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How farmer characteristics and dimensions of resilience correlate with farmers' ability to recover from shocks: a case study of Indonesian palm oil smallholders

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Abstract: Most studies on the effects of certification on smallholders' livelihood emphasize vulnerability while neglecting resilience. This paper assesses the farmer resilience of five different types of palm oil smallholders in Indonesia. We use and apply Speranza's (2014) framework to assess and understand farmer resilience. We conclude that the correlations between buffer capacity, learning capacity, and resilience are rather weak. Our results further reveal that palm oil smallholders are relatively resilient to price declines, haze from forest fires and El Niño. The differences in resilience between the smallholder groups are small, although certified smallholders collaborating with companies and NGOs seem to be more resilient than uncertified smallholders collaborating with middlemen. The terminated Nucleus Estate Smallholder (NES) system allowed farmers to meet these favourable conditions. A few new initiatives, such as FAIR company-community partnerships may provide similar opportunities for smallholders. We also question the direct link between self-organization and resilience.

Keywords: *Livelihood resilience; Palm oil certification; Smallholders; Vulnerability.*

Introduction

Palm oil smallholders are susceptible to a diversity of risks in and beyond the palm oil sector, which makes them a vulnerable category of actors in the palm oil value chain. First, because they have limited knowledge about the market they are part of and the price-setting mechanisms of their product (Hidayat, Glasbergen, & Offermans, 2015), resulting in selling at prices below market standards and hence a relatively low income. Second, because palm oil smallholders strongly depend on other actors, such as companies and middlemen, to access the market. This creates dependencies and difficulties in selling their products timely. Third, because the smallholders have limited financial resources and limited access to credit, which hampers investments and improvements in their plantation (Molenaar, Persch-Orth, Lord, & Harms, 2013). Moreover, given unclear (customary) land rights in countries such as Indonesia and Malaysia, palm oil smallholders are often confronted with, and therefore involved in, land-use conflicts (Sheil *et al.*, 2009). Social conflicts between local communities and trans-migrants may also arise from the fact that palm oil companies prefer to hire trans-migrants rather than local community members to work on estate plantations, as migrant

workers are considered better skilled (Casson, 2000; Marti, 2008; Sheil *et al.*, 2009). Further, palm oil smallholders are exposed to external shocks, such as the effects of climate change and unpredictable price fluctuations in the global market (Hidayat *et al.*, 2015; Vermeulen & Goad, 2006).

One way of improving the vulnerability of palm oil smallholders is by improving farmers' resilience. This implies enhancing the farmer's ability to cope with, and recover from, stresses and shocks (Walker *et al.*, 2006). Farmers can recover from stresses and shocks if they are able to maintain or enhance their capabilities and assets (including a stable income, the fulfilment of daily needs, health, education and security), without undermining their natural resource base. We further conceptualize farmers' resilience as a crucial requirement for achieving a sustainable livelihood. Farmers' livelihoods can therefore be considered sustainable when the farmers are resilient and thus able to recover from stresses and shocks by maintaining assets and capabilities.

Participation in the certification scheme of the Roundtable on Sustainable Palm Oil (RSPO) was introduced in the early 21st century to improve the environmental sustainability of palm oil production while considering and improving the social and economic realities of producers (Brandi *et al.*, 2013; Schouten & Glasbergen, 2011). Research indicates that certification may positively contribute to the sustainability of smallholder's livelihoods by decreasing the farmer's vulnerability and strengthening their assets (Hidayat *et al.*, 2015). Certification for example reduces smallholder's dependency on middlemen and creates a better and more secure income through the provision of premium prices (Hidayat *et al.*, 2015). The organization of farmers around miller companies, which can be seen as a side effect of certification, may also improve farmers' market access, especially for independent smallholders (Brandi *et al.*, 2015). Further, training – provided along with the certification process – also potentially improves farmer's knowledge about farming practices, which may contribute to enhancing the productivity and quality of their palm oil products and their responses to stresses and shocks.

Where vulnerability and resilience (should) meet

Although literature on impacts of stresses and shocks on the sustainability of farmers' livelihoods is quite abundant (see Allison & Ellis, 2001; Bebbington, 1999; Das, 2012; Ellis & Mdoe, 2003; Kapembwa, Kalunga, & ... 2020; Tang, Bennett, Xu, & Li, 2013; Taringana & Mtisi, 2019), a limitation of these studies is that they only pay attention to the vulnerability context and the coping strategy of farmers (see Hidayat *et al.*, 2015; Schneider & Niederle, 2010; Swift, 2006; van Rijn, Burger, & den Belder, 2012). Farmer's ability to recover from stresses and shocks remains largely neglected although this is an equally important concept explaining the sustainability of farmers' livelihoods (Marschke & Berkes, 2006; Nyamwanza, 2012; Scoones, 2009; Speranza, Wiesmann, & Rist, 2014). Farmers who cannot directly cope with stresses and shocks, but who are able to recover from those stresses and shocks in due time, succeed in maintaining their capabilities and assets. In such cases, the farmers can be considered vulnerable (i.e. susceptible) to the stresses and shocks, but also resilient (Contas, Frankenberger, Hoddinott, Luma, & Russo, 2014; Cutter, 2016), even though vulnerability and resilience (Cutter, 2016) are often interpreted as opposites (for example in Adger, 2000). Vulnerability addresses susceptibility to stresses and shocks (Cutter, 2016), while resilience refers to the capacity to sustain stresses and shocks in such a way that they do not have long-lasting consequences on the farmers' livelihoods (Contas *et al.* 2014, Harrison & Chiroro 2016).

One requirement for Smallholders' livelihoods to be sustainable is therefore that the smallholders are able to maintain and enhance capabilities and assets required for

sustaining or improving their means of living, also when they are confronted with stresses and shocks (Chambers & Conway, 1992; Hidayat *et al.*, 2015; Scoones, 2009; Tang *et al.*, 2013; Tao & Wall, 2009). Speranza *et al.* (2014) explain that farmers have a good chance of coping with and recovering from stresses and shocks if they have a sufficient buffer capacity, sufficient levels of self-organization and promotion of self-organization, and if learning occurs. These components, called *dimensions of farmer resilience*, provide a basis for in-depth empirical analysis of resilience from an actor and livelihood perspective (Liu *et al.*, 2020). Although these dimensions offer building blocks to analyze and compare farmers' resilience, the framework also has some limitations. First, because the suggested relationship between the dimensions of farmer resilience (buffer capacity, self-organization, and learning capacity) and actual resilience of the farmers is purely based on a review of theories and literature and never tested systematically or empirically (Speranza *et al.*, 2014). A high score on the dimensions therefore automatically implies a more sustainable livelihood (i.e. farmers being able to recover well from stresses and shocks). Second, because it does not give any information regarding the relative importance of the dimensions; and third, because it does not inform about potential interrelations between the dimensions. Moreover, although some studies showed that certification does not significantly improve the *vulnerability* of smallholders (see Bacon, 2005; Hidayat *et al.*, 2015; van Rijn *et al.*, 2012), the effects of certification on livelihood resilience are still unknown.

This study aims to contribute to methodological development in assessing farmers' resilience by revealing which dimensions of farmers' resilience more strongly correlate with the farmer's ability to recover from stresses and shocks. We apply the framework to different types of Indonesian palm oil smallholders to better understand the way in which RSPO certification correlates with farmer resilience. Our main question is: How and to what extent does participation in certification improve resilience of different types of palm oil smallholders?

The main question will be addressed by answering the following sub-questions:

1. Which dimensions of farmers' resilience correlate with the farmer's ability to recover from stresses and shocks, and to what extent?
2. How and to what extent do certified and uncertified smallholders differ in terms of farmer resilience?

This study is expected to provide insights for different actors (e.g. governmental actors, certification schemes, NGOs) to improve smallholders' resilience. More specifically, it will explain why certain groups of smallholders may be more resilient than others.

