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Opportunities and bottlenecks for upstream learning within RSPO certified palm oil value chains: A comparative analysis between Indonesia and Thailand

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A B S T R A C T

Smallholders play a key role in implementing best management practices that increase productivity and reduce environmental effects. However, they often lack the knowledge to implement these standards. This study investigates if and how RSPO certification fosters upstream learning to improve farming practices. Taking a comparative approach between Thailand and Indonesia we find that the current structure of the value chain is not always well-suited for upstream learning beyond knowledge transfer. In particular, farmers in Indonesia suffer from the delegation of practices to the mill and cooperative, and from incentive-incompatible pricing practices, limiting the extent to which farmers absorb new knowledge on farming practices. In Thailand instead, price incentives based on quality are more developed, and only hindered by the presence of intermediary collectors. This makes that Thai farmers are systematically more aware of farming and environmental practices, and more likely to report compliance with RSPO principles and criteria. Their relatively higher independence in farming decision-making, however, results in weaker peer-to-peer interactions and higher deviations from best management practices, with consequences both for productivity and quality. This research highlights the major bottlenecks in upstream learning within RSPO-certified palm oil value chains in Indonesia and Thailand. Addressing such bottlenecks is a precondition to improving smallholders' farming practices.

1. Introduction

The continuously growing global demand for palm oil translates into increasing conversions of forests and encroachment of fragile ecosystems rich in biodiversity—exacerbating climate change impacts (Barthel et al., 2018; Butler and Laurance, 2011; Fargione et al., 2008; Koh and Ghazoul, 2008; Sanders et al., 2013; Saswattecha et al., 2016a, 2016b). In order to minimize these impacts, researchers and stakeholders have suggested a more sustainable mode of palm oil production: maximizing the use of existing plantation areas, partially through the adoption of more efficient and sustainable farming practices, and partially through choosing optimal planting materials and strategic land management. This transition is, however, not universally applicable. And even where possible, implementation may be faced with delays and challenges (Azhar et al., 2015; Azhar et al., 2017). The implementation of innovative practices, such as Best Management Practices (BMPs), requires knowledge (World Bank & IFC, 2011) and a shared understanding of what sustainability means and, in particular, what it entails in practice for smallholder farmers (Saadun et al., 2018). These complications have received insufficient attention as most attention has been given merely to providing training to smallholders.

This study seeks to close this gap by providing an empirical understanding on how different upstream chain contexts, and related actor relationships, affect knowledge transfers, as well as the prospects that knowledge evolves into learning towards sustainable palm oil production. In doing so, our study intends to contribute to the debate and conceptualization of social learning. It does so by exploring how this takes place among oil palm farmers in Indonesia and Thailand in three cases. We compare smallholders from Indonesia and Thailand participating in the process of certification through the Round Table on Sustainable Palm Oil (RSPO)—an international voluntary sustainability standard. Indonesia and Thailand are important actors in palm oil production, but with very different historical and present dynamics. Indonesia is a country with a long history of palm oil production, while Thailand is a country with a more recent expansion of palm oil. Indonesia is the world's leading palm oil producer with 42 million tons, while Thailand is ranked third with 3 million tons (Indexmundi, 2020). However, Thailand had the highest growth rate of palm oil production worldwide between 1999 and 2019—the only country averaging a growth of over 10% per year over this period (Indexmundi, 2020). Furthermore it expects to expand its plantation area to 1.6 million hectares by 2029, compared with 650,000 ha in 2011 (Yangdee, 2007).

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The rest of the paper develops as follows. The next section discusses the theoretical framework applied, section 3 gives an overview of the palm oil supply chain in Indonesia and Thailand. Section 4 presents our research methods and introduces the selected case studies. Section 5 presents the analysis of the data. Section 6 discusses these findings while section 7 draws the overall conclusions.

2. Theoretical framework and literature

Sustainability remains a seriously debated concept in science and politics. The concept of sustainability is *contestable* because of the lack of an authoritative and universally valid definition, it is *normative* given that it generates pathways for which action to follow and it is *revolutionary* because it requires transformation of existing systems and institutions (Laws and Loeber, 2011).

In this study, we discuss sustainability within the context of the global palm oil value chain (Gereffi, 1995; Kaplinsky and Morris, 2000). In this globalised value chain producers are linked with distant buyers (Siregar and Sugino, 2008) and these buyers transmit demands and requests to the primary producers (Bolwig et al., 2010). It is important to analyse whether and how these demands, in particular those related to sustainability, are transformed into innovative producer practices.

The adoption of sustainability practices by oil palm smallholders is an interesting case of knowledge transfer and social learning. Implementing sustainable standards by oil palm smallholders requires supplying technical knowledge on these standards and the capacity to transform the transferred knowledge into practice. Initiatives that focus only on knowledge transfer have been repeatedly unsuccessful in changing smallholders' practices (Mancini et al., 2008; Martin et al., 2015), especially if the change involves shifting from a well-established set of economic relationships (Deans et al., 2018).

In this study we use the concept of knowledge transfer as being part of the more general concept of learning. In a system innovation context, the learning process through communicative interaction is represented by discursive exchanges of knowledge, actions and relations (Beers et al., 2016). Hereby, knowledge refers to context exchanged (Wals, 2007), actions to agreements, decisions, and other forms of action that are voiced during communication, and relations refers to roles, identities and positions (Leeuwis and Aarts, 2011; Pahl-Wostl, 2006; van Mierlo et al., 2010). Learning outcomes occur when knowledge, actions and relations become substantively intertwined (see Argyris and Schön, 1978). The learning process may, however, have different outcomes depending on the specific discursive setting, which deserves as much attention.

The potential for internalizing new practices is affected by the specific organizational context in which smallholders operate, which depends in turn on the relevant material (tangible goods) and non-material (e.g. information and knowledge) flows (Granovetter, 1985; Murdoch et al., 2000). The success of a system innovation initiative depends on the capacity of the institutional setting to change along with the initiative itself (Elzen et al., 2012; Regeer et al., 2009; van Mierlo et al., 2012).

We also use the concept of *social* learning, which has its origin in behavioural psychology, and which Bandura (Bandura, 1977:39) defines as "*casual or directed observation of behaviour as it is performed by others in everyday situations*". Learner and environment affect each other in a continuum of feedback iterations; the learner changes the environment, which in turn changes the learner (Pahl-Wostl et al., 2008). The environment is composed of individuals and organizations and therefore learning takes place through interactions with them (Lave and Wenger, 1991). Social learning processes imply a change in understanding derived from those interactions (Reed et al., 2010).

Although social learning has been framed in general as a form of learning that relies on inputs from others (Glasser, 2009), we want to specifically study the contexts in which social actors change their minds after interacting with others (Schneider et al., 2009) and whether this happens as an act of imitation or as a process of 'learning together to manage together' (Tran et al., 2018). We study the specific settings that may or may not create social learning. According to Gereffi (1995) knowledge transfer and social learning in value chains are embedded in an institutional framework that directly influences the possibilities for actors lower in the chain to acquire information and technology from actors higher up in the value chain (Fromm, 2007; Gereffi, 1995).

