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Unpacking Indonesia's independent oil palm smallholders: An actor-disaggregated approach to identifying environmental and social performance challenges

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ABSTRACT

Processes of globalization have generated new opportunities for smallholders to participate in profitable global agro-commodity markets. This participation however is increasingly being shaped by differentiated capabilities to comply with emerging public and private quality and safety standards. The dynamics within Indonesia's oil palm sector illustrate well the types of competitive challenges smallholders face in their integration into global agro-commodity chains. Because of public concern over the poor social and environmental performance of the sector, many governments, companies and consumers are attempting to clean up the value chain through self-regulatory commitments, certification and public regulation. As a result, many of Indonesia's oil palm smallholders face compliance barriers due to informality and poor production practices, and threaten to become alienated from formal markets, which could in turn lead to a bifurcation of the oil palm sector. Recognizing that many oil palm smallholders lack compliance capacity, myriad public and private actors have begun designing initiatives to address compliance barriers and enhance smallholder competitiveness. However, failure to properly account for the heterogeneity of the smallholder oil palm sector will undermine the effectiveness and scalability of such initiatives. By developing a typology of independent smallholder oil palm farmers in Rokan Hulu district, Riau province, this article reveals the wide diversity of actors that compose Indonesia's smallholder oil palm economy, the types of compliance barriers they face and the sustainable development challenges they pose. In doing so, this article illustrates how global agro-commodity chains can drive agrarian differentiation and offer new insights into the complex dynamics of agricultural frontier expansion.

1. Introduction

An estimated 84% of the world's farms are managed by smallholders cultivating less than 2 ha of land (Lowder et al., 2016). Although most smallholders in developing countries are involved primarily in subsistence-based production, globalization and rising global trade flows have over recent decades enabled many smallholders to participate in and benefit from more commercialized global value chains (Lee et al., 2012; Rigg et al., 2016). Changing rules and relations in many of these global value chains have though begun to raise concerns over the appropriate modes and effects of smallholder participation. For example, the proliferation of safety and quality standards, quality-based competition and rising market concentration is increasingly shifting power relations between farmers and processors/retailers in favour of the latter and brought about new barriers to smallholder market participation (Lee et al., 2012; McCullough et al., 2008). This poses new challenges for leveraging commercial smallholder production in support of inclusive and sustainable development objectives and calls for targeted support in order to enable smallholders to more effectively compete in global markets. However, because public statistics and discourse tends to treat 'smallholders' as a homogenous population (e.g. DJP, 2015) or as a dichotomy of company-assisted and independent smallholders (e.g. Brandi et al., 2015; Euler et al., 2016; Lee et al., 2013), development policies often fail to adequately account for the wide range of actors they represent and issues they face. In order to avoid inefficient and sometimes detrimental one-size-fits-all solutions, there is a need to further unpack smallholder attributes and develop more actor-disaggregated interventions (Fan et al., 2013).

This article focuses on smallholder oil palm farmers in Indonesia, which account for an estimated 40.8% of the total Indonesian oil palm

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acreage (DJP, 2015). The dynamics within Indonesia's oil palm sector illustrate well the types of competitive challenges smallholders face in their integration into global agro-commodity chains. For example, due to public concern over the poor social and environmental performance of the sector (e.g. Enrici and Hubacek, 2016; Lee et al., 2014; Obidzinski et al., 2013), most major buyers from Europe and North America have over the past decade begun demanding producer compliance with voluntary certification systems such as the Roundtable on Sustainable Palm Oil (RSPO). Increasingly, major chain actors are augmenting these requirements with so-called zero-deforestation commitments, which aims to eliminate deforestation and peatland conversion from their entire supply chain (Pirard et al., 2015). In an attempt to enhance the global competitiveness of Indonesian palm oil, the Indonesian government has also developed a mandatory public standard, the Indonesian Sustainable Palm Oil (ISPO) system. In spite of the latter being widely criticized for attempting to undermine the more encompassing private standards (McCarthy et al., 2012), the increasing imperative to comply with the various standards has placed increasing sustainability and legality demands on Indonesia's oil palm smallholders. Independent smallholders are currently poorly equipped to comply with standards (Hidayat et al., 2015; Rietberg and Slingerland, 2016) and without adequate support, many smallholders threaten to become increasingly alienated from both domestic and global palm oil markets (Cramb and McCarthy, 2016; Lee et al., 2012). Recognizing that many oil palm smallholders lack compliance capacity, numerous development agencies, corporations, and multi-stakeholder initiatives have begun designing initiatives to address compliance barriers and enhance smallholder competitiveness.[1] However, failure to properly account for the heterogeneity of the smallholder oil palm sector may threaten to undermine the effectiveness and scalability of such initiatives.

By developing a typology of independent smallholder oil palm farmers in Rokan Hulu district, Riau province, this article reveals the wide diversity of actors that compose Indonesia's smallholder oil palm economy, some of the compliance barriers they face, and sustainable development challenges they pose. By examining the social geography of independent smallholder oil palm production, we illustrate how global agro-commodity chains can drive agrarian differentiation and offer new insights into the complex dynamics of agricultural frontier expansion.

As context, this article starts with an historical overview of smallholder oil palm development in Indonesia and a reflection on how smallholders are formally classified. This is followed by a description of methods and the analytical approach. The results that are subsequently presented comprise an analysis of the social geography of the smallholder oil palm landscape and a smallholder characterization drawing on hierarchical clustering. The paper concludes with a discussion and a reflection on findings.

2. Background

2.1. Transformation of smallholder oil palm production in Indonesia

Smallholder oil palm farming in Indonesia began to be actively promoted under the New Order regime with support of the World Bank in the 1970s through so-called *Perkebunan Inti Rakyat*/Nucleus Estate Smallholder (PIR/NES) schemes. The schemes principally served as a vehicle for the socio-economic development and political integration of Indonesia's outer islands (McCarthy et al., 2012; Molenaar et al., 2013). Early iterations of the schemes were state-led, which linked smallholders to state-owned plantation companies through outgrower arrangements. Under these arrangements, the plantation companies developed plantations for smallholders (referred to as plasma) and provided inputs, technical assistance and finance. When the cost of plasma establishment was repaid, the formal ownership over the land was transferred to the smallholders. As the state, in the face of international criticism, began to take on a less active role in the sector over the course of the 1980s (McCarthy et al., 2012), responsibilities for plasma development began to shift to the increasingly prominent private sector (Badrun, 2011; Zen et al., 2016). Although numerous variations of the original PIR/NES were introduced during this transition (e.g. *PIR Akselerasi, PIR Swasta, PIR-Trans*), the *Kredit Koperasi Primer Anggota* (KKPA) scheme became the dominant model for smallholder integration during the 1990s. In an attempt to promote rural entrepreneurship, KKPA schemes adopted a more decentralized governance system, where Village Unit Cooperatives were responsible for credit and infrastructure management (Gillespie, 2010; Molenaar et al., 2013; Zen et al., 2016). Many of these cooperatives also took on plantation management responsibilities, albeit with mixed success. Although some district and provincial governments continued to promote PIR schemes during the 2000s (Zen et al., 2015), state subsidies to the schemes began to dry up following the East Asia Crisis and the end of the New Order regime in the late 1990s. Plantations companies were reluctant to guarantee commercial loans to smallholders and sector investments increasingly suffered. In order to reinvigorate the sector, the originally mandated 70:30 land split between plasma and nucleus was replaced in 2007 with a 20:80 land split (Gillespie, 2011; McCarthy et al., 2012). However, to date many companies still fail to achieve this 20% obligation and many new plasmas are 'one roof management' schemes, where plantation companies fully manage smallholder plantations (Gillespie, 2011; Zen et al., 2016).

Despite their declining significance, the various PIR schemes did make important contributions to rural development and the development of smallholder oil palm management capacities. As the oil palm market in Indonesia matured and infrastructure improved, many smallholders were increasingly able to develop oil palm independently (see Belcher et al., 2004; Feintrenie et al., 2010 for a more elaborate review of the emergence of the independent oil palm sector). Although the PIR programs managed to incorporate smallholders across an estimated 700,000 ha (Badrun, 2011) to 900,000 ha (Zen et al., 2015), the vast majority of the 4.76 million ha cultivated by (what the government classifies as) smallholders in 2016 is likely to be independent (Fig. 1).

In contrast to PIR development, the growth of the independent oil palm sector occurred without any far-reaching government planning or support (McCarthy and Zen, 2016). In part due to lack of state oversight, most independent smallholders receive little to no extension support and are often required to depend on informal land, input and offtake markets. As a result, they are often perceived as marginal and backwards when compared to modern estate agriculture (Gillespie 2011; McCarthy and Zen, 2016) and difficult to monitor through existing traceability systems (e.g. in the context of RSPO and zero-deforestation). Moreover, due to insufficient use of and access to high quality production inputs and adoption of poor management practices, most independent smallholders tend to be considerably less productive than commercial estates and PIR smallholders (DJP, 2015; Euler et al., 2016; Molenaar et al., 2013). The need to address this high yield gap and level of informality is however increasingly featuring in Indonesian policy and development discourse since it is increasingly recognized that failure to improve smallholder compliance with emerging market standards is not only an inclusive development issue, but also a sector competitiveness and sustainability issue.

2.2. The arbitrary definition of smallholders in Indonesia

While the Directorate of Estate Crops (DJP) and the Indonesian Bureau of Statistics (BPS) divide oil palm producers into three categories, namely smallholders, state-owned companies and private sector

[1] This includes, for example, activities undertaken under the Indonesian Palm Oil Platform (InPOP), Sustainable Palm Oil (SPO) Initiative, IDH Palm Oil Program, and the Smallholder Acceleration and REDD program (SHARP).