In the next section, we further introduce the analytical framework to analyze smallholders' livelihood resilience, followed by a description of the study area, methods, smallholders' characteristics, stresses and shocks, and results and end with a conclusion.

Analytical Framework

Speranza *et al.* (2014) developed an indicator framework for assessing farmers' resilience[1] based on a review of theoretical and empirical literature related to livelihood and resilience. They indicate that farmer resilience correlates with three dimensions:

[1] *Speranza et al. (2014) use the vocabulary of "livelihood resilience". However, how they define "livelihood resilience" resonates better with the concept of "farmer resilience" as we, and other authors, use. This is why we will consistently use "farmer resilience", even though Speranza et al. (2014) use the vocabulary of "livelihood resilience".*

1. The buffer capacity is the capacity to cushion change and to use emerging opportunities to achieve better livelihood outcomes (Speranza 2014: 112). Buffer capacity consists of the possession of, and access to, assets (Speranza, 2013, p. 523). Assets generally comprise human capital, natural capital, financial capital, social capital and physical capital (Carney *et al.*, 1999; Tao & Wall, 2009).
2. Self-organization indicates a level of autonomy, freedom to act, independence, and having power and control over own actions (Speranza *et al.*, 2014, p. 113). Attributes of self-organization include membership of institutions, cooperations and existing network structures.
3. Learning capacity refers to the ability to incorporate previous experiences into current actions (Speranza *et al.*, 2014). Indicators include knowledge of threats and potential opportunities, commitment to learning, capability to identify, share and transfer knowledge, and the existence of a well-functioning feedback mechanism between various actors, such as between smallholders, companies' staff and extension officers.

These three dimensions create diversity in strategies and therefore diversity in the ability to recover from stresses and shocks (Speranza *et al.*, 2014).

To address our research questions, we adapted the framework of Speranza *et al.* (2014) and empirically verified the correlations between the dimensions of resilience and farmer resilience (number 1 and number 2 in Figure 1). We adapted the framework in two ways: first, by adding potential correlations between the dimensions (number 3 in Figure 1); and second, by adding certification, collaboration, and the type of management to the framework (number 4 in Figure 1). These three variables explain differences between different types of palm oil smallholders in Indonesia (see methods section and Table 1).

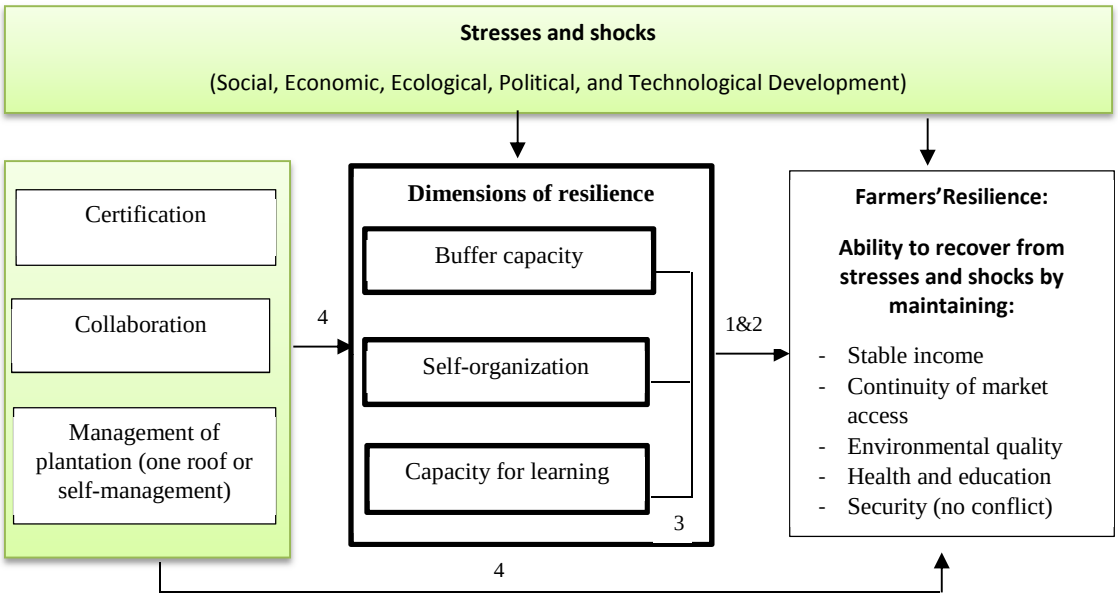

Figure 1 - Framework to assess farmer resilience (Modified from Speranza et al., 2014)

Regarding the role of certification, some literature presents a positive link between certification and smallholder's buffer capacity through enlargement of their capital, and improvement of access to assets (Ayuya *et al.*, 2015; Donovan & Poole, 2014; Ruben & Fort, 2012). Regarding the second variable added, collaborations with companies may enlarge smallholders' capacity to learn and may give opportunities for smallholders to gain better access to information, technology, technical skills, access to seedlings, fertilizers, and equipment (Kirsten & Sartorius, 2002; Vellema, 2000; Vermeulen & Goad, 2006), and to financial capital (Hudson, 2000). Moreover, and related to the

management of the palm oil plantation, smallholders who are not self-managed, but part of a centralized contract-farming system (such as the Indonesian KKPA), may lack autonomy to freely choose how to manage their plantation, especially if this deviates from the practices required by the system they are part of. This potentially results in a lower score for self-organization (see for example Kirsten & Sartorius, 2002; Rehber, 1998). In the next sections, we will analyze whether these first indications from the literature can be explained by, and verified through, the framework in Figure 1.

Materials and methods

Study Area

The fieldwork was conducted in the Province of Riau, at the Island Sumatra in Indonesia. Riau is not only the largest palm oil-producing region in Indonesia, covering 24% of the total Indonesian palm oil production in 2015 (Directorate General of Estate Crop, 2015), but it is also home to more than a quarter of the palm oil smallholders in Indonesia and accommodates all smallholders types distinguished in Table 1 and covered in Figure 1. Further, the majority of the oil palm plantations (in terms of area) belongs to smallholders, and a large percentage of the oil palm production in this region thus results from them. This amounts to approximately 61 percent of the 2.4 million ha of oil palm plantation areas in Riau and 56 percent of the total production of Crude Palm Oil (CPO) (4.2 million ton, Statistics of Riau Province, 2016).

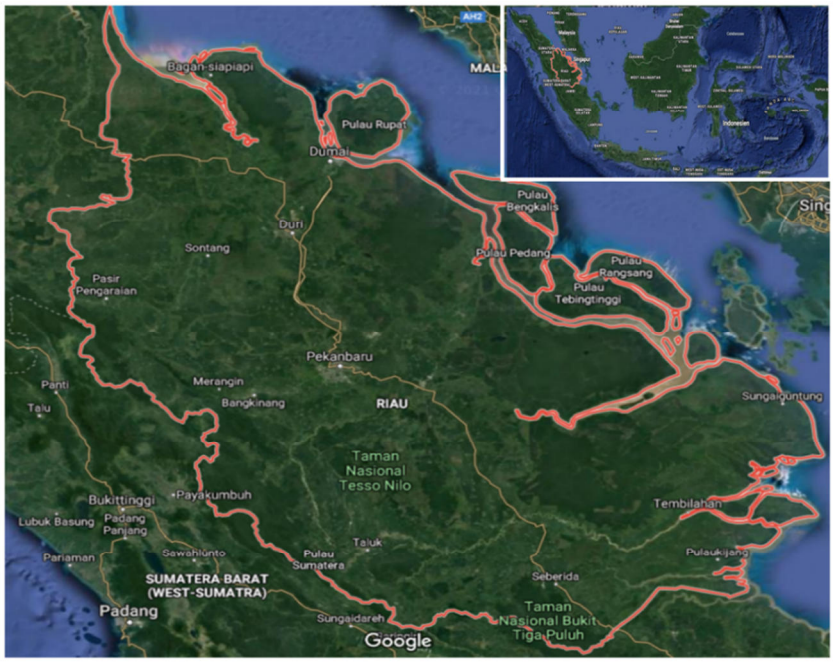

Figure 2 - Map of Riau Province[2] Source: Google (2021)