We intend to contribute to the literature on social learning, by studying its dynamics in the specific context of oil palm smallholders in Indonesia and Thailand. To the best of our knowledge – notwithstanding the growing importance of palm oil certified value chains and their potential impact on global environmental challenges – this is the first study to investigate how upstream arrangements in these chains, resulting in information and material flows, create opportunities (or not) for social learning. In fact, this study goes beyond the concept of knowledge as exchange of content between actors, and applies the concept of knowledge transfers as used in organization theory (Argote et al., 2000; Blackler, 1995). It focuses on the extent to which knowledge can be "embodied", rather than merely encoded. *Embodied knowledge* is engendered by interactions between actors and their (interpretation of the) environment, as well as by explicit and non-explicit information flows.

We operationalise the concept of *social learning* by analysing learning by *experience* and learning by *interaction*. First, learning by experience is further operationalised as learning *by doing*: experiencing (actions) and reflecting (on actions taken) (Arrow, 1962; Rosenberg, 1982). This is single-loop learning: from experiment-based practices to improvement of routines and performances (Pahl-Wostl, 2009; Tàbara and Pahl-Wostl, 2007). To study this we analyse to what extent smallholders are exposed to the doing themselves and what is delegated to other individuals or entities. Learning *by deciding* (deciding on the next actions based on previous actions and their effects) (Kolb, 1984) is the second part of learning by experience and this is studied by observing to what extent smallholders are making choices and are able to reflect on choices previously made. Secondly, learning by interaction is understood as interacting with other individuals (Lundvall, 1992) operating in the same context (Argyris, 1990; Forester, 1999; Grin and Hoppe, 1995; Grin and van de Graaf, 1996; Leeuwis, 2004; Leeuwis, 2000; Mendes Betim et al., 2018; Schön, 1983; Wals, 2011). These other individuals may be horizontal actors, involved in the same production steps, or vertical actors downstream in the chain (Bolwig et al., 2010; Marsden, 2013; Ros-Tonen et al., 2015; Verschoor et al., 2011). According to Deans (Deans et al., 2018) both farmers and buyers profit from being part of a certified chain. Finally, double- and even triple-loop learning may occur as well. Double-loop learning consists of transforming, innovating and creating forms of institutional interaction, whereby not only new actions are taken but where also the assumptions behind those are new (Sol et al., 2013). It is an exploratory process through which social actors experiment with innovations and try to overcome constraints. Triple-loop learning involves changes of the values, beliefs or norms that are behind operational assumptions and actions (Argyris, 2003; Keen et al., 2005; Pahl-Wostl et al., 2011).

The research identifies opportunities for learning during the following critical phases of oil palm production: planting, farming, selling and grading. The analysis results in a score on the learning opportunities for each type. The score is based on: 1) the capacity of the operator and 2) the opportunities for learning loops in the institutional context (see Fig. 1).

First, we study which specific dynamics and conditions allow the individual farmer to move from knowledge acquisition to learning; we assess whether farmers who take decisions independently are more exposed to learning compared with farmers participating in value chains managed by the mills. Secondly, we study whether different value chain structures lead to different opportunities for learning. We look at the relation between the local institutional framework and the opportunities for social learning. We explore whether interaction is a matter of

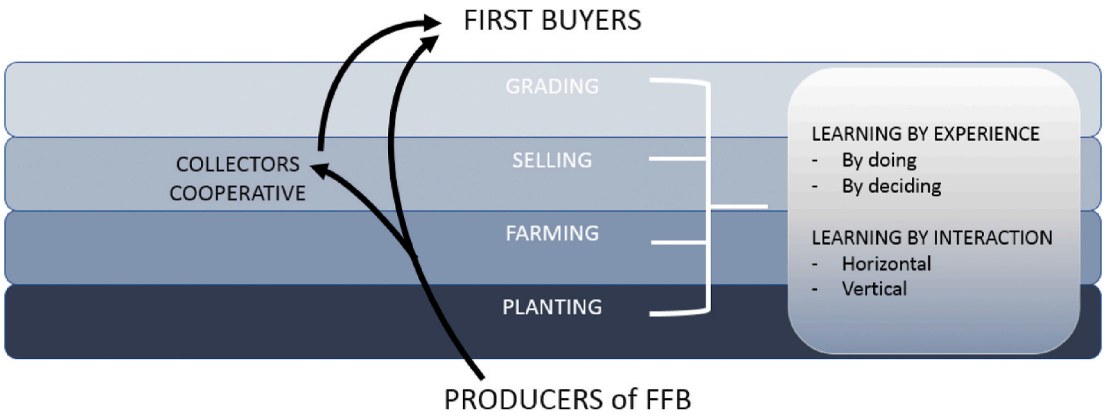

Fig. 1. Analytical framework: potential for learning in the value chain phases.

proximity, whether learning results from a set of instructions, from mistakes (Argyris and Schön, 1978) or from dissonance and co-creation (Wals, 2011), and what the conditions are that create dissonance. We do this with the pre-assumption that our case studies represent a range from scheme farmers with very formalised vertical interactions to independent farmers with less structured interactions with buyers.

3. Palm oil upstream in Indonesia and Thailand

In Indonesia the area of smallholder oil palm cultivation more than tripled between 2000 and 2011 (Aidenvironment, 2013). Oil palm cultivation expansion is the 'greatest single driver of deforestation in Indonesia, accounting for about a quarter of all forest loss' (Greenpeace International, 2014). In Thailand around 76 per cent of the land under oil palm cultivation is managed by smallholders (OAE, 2020; Teoh, 2010; World Bank & IFC, 2011) and 75% of Thai oil palm growers are small scale working plots (Chuasuwan, 2018). Smallholders tend to underperform in terms of productivity per hectare compared with larger plantations. For instance, Indonesian scheme and independent smallholdings yielded respectively 6% and 40% lower compared with scenarios for good management practices for smallholders (Aidenvironment, 2013).

The RSPO provides an institutional framework for social learning towards sustainable intensification, also for smallholders. The RSPO is a global stakeholder-based association that developed a voluntary standard for sustainable palm oil and both Indonesia and Thailand have been incorporating this standard through co-supported projects. Thailand has been a pioneer with a stakeholder project resulting in the first RSPO-certified group of independent smallholders (RSPO, 2012). In Indonesia, RSPO certification was initially undertaken by a scheme of Musim Mas (2011) and later by a group of independent smallholders in Riau district (2013). However, after these initiatives, the expansion of RSPO-certification among independent smallholders remained limited.

3.1. Indonesian palm oil sector

Indonesia has 'scheme' and 'independent' smallholders in oil palm cultivation.[1] Schemes connect smallholders to a particular mill and its plantation (Sawit-Watch, 2014). In these so-called "Nucleus Estate Schemes" (NES) (Zen et al., 2005) a private company receives a portion of land from local farmers and constitutes a core (estate) plantation, locally called *'inti'*. The rest of the land where the company also plants oil palm, is divided into smallholdings and returned to the scheme farmers and their households, locally called '*plasma*' (McCarthy, 2010; Rist et al., 2010). In addition, these households receive a small piece of land for food crops around their homestead. Until the palm trees are mature, farmers may work occasionally on the nucleus estate. Farmers have to return the preparation costs when the palms are in their fifth year by selling their FFBs to the plantation mill. The exact mode of these arrangements has changed since the start in the 1960s (Pramudya et al., 2017) but the model remains being used by the Indonesian government and private companies as a vehicle for supporting smallholder participation in the sector.