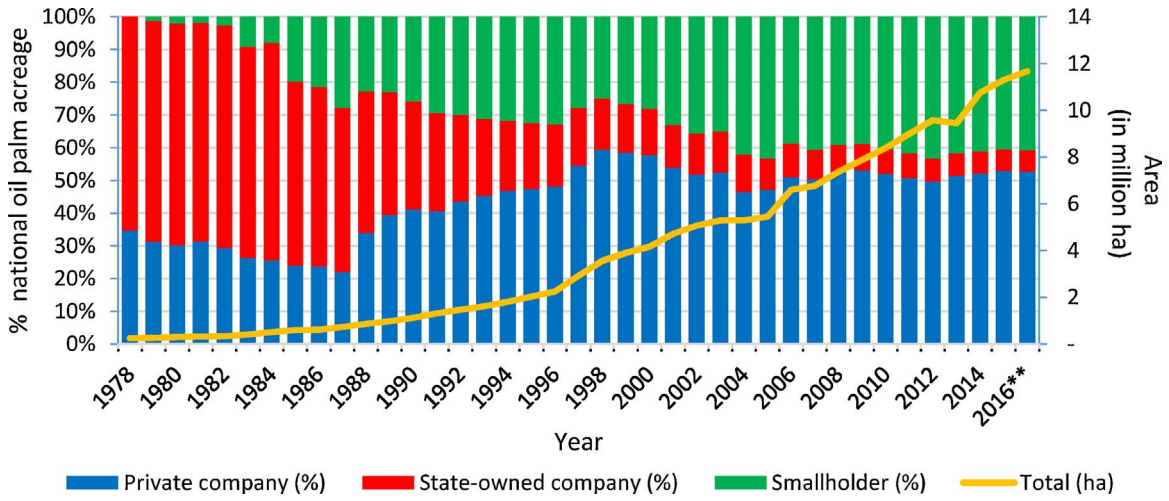

Fig. 1. Indonesia's oil palm production, by actor type (1978–2016).
**2016 data is based on projections.
Source: DJP (2015).

companies (DJP, 2015), they do not provide clear definitions of what these categories entail. As noted by Cramb and Sujang (2016), the term smallholders oil palm farmer often lacks a precise definition, but in practice tends to refer to differences in size and level of reliance on family labour. This aligns with the definition of the RSPO (2016): *"… farmers who grow oil palm, alongside with subsistence crops, where the family provides the majority of labour and the farm provides the principal source of income, and the planted oil palm area is less than 50 ha"*. The Ministry of Agriculture's Guidelines for Plantation Licensing (Regulation No.98/Permentan/OT.140/9/2013) does make a distinction between producers based on size. For example, those that cultivate less than 25 ha of oil palm are required to apply for a Plantation Registration Certificate (STD-B), while those producers cultivating more than 25 ha require a Plantation Business License (IUP-B). The latter involves more complex procedures and regulatory requirements such as an environmental impact assessment (Paoli et al., 2013). Those with an STD-B are exempted from most of these requirements. This points to a legal distinction between smallholders and commercial producers based solely on land area.

Interviews with government officials and producers revealed that these regulatory requirements are typically not known to producers or circumvented. Meeting requirements is generally perceived to be cumbersome, lengthy, and expensive. Many producers also contend that completely formalizing operations attracts increased state scrutiny. The circumvention of regulations is typically achieved by registering different landholdings in different names. Government officials in the Regency's Office and District Forestry and Plantation Office also confirmed that both STD-Bs and IUP-Bs are rarely issued in practice. This lack of proper administration and documentation poses serious challenges for regulating and providing targeted support to independent oil palm farmers. It also raises questions about the accuracy of official statistics since both under- and over-reporting issues are simultaneously present. Realities on the ground for example showed that local government, the primary source of data for the DJP and BPS, classifies farmers cultivating between 25 and 250 ha as *'perkebunan rakyat'*, which is translated as 'smallholders', despite these technically requiring business licenses. On the other hand, since many producers are able to circumvent regulations entirely, many are not captured by local government at all.

3. Methods

3.1. Case study context and site selection

This research was undertaken in Sumatra's Riau province, a province with a vibrant fossil fuel, plantation agriculture and pulp and paper industry. The main ethnic groups of Riau are Malay (indigenous to Riau, 33.0%), Javanese[2] (indigenous to Java, 30.4%), Batak (indigenous to North Sumatra, 12.5%), and Minang (indigenous to West Sumatra, 12.2%) (Na'im and Syaputra, 2011). Riau is strategically located across the Strait of Malacca – in close proximity to major markets in Malaysia and Singapore – and south of North Sumatra, where Indonesia's plantation agriculture originally emerged in the late 19th century under Dutch colonialism (Budidarsono et al., 2013). With Riau's comparatively low population density and the abundance of cheap and 'empty' agro-ecologically suitable land, towards the latter end of the 20th century many oil palm producers in pursuit of new land began to migrate from North Sumatra to Riau (Budidarsono et al., 2013); overtaking North Sumatra as the largest oil palm producing province in Indonesia by 1999 (World Bank, 2014). Riau accounts for an estimated 22.8% of Indonesia's total mature oil palm acreage and 30.3% of Indonesian oil palm smallholders. Of the 2.46 million ha of land under oil palm cultivation in Riau (equivalent to 27.6% of Riau's land area), 58.6% is officially classified as being under smallholder oil palm cultivation, with 3.6% and 37.8% cultivated by state-owned and private companies, respectively (DJP, 2015). Mills without plantations, also referred to as stand-alone mills, account for 33.0% of Riau's palm oil processing capacity (DIS-BUN Propinsi Riau, 2015). These mills source primarily from independent smallholders, highlighting the maturity of the independent oil palm sub-sector in Riau.

Within Riau, research activities focused on Rokan Hulu district (Fig. 2). With a total processing capacity of 1605 MT of fresh fruit bunches (FFB) per hour (of which 33.6% by stand-alone mills), Rokan Hulu district has the largest palm oil processing capacity in Riau (DIS-BUN Propinsi Riau, 2015). Approximately half of its land area is occupied with oil palm, with 'smallholders' accounting for approximately 55% of the total cultivated areas (DJP, 2015). Seven of Rokan Hulu's 16 sub-districts were selected for research activities across two similarly sized, but ecologically and demographically distinct, areas. One area is Bonai Darussalam in the northeast (comprised of one sub-district), which consists largely of peat soils, experienced high rates of

[2] In this research Javanese includes Sundanese, who are indigenous to West Java.

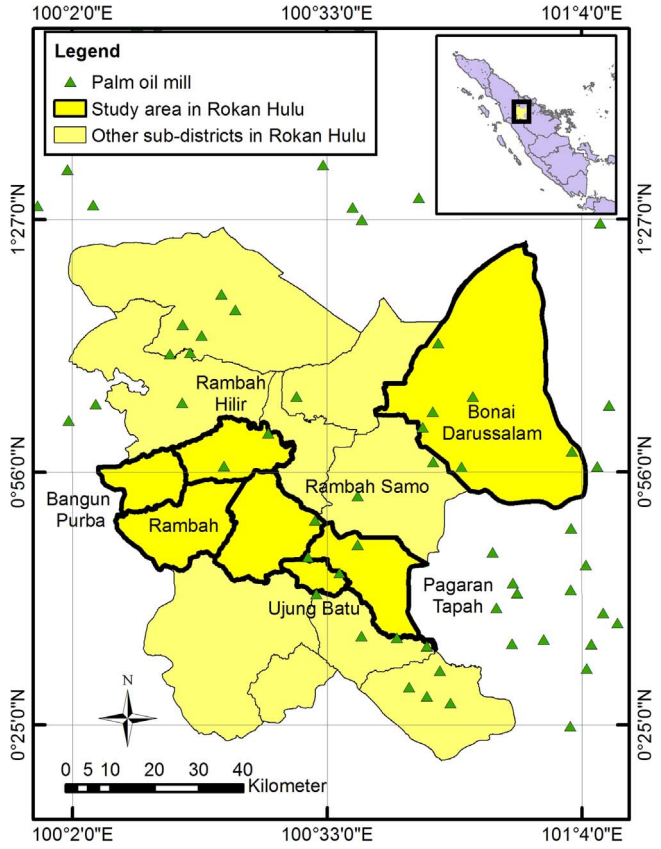

Fig. 2. Research area and distribution of palm oil mills.
Source: authors' representation based on CIFOR mill identification (unpublished) and BAPPEDA Rokan Hulu (undated).

deforestation in recent years, and has a population density of only 29.5 inhabitants/km^2 (see Appendices A and B for deforestation and peat distribution maps). This area can be considered a recently converted forest frontier. The other area is Central Rokan Hulu (comprised of six sub-districts), which almost exclusively consists of mineral soils.[3] Deforestation there was most prevalent before the 1990s and Central Rokan Hulu has a comparatively high population density of 151 inhabitants/km^2 (Badan Pusat Statistik Kabupaten Rokan Hulu, 2015). This area can therefore be regarded as an established agricultural area. Recent oil palm expansion in Rokan Hulu has taken place in Bonai Darussalam on considerable scale, often on lands legally classified as state forestlands and where peat fires associated with oil palm expansion are common. Smallholder oil palm production can legally only take place on land classified as 'non-forest estate land' (*Areal Penggunaan Lain*, APL), and not in the state forest domain.[4] Unpacking dynamics in such different locations within one district provides valuable insights into peatland conversion processes in Indonesia (Bonai Darussalam), especially when juxtaposed against independent oil palm smallholder development in more established agricultural areas (Central Rokan Hulu). Although Bonai Darussalam can be considered a frontier area, Fig. 2 highlights that there is a considerable presence of mills in and around both research areas, indicating that Riau as a whole has a well-established oil palm landscape. This shows how smallholders are in neither area subjected to monopsonic market conditions.

[3] Mineral soils refer to sand, loam, silt, clay, and/or volcanic soils. These are usually more suitable for oil palm than peat soils, which are in contrast classified as organic soils (Corley and Tinker, 2016).

[4] APL is a legal classification of land that is not part of the state forestry domain. This does not however imply that APL land is devoid of forests or that state forestland is necessarily forested. For more details on the forestry domain and non-state forest lands see Enrici and Hubacek (2016)

3.2. Surveying activities and data

Due to lack of administrative oversight and smallholder licensing, no reliable sample frame could be derived from official data. Therefore, this research sampled smallholders spatially using recent high-resolution satellite imagery available through Google Earth. Using images taken between August 2013 and July 2014, all individual oil palm plots in the research area were manually photo-interpreted with ArcGIS 10.3. A total land area of 304,355 ha was mapped (see results in Table 1). Approximately 2.7% of the selected sub-districts' land area could not be mapped due to excessive cloud cover. Those areas identified as being planted with oil palm were classified as being either independently or company-planted, based primarily on planting patterns. In areas with a low elevation gradient, like much of our research area, companies are typically distinguishable by a large number of rectangular 50 ha blocks comprised of oil palm of similar age and clear road patterns. Smallholders often have less uniform planting patterns, smaller plots and a less distinguishable infrastructure. Those areas where this distinction could not confidently be made were subsequently visited. Fig. 3 depicts the geographic distribution of these two classifications in the study area.