Sampling technique and survey procedure

Crucial in selecting our study area was the coverage of different types of oil palm smallholders, and therewith covering diversity in the three variables in Figure 1

[2] *The red line indicates the border between the Province of Riau and neighbouring Provinces or other national territories.*

(certification, collaboration and management). In Indonesia, we distinguish five types of smallholders based on 1) whether they work independently or are connected to a scheme system, 2) the type of actor they collaborate with, and 3) whether they manage their plantation under a one-roof management system or not. Different types of smallholders qualify for certification and are made aware of certification by companies and/or NGOs (Hidayat *et al.*, 2015). The five different groups of smallholders in the Indonesian palm oil sector are the following:

1. Scheme smallholders collaborating with a company under the Nucleus Estate Smallholders (NES) system and the *Koperasi Kredit Primer Anggota* (Members' Primary Credit Cooperative or KKPA) system under self-management (centralized contract-farming system)
2. Scheme smallholders collaborating with a company under the KKPA system under one- roof management
3. Independent smallholders collaborating with a company
4. Independent smallholders collaborating with an NGO
5. Independent smallholders collaborating with middlemen (informal contract).

Table 1 - Respondent selection criteria

NO.	DEPENDENCY RELATION	ACTOR OF COLLABORATION	TYPE OF MANAGEMENT	CERTIFICATION STATUS	N
1	Scheme smallholders	Company under NES system and KKPA following NES structure	Self-management	Certified and uncertified	45 (NES certified) 45 (NES uncertified) 15 (KKPA certified)
2	Scheme smallholders	Company under KKPA system	one- roof management	Uncertified	36
3	Independent smallholders	Company	Self-management	Certified	45
4	Independent smallholders	NGO	Self-management	Certified	45
5	Independent smallholders	Middlemen (informal contract)	Self-management	Uncertified	44

We conducted surveys in September and October 2016 and selected respondents in two steps. First, we geographically limited our sample by purposely selecting sites in Riau based on the five categories of smallholders. Next, in these regions, we performed a snowball sampling technique, starting by selecting farmer experts and key stakeholders that could subsequently bring us in contact with farmers (see Table 1). The survey consisted of two parts: the first on farmer resilience, questioning the ability of smallholders to recover from stresses and shocks (see Table 2); the second part on the three dimensions of farmer resilience, that is, buffer capacity, ability to learn and self-organization (see Appendix 1). As the respondents filled out the questionnaire in the presence of the researcher, the respondents usually gave an explanation on why they chose a particular answer. Although this information was not recorded and transcribed in a structured way, it allowed us to gain better insight in the correlation patterns resulting from the questionnaires. Before conducting the survey, we selected stresses (a small, regular, predictable disturbance with a cumulative effect) and shocks (a large, infrequent, unpredictable disturbance with immediate impact) based on discussions with three farmer experts from two different districts in Riau (Pelalawan and Siak).

Farmer experts are farmer leaders who have lived in our study areas for more than ten years at the moment this study was conducted. Therefore, they have experienced

developments in the study areas and have knowledge on phenomena faced by farmers and ways in which farmers have dealt with situations encountered. The discussions with the experts focused on the identification and understanding of stresses and shocks that have been experienced by farmers in the last 10 years, and that are likely to occur again in the future. This information was also used to provide an illustration to the farmers during the survey. These illustrations turned out to be helpful in challenging the farmers to think about and to relive past situations in which stresses and shocks occurred, and the way in which they responded to, and (potentially) recovered from these stresses and shocks.

Assessment of Farmer vulnerability and resilience

First, we asked the farmers how vulnerable (i.e. how severely impacted) they would be if a shock or stress would happen again in the near future. This was measured on a 5-point Likert scale varying from extremely impacted (score 1) to not impacted (score 5). It was allowed to give multiple answers (however, not more than two). We used three types of stresses and shocks (price decline, haze from forest fires and El Nino) that were formulated by the farmer experts in the preceding interviews (see section above). In a next step, farmer resilience is measured on a five-point Likert scale (see Table 2) representing the extent to which smallholders are able to recover from the identified stresses and shocks, from low (score 1) to high (score 5).

Table 2 - Operationalization of farmer resilience

LIVELIHOOD OUTCOMES	COPING ABILITY/ VULNERABILITY	RECOVERING ABILITY/ RESILIENCE
Household Income		
Daily needs	1=Extremely impacted;	1=could not recover;
	2=Highly impacted;	2=slightly recover;
Environmental quality in general (soil fertility, water supply, pest outbreak)	3=Moderately impacted;	3=moderately recover;
	4=Slightly impacted;	4=highly recover;
	5=not impacted	5=fully recover
Health and education		
Security		
Maximum score	# (meaning: not vulnerable at all)	# (meaning: very high ability to recover/ farmer resilience)

We used the arithmetic means method to calculate the aggregate score of coping ability and recovering ability. We assigned equal weights to each of the five livelihood outcomes and each type of stress and shocks. The following equation was applied:

$$v_s(P_s, P_{so}, v_{soi}) = \sum_{o=1}^{P_s} \frac{1}{P_s} \sum_{i=1}^{P_{so}} \frac{1}{P_{so}} v_{soi}$$

$$r_s(P_s, P_{so}, r_{soi}) = \sum_{o=1}^{P_s} \frac{1}{P_s} \sum_{i=1}^{P_{so}} \frac{1}{P_{so}} r_{soi}$$

Where,

v_s = the overall score of coping ability of farmer i

r_s = the overall score of recovering ability of farmer i

P_s = the number of identified stresses and shocks (i.e. three stresses and shocks: a sharp decline in oil palm price, El Nino, and forest fire)

P_{so} = the number of livelihood outcomes (i.e. five outcomes: stable household income, fulfillment in daily needs, sustaining environmental quality, maintaining good health and education as well as security)

v_{soi} = the score of coping ability of farmer i in term of livelihood outcome o to stresses and shocks s, and

r_{soi} = the score of recovering ability of farmer i in term of livelihood outcome o to stresses and shock

Assessment of dimensions of resilience

The three dimensions of resilience (buffer capacity, self-organization, and capacity for learning) are operationalized based on indicators that were developed, but not further applied to practice, by Speranza *et al.* (2014) (see Appendix 1). All answers are phrased along a five-point Likert scale, varying from 1 (low resilience) to 5 (high resilience). We finally sum up the scores of all indicators belonging to one dimension to determine the smallholders' buffer capacity, self-organization ability and learning capacity. The higher the total scores, the greater the buffer capacity, self-organization ability and learning capacity.

The Cronbach's Alpha reliability test (see Tavakol & Dennick, 2011) indicates a strong degree of internal consistency for the questions on farmer resilience (0.88) and for the dimensions of resilience (0.73).

Differences among smallholders and correlation

Next, we used Pearson Correlation to analyze the existence of potential relations:

1. Between and among the three dimensions of resilience.
2. Between the separate dimensions and farmer resilience.
3. Between certification (certification vs. uncertified) and farmer resilience and between certification and the three dimensions.
4. Between the actor of collaboration (middlemen vs. companies vs. NGOs) and farmer resilience and between collaboration and the three dimensions.
5. Between the type of management (self-management vs. one-roof management) and farmer resilience and between type of management and the three dimensions.

To analyze the relative importance of the different dimensions of resilience in explaining differences in farmer resilience, we also used the results from the Pearson correlation test. In cases where we found a significant effect, we used either an ANOVA (for ordinal values for more than two groups) or a T-test (for scale variables and explaining differences between two groups only) to gain more insight in the way in which the different smallholder groups differ. We adopted a significance level of 5 percent ($P \leq 0.05$).

