (Ruben & Tholen, 2017: 66). Specific deforestation criteria for the three pilot landscapes in Brazil, Indonesia and Vietnam are not indicated on the IDH website.

Corporate pledges

Individual corporate initiatives and actions by associations or groups of companies are a form of corporate social responsibility and self-regulation, whereby a business pledges and then monitors and ensures active compliance with the spirit of the law, ethical standards, and national or international norms on CSR, and may engage in actions that appear to further a social or environmental good, beyond the interests of the firm and what is required by law. Therefore fits with neoliberal discourse. Corporate programmes and pledges have increasingly been used by traders-exporters, processors, and manufacturers since the mid-2000s, who have offered packages of interventions or services (such as organising farmers into groups, training, credit, and farm inputs (fertilisers, agrochemicals, seedlings, equipment etc) to farmers and their organisations, as a way to secure supplies of a commodity of specific quality, produced in specific, often traceable, environmental and social conditions (Ingram et al. 2018). The focus and location of authority and legitimacy is with the private sector, as the main actor. Most pledges are from companies in the buying, manufacturing and retailing stage of the value chain.

All the major cocoa traders and processors have corporate programs which emerged either from certification and alongside it, for example, Hershey's, Ferrero, Nestle and Mars have 100% certification commitments often framed as corporate sustainability programmes. Most have also made specific zero-deforestation commitments, and often rely on VSSs to realise this. The World Cocoa Foundation, a grouping of major companies along the cocoa value chain started the Cocoa & Forest Initiative initially as a private sector programme, which has since grown into the public-private partnership.

Many companies who trade palm oil have made zero-deforestation pledges of varying strength, making commitments related to no conversion of High Carbon Stock (HCS) forests as defined by the HCS Approach, no conversion of High Conservation Value (HCV) Areas as defined by the HCV Resource Network, no new conversion of any peatlands and the use of best management practices for existing operations on Peatlands (using for example RSPO's Manuals on Best Management Practices for Management and Rehabilitation of Natural Vegetation Associated with Oil Palm Cultivation on Peat) and developing land use policies.

However independent monitoring (ZSL 2019) suggests that of the world's 70 largest palm oil producers and traders with zero-deforestation pledges, many fall short of enforcing their commitments, and that these lacked scope and on-the-ground verification. Just over half (53%) had met deforestation and biodiversity commitments, with almost 48% committing to not planting of oil palm on peat, 22% had weak or unclear commitments didn't specify peat depths, 28% had no commitment to prohibiting development on peat at all, 48% had committed to the HCS Approach methodology, while 35% had no HCS commitments. Whilst some companies report to initiatives such as the CDP, others – such as Pepsico (see Annex 3) make such information available on their corporate website, voluntarily provide annual sustainability reports and have provided specific reports on deforestation since 2014.

As of March 2017, at least 760 public commitments were made by 447 producers, processors, traders, manufacturers and retailers to reduce deforestation from timber supply chains (Lambin et al., 2018: 109). The impact and measurable reduction of deforestation as a result of such commitments partially depends on the motivation of companies to act and report on their actions. Collective commitments to reduce or end deforestation include the Tropical Forest Alliance 2020 initiative (Lambin et al., 2018). Within the Consumer Goods Forum (CGF) pledge, 400 companies aimed towards zero net deforestation supply chains in 2020, which allows this voluntary commitment to (partially) be achieved through certification such as FSC and PEFC (Lambin et al., 2018). In the Netherlands, sector commitments have been made in voluntary agreements (in Dutch known as *covenants*), such as the 2018 food sector agreement (*Convenant Voedingsmiddelen*) signed by trade sector organisations, NGOs and Dutch Ministries on international corporate social responsibility including deforestation in food value chains and the Dutch timber sector association's (VVNH) policy plans "Clever with timber" (*Wijs met Hout*) 2010 – 2015 and 2016 to 2020.

Public-private partnerships

The term public-private partnerships (PPPs) includes platforms, networks, associations, partnerships and agreements between private sector and public sector, also often with research, and/or civil society (CSO) and/or non-governmental (NGO) organisations collaborating on a common goal of sustainability with a declared policy or programme and plan of action (Ingram et al 2018). The 'consensus based' approach, particularly in the form of a voluntary agreements with a facilitating role of the government, often leading to public-private and CSO partnerships - has been common approach in environmental policy making during the last two decades to improve the sustainability of international commodity value chains (Vermeulen and Seuring 2009). The focus and location of authority and legitimacy is balanced between the state and private sector, who are the main actors. Many of the PPPs include governments in producer and consumer countries, with large companies in trading, manufacturing and retailing stages of value chains.

In the cocoa value chain, three main PPPs have developed. The *Cocoa and Forests Initiative* was started in 2017 by the World Cocoa Foundation, the Sustainable Trade Initiative (IDH), the Prince of Wales, 34 companies in the cocoa sector and the governments of Ghana and Côte d'Ivôire and later Colombia, as a platform pledging a halt to deforestation, with individual country action plans that focus on forest protection and restoration, increasing cocoa production and sustainable agricultural intensification, farmers' livelihoods via payments for environmental services, and community engagement and social inclusion. It is coupled with (many already ongoing) land tenure reforms and strengthening existing protected areas. In 2019, action plans have been published, but there is no information on the impacts attained, for example the extent of illegal deforestation in hotspot areas and deforestation alerts actually issued. The *Amsterdam Declaration* is a public voluntary initiative, but is included here as it was inspired by private-sector efforts and Agenda 2030. The governments of the Netherlands, Denmark, France, Germany and the United Kingdom signed the Declaration in 2015 (AD, 2015) committing to ensure that all cocoa entering their countries by 2020 will be from sustainable sources. The declaration "strongly encourage the consequent application of internationally recognized labour, social and environmental standards and principles in global supply chains" and refers to the policy options (regulatory measures, voluntary measures, market based instruments, information and awareness raising, funding mechanisms, capacity building and technical assistance) identified in the EC Report on Consumption and Deforestation (European Union 2013). The 2010 *Dutch Letter of Intent for Sustainable Cocoa* (Ministerie van Landbouw Natuur en Voedlselkwaliteit 2010, Logatcheva and Ingram 2014) was developed by a group of companies, trade unions, NGOs and governmental bodies who signed a Declaration stating that by 2025 all chocolate sold in the Netherlands will be sustainable. The commitment was instrumental in bringing together multiple stakeholders, stimulating them to both adopt certification and examine other ways of making cocoa more sustainable. Since 2018 this has been in a process of renegotiation as the Declaration of Intent for Sustainable cocoa (DISCO), moving away from a focus on certification to one that also includes increasing productivity as a land sparing strategy, diversification and restoration - emulating similar multi-stakeholder PPP agreements made since 2012, such as the German Initiative on Sustainable Cocoa (GISCO), the Swiss Kakaoplattform Platform for Sustainable Cocoa and the Belgian Beyond Chocolate agreement.

PPPs have resulted in moratoria such as the Brazilian Soy Moratorium of 2006 (see below for details). However, given the weaker position of the EU private and public sectors in the beef sector, given the high volume sold on the Brazilian domestic market, the EU had little negotiating power to avoid spillage of soy production from the Brazilian Amazon to the cerrado. Leverage from EU however works for commodities like leather where the majority is imported to Italy and after processing, and exported Mammadova et al., 2020b).

Due diligence mechanisms

Due diligence mechanisms refer to individual and joint actions, investigations or the exercise of care by companies to avoid committing an offence. The offence maybe due to a legal obligation or a voluntary initiative. The underlying premise of the four different types of due diligence mechanisms identified are that potential or actually revealed illegalities present legal and/or corporate reputational risks, which can lead to consumer, shareholder or investor actions, affecting sales and markets, or legal actions against violators. Due diligence mechanisms often lead to implementation of other approaches, for example claiming legality and compliance with regulation, establishing a moratorium, industry coalitions and multi-stakeholder partnerships. The focus and location of authority and legitimacy in due diligence approaches is with the private sector, with actors such as NGOs, CSOs and consultancies investigating due diligence by companies.

Traceability mechanisms such as *Amazon Watch, Global Witness, Forests 500, Supply Change by Forests Trends, Tropical Forest Alliance 2020 (TFA 2020), CDP Disclosure Insight Action,* the *Accountability Framework,* the WWF led *Collaboration for Forests and Agriculture (CFA)* on beef and soy, and *SPOTT* have been a common route to assess negative environmental and social impacts, show legality along the value chain and demonstrate the exercise of due diligence. This has sometimes demonstrated by the adoption of VSS. For palm oil for example, the Indonesian ISPO and Malaysian MSPO government schemes aim to trace and demonstrate corporate and state producer compliance with legal standards and thus can be seen as types of due diligence to ensure the exercise of care to avoid committing an offence. Also in timber chains, voluntary FSC certification can help companies evidence traceability, demonstrate compliance and meet FLEGT and EUTR timber legality requirements. These commonly occur at the supply and consumer ends of commodity value chains.

Secondly, **third-party campaigns and investigations** (often by NGOs and CSOs, such as Mighty Earth in the cocoa sector) have sought to reveal the (lack of) due diligence at corporate, chain and sector scale (Ingram et al. 2018) disclosing practices based on field research (c.f. Hignonnet et al., 2019) which are published in reports, via the media and on interactive websites. The transformation of reputational risk to financial and legal risks is the key assumption for this influence pathway. Reports such as "Slaughtering the Amazon" (Greenpeace, 2009) and "Time to pay the bill" (*Hora di Conta*) (Smeraldi and May, 2009) led to significant market impact and boycotts in 2009 when major meat and leather producers were accused of driving deforestation. As the result, in 2009 the biggest four Brazilian slaughterhouses - JBS, Minerva, Marfrig and Bertin signed an agreement with Greenpeace, known as G4 Agreement or Zero Deforestation Cattle Agreement, to boycott illegal farms and eliminate legal and illegal deforestation from their supply chains. Greenpeace left the agreement in 2017 (Greenpeace, 2017). In 2017, Instituto do Meio Ambiente e Homem da Amazônia (IMAZON) published a wide-spread report demonstrating the illegality still existing in the meat industry (Barreto et al., 2017). Currently, AmazonWatch, the Articulation of Indigenous Peoples of Brazil (APIB), Forest500, Supply-Change and other initiatives focus on companies, their investors and supply chains. The APIB is calling for European and North American boycotts of Brazilian forest risk commodities (Brokeer, 2019). In the cocoa sector, the Cocoa Barometers (c.f. Voice Network 2012, 2018) and Mighty Earth campaigns (Higonnet et al., 2018) have stimulated companies to avoid risk and mitigate negative publicity. This has resulted in corporate pledges, engagement in VSS and PPPs, such as the Dutch Sustainable Trade Action Plan in 2010. Targeted campaigns directed at consumers and companies include the 1995 US State Department and ILO, news items by the BBC and CNN, campaigns regarding slave and child labour in the cocoa sector dating from the mid-1990s onwards, Oxfam's 'chocolate letter' campaign in 2009 and Behind the Brand campaign. In palm oil, campaigns, reports and websites (such as WRI and WWF) have disclosed planting on peat lands and illegal expansion and near-real time deforestation (c.f. Larson et al 2018). Third-party investigations on deforestation due to timber chain abound, often with a focus on illegal logging, such as Global Forest Watch and Obster in the Congo Basin.

A third type of due diligence mechanisms are **voluntary disclosure initiatives** of company performance – such as individual corporate reports and aggregated commodity or sector initiatives. Many of these are the result of Public Private Partnerships. Examples are the Tropical Forest Alliance 2020, CDP Forests Programme, Collaboration for Forests and Agriculture (CFA) and the Agreement on International Responsible Business

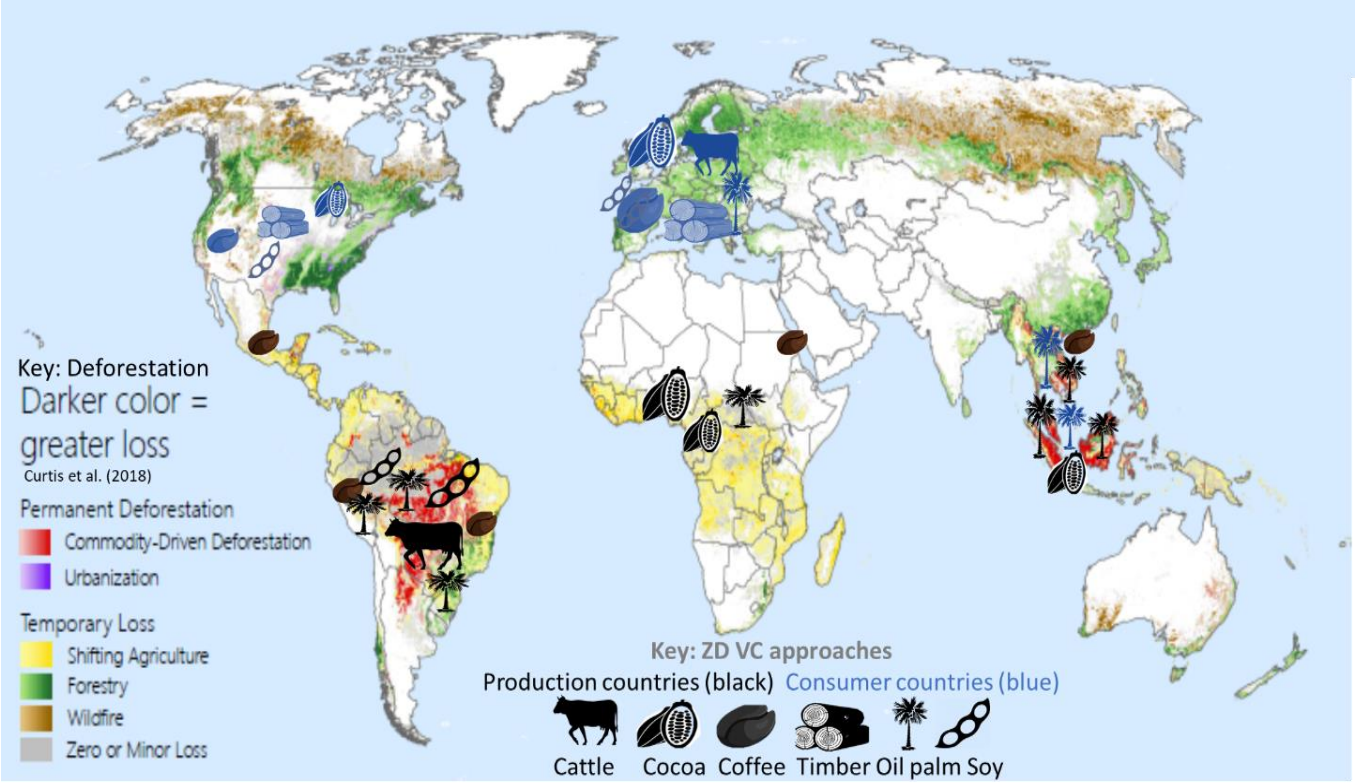
Conduct (IRBC) for Promoting Sustainable Forestry in the Netherlands. The latter was set up by the Dutch Ministry of Foreign Affairs and the Dutch timber sector with other parties in 2017. The resulting *IMVO Covenant* (a PPP) aims to increase the procurement of sustainable timber on the Dutch market by 2020. The parties aim to improve global sustainable forestry by creating criteria for IMVO certification and socio-economic and environmental impacts (*Convenant Bevorderen Duurzaam Bosbeheer* 2017). The IMVO does not currently tackle zero-deforestation in supply chains. Van Ojik and Diks (2019) suggest ZD criteria be added (as well as zero child labour and respect for human and animal rights), an independent auditor established and that sustainable timber is included in current and future trade agreements (e.g. the Mercosur Deal). The Banking Environment Initiative (BEI) by a group of international banks aims "to identify ways to collectively direct capital towards environmentally and socially sustainable economic development" (BEI, n.d.). One result of the collaboration between BEI and the Consumer Goods Forum (CGF) is the Soft Commodities Compact which seeks to transform soft commodity supply chains (in particular palm oil, timber products, soy and beef) to achieve zero net deforestation by 2020 through financing. BEI attempts to bring the financial industry together in order tackle the issue of deforestation.

Fourthly, **moratoriums** have been used to exercise care and avoid offences. In Brazil, the Soy Moratorium of 2006 was the first voluntary agreement on zero illegal and legal deforestation. It was signed by major soybean companies, public and civil society organizations not to trade soybean produced in deforested areas in the Brazilian Amazon biome. It appeared to be successful, however, despite the moratorium deforestation driven directly by soy continued in Amazon biome after 2006 (Junior & Lima, 2018), and was displaced from Amazon to the Cerrado (Fearnside, 2001; Walker *et al.*, 2009; Gibbs *et al.,* 2015; Godar *et al.*, 2015). Private-sector moratoria have been used for timber. The Joint Solutions Project (JSP) in Chile was the result of 10 environmental NGOs and the Chilean forestry corporations CMPC and Aurauco, committing the timber corporations not to clear any natural forests on their property (Heilmayr & Lambin, 2016; Lambin et al. 2018). This moratorium led to a successful reduction in natural forest conversion to plantations, although FSC certification in the same location achieved better environmental performance (Heilmayr & Lambin, 2016).