The area identified as being cultivated by independent oil palm smallholders was subsequently partitioned into 500 m by 500 m (25 ha) cells and assigned a unique code. This cell area was deemed appropriate since it struck a balance between capturing geographic diversities and time and cost efficiency. A total of 287 cells, comprising 5.2% (equivalent to 4331 ha) of the total mapped smallholder oil palm acreage, were randomly selected using Hawth's Analysis Tools (see Table 2 for an overview of cells and surveying activities). Every smallholder oil palm plot contained within the selected cells was visited between April 2015 and November 2015 by the lead author and a team of six field technicians. In Bonai, the sampled cells (119) comprised a total of 509 different farmers, while in Central Rokan Hulu sampled cells (168) comprised 1331 different farmers; reflecting differences in average farm size and farm density between the two areas. There were, however, minor discrepancies between the areas identified within selected cells through photo-interpretation and field measurements due to new plantings and cuttings after July 2014.

Field technicians collected data from the 1840 plots on inter alia the identity of the plot owner, his/her origin, ethnicity, and place of primary residence, the age of planted oil palms, the plot area, and size of additional oil palm plots. Data was obtained from local sources, which consisted of plot owners or, where these were unavailable, plot labourers, middlemen, and community and neighbourhood leaders knowledgeable about the nearby plantations and their owners. The reliability of this approach was validated by cross-referencing data provided by non-plot owners with data obtained from follow-up surveys with plot owners. In the first surveying phase, survey depth was intentionally sacrificed for a large locally representative sample size that captures actor diversity within and across the two landscapes. We contend that valuable insights into the social and economic differentiation amongst plot owners can be generated using basic demographic and plot data.

Within each of the cells, the plot owner located in the middle of the cell was, where feasible, selected for an in-depth survey. This survey instruments captured a wide range of topics, ranging from former and current livelihood activities to articulation to input and offtake markets, sources of finance, and standards compliance barriers (e.g. proof of land ownership, use of certified planting material, and production practices). The objective of the survey was to enable more rigorous assessment of upgrading challenges faced by different producer groups, as identified by the clustering (see Section 3.3). In total, 231 in-depth surveys (12.6% of previously surveyed plot owners) were conducted. Absenteeism of large farmers, especially in Bonai Darussalam, was an issue, but was in most cases resolved by interviewing the plantation manager, who often had considerable knowledge on plantation

Table 1
Photo-interpretation results, peat and land classification in research area.

Type of land use	Frontier (BD)		Established agricultural area (CRH)		Total	
	Area (in ha)	Share	Area (in ha)	Share	Area (in ha)	Share
Oil palm	75,252	54.2%	76,846	25.2%	152,099	50.0%
Independent smallholder oil palm	39,568	28.5%	43,493	14.3%	83,062	27.3%
Company developed oil palm	35,684	25.7%	33,353	11.0%	69,038	22.7%
Non-state forest land (APL)	51,400	37.0%	101,050	33.2%	152,450	50.1%
State forest land	87,538	63.0%	64,367	21.1%	151,905	49.9%
Peatland (> 100 cm)	110,734	79.7%	0	0.0%	110,734	36.4%
Total area	138,938		165,417		304,355	

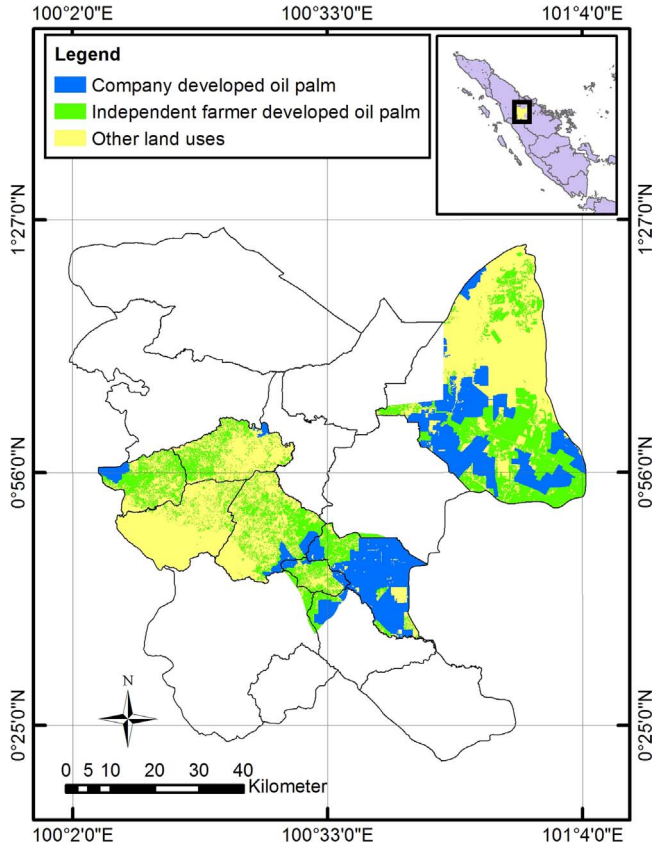

Fig. 3. Classification of oil palm ownership in research area.
Source: Authors' representation based on field research and Google Earth (2015).

management and the owner.

3.3. Analytical approach

The first part of the analysis involved characterizing the social geography of the smallholder oil palm landscape in Rokan Hulu. It examines the distribution of smallholders in both numbers and the area they occupy within the landscape on the basis of ethnicity and the first three variables used in the cluster analysis (see below). This data is corrected for sampling bias. Because farmers are sampled spatially, a large farmer is more likely to be sampled than a small farmer. To correct for this, we assign probability weights to the different farmers using the following simulation-tested expression:

$$P = 1 - \left((1 - c)^{(\frac{\sqrt{h}}{g} + 1)^2} \right)$$

Where P is the probability of being selected; c the proportion of total grids sampled; h the farm size (in ha); and g the diameter of a cell (in hectometres).

Although the descriptive data offers important insights into smallholder characteristics, it provides limited insights into within group differences and patterns across variables. In order to gain a more integrated perspective, we develop a smallholder typology through cluster analysis in order to cluster sampled plot owners into more homogenous sub-groups where within-group variances are minimized across a range of variables. Specifically, we adopt a hierarchical clustering procedure using agglomerative techniques, which sequentially forms clusters by merging individual cases based on similarity. A hierarchical procedure was preferred over clustering procedures such as, for example, k-means and two-step since the number of desired clusters could not be pre-identified and for its appropriateness for our type of clustering variables (e.g. being either nominal or ordinal) (Mooi and Sarstedt, 2010). We employ one of the most widely used clustering algorithms, Ward's method, because of the absence of outliers and the algorithm's tendency to combine clusters with small numbers of observations (Dolnicar, 2002; Ward, 1963). The number of clusters was determined through analysis of a dendrogram and scree plot, which, based on the change in distance between mergers, pointed to either a five or seven-cluster solution. A seven-cluster solution was considered more appropriate since that split large farmers into two separate groups rather than one, as in the five-cluster solution. This better aligned with qualitative field observations, which suggested that larger farmers in peatland areas adopt different (business) strategies and have a different social background than larger farmers in established agricultural areas.

The cluster analysis draws on five variables, namely (1) *total area of oil palm land owned by plot owner* (split into three categories; small farmers ranging from 0 to 3 ha, medium farmers from 3.1 till 15 ha and large farmers when < 15 ha), representing differences in wealth between farmers; (2) *primary place of residence of plot owner*, in order to capture absenteeism and possible involvement in day-to-day plot management; (3) *origin of plot owner*, in order to capture the role of external/migrant actors in sub-sector development; (4) *plots' primary soil type*, to capture differentiation based on geography (this also functions as a proxy for preparedness to take risks due to the hazardous nature of production on peatlands); and (5) *land status,* which illustrates (potential) legality of land ownership. Although ethnicity is often considered to strongly shape social differentiation in Indonesia (Aspinall and Sukmajati, 2016), and therefore included in the results, it was excluded from the hierarchical cluster analysis because it strongly correlated with the 'origin of plot owner' variable, thereby resulting in clusters being excessively defined by differences in heritage. Because mixed variables should not be used in a hierarchical cluster analysis, all variables were converted into binary variables. Cases with missing data were omitted from the analysis. This reduces the total number of cases used in the cluster analysis from 1840 to 1728.

Table 2
Sample overview.

	Frontier (BD)	Established agricultural area (CRH)	Total
Number of cells surveyed	119	168	287
Average areas under independent smallholder oil palm per cell (in ha)[a]	18.0	13.0	15.1
Total area mapped from satellite (in ha)	2141.5	2189.9	4331.4
Total area identified on the ground (in ha)	2202.5	2248.4	4450.9
Proportion total mapped area surveyed	5.4%	5.0%	5.2%
Number of rapid plot surveys	509	1331	1840
Number of farmer surveys	82	149	231

[a] For logistical purposes, only cells containing more than 3.5 ha of independent oil palm were selected for analysis.

4. Results

4.1. The social geography of smallholder oil palm production

In the research areas, small independent oil palm farmers accounted for more than half the total smallholder population, but account for only 19.7% of the area (Fig. 4). Large independent oil palm farmers are, despite comprising only 8.4% of the population, the most dominant land users, accounting for 49.9% of the area under oil palm in the two research areas. Large variations between the two sampled landscapes can be observed however. For example, in the established agricultural landscape of Central Rokan Hulu (CRH), small farmers, proportionally, occupy four times more land than they do in the frontier landscape of Bonai Darussalam (BD). Conversely, large farmers account for 69.7% of the smallholder land area in the frontier area (BD), but only 25.2% of the smallholder land area in the established agricultural area (CRH). This suggests that smallholder oil palm in peatland areas is rarely owned by genuine smallholders, who instead tend to gravitate towards more populous and established agricultural areas on mineral soils. This can be attributed to comparatively high costs of establishing plantations on peatland soils (e.g. due to additional land preparation and water management), comparatively high risks (e.g. due to fire and pests), and hence frequent low productivity (Gaveau et al., 2014; Lim et al., 2012; Woittiez et al., 2017). Moreover, in peat areas, physical and production infrastructure tends to be less developed, thereby further raising costs of production and reducing access to production inputs. Off-farm economic opportunities and public services are also more plentiful in the established agricultural area than the frontier. On the other hand, land prices in frontier areas tend to be considerably lower than in more populous established agricultural areas, thereby making it attractive for land speculation.