Results

Stresses and shocks

Identification of stresses and shocks faced by farmers in this study is based on interviews with three farmer experts. The interviews with the three farmer experts

revealed three stresses that all farmers had been confronted with in the past and which are –according to them- likely to occur again in the future: 1) a sudden and sharp decline in palm oil prices, 2) El Niño, and 3) haze problems resulting from forest fires.

The first one, sudden and/or sharp price declines, exists because the Indonesian palm oil industry is strongly influenced by fluctuations in the global economy. At the end of 2008, Indonesian palm oil smallholders experienced a sharp decline in Fresh Fruit Bunch (FFB) prices due to the global financial crisis.[3] Reductions in price led to a lower income and a decrease in palm oil productivity as smallholders faced difficulties in affording fertilizers.

Oil palms are also sensitive to climate and need an adequate water supply to provide an optimal yield. The water supply may be threatened in the case of El Niño weather patterns. For Indonesia, El Niño implies a reduction in rainfall, leading to lower productivity in terms of palm oil yield (Harun *et al.*, 2010). El Niño occurs every two to seven years and differs in intensity, depending on the exact increase in ocean surface temperatures. In the last one and a half decades, Indonesian palm oil smallholders were confronted with an El Niño three times, ranging from a rather weak El Niño (2006–07), to a moderate occurrence (2009–10) and a very strong one (2015–16) (GGWeather, 2016). The last occurrence in 2015, affected oil palm plantations particularly the southern region of equatorial Indonesia, including Riau, and reduced productivity of oil palm production up to 60 percent (Darlan *et al.*, 2015a). Our respondents further reported that El Niño may even reduce FFB production by 30 to 50 percent if farmers do not fertilize their plantation properly (i.e. using fertilizer in low quantities or incorrect timing).

The third disturbance, haze resulting from forest fires, has become a seasonal phenomenon in Indonesia. The main reason lies in the practice of forest clearance, or 'slash and burn', which is the cheapest way to clear forests for establishing new plantations (Balch, 2015). Planting new oil palms in peatland areas is another trigger for forest fires, as canalization of peatland dehydrates the land and makes it more susceptible to fire, particularly in the dry season (Asurambo, Harizajudin, & Andriyanu, 2014). In late October 2015, there were more than 115,000 of such fires in Indonesia, concentrated in Riau, Jambi and Borneo (Cifor, 2015). The fires caused health and transportation problems, and reduced the UV-radiation intensity by 60 percent. Such a reduction in UV-radiation intensity has a negative effect on agriculture as it leads to problems regarding photosynthesis, thereby disturbing the fruit maturing process, and reducing the palm oil productivity by 5.3 percent (Darlan *et al.*, 2015b).

Vulnerability and farmer resilience

The majority (78.1%) of palm oil smallholders are indeed vulnerable to price shocks, haze from forest fires and El Niño, with an average score of 2.64 (between highly and moderately impacted). However, they also indicate they are rather resilient, and score, on average, a 4.25 on their livelihood resilience (corresponding to a score between high and full ability to recover, see Figures 3 and 4). This means that palm oil smallholders are exposed to, and adversely impacted by, these stresses and shocks, but that they also have a high ability to recover. This pattern holds for all three shocks (see Figure 4) and although the average vulnerability to the three shocks does not differ greatly (2.52 for price shocks, 2.54 for haze from forest fire, and 2.96 for El Niño), we could identify that farmers are significantly less vulnerable to the effects of El Niño than to those of haze

[3] *According to our interviews, oil palm price sharply decreased from IDR 1,400–2,000 to approximately IDR 600 for dependent smallholders and from more than IDR 1,000 to IDR 300–500 for independent smallholders*

from forest fires and the effects of price shocks (P=0.00). Although the recovering ability (resilience) is relatively high for all shocks, we see that farmers have significantly more difficulties in recovering from price shocks compared to haze from forest fires (P=0.022). The strong recovering ability can be explained by the farmers' social capital and ability to relatively easily find alternative jobs and income sources outside their oil palm plantation, if there is a crisis. Examples of alternative sources for income include working as construction workers, selling cattle, and borrowing money from family, friends, neighbors or cooperatives.

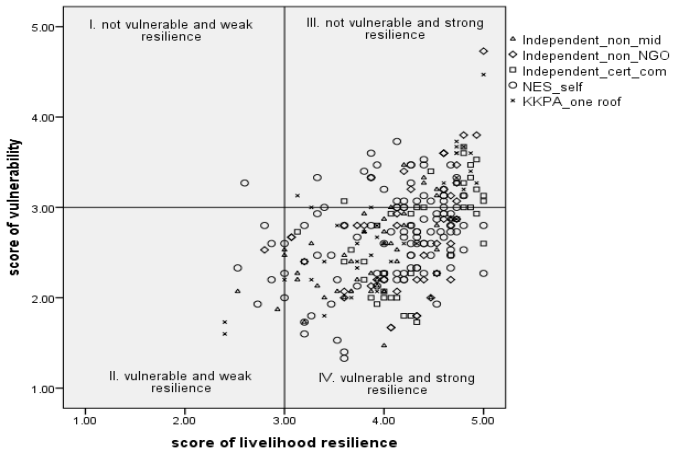

Figure 3 - Distribution of palm oil smallholders' average vulnerability and livelihood resilience to stresses and shocks (price declines, haze from forest fires and El Nino)