Independent smallholders do not have direct relations with mills. They may sell to any mill but they are constrained by the requirement to process FFBs within 24 h after harvest to preserve the quality, because a larger time gap would increase the Free Fatty Acid (FFA) content in Crude Palm Oil (CPO) (Tagoe et al., 2012). Moreover, smallholders usually have a contract with a collector (a larger producer or a local trader) as mills prefer to deal with larger volumes (Aidenvironment, 2014).

3.2. Thai palm oil sector

Thailand's oil palm growers are predominantly independent smallholders (Aidenvironment, 2013; Colchester et al., 2011). Smallholders (owning less than 50 ha of land) cultivate on average around 4 ha while large plantations cover on average 800 ha. Most farmers do not have a contract with a mill and FFBs are collected through local intermediaries, so-called ramps. Ramps are usually equipped with large trucks bringing FFBs from several smallholders to the crushing mills. They also have become providers of a wide range of services, including transportation, as well as support in harvesting, fertilizing, pruning and planting. Ramps collect large volumes of FFBs and can bargain a higher price with the mills. Mills may have relationships with several ramps in order to ensure their supply is met throughout the year.

4. Materials and methods

4.1. Data

For this study, data has been collected in 2013 in Thailand and Indonesia. Respondents for the survey have been randomly selected from areas with early RSPO certification and they are divided into three samples that we used as case studies. We selected Musim Mas, the first RSPO certified scheme in Indonesia, the Amanah Group, the first independent smallholder certification project in Indonesia, and the (first)

[1] Scheme Smallholders are farmers, landowners or their delegates that do not have the: 1) Enforceable decision-making power on the operation of the land and production practices; and/or 2) Freedom to choose how they utilise their lands, type of crops to plant, and how they manage them (whether and how they organize, manage and finance the land). (See also smallholder and Independent Smallholder). All smallholder farmers that are not considered to be Scheme Smallholders are considered Independent Smallholder farmers (RSPO, 2019).

Table 1
Characterising the respondents.

Variables	Thai independent	Indonesian independent	Indonesian scheme	Differences		
	A	B	C	B-C	B-A	C-A
Age	51.37	44.01	46.54	−2.53	−7.36***	−4.83***
Education	7.22	4.15	1.99	2.16***	−3.07***	−5.23***
Gender	0.74	0.93	0.74	0.19***	0.19***	−0.00
Household Size	4.38	3.75	4.38	−0.63***	−0.63***	−0.00
Asset Index	0.80	−0.23	−0.55	0.32**	−1.03***	−1.36***
Non-farm Income	0.32	0.43	0.43	−0.001	0.12*	0.12*
Other Certification	0.11	0.03	0.02	0.01	−0.08**	−0.09***
RSPO Training	0.98	0.62	0.41	0.20***	−0.36***	−0.57***
Palm Oil Farm Area	9.3	3.5	2.6	0.9***	−5.8***	−6.7***
Observations	101	102	104	–	–	–

Notes: Stars refer to *t*-test results on differences: *** = $p < 0.01$, ** = $p < 0.05$, * = $p < 0.10$.

GIZ-RSPO project in Thailand. The research area in Indonesia is Sumatra, where 70% of the country's oil palm plantation area is located (McCarthy, 2010). For Thailand the provinces of Surat Thani and Krabi were selected being the major production sites (OAE, 2012). In total, we selected 307 RSPO-certified farmers (101 in Thailand and 206 in Indonesia, of which 104 from the scheme and 102 from the independent group). Survey data were analysed using STATA software, to conduct descriptive statistics and regressions. In addition, 31 qualitative interviews were held with farmers (4), ramp owners (10), management of mills (4), a palm oil refinery, GIZ (2), an expert from Prince of Songkla University (Thailand), NGOs (5), consultants (2), an RSPO representative and the Trade Union Association for palm oil producers (SPKS) in Indonesia.

By studying the context and interactions between actors, we assessed the opportunities for (social) learning within RSPO-certified value chains in Indonesia and Thailand. We used the RSPO-defined Best Management Practices (BMP) as a reference standard. We particularly studied learning with regard to the following issues: variety of oil palm tree when planting, tree density, weeding and pruning, water and soil management, pesticide use, harvesting and post-harvesting practices. We also analysed the criteria for FFB-grading because they may also influence farmers' farming and harvesting practices.

4.2. The case studies

4.2.1. Musim Mas scheme (Indonesia)

Musim Mas is the first RSPO-certified scheme in Indonesia (certified in 2011). The private company Musim Mas provided financial and technical assistance to develop villagers' arable land into oil palm smallholdings. The project has two sites: one in West Sumatra Province with PT Agrowiratama (1524 ha and 762 smallholdings) and one in Riau Province with PT Musim Mas (1667 ha and 819 smallholdings). The project was designed with a strong involvement of the Musim Mas company in the cultivation of the oil palm plots owned by the smallholders. Smallholders work on the company plantation where they learn best agricultural practices. The company also assisted in the constitution and management of a smallholder cooperative. The company adopted two models: in West Sumatra a low-involvement KKPA scheme (Koperasi Kredit Primer untuk Anggota: Primary Members Credit Cooperative), in Riau a high-involvement KKPA scheme. In both cases, the company was responsible for clearing the land and planting. In the first model smallholders would not need to conduct any activity on their plot but would receive a monthly payment corresponding to the production coming from their plot. They could, however, work on their own plot under Musim Mas Group management to increase their income. The second model encouraged the active involvement of smallholders so training and extension services on oil palm practices and techniques were provided. In 2007 a Sustainability Department was constituted to support, coordinate and monitor the implementation of RSPO sustainability requirements. A gap analysis was conducted in 2009 and corrective actions, including trainings, were planned to end non-compliance. In 2010 a second gap analysis was conducted and progress was measured. After an external audit in 2010, the scheme was certified on March 2, 2011 (The Planter, 2012).

4.2.2. The Amanah group (Indonesia)

In 2011, the Amanah Independent Palm Oil Smallholders Association started with the objective of acquiring RSPO certification, as the first group-certification of independent smallholders in Indonesia. The project was supported by WWF Indonesia, the RSPO, the Ministry of Agriculture, the Riau Provincial Government, and Carrefour Foundation International. The mill involved was Inti Indosawit Subur (IIS), a subsidiary company of the Asian Agri Group. The group received certification on 29 July 2013. The group is composed of 349 members organized in 10 sub-groups, cultivating 763 ha in three villages (Bukit Jaya, Trimulya Jaya and Air Mas). RSPO staff trained a facilitator (from the government extension service) to train smallholders and since 2012 they have received 11 trainings on different topics.

Most farmers participating in this project are also scheme-farmers under IIS (thus they own land both outside and inside the scheme). Only 70 out of 349 RSPO certified independent farmers were not part of the IIS scheme. Being part of the scheme facilitated the implementation of the RSPO standard given that the group could use the existing setting of an organized cooperative to structure different services including the collection and sale of FFBs. So, although the Amanah farmers are free to sell to any mill, they have arrangements for selling to Asian Agri IIS only, provided that the latter is interested in certified FFB (WWF, 2014).