An often-cited advantage of smallholder agriculture over corporate agriculture is that those working on smallholder plantations are often more vested in the plantation's productivity than those working on corporate plantations due to the use of household rather than hired labour, which by and large is more vested in the performance of the plantation (Hayami, 2010; Hazell et al., 2010). The plot owner's primary place of residence is a useful indicator for the possibility of direct involvement of the plot owner (and his/her household) in the day-to-day management of the smallholder plantation. Fig. 5 shows that in the established agricultural area (CRH) 74.7% of farmers and 58.4% of the planted oil palm area is owned by those that either reside by the plot or within the village nearest to the oil palm plot, suggesting that much of the planted smallholder oil palm can be directly managed or monitored by its owners. In the frontier (BD), however, only 54.8% of farmers and 22.5% of planted oil palm involves owners residing within the village, with 70.1% of the planted smallholder area owned by plot owners residing outside Rokan Hulu district. This illustrates that smallholder production in frontier areas is more likely to be characterized by absenteeism. This in turn suggests that smallholders operating in such areas are less likely to comply with the popular definition of smallholders (e.g. that rely predominantly on household labour for production activities) and involve direct monitoring of performance.

Ethnicity is widely considered to strongly shape the social geography of oil palm production, with non-indigenous, more affluent and politically aligned migrant groups often viewed as benefiting disproportionately from sector expansion (Budidarsono et al., 2013; McCarthy and Zen, 2016; Zen et al., 2016). The results show that in terms of numbers, the most dominant group is Javanese (50.3% of smallholders in the study areas), followed by North Sumatran and indigenous Batak (24.7%) and the indigenous Malay (22.7%) (Fig. 6). According to BPS data (2011), of the 59 villages captured in the research, 39.0% are predominantly Javanese, 18.6% predominantly

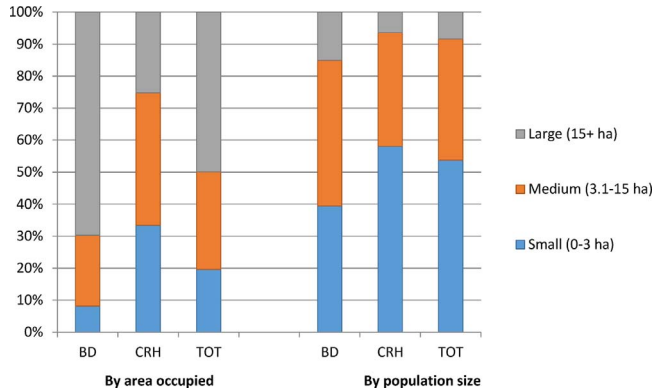

Fig. 4. Prevalence by farmer size category.

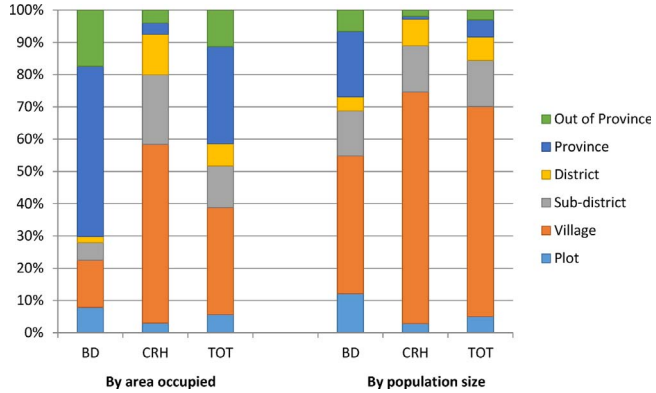

Fig. 5. Prevalence by place of primary residence.

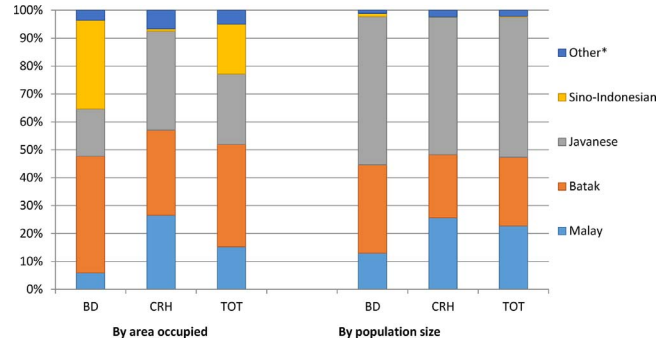

Fig. 6. Prevalence by ethnicity.
*The 'Other' category is comprised largely of Minang, an ethnic group indigenous to West Sumatra.

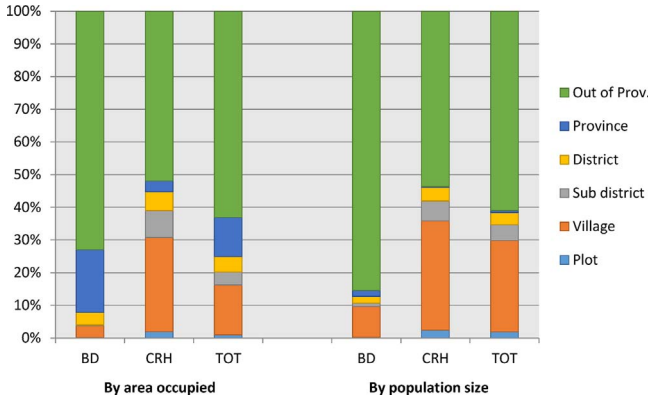

Fig. 7. Prevalence by origin.

Batak and 42.4% predominantly Malay. With Malay villages often being less populous than the Batak and Javanese villages, this distribution suggests that participation rates of the Malay population may be comparatively low and Bataks comparatively high. Much of the Javanese population settled in Riau through the government's transmigration schemes in the 1980's, but many also came as spontaneous migrants (often from North Sumatra). These Javanese, often referred to as Java-Medan, migrated to Riau for similar reasons as many Bataks, being high land prices in North Sumatra and the availability of cheap land in Riau (Susanti, 2016). With the Javanese population playing a dominant role in Indonesian politics and culture, historically they have often been prioritized in Indonesia's development initiatives (e.g. through allocation of land under transmigration schemes). While certainly evident in the number of Javanese farmers active in the sector, Fig. 6 illustrates that their footprint on the smallholder landscape is relatively modest. This suggests that Javanese oil palm farms are on average small in contrast to Batak and Sino-Indonesian farms in particular. Findings show that of all the ethnicities, Javanese farmers had the smallest average plot size (1.8 ha), reflecting the Javanese demographic participating in transmigration schemes. The footprint of transmigration is also evident in Bonai, where a transmigration scheme is located in the southwest; partly explaining the large share of uncharacteristically small farmers in that area. In contrast, Malay farmers have 2.4 ha plots on average, Bataks 5.3 ha, and Sino-Indonesians 226.2 ha. While Sino-Indonesian farmers comprise only 0.3% of smallholders, they account for 17.9% of the total area cultivated by smallholders in the study area and 31.8% in the frontier. As the most economically dominant ethnic group in Indonesia, this further points to the tendency of more affluent and arguably entrepreneurial groups to drive oil palm expansion onto peatlands/frontiers (BD). Bataks appear well represented in the established agricultural as well as the frontier areas. Whereas some Bataks are indigenous to the established agricultural area (CRH), they are not to the Bonai frontier (BD). The Malay population on the other hand appear to predominantly exploit the more populous established agricultural areas (CRH); partly due to pre-existing land claims, risk aversion and other socio-economic ties they have to their indigenous environment.

Analysis of plot owners' origin reveals, predictably, similar trends. The vast majority of plot owners (63.1%) originate from outside Riau; meaning they are first generation migrants to Riau and/or established a farm in Riau while residing in different provinces (Fig. 7). In line with the observed ethnic distribution, oil palm farmers originally from outside Riau are comparatively dominant in the frontier, both in terms of numbers and area. Only 3.8% and 30.8% of the smallholder oil palm area in the frontier (BD) and established agricultural area (CRH), respectively, is cultivated by farmers that originate from the village in which their plantation is located. This highlights the prominent role of external stakeholders in driving the development of the independent smallholder oil palm sector in Riau.

4.2. The smallholder typology

Results from the hierarchical cluster analysis (HCA) are presented in Table 3. As previously indicated, seven relevant clusters were formed, each accounting for between 7.0% and 30.9% of the smallholder oil palm landscape and between 2.2% and 28.9% of smallholder oil palm farmers (after correcting for survey bias).

The seven clusters can be characterized as forth:

1) Small local farmers

This group of small farmers both originates from and resides in the sub-district of their plantation. While the majority of this group is Malay (61.9%), Bataks and Javanese farmers, who mostly migrated at least one generation ago, comprise 37.8% of farmers in this group. Although accounting for only 7.0% of the smallholder oil palm area, this type does comprise 19.4% of smallholder farmers, who on average have a 1.2 ha plot size. Most of these farmers are located on lands outside the forestry domain (thus in APL), typically because they have long established land claims in the more populous, mineral soil, areas of Central Rokan Hulu.

2) Medium local farmers

These farmers are similar to the small local farmers in that all farmers originate from and reside in the sub-district of their plantation. Although dominated by the indigenous Malay like the small local farmers, second (or more) generation migrants constitute the majority. Farmers in this group occupy 7.7% of the smallholder land area and constitute 11.3% of farmers. While this group is located almost exclusively on the mineral soils of the established agricultural area, only 55.7% of farmers in this group are located at least partially on APL; significantly less than the small local farmers. This suggests that many farmers in this group have sought to expand individually onto lesser-populated state forestlands.