Geographic focus

Figure 8 and detailed in Annex 5, show that the main geographic focus of zero deforestation initiatives in the cattle, cocoa, coffee, timber, oil palm and soy value chains are in already-known, historically deforested hotspots. These deforested areas are shown in the figure in red as permanent deforestation or in yellow as a temporary loss such as West Africa (for cocoa, timber), the horn of Africa (coffee), Indonesia (cocoa, palm oil, timber) and Brazilian/Peruvian Amazon and Cerrado (cattle, soy, timber). The figure also shows that a value chain approach to ZD commodities is taken mainly by consumer countries (shown in blue per commodity) with high and increasing levels of forest cover working with producer origin countries (shown in black). Emerging hotspots of commodity driven deforestation (shown in red) on the edges of the Amazon basin and in Myanmar, Vietnam and part of Congo and East Africa do not currently have ZD-VC initiatives and some areas- such in Colombia - have only recently seen initiatives.

Figure 8 Main geographic focus of ZD initiatives in six commodity value chains



Scant evidence of positive outcomes for all approaches except VSS

This section responds to question five by first examining the **evidence on outcomes and impacts of current approaches to date.** To do this we look at the proven ToC-pathways, outputs outcomes and impacts on avoided deforestation, and reforestation, afforestation and restoration[3Error! Bookmark not defined.], which spatial and t emporal leakages and spillover have occurred, and if outcomes and impacts differ according to approach and the commodity. As there is little evidence in general, teasing out lessons from the cases and studies analysed should be seen as portraying only a limited part of the reality in the commodity chains.

Regulatory approaches

Regulations – in the form of protected areas- have been reported as working to reduce or avoid deforestation and degradation. For example, in 292 protected areas in the Brazilian Amazon, for any given level of deforestation pressure – including driven by soy and beef), strictly protected areas consistently avoided more deforestation than sustainable use areas (Nolte et al., 2013). Protecting indigenous lands were particularly effective at avoiding deforestation in locations with high deforestation pressure across two time periods featuring major shifts in the intensity of government enforcement. Between 2000 and 2005 strictly protected areas were more likely to be established in high-pressure locations than in sustainable use areas and indigenous lands. These findings confirm that all protection regimes helped to reduce deforestation in the Brazilian Amazon (Nolte et al., 2013). Although some reductions in deforestation can be attributed to price declines of agricultural commodities, regulatory government policies—including a drastic increase in enforcement activities, embargoes on soy and beef markets in selected municipalities, and the expansion and strengthening of protected area networks—all contributed significantly to the observed reductions (Kis-Katos & Silva 2010, Assunção et al 2012, Soares-Filhoet al 2010). Vuohelainen et al. (2102) also showed that protected areas in Peru had positive effectiveness in decreasing deforestation rates, monitoring and surveillance activities and good relations with surrounding communities were reported as possible factors in decreasing deforestation rates. In contrast to the Nolte et al. (2013) study in Brazil, native community areas had the lowest scores, with deforestation mainly driven by internal resource use and population growth. Weak local governance and immigration were identified as underlying factors decreasing the effectiveness of protection, whereas good relations with surrounding communities and monitoring activity increased effectiveness. The expansion of the Soy Moratorium of 2006 to the Cerrado biome (FAIRR, 2018) to end zero legal and illegal deforestation currently faces strong opposition by businesses (Sax, 2019).

However regulatory approaches do not always work well. Whilst protected areas in Ghana and Ivory Coast have higher levels of forest cover compared to areas outside reserves, in the period covered by the Cocoa & Forests Initiative from 2017 to 2019 they were not sufficiently enforced to avoid suffering from high levels of deforestation, degradation and encroachment with cocoa one of the main commodities grown. The lack of government enforcement and sanctions enabled illegal settlements and cocoa farms to be created in the protected areas (Higonnet 2019, Tropenbos International and Tropenbos Ghana 2019). In Ghana, deforestation - including in three forest reserves - in the period 2010 to 2019, when many PPPs, company pledges and VSS were implemented in area, also increased seven fold (Tropenbos International and Tropenbos Ghana 2019).

On average granting a concession for oil palm, timber, or logging in Indonesia increased site-level deforestation rates by 17–127%, 44–129%, or 3.1–11.1%, respectively, above what would have occurred otherwise. Busch et al. (2014) estimate that if Indonesia's moratorium had been in place from 2000 to 2010, then nationwide emissions from deforestation over that decade would have been 2.8 to 7.2% lower without leakage, or 2.5–6.4% lower with leakage. For Indonesia to have achieved its target of reducing emissions by 26%, the geographic scope of the moratorium would have had to expand beyond new concessions to also include existing concessions and address deforestation outside of concessions and protected areas (Busch et al. 2014).

Currently only for timber are there regulations (the European FLEGT Action Plan and the 2013 EUTR, and associated EU Voluntary Partnership Programme (VPA) with bilateral agreements between the EU and timber producer countries; the 2008 US Lacey Act amendment and 2012 Australian Illegal Logging Prohibition Act) seeking to regulate deforestation via legality and value chain traceability. These regulations allow access for legal timber, but don't guarantee it is deforestation free or sustainably logged. Regulations for deforestation-free markets could take a more proactive role in clarifying the standards for deforestation-free commodity production within their jurisdictions, alignment with deforestation-free standards and setting a clear standard for corporate ZD pledges to integrate with or align with legality approaches such as FLEGT, instead of trying to replace them (Pasiecznik & Savenije 2017, p16).

Voluntary sustainability standards

All VSS certification standards publish impact reports that reflect their ToCs. However, progress of specific deforestation aspects within certification standards are not uniform, varying between standard, country, scales, methods and indicators (Potts et al., 2014, ITC 2015). VSS focus on farm level rather than landscape level but have not made clear specific reforestation, restoration and afforestation actions at farm level. In general, VSS certification schemes have had mixed progress on preventing deforestation with some positive, neutral and negative examples (Dietz et al., 2018), with much of this evidence carrying a 'risk of bias' and being highly location and context specific, so that it is not generalizable to all certified commodities and production locations (Jopke and Schoenveld 2018). For example, certified coffee farms in the eastern Andes of Colombia increased tree cover significantly more than on non-certified farms (Lambin et al., 2018, Rueda et al 2014). Whilst FSC certification had no or minimal effect on deforestation generally in Mexico, Cameroon and Peru, it has reduced deforestation in certified forests in Chile and Indonesia (Lambin et al. (2018) p. 112). A positive relationship has been found between total national share of certified forests and long-term deforestation risks (Cashore and Auld 2012, Oorschot et al. 2014), pointing at the effect of established good forest governance as an enabling condition. When there already is a good national forest law in place (plus enforcement) it is easier to attain conformity with standards criteria and get certified. RSPO certified palm oil plantations have significantly reduced deforestation, but not fire or peatland clearance in Indonesia (Carlson et al 2017), with certification mostly adopted by older plantations that contained little remaining forest (Carlson et al 2017). Broader adoption by oil palm growers, especially in expansion, frontier areas is needed for certification to have a larger impact to reduce the total forest area lost to oil palm expansion. Whilst RSPO has adopted new standards that will prohibit its member companies from clearing any type of forest for palm plantations, welcomed by environmental activists, they note that enforcement of the RSPO standards has historically been lax. Loopholes in certification standards and enforcement mechanisms also present barriers to effective implementation (van der Ven et al. 2018).

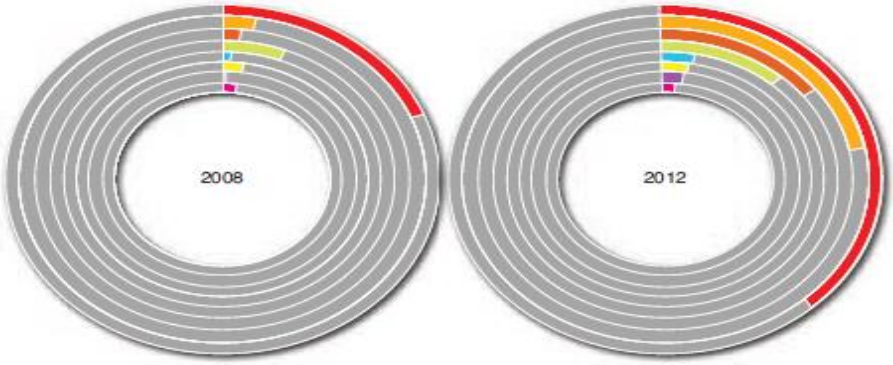
There is little evidence that certification encourages land conversion for agriculture, responding to the inverse land sparing-sharing discourse that by increasing price and productivity, certification may increase forest land conversion (van der Ven et al. 2018) as it provides an attractive opportunity for more farmers to switch to cocoa. Grabs and Zurich (2019) found that for coffee in Honduras, Colombia and Costa Rica "standards increasingly support a land sparing approach to biodiversity conservation, marked by set-asides of high conservation value forestland combined with sustainable intensification, rather than a land sharing perspective, which would support agroforestry and shade coffee production". They found that 50% of certified coffee farmers expanded their farms on former forestland, thus questioning whether certification does, in fact, prevent deforestation. Given the use of cut off dates, it arguably only prevents for certified firms where the date has been verified and former land use has been verified, and further expansion of existing, certified farms into forests. It cannot prevent non certified farmers from deforestation, as this is out of the sphere of certified buyers control and enforcement.

Although certification has led to impacts, both by excluding natural forest parts and by promoting agro-forestry systems, it has also led to a realisation among certified cocoa and coffee companies that deforestation cannot be tackled by certification alone. Thus VSS has led to other ZD approaches such as public private partnerships and landscape initiatives on ZD. Other reasons behind this mixed impacts are that only a small percentage of global commodity production is certified, and even less is actually sold as (Potts et al 2014, Voice Network 2012). There are also wide variations in how certification programs address ZD, with no specific zero-deforestation certification, little enforcement from companies and governments in forest-coffee and cocoa

frontiers, and insufficient understanding of how coffee, cocoa and palm oil agroforestry systems can have a positive impact and be a part of restoration initiatives. For many producers implementing land sharing techniques such as agroforestry is costly, which combined with the economic benefits of certification (Grabs & Zurich, 2019) and effect that agroforestry can have in lowering the productivity of the main commodity crop, means that the economic costs of certification may not outweigh the environmental benefits. Most certification schemes do not address degradation, only deforestation and many do not have reforestation, afforestation or restoration commitments.

Certification for agricultural crops has yet to halt land use change globally partly due to sparse and uneven market uptake – as the majority of forest risk commodities is not certified (Potts et al 2014). This is despite consumer willingness to buy certified products being a manifestation of how consumers purchasing power can influence trade practices (Smith and Barrientos 2005). Low adoption rates for VSS, due to unclear business case, the costs of compliance and market demand mean that producers often bear the costs of certified deforestation-free production systems and often do not perceive the indirect, non-financial benefits of VSS, especially when there are no price premiums (Lambin et al 2018, Potts et al. 2014, Ingram et al. 2018). Despite growth in the area and volume of certified commodities, low adoption rates mean that market coverage of VSS varies between 2 and 40% – shown in 9. As non-certified producers are largely not included in corporate programs related to company pledges, in PPPs and landscape approaches (evidenced from the cocoa sector – see Ingram et al. 2018, and soy, timber and palm oil chains – see Ingram et al 2018a), this means that the majority of commodity producers are not bound or covered by initiatives that have an element or a specific focus on zero deforestation.

Figure 9 Growth of VSS compliant commodity production as % of total commodity production 2008-2012



Commodity	2008	2012
Coffee	15%	40%
Cocoa	3%	22%
Palm Oil	2%	15%
Tea	6%	12%
Cotton	1%	3%
Bananas	2%	3%
Sugar	<1%	3%
Soy Beans	2%	2%

Source: Potts et al. (2014)

Landscape and jurisdictional approaches

The majority of landscape and jurisdiction approaches with a specific focus on ZD and commodities have emerged since around 2016. Given the long time scale, complex nature of developing multi sectoral, multi-stakeholder landscape approaches (Arts et al. 2017), it is to be expected that little evidence has emerged on the impact of these approaches. However, short term measures and indicators of the effectiveness of such approaches do exist (Sayer et al 2017). Despite many reports detailing outputs and expectations, little evidence was found. For example, reports on IDH's specific landscape and VSA initiatives and evaluations of all its programs (Waarts et al. 2017, Ruben and Tholen 2017) do not find evidence on outcome or impacts of landscape initiatives on deforestation based on the assumptions in the Landscape and VSA programs ToCs that support to multi stakeholder coalitions, stronger regulatory frameworks and enforcement capacity and lands use planning create an enabling environment for stopping deforestation and forest degradation. A review of the cocoa sector sustainability interventions in West Africa (Nelson and Phillips 2018) found no evidence of landscape level impacts.

Corporate pledges

A comparison of companies pledges towards zero deforestation in 2015 and 2018 by *Forest 500* shows some improvement on output since the Amsterdam Declaration was signed: the number of ZDC for soy, timber and paper increased during this time (Rogerson, 2019a). However over 40% of the companies report doing nothing to tackle deforestation in their chains, almost a third that made commitments didn't have any concrete policies on implementing these commitments, including publishing direct supplier lists or monitoring and verifying compliance. So despite positive outputs, there are hardly any clear outcomes, making it improbable that positive impacts could (already) have been achieved. Between 30 and 60% of companies, mostly in the beef chain, report on collaborative progress to meeting their corporate targets. For example in 2017, Nestle said 58% of its corporate deforestation commitments were met and JBS (the world's largest processor of a fresh beef and pork) reported that 99.7% of its purchases were compliant to certification and independently audited, and had mapped all of its Amazon basin suppliers for their DD approach (Rogerson, 2019). Overall, disclosure rates on … are low at under 20%. For timber, 33 out of the 180 companies assessed source timber out of which only three have a ZD Commitment for timber supply chains (Rogerson, 2019).

Figure 10 Company performance on ZD commitments

Source: Rogerson (2019)

The NYDF five-year progress report states that despite progress, reducing global? deforestation and restoring natural forests has not kept pace with the scale of worldwide commitments and the need for climate mitigation (NYDF Assessment Partners, 2019). Despite the large-scale commitments by companies to end commodity-driven deforestation by 2020, very few initiatives are on track and disclose quantitative progress toward achieving this goal (CERES, 2019).

The most prevalent **voluntary disclosure initiatives** are where companies report results in annual reports, some in dedicated sustainability (online) reports. Many of these reports are tracked by **traceability mechanisms** and **third party investigations** with the results published online. Examples are CDP, SPOTT, and Supply Change from the USA NGO Forest Trends, which tracks 450 company (including Unilever, Cargill, General Mills and Coca Cola) commitments to reducing deforestation, monitors company progress towards zero-deforestation goals and make more transparent company' and investors involvement in the value chains. The indicators used in corporate publications are generally not standardised. Supply Change reports that commitments by companies are not alike, with different targets, commodities, product lines or brands, extent that their commitments extend to suppliers and ecological stringency of targets eg "zero deforestation" (no deforestation anywhere) or "zero net deforestation" (e.g. forest loss might occur, but offset by restoration). In most but not all cases, companies have specified timetables to achieve their commitments ("time-bound" commitments), bookended by baseline and target dates and possible interim milestones. Some have strengthened their pledges by committing to additional environmental or social criteria that go above and beyond certification requirements. SPOTT found that overall 29% of the palm oil companies they assessed in 2019 met deforestation and biodiversity, such as having a commitment to ZD, restoration, evidence of monitoring deforestation and taking landscape or jurisdictional approach. CDP found that 70% of the 1,500 companies asked to disclose on four forest-risk commodities (timber, palm oil, cattle and soy) in 2018, failed to do so and over 350 companies consistently failed to report over the last three years. Of those companies that did disclose in 2018, nearly a third did not include forest-related issues in their risk assessments, concluding

that the business and financial risks associated with deforestation are under-reported and ignored. Although over 450 companies and 50 governments pledged to end deforestation by 2020, action to date has not been enough to achieve this. Nearly a quarter of companies have yet to take significant action, either taking no action (eg setting targets, certification, engaging with supply chains, or external initiatives), or acting on only one commodity when they have others requiring attention.

Public private partnerships

Since the 2010 *Dutch Declaration of Intent for Sustainable Cocoa* (now termed DISCO*),* and similar agreements have developed in Germany (German Initiative on Sustainable Cocoa, GISCO), Switzerland (Swiss Platform for Sustainable Cocoa) and Belgium (Beyond Chocolate agreement). These countries have also strengthened their international collaboration, leading to European level actions such as the *EU Action Plan and Communication on Stepping-up EU Action to Tackle Deforestation.* However, evidence on the impacts of such PPP roundtable voluntary agreements on deforestation (but also on the social and economic aspects of cocoa production they all focus on) have not been forthcoming. In the Netherlands many NGOs and CSOS members of the DISCO are unsatisfied that the ambitions of the commitments are not set high enough to represent structural change in the value chain ending in the Netherlands, instead reinforces a business as usual scenario, and that the declaration lacks monitoring and sanctions. Monitoring of the 2010 declaration of intent did not address deforestation. The recently launched new DISCO initiative states as one of the main objectives "that cocoa-related deforestation and forest degradation in producing regions where the Dutch cocoa industry and their trade partners are sourcing from will have ended in their supply chains by 2025". The *Cocoa & Forest Initiative* has been criticised for not resulting in halting deforestation in the period 2017 to 2019, with an increases in deforestation of 60% in Ghana and 26% in Ivory Coast relative to 2017, and although the extent to which deforestation is attributed to cocoa production is not specified, increasing agricultural enforcement was found in Ghanaian forest reserves (Higonnet et al., 2019). The C&FI does not include all key actors locally, nationally and internationally, did not create joint frameworks for action between producer and consumer countries, ignores structural drivers of forest loss or offers incentives for change - such as tree and land tenure reform and lacks clear monitoring indicators for (jointly) assessing progress (Higonnet et al. 2019).