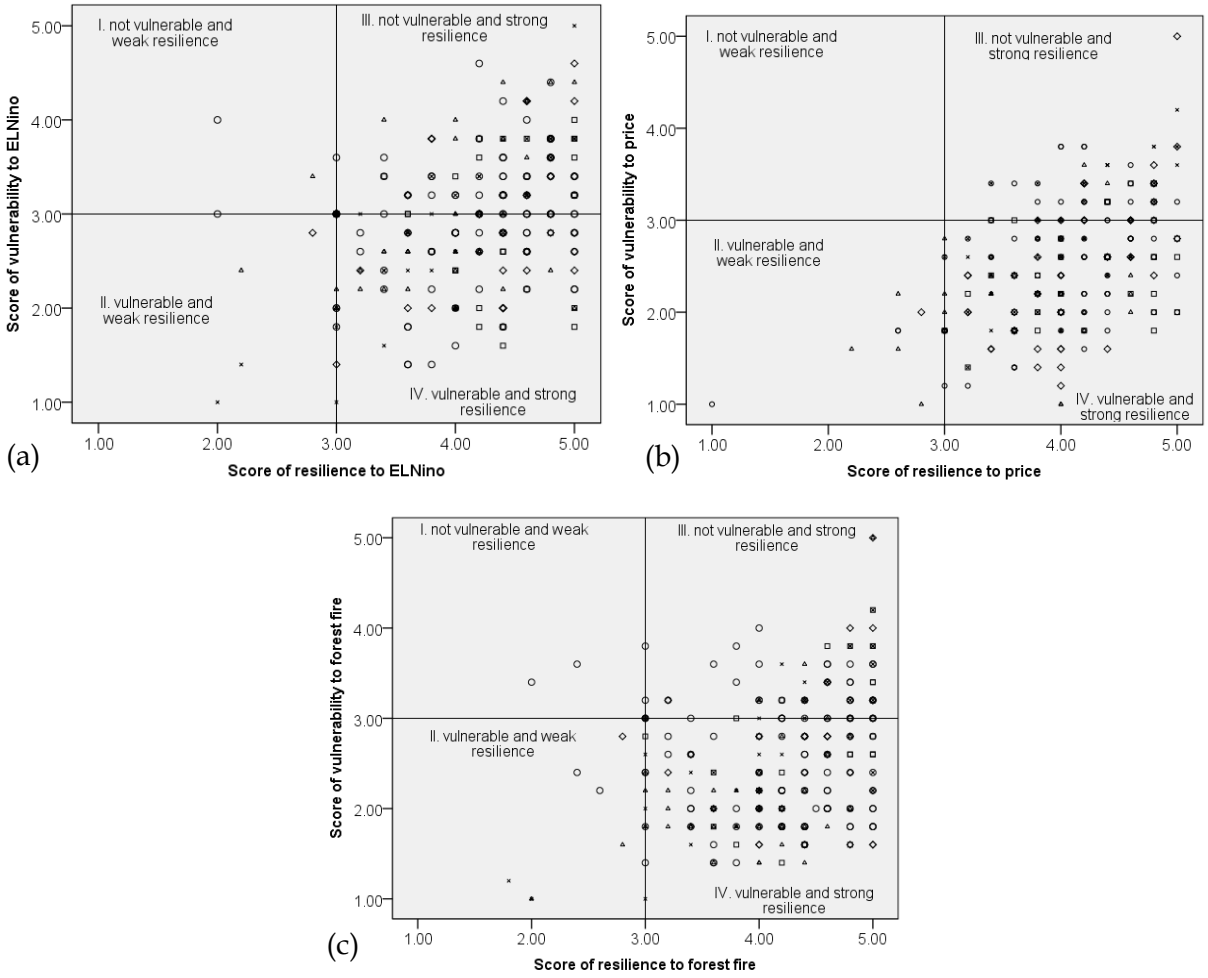

Figure 4- Distribution of palm oil smallholders' vulnerability and livelihood resilience to price shocks (a), haze caused by forest fire (b), and El Nino (c)

Dimensions of resilience

Buffer capacity

In line with the framework of Speranza *et al.* (2014), we find a positive, but rather weak correlation between the dimension of buffer capacity and farmer resilience (r=0.138). This implies that greater assets (or access to assets) go together with a higher capacity of smallholders to cushion stresses and shocks. Our field observations indicate that financial capital may play an important role in explaining this correlation: smallholders with a higher income commonly reinvest this money, for example in buying livestock. Cattle and other animals can be sold again as a strategy to maintain livelihoods in the event of a crisis. Moreover, smallholders who participate in a cooperative tend to have higher scores on social capital[4] and tend to be more resilient. Organized farmers

[4] *The mean difference in scores on social capital between Independent smallholders collaborating with middlemen (not participating in cooperative) and Independent smallholders collaborating with company (participate in cooperative) = -3.811 (Sig. .000). The mean difference in farmer resilience between Independent smallholders collaborating with middlemen (not participating in a*

have a more stable income and easier access to credit compared to unorganized farmers. The stability of income partly results from road maintenance activities performed by the cooperatives, which allows a more structural, predictable, and rather fast transportation of FFB to the mills. Stable income allows for structural savings, which leads to the creation of a buffer that farmers may use in the event of a crisis. Further, the relatively easy provision of credits by cooperatives (e.g. to buy fertilizers) also helps farmers resume the thread after a shock has taken place. This prevents further impacts on livelihood resilience and shortens the recovery period.

Learning capacity

Learning capacity correlates with farmer resilience in line with the theory of Speranza *et al.* (2014); we found a rather weak, but positive correlation (r=0.166). Smallholders who have up-to-date information and knowledge regarding palm oil, and who have opportunities to discuss problems and possible solutions, turn out to be more resilient than more isolated smallholders. We found that informally exchanging knowledge (e.g. in small shops, plantations, or the mosque) helped the farmers to more effectively translate information and knowledge into concrete actions. Further, we found that the interaction between learning capacity and buffer capacity also correlates weakly with farmer resilience (r=0.173, see Figure 5).

Self-organization

Contrary to the framework of Speranza *et al.* (2014), we could not identify a direct correlation between the dimension of self-organization and farmer resilience. However, this does not imply that the dimension becomes fully redundant in the suggested framework. We did find that a high score on self-organization combined with a high score on capacity for learning, correlates with farmer resilience (r=0.128). This correlation is slightly stronger if smallholders subsequently also score well on buffer capacity (r=0.129, see Figure 5). This means that farmers who are able to organize themselves are not automatically more resilient than farmers who are not organized. However, being organized seems to go together with a higher buffer capacity and capacity for learning, which, in their turn, correlate positively with farmer resilience. Self-organization therefore indirectly correlates with farmer resilience.

We conclude that buffer capacity, and capacity for learning positively, but rather weakly, correlate with farmer resilience, and that self-organization has a positive intermediating effect on farmer resilience in interaction with learning capacity and buffer capacity. Figure 5 reveals that all correlations between the three dimensions and farmer resilience are rather weak. Although none of the dimensions correlates strongly and significantly with farmer resilience, learning capacity most strongly correlates with farmer resilience, while self-organization shows the weakest correlation. If we subsequently also look at the interaction between and among the dimensions, we conclude that the interaction between buffer capacity and learning capacity has the strongest correlation (r=0.470) with farmer resilience.

Table 3 shows that the dimensions of resilience are not independent from each other, as the framework by Speranza *et al.* (2014) suggests. Buffer capacity does not only correlate with resilience, but also to learning capacity and self-organization.

Table 3 - Correlations between the dimensions of resilience

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cooperative) and Independent smallholders collaborating with a company (participating in cooperative) = -.5048 (Sig. .002)

PERSON CORRELATION	BUFFER CAPACITY	SELF-ORGANIZATION	LEARNING CAPACITY
Buffer capacity	1	.404** (.000)	.470** (.000)
Self-organization		1	.339** (.000)
Learning capacity			1

P-value is in the bracket
*** Significant level = .01*

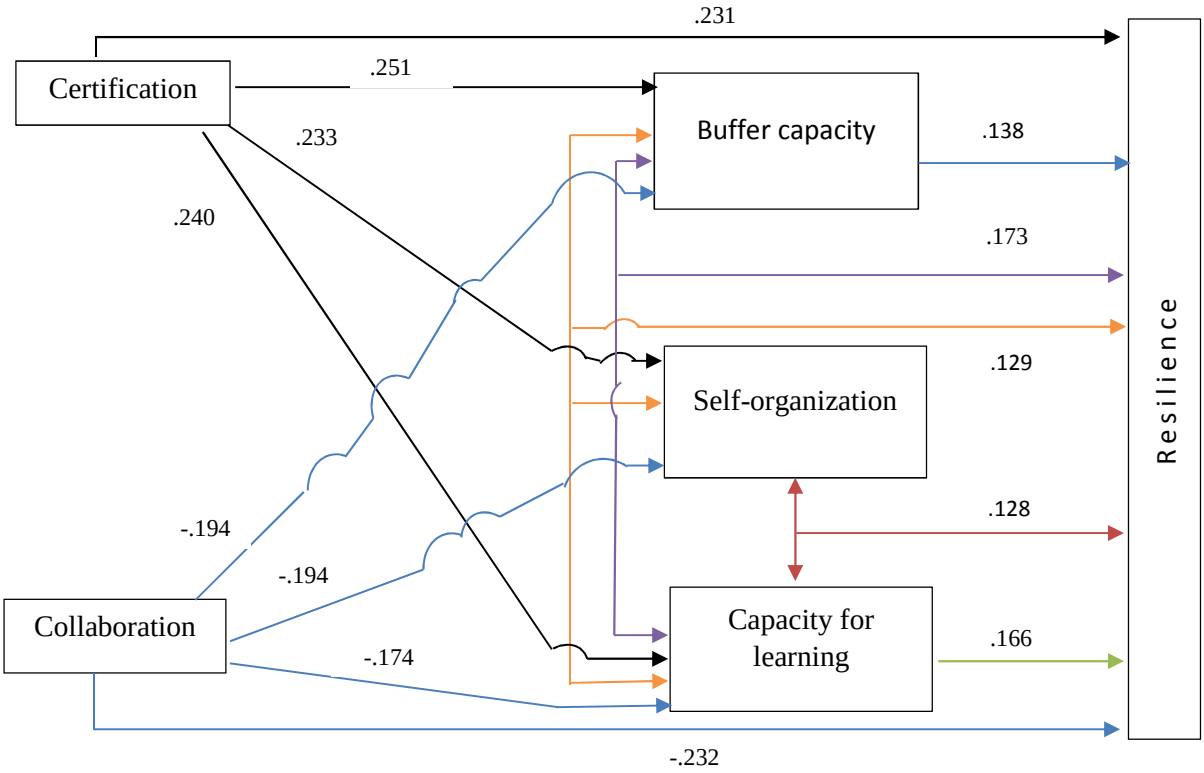

Figure 5 - Correlation between dimensions of resilience and farmer resilience

Relationship between certification, management, collaboration and farmer resilience

Certification

We found that certified farmers are significantly more resilient than uncertified farmers (difference in mean 0.29; P=0.00, see Table 4), and score higher on buffer capacity (difference in mean= 7.02; P=0.00, see Appendix 3a) and learning capacity (differences in mean= 3.78; P=0.00, see Appendix 3c). We also found a positive, significant, but rather weak correlation between certification and farmer resilience (0.231, see Figure 5 and Appendix 2). Although still relatively weak, this correlation is stronger than the correlations between the dimensions of resilience and farmer resilience.