3) Large resident farmers

Despite having an average plot size of 10.3 ha, these farmers usually own several of these plots and therefore are large farmers, as is further

Table 3
HCA results.

	Cluster	1	2	3	4	5	6	7
Variable								
Farmers size	Small (0–3 ha)	100.0%	0.0%	0.0%	100.0%	0.0%	35.2%	0.0%
	Medium (3.1–15 ha)	0.0%	100.0%	0.0%	0.0%	100.0%	64.8%	0.0%
	Large (> 15 ha)	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	100.0%
Soil type	Peat soil	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	100.0%
	Located on mineral soils	100.0%	100.0%	100.0%	100.0%	100.0%	0.0%	0.0%
Primary place of residence	Within sub-district	100.0%	100.0%	67.2%	86.6%	76.4%	64.8%	18.4%
	Outside district	0.0%	0.0%	14.6%	5.7%	8.3%	28.8%	78.2%
Origin	Within sub-district	100.0%	100.0%	28.5%	4.3%	2.1%	4.7%	2.3%
	Outside district	0.0%	0.0%	67.2%	90.2%	88.8%	93.2%	95.4%
Land legal status	Outside Forest domain (APL)	73.6%	55.7%	59.1%	82.8%	74.3%	26.3%	26.4%
	Convertible Production Forest (HPK)	23.3%	37.0%	27.7%	10.4%	17.4%	11.9%	6.9%
	Production Forest (HP)	2.4%	1.6%	8.8%	7.0%	7.7%	62.7%	72.4%
	Limited Production Forest (HPT)	2.0%	8.3%	6.6%	0.2%	1.5%	1.3%	6.9%
Ethnicity	Malay	61.9%	47.6%	21.9%	9.6%	6.5%	7.2%	3.4%
	Batak	20.6%	31.4%	40.9%	16.9%	23.6%	40.0%	54.0%
	Javanese	17.2%	20.4%	29.2%	72.1%	66.4%	51.5%	14.9%
	Sino-Indonesian	0.0%	0.0%	2.2%	0.0%	0.0%	0.4%	24.1%
	Other	0.3%	0.5%	5.8%	1.4%	3.5%	0.9%	3.4%
Location	Central Rokan Hulu (CRH)	95.3%	95.8%	80.3%	86.6%	86.7%	0.0%	0.0%
	Bonai Darussalam (BD)	4.7%	4.2%	19.7%	13.4%	13.3%	100.0%	100.0%
Prevalence	Total area within sample (ha)	281.6	342.4	793.1	437.9	638.5	638	998.3
	Share of total area within sample	6.8%	8.3%	19.2%	10.6%	15.5%	15.4%	24.2%
	Number of farmers within sample	296	192	137	441	339	236	87
	Share farmers within sample	17.1%	11.1%	7.9%	25.5%	19.6%	13.7%	5.0%
	Average plot size (ha) – bias corrected	1.2	2.4	10.3	1.2	2.4	3.5	49.8
	Share of total research area (ha) – bias corrected	7.0%	7.7%	17.8%	10.3%	13.7%	12.7%	30.9%
	Share of total farmers in research area – bias corrected	19.4%	11.3%	6.0%	28.9%	19.8%	12.5%	2.2%

shown in Section 4.3.1. Absenteeism is not prevalent since more than two thirds reside in the same sub-district as their plantation. While 28.5% originates from the sub-district, 67.2% originates from outside the district, indicating that this group is comprised especially of migrants. This group is ethnically diverse, comprises a sizable number of Bataks, Malays and Javanese. These farmers cover 17.8% of the area and comprise 6.0% of the farmers, illustrating that despite not being numerous, they do have a significant footprint on the landscape. While they are – like Type 1 and 2 farmers – located exclusively on mineral soils, farmers in this group are considerably more likely to be located on state forestland (40.9%), suggesting that many of these farmers have sought to claim new land individually.

4) Small migrant farmers

Farmers in this cluster are primarily migrants of Javanese origin who now reside within close proximity to their plantation. Although this type accounts for only 10.3% of the smallholder oil palm area, with an average plot size of only 1.2 ha, they do constitute 28.9% of farmers in the area, making it the most prolific group. These farmers exclusively cultivate mineral soils and are most likely to be established outside the legal forest zone. Because this group is comprised especially of transmigrants and were therefore allocated land by the state, most of their plots have typically already been reclassified to APL.

5) Medium migrant farmers

On the basis of clustering variables, this type displays similar characteristics to the small migrant farmers, with land size being the primary differentiating variable. Average plot size is about double (2.4 ha). This type is only present on mineral soils, resides in close proximity to their plantations, and is largely Javanese as well. They occupy 13.7% of the smallholder oil palm area and constitute 19.8% of all farmers in the area. Therefore, while they are less prevalent than small migrants, they have a larger footprint on the landscape.

6) Small- and medium peat farmers

This group of small and medium farmers, with an average plot size of 3.5 ha, are located exclusively on the Bonai peatlands. They account for 12.7% of the smallholder oil palm area and 12.5% of smallholder farmers. These farmers are mostly migrants from outside the district and although more than half reside within the sub-district, compared to Type 4 and 5 a comparatively large proportion resides outside the district, illustrating that absenteeism is comparatively prevalent amongst these types of farmers and in such landscapes. Most farmers are Javanese and Batak, with Malays comprising a small minority. Their farms are mostly located on state forestlands.

7) Large investor farmers

Farmers of this type are located exclusively in the Bonai peatlands and neither reside in nor originate from the area. With only 18.4% residing in the same sub-district as their plantations, few are likely to be involved in day-to-day plantation management. This type is the smallest group in terms of number (2.2%), but the largest in terms of area (30.9%), with an average plot size of 49.6 ha. Although ethnically this group is dominated by Bataks, an ethnicity well represented across the clusters, it also comprises many Sino-Indonesians, who are rarely encountered in the other groups. Like the smaller peat farmers, most farmers are located on state forestland, with only 26.4% at least partially located on APL. This illustrates that this group plays an important role in oil palm expansion onto peatland and state forestlands. Considering their size and comparatively high rate of absenteeism, farmers in this group clearly operate more like companies than smallholders.

Table 4
Role of oil palm in livelihoods.

Type of farmer		Small local	Medium local	Large resident	Small migrant	Medium migrant	Small-medium peat	Large Investors
N		30	32	33	33	39	31	31
Plot size	ha	1.1	2.9	52.3	1.4	3.4	4.2	179.2
	Std. dev.	0.6	1.4	76.2	0.6	2.2	3.4	222.9
Total area under palm	ha	1.7	6.9	94.5	2.3	6.8	5.1	241.0
	Std. dev.	0.6	3.0	106.0	0.8	2.4	3.3	274.0
Other sources of income	Civil servant	10.0%	16.7%	20.8%	0.0%	21.6%	3.6%	16.0%
	Company employee	6.7%	3.3%	20.8%	3.1%	13.5%	35.7%	32.0%
	Other non-agrarian	23.3%	30.0%	41.7%	21.9%	35.1%	7.1%	52.0%
	Land labourer	23.3%	6.7%	4.2%	50.0%	8.1%	39.3%	0.0%
	Other farm	63.3%	73.3%	37.5%	40.6%	43.2%	14.3%	12.0%
Income from oil palm	% total income	48.0%	61.5%	70.2%	56.7%	62.8%	53.3%	54.2%

4.3. Productive and economic characteristics

This section provides an overview of selected results from analysis of the 231-survey sub-sample. Based on this data, it explores differences and similarities between the seven clusters across a range of themes, namely (1) role of oil palm in livelihoods; (2) land legality; (3) market linkages; and (4) production practices.

4.3.1. Role of oil palm in livelihoods

Oil palm accounts for the majority of income for most farmers in most groups (Table 4). Based on an average total farm size of 1.7–2.3 ha, small local and migrant farmers derive an estimated net income of between 1.5 and 2.0 million IDR per month from oil palm cultivation.[5] This is similar to the minimum wage in rural Riau (1.8 million IDR). However, since the cultivation of oil palm only absorbs an estimated 0.2 man-years per ha (Corley and Tinker, 2016), it tends to be one of the more desirable locally accessible sources of income. While household labour constraints should therefore not inhibit further expansion, the comparatively high current costs of plantations and land reduces smallholder capacity to expand acreage under production, especially in relatively developed areas as Central Rokan Hulu. For example, a regular oil palm plantation now costs between 50 and 150 million IDR per ha in the research area, which tends to exceed what most small farmers are able to pay or borrow (see Section 4.3.3 for analysis of capital sources).

Despite the prominent role of palm in livelihood portfolios, most farmers do derive income from other sources. For example, more than one third of medium migrant and large resident farmers also earn an income from formal employment (especially as civil servants) and small farmers from menial labour. Almost half of large farmers also own businesses unrelated to palm. Moreover, many farmers, especially the small and medium farmers on mineral soils, are also engaged in the cultivation of other crops, notably rubber and to a lesser extent paddy. Most small and medium scale farmers were engaged in agriculture prior to adopting oil palm; few, especially local farmers, abandon all their previous crops in favour of oil palm. This suggests that smaller farmers are reluctant to fully specialize in palm production. Larger peat farmers in contrast have comparatively low on-farm diversification rates and limited prior farming experience. This suggests that many farmers in peatland areas are not seasoned farmers, but are engaged in palm production strictly as a business venture. This is consistent with observations that exploitation of peat requires considerably more entrepreneurialism, as is also evident in the comparatively high rate of business ownership amongst peat farmers.

