On The Profitability of Sustainability Certification: An Analysis among Indonesian Palm Oil Smallholders

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Abstract
This paper analyses the profitability of palm oil certification through the use of a financial Cost-Benefit Analysis (CBA) and the assessment of Net Present Value (NPV). Better understanding the investment value of certification adoption can be used by policy makers or certification providers to bring in more smallholders and to make certification more beneficial for the generally vulnerable smallholders. The results indicate that certification is currently profitable for different types of Indonesian palm oil smallholders. The extent to which certification is profitable depends on the smallholder's pre-conditions. In the self-funded scenario, certification is not profitable for scheme smallholders and only remains profitable for independent smallholders when they continue to receive premium prices. If premium prices are however removed the independent smallholders may need unrealistically high premium fees for certification to remain profitable in this scenario. Next to certification, we found that the organization of farmers around miller companies contributes positively to profit, even before certification takes place. Therefore investing in organization may be an effective form of government involvement.
Keywords: Profitability; palm oil; Indonesian smallholders; sustainability certification; RSPO

1. Introduction

If we consider monetary returns in relation to investments, oil palm is one of the most attractive commodities for smallholders, also compared to crops like cassava, rice, and rubber (Brandi et al., 2015; Subervie & Vagneron, 2013). Although the expansion rate of oil palm plantations in Indonesia is slowly decreasing from 11% in 2009 to 7% in 2013 (Statistik_Indonesia, 2014), the total land area of oil palm plantations owned by smallholders in Indonesia still increases every year. Oil palm plantations contribute positively to the economic situation of smallholders by reducing unemployment and poverty, particularly in rural areas (Allen Blackman & Guerrero, 2012; McCarthy, Gillespie, & Zen, 2012; WorldGrowth, 2011; WWF, 2013). Notwithstanding these positive effects, the expansion of palm oil plantations is not undebated as many studies also discovered negative effects of oil palm plantations on the environment and social position of smallholders (McCarthy et al., 2012). More specifically, palm oil expansion is said to contribute to deforestation, greenhouse gas emissions, and land conflicts (Fitzherbert et al., 2008; Obidzinski, Andriani, Komarudin, & Andrianto, 2012).

Increasing awareness of international buyers about sustainability problems related to the production of agricultural commodities has led to the emergence of private sustainability certification standards (Basu, Chau, & Grote, 2004; Jena, Chichaibelu, Stellmacher, & Grote, 2012), such as the Roundtable on Sustainable Palm Oil (RSPO). These standards can be seen as new governance models (Glasbergen, 2013) and alternative steering instruments for governmental regulation to overcome the downside effects of agricultural production (Oosterveer, Adjei, Vellema, & Slingerland, 2014).

The RSPO, as one of the most important organisations for sustainability certification (Offermans & Glasbergen, 2015), was established in 2004 (Preusser, 2015) and initially targeted large-scale producers (Schouten & Glasbergen, 2011; Silva-Castañeda, 2012). However, 42% of the Indonesian palm oil producers are smallholders who together own 4.42 million ha of oil palm plantations (Statistik_Indonesia, 2014). Although palm oil certification has a potentially positive effect on smallholder's livelihoods, certification does not improve smallholders' vulnerable position or market access (Hidayat, Glasbergen, & Offermans, 2015). There are two types of oil palm smallholders in Indonesia (Brandi et al., 2013): the scheme smallholders, who are tied to a palm oil company through formal partnerships that also provide the farmers with technical assistance, and the independent smallholders, who operate independently and without assistance from palm oil companies. Although both groups are differently institutionalized, they face comparable challenges to enroll in certification (Brandi et al., 2013), which puts them in a marginalized position from the sustainable palm oil market (Asfaw, Mithöfer, & Waibel, 2010; Pichler, 2013). These challenges include the lack of capacity and knowledge regarding compliance to the standards, the lack of organization and incentives to become involved, and high

certification cost (Brandi et al., 2015). Therefore, even though the establishment of the RSPO took place more than a decade ago already, only 3.8% of the total Indonesian smallholders are certified (Estimated value).