Table 4 - T-test: mean differences in farmer resilience based on participation in certification

	CERTIFICATION	N	SIG. (2-TAILED)	MEAN DIFFERENCE
Score of farmer resilience	uncertified	170	.000	-.28913
	certified	105		

In addition to a direct correlation between certification and farmer resilience, we also identified an indirect correlation through the dimensions of resilience (buffer capacity 0.251, self-organization 0.233, and learning capacity 0.240) (see Figure 5 and Appendix 2). It should, of course, be noted that correlations do not provide information about (the direction of) causal relationships. Further research would therefore be required to investigate whether and to what extent certification causes or precedes higher scores on the dimensions of resilience and farmer resilience, or whether farmers who tend to score well in terms of resilience are more eager to become certified. Based on earlier research however, certified smallholders commonly have more financial capital because their productivity and FFB selling prices are generally higher compared to uncertified smallholders (see also Hidayat *et al.* 2016). Certification standards further require farmer organizations to be more transparent and accountable, which creates and maintains trust among members. This trust is said to smoothen the provision of credits and encourage labor sharing in the event of a crisis. Training sessions and periodic meetings that go along with certification may provide farmers with information, thus allowing them to better prepare for stresses and shocks and to diversify their recovering strategies (Sina, Chang-Richards, Wilkinson, & Potangaroa, 2019). This is also in line with information provided by the respondents of this study who argued that certification has led to improvements in financial capital and social capital.

Management

The way in which farmers are managed (self-management, one-roof management, or fully independently) does not significantly correlate with farmer resilience (see Appendices 2 and 4). This deviates from the framework of Speranza *et al.* (2014), who suggest that self-organization positively contributes to resilience. We can explain this by elaborating on the limited involvement of smallholders under one-roof management in their plantation. Smallholders under a one-roof management type, are –according to the definitions used by Speranza *et al.* (2014) to a lesser extent self-organized. However, in practice, they only spend limited time working on their plantations and therefore have plenty of time to work outside the palm oil sector. This allows them to easily find alternative sources of income when they are confronted with stresses and shocks impacting the oil palm plantation.

Collaboration

Our results reveal that collaboration correlates with farmers resilience ($r=-0.232$) (see Figure 5 and Appendix 2). More specifically, we found a significant difference between the resilience of smallholders collaborating with middlemen, and those collaborating with companies ($P=0.008$) or NGOs ($P=0.005$, see Appendix 5). The former (smallholders collaborating with middlemen) are significantly less resilient and have a lower buffer capacity compared to smallholders collaborating with company (see Appendix 6a).

Smallholders collaborating with middlemen are fully independent and cannot participate in farmer organizations. This implies that they cannot benefit from being

organized in terms of cost-sharing, road maintenance, or labor sharing.[5] Smallholders collaborating with middlemen also score lower on learning capacity than smallholders collaborating with NGOs (P=0.001) and companies (P=0.000, see Appendix 6c). Smallholders collaborating with middlemen do not have a learning platform and do not have many opportunities for sharing information and knowledge. We found that middlemen, as external sources of information, are not transparent towards the smallholders. Farmers argued, for example, that information about FFB price decreases spreads more quickly than information about price increases. Public extension officers may play a role here, but currently focus on, and prioritize, non-estate crops, such as rice. Besides, extension officers are often not available in palm oil regions due to the extensive working area and the limited amount of staff.

Implications of results for to the five types of smallholders

We extract different patterns from the study results:

1. Certified farmers score significantly higher (P= 0.000) on farmer resilience than uncertified farmers, but the difference is relatively small (0.29). (Answer to the second research question).
2. Farmers collaborating with NGOs and companies score significantly higher on farmer resilience than farmers collaborating with middlemen (difference in mean= 0.399, P=0.005 and 0.30, P= 0.008 respectively).
3. Buffer capacity and capacity for learning correlate weakly but positively and significantly with farmer resilience (answer to the first research question).
4. Smallholders collaborating with NGOs or companies score significantly higher on both buffer capacity and capacity to learn than smallholders collaborating with middlemen.
5. The way in which a plantation is managed (independently, one-roof management, or self-managed) does not lead to differences in the dimensions of farmer resilience and does not correlate with farmer resilience.

Following these patterns, and looking at the five different types of Indonesian palm oil smallholders, we conclude that certified, independent smallholders collaborating with companies turn out to be the most resilient type of smallholders. NES and KKPA scheme smallholders under self-management may not differ in terms of livelihood resilience from independent or semi-independent smallholders if they are certified. The decision of scheme smallholders to participate in certification depends on their affiliated companies.

Independent smallholders collaborating with NGOs also score relatively high on resilience, although their score on buffer capacity is below average (but still well above the score for smallholders collaborating with middlemen). This can be explained as their plantations are located in flood-prone areas. Capital savings are therefore relatively often needed to cope with the impacts of a flood. Reduced time between different shocks also reduces time to rebuild buffers against the next shock. Independent smallholders collaborating with middlemen are the weakest in terms of livelihood resilience. Their scores on the dimensions of resilience are below average. They do not have access to certification and lack external supports. (different from KKPA smallholders under one-roof management).

[5] *The mean difference in scores on social capital between Independent smallholders collaborating with middlemen and Independent smallholders collaborating with NGOs= −1.566 (Sig. 0.000) and the mean difference between Independent smallholders collaborating with middlemen and Independent smallholders collaborating with a company= −3.811 (Sig. 0.000)*

Table 5 - Smallholders ranking on resilience

TYPES OF SMALLHOLDERS	BUFFER CAPACITY (MAX. = 75)	SELF-ORGANIZATION (MAX. = 30)	LEARNING CAPACITY (MAX. = 30)	CERTIFICATION	MANAGEMENT OF PLANTATION	COLLABORATION	RANK
NES/KKPA self-management	39.69 a	18.34 c	15.52 a	Yes/No a	Self-management c	Companies a	2
KKPA one-roof	29.58 b	9.86 c	10.75 b	No b	One roof c	Companies a	4
Independent smallholders with companies	42.29 a	18.16 c	17.22 a	Yes a	Self-management c	Companies a	1
Independent smallholders with NGOs	34.51 b	20.09 c	14.33 a	Yes a	Self-management c	NGO a	3
Independent smallholders with middlemen	35.32 b	18.91 c	11.57 b	No b	Self-management c	Middlemen b	5
Average	36.28	17.02	13.90				

Notes:
a: score above average and positively correlates with resilience
b: score below average and negatively correlates with resilience
c: not significantly correlates with livelihood resilience
The ranking is defined based on components that significantly correlate with resilience

Discussion and conclusion

Most studies about the relationship between certification and smallholders' livelihood emphasize the vulnerability component (susceptibility) while neglecting resilience (recovering ability). This paper contributes to knowledge development in this area by empirically applying and verifying an assessment framework developed by Speranza *et al.* (2014), and through assessing livelihood resilience for five different palm oil smallholder groups in Indonesia.

