

Palm oil supply chain complexity impedes implementation of corporate no-deforestation commitments

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Author Contributions

J.L.W. led the study design, collected and analysed the data, and drafted the manuscript; A.K. supervised the study, contributed to the design and analysis, and reviewed the manuscript.

Declaration of Interest

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Abstract

In recent years, many palm oil companies have committed to eliminating deforestation activities from their operations. NGO reports and companies' self-identified challenges indicate that barriers exist that impede the implementation of these commitments. Here we show that complexity across the extent of the palm oil supply chain poses a major barrier that hinders companies from being able to secure guaranteed no-deforestation commitments. Other barriers include the lack of consensus on definitions of deforestation, inadequate government support and persisting markets for unsustainably-produced palm oil in China and India, which undermine companies' efforts to achieve supplier engagement and compliance. Current certification standards, meanwhile, require amendment to help overcome barriers posed by supply chain complexity. In conclusion, the existing model used

to address palm oil-driven deforestation, based on NGO shaming campaigns and unilateral adoption of commitments by individual companies, is unlikely to achieve no deforestation in the current context of palm oil production and trade. Instead, a broader set of complementary mechanisms is required to overcome supply chain complexity and ensure that no-deforestation commitments can be implemented successfully.

Keywords

Biodiversity

Deforestation

Land-use change

Palm oil

Supply chain

Zero deforestation

1. Introduction

Palm oil is a high-yielding and highly-profitable vegetable oil used in food, soap and oleochemicals manufacturing (Mba et al., 2015). Growing demand has seen a large increase in global production over the past 30 years (UN FAO, 2017). Much of this increase has taken place in Malaysia and Indonesia, which accounted for more than 90% of production in 2014. Palm oil is economically important for producing countries (Koh and Wilcove, 2007) but expansion of cultivation has been associated with deforestation, causing loss of biodiversity (Fitzherbert et al., 2008) and ecosystem services (Koh et al., 2011), and contributing to greenhouse gas emissions (Carlson et al., 2013). The expansion of oil palm plantations replaced over 1.0 million hectares of forest in Malaysia and 1.7–3.0 million hectares of forest in Indonesia between 1990 and 2005 (Fitzherbert et al., 2008). Recent research suggests palm oil-driven deforestation in Indonesia is ongoing, with the rate of deforestation for new oil-palm plantations remaining stable between 2005–2010 and 2010–2015 (Austin et al., 2017).

The rapid expansion of oil palm and its association with deforestation have led to non-government organisation (NGO) campaigns for more sustainable production (Khor, 2011). The Roundtable on Sustainable Palm Oil (RSPO) was established in 2004 as a non-profit, industry-led trade organisation to “promote the production and use of sustainable palm oil” (RSPO, 2015). The RSPO provides certification for sustainably-produced palm oil (Certified Sustainable Palm Oil; CSPO) based on its Principles and Criteria (P&C), which include conservation of biodiversity and natural resources, and reductions in greenhouse gas emissions (RSPO, 2013). Recent research suggests that RSPO certification reduces the loss of primary forests in certified plantations (Carlson et al., 2018) and as of March 2018, 19% of global palm oil production was RSPO-certified (RSPO, 2018).

86 Despite its apparent success, however, the RSPO has been criticised for shortcomings
87 including domination by commercial interests, tardiness in promoting bans on destructive
88 activities and non-compliance by members (Laurance et al., 2010). The RSPO standard has
89 also been criticised for being insufficiently strict (Schouten and Glasbergen, 2011). For
90 example, although the RSPO P&C protect primary forests and other areas identified as
91 being of High Conservation Value (HCV; RSPO, 2013), the majority of remaining forest in
92 Indonesia and Malaysia is classed as secondary, selectively-logged or degraded (Padfield et
93 al., 2016). While primary forest is invaluable for sustaining tropical biodiversity, these other
94 forest types may also retain biodiversity value, depending on their age and land-use history
95 (Deere et al.; Gibson et al., 2011). This has led some groups to claim that forests which are
96 not identified as HCV still merit protection (Rosoman et al., 2017). Under the RSPO
97 standard, however, non-primary forest types which are not identified as HCV may be cleared
98 to make way for new plantings. The absence of a blanket 'no-deforestation' requirement in
99 the existing RSPO standard resulted from the need to find a compromise between corporate
100 and civil-society interests during the 2013 P&C negotiation (Carlson et al., 2018). However,
101 the 2013 P&C are currently under review, with a revised version due to be published in
102 November 2018, and the inclusion of a no-deforestation requirement is under consideration
103 (RSPO, 2017a).

104
105 In light of the perceived inadequacy of the RSPO and the pressure exerted by NGOs, many
106 palm oil companies have made independent 'no-deforestation' commitments (Khor, 2011).
107 No-deforestation commitments are non-governmental, privately-adopted corporate policies
108 that aim to eliminate deforestation from companies' operations and supply chains. They may
109 also include other environmental and/or ethical objectives, such as the avoidance of
110 peatland destruction and worker exploitation, as encapsulated by the phrase 'No
111 Deforestation, no Peat, no Exploitation' (NDPE). Commitments of this sort provide
112 reassurance for investors, NGOs and other stakeholders concerned about deforestation

(Padfield et al., 2016). No-deforestation commitments have been adopted by companies throughout the palm oil supply chain, from growers to retailers (Donofrio et al., 2017). An estimated 96% of global palm oil production is covered by some form of no-deforestation commitment (Hurowitz, 2014).

In the absence of a widely-accepted certification standard for no deforestation (Greenpeace Indonesia, 2016), NGOs have been monitoring companies' implementation of no-deforestation commitments through initiatives such as the Sustainable Palm Oil Transparency Toolkit (SPOTT; Zoological Society of London [ZSL]; www.spott.org) and Global Forest Watch (GFW; World Resources Institute [WRI]; www.globalforestwatch.org). Both SPOTT and GFW use satellite monitoring to detect tree cover loss and fires (WRI, 2017; ZSL, 2017). Unfortunately, it can be problematic for NGOs to use these tools to track implementation effectively, as deforestation events observed using satellite monitoring are difficult to definitively attribute to corporate concession holders because land occupancy is often disputed between tenants (Gaveau et al., 2016). The lack of standardisation between company commitments also makes cross-company comparisons problematic (Pirard et al., 2015).