Acknowledging the importance of smallholders in the oil palm production, the RSPO developed many sub-programs intended to bring in more smallholders in the certification. Examples are the Smallholder Task Force (STF) and the RSPO Smallholders Support Fund (RSSF) (Pesqueira & Glasbergen, 2013). Furthermore, the Indonesian Sustainable Palm Oil (ISPO) sustainability standard that was developed by the Indonesian Government, is now mandatory for large-scale companies, and will become mandatory for smallholders in 2022 (for more information see Hospes, 2014; Hospes & Kentin, 2012; Schouten & Bitzer, 2015).

Earlier research shows that financial benefits are the main motivation of smallholders to participate in sustainability certification (Hidayat et al., 2015). So far, it however remains unclear whether the new practices that go together with palm oil certification, present better profit. We argue that, for smallholders, certification adoption may be seen as an investment project that should offer tangible financial benefits in order to consider participation in it. Next, it is not only the present profitability of palm oil certification that remains unclear, but also the potential future profitability. The latter is particularly uncertain because certified smallholders are currently dependent on companies or NGOs to pay the certification costs (Bitzer, Glasbergen, & Arts, 2013; Hidayat et al., 2015), and to provide the farmers with a premium fee. Both forms of support can however not be guaranteed into the future, and changes may result in consequences for smallholder's profit, making certification adoption less attractive.

To this end, this study analyses whether or not certification is profitable for Indonesian palm oil smallholders. We defined two research questions: (1) to what extent and in what way is sustainability certification profitable for Indonesian palm oil smallholders? (2) Following from the fact that certification costs are currently paid by the affiliated miller companies or donors we question: Is certification still profitable for Indonesian palm oil smallholders if they had to pay all certification costs themselves? If not, how much premium fee would then be necessary to make certification profitable for the smallholders?

A way to analyse the profitability of palm oil certification is to use cost-benefit analysis. This analysis assesses the profitability of an investment project or program (Campbell & Brown, 2003) as an aid for decision making (Zerbe & Dively, 1994). It provides information on whether or not a particular project is worthwhile (Campbell & Brown, 2003; Prest & Turvey, 1965) given present resources and expected future outputs and by comparing costs and benefits in the case of project adoption and in the case wherein the project will not be adopted, or will be adopted in a different way. This approach helps to better understand the investment value of certification adoption. This information, on its turn, can be used by policy makers or certification providers to bring in more smallholders and to make certification more beneficial for the generally vulnerable smallholders.

First we present information from previous studies on profitability of certification adoption (section 2), that results in our conceptual framework to assess profitability of the sustainability certification, which is presented in section 3. Sections four and five introduce the research methods, study sites and characteristics of the smallholder respondents. Our findings are presented in section six to eight, before turning to the conclusion in section nine.

2. Literature Review

There are several studies on the economic effects of certification. Most of them however focus on the effects of certification on gross income. For example, Méndez et al. (2010) who indicate positive effects of certification on gross income, or Ruben and Zuniga (2011) and Ruben and Fort (2012) who use a so-called Propensity Matching Score to compare differences in gross income between certified and uncertified farmers. Other impact studies compare differences between certified and uncertified farmers by looking at the revenues (e.g. incomes) minus the costs of production. Some authors refer to this as profit (Blackmore & Keeley, 2012; Valkila, 2009), others as net income (Christopher M. Bacon, Ernesto Méndez, Gómez, Stuart, & Flores, 2008; Jena et al., 2012), or gross margin (Bachmann, 2012; Beuchelt & Zeller, 2011). Although these studies use the same concept, they show conflicting results. Bachmann (2012), C. M. Bacon (2010), A. Blackman and Rivera (2011), and Blackmore and Keeley (2012) for example, conclude that certification contributes to higher profits for farmers. Christopher M. Bacon et al. (2008), Beuchelt and Zeller (2011), Valkila (2009), however, argued that the economic effect of certification is not clear and dependent on the type of certification, the price of uncertified commodities and the existence and size of a price premium. Jena et al. (2012) in their study about the profitability of coffee certification even reveal a negative contribution of certification to net income. The above presented studies share one important limitation as they only focus on production costs and therewith neglect the costs of certification in their calculations. Therefore these studies can be expected to present an incomplete understanding of the effects of certification on profitability.