Due diligence mechanisms

Traceability mechanisms focussing on transparency and public accountability – for example *Amazon Watch, Global Witness, Forests 500, Supply Change, TFA 2020, CDP Disclosure Insight Action,* the *Accountability Framework,* the *Collaboration for Forests and Agriculture* on beef and soy*,* and *SPOTT* for palm oil, rubber, timber and pulp, have all made more transparent the actors in value chains – including the banks and investors involved in forest-risk commodities, and their activities (Conant et al., 2019; Global Witness 2019). **Third-party investigations** such as by *Mighty Earth* into cocoa related deforestation have also played a role in placing deforestation into public spotlight and higher up in sector wide agendas. However a causal link has not yet been established between the outputs of these mechanisms and if they have resulted in concrete impacts – such as changes in deforestation, or changes in perceptions of reputation risks. The Disclosure Insight Action report (CDP 2020) focuses on 306 high impact forest risk companies in the cattle, soy, palm oil and timber, disclosing to investor shareholders or purchasing organizations compared to the situation 2018, measuring corporate awareness of deforestation risk and actions to remove deforestation from supply chains. In 2020 CDP found disclosure and transparency on deforestation still poor with 70% and many large brands failing to report. Although two thirds of companies indicated understanding the risks and reporting US$30.4 billion in potential losses due to the impacts of deforestation, despite commitments and public pressure, a third were unaware of deforestation risk and a quarter (24%) of companies had not started interventions to remove deforestation from supply chains (CDP 2020). **Voluntary disclosure initiatives**, such as the Consumer Goods Forum - a group of retailers and manufacturers - have made value chains more transparent. Individual companies, such as the VF Corporation and H&M, banned Brazilian leather in response to forest fires in Brazil in 2018 to 2019, until they could "…have the confidence and assurance that the materials used in [its] products do not contribute to environmental harm in the country" (Spring & Slattery, 2019; Andreoni & Maheshwari, 2019). The *timber moratorium* in Chile led to a successful reduction in natural forest conversion to plantations, although *FSC certification* in the same context achieved better environmental performance (Heilmayr & Lambin, 2016).

No one individual approach has successfully halted commodity-related deforestation

This section responds to question six, presenting the **approaches which appear most successful in tackling commodity-related deforestation,** by analysing the approaches against the criteria for success. These criteria are presented in the methodology. Recommendations are made based on these findings. The approaches which meet the success criteria per commodity are shown in overview in Table *3* and in Table 4 the approaches per commodity that meet success criteria are shown.

Table 3 ZD initiatives that meet success criteria per commodity value chain

Criteria	Cattle	Cocoa	Coffee	Palm oil	Soy	Timber
Baseline year defined	VSS 2009 G4	VSS 2008 UTZ 2014 RA	VSS RA 2005 with HCV 2014 2006 4C 2008 UTZ 2005 Nespresso 2004 CAFE Practices 5 years IFOAM	VSS 2005 RSPO	VSS 2009 RTRS	VSS 1994 FSC
(De)forestation definition		VSS	VSS	VSS R	VSS	VSS
No deforestation or degradation of HCV forests	VSS S CP	VSS	VSS	VSS	VSS CP	VSS R
Effective governance	L/J DD PPP	L/J PPP	PPP	L/J PPP	L/J DD PPP	L/J PPP
Collective action	L/J PPP	VSS PPP	VSS PPP	VSS PPP	L/J PPP	VSS PPP
Market benefits	L/J VSS	VSS PPP	VSS PPP	VSS	L/J	VSS
Smallholder support	L/J	VSS PPP	VSS PPP	VSS	L/J	VSS
Smallholder fairness		CP	CP	CP		CP
No leakage	L/J DD				L/J	
Free, prior & informed consent process	CP DD				DD CP	VSS
Transparency, monitoring & accountability mechanisms	CP DD VSS	VSS	VSS	VSS	DD CP VSS	VSS
Effectiveness, efficiency & equity	L/J DD					

Key: VSS = Voluntary sustainably standards CP = company pledges R= Regulation PPP = public private partnerships DD= due diligence mechanisms L/J=Landscape/jurisdictional

Table 4 ZD initiatives per approach and commodity that meet success criteria

Criteria	VSS	Corporate Pledges	Regulatory	PPP	Due Diligence	Landscape/ Jurisdiction
Baseline year defined	Cocoa, Cattle, Coffee, Palm oil, Soy, Timber					
(De)forestation definition	Cocoa, Coffee, Palm oil, Soy Timber					
No deforestation or degradation of HCV forests	Cattle cocoa, coffee, palm oil soy, timber	Cattle, Soy	Timber			
Effective governance	All (ISEAL code)		Soy (Brazil)	All (inspired EU policies0	Soy, Cattle	Cattle, cocoa Palm oil, Soy, Timber
Collective action	Cocoa, coffee palm oil, timber	Sector covenants		All		Cattle Soy
Market benefits	Cattle, cocoa, coffee, palm oil, timber			Cocoa, coffee		Cattle Soy
Smallholder support	Cocoa, coffee palm oil, timber	Via CSR programs	n.a.	Cocoa, coffee		Cattle Soy
Smallholder fairness		Cocoa, coffee, palm oil, timber	n.a.			
No leakage			.		Cattle	Cattle, soy
Free, prior & informed consent process	Palm oil	Cattle, soy			Cattle, soy	
Transparency, monitoring & accountability mechanisms	Cattle, cocoa, coffee, palm oil, soy, timber	Cattle, soy			Cattle, soy	
Effectiveness, efficiency & equity					Cattle	Cattle

Regulatory approaches

In general, regulatory approaches were hardly used as an approach to zero deforestation, and in those chains where it was used, such as the legality regulations for timber, did not meet many of the success criteria. However, regulatory approaches to protect forests using protected areas (including state, community and indigenous managed reserves) and that enforce and sanction the illegal conversion of designated forest lands to other land uses through moratoria, appear to work better than having no protected areas or land designated as forest, or sustainable use areas. Experience of soy and beef value chains in the Brazilian Amazon was more positive and shows that regulatory approaches can be more effective in avoiding or halting deforestation when combined with other mechanisms – such as PPPs, landscape approaches and due diligence mechanisms (particularly whistleblowing and external monitoring).

Leakage from one area to another (exemplified by soy production spillage from the Brazilian Amazon to the Cerrado (c.f. Fearnside, 2001; Walker et al., 2009; Gibbs et al., 2015; Godar et al., 2015) remains an issue which is often under the radar and not explicit in regulatory approaches. One reason is the differences between the legal definition and designation of forest – such that some forested areas are not legally designated as such – e.g. the Cerrardo. There are also differences between actual forest cover as shown on land use maps and legal definitions of forested land e.g. oil palm and cocoa in forested areas in Cameroon (Ordway et al., 2019) and oil palm grown in designated forested land in Indonesia, as well as designated forest land not actually having forest cover (Busch et al 2015, Levang et al., 2016).

From the evidence of the outcomes of the Indonesian timber and palm oil concession moratorium and Brazilian soy moratorium, moratoria appear effective bridging strategies that can be rapidly implemented, allowing the institutions to avoid deforestation in one specific area, and enable carbon price-based instruments and other tools to be developed that change trading relationships (Busch et al. 2014). They have also resulted in further lobbying to extend their scope and verify if leakage occurred to other areas, which did happen in the soy case.

Landscape and jurisdictional approaches

Landscape and jurisdictional approaches through the use of legal frameworks and delegation of authority to lower levels provide opportunities. But they may also limit the scope of what can be achieved nationally and allow leakage. In the soy and cattle chain landscape approaches appear successful, but for the other commodities there is little evidence. For example, the main constraint on district governments in Indonesia in jurisdictional certification is that the forest estate remains under the authority of provincial governments. District governments only have authority over the people who live in forest areas and can propose changes to the forest area. When management authority for these areas resides at national level e.g. Ministry of Environment and Forestry, or is devolved to the provincial level, district governments have limited authority for revoking existing licenses responsible for deforestation (Watts et al 2019).

In theory, a jurisdictional or landscape approach has potential to be complementary to certification and address issues that go beyond the supply chain including stakeholder inclusion, conflict resolution, food security, reduced GHG emissions from deforestation and biodiversity conservation (van Houten and de Koning 2019). van Houten and de Koning's (2019) study of jurisdictional approaches in Indonesia suggest because it operates on a larger geographical scale, the approach can institutionalize change by direct government involvement, and potentially shares some costs and benefits across stakeholders. However, it is not clear how jurisdictional approaches cover and affect other drivers of deforestation, and include those stakeholders in the process. Identifying HCV (and HCS) is a common approach of both VSS such as RSPO and of jurisdictional approaches, and if integrated properly into formal spatial planning appears to reduce deforestation on landscape level. As most jurisdictional approaches (see Figure 7 and Annex 3) are still in their early stages and it is noted that such processes need time, their effectiveness has not yet been established (Arts et al. 2017). As there are few reports on the outputs shown in Figure 6, meaning their effectiveness has not yet been established.

A jurisdictional approach is a multi-stakeholder process. As such, it is crucial that it solves existing, and avoids new, social and environmental conflicts. Multi stakeholder ownership, genuine participation and free, prior and

informed consent are seen as essential elements for the added value of a jurisdictional approach. In theory, a jurisdictional or landscape approach has a clear potential to be complementary to certification and address issues that go beyond the supply chain including stakeholder inclusion, conflict resolution, food security, reduced GHG emissions from deforestation and biodiversity conservation (van Houten and de Koning 2019)

Moutinho et al. (2016: 5) identified landscape approaches such as Brazils Growth Acceleration Plan (PAC) and expanding production on already deforested lands; expand protected areas, allocate undesignated public forests to some legal category and secure land titles for consolidated smallholders to guarantee landscape and development planning in new development frontiers. six threats to deforestation reduction and six strategies to achieve zero deforestation which include

Voluntary sustainability standards

VSS met many of the success criteria in the majority of commodity value chains.

In coffee, the Smithsonian Bird Friendly coffee standard upholds stringent conditions and appears to halt deforestation, however it is a small niche market (Grabs, 2019). In contrast most other certified coffee farms use "intensified methods with sparse shade that have not shown to yield biodiversity benefits" (Grabs, 2019: 2), questioning the effectiveness of the primary forest and HCV concept. Therefore, it is questionable whether "the private governance of mainstream commodity markets is an effective strategy for navigating the trade-offs present between economic development and environmental conservation" (Grabs, 2019).

In palm oil certification, a major lesson has been to involve the government – such that deforestation is not just a private, voluntary affair (experience of RSPO to IPOP) (Dermawan & Hospes 2018). Some of the methodologies used in RSPO certification, such High Conservation Value Area" and "High Carbon Stock" assessments are not recognized by public agencies, that have their own approaches to conservation assessment. Hence, without integrating these concepts into the government approach, it will not lead to effective implementation by the government. Whilst the RSPO and RTRS have served as models for the general design and principles of national standards, they differ from the global standards in terms of normative contents: the national standards offer more room to palm oil plantations and large-scale soy producers to expand production at the expense of forests and other high conservation areas. Governments and producer associations in Indonesia and Brazil did not launch national standards to implement the RSPO or RTRS but to challenge these interventions from the North (Hospes 2014). As many states (e.g. Government of Indonesia) do not have systems for registering or monitoring smallholder farmers, certification enables tracking and provision of programs providing them with farming practices and productivity technical assistance, credit and financial contributions to farmers, business know-how, as well as enabling the traceability of the value chains and therefore its deforestation footprint.

Corporate pledges

Few corporate pledges met either? of the success criteria, with no one particular commodity value chain pledge standing out as meeting several of the success criteria. Corporate pledges cannot be considered successful if they stay as intentions on paper without any monitoring or progress reporting. As such, corporate pledges have to be coupled to other intervention types. Many companies and businesses use corporate confidentiality as a reason not to report. Back door pressure from financers and upcoming transparency regulation has been working to get the biggest/most sensitive/and 'responsible' companies to commit and then be (more) transparent (Rothrock et al. 2018) and public commitments have made companies more likely to report on progress (Rothrock et al 2018). Initiatives such as the *Accountability Framework Initiative, Policy Transparency Toolkit (SPOTT), Global Canopy's Forest 500 initiative,* the *Trase platform,* the *CDP Disclosure Insight Action* and *Global Forest Watch* seek to remedy this, but so far corporate reporting rates on the interventions taken as part of pledges are low. Many of these due diligence traceability and third-party investigation mechanisms lack universal application, do not focus on all or the same commodities, are still in a pilot phase, do not systematically cover the aspects of pledges (i.e. interventions, reporting on impacts, transparency, risk portfolio), or cover one or only short periods of time (i.e. CDP 2018 and 2020).

Public private partnerships

PPPs met few of the success criteria, with few examples of success found in the commodity value chains. PPPs however appear to be increasing, with examples of international and multi-stakeholder declarations (i.e. NYFD), collective government declarations (i.e. Amsterdam Declaration), which often combine with private-public sector partnership initiatives (i.e. TFA 2020), industry coalitions (i.e. Tropical Alliance), commodity certification (i.e. RSPO) and landscape and jurisdictional approaches (i.e. "Produce, Conserve, Include" (PCI) in Mato Grosso state, Brazil), and moratoriums and boycotts. The diversity and tone of the PPPs has led to diverse interventions but little evidence of success. A co-dependent relationship instead has developed between corporate and state-led efforts to reduce deforestation, where the success of zero deforestation cocoa relies on synergistic public–private interaction (Carodenuto 2018). There appears more chance of governments supporting such commitments when they fit well with both national cocoa, development/poverty and forest strategies of producer countries , such as to aim at increasing the productivity of cocoa farmers, which is touted as a poverty alleviation strategy (Carodenuto 2018).

Due diligence mechanisms

Due diligence mechanisms did not meet many success criteria. Most examples of where they did were from cattle and soy, suggesting that they are most successful in chains with large scale commodity farming.

A growing number of initiatives in the last five years have provided a level of transparency and public accountability by direct value chain actors, mainly downstream in trading and manufacturing different forest-risk commodities- who have concerning forest related private commitments. Examples are Forests 500, Supply Change, Consumer Goods Forum, Tropical Forest Alliance 2020, CDP Forests Programme, Accountability Framework, and Collaboration for Forests and Agriculture which are third party or multi-stakeholder initiatives emerging as the result of extended attention to the issue.

The extent of evidence and general direction by the evidence found in terms of effectiveness of different approaches, is summarized in Table 5.

Table 5 Overview of the evidence for and effectiveness of approaches to commodity drive zero deforestation

Commodity	Zero Deforestation Value Chain Approach					
	VSS	Landscape/ Jurisdictional	PPP	Corporate pledges	DD	Regulatory
Cattle						
Cocoa						
Coffee						
Palm oil						
Soy						
Timber						
Summary						

Key:

Very effective	Partially effective	No effect	Not effective	No or little evidence

Recommended actions and research needed to evidence the impacts of ZD commitments

This section reflects on the seventh question by reflecting and discussing the previous sections, and the presenting actions to address the current concerns and provides recommendations for further research.

Discussion

Garret et al (2019) suggest that existing ZDCs have the potential to be **moderately effective in reducing deforestation within targeted supply chains and regions but leave substantial room for improvement with regards to achieving global reductions in deforestation**. They need to include zero-gross targets with immediate deadlines, clear sanction-based implementation mechanisms, and traceability to indirect suppliers. CSO due diligence initiatives like the Accountability Framework help to create a common set of definitions, norms, and guidelines to promote adoption of more effective ZDCs. However, there is a raising the bar effect: as increasing the stringency of ZDCs could discourage wider adoption. Since global effectiveness of initiatives depends on the effectiveness of individual and partnership commitments and the extent of adoption, improvements to commitments hinge on simultaneous improvements in state governance that enable greater property level monitoring of compliance with deforestation cut-offs (Vogel, 2010).

We share Garrett et al's (2019) comment that **voluntary corporate pledges should be viewed with caution** for a number of reasons. They do not cover all the market; they advantage the most powerful companies; do nothing to address non-certified producers or commodities consumed in lower risk-sensitive markets; and reduce the agency of affected local communities by moving control of deforestation activities to market forces (Larsen et al., 2018). Arguably especially small scale farmers in cocoa, coffee, timber and oil palm who are not grouped and located in forest frontiers far from established traders and certified buying centres, present the highest deforestation risk. These often have least access to the training, support and monitoring that corporate programmes - if done well, can offer. Corporate pledges however can be tests of non-state and non-regulatory mechanisms to control deforestation in lower forest risk, high forest cover areas - and especially to conduct restoration - which can be ratcheted up to legally binding regulations once found effective (Lambin and Thorkalson, 2018; Utting, 2005). There is a major risk in using ONLY voluntary commitments (pledges and VSS) to control commodities in high-risk forest areas. Yaap et al (2009) stressed the **role of CSOs in the development of and successful implementation of due diligence and voluntary approaches**. **Consumer country governments** can support this civil society role, **establish monitoring and enforcement mechanisms** that enable the adoption of more stringent company due diligence mechanisms, pressuring and supporting commodity origin governments with who they have trading and development links to adopt their policies to reduce commodity-linked deforestation.