4.3.2. Land legality

There are pronounced differences amongst the different groups with respect to the legality of their oil palm landholdings. Small and medium-sized migrant farmers are, for example, most likely to be located on APL, while large resident and peatland farmers are mostly located within the state forest domain (Table 5). Accordingly, many small and medium migrant farmers possess nationally recognized land rights (SHM), while peat farmers generally possess village (SKT) and sub-district level (SKGR) land documentation. Local farmers, on the other hand, are most likely to not possess any land documentation, despite typically being located on APL. This is attributable to the perceived legitimacy and security of historical claims and traditional land access mechanisms. The SKT and SKGR documentation governing many land claims of peatland farmers are of questionable legality and cannot be equated with fully secure land ownership since they cannot be formalized through the National Land Registration Agency (BPN) when located in state forestlands. In frontier areas like Bonai, land markets are often shaped by so-called *Mafia Tanah* (or land mafia), a complex network of local public and private actors that facilitate access to land that cannot be formally alienated and allocated for palm production (e.g. in the state forest domain). Land documentation in such areas is often obtaining through grey and/or informal legal processes that are a combination of overlapping authorities, weak institutional capacity, corruption and a lack of sanctions when rules are violated (Enrici and Hubacek, 2016). However, if the government does not initiate land reclassification programs these producers cannot be certified because land ownership documentation on state forestland are not recognized under, for example, ISPO. Lack of such documentation also restricts access to key production inputs such as bank credits and certified planting material. As can observed in Table 5, it is especially the larger farmers in mineral soil areas and the peatland farmers that tend to possess land documentation not recognized by public and private standards. Incompliance issues are however also prevalent amongst the local farmers, but, because these are often located on land which allows for oil palm production, only land formalization support would be required to resolve land legality challenges. However, local farmers often perceive the formalization process to be time consuming and expensive

[5] Based on an average price of 1055 IDR/kg for FFB for independent farmers in Rokan Hulu in 2015 (data obtained at District Plantation and Forestry Office) and an average yield of 15.5 tons of FFB per year (survey result, including immature stands), the average gross revenue per hectare is 16.5 million IDR per year or 1,375,000 IDR per month. With 35% of gross oil palm revenues being spend on fertilizers, herbicides and transportations costs (see Cramb and Sujang, 2016), net monthly income for independent oil palm farmers is estimated at approximately 900,000 IDR ha/month (excluding labour and land costs). Based on February 2017 exchange rates, 1 million IDR is equivalent to approximately US$75.

Table 5
Land legality.

Type of farmer N	Small local 28	Medium local 30	Large resident 32	Small migrant 32	Medium migrant 39	Small-Medium peat 30	Large Investors 24
No legal registration	39.3%	23.3%	6.3%	9.4%	0.0%	0.0%	0.0%
Village level (SKT)	21.4%	26.7%	21.9%	28.1%	33.3%	50.0%	12.5%
Sub-district level (SKGR)	21.4%	23.3%	40.6%	15.6%	12.8%	46.7%	83.3%
National Land Agency (SHM)	17.9%	26.7%	31.3%	46.9%	53.8%	3.3%	4.2%
State forestland and registered[a]	3.6%	40.0%	53.1%	18.8%	41.0%	86.7%	66.7%
State forestland and not registered	10.7%	10.0%	3.1%	9.4%	0.0%	0.0%	0.0%
APL and not registered	28.6%	13.3%	3.1%	0.0%	0.0%	0.0%	0.0%
APL and registered	57.1%	36.7%	40.6%	71.9%	59.0%	13.3%	33.3%

[a] The plots of four farmers were located on both state forestland and APL. They are classified as being located on state forestland and not APL for the purpose of this analysis.

without significantly affecting tenure security.[6]

4.3.3. Market linkages

There are significant differences between the groups in terms of how they access both off-take and input markets. The two groups of larger farmers are, for example, significantly more likely to directly sell to the mills through their own delivery orders as they are more likely to deliver FFB that meets mills' quantity requirements, thereby cutting out middlemen or allowing these farmers to become middlemen as well. All the small and medium sized farmer groups instead sell their FFB to middlemen who bulk and sort the FFB based on quality. Smaller middlemen often sell to larger middlemen since they are unable to obtain a delivery order from a mill. The smaller peat farmers are especially dependent on small middlemen. This can be attributed to poorer production infrastructure and higher logistics costs in the peatland areas and the comparatively low quality of FFB of smaller peat farmers.

The medium and large farmers in the mineral soil areas (Type 2, 3 and 5) on average obtain significantly higher FFB prices than the other farmers. This suggests that in an area with a well-developed marketing infrastructure (and therefore more competition among middlemen), higher production volumes do increase farmer bargaining capacity – despite observations that some middlemen engage in the (legally questionable) practice of price fixing. In peatland areas, where road network and input and off-take markets are less developed, the FFB purchase price is on average lower than in mineral areas, especially for smaller farmers. This is partly a product of less competitive and mature off-take markets and nearby mills not purchasing smallholder produce due to full processing capacity and perceived poor quality. Regardless, across the board, prices obtained by independent smallholders are between 32.0% and 53.1% lower than TIM-POKJA prices; prices that companies, government and plasma smallholders agree upon during weekly plasma price setting meetings at the provincial level. This is inter alia a product of lack of collective organization and bargaining, the additional margins absorbed by middlemen, externalization of transaction costs and the comparatively low quality of FFB from independent farmers.

The quality of planting material strongly shapes type of fruits produced and hence oil content and quality of produce. For example, two common fruit forms, *Dura* and *Tenera,* differ significantly in their oil content, with, on average, a *Tenera* fruit containing 30% more oil per FFB than *Dura* due to its large mesocarp (fruit) to endocarp (kernel) ratio (Corley and Tinker, 2016). As a result, in establishing FFB prices many mills and middlemen will evaluate each load individually. Findings show that on average 31.7% of sampled farmers' oil palms produce fruits with *Tenera* characteristics, with the large farmers and peat farmers having a slightly higher share of *Tenera* than mineral soil small and medium sized farmers (Table 6). This widespread use of sub-standard planting material by independent smallholders is primarily attributable to sourcing mechanisms. Findings show that farmers procuring from certified seedling dealers or from commercial seedling producers directly tend to have a significantly higher proportion of *Tenera* fruits from their plantations than farmers that procure from uncertified (and informal) seedling dealers or use loose fruits. As expected, almost two-thirds of the two groups of better capitalized larger farmers procured seedlings from certified dealers or directly from commercial producers, while only 15.2% and 24.1% of small migrant and small local farmers, respectively, procured from an official source.

With regards to fertilizers, most farmers (86.6%) rely on local shops, with cooperatives and informal farmer groups supplying only a small proportion of farmers. Government and larger oil palm companies play an insignificant role in smallholder fertilizer supply. Many medium and large farmers indicated that because subsidized fertilizers often do not arrive on time and in the desired quantities they prefer to source from local vendors that are especially plentiful in the more established agricultural areas. Despite the alleged prevalence of fertilizers that do not meet quality standards, most farmers do not consider this to be problematic.

With regards to plantation establishment, the overwhelming majority of farmers in all of the seven groups rely primarily on private capital, with only a small proportion of farmers relying on formal credits through local banks. The medium and large farmers in the mineral areas (Type 2, 3 and 5) are most likely to obtain credits through formal channels. These capital sources are often inaccessible to small farmers due to lack of collateral and/or legal land documentation and absence of formal employment income. Although our data would suggest that independent smallholder development is financed primarily through personal savings, the role of informal moneylenders was (unfortunately) not explicitly captured in the survey instruments. Qualitative evidence however suggests that middlemen trading FFB also provide short-term loans and fertilizers on credit, which are repayable with FFB. This is a common strategy to lock-in smallholders. Unlike bank credits, these loans rarely cover land purchases or plantation establishment, but rather operational or large (unforeseen) consumptive expenses.

4.3.4. Production practices

With respect to plantation management, small migrant and local farmers rely primarily on the labour from the nucleus household, while the two large farmers group rely primarily on hired labour, with medium scale farmers relying on both. Of the different plantation management activities captured by this research, harvesting tended to involve the largest proportion of hired labour for most groups as

[6] According to Clarvis and Litovsky (2015) the cost of certifying a plot is approximately 4 million IDR.

Table 6
Input and off-take markets.

Type of farmer		Small local	Medium local	Large resident	Small migrant	Medium migrant	Small-medium peat	Large investors
N		30	31	33	33	40	30	32
Marketing	Middlemen without delivery order	40.0%	29.0%	6.1%	66.7%	38.5%	87.1%	25.0%
	Middlemen with delivery order	56.7%	61.3%	48.5%	30.3%	56.4%	12.9%	34.4%
	Delivery order	3.3%	9.7%	45.5%	3.0%	7.7%	0.0%	46.9%
FFB price	% of TIM-POKJA price	47.6%	50.6%	68.0%	46.9%	56.2%	47.4%	55.5%
Source of capital for plantation development	Private capital	100%	96.7%	96.9%	100%	100%	93.5%	96.2%
	Bank loan	0.0%	16.7%	18.8%	9.1%	17.9%	0.0%	0.0%
	Social fund	0.0%	0.0%	3.1%	0.0%	0.0%	0.0%	3.8%
	Other	0.0%	0.0%	0.0%	0.0%	0.0%	6.5%	0.0%
Planting material suppliers	Official seedling company	6.9%	0.0%	31.3%	3.0%	5.0%	6.7%	34.5%
	Local agent with certificate	17.2%	32.3%	34.4%	12.1%	25.0%	30.0%	31.0%
	Local agent no certificate	51.7%	51.6%	18.8%	54.5%	40.0%	40.0%	20.7%
	Loose fruits	31.0%	25.8%	6.3%	18.2%	12.5%	6.7%	6.9%
	Unknown	3.4%	3.2%	18.8%	15.2%	20.0%	16.7%	20.7%
Fruits types[b]	Dura	75.4%	72.6%	64.1%	83.0%	70.9%	62.9%	53.6%
	Tenera	24.6%	27.4%	35.9%	17.0%	29.1%	37.1%	46.4%
Source chemical fertilizer purchases[a]	Local vendor	84.9%	81.9%	92.9%	66.7%	90.6%	88.5%	96.7%
	Oil palm company	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.2%
	Cooperative	4.1%	3.2%	6.1%	4.9%	3.4%	3.8%	0.0%
	Informal farmer group	0.0%	12.8%	1.0%	12.3%	1.7%	1.3%	0.0%
	Government	1.4%	0.0%	0.0%	2.5%	0.0%	0.0%	0.0%
	Middlemen	5.5%	0.0%	0.0%	11.1%	2.6%	5.1%	0.0%
Fertilizers	Quality is good (non-false)	100.0%	100.0%	83.3%	84.4%	91.7%	77.3%	80.0%
	Available on time	92.0%	100.0%	90.0%	90.3%	89.2%	78.3%	85.2%

[a] Non-chemical fertilizers used were manure and empty fruit bunches. Manure was sometimes used by smaller farmers and usually came from their own chickens and applied in small quantities. Empty fruit bunches were reported in only 7 cases. Data based on 633 chemical fertilizer applications mentioned by farmers.