4.2.3. The RSPO-GIZ project (Thailand)

In Thailand, RSPO certification was promoted in 2010 by the German agency for development cooperation (GIZ) in order to achieve sustainable palm oil production for bio-energy. GIZ together with the Thai government Office of Agricultural Economics (OAE) and other partner institutes started a project to increase productivity, improve FFBs quality and internalize sustainability through BMPs by organizing trainings. In collaboration with four mills, United Palm Oil and Univanich in Krabi province, Southern Palm Oil in Surat Thani province and Suksomboon Palm Oil in Chomburi province, plus the Aoluek cooperative (GIZ, 2012). In total, around 500 farmers were certified (GIZ, 2014).

4.2.4. Characterising the sample

To characterise respondents, we collected information on standard demographic statistics, which are also commonly used in literature to assess drivers of environmental behaviour (Burton, 2014). These general characteristics provide the background necessary to analyse the learning process. There are several statistically significant differences between

the three case studies (See Table 1).[2] The Thai sample is significantly older than the two Indonesian ones and their education is significantly higher. Most Indonesian scheme farmers are male (93%) compared with the other two samples (74%). Using an asset index as a proxy for wealth (O' Donnell et al., 2008), standardized across all samples, we found that the Thai farmers have significantly more assets and Indonesian scheme farmers significantly less than the independent smallholders. The Thai sample has a lower prevalence of income generated from non-agricultural activities (32% against 43% for both Indonesian groups), meaning that for many of them agriculture is the main way of generating income. They also have larger oil palm areas. Finally, the Thai sample contains more respondents certified against other standards and is also the group which received most RSPO trainings, with 98% of farmers having attended at least one training compared with Indonesian scheme farmers only 41%.

5. Analysis: learning opportunities and bottlenecks

5.1. Planting

Choosing the right planting material (variety, size and height of seedlings, from reliable sources) and use the correct plot design (tree patterns and density) affect the potential yield of the future plantation and requires prior knowledge. On average, Thai and Indonesian independent producers have 12 years of experience in oil palm production and Indonesian scheme producers 9 years.

Most Indonesian scheme farmers engage for the first time with the oil palm trees only four years after they were planted because mills prepared the land that farmers received when the trees were mature (Zen et al., 2005). Therefore, scheme farmers have limited knowledge on land preparation and good quality seedlings and no opportunities for learning. Independent smallholders in both Indonesia and in Thailand have the freedom to select planting materials and choose agricultural practices, which allows them to experiment and learn-by-doing. Among respondents in Indonesia we found that the percentage of independent smallholders (Amanah sample) that know the oil palm variety they are cultivating and could name at least one good variety is distantly higher than for the scheme farmers (Musim Mas). All independent smallholders in Thailand know the variety used and could mention a good variety in 66.3% of the responses (Table 2).

On the other hand, independent smallholders face greater technical problems and are often confronted with their lack of knowledge on oil palm (GIZ, 2014). For example, it is not uncommon for independent smallholders to buy oil palm varieties sold at low prices but often of poor quality. Sometimes they even collect hybrid seeds from the ground, which are actually sterile, and only discover this once the trees are already four years old, and turn out to be unfruitful (interviews, RSPO independent Indonesia). Some good practices concerning the preparation of the plantation (e.g. triangle patterns, distance between palms, distance between rows of palms) cannot be applied once the palm trees have already been planted. In case independent smallholders get to know these BMPs after planting, they can only apply this when they replant (around twenty-five years later).

We found no difference between scheme and independent smallholders in Indonesia regarding the average number of trees planted on 1 ha (around 130). Yet, there is a clear difference in the variation around this number. The 50% higher standard deviation for independent farmers indicates their greater freedom of choice, but also their potential lack of knowledge about the recommended number for optimizing productivity. Among farmers in Thailand this is even higher; while the "average" Thai farmer is in line with BMP about planting distance, only 42,6% of them actually comply with the recommendation. For all cases, learning seems quite limited for this phase of the value chain (see standard deviation Table 2).

Table 2
Knowledge of planted variety, good variety and palm trees per hectare.

Knowledge of:	Thailand	Indonesia independent	Indonesia scheme
Variety planted	100%	89.2%	24.0%
Good variety	66.3%	71.6%	29.8%
Palm Trees/hectare	127.1	129.5	132.5
Min-Max	28–208	60–163	115–148
SD* palm trees/ha	32.9	9.1	6.8

Notes: *Standard Deviation.

5.2. Farming

Indonesian scheme farmers are not necessarily the main workers on their plots and this may affect learning on farming practices and maintenance 'by-doing'. Maintenance includes clearing the plantation site, removing tree stumps and maintaining the roads, for one week per month. According to SPKS, smallholders rarely receive training on maintaining the oil palms and monitoring maintenance practices was hardly ever conducted (SPKS, 2013).

The awareness among farmers of their RSPO-certification status is low as only 60,6% of the respondents participating in the Musim Mas scheme was aware of this, compared with 92,2% for the independent smallholders in Indonesia and 98% in Thailand.

Important farming activities relate to fertilizer application, weeding and pruning, and pest control. There are significant differences in the frequency in which these practices are applied. In particular, Thai farmers fertilize, circle weed, and prune significantly less frequently than their Indonesian counterparts (Table 2). The total amount of fertilizer they use per hectare is also much lower: Thai farmers reinsert on average only 25,6% of the nutrients needed for oil palm cultivation (Goh and Härdter, 2003) through fertilizers, compared with 62,5% for independent farmers and 86,1% for scheme farmers in Indonesia. This difference may be explained by the pre-financing scheme for inputs that Indonesian farmers benefit from: they request inputs from the mill, which are deducted from the FFB sales at the time of harvest (WWF, 2014). Scheme farmers also typically delegate fertilization to teams managed by the mill, resulting in higher and more timely fertilizer application. When comparing the frequency of farming practices, Indonesian independent farmers most frequently fertilize and weed, but they prune less frequently than the other groups (Table 3).

In Thailand the use of herbicides is less common than in Indonesia. Among those who use herbicides, Thai producers use on average less litres per hectare than the independent farmers in Indonesia, which in turn use less than the scheme farmers. In both countries the most commonly used herbicides are Glyphosate and Paraquat, and their average use is below best management practices of 2–2.5 L/ha. Yet, there is a risk of overuse, as some independent farmers in Indonesia claimed to use up to 4.5 L of glyphosate per hectare.

Also in terms of pesticide usage, Thailand[3] has lower frequency among respondents and applied quantity than the independent farmers in Indonesia. Although they manage their fields themselves, the latter make use of "spraying teams" from the neighbouring scheme plantations paying a fixed fee that the cooperative deducts from the sale of FFB. A similar service is in place for the scheme farmers of Musim Mas. It is therefore not surprising, that, when asked details on pesticide use, over 90% responded they did not know (Table 4).

Fig. 2 shows the scores on an awareness index based on responses to

[2] We do not make specific assumptions or derive direct conclusions based on these statistics. However, we use them to provide a picture of how different the starting point of each sample is as part of the in-depth analysis of context.