Effective governance of both the production system and ecosystem services landscape and the value chain, combining the different single approaches, can prevent deforestation (Nolte et al., 2013, Vuohelainen et al., 2012, Van der Ven et al., 2018). A critical element highlighted in the evidence was the often low level of enforcement of regulations and loopholes in voluntary standards, undermining effective governance (Nolte et al 2013, Nelson & Philips 2018, Higonnet et al., 2019, van der Ven et al. 2018). Some PPPs (such as the Cocoa and Forest Initiative) focus on strengthening the role of states to do what they have been mandated to do, but have failed to do (i.e. conserve and enforce protected areas). Thus strengthening the implementation and enforcement of state regulations in forest risk regions is a high priority. Effective zero-deforestation commitments require the alignment of public and private governance arrangements. This requires agreement on private sector commitments which are enabled and supported by public policies *and* the enforcement of regulations at national and regional levels, and legacy issues – particularly relating to land tenure - must be addressed (Pirard et al 2015).

Recommendations

This study leads to four main recommendations for further actions by government, private, civil society and research actors to effectively reach the objective of ZD-VC. These are first a better understanding of direct and indirect drivers of deforestation per commodity and region; and second further study of the appropriateness and success of specific approaches, again per commodity and region. Finally, the complexity of ZD-VC and the political nature of ZD discourses requires standardisation of traceability mechanisms that is both credible and relevant as well as the clarification of concepts used by government, industry and civil society to establish causal links in the value chain from production to trade to consumption.

First, by acknowledging that the drivers of deforestation differ for each region and commodity, more detailed understanding is needed of how specific production and trade practices across the value chain lead to deforestation and how these relate to independent trends of de- or reforestation. Today, the drivers of deforestation are still not properly mapped and only recognised on aggregate levels of trade and large scale of geography. While we know that commodity production causes land use change from forest to agricultural use, the type of agricultural use following forest clearance is often not clear and insights into the succession of land use change are needed to reveal hidden deforestation dynamics. Acknowledging the various mechanisms by which deforestation occurs (e.g. direct land use change, land use change cycle, leakage, shifting land use, etc.) is needed. The geographical and ecological context strongly influences whether a certain type of commodity production causes deforestation directly, indirectly or not at all. A focus on tropical regions is therefore warranted, with attention to deforestation in temperate regions also needed. In addition, a complex set of environmental and societal trends drive land use change further. Changing consumption patterns, climate change, and global market dynamics are all relevant to understanding why deforestation is linked to specific commodities in specific regions.
The land-use dynamics that lead to deforestation also create an attribution problem, where individual companies cannot be blamed for indirect effects at higher geographical and temporal scales. This also implies that single firm voluntary ZDC cannot solve higher and longer scale phenomena. It does show willingness to act and contribute, but a complementary governance mechanism is needed to tackle effects like spill-overs. A stronger role for governments is needed to make this possible, in the form of multi-actor engagement in land-use planning.

Second, many approaches and interventions currently advocated are largely untested. While more longitudinal studies exist on VSS (e.g. certification), evidence of the success of different ZD approaches is scarce and fragmented. Especially the long-term effects of corporate pledges or PPPs are unknown. As a result, actors obliged or who wish to carry out due diligence mechanisms may be drawn to regulatory and VSS approaches as these have a stronger body of evidence and legitimacy/acceptance. This convergence/consolidation risks neglecting appropriate ZD approaches or elements of those approaches that are yet untested. As approaches such as VSS and regulations have been around for many years – but are only recently explicitly applied to ZD-VCs interventions - large-scale, longitudinal studies that draw on current innovations in traceability of commodities and on increasingly available remote sensing technologies may offer more insight in these approaches.

Third, the complexity of ZD and the political values identified behind various approaches call for standardisation of concepts and indicators to establish deforestation across the value chain and to measure outcomes and impacts. To compare the different approaches common indicators are needed for different forms of deforestation (permanent clearance, shift to pasture, shift to agroforestry, temporary clearance, sustainable logging, degradation, reforestation ,etc.) to help refine understanding of the specific impacts of value chains and the specific success that various approaches aim for. As the approaches embody different values e.g. sustainable use or conservation, making these values explicit can bring more clarity about the actual impacts and the desirability of specific outcomes.

Fourth, there are other tools available that could complement the current combination of approaches used. Little used to date are economic and financial mechanisms (such as commodity pricing, compensatory finance etc). Also missing is a focus on different major players in value chains – such as midstream value chain agents, and on consumers. Current approaches tend to take a specific commodity-focussed approach, whereas an alternative is to focus on the mode of production (such as intensive vs extensive systems, or the costs and benefits of monoculture and plantation production compared to agroforestry or intercropping production systems). Such a focus could help restructure agricultural and livestock production systems more generally, as evidence from livestock (poultry, beef and dairy) value chains shows differing production systems impact deforestation, biodiversity and land use differently (Baltussen et al. 2017).

Options for action

The different stakeholders in ZD-VCs have a variety of options for concerted action to address the recommendations above:

- **Consumer country governments** can combine regulatory and due diligence mechanisms and speed up compliance by providing fiscal incentives, which later become statutory requirements. They can require traceability and legality for product value chains; and fiscally support platforms and third party information and monitoring activities that enable consumers to understand where the source of products consumed and the externalities they create. Concerted action among consumer governments on an EU level and with major consumer countries (China, Brazil, India, USA) can lead to more coherent, global policies to level the "playing field" (legally, fiscally, trade tariffs) and inhibit spillover and leakage of embodied deforestation commodities from one consumer region to another.
- Specifically for the **Dutch government** – which is developing the international element of the National Forest Strategy (*Bossenstrategie)* (LNV 2020) in cooperation with the Minister for Foreign Trade and Development Cooperation - the actions below are relevant to the Dutch financial sector, businesses, consumer organisations, certification standards with a strong consumer and import market share in the Netherlands. Given Dutch leadership of the Amsterdam Declaration Partnership, leading a cross-commodity platform could contribute to reach ZD targets and broaden their approach beyond certification. The link between reforestation, restoration and afforestation and meeting international and national (*Klimatakkord*) climate change targets is also an angle for exploration.
- **Origin, producer country governments** can lead on identifying hotspots and frontiers of the risks of direct and indirect commodity-based deforestation; strict enforcement of protected and HCV and HCS areas (also identifying these if not already done) by moratoria and PA expansion; and convening multi-stakeholder platforms and partnerships in spatial planning efforts at production landscape scales. Addressing the issue of customary and statutory tenure of lands subject to deforestation by commodities is difficult but essential.
- **Financial institutions** can oblige clients to consistently and publicly report - using commodity and sector standards (including certification) - on the impacts (not just interventions) of both individual corporate and partnership interventions on annual time scales. Reporting on activities in or proximate to (HCV or HCS) forest areas at high risk of deforestation helps to support financial institutions risk analysis, investment choices and financing terms. Reporting on the extent and value of reforestation, restoration and afforestation by ZD commitments, can aid to minimise risks and the positive impacts of these activities can affect corporate value (share price, reputation etc) in turn affecting markets. This knowledge also contributes to evidence financial institutions investment choices.
- **Business** can take more responsibility for tracing their supply chain for all its production (not just products with well-known consumer labels), given mix of pressure from a due diligence perspective, from concerned consumers and from consumer and origin country governments. This could be conducted alongside coordinated sector covenants and partnership interventions on issues outside its direct sphere of sourcing influence (i.e. landscape level) and addressing indirect drivers of deforestation.
- **Business sector associations** can play a leading role in standard setting, sector-wide 'convenants' and agreements, scaling-up to more and smaller business (beyond major listed ones) baseline definitions, and coherent traceability and reporting systems.

- **Consumer organisations** can collaborate more with business and other partners to enable consumers to make informed choices – particularly the traceability of product ingredients, where products originate form, and the impacts of value chain interventions.
- **Certification standards** and their **alliances** should engage actively with non-certified value chain traders so that the rich lessons learnt from voluntary sustainability standards can be translated to non-certified but organised farmers, for example through producer country government agencies and support from collective private platforms.
- Research and conceptual work by **academic institutions** working with critical **NGOs** and **business** partners is needed to establish shared effectiveness assessment strategies for ZD-VCs across commodity markets and approaches; standard setting with baseline-cut off dates; measuring deforestation and cycles of (in)direct drivers; mechanisms for the financial sector to influence ZD corporate, chain and sector interventions; and accounting of forest gain and loss to create an systematic evidence base supporting claims about the effectiveness of different ZD approaches. ZD approaches should be scrutinised for the societal and political values inherent to them and the theories of change they ascribe to.
- Building on the research above, a **multi-stakeholder, cross-commodity, international platform** could be a pathway to develop global ZD standards and accompanying enforcement and reporting requirements.

Future research needs

Research and conceptual work by academic institutions could benefit from collaboration with critical NGOs and business partners to establish shared assessment strategies for ZD-VCs across commodity markets and approaches. Key knowledge gaps were research is needed include:

- Standard setting with baseline-cut off dates;
- Measuring deforestation and cycles of (in)direct drivers;
- Accounting of forest gain and loss to create an systematic evidence base supporting claims about the effectiveness of different ZD approaches.
- Developing global, standardised impact indicators common to different tropical commodities alongside specific commodity related indicators
- More detailed identification of drivers across the value chain
- Identification of high forest risk areas in the new frontiers
- Disentangling the impacts of how combined initiatives work to create impact (or not)
- Understanding the mechanisms for the financial sector to influence ZD corporate, chain and sector interventions
- Evaluating the high speed, effective, restoration activities- including agroforestry - which both small scale farmers and particularly large industrial scale are able and willing to adopt: now this is included in only a few initiatives (e.g. VSS)
- How do the political ideals implicit in discourses prevent or support effective approaches? ie what are the societal and political values inherent to them and the theories of change they ascribe to
- How to connect indirect drivers to values embedded in discourses?

Conclusion: Little evidence on the effectiveness of ZD-VC approaches – combining the best of different approaches could be a solution

This section concludes on the main questions of the study.

1. Commodities drive deforestation directly and indirectly, both large- and small-scale production, clear cut-off dates are needed for current exposure

There is ample evidence that the commodities discussed in this study – cattle, coffee, cocoa, soy, palm oil, timber – have driven deforestation in the past. Less is known about the scale of deforestation, degradation and reforestation (particularly when agroforestry practices are used) caused by large- and small-scale producers, and which commodities drive deforestation in different localities. When major periods of deforestation have happened is clear, but how booms and bust cycles of commodities interact and how smallholders or large scale producers react to it (e.g. Ruf 2007) are not clear. In order to get a grip on these issues, **baseline cut-off dates** for deforestation play a key role. However, cut-off dates for different commodities and geographies differ widely: reflecting more the periods when initiatives started than when major periods of commodity driven deforestation occurred in specific places. Thus the concept of current exposure to ongoing (and not historical / pre cut-off) deforestation risk (see Annex 1 for definitions) is key.

2. Five discourses show differing perspectives on who and what is driving commodity-driven deforestation and lead to different solutions and interventions

While the discourses diverge on their problem definitions, they share specific solutions and approaches to ZD, including PES schemes, transparency mechanisms, coordination between different governance actors and recognising the role of different actors and their interventions in the value chains. A main characteristic is the global nature of deforestation causes, in the absence of cross-border governance. These discourses show that the reasons why various zero deforestation approaches are preferred by different actors vary significantly and that how the impact of an intervention is assessed also varies accordingly. The different discourses argue for specific links and causalities of social systems and interactions - for example consumer behaviour, market rules or government intervention – to direct drivers of deforestation such as converting forested land for pastureland. What is considered successful thus depends on the problem definition implicit in a discourse. By making these problem definitions explicit, distinguishing and balancing the roles of public and private actors, and linking them to direct and indirect drivers of deforestation, steps can be made towards understanding what makes approaches successful and how.

The choice for ZD approaches is driven by the values and understanding of those actors involved about how the world works. The discourses used propose specific solutions that are often connected to actors understandings of the causes of deforestation. Actors expressing a specific discourse often play a role in those solutions. As such, we distinguish five discourses on zero deforestation that shape specific impact stories and impact pathways, and define their own set of by outcomes, impacts and success factors.

- Neoliberal market -Win-wins are possible, i.e. cattle intensification to satisfy global demand for beef while protecting the world's forests. Sustainable supply chains and voluntary sustainability certification are solutions.
- Legality and responsibility – Increasing legislative efforts together with traceability and monitoring for due diligence obligations may steer commodity markets towards zero deforestation. This operates in tandem with changes in consumer behaviour.
- Limits to growth - Decoupling deforestation from global commodity production and trade is not possible unless we focus on zero gross deforestation and conserve the world's forests. Individual ZD approaches based on companies willing to act without transformation of the economic system cannot guarantee zero deforestation.

- Local livelihoods - Zero deforestation requirements are unjust and unfair, like most conservation initiatives in developing countries established by hard core NGOs. PES schemes could help to fix the situation. Revalue forests and capture the benefits at local levels, removing the need for further agricultural expansion.
- New colonialism - The developing / tropical countries claim zero deforestation requirements are being used as an excuse to prevent their development and undermine their sovereignty over their own natural resources by establishing conservation areas (Brazil, Malaysia, Indonesia). PES or REDD+ are a better way to go. Value forests

So discourses are not alternative pathways, there is no single right discourse – they present normative but different (political) preferences of involved stakeholders on how issues could be treated. Combining the most successful interventions can serve more than single discourses and stakeholder needs, leading to broader societal support and ultimately effectiveness. Discourses are dynamic: they can combine and change into new discourses. A recent attempt to do this is evident in the recommendations for "promising pathways to strengthen Dutch international policies for forests" (van Dam 2019) which include making markets and trade in commodities more sustainable; developing a sustainable bio-economy; and food security via the sustainable intensification of agriculture.

3. Current theories of change have blind spots

While the discourses thus all combine a specific problem definition and causal mechanism to favour certain solutions, there are also shared **blind spots**. All discourses focus predominantly on deforestation - not degradation and fragmentation - which are just as important in understanding the problem and land-use dynamics that ultimately lead to forests disappearing. There is little focus on reforestation, restoration, afforestation or compensation - also critical in redressing the problem. A single commodity focus - even most landscape approaches use one commodity as the main entrance point, also tends to ignore how interactions and spillage between commodities can occur. Finally, the topic of historical deforestation and baseline cut-off dates tend to take away attention from the new deforestation frontiers (i.e. the non-traditional commodity producing countries). An explicit theory of change that embodies and addresses both (gross) deforestation and reforestation (as a model of intervention logic and an intervention philosophy) was only found for certification. Most interventions do not explicitly address leakage/spillage and cross commodity interactions at any scale - from household to regional to international, except some landscape scale initiatives. However these often do not consider leakage to other landscapes e.g. from the Amazon to the Brazilian Cerrado in the case of soy.

Most approaches also tend to have complex change pathways and/or don't make their ToC pathways clear. Most pathways don't address leakage, whereas this is a major issue in establishing outcomes and impacts on deforestation.

4. Six current approaches towards zero deforestation

Out of the current interventions / approaches (regulations, voluntary sustainability standards certification, corporate pledges, public-private partnerships, landscape and jurisdictional approaches and due diligence mechanisms), **certification** has the longest history and fulfils the most success criteria and has the most demonstrated positive impact in preventing deforestation. **Regulatory** approaches have also been shown to be successful in demarcating protected lands, but there is not a strong historical association with commodity production and value chains, other than for moratoria. For the other four approaches, most are still in initial start-up phase and little robust evidence was found relating to their impacts.

Increasingly, different elements of all the approaches discussed are used together- or one builds on the other (e.g. certification had been incorporated into ZD corporate pledges and then a PPP and landscape and jurisdictional initiatives) making it very difficult to determine the impacts of separate initiatives over time. This study argues that **combining approaches** appears a more effective way to tackle all the drivers and pathways of deforestation at different spatial and temporal scales. Cooperation between actors, public and private is needed that incorporates multiple strategies and compensates for limited spheres of influence of different stakeholders. Building a multi-level multi-intervention approach: To make the best use of the strong and weak

points of each approach, a systematic analysis of alternative combinations of single interventions at both consumer as production side of VCs is needed.

A weakness of most approaches is that their **geographic focus** (shown in and detailed in Table 6) on areas where **past deforestation** has long since occurred e.g. cocoa VC approaches predominately focus on West Africa, soy in Amazon, and oil palm in Kalimantan and Sumatra in Indonesia. The new deforestation frontiers are where the least ZD-VC approaches have been initiated. These new frontiers are countries with increasingly levels of forest-risk commodity production and still significant forest cover levels (e.g. Suriname, Colombia, Cameroon, Republic of Congo, DR Congo, Sierra Leone, Liberia, Vietnam, PNG, Myanmar), often HCV, HCS and native forests, and frequently also difficult governance situations. This combination of characteristics signals that **urgent attention to these geographical areas is needed to avoid the cycles of commodity led deforestation and leakage seen historically.**

A growing set of **due diligence mechanisms** – all using traceability tools and remote sensing techniques - have emerged that aid financiers and investors, CSOs and consumers and other critical stakeholders, to identify some high risk areas, commodities with investment risks, and to "name and shame" companies not providing information on their value chain activities and policies. These technologies and tools still need to be connected to theories of change that have clear concepts, values and use standardised indicators.