Our results show that palm oil smallholders are relatively resilient to price declines, haze resulting from forest fires, and El Niño. This result aligns with the study on the livelihood resilience of oil palm smallholders in Mexico, conducted by Abrams *et al.* (2019) who showed that oil palm production can contribute to the livelihood resilience of smallholders linked to a formal organization and state supports. In this study, we see that the differences in resilience resulting from the different shocks and between the different groups of smallholders are small.

Regarding the assessment framework, we found that correlations between the dimensions of resilience and farmer resilience are rather weak for buffer capacity and learning capacity, and absent for self-organization. Although self-organization contributes positively to buffer capacity and learning capacity, it does not directly improve the palm oil farmers' resilience. This may seem to contradict literature assigning positive implications to self-organization, or to organization in general. However, we found that a lack of self-organization does not necessarily imply a lack of self-determination. This aligns with Liu *et al.* (2020) who found that a variety of income and job alternatives enables farmers a better recovering ability from stresses and shocks. The fact that farmers under a one-roof management system (not self-organized) have more opportunities to diversify their income and find a part-time job outside their plantations explains their relatively high resilience-score. Following this, we consider a better conceptual distinction between self-organization and self-determination a needed contribution to the literature and the framework by Speranza *et al.* (2014).

Projecting the results of this study to current and past developments in the palm oil sector in Indonesia, we conclude that the finalized NES system is one of the few that

allowed for – and actively stimulated – certification and collaboration with companies. If we regard these variables as favorable conditions for farmer resilience, it can be questioned whether determination of the NES system can be justified in the light of farmer resilience. Where some initiatives were determined in the last couple of years, new initiatives arose as well.

First, the standard for Indonesian Sustainable Palm Oil (ISPO) (Hospes, 2014; Wijaya & Glasbergen, 2016). The ISPO standard is a public sustainability certification scheme initiated by the Indonesian Government through The Ministry of Agriculture, with the aim of regulating the palm oil sector to achieve more sustainable production. This initiative is now mandatory for companies and will become mandatory for smallholders in the future (Hidayat, Offermans, Glasbergen, & values, 2018; Suharto, 2010). We see that the ISPO certification body explicitly considers the favorable conditions for livelihood resilience as they certify smallholders and promote collaboration between smallholders and companies. A second initiative is the establishment of so-called FAIR company-community partnerships initiated by Oxfam, aiming to improve economic development and reducing adverse impacts of palm oil expansion on local communities (Oxfam, 2017). Initiating collaborations between smallholders and companies is central to their approach, combined with support for smallholders to become certified. In addition, this model follows a so-called landscape approach, focusing on diversification instead of monoculture, which may provide opportunities for smallholders to improve their recovering ability should shocks impact their oil palms.

Although we could verify most relations between the dimensions of resilience and farmer resilience as suggested by Speranza *et al.* (2014), and defined two more variables correlating with livelihood resilience (certification and collaboration), most correlations turned out to be rather weak. The resilience of Indonesian palm oil smallholders to current and past shocks and stresses turned out to be rather high. Although this can be considered positive from a sustainable livelihood perspective, it does not say a lot about resilience to future stresses and shocks. The potential role of climate change deserves therefore more attention in the discussion on farmer resilience. Climate change and the resulting confrontation to weather extremes and their effects, such as storms, floods and other natural disasters may negatively impact the resilience of palm oil smallholders. Especially those who are not certified and are working together with middlemen. Climate change may also induce more frequent exposure to shocks, and there with a shorter time between shocks, and less time to rebuild capital and accumulate savings. Following from this we believe that climate change may pose risks to livelihood resilience in the near future that cannot be overcome by current forms of certification or collaboration with companies alone. Follow-up research could also further increase our understanding of causal relationships between the dimensions of resilience, certification, collaboration, and livelihood resilience through a more advanced statistical analysis (e.g. using simultaneous equation modeling). This will also help overcoming limitations in this study: although the conceptual and theoretical frameworks assume a causal relationship between dimensions of resilience and farmer resilience, we could mainly verify or falsify the existence of correlations (not causalities). As we however complemented correlation-tests with ANOVA and t-tests, we can say that certified farmers have (on average) a higher score on resilience. However, it cannot be concluded whether certification leads to (i.e. is the cause of) a higher resilience (or that more resilient farmers tend to be more often certified). We also acknowledge that the way in which we measured vulnerability and resilience (i.e. by making use of indicators used in other studies) can be both a strength (i.e. the indicators have been used, verified and peer-reviewed in previous studies) and a weakness (i.e. the use of a different set of indicators or a different way of operationalizing resilience could have led to different results and nuances).

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Appendices

Appendix 1 - Indicators and measurements of dimensions of farmer resilience

VARIABLES	INDICATORS	MEASUREMENTS
Dimension of buffer capacity		
Human capital (score=4-20)		
Education	year of schooling	1=didn't go to school; 2=1-12 year (SD); 3=13-15 year (SMP); 4=16-18 year (SMA); 5=>18 year (University)
Skill	Skills being practiced	1=don't have any other skill; 2=only have palm oil plantation related skills e.g. harvesting, spraying, fertilizer application; 3=have palm oil plantation related skills and any other agriculture skills; 4=Have agriculture and Non-agriculture (informal) related skills (blue-collar skill); 5=have entrepreneurial skill or white-collar skill
Health condition	Ability to use own (family) labor to work at plantation	1=never/unable to use family labor; 2=seldom; 3=sometime; 4=often ; 5=Almost always
Knowledge	Training attended in the last 12 months	1=never attend training; 2=seldom (1-4); 3=sometime(5-8); 4=often (9-12) ; 5=Almost always (>12) (the value may change dependent on distribution of data in the field)
Financial capital (score=5-25)		
Income	Last month income from selling Fresh Fruit Bunch (FFB)	1=very low; 2=Below average; 3=Average; 4=Above average; 5=very high (dependent on distribution of data in the field)
Yield	Yield per ha last year or (average monthly production per ha*12)	1=very low; 2=Below average; 3=Average; 4=Above average; 5=very high (based on diagnostic study average yield of smallholder is 16-18 ton/year/ha, with OER 18-22%
Saving	Saving: number of livestock	1=don't have saving; 2=Below average; 3=Average; 4=Above average; 5=very high (dependent on distribution of data in the field)
Non-farm income	percentage of non-oil palm plantation income to household income (including remittance)	1=none ; 2=x=<25%; 3=50>=x>25%; 4=75>=x>50; 5=100>=x>75
Dependency ratio	percentage of household member who do not earn income (do not work)	1=100>=x>75; 2=75>=x>50; 3=50>=x>25%; 4=x=<25%; 5=none
Social capital: any benefits from participation in a group or organization (score=3-15)		
Access to tools/equipment owned by organization	Availability of tools and access	1=not available, 2=available but difficult to access, 3=available and accessible, but poor quality; 4=available, accessible, good quality, but limited time to use; 5=available, accessible, good quality, and free to use anytime
Better infrastructure quality supported by organization	Road built and maintained by group	1=not available; 2=available but in bad condition; 3=available in good condition only in the main road access; 4=available in good condition until plantation road inside group; 5=available in good condition until private road plantation