The challenge of verifying implementation is further complicated by a historical lack of consensus over definitions of 'forest' and 'deforestation'. Definitions of forest are contentious due to differences in forest types, users, applications and cultural understandings, among other factors (Putz and Redford, 2010). Meanwhile, companies have variously committed to eliminating 'net deforestation' or 'gross deforestation', each of which has different implications (Brown and Zarin, 2013). In an effort to resolve these differences, two competing methods have been developed for classifying forest: the High Carbon Stock (HCS) Approach and the HCS Study (HCS+) (HCS Approach Steering Group, 2017; HCS

Study, 2015). Convergence of the two methods has now been agreed under the HCS Approach (HCS Convergence Working Group, 2016) but the new, unified approach is yet to be universally adopted and does not yet feature in the RSPO standard. Furthermore, questions remain over how it can be applied in highly-forested regions where some degree of deforestation may be unavoidable if socio-economic development is to be improved (Senior et al., 2015).

Although it is difficult to verify implementation by individual companies, some NGOs have claimed that no-deforestation commitments are failing across the industry. For example, Greenpeace cited the high proportion of deforestation alerts originating in oil palm plantations in Indonesia in 2014 and 2015 as an indication that no-deforestation commitments are failing to be implemented (Greenpeace International, 2015). In its palm oil scorecard for 2016, Greenpeace also claimed that a number of consumer goods manufacturers (CGMs) are failing to implement their commitments (Greenpeace International, 2016). Periodic media reports of commitment breaches support the claim that implementation failures occur at least occasionally (Jacobson, 2015, 2016a).

In light of accusations that companies are failing to deliver on their no-deforestation commitments and considering statements from companies about the challenges of implementation (John, 2016), we investigated the barriers experienced by palm oil companies when implementing no-deforestation commitments. Given the importance of multi supply chain-tier relationships for sustainability (Mena et al., 2013) and the adoption of no-deforestation commitments across the palm oil supply chain, we examined companies and their internal and external relationships across all supply chain tiers. Our aims were to: 1) identify the types and scale of barriers experienced by companies to the effective implementation of no-deforestation commitments; 2) understand how companies perceive

their relationships with other stakeholders to influence implementation; and 3) investigate how the structure of supply chains influences the effective implementation of no-deforestation commitments.

2. Methods and materials

2.1 Supply Chain Structure

This study investigated companies representing the major tiers of ‘the palm oil supply chain’ considered as a generic system covering palm oil trade from production to consumption. The supply chain was understood as flowing from production (upstream) to consumption (downstream). Individual supply chains characterised by explicit customer-supplier relationships could not be identified due to the lack of information in the public domain. In addition, physically-isolated supply chains are only used for low volumes of palm oil due to high costs (van Duijn, 2013).

2.2 Developing the Interview Guide

A focus group was held to identify key themes to guide subsequent interviews. Five participants were selected from two NGOs and two sustainability consultancies based on their no-deforestation activities. Two participants from a third NGO were unable to join the focus group but participated in follow-up interviews. Both the focus group and follow-up interviews were audio recorded and the recordings transcribed. Key themes were identified from the transcripts and used to develop the interview guide (Brinkmann and Kvale, 2015).

2.3 Participant Sampling

Participants were selected using a purposive sampling approach (Russell, 2006) designed to ensure coverage of six tiers of the palm oil supply chains serving European markets. Supply

chain tiers were identified from the sustainable palm oil literature as Grower, Large Integrated Supply Chain Company (LISCC), Processor/Refiner (Processor), Manufacturer, CGM and Retailer (van Duijn, 2013; von Geibler, 2013). The distinction between tiers was to some extent subjective, as some palm oil companies – particularly LISCCs – often straddle multiple tiers (Wilmar, 2016). However, allocating tiers ensured inclusion of participants from across the extent of the supply chain. Participants were also selected from NGOs due to the important role of civil society stakeholders in operating beyond, but influencing, sustainable commodity supply chains (Newton et al., 2013). Participants were invited either in person at the RSPO European Roundtable (EURT) in Milan in June 2016, through contacts at two partner NGOs or by personalised emails.

A minimum of two organisations from each supply chain tier were targeted for inclusion to ensure response reliability. The final sample comprised 24 participants, just below the upper bound of the range recommended for interview studies (interview study samples should normally include 15 ± 10 participants in order to permit sufficiently detailed and robust analysis of individual responses; Brinkmann and Kvale, 2015). This ‘grounded’ approach (Corbin and Strauss, 2015) does not aim to achieve statistical representativeness of a study population, but rather to explore the diversity of participants’ perspectives where these cannot be anticipated *a priori* with any certainty. Identification of a ‘saturation’ point for emergent themes (the point during data collection after which no new concepts emerge; Corbin and Strauss, 2015) indicates a high likelihood that all relevant themes have been identified. Accordingly, results are not reported as the proportion of responding participants from the sample of 24 participants, but instead as per established qualitative social research practice. The majority of participants were sustainability directors at their companies and could be considered ‘elite’ subjects, i.e., experts with influential industry positions.

2.4 Interviews

Semi-structured, in-depth interviews were conducted across the palm oil supply chain with the 24 participants, representing 18 companies and 5 NGOs (23 organisations in total; Table 1). All supply chain tiers featured at least two participants except for 'Manufacturer', which featured one. This was acceptable due to functional overlap with the adjacent tiers, 'Processor' and 'CGM'.

Table 1. Types of participants involved in this research classified according to supply chain tiers for 23 organisations affiliated with the palm oil industry.

	Grower	LISCC	Processor	Manufacturer	CGM	Retailer	NGO
	GRO 1	LISCC 1	PRO 1	MAN 1	CGM 1	RET 1	NGO 1
	GRO 2	LISCC 2*	PRO 2		CGM 2	RET 2	NGO 2
	GRO 3	LISCC 3*			CGM 3	RET 3	NGO 3
	GRO 4	LISCC 4			CGM 4		NGO 4
					CGM 5		NGO 5
Total	4	4	2	1	5	3	5

* Participants LISCC 2 and LISCC 3 represented the same company.

CGM = Consumer Goods Manufacturer; GRO = Grower; LISCC = Large Integrated Supply Chain Company; MAN = Manufacturer; NGO = Non-Government Organisation; PRO = Processor/Refiner; RET = Retailer.

Participants were interviewed preferentially by Skype or alternatively by telephone. Mean interview duration was 63 mins (range: 43–84 mins). Interviews were audio recorded and, after completion, recordings were transcribed. Interviews were conducted under condition of anonymity and confidentiality. Two participants declined be audio recorded, so notes were

drafted post-interview and circulated to participants for validation (Lacey and Luff, 2001). The interview guide was continually refined throughout the interview period in response to issues raised by participants. This ensured that the research process was receptive to the deepening understanding of the themes explored and the interviews were of optimal quality (Brinkmann and Kvale, 2015).