5. Outcomes and impacts of current approaches on the ground need to be demonstrated

There is no documented evidence that any of the approaches on their own halt deforestation. Out of the six current approaches (certification, corporate pledges, joint public-private agreements, landscape/ jurisdictional approaches, due diligence mechanisms), only certification has been in operation sufficiently long enough, with sufficient critical onlookers, that there is robust evidence about its impacts. The others can only be evaluated in terms of input, output and sometimes outcome. The evidence on VSS provides a mixed, modest view of impacts on avoiding deforestation and shows inherent biases: all the VSS commodity certification schemes have baseline dates and conditions that mean only land deforested before specific cut off dates can be certified, thus certified commodities do not further contribute. However, as certified commodities do not constitute the majority of total commodity production, this means that a significant proportion of commodity markets is still driving deforestation. Whilst many companies use certification as an intervention, claims of the impacts of certification are not systematically supported by evidence of what's happening on the ground beyond an input/activity level (see also annex 3). Even the most well implemented VSS have not had significant impacts beyond a farm scale and farmer-livelihood impacts. Whilst moratoria, such as those restricting soy expansion in the Amazon and palm oil in Indonesia, appeared to work on a landscape level, studies showed leakage to other landscapes and countries. Regulations have also had mixed success and increasingly been incorporated into other approaches as a legality aspects - such as PPPs and landscape programs in West Africa focussing on enforcing and sanctioning infringements of cocoa growing into national parks. Although a number of (third party, independent) monitoring and traceability systems – taking a due diligence review approach - have emerged, these are highly geographic and commodity specific and do not monitor interventions, and thus provide few insights into the effectiveness of different approaches. Legality issues are often ill addressed in impact evaluation studies. Whilst some certification schemes (palm oil and timber) do address land tenure and permitting as key aspect of legality, many of small holder schemes do not address problems inherent in customary titles held by many small-scale farmers, which can lead to farming in areas classified as forests and protected areas. For all the four most recent approaches (see timeline in Figure 7), generally they have:

a) not been in operation long enough to have outcomes and impacts and/or
b) these are not well documented and/or
c) not documented in coherent ways to enable comparison.
d) the criteria and terms used are inconsistent and difficult to compare

Overall, few examples exist of where ZD approaches have demonstrated avoided deforestation, or of the extent and impacts of directly linked reforestation, afforestation or restoration initiatives[9].

The six approaches appear to be converging as different actors in the value chains take similar approaches across commodities. This maybe in part because some of end of chain actors operate in many commodity chains (e.g. Pepsi, Unilever, Olam and Cargill) and collaborate in different programs, and also as consumer governments increasingly focus on multiple forest-risk commodities, rather than just those that are important in their bilateral trade relations.

6. No one approach stands out as most successful in tackling commodity-related deforestation: combining the best of all approaches could be a solution

Given the available empirical evidence and methodological problems of attribution, no one approach stands out as being complete effective, although VSS appear partially effective. Table *3* provides a summary of the evidence and the success of different approaches to reduce deforestation driven by forest-risk commodities.

Rather than being able to identify one approach as successful, this study points towards the need to build an evidence base for specific approaches using several interventions that are sensitive to regional scales, type of commodity, and interaction between commodities (e.g. cattle, soy). From that evidence, and taking into account the different discourses and values that are associated with the choice for specific approaches to ZD-VCs. Combining the best of different approaches could be a solution. Today, different elements of all the approaches discussed are increasingly used together. For example, certification is part of many ZD corporate pledges, giving these pledges extra credibility and accountability, as well as an established institutional framework to build on. Public-private partnerships are also increasingly working together implementing landscape approaches, such as the Cocoa and Forest Initiative in Ghana and Côte d'Ivoire. Combining approaches appears indeed a more effective way to tackle all the drivers and pathways of deforestation at different spatial and temporal scales. Cooperation between actors, public and private is needed that incorporates multiple strategies and compensates for limited spheres of influence of different stakeholders. Building a multi-level, multi-intervention approach, may make the best use of the strengths and weaknesses of each approach.

Taking the "best of" the different approaches leads to the following recommendations for successful ZD approaches to have:

- Having a clear definition of 'forest' and 'deforestation'
- Defining a broad reference date against which deforestation is measured that is comparable across regions and between commodities
- Producer countries could regulate to incentivize not only legally produced but also deforestation-free commodities – thus taking a proactive role in clarifying the standards for deforestation-free commodity production within their jurisdictions. Coordinated consumer country regulations would also provide a more level playing field so that corporate ZD pledges are more effective if they support, integrate with or align with legality approaches such as FLEGT and sustainability certification systems (e.g., FSC or RSPO) instead of trying to replace them (Pasiecznik & Savenije 2017, p16)
- Back door pressure from financers has been working to get the biggest/most sensitive/and 'responsible' companies to commit and then be (more) transparent (Rothrock et al. 2018)
- Public commitments make companies more likely to report on progress.
- Effective zero-deforestation commitments must align public and private governance arrangements. This requires agreement on private sector commitments which are enabled and supported by public policies,; and the enforcement of regulations at national and regional levels; Legacy issues – particularly relating to land tenure must – also need to be addressed (Pirard et al 2015).

[9] See Annex 1 for definitions.

- Investing in traceability and monitoring can anchor causality claims from various ZD-approaches in reality
- ZD approaches should be sensitive to geographical context of producer regions and commodity type.
- ZD approaches should take wider social, environmental, and market trends into consideration, such as consumer behaviour, climate change and loss of ecosystem services, and commodity prices.
- Regulatory approaches and certification are likely to be strong elements of any ZD-VC.

7. Action-research is needed to address and measure current deforestation risks

Research and conceptual work by academics working with critical NGOs and business partners is needed to establish shared assessment strategies for ZD-VCs across commodity markets and approaches. This includes standard setting regarding baseline-cut off dates (how far back do you measure deforestation?); measurement of deforestation (forest cover) and cycles of (in)direct drivers; and accounting of forest gain and loss (include or exclude reforestation efforts?) to create an systematic evidence base that supports claims about the effectiveness of different ZD approaches. The mechanisms available to the financial sector to influence individual corporate, value chain and sector strategies and how this is envisaged in theories of change requires elaboration.

Different interventions need to be characterized using a common language and structure, to aid planning and analysis of interventions and approaches, and to facilitate the evaluation of interventions with respect to their structure and outcomes. The classification of six approaches in this study provides a start. Building on Newton et al. (2013), research on the collective experience of multiple interventions across commodities and spatial contexts is still necessary to generate more systematic understandings of the impacts of commodity supply chain interventions in forest-agriculture landscapes.

More detailed knowledge is also needed, for example which current forests are under high risk of deforestation, so financial institutions can choose where to invest and not invest. Little is also known about the value of reforestation, restoration and afforestation initiatives directly linked to ZD commitments. risks approaches allow to consolidate existing markets.

ZD approaches should be scrutinised for the societal and political values inherent to them and the theories of change they ascribe to. A stronger evidence base can help develop robust theories of change that satisfy multiple political values currently expressed in political discourses and debates about zero deforestation and commodity value chains. As long as different approaches are bogged in limited impact and political contestations, ZD-VCs are unlikely to gain a substantial market share of commodity trade. Yet, that is exactly what is necessary for ZD-VCs to be effective in halting forest loss and to avoid unintended effects of leakage and spill over.

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Annexes

Annex 1: Key definitions

Actors (also referred to s stakeholders) in value chains refer to the individuals, enterprises and other organisations directly and indirectly involved in a value chain, Commodity driven deforestation can be defined according to the actors involved. The production of some commodities is horizontally concentrated among a small number of oligopolistic large producers, or spread across hundreds of smallholder producers. For example, the nature of soy production allows it to be dominated by corporate giants such as Bunge and Cargill. Most of the deforestation due to soy cultivation happened in Cerrado biome in Brazil, adjacent to the Amazon (Green et al. 2019), but despite a Soy Moratorium in the area since 2006, the five companies responsible for the majority of production and global trade of soy, faced fines in 2018 by Brazilian Environmental Agency (IBAMA) (Vasconcelos and Burley, 2018). Other commodities do not have such a high concentration: cocoa and coffee production is largely produced by smallholders, but the value chain is dominated by oligopolistic intermediaries (traders, processors and manufacturers) (Ingram, Waarts et al. 2018). In contrast, the palm oil sector in Asia has both smallholder and largescale producers, and does the cattle chain (Ingram, van den Berg et al 2018).

Afforestation Establishment of forest through planting and/or deliberate seeding on land that, until then, was not classified as forest. This implies a transformation of land use from non-forest to forest (FAO 2015).

Approach is defined here as a body of initiatives, which may be state or non-state (transnational) governance arrangements (Cashier (2002) in which similar instruments and processes are used to achieve stated goals, with specific groups of stakeholders involved, with commonly shared intervention and impact logics.

Baselines and **cut-off dates** refer to the temporal, historical dimension of deforestation by forest-risk commodities is important. Around 90% of land originally occupied by forest globally, was deforested before 1950, beginning probably half-a-million years ago. Since the mid-twentieth century deforestation has accelerated. Compared to previous time periods, more sensitive environments have been impacted and more irreversible damage has occurred (Williams 2001), and the drivers and land use replacement of forests have been able to be more accurately determined, as well as the landcover replacing them (Kissinger et al. 2012). Often, a succession of landcover is observed in deforestation dynamics, where natural forest turns is succeeded by planted forest for timber production, which in turn is succeeded by agricultural land, first for cattle ranching and later soy/crop production (Rudel et al. 2009, Kissinger et al. 2012). The timing of deforestation and replacement of forest by commodity production is a critical aspect in as many initiatives work on the premise of baselines based on a cut-off date: the date after which forest conversion is prohibited (usually the date on which a standard or commitment is established). (i.e., products from land deforested before year X are acceptable, those after year X not). Defining the baseline is a crucial factor in implementing zero deforestation approaches. If the cut-off date is too far in the past a transparent and reliable verification of land-use can become difficult and declaring products as zero-deforestation can be problematic without a compensation mechanism. Equally, a baseline that is too far in the future can set the wrong incentive to deforest now and claim their products as deforestation-free later.

Collective action refers to meaningful participation of and collaboration between (groups of) agricultural commodity producers, public institutions, private businesses and financers.

Commodity A raw material or primary agricultural product that can be bought and sold and/or that is a useful or valuable thing.

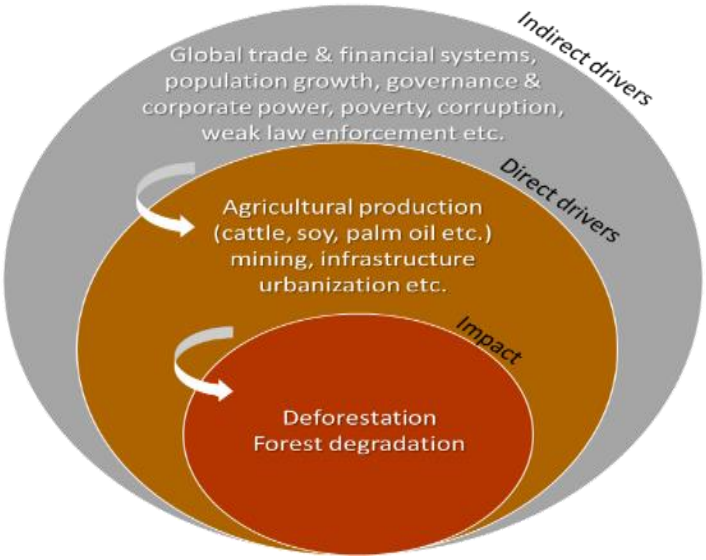
Carbon neutral means that an activity releases net zero carbon emissions into the atmosphere.

Carbon or Climate positive means that an activity goes beyond achieving net zero carbon emissions to actually create an environmental benefit by removing additional carbon dioxide from the atmosphere.

Deforestation The conversion of forest to other land use or the permanent reduction of the tree canopy cover below a minimum threshold. The FAO stipulates 10% (FAO, 2000). This implies 1. the long-term or permanent loss of forest cover and implies transformation into another land use. 2. It includes areas of forest converted to agriculture, pasture, water reservoirs and urban areas. The term specifically excludes areas where the trees have been removed as a result of harvesting or logging, and where the forest is expected to regenerate naturally or with the aid of silvicultural measures, unless logging is followed by the clearing of the remaining logged-over forest for the introduction of alternative land uses. Deforestation also includes areas where, for example, the impact of disturbance, over-utilization or changing environmental conditions affects the forest to an extent that it cannot sustain a canopy cover above the 10 percent threshold (FAO 2015, Chadzon et al., 2016). Under the common forest definitions, harvesting or clearing of all trees from a tract of land does not constitute deforestation in cases ''where the forest is expected to regenerate naturally or with the aid of silvicultural measures within the long-term'' (Chadzon et al., 2016). One approach to define deforestation is based on tree cover loss, a second is the change in the use of the land. Land-use definitions, even if the forest is cleared, may not count as deforestation until that area is converted to agriculture, or developed or used in another way.

Drivers of deforestation include direct and indirect drivers**. Direct drivers** include the production and extraction of commodities when production involves land-use change and so directly affects forest cover. Thus direct drivers of deforestation and forest degradation are human activities and actions that directly impact forest cover and result in loss of carbon stocks. Not only agricultural commodity production, but also mining, infrastructure development and urbanization can drive deforestation. These new frontiers are usually interlinked with or succeed illegal or legal timber extraction – a traditional economic activity linked to the deforestation and forest degradation in the tropics and direct driver of deforestation and forest degradation. Focusing on direct drivers in decision-making process and policy design – shown in Figure 11 – can be pragmatic but also limits the vision and the success of policy implementation and needs to be contextualized within the debate about indirect drivers and the role of commodity value chains and impacts. Indirect drivers of deforestation are global, national and local level interactions of social, economic, political, cultural and technological processes that affect commodity production and extraction. Complex social systems and interactions, including national economies, global financial systems and trade, population growth, resource governance and corporate power, poverty, corruption, weak law enforcement, can be classified as **indirect drivers** of deforestation (Kissinger, Herold and De Sy, 2012; p.143, IPBES, 2018). Isolating these indirect drivers of deforestation and connecting them to absolute occurrence of deforestation is at the very least highly challenging and often impossible. This is even more problematic for avoided deforestation. For example, when a global company invests in sustainable supply chains in a certain region, while large investments are made elsewhere without considerations for sustainability, the net effect on the sustainability of a company or sector of the sustainable supply chain may be negligible. Due to such leakage and attribution problems we therefore speak of reducing 'deforestation risk' rather than absolute reduction in deforestation.

Figure 11 Direct and indirect drivers of deforestation and forest degradation



Due diligence is defined as the investigation or exercise of care that a reasonable business or person is expected to take before entering into an agreement or contract with another party to avoid committing a tort or offence. It can be a legal obligation or voluntary investigation. To exercise due diligence in commodity value chains companies and financial institutions trace back the supply commodities to the production systems and assess negative environmental and social impacts that may result along the value chain. Due diligence thus plays an important role in translating zero-deforestation commitments to approaches that seek to prevent, mitigate and make transparent negative impacts of companies' activities on forests and people through their value chain.

Effective governance refers to how institutions conduct public affairs and manage resources in the way that meets their aims. Governance is "the process of decision-making and the process by which decisions are implemented (or not implemented)". Institutions refer to both public (state), private (non-state), citizen and hybrid forms of governance that set rules, and include sanctions and enforcement mechanisms.

Effectiveness, efficiency and **equity,** also known as the "3E" test, is a common measure of success in impact evaluation theories of change (see the conceptual framework). Drawing on Garrett et al. (2019) and shown in Figure 12, effectiveness implies that consumers and markets are sensitive to environmental and social criteria and that producers are willing to work to these extrinsic criteria to supply them. Efficiency implies that companies (alone or in collaboration) invest in tracing their value chains to farms or plantations to manage the risk of sourcing from "recently" deforested land (unless sourced from areas with no deforestation at all). Equity means that as part of managing deforestation risk and costs, certain producers may be eliminated from a supply chain and others rewarded (i.e. producers who deforested early, which disadvantages forest-rich areas that came late to an initiative). If the government is involved, a jurisdictional scale can provide a condition and entry point for dealing with land-use conflicts, including those stemming from illegal land conversion in the past.

Figure 12 Effectiveness, efficiency and equity criteria to measure the sucess of zero-deforestation commitments

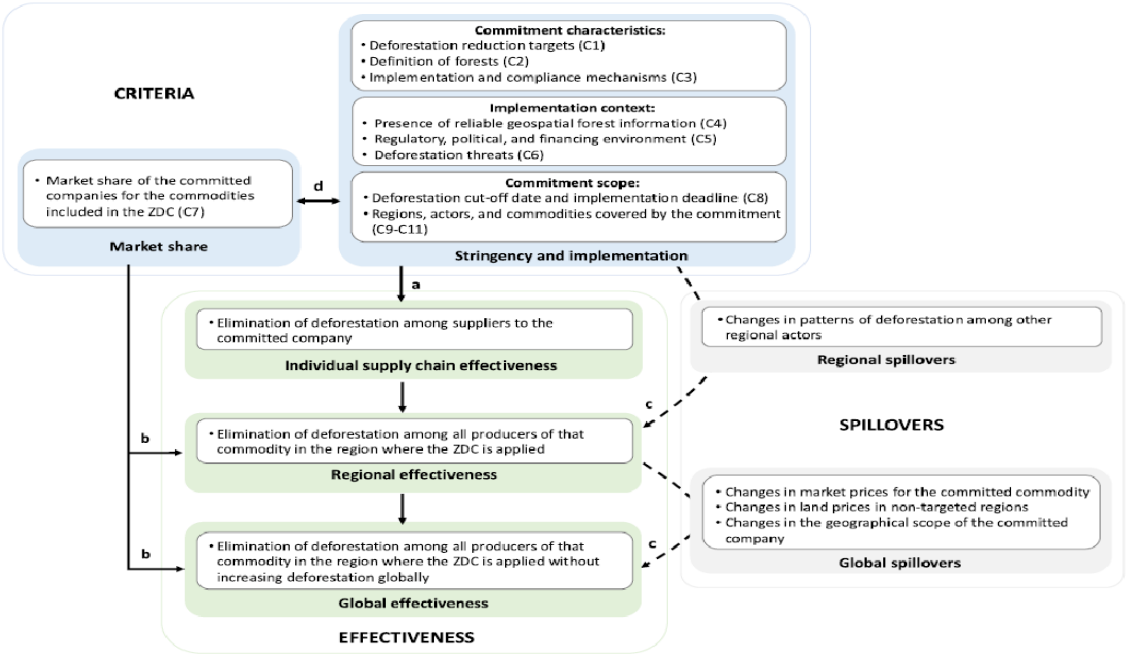


Fig. 1. Framework for understanding the expected effectiveness of ZDCs. Green boxes indicate three scales at which effectiveness can be defined. Blue boxes indicate criteria important for commitment effectiveness. Grey boxes highlight types of spillovers that can occur. Letters (a–d) focus on interactions between the boxes (criteria, effectiveness, and spillovers), as referenced in the main text. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article).