[b] Determination of *Dura* vs. *Tenera* was based on shell thickness and presence of fibres on the shell of the kernel. *Pisifera* fruit types were excluded as these lack kernels with shells, and in some plantations only kernels could be used for analysis.

harvesting tends to be the most strenuous, time-consuming and skill-intensive activity. While the size of operations strongly determines household labour participation rates, so too does primary place of residence, thereby confirming our earlier hypothesis on the effects of absenteeism. For example, findings show that 87.2% of farmers residing within the sub-district of their plantation involve household labour for fertilizer application, as opposed 53.5% of those residing outside the sub-district. Obviously, there are strong interaction effects between size, place of residence, and location (e.g. frontier (BD) farmers are on average larger and more inclined to reside further from their plantations). Regardless, most of the medium and large farmer do not allocate household labour to plantation management, suggesting that in addition to their size most neither comply with the labour criteria adopted in smallholder definitions.

Prior experience with oil palm through working for an oil palm company or for other farmers was absent with 74.0% of farmers. Large resident farmers and small to medium peat farmers, the latter frequently working for larger investors, have most prior experience (50.0% and 63.3% respectively). While prior experience is by no means a guarantee that good management practices are adopted, the general lack of any prior agronomic experience with the crop undoubtedly undermines productivity and adherence to sustainable production practices. The most important sources of information amongst all farmer types appear to be informal farmer groups and input suppliers. Although we cannot evaluate the quality of information originating from those sources, the limited and uneven access to professional sources of information such as oil palm companies and government extension services does raise concerns about the effectiveness of knowledge dissemination in the area. Larger producers are though most likely to benefit from company information by virtue of their direct access to mills and access to professional networks.

In terms of infrastructure development, peatland farmers in particular were often responsible for developing and maintaining public (feeder) roads to plantations, reflecting lack of direct government involvement in opening up and the spatial planning of frontier areas. However, road networks established by logging, corporate oil palm, and petroleum companies greatly contributed to opening up Bonai. Large farmers with large plots often developed road networks individually or with other large farmers surrounding them, smaller farmers often collectively. These costs further contribute to the high costs of plantation establishment and management in peatland areas and, therefore, the more prominent presence of larger and more capitalized smallholders. With regards to the development of drainage systems, which is especially pertinent in peatland areas, particularly the larger farmers also often coordinate canal development themselves and smaller farmers collectively (Table 7), with negligible oversight of and contribution from government. This lack of government involvement is highly problematic since unplanned and unregulated drainage systems produces a host of undesirable environmental impacts such as lowering of the entire landscape's water table, peat oxidation, CO^2 emissions and increased threat of peat fires.

Table 7
Production practices.

Type of farmer		Small local	Medium local	Large resident	Small migrant	Medium migrant	Small-Medium peat	Large investors
N		32	39	33	30	31	30	30
Yield compared to Cramb (2016) productivity graph[a]	Proportion mean yield	100.4%	101.4%	102.9%	103.8%	103.0%	84.2%	80.0%
	Std. dev.	25.3%	35.3%	24.8%	34.8%	24.8%	37.5%	32.0%
Labour: Fertilizer application	Household	96.7%	69.0%	21.2%	87.9%	60.0%	51.7%	3.1%
	Extended family	0.0%	13.8%	18.2%	15.2%	32.5%	31.0%	3.1%
	Hired laborers	3.3%	17.2%	66.7%	3.0%	17.5%	17.2%	93.8%
Labour: Harvesting	Household	80.0%	45.2%	9.1%	57.6%	17.9%	36.7%	3.1%
	Extended family	10.0%	35.5%	27.3%	39.4%	38.5%	43.3%	3.1%
	Hired laborers	10.0%	29.0%	63.6%	3.0%	43.6%	20.0%	93.8%
Sources information on plantation manage-ment	Shop	11.5%	22.2%	13.8%	28.6%	25.6%	3.7%	4.3%
	Oil palm company	0.0%	3.7%	31.0%	3.6%	10.3%	7.4%	30.4%
	Cooperative	0.0%	0.0%	6.9%	0.0%	0.0%	3.7%	0.0%
	Informal Farmer groups	76.9%	70.4%	37.9%	64.3%	56.4%	77.8%	52.2%
	Government extension	0.0%	3.7%	6.9%	3.6%	5.1%	0.0%	0.0%
	Other, usually middleman, books or internet	11.5%	3.7%	6.9%	3.6%	7.7%	3.7%	13.0%

Type of farmer		Small local	Medium local	Large resident	Small migrant	Medium migrant	Small-Medium peat	Large investors
N		3	5	13	4	2	22	26
Organize develop-ment of drainage system (where relevant)	By farmer	0.0%	60.0%	100.0%	25.0%	50.0%	45.5%	80.8%
	With friends and family	0.0%	0.0%	7.7%	0.0%	0.0%	0.0%	3.8%
	Collectively with other nearby farmers	66.7%	20.0%	0.0%	50.0%	50.0%	27.3%	30.8%
	Government	33.3%	0.0%	0.0%	25.0%	0.0%	0.0%	0.0%

[a] The productivity curve can be found in Appendix C. In order to account for differences in yields arising from differences in stand age, for each farmer we calculate the extent to which they deviate from the average production curve at the stand age in question.

5. Discussion: smallholder certification and upgrading challenges

While this paper does not fully explore the nature and scope of independent smallholder ISPO and RSPO incompliance – focussing rather on unpacking the heterogeneity of smallholder oil palm producers – results do highlight structural issues that many of the sub-groups face and pose for upgrading and improving producer adherence to public and private sustainability standards. For example, both ISPO and RSPO have hard land legality requirements. Findings shows that the majority of sampled smallholders (54.4%) are incompliant because they are either (i) located on APL but are not in possession of any land registration documentation (11.1% of incompliant farmers); (ii) located on state forestland and have no land registration documentation (8.5%); or (iii) located on state forestland and wrongly possess land registration documentation (80.3%). Most incompliant smallholders fall into the last category, highlighting how extra-legal land registration of state forestland has become common practice in parts of Indonesia. This raises serious questions about appropriate pathways for preventing further disarticulation and criminalization of oil palm smallholders. While land registration initiatives could support a comparatively small number of smaller smallholders operating on land legally permitting oil palm production comply with land legality requirements, most incompliant producers will remain incompliant unless the state forestland on which they are operating is reclassified to APL. However, as this research has shown, the smallholders pioneering development in ecologically significant and sensitive peat- and forestlands are often economic and political elites whose operations more closely resemble that of corporate plantations than family farms. Such farms often primarily fulfil investment (and sometimes speculation) purposes rather than basic needs. Regularizing and supporting the upgrading of such farmers is therefore foremost about environmental management and sector competitiveness as opposed to an inclusive development issue. With increasing demand for ISPO and RSPO compliant oil palm, alienating incompliant farmers is likely to further bifurcate the palm oil market and reduce the capacity of government agencies to disseminate technologies and provide extension support (e.g. since public resources cannot legally be allocated to oil palm cultivation on state forestland). This also applies to corporate technical or financial support, since corporations also increasingly require proof of legal land ownership from their sources. Here the state arguably carries responsibility in addressing legality problems given the past laissez faire approach to independent oil palm expansion, conflicting legal frameworks and authorities, and lack of political will to enforce land and forest regulations.

Land reclassification and regularization does raise myriad political challenges. Despite land use planning being mandated under the 2007 Indonesian Spatial Planning Law, Riau is yet to finalize its spatial plans (Resosudarmo et al., 2014; Susanti, 2016). Conflicts between the Ministry of Forestry that is vested in retaining control over the national forest estate and sub-national governments seeking to consolidate their territorial authority have, amongst others, frustrated efforts to develop more coherent land use policies. The extra-legal land markets prevalent in frontier areas also points to rife illicit land trading practices in which local state actors are complicit. This could result in local opposition to efforts to upset the accumulation networks that the status quo has produced and sustained. Nevertheless, emerging political commitment

to agrarian reform, the diplomatic fallout of Riau's frequent peatland fires, and lobbying efforts by major oil palm to develop territorial sustainability strategies is gradually enhancing pressure on the different layers of governments to address the chaotic situation on the ground.

The second major upgrading challenge relates to the mechanisms through which smallholders access credit, production inputs, and knowledge. Though not comprehensively assessed in this article, the low yields, use of poor quality planting material and variable inputs, and failure to adopt best management practices across all groups of the typology certainly undermines smallholder productivity, profitability, and environmental performance potential. Findings show that inputs are typically sourced through (informal) vendors that are rarely able to guarantee quality and FFB is sold to mills through intermediaries. Direct access to mills is typically reserved for the larger farmers and access to official sources of inputs limited by virtue of logistical challenges and lack of land documentation (notably for planting material and bank loans). This not only adversely impacts smallholder productivity and offtake prices, but also results in insufficiently effective knowledge dissemination – with knowledge, especially for the groups with smaller and medium farmers, typically obtained through informal farmer groups and vendors. Clearly improved access to technical and managerial assistance through more formal channels is needed to facilitate certification and upgrading more generally. For example, ISPO and RSPO certification would for especially the smaller farmers require organization into farmer groups or cooperatives. However, cooperatives and official farmer groups in Indonesia have, as in many other places, a chequered history due to political misuse, poor leadership, and internal conflict; with many farmers as a result expressing apprehension about formal organization (Brandi et al., 2015; Feintrenie et al., 2010). Although there are cases in the oil palm sector where successful collective action by farmers has contributed to comparatively high yields and incomes (see e.g. Jelsma et al., 2017) such organizations rarely emerge without substantial financial and institutional support. Although such groups could under the right conditions function as important vehicles for accessing formal sources of inputs, disseminating knowledge, and collective bargaining, strengthening direct linkages between corporate producers and independent smallholders could work to similar effect, whilst alleviating the state cost burden. While some producers are trialing mechanisms to achieve that, viable business models that effectively resolve challenges associated with traceability, side-selling, and high costs of monitoring geographically dispersed smallholders (as opposed to consolidated plasma farmers) are yet to be developed. However, given the vertically integrated and producer-driven nature of the oil palm sector, it is questionable whether lead firms are sufficiently willing to absorb the risks and costs of strengthening backward linkages with independent smallholders. This suggests that effectively upgrading independent smallholders at scale and incentivizing investments to that effect requires improved collaboration between civil society, the private sector, and the state; for example in developing coherent territorial policies and strategies, harmonizing resource allocations, managing risks, and exploiting differentiated capabilities. However, pervasive conflicts between and within these stakeholder groups, as well as widely diverging priorities, remain undersolved obstacles to developing more articulated approaches.