2.5 Data Analysis

Interview transcripts were analysed using the Framework approach for applied policy research (Ritchie and Spencer, 1994). Framework is a systematic qualitative approach that documents the analysis process to ensure transparency and rigour of research activities from reviewing transcripts through to interpreting findings. The approach consists of five stages (familiarisation, development of a thematic framework, coding, charting and interpretation), which were applied in a step-wise fashion. Coding was conducted using NVivo 11 Pro software (QSR International, 2015). Further details on the data analysis are provided in the Supplementary Methods.

To ensure validity of interpretation and fair representation of the data, a second researcher assessed a subset of the analysis. This researcher undertook familiarisation with a randomly-selected subset of four interview transcripts and reviewed the thematic framework to assess whether it was a precise and accurate representation of the data. To acknowledge the potential for bias introduced by the primary researcher's observational standpoint, his standpoint was defined as instructed by Clark (2002); (Supplementary Note).

2.6 Ethics

The study was conducted in compliance with the Society for Conservation Biology Code of Ethics (Society for Conservation Biology, 2016) and Imperial College London research ethics procedure. Participants were required to sign a free, prior and informed consent agreement before participating.

2.7 Data Availability

Coded data are available in Supplementary Table 1. Raw data collected during the study are not publicly available as they contain information that could compromise participants' anonymity.

3. Results

Twelve barrier themes and twelve other themes were identified from the interview transcripts during the development of a thematic framework (Fig. 1). Seven major subjects were identified from among the themes and charted (see Supplementary Table 1 for the full thematic framework).

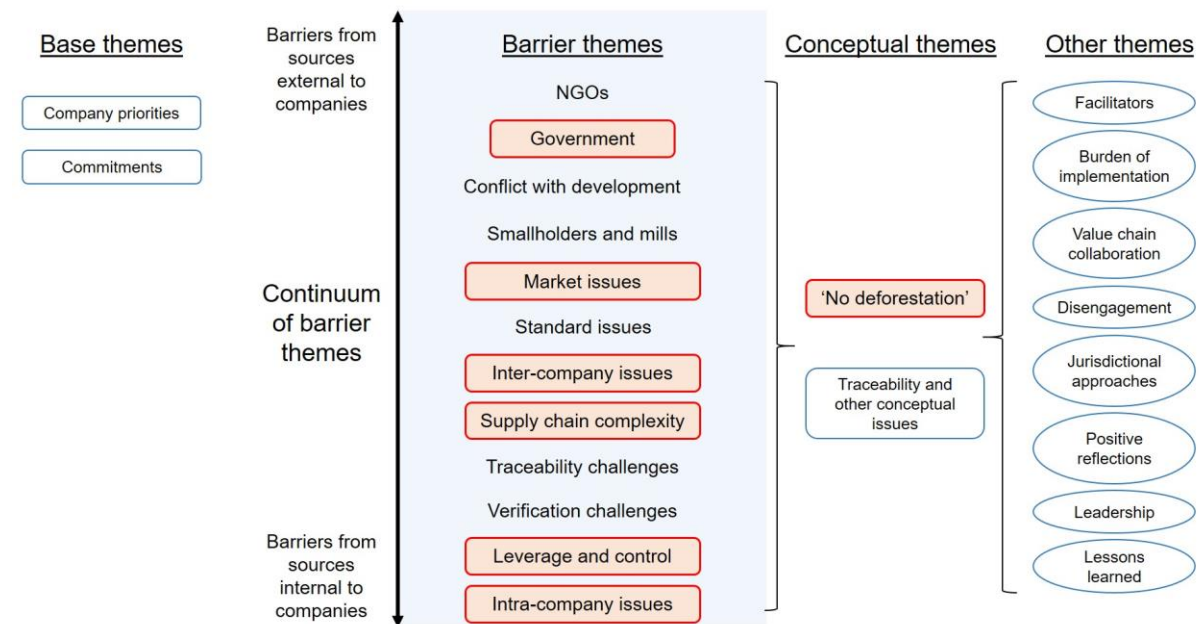


Figure 1. Illustration of the thematic framework identified during analysis, with major subjects highlighted in red boxes. Base themes are those related to companies' business priorities and adoption of no-deforestation commitments. Barrier themes are those related to the experience or perceptions by individuals of barriers to the implementation of commitments. Conceptual themes are those related to challenges resulting from disputed or poorly-defined concepts.

3.1 Barriers to Implementing No-deforestation Commitments

3.1.1 No-deforestation Definitions

There was a clear relationship between participants' supply chain tiers and their perceptions of the problems posed by 'no deforestation'. Growers felt that 'no deforestation' was a marketing term that made little sense in practice (Table 2, Quote 1). Further downstream, there were differences between CGMs in their understanding of 'no deforestation' and its practical implications. While some CGMs felt that eliminating deforestation might be unachievable, others felt unequivocally that "no deforestation means no deforestation" (Table 2, Quote 2).

The perceived incompatibility of no-deforestation commitments and development priorities was discussed by the majority of participants. This was particularly the case at the production end of the supply chain, where all but one grower and all LISCCs raised the topic. Growers felt that, in highly-forested regions, no-deforestation commitments meant denying impoverished communities the opportunity for development through agricultural expansion (Table 2, Quote 3). These views were generally supported by NGOs, although one felt that "painting zero deforestation... as some sort of Western colonial imposition on things just simply isn't true" (NGO 5).

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Table 2. Examples of participant statements identifying and explaining barriers to the implementation of no-deforestation commitments.