Source: Garrett et al. 2019

Embodied deforestation captured the uncertainties regarding the distance between the deforested lands and markets where the forest-risk commodities are consumed complicates the establishment of firm and causal links between commodity production, consumption and deforestation (Cuypers et al., 2013; Weatherley-Singh & Gupta, 2018), defined as "…the deforestation embodied (as an externality) in a produced, traded, or consumed product, good, commodity or service during their production phase" (Cuypers et al., 2013, p.14).

Embodied emissions refers to land-use change and carbon emissions embodied in the production and exports of forest-risk commodities. Deforestation and forest degradation are important sources of carbon emissions aggravating the current climate change crisis. Around 15% of global carbon emissions result directly from deforestation (Vermeulen et al., 2012). The IPCC special report indicates that agriculture, forestry and other land use (AFOLU) is responsible for 23% of total net anthropogenic emissions of GHG for the period 2007-2016 (IPCC, 2019). The majority of these emissions result from transformation of forested territories to croplands and pastures as a follow up activity to forest clearing. The embodied emissions of the production of beef, soy, palm oil, and wood products in countries with high deforestation rates (Argentina, Bolivia, Brazil, Paraguay, Indonesia, Malaysia, and Papua New Guinea) in the period 2000–2011, caused 40% of total tropical deforestation and 44% of associated resulting carbon losses (Henders et al. 2015).

Embedded deforestation has a similar meaning, referring to how greenhouse gas emissions travel along a value chain "embedded" in traded products to reach consumers around the world, becoming embedded in a countries' consumption (Pendrill et al. 2019a).

Exposure to deforestation risk occurs due to the complexity of global production systems and trade flows there are also commodities that possess the risk of originating from deforested areas without being direct deforestation/forest degradation drivers. Differentiation between commodities with direct causal links and those with exposure to deforestation in their value chain has an impact on how responsibility and accountability is constructed. Exposure to deforestation risk can happen through three channels:

1. Commodity production directly causes deforestation and degradation as a land use change (i.e. forests cleared to grow soy).
2. Forest-risk commodities are used to produce another product (i.e. soy is used in feed for beef).
3. **By-products** are created from forest-risk commodities (e.g. leather is produced from cows grazing on deforested land) (Mammadova et al., 2020a).
4. **Market benefits** deliver value for producers and incentivize them to continue producing sustainably and deforestation free.

The **financial sector** refers to the organisations providing financial services to commercial and retail customers and comprises a broad range of industries including banks, investment companies, insurance companies and real estate firms. With their strong influence on economic systems of production, the financial sector plays an important role in steering deforestation risk. Grey, green and blended finance are relevant concepts here**. Green finance** is finance that is aligned with objectives for the conservation, protection, or sustainable use of forests. This includes finance provided with a clear and stated objective of climate mitigation in the forestry sector, REDD+, conservation, and sustainable forest and land use. **Grey finance** is finance that has no stated objective to positively impact the forest but has the potential to have an impact on forests. Whether this impact is positive or negative depends on the policy context, as well as the design and implementation of these activities (Climate Focus, 2017). **Blended finance** combines government and private sector capital to lower investment risks is defined "as the strategic use of development finance and philanthropic funds to mobilize private capital flows in a co-finance arrangement to emerging and frontier markets" to support progress towards the Sustainable Development Goals (SDGs) and resulting in positive results for both investors and communities designed (World Economic Forum, 2019). According to the latest estimates, grey finance for agriculture is 15 times more than green finance for forests. Besides, forests receive 1.5 percent of the climate finance to all sectors (NYDF Assessment Partners, 2019). The role of smallholder finance is also important, given that commodity crop expansion for trade and self-consumption is driven by small and medium scale farmers in parts of sub-Saharan Africa (Ordway et al. 2017), as is the role of foreign investment in larger scale commodity farmlands and plantations (Schoneveld 2014). With the upcoming ratification of EU-Mercosur Free Trade Agreement the underlying drivers of tropical deforestation by global trade liberalization and grey finance have come under public scrutiny. Over 600 scientists and 300 Brazilian indigenous groups urged the European Union (EU) to reconsider the trade agreement and put human rights and deforestation above economic gains (Kehoe et al., 2019). Indigenous communities in Brazil and organizations such as Amazon Watch have traced the destruction of forests to European and North American companies' financial flows, calling for EU-led sanctions and boycotts on the Brazilian commodity trade to stop the destruction of the natural ecosystems (Amazon Watch, 2019).

Forest is land with certain characteristics and criteria (crown or canopy cover, tree height, tree density, land area, layered vegetation storeys and temporality of stocking – see below for main definitions) that determine its demarcation (Chadzon et al., 2016). Widely accepted criteria include that that a forest should have a minimum area, a minimum potential tree cover and a minimum tree height (FAO 2010). Many countries define the thresholds within these criteria differently due to the characteristics of their specific forested ecosystems. Definitions by major players in the forest sector include:

United Nations Food and Agriculture Organization (FAO, 2000) Land with tree crown cover (or equivalent stocking level) of more than 10 % and area of more than 0.5 ha. The trees should be able to reach a

minimum height of 5 m at maturity in situ. May consist either of closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground; or open forest formations with a continuous vegetation cover in which tree crown cover exceeds 10 %. Young natural stands and all plantations established for forestry purposes which have yet to reach a crown density of 10 % or tree height of 5 m are included under forest, as are areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention or natural causes but which are expected to revert to forest.

A minimum area of land of 0.05–1.0 ha with tree crown cover (or equivalent stocking level) of more than 10–30 % with trees with the potential to reach a minimum height of 2–5 m at maturity in situ. A forest may consist either of closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground or open forest. Young natural stands and all plantations which have yet to reach a crown cover of 10–30 % or tree height of 2–5 m are included under forest, as are areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention such as harvesting or natural causes but which are expected to revert to forest. United Nations Framework Convention on Climate Change (UNFCCC, 2002)

A land area of more than 0.5 ha, with a tree canopy cover of more than 10 %, which is not primarily under agriculture or other specific non-forest land use. In the case of young forest or regions where tree growth is climatically suppressed, the trees should be capable of reaching a height of 5 m in situ, and of meeting the canopy cover requirement. United Nations Convention on Biological Diversity (UN-CBD, 2010)

Dense canopy with multi-layered structure including large trees in the upper story. United Nations Convention to Combat Desertification (UN-CCD, 2000)

A land area with a minimum 10 % tree crown coverage (or equivalent stocking level), or formerly having such tree cover and that is being naturally or artificially regenerated or that is being afforested. International Union of Forest Research Organizations (IUFRO, 2002)

Forest degradation refers to the reduction of the capacity of a forest to provide goods and services (FAO 2015).

Forest-risk commodities are commodities likely to cause deforestation. Commonly mentioned commodities are cocoa, coffee, cattle, soybean, palm oil, wood pulp and rubber.

Forest positive actions include investing in responsible forest management, restoring forests, supporting jurisdictional approaches to forest conservation, and engaging with policy-makers and consumers on forest-related issues (WWF 2018).

Free, Prior and Informed Consent (FPIC) establishes bottom up participation and consultation of an indigenous population prior to the beginning of a development on ancestral land or using resources within an indigenous population's territory.

High Conservation Value (HCV) areas are defined as natural habitats where these values are considered to be of outstanding significance or critical importance. Designation first established by the Forest Stewardship Council, HCV refers to forests of exceptional importance for biodiversity conservation, ecosystem services or local communities.

Interventions in value chains may be implemented by civil society, market and/or state actors can influence any one or more market actors in the chain (Smith, 2008). They can do so by moderating patterns of behaviours through changed governance structures that target the land-use practices of agriculture commodity producers, the sourcing policies of distributors and retailers, or the purchase decisions of consumers (Newton et al. 2013).

Imported deforestation is a similar term to embedded deforestation, mainly used in French speaking countries,: the environmental footprint of products consumed by one group but produced elsewhere. The French National Strategy Against Imported Deforestation (SNDI) used imported deforestation to lobby the European Union to distinguish between customs duties on imports of agricultural, forest and livestock products, and raise duties on products derived from deforestation in favour of zero deforestation certified products and supporting small-scale farmers to transition to sustainable practices (IDDRI 2017).

Leakage or **spillover**, defined as where unsustainable production activities are instead transferred from one region to another or from one type of producer to another (Henders & Ostvald 2014; Garrett et al., 2016; Gibbs et al., 2016; Alix-Garcia & Gibbs 2017). This displacement may be the result of increases in conservation restrictions in existing production regions (de Waroux et al., 2017; Garrett et al., 2017; Meyfroidt et al., 2013). Leakage can occur if the reduced impact of the value chain of one commodity (e.g. sugarcane) is cancelled out by increased impact of another (e.g. palm oil) (Larsen et al., 2008; Newton et al., 2013; Boström et al., 2015). Leakage also occurs when individual value chain sustainability initiatives are contaminated by laundering/whitewashing of deforestation via the introduction of unsustainable products into the system (Gibbs et al., 2016). For example, unsustainably produced products are mixed with sustainably produced ones in warehouses.

The **location** of commodity producers in ZD commitments matters in assessing interventions – for example whether they are in forest-rich areas, or high conservation value (HCV)[10] forest. Deforestation can appear to slow when fewer trees remain and forests are not the major land cover type. Moreover, many interventions focus on main production areas of specific commodities based on their land footprint (see figure 2), which may not necessarily be synonymous with areas and countries that have high forest cover, areas of HCV and/or high deforestation risk. Countries with high forest cover and/or HCV forests and where production of agricultural commodities has significantly increased in the last decade include DR Congo, Sierra Leone, Liberia, Vietnam, PNG, Myanmar (Pendrill 2019a, Ordway et al., 2017). In contrast, in West Africa, the two main cocoa production countries Ivory Coast and Ghana are now largely deforested with 32% and 21% forest cover respectively remaining (FAO 2016), while 6.1% and 4.6% of landcover is a protected area (Ruf & Varlet 2017).

Reforestation is the re-establishment of forest through planting and/or deliberate seeding on land classified as forest. This 1. Implies no change of land use; 2. Includes planting/seeding of temporarily unstocked forest areas as well as planting/seeding of areas with forest cover; 3. Includes coppice from trees that were originally planted or seeded; and 4. Excludes natural regeneration of forest (FAO 2015). Reforestation does not increase forest area, as it occurs on lands already defined as forest (Chadzon et al., 2016).

Restoration emphasizes historical fidelity and recovery of native species composition (ecological integrity), whereas forest rehabilitation emphasizes functional aspects of recovery, and can involve non-native species. Taking a landscape approach considers forests as internally interactive landscape units in which the trajectory of a forest patch is influenced by the state of neighbouring patches such that restoration outcomes for a particular forest patch will heavily rely on the connectivity with other patches, while the status of these patches will also influence restoration success, for ecosystem services provisioning and biodiversity conservation alike (Chadzon et al. 2016).

[10] See Annex 1 for definitions.

Smallholder support and fairness is often based on the premise of smallholder participation, investing in their progress, provides capacity building, is sensitive towards fair benefit and responsibility sharing around deforestation free production.

Supply chains are the network of all the individuals, organizations, resources, activities and technology involved in the creation and sale of a product, from the delivery of source materials from the supplier to the manufacturer, through to its eventual delivery to the end user. A supply chain is thus about the management and logistics of getting a product from A to B.

Transparency, monitoring and accountability – Over the last decades, transparency has evolved to be recognised as a key condition of environmental governance (Fung et al., 2007; van Oorschot et al. 2018; Mol, 2010). Transparency, monitoring and accountability is relevant in relation to corporate power and business operations and associated socio-environmental impacts. For example, an corporate pledge cannot be considered successful if is an intention on paper without any monitoring or progress report. Many companies and businesses use corporate confidentiality as an reason not to report.

Value chains are similar to supply chains but recognise that value is not only the economic, monetary value added as the sequence of activities in getting a product from A to B often creates a higher unit value for the product sold at the end of the chain than the raw commodity at the beginning. Value is also socially, culturally and environmentally defined. It is the regard that something is held to deserve; its importance, worth, or usefulness. It reflects principles or standards of behaviour, and a person's or society's judgement of what is important in life. Value can be intrinsic – the value of something in and for itself, irrespective of its utility for someone else. Examples are the price that some people are willing to pay for a certain brand or label. It is also the price and processes that include these externalities – the things not included in many market values: such as a decent wage, or the environmental externalities or costs of, for example producing cotton or tanning leather. Many of the processes in value chains involve or embody unfairness, inequality and have undesirable impacts – economic, social and environmental. Using the term supply chain ignores this political dimension and instead, focuses on the logistics, information and activities. The term value chain acknowledges, and emphasises the value that can be built into chains (Ingram 2014).

Vulnerable forest areas, such as in High Conservation Value (HCV) and High Carbon Stock (HCS) areas, are adjacent to protected areas that are not well enforced and monitored and areas that are forested and agronomically and climatically suitable for the production of specific commodity but outside protected areas (Vijay et al. 2019). Risk exposure is higher when production systems are located in vulnerable forest areas.

Zero deforestation is that no forest areas are cleared or converted to other land uses.

Zero-deforestation commitment is a type of voluntary sustainability pledge or initiative adopted by a company to signal its intention to reduce or eliminate deforestation associated with commodities that it produces, processes, or trades (NYDF Assessment Partners, 2019).

Zero gross deforestation excludes deforesting of native vegetation conversion of pristine forests at any cost.

Zero net deforestation allows certain conversion to be compensated later by planted forests.

Annex 2: Theory-based logic of intervention framework

In Theory-Based-Evaluation (TBE), the logic of a value chain intervention – such as a Zero deforestation approach – is broken down into interchangeable concepts, using a 'logic chart' (Mayne, 2001), 'result chains' (DCED, 2010), 'programme theories' (Chen, 1994; Rogers, 2009) and 'theories of change' (Weiss, 1997). This exercise explores the causal chain expected to result in impact(s). The intervention logic set-up used here is inspired by Mayne (2001). The impact logic pays attention to the outputs and expected outcomes on the different stakeholder groups involved, and the disaggregation of outcomes into three categories: immediate, intermediate and ultimate, final outcomes. In practice, outcome categories are often used flexibly: what is considered an immediate outcome of one activity can also be considered an intermediate output or impact of others. The tandem of output/reach and their link to immediate outcomes of activities helps identify indicators of progress that are closer to the sphere of influence of an intervention and help inform learning and results-based management. Outputs can then be used as performance indicators for evaluating interventions rather than using only indicators of final impact (Armytage, 2011). This step leads to 'areas' where a focus on causality and attribution can aid reflection on the performance of the intervention and/or generate information on key assumptions about the way that activities translate in the desired outcomes.

The definitions used here are that *Zero-deforestation commitments* are realised by *interventions* (on macro, meso or micro level), which are comprised of *activities* or *inputs* that aim to have a positive impact to reduce or eliminate deforestation associated with commodities that a company produces, processes, or trades. Inputs refer to the means that are necessary to carry out the process (Van Tulder, 2010) or the provision of regimes (Young, 1999, 111). Interventions result in outputs. *Outputs* are tangible actions, reports and/or products (e.g. events). Output refers to the results of a decision-making process or the norms, principles, and rules established (Underdal, 2002). An output may be located in an organisation or a physical location but influenced by interventions. Outputs result in behavioural change of a company (products, systems, processes and relationships) and the stakeholders in its value chain (suppliers, farmers, buyers and consumers), and/or government (regulations, policies), non-governmental or civil society organisations (campaigns, projects, programmes), and citizens (such as farmers supplying the commodity and communities they live in) and can be manifested at different temporal and spatial scales, that lead to outcomes. *Outcomes* are the consequences of the implementation of and adaptation to these norms, principles and rules (Underdal, 2002). An outcome is a shorter-term effect, also known as intermediate or immediate effect – caused by interventions and changed company behaviour. Outcomes can occur concurrently, and at many different levels, such as on a national macro-economic level, an ecosystem or landscape, sector, firm, community, household and individual. Outcomes can be influenced by indirect drivers – that is external, contextual factors, such as are global, national and local level interactions of social, economic, political, cultural and technological processes. The ultimate effect of Zero-deforestation commitments are *impacts,* the social, biophysical and ecological effects of **initiatives** and the cumulative impacts of an **approach** (i.e. similar initiatives in terms of actors, interventions and underlying theories of change). Outcomes and impacts can be attained through different *impact pathways*. These are causal chains of effects. Pathways indicate how specific policy interventions are believed to cause impacts. High outcomes may not lead to high impacts due to *leakage* (Meijer, 2015), the situation where reductions in deforestation lead to an increase in deforestation by others, for other purposes, or elsewhere (Wunder, 2008).