VARIABLES	INDICATORS	MEASUREMENTS
Labour sharing among farmer group members	Labor provision/ sharing in group	1=not available; 2=available but difficult to access; 3=available, accessible, but often unsatisfactory work; 4=available, accessible, but sometimes unsatisfactory work; 5=available, accessible, and always satisfactory work
Physical capital (score=2-10)		
Availability of private tools/equipment	Availability of own spraying tools and its safety	1=not available; 2=available with poor quality without safety tools; 3= available with good quality but without safety tools; 4=available with good quality but not complete safety tools; 5=available with good quality and complete safety tools
	Availability of own harvesting tools and its safety	1=not available; 2=available with poor quality without safety tools; 3= available with good quality but without safety tools; 4=available with good quality but not complete safety tools; 5=available with good quality and complete safety tools
Natural capital (score=1-5)		
Plantation risk	Plantation risk to erosion/flood	1=extremely risky to flood or erosion; 2=very risky to flood or erosion; 3=moderately risky to flood or erosion; 4=Slightly risky to erosion; 5=not et al
Dimension of self-organization (score=6-30)		
Institutions	Rules, regulation, local norm and government policies may restrict self-organization of farmers	1=there are rules definitely not allow us to manage plantation on his own; 2=there are rules, so probably not able to manage plantation (too difficult to follow the rule); 3=there are rules, but we still possibly able to manage plantation (but with many consequences); 4=there are rules, but we probably able to manage plantation (but with some consequences); 5=there are rules but we definitely able to manage plantation without any consequences
Cooperation and network	membership and participation	1=No organization; 2=Follow at least one organization as passive member (e.g. never follow meeting); 3=Follow one organization as active member (e.g. follow all organization activities); 4=join one organization and active in management; 5=join more than one organization actively as member and/or management
	Trust and reciprocity	1=Definitely not able to borrow money from (or labor exchange with) other farmers (impossible); 2= probably not able; 3=possibly able a; 4=probably able; 5=definitely able
Network structure	Bounding level to actors or organizations	1=one roof management or part of company concession ; 2=tight in formal contract/ scheme; 3=tight informally for input supply and selling FFB ; 4=tight informally to sell FFB ;5=do not tight to any organization/agency

VARIABLES	INDICATORS	MEASUREMENTS
	The level of centralization of plantation management	1=all plantation management are conducted by other actor, farmer could not influence et al; 2= all plantation activities are managed by other actor, with farmer groups/cooperative control; 3=partly plantation activities are managed by other actors under farmer groups/cooperative control; 4=partly/all plantation activities are managed by other actors under farmers' control (individually); 5=all plantation activities managed by farmers themselves (managed=application including, input provision, decision when the activities conducted etc)
Reliance on own resources	Percentage of external input reduction because of internal input substitution	1=none ; 2=x=<25%; 3=50>=x>25%; 4=75>=x>50; 5=100>=x>75
Dimension of learning capacity (score=6-30)		
Knowledge of threats and opportunities	Ability to get information about ongoing issues around palm oil	1=Very poor (never get information); 2=Poor (Difficult to get information, most of the time no); 3=Fair (sometime get information); 4=Good (often get information, most of the time get); 5=Very good (always)
Commitment to learning	How many time in a year regular meetings in organizations are conducted to discuss performance in the last season/ last year	1=None/Never attend such meeting; 2=seldom (1-4); 3=sometime(5-8); 4=often (9-12) ; 5=Almost always (>12) (the value may change dependent on distribution of data in the field)
Functioning feedback mechanism	Frequency discussion between farmers and extension officer (from government or company or NGO) in the last 12 months	1=None/ Never join such discussions; 2=seldom (1-4); 3=sometime(5-8); 4=often (9-12) ; 5=Almost always (>12) (the value may change dependent on distribution of data in the field)
Knowledge identification capability-monitoring	Experimentation	1=Definitely not able to do experiment (no available external support); 2= probably not able (can ask external support but they have done it before); 3=possibly able, (it is done occasionally with external supports); 4=probably able with external support, (it is done continually); 5=definitely able (with own resources and it is done continually)
Knowledge sharing and transfer capability	Sharing information and knowledge among farmers	1=None/ Never join such discussions; 2=seldom (1-4); 3=sometime(5-8); 4=often (9-12) ; 5=Almost always (>12) (the value may change dependent on distribution of data in the field)
	Applicability of new knowledge to practice in plantation	1=Never applicable; 2=seldom applicable; 3=sometime applicable; 4=often applicable; 5=Almost always

Appendix 2 - Correlation between dimensions of resilience, its interactions and farmer resilience

VARIABLES	CORRELATION COEFFICIENT (R)	SIG. 2 TAILED
Buffer capacity	.138*	.022
Self-organization	.040	.507
Learning capacity	.166**	.006
Interaction: buffer capacity and self-organization	.077	.204
Interaction: buffer capacity and learning capacity	.173**	.004
Interaction: self-organization and learning capacity	.128*	.034
Interaction: among all dimensions	.129*	.032
Certification*)	.231**	.000
Collaboration 1 (middleman as control)*)	-.232**	.000
Collaboration 2 (company as control) *)	.102	.091
Management 1 (independent as control) *)	.035	.565
Management 2 (one-roof as control) *)	-.030	.616
Interaction: certification and buffer capacity	.251**	.000
Interaction: certification and self-organization	.233**	.000
Interaction: certification and learning capacity	.240**	.000
Interaction: management (one-roof as control) and buffer capacity	-.027	.657
Interaction: management (one-roof as control) and self-organization	-.021	.725
Interaction: management (one-roof as control) and learning capacity	-.036	.552
Interaction: collaboration (middlemen as control) and buffer capacity	-.194**	.001
Interaction: collaboration (middlemen as control) and self-organization	-.194**	.001
Interaction: collaboration (middlemen as control) and learning capacity	-.174**	.004

**. Significant level = .05*
*** Significant level = .01*

Appendix 3 - T-test: mean difference dimension of farmer resilience based on participation in certification scheme

a. Buffer capacity

	CERTIFICATION	N	MEAN	SIG-2 TAILED	MEAN DIFFERENCE
Buffer capacity	certified	105	41.5810	.000**	7.01625
	uncertified	170	34.5647		

b. Self-organization

	CERTIFICATION	N	MEAN	SIG 2-TAILED	MEAN DIFFERENCE
Self organization	certified	105	17.8857	.172	.49748
	uncertified	170	17.3882		

c. Learning capacity

	CERTIFICATION	N	MEAN	SIG. (2-TAILED)	MEAN DIFFERENCE
Learning capacity	certified	105	16.6857	.000**	3.780
	uncertified	170	12.9059		

Appendix 4 - Analysis of Variance (ANOVA) test: mean difference of farmer resilience based on plantation management

Mean difference (H-V)	Independent	NES/KKPA self-management	One roof
Independent		.0513 (.796)	.1133 (.586)
NES/KKPA self-management			.586 (.859)
One roof			
			F=.608, Sig.=.545

P-value is in the bracket
**The mean difference is significant at the .05 level*

Appendix 5 - Analysis of Variance (ANOVA) test: mean difference of farmer resilience based on partner that smallholders collaborate with

MEAN DIFFERENCE (H-V)	MIDDLEMEN	COMPANY	NGO
Middlemen		-.3015* (.008)	-.3995* (.005)
Company			-.0980 (.587)
NGO			
			F=6.360, Sig. = .002

P-value is in the bracket
**The mean difference is significant at the .05 level*

Appendix 6 - ANOVA test: mean difference of dimensions of farmer resilience based on collaboration

a. Buffer capacity

MEAN DIFFERENCE (H-V)	MIDDLEMEN	COMPANY	NGO
Middlemen		-3.042*(.006)	-.807 (.795)
Company			3.849* (.000)
NGO			
			F=10.523, Sig. = .000

P-value is in the bracket
**The mean difference is significant at the .05 level*

b. Self-organization

MEAN DIFFERENCE (H-V)	MIDDLEMEN	COMPANY	NGO
Middlemen		2.253* (.000)	-1.180* (.007)
Company			-3.433* (.000)
NGO			
			F=24.502, Sig. = .000

P-value is in the bracket
**The mean difference is significant at the .05 level*

c. Learning capacity

MEAN DIFFERENCE (H-V)	MIDDLEMEN	COMPANY	NGO
Middlemen		-3.443* (.000)	-2.765* (.001)
Company			.677 (.506)
NGO			
			F=15.727, Sig. = .000

P-value is in the bracket

** The mean difference is significant at the .05 level*