A) No-deforestation definitions	B) Intra- and inter-company barriers	C) Supply chain complexity
1. "We're a bit confused with 'no deforestation' because we don't really understand what they're trying to achieve. 'Not cut trees.' Well sorry, that's not possible. If you see what I mean; you can't just say that the point is not to cut down trees." (Participant GRO 4) 2. "At the end of the day, when it says 'no deforestation', it means 'no deforestation'. You know. And it could be, there could be a little bit of fine tuning between you know, whatever the number of the actual physical measure that they've got in there." (Participant CGM 2) 3. "We're dealing with communities that are in extreme poverty in terms of health services, education, there's basic cash flows in the area, infrastructure... They are desperate. Indicators like child mortality and other things are just absolutely disgraceful. And in that situation we have to turn around and say, sorry, you have too many trees." (Participant GRO 3)	4. "With the size of [our workforce]* the big challenge for me is to bring them up to the level of understanding of what the new standard of sustainability means in their day-to-day operations. If you have two trainings a week, say 100 people, then in a year you can only train 5,000 people." (Participant LISCC 2) 5. "We call it the 'say-do gap'. And I often say it's a bit like that with the retailers. So they'll put a policy out – they'll put a standard out there – and it'll come out of their responsible sourcing team, or their sustainability team, or ethics team, or wherever they all do it. But then what the commercial team do is ignore it completely." (Participant CGM 3) 6. "People have made commitments first. No deforestation. They forgot that they didn't have the tools, or we didn't have the tools, to implement it. And so to me, that's where really we are in a problem now." (Participant GRO 4)	7. "I think all of us still have the risk of dealing with suppliers that are having deforestation. That is how complex the supply chain is. I don't have the full visibility yet to know where every single plantation operator is doing what... So, to say, 'Oh, we are completely deforestation-free,' is nonsense." (Participant LISCC 1) 8. "Palm oil isn't just straight palm oil. There is fractionation. So just because you produce sustainable palm oil at one end, actually getting it through the system, how the ingredients are used and the versatility of palm oil just makes it incredibly difficult." (Participant PRO 1) 9. "We sell, roughly, I think, I will keep it top line, but [thousands of]* products roughly will have palm oil or palm derivatives in them. That will be food or non-food. They will come from hundreds of different suppliers, manufacturers who will then take it from their own various different supply chains. But the complication also is one product can have five or six different palm derivatives each with their own supply chains in them." (Participant RET 3)
D) Leverage and control	E) Market issues	F) Government issues
10. "Buying from other people's mills, it is difficult to impose our standards to them, because they also have freedom to choose whether they would like to sell to us or to sell to our competitors... Third-party mills are not an entity that we can give instruction to, that we can tell them what to do. We need to talk with them as business partners." (Participant LISCC 2)	13. "We've got a demand; a demand for sustainably-produced oil. Concept requests for assurances – no deforestation – but a market that's not prepared to pay for it. So, yeah. That would be the single big issue. Yes, we can do these things, but surely you're going to pay for it." (Participant GRO 3) 14. "Premiums are a contentious topic. So where does the premium cost lie? Who should it lie with? Should it	16. "Genuine issues exist within the countries like conflict or lack of coordination between different ministries. You know, does the agriculture ministry which regulates farming really have an aligned policy with the forestry or environment ministry, which regulates granting concessions to exploit forests?" (Participant CGM 4) 17. "If the law is not being enforced, then actually they are shifting the burden of law enforcement to the

11. “We lack direct control over a complex supply chain, it’s quite an important point. We can ask our suppliers for things, but our suppliers in turn are sourcing from third parties that they don’t directly control.” (Participant CGM 4) 12. “Our company is touching on, I would guess, [several hundred]* plantations, mills. If you look at that relative to our volume usage, you’re looking at an average of about 20–30 tonnes per mill... So that means I’ve got to then talk to [hundreds of]* different mills in relation to the [tens of]* tonnes a year we might be using from them, to try and persuade them that that’s a good investment and to try and create some leverage.” (Participant RET 1)	be the grower, should it be the company? It certainly shouldn’t be the consumers.” (Participant CGM 1) 15. “I agree that the next job is going to be much more difficult. That’s going to be about creating demand in Asia, and that’s not just China and India; even Indonesia and Malaysia.” (Participant NGO 3)	market. Which in real terms, the market has no ability to do law enforcement. All that the markets can do is to not buy or to boycott, to ban.” (Participant LISCC 2) 18. “Where there are good medium-to-long-term plans and policies in place, these allow transition to zero-deforestation production on a gradual basis, meaning rules can be adopted more effectively. If the rules are more clear, people know what is expected of them and it makes implementation of those rules easier.” (Participant GRO 2)
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- 303 * Terms in square brackets have been substituted for original words quoted to remove the possibility that participants might be identified.
- 304 CGM = Consumer Goods Manufacturer; GRO = Grower; LISCC = Large Integrated Supply Chain Company; NGO = Non-Government Organisation; PRO =
- 305 Processor/Refiner; RET = Retailer.

3.1.2 Intra-company Barriers

Participants described a range of 15 barriers related to the implementation of no-deforestation commitments arising from their companies' internal structures, organisations and operations (Table 3). These included limited financial and human resources for implementation; anxiety about, and resistance to, implementation, often arising from deeply embedded institutional cultures; and problems arising from poorly written policies. Participants from larger companies cited the need to educate huge workforces about new commitments as a major challenge (Table 2, Quote 4). Education issues were less problematic for smaller companies, although they were mentioned across the length of the supply chain. Another major challenge faced by large companies was how to coordinate the implementation of no-deforestation commitments across multiple departments. For growers at the upstream end of the supply chain, implementing commitments requires large numbers of departments to work together, including land buying, licensing, operations and sustainability departments.

Some participants felt that no-deforestation commitments conflicted with their companies' commercial objectives. One CGM described how implementing no-deforestation commitments involved an internal struggle with her company's procurement department, which is driven by commercial key performance indicators (KPIs). Another CGM claimed that his retail customers often failed to adhere to their commitments because their commercial teams ignored sustainable sourcing policies (Table 2, Quote 5).

Table 3. Intra-company barriers to the implementation of no-deforestation commitments related to companies' internal structures, organisation and operations.

Barrier category*	Barriers described by participants
New policies	Challenge of developing and drafting company procedures
Limited resources	Cost of implementing commitments (financial, time) Insufficient capacity of different company departments
Lack of understanding	Insufficient knowledge or expertise within a company Challenge of raising awareness within a company
Internal opposition	Difficulty of changing ingrained culture in large organisations Anxiety about adopting new policies Resistance to making operations transparent
Commercial conflicts	Conflict with commercial KPIs and procurement targets
Coordination challenges	Organising implementation across many company departments Poor planning for implementation Difficulty of achieving consistency in implementation Internal communication challenges Difficulties associated with a company's large or small size
Commitment issues	Policies too weak to be implemented effectively

* As there was conceptual overlap between several barriers, 'barrier categories' were developed to group similar barriers together and facilitate charting. KPIs = key performance indicators.