Indicators used in this study recognise deforestation as a value chain risk, the initiative(s) made by a company individually and sector, the actors of the chain involved and the type of commitment made. Ludwig (2018) measured outputs as the share of companies that developed policies to adhere to their commitments, type of policies in place, as well as the overall number of policies developed to implement commitments. Outcomes can be measured as the part of the sector, or the number of companies, that

change behaviour (Meijer, 2015). High zero deforestation policy implementation rates by a sector form one component of this. Another indicator is the market share of sustainably produced products within a chain, however this can be a weak indicator if companies do not significantly change their sourcing practices, as observed in the adoption of the Forest Stewardship Council (FSC) certification scheme (Pattberg, 2007). Ludwig (2018) suggests that zero deforestation outcomes can better be measured in terms of zero deforestation policy implementation rates and the share of commodities compliant with certification standards or internal standards. Indicators of impacts include the amount of avoided deforestation. However, data establishing a clear link between commitments and avoided deforestation is still rare, and attribution is difficult due to different spatial scales of interventions, outcomes and impacts.

Evaluating zero-deforestation initiatives

The impact evaluation of zero-deforestation commitments per commodity is methodologically challenging. Not only have many different approaches to zero deforestation occurred in different countries and commodity chains, but also different interventions (i.e. the approaches used) have emerged and have diversified over time, from the use of voluntary sustainability certification to a wider range of activities, including landscape programs and multi-stakeholder partnerships. There have also been different definitions and indicators used to measure outcomes and impacts of these interventions. This increasing complexity is indicative of the dynamic and evolving state of national and international policies, corporate social responsibility and pressure by NGOs and CSOs, and it creates a challenge of 'breadth versus depth' in the impact evaluation. It makes it necessary to aggregate outcomes in a large diversity of situations into more general and concise impact storyline.

Another challenge is the 'attribution' of changes to the different approaches and interventions of different stakeholders. To obtain some outcomes, multiple parties have collaborated in public-private and private-NGO partnerships which all contribute to change processes. In such instances, it is difficult to directly attribute impacts at the level of corporate practices and value chain governance to one organisation or one partnership alone, as other factors and **actors**[11] also have had an influence on such impacts that may emerge at higher spatial scales than that of direct corporate 'reach'.

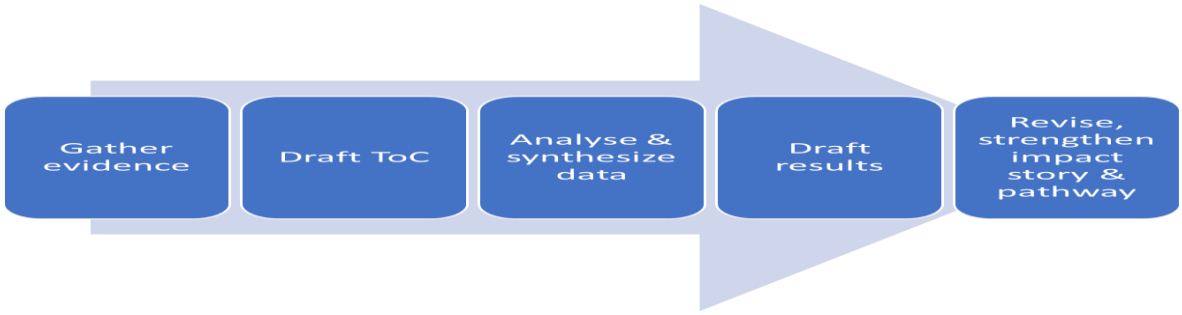
To analyse the impacts of zero-deforestation commitments, first, we took an impact evaluation, theory-based methodology. An intervention logic was constructed for each of the commodities identified through the discourse analysis and review of literature. The intervention logic reflects expectations embodied in approaches about the causal relations between intervention activities and interventions to halt deforestation and degradation and restoration, and their final outcomes and impact. A *counterfactual situation* refers to "what would have been the social and economic impacts if there was no initiative". This is sometimes-termed business as usual or the 'without the project' scenario.

Subsequently, we collected multiple sources of available evidence (from literature, databases) using a theory-based logic of intervention (see Annex 1) to investigate the evidence for the causal relations for each of the commodities and the different approaches used. In the analysis and synthesis stage, we critically analysed the available evidence to verify and refine the rationale behind each of the approaches. Contribution analysis is a systematic way to exploit a variety of information sources to assess impact, even where it is not possible to attribute the outcomes unambiguously to the approaches. Rather than attribution of net-effects, contribution analysis – illustrated in Figure 13 – focuses on whether a convincing claim can be made that an approach has been a necessary factor, in a configuration of actors and factors, which created the observed changes. Process tracking is used to assess whether changes

[11] See Annex 1 for definition.

occurred and whether the approach contributed to such changes, by examining evidence (e.g. statements and reports, although ideally also interviewed) about specific moments in time that changes have taken place in the sector, and examples of how the activities and events in the different approaches used have played a role in these change processes. The result is a diagrammatic impact pathway and associated impact stories- showing the evidence of how these impact pathways appear to work.

Figure 13 The steps in the contribution analysis framework



The final step was to present and discuss the draft impact stories and pathways evaluation results with PBL experts (Mark van Oorschot, Marcel Kok and Johan Meijer) in February and September 2020. After the discussion, the study conclusions and structure were sharpened according to feedback.

Scope

This study is configurative, explorative and aggregative. It is configurative because definitions were needed to clarify the objects of the evaluation (Question 1). It is explorative in nature because it investigates different types of ZD commitments and the types of impacts effects they generate through the behaviour of companies in developing countries. Different types of commitments were expected to produce different behaviours, resulting in a range of different impacts. This study is aggregative as it summarises literature documenting the impact of similar interventions, with both similar and different types of impact measures.

Conclusions are provided based on evidence in the literature which explains how corporate commitments generate outcomes and how company behaviour impacts upon deforestation. This approach is known as a realist synthesis. Both quantitative and qualitative empirical data relating to ZD commitments have been considered. The study is based upon the premise that (corporate or government led) interventions (alone or with other parties), have effects (impacts and outcomes) which may be positive or negative, intended or unintended, direct or indirect, which reduce or eliminate deforestation associated with commodities that it produces, processes, or trades.

The scope of this study is limited to the six commodities and does not include others identified for deforestation risk, such as rubber and wood pulp. The scope was limited to initiatives from 2000 onwards. Geographically, it includes interventions and corporate commitments in tropical countries.

Annex 3: Evidence on initiatives - their outputs, outcomes and impacts

Access the database via this link

Commodity	Name of initiative/ approach	Classification of initiative/ approach [1]
Cattle (beef)	Slaughtering the Amazon campaign	DD
Cocoa	Cocoa Barometer	DD
Coffee	Coffee Traceability Platform	DD
Palm oil	Sustainability Mapper , Forest Cover Analyzer	DD
Palm oil, cattle, soy, timber	Forest 500	DD
Soy	Soy Moratorium	DD
Timber	Agreement on International Responsible Business Conduct (IRBC) for Promoting Sustainable Forestry and follow up Convenant Bevorderen Duurzaam Bosbeheer 2017.	DD
Cattle (beef)	Produce, Conserve and Include (Produzir, Conservar e Incluir, PCI)	L
Cocoa	Climate Cocoa Partnership for REDD+ Preparation/ Cocoa and forest initiative Western Ghana	L
Coffee	Carbon-Coffee Project	L
Palm oil	Green Development - Landscape approach	L
Palm oil	Oli palm sustainable landscapes project	L
Palm oil	INOBU - Memorandum of Understanding (MoU) with the provincial government of Central Kalimantan, the district government of Kotawaringin Barat and Yayasan Penelitian Inovasi Bumi (INOBU)	L
Soy	Produce, Conserve, Invest (PCI) plan, Mato Grosso state, Brazil	L
Timber	Tri-national Dja-Odzala-Minkébé (TRIDOM) Landscape	L
Palm oil	Living landscape approach	L
Cattle (beef) (chicken, soy, palm oil, coffee, packaging fibre)	Commitment on Forests and addendum	P
Cocoa	Forever Chocolate	P
Coffee	The Positive Cup	P
Coffee	C.A.F.E Practices	P
Coffee	Nespresso AAA Sustainable Quality™ Program	P
Palm oil	Sustainable Palm Index	P
Palm oil (Paper & board, timber, soya, meat & dairy products, cocoa, coffee, cassava, biofuels)	Nestle responsible sourcing standard, Nestlé Commitment on Deforestation and Forest Stewardship	P
Palm oil, timber	Pepsico Forestry Stewardship Policy and Global Policy on Sustainable Palm Oil	P
Soy	Deforestation-free supply chain	P
Timber	Sustainability as Core of Our Business	P
Cattle (beef and leather), palm oil, paper and pulp, soy, cocoa, rubber	Amsterdam Declaration Towards Eliminating Deforestation from Agricultural Commodity Chains with European Countries	PPP
Cattle (beef)	G4 Agreement or Zero Deforestation Cattle Agreement	PPP
Cattle (beef)	TAC (Terms of Adjustment of Conduct)	PPP
Cocoa	Cocoa & Forests Initiative (CFI)	PPP
Coffee	National Sustainability Curriculum (NSC) , Global Coffee Platform (GCP) a merger of 4C and IDH's Sustainable Coffee Program	PPP
Palm oil	Green growth agenda West Kalimantan	PPP
Palm oil	Mesoamerican Palm Oil Alliance (MAPA)	PPP
Soy	Soft Commodities Forum	PPP
Coffee	none found	R
Soy	Brazilian Environmental Agency's (IBAMA) Operation "Soy Sauce"	R

Commodity	Name of initiative/ approach	Classification of initiative/ approach [1]
Timber	FLEGT (EU Forest Law Enforcement, Governance and Trade)	R
Cattle (beef)	Standard for Sustainable Cattle Production Systems and Chain of Custody Standard	VSS
Cocoa	UTZ Certified	VSS
Coffee	UTZ Certified	VSS
Coffee	Rainforest Alliance (Sustainable Agriculture Network (SAN) is the standard-setting body)	VSS
Coffee	Smithsonian Bird Friendly	VSS
Coffee	4C (now Global Coffee Platform (GCP) and Coffee Assurance Services (CAS))	VSS
Palm oil	RSPO Certification	VSS
Soy	Roundtable on Responsible Soy (RTRS) & Zero Deforestation multi-stakeholder 3.0 RTRS Production Standard	VSS
Timber	Forest Stewardship Council (FSC)	VSS
Timber	Program for the Endorsement of Forest Certification (PEFC)	VSS

Annex 4: Theories of Change for zero deforestation commitments in commodity value chains