[3] Pesticide are generally used to mitigate rats, leaf eating caterpillars, rose beetles, rhinoceros beetles among others (Source: survey, 2013).

Table 3
Average scores for pre-harvest practices of RSPO farmers in Thailand and Indonesia.

Times/Year	Cross-country comparison			Within Indonesia comparison		
	Thailand	Indonesia	*t*-test	Independent	Scheme	*t*-test
Fertilizing	2.67	3.90	7.70***	4.68	3.08	8.95***
Circle weeding	2.10	2.58	1.73*	2.90	2.23	1.87*
Weeding	1.87	1.65	0.14	2.05	1.65	2.42**
Pruning	1.43	1.62	2.11**	1.41	1.86	−4.22***

Notes: *** = $p < 0.01$, ** = $p < 0.05$, * = $p < 0.10$.

four environment-related subjects (water, planting, pest control and pesticides handling) each ranging from 0 (not aware at all) to 10 (fully aware). It reveals that environmental awareness was weakest among Indonesian scheme farmers.

Table 5 shows that Indonesian independent farmers are the most likely group to take action with respect to water and land contamination. There is a stark contrast between the greater use of BMPs by Indonesian scheme farmers and their extremely low awareness and capacity to take action.

All farmers use so-called "harvesting teams" when harvesting. In Thailand independent producers have two alternatives: they can bring their FFBs directly to ramps or mills, or they can request harvesting teams, usually organized by ramps, to harvest and transport their FFB. In the latter case the costs of harvest and transport services are directly deducted from the FFB sale. As a result, only 18,8% of the farmers in our Thai sample declared that at least one household member is involved in each harvesting. Thai producers have high potential for learning by experience and taking decisions on the harvesting time and on post-harvesting practices because this determines the quality. This potential is quickly reduced when they use harvesting teams; the task is delegated to the subcontractor and no learning by experience occurs. There is still a potential for learning when producers engage in checking the fruits that have been collected because harvesting teams often focus on weight only and do not consider quality to maximize their profits. In Thailand there is no interaction with peers during harvesting, as each farmer harvests his/her own plantation individually.

In the Indonesian samples harvesting is organized by the cooperative. In the Amanah group the harvest is organized per subgroup of farmers with adjacent plantations. Each subgroup rents a means of transport to bring their FFBs to the mill (WWF, 2014). This event is also an occasion for interaction among producers and as respondents mention, this encounter has become central in the farmers' calendar. Harvesting takes place every 10 days and each farmer can decide to participate in the harvest or leave it to the other farmers in their subgroup—on average 40% of them report to participate each time. The scheme farmers of Musim Mas have their harvesting teams organized and managed by the company while the workers are hired. Nonetheless 28,9% of the scheme farmers claim to always participate, either themselves or with another household member. Table 6 shows that

Table 4
Number of respondents using herbicide and pesticide, and applied quantity (litres/hectare).

Use of:	Thailand	Indonesia independent	Indonesia scheme
Herbicide	20.8%	72.5%	77.0%
Herbicide (lit/ha)	0.73	1.23	1.15
Pesticide	12.9%	15.7%	–
Pesticide (lit/ha)	0.9	3.00	–

non-optimal harvesting practices are not uncommon, with over 50% of the Thai farmers reporting that they very often harvest over-ripe and fallen fruits from their plantations. In Indonesia, both independent and scheme farmers are harvesting less under-ripe fruits, which is possibly linked to the higher vertical integration of their chain: harvesting teams in Thailand are paid per weight collected, and if they do not harvest under-ripe fruits they may not only forego revenue directly, but risk this is being harvested next time by a competing harvesting team. In Indonesia harvesters do not fear competition from other harvesting teams and the under-ripe fruits are likely to be ripe the next time. On the other hand, competition between harvesting teams in Thailand ensures that significantly more FFBs are transported within 24 h. Overall, learning-by-doing is more prevalent in the Thai case as, even when not harvesting themselves, Thai smallholders are decision-makers throughout the entire production cycle. By triangulating the different data (survey, interviews and RSPO definitions), we can conclude that the Indonesian respondents tend to perform better in terms of harvesting practices (Table 6) due to a higher level of control and vertical integration (RSPO, 2019). While convenient from the point of view of the quality of fruits harvested, the drawback of this centralization of activities in the hands of the mill or cooperative is the reduced capacity of Indonesian farmers to learn as they farm, resulting in low awareness scores.

Independent Indonesian farmers visit mills for learning purposes more frequently than Indonesian scheme and Thai farmers. They also receive most frequently visits from mills' staff, around twenty on average per year, whilst Thai farmers receive one visit and Indonesia scheme farmers around ten visits per year. Only very few farmers report receiving useful information on farming practices from actors downward in the value chain during these visits which they associate rather with control by the mill (Table 7).

When looking at yield, we find no difference between independent and scheme farmers in Indonesia, averaging about 18 tonnes per hectare per year. Governments transpose the responsibility of training farmers to mills but although companies have the expertise, they have to cover the expenses for the license and they lower the costs of production, even if this means low yield (Sawit-Watch, 2014).

Among Indonesian farmers, almost 90% talked with peers about farming at least once per month. Furthermore, all independent and 90% of scheme smallholders claim to be part of a palm oil organization/association. Slightly more than half of the Thai sample talked to their peers 4 times a year or less. Unlike in Indonesia, in Thailand peer-to-peer interaction occurs during group meetings and internal inspections in preparation for the annual audit for RSPO certification. Only 58% of the Thai palm oil producers who were RSPO-certified "on paper" responded that they were part of a growers' organization/association. This means that they did not see the RSPO group as an actual group, with meetings, joined activities, and shared sustainable farming practices. Some of them perceived their access to RSPO as a bureaucratic requirement necessary to have better marketing and pricing opportunities.

Knowledge transfer from other stakeholders is an integral part in the cases included in this study. In Thailand, the implementation of RSPO-certification has been supported by GIZ, and Prince of Songkla University, while government extension officers support farmers with Good Agricultural Practices (GAP) training. In Indonesia, members of the Amanah group received several trainings in collaboration with WWF, the certification body Bio-Cert and the Asian Agri mill (WWF, 2014). Also, Musim Mas has supported training on the requirements of the RSPO standard from 2007 and in collaboration with WWF in October

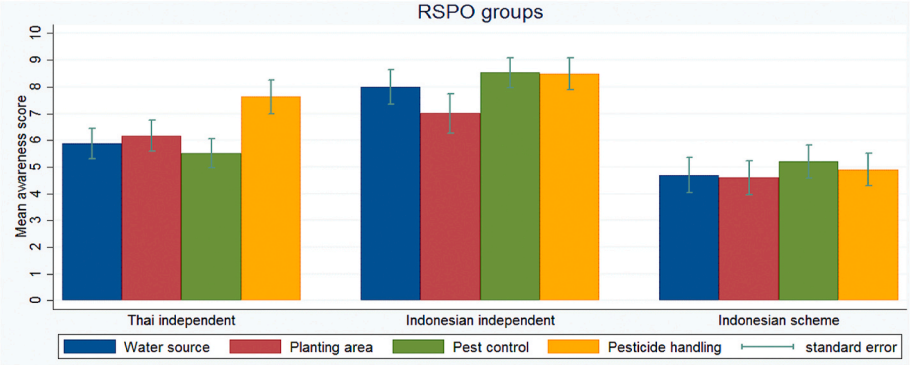

Fig. 2. Environmental awareness scores across case studies.