3.1.3 Inter-company Barriers

Participants also perceived barriers to arise from differences between their own companies and other stakeholders in the supply chain. Differences in company size, values, operations (e.g., use of data) and culture were all cited as barriers that could hinder implementation by

obstructing collaboration. For example, one manufacturer described how companies with different languages, values, and cultural origins might struggle to agree on the terms for supplying deforestation-free palm oil. Further upstream, LISCCs reported that trying to meet the various demands of numerous customers with widely varying sizes, values and priorities (including deforestation-free palm oil) was an “impossible task”. One retailer claimed that their smaller suppliers were unable to prioritise supplying deforestation-free palm oil due to limited company capacity. Participants along the length of the supply chain reported a lack of trust that other supply chain stakeholders would fulfil their commitments.

Participants across the supply chain claimed that their business partners had a poor understanding of the challenges posed by their business environments. Growers felt that downstream companies made unrealistic commitments without first considering whether growers had the tools necessary for implementation, such as techniques for classifying forest (Table 2, Quote 6). At the downstream end of the supply chain, retailers felt that there was poor understanding of their lack of control over sourcing palm oil products from particular growers or LISCCs.

3.1.4 Supply Chain Complexity

Participants described the palm oil supply chain as being hourglass-shaped, with many different stakeholders at the supply and demand ends and a small number of trading companies in the middle (Fig. 2). Most participants saw the complexity of the supply chain as posing a major barrier to the implementation of no-deforestation commitments by obscuring palm oil traceability and hindering engagement with indirect customers or suppliers.

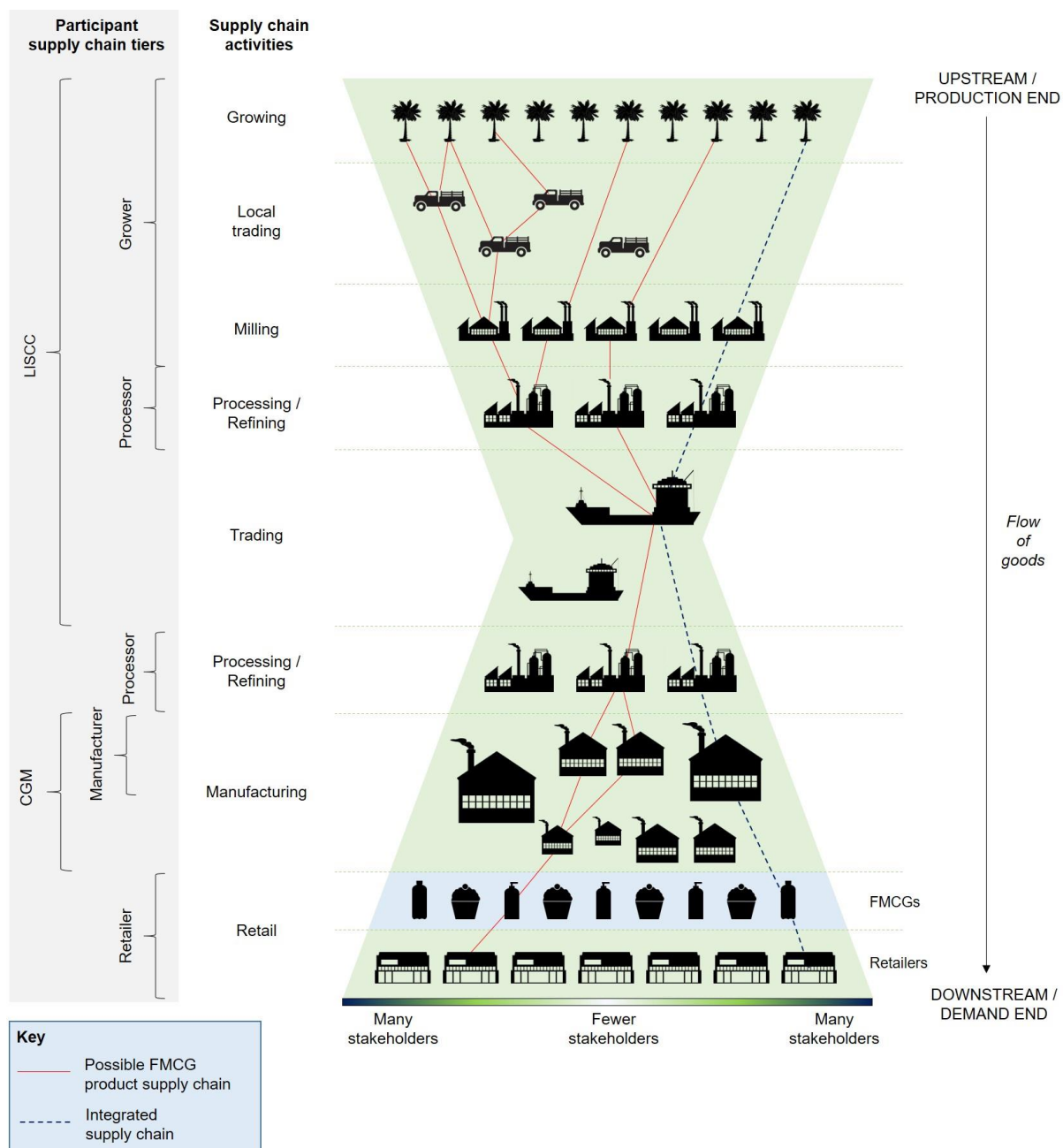


Figure 2. Schematic representation of the generic palm oil supply chain synthesized from participants' responses. Supply chain tiers identified from the literature are shown on the left in grey (van Duijn, 2013; von Geibler, 2013). Note that some participant supply chain 'tiers' (categorisations used in this study to distinguish the different supply chain roles of participant companies) straddle multiple supply chain 'activities' (e.g., Large Integrated Supply Chain Companies [LISCCs] straddle activities from production to trade). The 'Possible FMCG product supply chain' (solid red line) illustrates the flow of palm oil ingredients for a single Fast-Moving Consumer Goods (FMCG) product. The 'Integrated supply chain' (dotted blue

line) illustrates a possible supply chain within a LISCC, which owns operations from growing through to FMCG manufacture. CGM = Consumer Goods Manufacturer.

At the production end of the supply chain, LISCCs described how fresh fruit bunches (FFBs; collected from oil palm trees) were often traded between multiple smallholders (farmers with a planted area <50 ha; RSPO, 2017b) and local traders before arriving at a mill. This could make tracing the origin of third-party FFBs difficult or impossible. One LISCC felt that companies using third-party suppliers could not claim to be “deforestation-free” (Table 2, Quote 7).