Figure 14 Theory of Change of ZD interventions in the cattle value chain

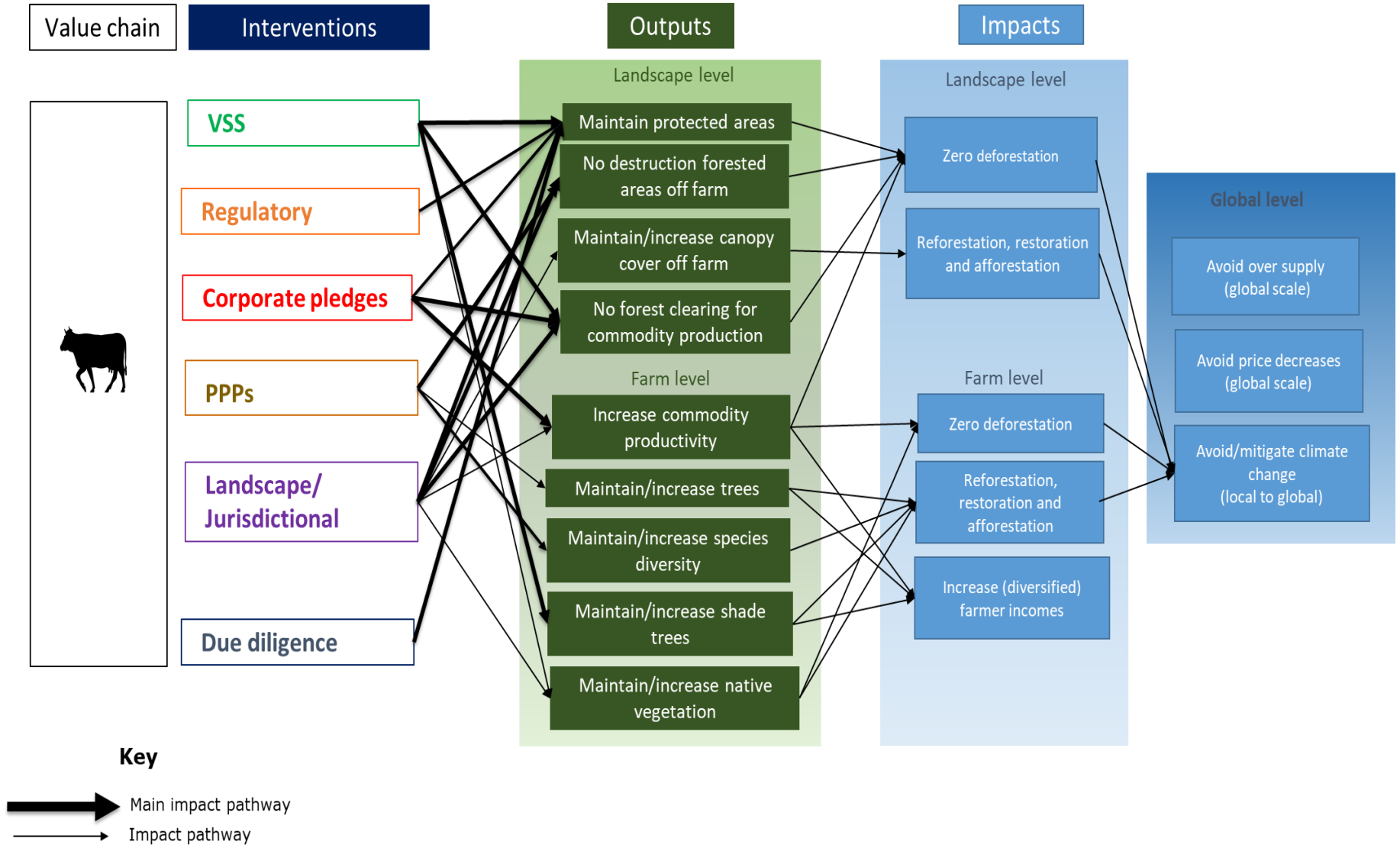


Figure 15 Theory of Change of ZD interventions in the coffee value chain

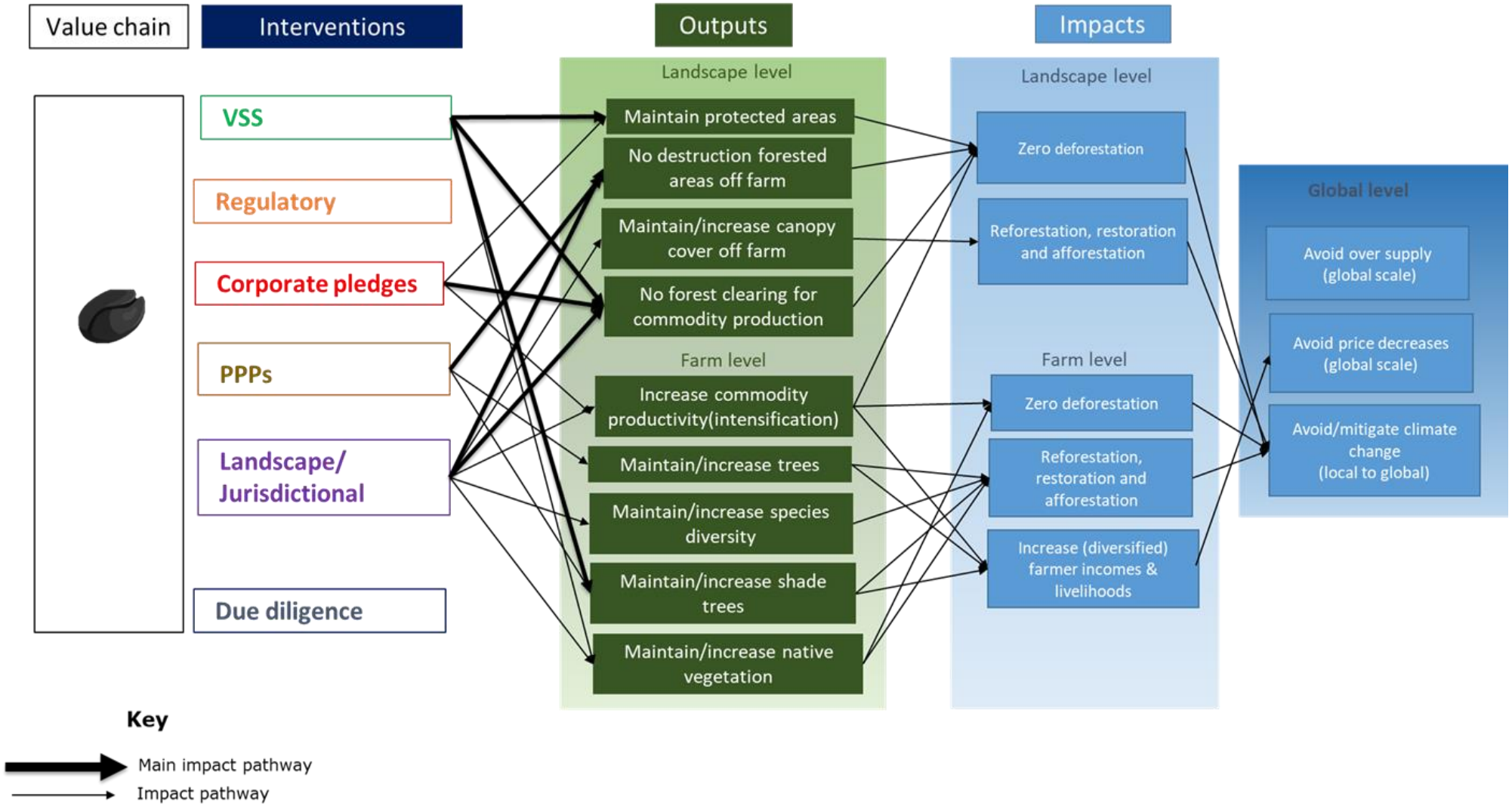


Figure 16 Theory of Change of ZD interventions in the cocoa value chain

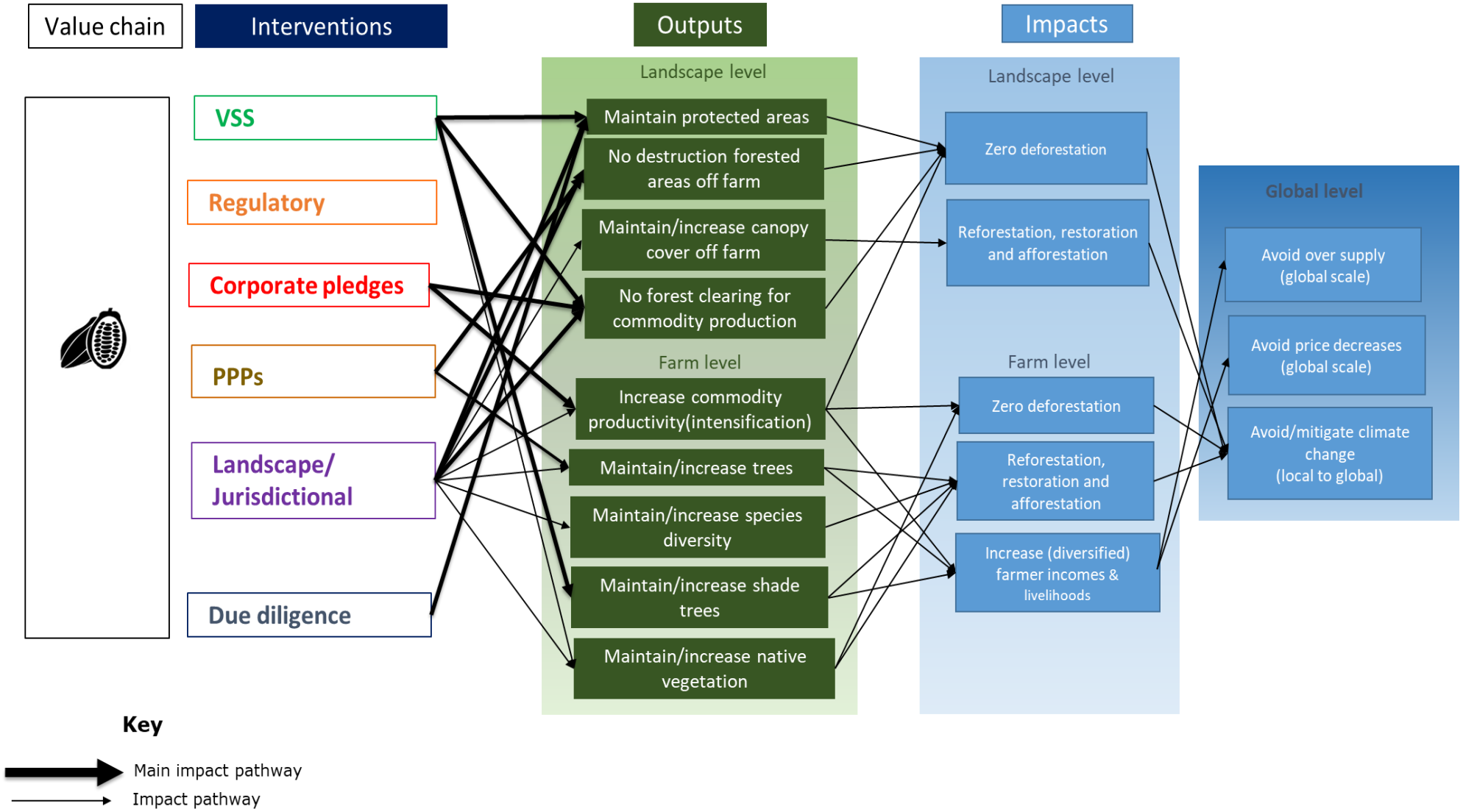


Figure 17 Theory of Change of ZD interventions in the soy value chain

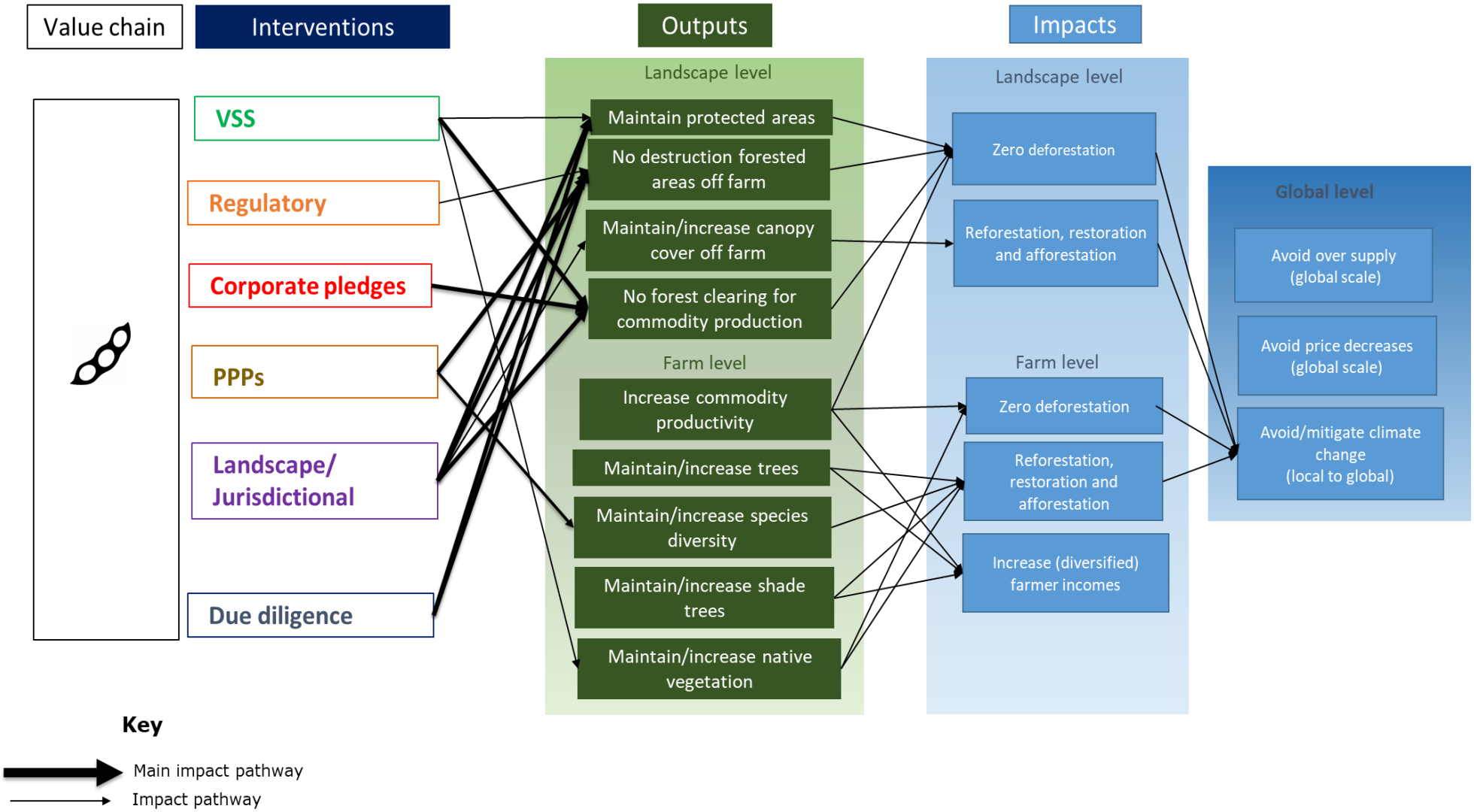


Figure 18 Theory of Change of ZD interventions in the palm oil value chain

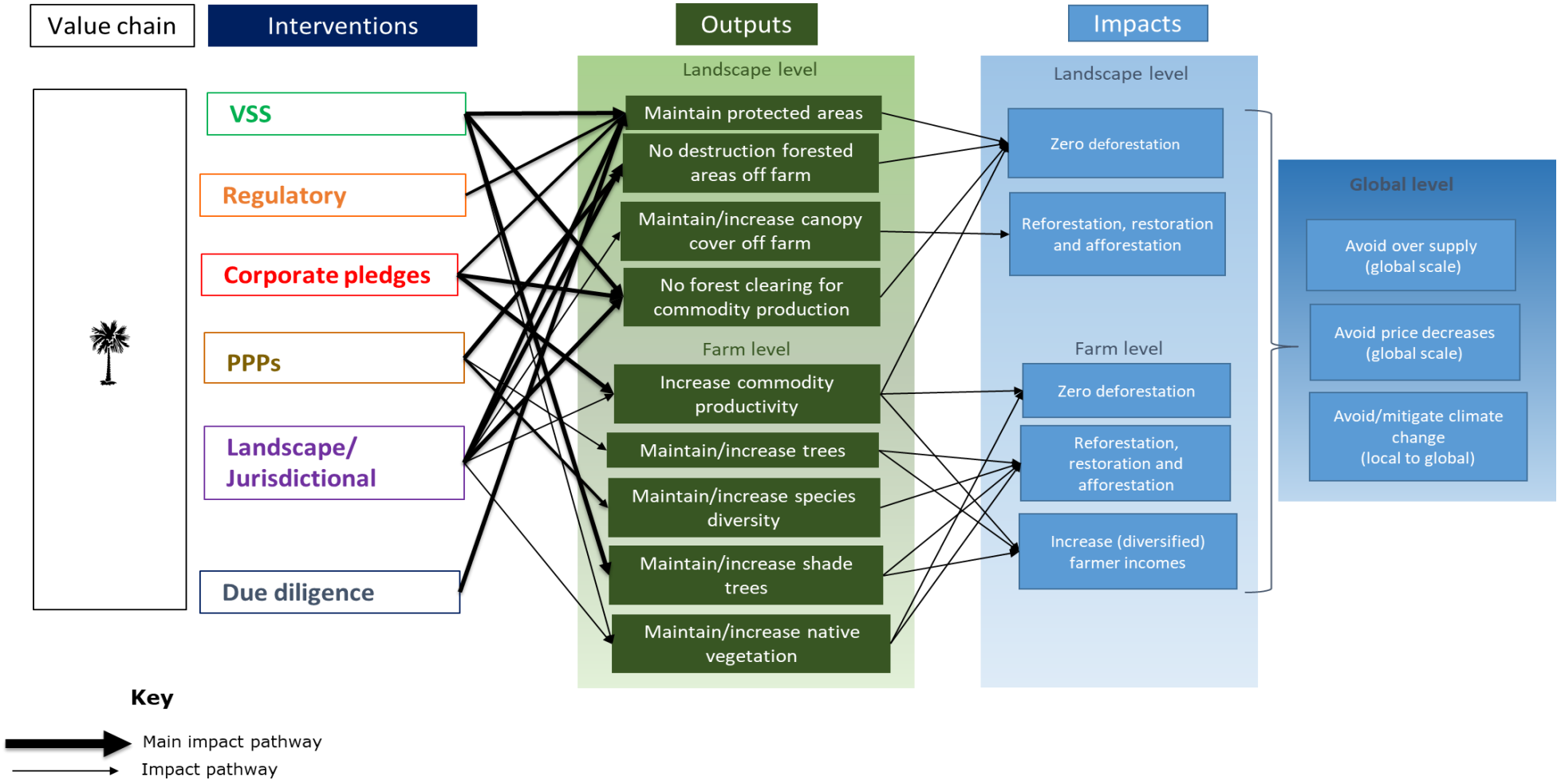
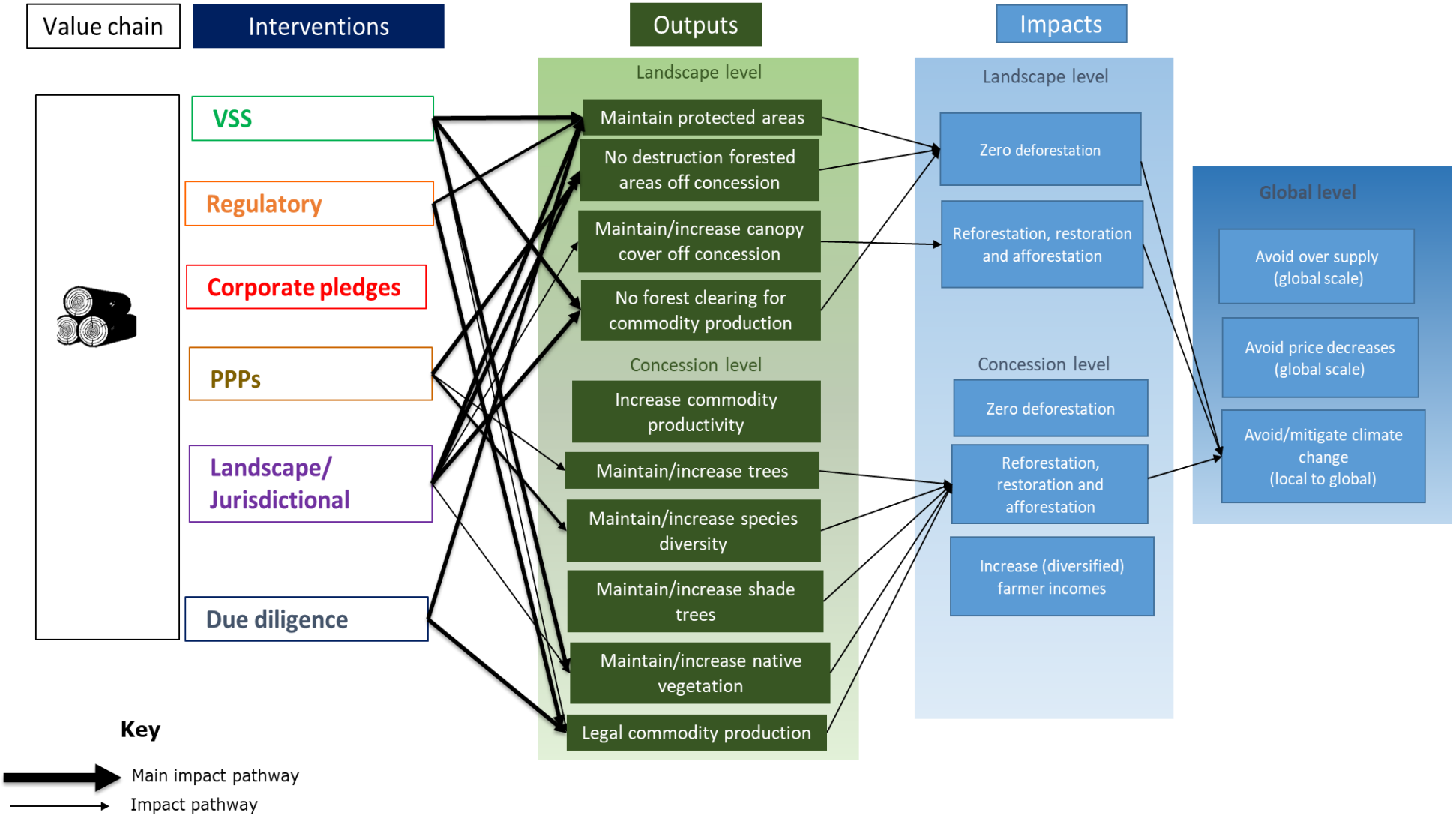


Figure 19 Theory of Change of ZD interventions in the timber value chain



Annex 5: Geographic focus of zero deforestation commitments in commodity value chains

Table 6 Main geographic focus of ZD initiatives in five commodity value chains

Commodity	Africa	SE Asia	Asia	Central America	Latin America	Europe	North America	Oceania
Soy				Brazil, Argentina	Paraguay, Uruguay Bolivia	EU		
Palm oil	Cameroon, RoCongo	Indonesia Malaysia, PNG			Ecuador, Peru, and Brazil			
Cocoa	Ivory Coast Ghana Cameroon	Indonesia			Peru	EU		
Coffee	Multiple, including: Ethiopia, Uganda, Tanzania, Cote d'Ivoire	Indonesia, Vietnam, Laos,		Multiple, including: Mexico, Guatemala, Honduras	Multiple, including: Brazil, Colombia	EU		
Timber	Multiple, including: Cote D'Ivoire, Cameroon, Gabon, Ghana, Liberia, Republic of Congo, Cameroon	Multiple, including: Malaysia (PEFC), Indonesia			Multiple, including: Surinam, Brazil	EU, Russia	Canada, USA	Australia
Cattle				Amazon) Brazil, Peru and Bolivia, (Cerrado & Gran Chaco) Argentina, Paraguay Bolivia		EU		

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Back cover photo: RSPO certified oil palm plantation and part of a landscape project, Indonesia. Credit: Verina Ingram
Front cover photo: UTZ certified cocoa farm and part of a corporate sustainable cocoa project and public private partnership program, Ivory Coast. Credit: Verina Ingram

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