Considering high opportunity costs of public resources, it is debatable whether large resident and investor farmers should be prioritized for upgrading and compliance support. Findings, for example, show that for many of these farmers oil palm plantations often primarily function as investments, involve exclusively hired labour, and due to high rate of absenteeism are often not directly managed by their owners. This raises questions about owner willingness to apply improved practices since many are arguably already sufficiently entrepreneurial and resourced to augment performance if so desired. Where interventions could yield tangible results is in preventing these farmers from entering sensitive areas by increased monitoring of these areas and addressing issues that are likely to arise when farmers in these groups are pressured to comply with the full ISPO and/or RSPO standard, which are considerably more comprehensive than the smallholder-specific guidelines. Since this invites greater scrutiny of operations and raises operational costs, farmers however could be compelled to pursue opportunities to circumvent existing regulations (e.g. by registering plots in multiple names as already is common practice). Identifying potential incentive mechanisms and pathways to fostering compliance with full standards would therefore need to be more closely examined, as would addressing regulatory loopholes that have long enabled such farmers to operate under the guise of smallholders with impunity.

6. Conclusion

In this article we developed a typology of smallholders – comprised of seven unique groups – to demonstrate that smallholder oil palm farmers are not a uniform population. This diversity warrants adoption of more actor-disaggregated intervention approaches to promote upgrading of practices and standards compliance. For example, we show that the four small and medium scale farmer groups operating on mineral soils could benefit from technical support in improving production practices, applying for the necessary permits and forming farmer groups for standards purposes, and improving access to formal input markets. Particularly small and medium local farmers without land documentation would benefit from land certification initiatives. The legality and environmental issues posed by the larger smallholders and those operating on peatlands, on the other hand, demand improved regulatory oversight, spatial planning and land reclassification programs; recognizing that standards incompliance is for many farmers in these groups – unlike farmers in the other groups – not attributable to lack of capacity, but rather to lack of incentive.

Findings also show that many of Rokan Hulu's independent oil palm smallholders neither fit the legal nor popular definition of 'smallholders'. While oil palm clearly plays an important role in rural development in Indonesia, we illustrate that the sector may not be as inclusive as is commonly depicted, with a large proportion of farmers that legally should but fail to comply with business regulations being wrongly classified as smallholders. Considering the evident preference of many of these farmers for frontier areas where land is cheap and abundant, genuine smallholders likely play an insignificant role in oil palm expansion into ecologically significant peatland and forestland areas. Rather, findings point to the prominent role of external (risk) capital, speculation, informal land markets and lack of capability and/or duplicity of local authorities. However, with (international) market access becoming increasingly conditional on producer compliance with both soft (RSPO) and hard (ISPO) regulations, the increasing risks associated with such operations could in future undermine the viability of further expansions into forest and peatland frontiers. Preventing bifurcation of the oil palm market along the lines of formality and sustainability will likely prove instrumental in realigning the incentives of these smallholders. This will be fully contingent on the quality of ISPO enforcement since failure to effectively sanction incompliance will enable mills articulated purely to local or Asian markets to continue benefiting from a large unsustainable and/or ISPO incompliant smallholder supply base. Given the political sensitivity of criminalizing smallholders, vested interests, the political leverage of frontier producers, and the need to protect important pathways out of poverty, generating sufficient government commitment and collaboration across scales to enforce ISPO requirements for smallholders will be no easy feat.

This article shows how smallholders integrated into global agro-commodity chains are increasingly exposed to the effects of changing global environmental norms as expressed by increasingly rigorous public and private sustainability standards. While international standards emerged primarily to fill regulatory vacuums in producer countries, the scope and nature of smallholder incompliance issues demonstrates that with international actors increasingly dictating terms of trade and production, states are required to play a more prominent role in sector development in order to resolve resultant development consequences. In the Indonesian oil palm sector this could lead to a gradual shift from a laissez faire approach to independent smallholder expansion to one where there is increased commitment to addressing structural smallholder productivity, sustainability, and legality issues in recognition that smallholder disarticulation from the global palm oil market is not in the interest of national development. It is however questionable whether the state is best positioned (and arguably responsible) for resolving these challenges considering capacity and resource constraints and lack of a coherent internal political vision. While corporate palm oil producers are in many respects better placed to resolve some of the challenges facing smallholders, lack of imperative and financial burden will likely stifle the innovation needed to build productive backward linkages. This is in large part attributable to the vertically integrated and producer-led structure of the palm oil industry and the lack of opportunities for product differentiation. Similar issues are also emerging in the timber and rubber sectors, which share similar industry structures. This calls for closer examination of appropriate incentive mechanisms to harmonize stakeholder interests in support of resolving the adverse development implications that certification standards produce.

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Appendix A

See Fig. A1.

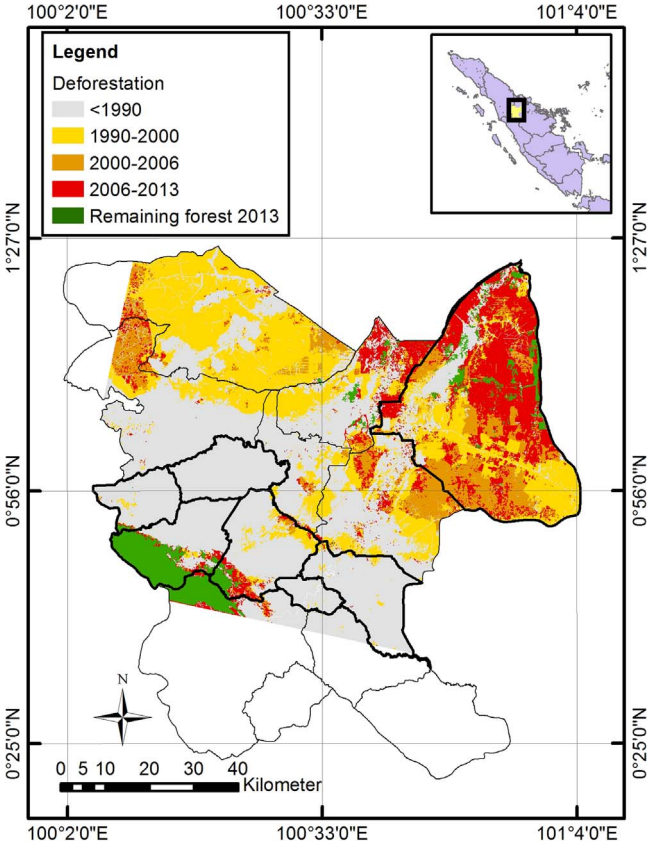

Fig. A1. Deforestation in study area.
Source: Authors' representation based on CIFOR (2014) and BAPPEDA Rokan Hulu (Undated), for white area data was not available.

Appendix B

See Fig. B1.

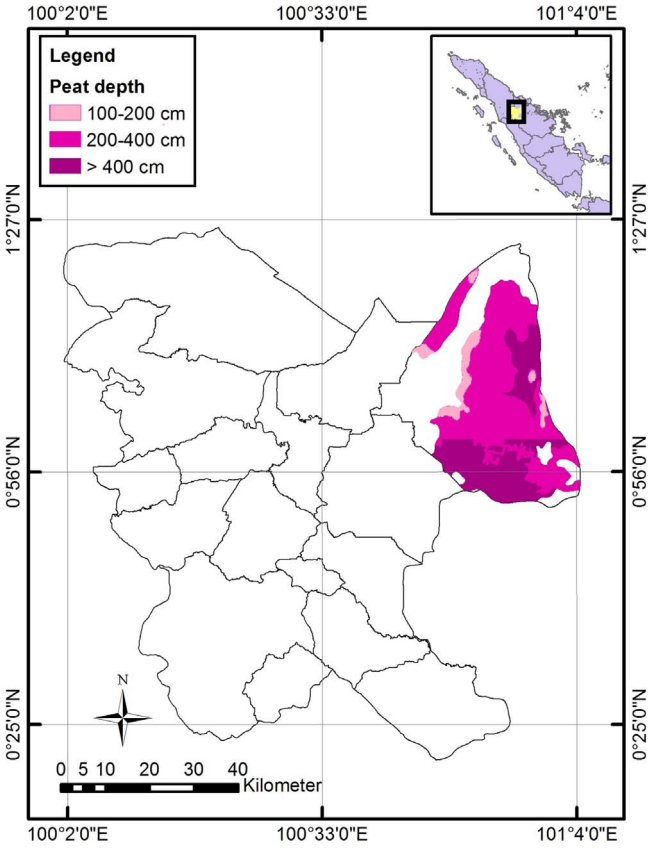

Fig. B1. Peatland presence and depth in study area.
Source: Authors' representation based on BAPPEDA Rokan Hulu (Undated) and Kementerian Pertanian (2011).

Appendix C

See Fig. C1.

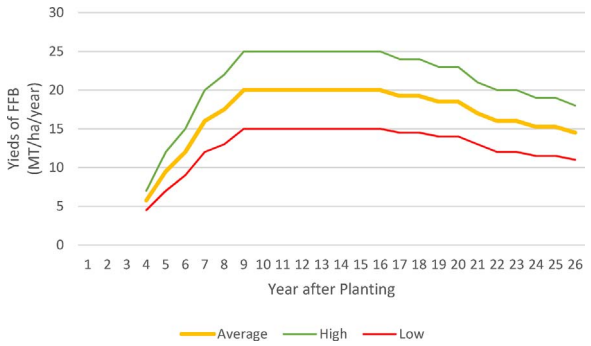

Fig. C1. Production curve of independent smallholders, adapted from Cramb (2016), p.32 (original does not contain the average yields).

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