Further downstream, LISCCs and one of the larger CGMs reported that the rapid speed and large scale of palm oil trading on commodity markets hindered tracking of consignments, obstructing traceability to mills. Processors stated that the complex interplay between mixing, fractionation, derivation and blending of palm oil further stymied downstream stakeholders’ ability to reliably claim their products were “deforestation-free” (Table 2, Quote 8).

Smaller CGMs and retailers perceived major challenges arising from the multifarious “fragmented” ways in which their companies used palm oil. For example, Retailer 3 described carrying thousands of products, many containing multiple palm oil derivatives, with each derivative potentially having a unique supply chain (Table 2, Quote 9). All retailers stated that this “fragmented usage” hindered traceability. They also felt that the length and complexity of the palm oil supply chain prevented them from engaging with upstream suppliers.

3.1.5 Leverage and Control

Many downstream participants – particularly CGMs and retailers – felt that supply chain complexity inhibited their companies' control over their ability to source palm oil from compliant suppliers. Perceived control over supply bases diminished with progression towards the downstream end of the supply chain.

Growers and LISCCs reported good control of their own plantations and in areas where their mills held a monopsony over smaller producers. Where they relied on independent suppliers with access to open markets, however, ensuring compliance was problematic. Some growers and LISCCs stated it was impossible to eliminate the risk of deforestation from their supply chains. LISCCs felt unable to dictate no-deforestation policies for fear of driving their suppliers' business to their competitors (Table 2, Quote 10). Further downstream, processors, the manufacturer and CGMs also perceived a lack of control over their supply bases and struggled to know where to exert influence in the supply chain (Table 2, Quote 11).

Growers, LISCCs, processors and CGMs discussed using their commercial leverage to encourage suppliers to comply with their commitments by providing premium prices, longer-term contracts and faster payment cycles. Retailers perceived themselves as having little commercial leverage. Due to their "fragmented" use of palm oil, they felt they lacked purchasing power and struggled to wield influence upstream (Table 2, Quote 12).

3.1.6 Markets

Participants described barriers related to market forces, including price premiums, supply and demand, and competition law. Growers and LISCCs consistently reported low customer

willingness to pay premiums for sustainable palm oil. This was cited as a major barrier to implementation (Table 2, Quote 13), as producing companies that had adopted commitments under pressure from their customers felt unable to recoup the costs of deforestation-free production. Contrary to this, CGMs expressed a willingness to pay premium prices – and therefore support the costs of commitment implementation – but felt these needed to be covered by making savings in their other business departments. CGMs and retailers were clear that costs could not be passed on to consumers due to consumer reluctance to pay premiums for sustainable products (Table 2, Quote 14).

It is notable that participants reported global demand for RSPO-certified sustainable palm oil (CSPO) to be far lower than supply, leading to large volumes of CSPO being sold as non-certified, ‘standard’ palm oil. For many palm oil-producing companies, the ability to differentiate their product as CSPO provides an incentive for sustainable production, which may otherwise incur opportunity costs. With such large volumes of CSPO being sold as standard palm oil, however, the LISCCs questioned what incentives there were for growers (including the LISCCs’ own suppliers) to produce palm oil sustainably.

Participants from across the supply chain recognised that in the major global palm oil markets of China and India, low cost was the primary consideration of palm oil consumers, rather than sustainability. These countries were, therefore, perceived as providing markets into which unsustainably-produced palm oil could “leak”. This made it more difficult for LISCC, processor and CGM participants to engage with their suppliers on the issue of deforestation, as alternative, less-demanding customers could be found with ease. Ultimately, these participants felt that the availability of markets for unsustainably-produced palm oil undermined their efforts to secure supplier compliance with their no-deforestation commitments. Among the NGO participants, there was a feeling that an increase in demand

for sustainable palm oil in China and India would be required to drive sectoral transformation, but this was perceived to be highly challenging as a potential solution (Table 2, Quote 15).

3.1.7 Role of Government

Most participants stated that government had a critical role to play in eliminating deforestation from the palm oil sector. However, three participants – one grower, one manufacturer and one processor – specifically stated that government was not decisive in the implementation of corporate no-deforestation commitments, shifting the onus back onto companies. Nevertheless, the lack of consistent and effective regulation was seen as a considerable barrier by the majority of participants (Table 2, Quote 16).

Participants across the supply chain stated there was a limit to what the private sector could achieve without government regulation to actively prohibit deforestation. LISCCs reported that companies did not have regulatory power and could not enforce the law (Table 2, Quote 17). Furthermore, the relative influence of individual companies was perceived to be small, given the size of the palm oil industry. Most participants stated that implementation would be facilitated if regulations were clearer (Table 2, Quote 18).

Among participants from companies operating in Indonesia, the establishment of the national Peatland Restoration Agency (*Badan Restorasi Gambut*, BRG) and the moratorium on new oil-palm developments were cited as positive steps by government that would support the implementation of commitments. However, participants representing a variety of countries called on governments to do more to improve the regulation of concession licences; provide legal clarity on disputed land tenure; and enforce anti-deforestation policies in national parks

to prevent illegal FFBs from entering the supply chain. Participants also called for the development of national land-use strategies to end the issuance of concessions in importance conservation areas.

4. Discussion

This is the first study to have investigated companies' perceptions and experiences of barriers to the implementation of no-deforestation commitments, focusing specifically on the palm oil supply chain as a generic system. Barriers varied along the supply chain but were more homogenous within supply chain tiers. Variation within tiers was predominantly observed among CGMs and Growers, which also exhibited the most heterogeneous company characteristics. Barriers were more numerous and more extensive than some previous reports have suggested (Beckham et al., 2014; Pirard et al., 2015; Walker et al., 2013). However, the categories of barriers broadly reflected those identified in a cross-sectoral review of supply-chain initiatives which included an analysis of unilateral company commitments (Lambin et al., 2018). Our study has extended this knowledge further by providing an understanding of specific barriers as they are experienced by companies in the midst of commitment implementation, including issues to do with internal education and coordination, and challenges related to managing relationships and achieving leverage with other supply chain actors. Notably, supply chain complexity, which until now has primarily been reported anecdotally, was identified as a fundamental problem. Our findings suggest that supply chain complexity and other systemic characteristics of palm oil production and trade may preclude the implementation of corporate no-deforestation commitments.