Table 5
Farmers taking actions to prevent environmental contamination.

Pollution of:	Thailand	Indonesia independent	Indonesia scheme
Water sources	44.6%	73.5%	9.6%
Planting area	45.5%	55.9%	0.0%

Table 6
Self-declared harvesting and post-harvesting practices across samples.

Harvesting practice:	Thailand	Indonesia independent	Indonesia scheme
Under-ripe fruits	32.7%	1.0%	3.8%
Over-ripe fruits	52.5%	39.2%	28.8%
Fallen fruits	61.4%	54.9%	41.3%
No transport within 24 h	6.9%	13.7%	50.0%

Table 7
Visits for learning.

Visits for learning:	Thailand	Indonesia independent	Indonesia scheme
Visits to mills/year	1.54	6.14	1.24
SD* Visits to mills	3.2	11.9	2.3
Visits from mills/year	1.03	21.21	10.18
SD* Visits from mills	2.8	16.15	7.9

Notes: * Standard Deviation.

2010 (The Planter, 2012).

In Indonesia, 62% of the independent farmers and 41% of the scheme farmers claimed to have been trained on the RSPO standard with the support of another 'horizontal' actor in the chain. This leaves many Indonesian RSPO farmers effectively 'untrained', whilst 98% of the Thai sample self-reported having received training. Among those trained, about half of the independent farmers in Indonesia considered the information they received being understandable and easy to apply (51%). In Thailand, the vast majority of farmers answered that the information was easy to understand and to apply (95%).

Despite the proximity to plantation companies it seems that scheme farmers found it more difficult to absorb the information provided by plantation staff (only 8% found it easy to understand). This could be explained by the use of externally organized trainings in the independent farmers' projects in both countries and the focus on instructions on a narrow spectrum of activities for scheme farmers, because the overall management is controlled by the company itself.

5.3. Selling

Price responses can be an important guidance for improving farming practices and produce quality. Since the introduction of private schemes, in Indonesia scheme smallholders are obliged to sell to companies until they have completed the repayment of the land preparation costs (Fairhurst and McLaughlin, 2009; Mccarthy and Cramb, 2009). The price is based on: the weight of the FFBs, the quality of the land and the age of the palms (SPKS, 2014). No negotiations are taking place and actual palm management and farming practices are not taken into account when determining this price. When palm oil prices are high, having a stable relationship with a buyer (the mill), might be positive, but when prices are low this might have a negative effect, especially when the scheme farmer still needs to repay the company.

Independent smallholders deal with mills in a different manner. Mills in Indonesia are legally obliged to have their own plantations (SPKS, 2014) and therefore, during peak season, they may produce more than they can process. Although independent producers can sell to other mills, they are restricted by their transport capacity. Also, mills prefer to deal with middlemen that organize transportation of FFBs from different producers; this leaves them with less clients to deal with and reduces their (transaction) costs. As a consequence, most small-scale independent producers prefer to sell to the nearest mill, de facto barring price negotiations. Hence, their situation does not differ much from the scheme smallholders. Farmers reside in close proximity to the mill but despite sharing the same territory interaction is minimal; only the cooperative management interacts directly with the mill. For farmers, interaction is limited to the moment of delivering the bunches to the collection points. Hereby, they do not enter in direct contact with the mill but only with the people in charge of transport. The cooperative is responsible for payment to the farmers and the monetary exchange takes place at the cooperative office for both the Musim Mas scheme and Amanah. Payment is based on the average amount of FFBs coming from each plot with a certain number of hectares as established in the scheme contract. Interaction with the cooperative becomes therefore vertical, reducing opportunities for learning by experience and by interaction.

Thai producers, on the other hand, face a competitive market; if they have the means they can invest in quality through BMP and since they do not have a contract they can sell to mills with a better price. They can even turn to another activity like growing rubber, when the FFB price is too low, giving them more opportunities to develop their own strategy. Alternatively, they can sell to ramps on the basis of price or long-standing relationships. About 53,5% of the certified producers in Thailand claimed to sell to ramps, either directly (27,2%) or through harvesting teams (26,3%), while 44,2% sold directly to the mills. Ramps hold a strategic position in the market, because they offer interlink services to producers (from pre-harvest credit to harvesting teams). This is felt by mills, who often complain about the quality of FFBs that reach them through ramps. Ramps are not RSPO-certified, making it difficult

for mills to gather traceability data on certified volumes. For this reason, RSPO-certified producers in Thailand dealing with mills directly seem to have a higher degree of bargaining power than in Indonesia (Degli Innocenti et al., 2019).

In Thailand, although the distance between producers and mills is often larger compared with Indonesia, oil palm producers can still bring their FFBs to the mill of their choice individually if they have the means. There is a trade-off between price and transport costs and respondents mention a range of 7–30 km, within which they choose their buyer and this may be the reason for smallholders to engage with a ramp. About half of the farmers in our sample actually delivers FFBs personally to the mill while the other half relies on harvesting teams. In the first case producers experience both learning by interaction and by deciding, whilst in the latter case producers do experience learning by deciding as they consider selling to harvesting teams more profitable than seeking for an outlet themselves, but they are not exposed to learning by interaction with the mill.

Overall, transport from plantation to buyer is managed individually in Thailand and collectively in Indonesia, creating different interaction mechanisms, which affect their knowledge on the quality of the FFBs they produce. Among the farmers who claim to know the quality of their produce (60% for independent and 81,7% for scheme farmers), some also specified the quality. Indonesian independent farmers most often described their FFB as *good quality (38,2%)*, while for the scheme farmers this was specified as: the fruit is harvested at the *right time* (31,7%) and the *correct colour of the fruit* (31,7%). Harvesting is indeed the last activity scheme smallholders conduct before sending their FFBs to the mill.

In Thailand 58,3% of respondents answered they knew the quality of their product and mentioned the feedback they received from buyers during the sale; some define their percentage of oil content, some claim to have medium quality. These answers reflect two different ways of being exposed to markets. Thai producers receive feedback in terms of oil content (see Section 5.4 on grading) and they get paid accordingly, while Indonesian scheme smallholders do not receive this feedback; they are told when to harvest by the company and their meaning of quality relates to the right timing of harvesting. This limits their capacity to absorb price-related feedback, as improving farming practices would not increase their price.

5.4. Grading

FFB grading is the practice of determining its quality to base the purchase price on and thereby the acceptability of FFB for processors (Hennessy, 1995). However, agricultural products are more diverse and less standardized than industrial products. Weight, size, shape, colour, taste, cleanliness, odour, maturity, blemishes, moisture content, etc., are among the many parameters of FFB that buyers and sellers have to deal with in a short time while handling sometimes large volumes. Still, this is important for producers' decisions with respect to adopting new practices, because '*market pull factors that shape what is bought and for how much*', determine smallholders' willingness to invest in sustainable production (Martin et al., 2015, page 54). Grading determines whether their FFB is accepted and what the quality-related rewarding is.