The implications of these findings for the palm oil and conservation sectors are substantial. In recent years, corporate shaming campaigns by international NGOs and, in response, unilateral adoptions of no-deforestation commitments by individual companies have become

central to the movement to reduce palm oil-driven deforestation. The focus on corporate no-deforestation commitments has been particularly driven by a lack of confidence in public governance (Austin et al., 2017) and well-documented limitations of private certification schemes such as the RSPO (Ruysschaert and Salles, 2014), which have led to calls for the sector to move “beyond certification” (Poynton, 2015). Corporate commitments have been predicted to play a major role in reducing deforestation, particularly in Kalimantan and Papua, where large areas of forest remain vulnerable to conversion to oil palm (Austin et al., 2017). However, our findings suggest that corporate no-deforestation commitments are unlikely to be fulfilled in the prevailing context of palm-oil production and trade. As a result, commitments should not be expected to substitute for other governance mechanisms, such as RSPO certification, that have been deemed ineffective by some stakeholders in the past.

The finding that corporate commitments are unlikely to be fulfilled is pertinent in the light of recent reports by NGOs such as Greenpeace, which have continued to rebuke the palm oil industry for its failure to eliminate deforestation from supply chains. A Greenpeace report published in November 2017 shamed 11 of the world’s largest palm oil traders for failing to implement their commitments (Greenpeace, 2017). A subsequent report released by Global Canopy in December 2017 claimed that the Consumer Goods Forum (CGF; an industry association comprising over 400 corporate members from the retail and manufacturing sectors) is likely to miss its target of achieving zero net deforestation by 2020 (Rogerson et al., 2017). While it is important that companies are held to account, our findings suggest that persisting with shaming companies for failing to implement commitments is likely to bring diminishing returns. Instead, a more holistic approach is now required, based on the strategic design and implementation of a mutually-supportive suite of complementary mechanisms, of which corporate no-deforestation commitments are but (potentially) one.

4.1 Supply Chain Complexity

Complexity of the palm oil supply chain was the major barrier to the implementation of no-deforestation commitments. Palm oil sources were highly cryptic, hindering communication and formation of relationships between, and even within, companies at different supply chain tiers. This prevented companies seeking to achieve no-deforestation commitments from exerting positive influence upon their indirect suppliers.

Conceptualisation of the functioning of the palm oil supply chain has previously been limited to an understanding of commodity handling processes, with trading, mixing and processing activities identified as producing a highly complicated system (van Duijn, 2013). Traceability challenges have frequently been reported anecdotally (see Hospes et al., 2017), but we are unaware of data revealing the precise nature of palm oil supply chain relationships. Third-party supply chain traceability initiatives such as Trase are beginning to provide insights into global trade flows of commodities such as soy and, more recently, palm oil, but are still in their infancy and operate at a relatively coarse scale (Godar et al., 2016). The present study presents data and a deeper understanding, which reveals that the palm oil supply chain functions not simply as a commodity handling process but as a complex social system. The supply chain is conceptualised as a myriad of interrelationships linking diverse sets of stakeholders with many and varied perspectives, operating across broad institutional, political and operational boundaries (Reynolds and Holwell, 2010). This conceptualisation may facilitate the design of interventions to improve organisations' abilities to fulfil their no-deforestation commitments, because it acknowledges the intangible human and social dimensions of the system, in addition to the structural dimension of the supply chain. It follows that giving consideration to personal and organisational values, person-to-person interactions and sense of capacity for implementation will be essential for success.

The complexity of the palm oil sector was such that participants displayed poor knowledge of, and control over, their individual supply chains. The diversity of stakeholders between

plantations and mills hindered upstream companies (growers and LISCCs) from ensuring their suppliers complied with their commitments. At the downstream end of the supply chain, multiple or “fragmented” uses of palm oil within, and between, a wide diversity of stakeholder groups left retailers and smaller CGMs with little commercial leverage and prevented them from forming relationships with indirect suppliers. As a result, these downstream companies were unable to guarantee that their palm oil products met no-deforestation commitments. Consumers, the drivers of demand, who are expecting their purchases to be deforestation-free, risk becoming disillusioned, which could reduce demand for sustainable palm oil.

Unlike unilateral corporate commitments to no deforestation, RSPO certification has the potential to address the problems posed by supply chain complexity through its supply chain certification options, which can provide step-wise traceability through supply chain tiers (RSPO, 2016). However, the existing RSPO Principles and Criteria (P&C) do not include no deforestation (RSPO, 2013). Meanwhile, the RSPO NEXT add-on standard, which does include no-deforestation, has been criticised as “insufficient” due to its use of a “net carbon” approach rather than the High Carbon Stock (HCS) Approach (Greenpeace Indonesia, 2016). With the recent launch of a new toolkit for the HCS Approach, which constitutes a convergence of the HCS Approach and HCS+ methods for classifying forest, a unifying no-deforestation standard has now emerged (Rosoman et al., 2017). However, it remains to be seen whether the unified standard will be integrated into the existing supply chain certification mechanisms offered by the RSPO via its P&C, which are currently under review and due to be revised by late 2018 (RSPO, 2017c). While the RSPO does not currently include no deforestation, it is notable that in other respects RSPO certification goes further than corporate commitments by defining ‘sustainability’ as the enactment of best practice across all aspects of production, as opposed to the avoidance of harmful practice in a few areas (e.g., no deforestation, no peat, no exploitation [NDPE]). For example, RSPO Principle 4 includes requirements for the maintenance or improvement of soil fertility and groundwater

quality, the responsible use of pesticides, and the implementation of an occupational health and safety plan (RSPO, 2013), none of which necessarily appear in NDPE commitments. Nevertheless, in the absence of a no-deforestation standard implemented through a certification mechanism such as the RSPO, supply chain complexity will continue to impede individual companies from guaranteeing their products are deforestation-free.

Horizontal collaboration initiatives within supply chain tiers offer one way for stakeholders to act collectively to overcome challenges posed by complexity, such as low commercial leverage. For example, the CGF offers a platform for retailers and CGMs to collectively influence suppliers (Bregman et al., 2016). Vertical collaboration between different supply chain tiers, meanwhile, offers the potential for companies to develop inter-tier relationships and overcome mistrust and misunderstanding, both of which were frequently reported by participants. For example, SPOTS[®] (Sustainable Palm Oil and Traceability with Sabah small producers), an ‘integrated value-chain’ initiative, has fostered collaboration between five partner organisations within an individual value chain (SPOTS[®], 2016). Studies are now needed to explore whether such initiatives actively and positively contribute towards achieving no deforestation.

Future research could also explore how horizontal and vertical collaboration might be combined to improve understanding, support communication and coordinate efforts between and within supply chain tiers, thereby helping to provide reassurance that no-deforestation commitments are implemented. More generally, further research is required to provide a more complete understanding of the complexity of the palm oil supply chain, particularly as it impacts the implementation of no-deforestation commitments by retailers and smaller CGMs and, at the upstream end of the supply chain, by buyers of independently-produced fresh fruit bunches (FFBs).

604

605 ***4.2 No-deforestation Definitions, the Role of Government and Global Market Issues***

606 In addition to supply chain complexity, disputed definitions of deforestation, lack of
607 government support and market issues, including low willingness-to-pay among palm oil
608 buyers and leakage of unsustainably-produced palm oil into major Asian markets, were
609 perceived to be major barriers to the implementation of no-deforestation commitments.

610

611 With convergence of the two HCS methods now complete, a consensus definition of
612 deforestation has been reached and a toolkit for classifying forest types is now available
613 (Rosoman et al., 2017). However, it remains to be determined how the unified HCS method
614 can be applied in highly forested regions, where its rigorous application may stifle socio-
615 economic development (Senior et al., 2015). The question of how smallholder farmers and
616 small-scale producers can implement the unified HCS method also needs to be addressed.
617 Smallholders account for 40% of the world's palm oil production (Azhar et al., 2017), but they
618 often lack the financial resources and technical capability to implement complex
619 conservation approaches such as HCS and HCV. Although smallholders have not been
620 discussed in detail here, they play an important role in the palm oil supply chain and must be
621 considered during the development of approaches to achieve no deforestation.

622

623 The importance of effective public governance for the success of private-sector initiatives
624 has been reported elsewhere in the land-use governance literature (Lambin et al., 2014) and
625 calls have been made for supportive legal reforms and enforcement (Lambin et al., 2018).
626 Our findings reinforce this message by revealing the weakness of no-deforestation
627 commitments in the absence of suitable government support. Furthermore, our findings
628 suggest shaming campaigns by NGOs targeting companies that have already adopted
629 commitments are likely to yield diminishing returns in unsupportive public governance

contexts. Fortunately, the lack of government support for no-deforestation commitments has shown signs of improving over the past two years. For example, the Indonesian government implemented a moratorium on permits for new palm oil plantations in April 2016 (Jacobson, 2016b). Meanwhile, in November 2016 the governments of seven equatorial West African countries signed the Marrakesh Declaration, under which they agreed to implement national action plans for sustainable palm oil sector development, including reduced deforestation (Tropical Forest Alliance 2020, 2016). Companies and NGOs should continue to lobby for increased government support to build on these and other positive developments.

Participants reported that China and India provide markets for palm-oil producers who are disinterested in curbing deforestation. The availability of these markets undermines incentives for suppliers to comply with more-demanding customers' no-deforestation commitments. This may be particularly problematic in cases where it is impractical or impossible for customers to disengage with non-compliant suppliers. Similar 'leakage' issues have been described in international soy and beef supply chains (le Polain de Waroux et al., 2017). Several participants argued that efforts should be made to stimulate demand for sustainable palm oil in Chinese and Indian markets to incentivise deforestation-free production. This would support sectoral-scale implementation of no-deforestation commitments, which cover up to 96% of globally-traded palm oil (Hurowitz, 2014), while also driving down oversupply of CSPO and helping to fund deforestation-free production. Such a strategy of driving demand for sustainable palm oil in major Asian markets is more likely to support deforestation-reduction efforts than reducing the total global demand for palm oil. This is due to the large projected increases in global demand for vegetable oils (Corley, 2009) and the likely importance of palm oil in meeting this demand, owing to its superior yields and low costs compared to other oil crops (Basiron, 2007). Multi-stakeholder platforms such as the RSPO and CGF may prove useful in facilitating collaborative efforts to drive demand for deforestation-free palm oil in China and India, but members of these groups will

need to drive this agenda proactively. Research into how demand for sustainable palm oil may be grown among the burgeoning middle classes of these two countries could prove useful.

Closely related to the issue of demand in the world's largest markets is the issue of premiums for deforestation-free palm oil. Participants from the upstream end of the supply chain claimed their customers were unwilling to pay for deforestation-free palm oil, thereby stifling a source of funding for commitment implementation. This was disputed by downstream participants, but evidence from CSPO markets suggests that the costs of sustainable production have tended to dwarf the premiums paid by corporate buyers, even without considering no deforestation (Ruysschaert and Salles, 2014). Future studies should attempt to elucidate the feasibility of premiums and their utility in ensuring no-deforestation commitments can be implemented.

The findings from this qualitative study, which was based on established social research techniques, may be used to inform the design of future quantitative studies. Quantitative methods are relatively narrowly bounded by their structure, meaning assumptions are made by the researcher regarding the themes potentially defining a study system. In contrast, qualitative research avoids this limitation and, in this case, enabled the identification of the breadth of barriers existing within the system. Quantitative techniques could now be used to explore statistically representative patterns in the occurrence of barriers across the palm oil sector. For example, a random sampling technique could be used to explore the frequency and distribution of barriers experienced by particular subsets of companies.

5. Conclusions

This study has revealed the complexity of stakeholders, perspectives and relationships along the length of the palm oil supply chain, using a generic supply chain model to illustrate how this complexity poses a barrier to the implementation of no-deforestation commitments. The palm oil supply chain is a complex social system, not simply a commodity-handling process, which may preclude the implementation of no-deforestation commitments in many cases. Without effective collaboration between companies – both horizontally within supply chain tiers (e.g., collective action by CGMs to influence suppliers) and vertically between tiers (e.g., integrated value-chain initiatives) – the elimination of deforestation cannot be guaranteed. Multi-stakeholder platforms such as the RSPO and CGF are likely to prove important in facilitating such collaboration. Consensus in defining deforestation, improved government regulation and increased demand for sustainable palm oil in China and India must all be realised if industry transformation is to be achieved. The recent convergence of the two HCS methods, and resulting consensus on a definition of deforestation through the HCS Approach (Rosoman et al., 2017), may therefore constitute a positive step towards achieving this goal.

The existing model for managing palm oil production in which companies adopt unilateral no-deforestation commitments is unsuited to the complexity of the palm oil supply chain and is, therefore, likely to fail. The supply chain certification mechanisms offered by the RSPO have the potential to help address some of the shortcomings, if a unified and practicable no-deforestation concept can be incorporated into the standard. Implementing the required transformation effectively will require going beyond the entrenched NGO strategy of shaming palm oil companies into adopting no-deforestation commitments, towards the adoption of a broader suite of complementary mechanisms that equitably encourages the evolution of the industry towards jointly conceived and implemented policies and practices.

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