The main determinant of FFB quality is the *Deterioration of Bleachability Index* (DOBI), this is an international market standard to assess the quality of Crude Palm Oil (CPO). DOBI measures the oxidation level of CPO, which describes the absorbance ratio of palm oil dissolved to unsaturated/free fatty acid (FFA). The standard has a range between 1.8 (poor quality) and 3 and beyond (high quality) and the minimum DOBI index required for export is defined by the Codex Alimentarius Commission. While grading, first level processors (crushing mills) or collectors (middlemen), make sure whether harvesting has taken place within 24 h prior to the sale, by checking the moisture of the FFB stem. Workers at the delivery area of mills or collectors are trained to determine the quality on the basis of visual criteria such as colour, number of fallen seeds from the bunch, texture, ripeness and moist of the stem. Performing lab analysis to get the exact percentage of oil content and FFA is highly time consuming and expensive and therefore cannot be performed at the moment of delivery. This leaves a lot of room for subjectivity, especially with grading large quantities, where only few bunches are visually analysed and a general grade determined. To overcome this, buyers can use previous grading records to determine the CPO content related price for a specific client.

Learning through grading is a particular case of learning by interaction, where a knowledge transfer occurs when the buyer "grades" the quality of the FFB sold by the producer. In fact, FFB quality results from harvesting and post-harvesting practices at the farm and feedback from grading and pricing may lead to changes in harvesting practices. However, local dynamics strongly influence the link between grading and farming practices. When oil palm producers do not have access to different buyers they depend on the judgement of a single buyer. In this situation, smallholders have little bargaining power and become price-takers. When a price is decided upon without thorough quality analysis based on multiple indicators and homogeneous grading or when lack of quality discrimination occurred, producers' incentives for better practices implementation and related investments are reduced.

In Indonesia interaction occurred through supervision and control from the company or cooperative during harvesting/collection activities without individual smallholders having direct interaction with mills. Interaction is the check whether top-down instructions on harvesting time have been followed. The price is fixed and associated with the assumption that quality is constant based on the age and variety of palm trees for scheme farmers and on previous records for independent smallholders. In Thailand feedback occurs when delivering to collectors or buyers whereby farmers are directly faced with the grading results. This grading creates incentives for producers to decide on how to improve quality (CPO content and FFA) and get a better price. The exchanged information (feedback) with their immediate buyers cannot be easily ignored as Thai farmers have to meet buyers' standards, especially during peak season when it may be a matter of FFBs being accepted or rejected. Information panels at the mill describing grading and boards with texts like: "*We do not accept un-ripe fruits*", are vehicles for knowledge transfer to farmers and incentives for reflection on cause-effect relationship and deciding new actions.

However, the increasing number of ramps and mills in Thailand has led to a quality decrease as more outlets are available for producers because mills running under capacity are willing to accept lower quality FFB and sell to processors for whom FFA-levels are not relevant (non-edible oil). Mills that pursue high quality CPO have, instead, to collaborate closely with farmers. For this reason, Thai mills involved in the RSPO project are committed to upgrade smallholders by offering them training courses, discounts on fertilizers or fast-delivery ways.

6. Discussion

In this research, we have analysed how the organization of the palm oil supply chain affects opportunities for learning by smallholders. We have studied three different cases and identified challenges and opportunities for social learning based on two factors: 1) the capacity of the smallholders, and 2) the institutional context of the palm oil supply chain. To confirm and conclude our analysis we have also analysed the benefits of RSPO group membership (See Table 8).

Our findings show how downstream-upstream knowledge transfers are more dynamic in Thailand than in Indonesia, and within Indonesia more dynamic among independent smallholders than among scheme farmers. Thai farmers are generally aware of farming practices, and self-report to be complying to at least one of the RSPO principles and criteria in 95% of cases. They have to manage their plantations themselves from seeds to sale, making choices along the way and take most decisions individually which creates a high potential for learning through experience or single-loop learning. Learning through interaction via peer-to-

Table 8
Main benefits from RSPO group.

Benefits	Indonesia – independent	Indonesia – Scheme	Thailand
	%	%	%
Information about sale	71.6	68.3	29.7
Knowledge support	33.3	39.4	51.5
Technical support	4.9	0.0	18.8
Financial facilities	21.6	32.7	5.9
Transport	12.8	31.7	4.0
Other	25.5	3.9	6.9

Notes: Numbers in columns do not sum up to 100% as respondents could choose multiple answers.

peer exchange and horizontal networks is limited. There is a high potential for learning by interaction within vertical networks because the presence of multiple buyers allows farmers to choose where to sell for what price. This is also reflected in the perception of smallholders who identify knowledge support (51,5%) as the main benefit of being part of an RSPO group and not pricing information. Knowledge support is highly sought after by Thai producers, because information about farming practices can help increase their productivity, quality and therefore price; knowledge that they do not receive from irregular interactions with their peers. We found that quality grading and price incentives have high potential for learning by interaction and triple-loop learning; the first one by making leverage on performance in a process of dissonance and co-creation and identification of bad practices or mistakes and the second one by creating a change of values, beliefs or norms behind operational assumptions and actions through economic rewards. The effectiveness of learning by interaction is hindered by the presence of ramps, which blocks farmers' access to knowledge from downstream actors. However, when farmers execute farming practices (agrochemical application, harvesting, post-harvesting) themselves they have the opportunity to monitor ramps' performances and establish their decision-making based thereupon. This goes beyond the idea that intermediaries in certified chains are "*brokers of knowledge, inputs, and resources*" (Deans et al., 2018) and identifies them as a stimuli for learning.

In Indonesia the scheme setting creates a supervised and controlled production system, defined as 'paternalistic' by Barral (2014). This means that smallholders are de facto barely engaged in changing farming practices. We found that Musim Mas scheme smallholders have little knowledge of RSPO criteria. They are essentially implementers of instructions which gives a high potential for learning by interaction but a low potential for learning by decision making (single-loop learning) due to the limited cause-effect reflection and space for dissonance, from which learning is generated through co-creation. Given that all peers follow the same instruction the potential for horizontal learning is minimal. Moreover, the fixed price in schemes where farmers repay their debts is based on an assumed constant quality related to the age of palm trees, which does not stimulate farmers to improve the quality of their FFB nor triple-loop learning. There is low need for experimenting to address constraints which limits double-loop learning as new actions are taken only to implement the innovative system based on a set of instructions but not addressing the assumptions behind them.

The Amanah group of independent smallholders is more aware of RSPO criteria and has a higher potential for learning by doing and by decision-making (single-loop learning) with respect to the planting and farming phases. 86,3% of the Amanah sample claimed to implement at least one RSPO principle compared with only 52,9% for the scheme farmers. Even in this case, however, the presence of a fixed price reduces the incentives for producing better quality FFB and for improving farming practices (double-loop learning). In terms of selling and grading, their situation is comparable to that of the scheme farmers as they are also part of an initial scheme with the mill as the only buyer, which limits triple-loop learning despite producer and buyer being in the same problematic context. The mill wants to purchase certified FFBs which requires congruency between producer and buyer on sustainable practices. Social learning from grading is low, given the fixed OER-related price (based on oil palm age), even though there is a disincentive for delivering below the threshold of quality control. Importantly, the threshold in place is one of minimum quality to be attained. This is in contrast to the case of Thailand, where the threshold to be achieved is ameliorative: the better the quality the higher the price received.

In Indonesia, around 70% of the respondents (both independent and scheme farmers) mentioned information about selling prices as the main benefit of being part of an RSPO group. This response illustrates a lack of transparency on pricing. In the case of scheme farmers, the Indonesian instruction-based model nullifies the need for technical support and for certain types of knowledge. An instruction-based system creates no particular incentive for improving performance and impedes learning loops by both experience and interaction, despite a high level of assets in the system itself. For independent smallholders, the lack of pricing information can be explained by the absence of direct contact with the mill they are selling to. The cooperative only deals with purchasing and selling FFBs—and is therefore a vertical and not horizontal network. In Thailand the most frequently encountered direct vertical actor is the ramp, while in Indonesia this is the cooperative. Thai farmers have, however, the possibility to monitor ramps' work and to make their own choice, while in Indonesia the cooperative is checking farmer's performances. This is reflected in the perceived power that these vertical actors wield on them. In Thailand, only 24% of respondents consider their negotiation power with respect to ramps to be extremely weak. Instead in Indonesia, 39% of the scheme farmers perceive their power with respect to the cooperative as extremely weak and for independent farmers this is even 74%. This lack of perceived power has consequences on the learning opportunities generated through these vertical interactions by reducing co-creation and the process of 'learning together to manage together'. We have created a matrix of the opportunities for learning for palm oil production from planting to grading phases, differentiated by experience and by interaction. A low or high score is based on the results of the analysis and on the ability of farmers to conduct the learning cycle (action-reflection-action) in the supply chain they are part of (Table 9).

These observations have several implications when aiming for increasing sustainability in oil palm cultivation through social learning. Systematically conducted FFB quality assessment could support the implementation of BMPs and improve sustainability. This could be a third-loop learning, where learning can be understood as a way to detect and rectify errors. However, if this is not standardized, it may deliver feedback driven by market dynamics rather than by actual quality. Collectors who are key actors in quality assessment and grading both in Thailand and Indonesia are not really included in strategies promoting sustainability. These collectors represent a risk for lowering product

Table 9
Opportunities for social learning.

		Planting	Farming	Selling	Grading
Thailand Independent					
Learning by experience	By doing	*High*	*High*	*High*	*High*
	By deciding	*High*	*High*	*High*	*High*
Learning by Interaction	Horizontal	*Low*	*Low*	-	-
	Vertical	*Low*	*Low*	*High*	*High*
Indonesia Independent					
Learning by experience	By doing	*High*	*High*	*Low*	*Low*
	By deciding	*High*	*High*	*Low*	*Low*
Learning by Interaction	Horizontal	*Low*	*High*	-	-
	Vertical	*Low*	*Low*	*Low*	*Low*
Indonesia Scheme					
Learning by experience	By doing	*Low*	*Low*	*Low*	*Low*
	By deciding	*Low*	*Low*	*Low*	*Low*
Learning by Interaction	Horizontal	*Low*	*Low*	-	-
	Vertical	*Low*	*Low*	*Low*	*Low*

quality while they may also interrupt channels for transferring knowledge between the chain actors.

Involving key chain actors in sustainability programs strengthens vertical integration and information flows that allow knowledge being transferred to the different categories of smallholders. If a standard like the RSPO wants to increase sustainability through companies, they may decide to exclude groups of independent small-scale producers and concentrate on large volumes with a more normative approach. Because, as the Musim Mas management argues, successful implementation of agronomic, environmental and social standards needs the presence of a strong cooperative able to coordinate and administer the implementation of best management practices on all plots. Furthermore, the involvement of a leading company is key to guarantee organization and control and gain the trust of the scheme smallholders, so that they apply the acquired knowledge on their own plots. However, further integration of the smallholders in the chain is required to make sure they receive the appropriate information and practical guidance to help them access the sustainable supply chain. Further investments in knowledge transfers (learning by interaction) on planting material and farming practices may be required to fully achieve congruence between mills' demand and producers' supply. Grading and price-discrimination based on the quality of FFBs can be strong incentives to knowledge transfer and may increase awareness and implementation of RSPO-practices. This would create the conditions for including smallholders in certified supply chains and allow for the knowledge transfer and opportunities for social learning necessary for the implementation of sustainability standards.

7. Conclusions

Indonesia and Thailand are key actors among palm oil producing countries, increasingly faced with sustainability challenges. Large companies have ample resources and easy access to research to increase productivity and reduce environmental impacts. On the other hand, small-scale producers often lack the knowledge on how to implement more sustainable farming practices. Certification programs like the RSPO may act as a useful link between the two, contributing to knowledge transfers. Whether these result in actual changes in practices, however, depends on the extent to which knowledge transfers are translated into learning. With this study we contribute to the debate on social learning and learning loops, and the specific discursive settings that might affect the outcomes of an innovative system initiative like RSPO certification. We provide evidence of how material (tangible goods) and non-material (e.g. information and knowledge) flows are intertwined and how important it is to understand both when studying learning.

Learning can take place on an incidental base (targeted trainings) or more continuously in everyday practices and observations, provided that reflection on the actions and goals occurs. Highly controlled farming systems such as oil palm schemes in Indonesia – with vertical integration, proximity between smallholders and mills and long history of production – may achieve more sustainability without necessarily having farmers changing their beliefs and values. This because they focus on learning as an act of imitation, with strict instructions and control, rather than on training and processes of experimenting and co-creation. However, they leverage performance to a certain level only, due to a lack of incentives. Vertical integration, proximity and experience do not automatically translate into learning: as long as knowledge about RSPO and BMPs is transferred to scheme farmers as a set of instructions, it may be hard to expect them to implement sustainability standards by themselves once land is transferred to them or when they quit the scheme.

Independent smallholders in Indonesia and Thailand both have more opportunities to learn by doing compared to scheme farmers, but differ greatly in the extent to which they are exposed to incentives. In fact, context-related dynamics in chain governance – such as quality incentives, price regulation and grading systems – can determine the extent to which sustained knowledge transfers and actual learning are achieved. These appear to be more effective in Thailand than in Indonesia in triggering individuals' change of assumptions behind actions (action-reflection-new action)—even when activities are delegated to intermediaries. Addressing the key elements in the context in which farmers find information meaningful to the extent of changing their actions is necessary to improve the engagement of smallholders in fostering sustainability, and identify feasibility and probability of success.

Further research should investigate how upstream chain arrangements can be improved, such that smallholder farmers find the information they are exposed to meaningful, update their beliefs, and implement sustainable practices. Where bottlenecks in learning are found, policy makers should foster the capacity of pre-existing palm oil upstream arrangements to change along with the sustainability initiatives themselves.

CRediT authorship contribution statement

Elena Degli Innocenti: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Software, Visualization, Writing - original draft, Writing - review & editing. **Peter Oosterveer:** Conceptualization, Funding acquisition, Methodology, Project administration, Resources, Supervision, Writing - original draft, Writing - review & editing.

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