Studying the profitability of sustainability certification while including the costs of certification is not entirely new, but results from existing studies often conflict. Some studies pointed out that certification adoption is profitable for farmers (Nuva, Yusif, Hidayat, & Hanna, 2013; WWF, 2012), while other studies revealed that

certification adoption is not profitable (Beall, 2012; Simula, Antana, Ishmael, Santana, & Schidt, 2004; Wangrakdiskul & Yodpijit, 2013) or only reaches a break-even position (Victor, Gockowski, Agyeman, & Dziwornu, 2010). To calculate the size of benefits and costs, some studies (Nuva et al., 2013; Simula et al., 2004; Wangrakdiskul & Yodpijit, 2013) use Net Present Values (NPV), which refer to the discounted value of the returns minus the discounted value of the costs of investment projects (Campbell & Brown, 2003). Others (Beall, 2012; WWF, 2012), use numbers for input, yield and price to calculate benefits, and some (Beall, 2012; Victor et al., 2010) conduct scenario studies.

Nuva et al. (2013) conducted a cost-benefit analysis to assess the profitability of Eco-labelling for Indonesian coffee smallholders, concluding that certified plantations generated a higher NPV than non-certified plantations. Victor et al. (2010) explored the future profitability of Rainforest Alliance certified Cocoa in Ghana. They developed several scenarios for the use of inputs, farm gate prices and yields, and different parameters for technology advancements and the use of shade trees. Their results show that Rainforest Alliance certification may only reach a break-even point. Simula et al. (2004) also investigated the profitability of forest certification for Brazilian, Indonesian and Malaysian companies, showing different profitability results depending on the location and the initial performance of the adopters. The implementation of forest certification is profitable for companies in Malaysia and Indonesia, while it is not financially feasible in Brazil due to the high investment costs.

Regarding profitability of palm oil certification, WWF (2012) investigated the financial costs and benefits of RSPO compliance in Indonesia and Malaysia. They studied ranges for costs and benefits and did not use an aggregate measurement (such as NPV, IRR and ROI) and solely looked at certification costs and benefits without comparing these with costs and benefits of non-certified farmers. They conclude that the annual certification costs range from $1.19 to $34.66 per smallholder per hectare and that the annual benefit equals 9.4 to 26.9 MT yield improvement (WWF, 2012). They indicate that certification adoption is profitable as the benefits generally outweigh the costs of implementation.

Beall (2012) also used the concept of profitability to measure monetary effects of palm oil certification on smallholders in Thailand. Beall (2012) simply subtracted the average costs of certification from the average income (per hectare/year) in one specific year. However, she neglected investment costs and possible long-term benefits, such as the effects of yield improvement. She did however consider different scenarios for premium fee, yields and fertilizer costs in her analysis. The study points out that certification is only financially viable if smallholders receive a premium fee higher than US$ 13.34/ton crude palm oil (CPO), if certification increase yields, and if fertilizer costs decrease.

Where Beall (2012) analysed the profitability of certification in one random year, Wangrakdiskul and Yodpijit (2013) performed a cost-benefit analysis of RSPO certification for Thai smallholders based on 5 years. Wangrakdiskul and Yodpijit (2013) conclude that the prevailing premium fee of $15/ ton CPO is not enough to make RSPO certification a profitable project for farmers. The standard may however become profitable if training costs and certification costs decrease by 30% and if the premium price increases by 20%.

These limited numbers of studies about the profitability of oil palm certification have some limitations. First, none of these studies assess the profitability of non-certified palm oil smallholders. This is however crucially important as smallholders will only consider certification adoption if it results in higher net profits compared to their profit as non-certified smallholder. Second, only parts of the certification costs are included in their analyses. Previous studies, for example, do not include investment costs, such as the cost for capacity development, membership fees, the establishment of waste management systems, and safety tools into their calculations. Therefore, it is not unlikely that the results of these studies give a too positive impression of the profitability of certification. Third, previous studies only assess the profitability of palm oil certification for one year net return (Beall, 2012), or for one certification project life cycle (5 years, see Wangrakdiskul & Yodpijit, 2013). Average oil palm plantations however, have a long lifespan of about 25 years (Pahan, 2008). Zooming in on a specific period of the plantation neglects variations in productivity resulting from the age of the oil palms. This may lead to misleading conclusions, e.g. too low if the plantation under analysis is very young or too high if the plantation is in its most productive stage. Considering these limitations, we identify the need for a cost-benefit analysis to assess the profitability of palm oil certification for smallholders' by comparing certified and non-certified farmers, considering the investment costs and the entire oil palm plantation lifecycle.

3. Conceptual Framework

Profitability is commonly defined as the ability of an investment project to earn a return from its use (Howard & Upton, 1953) and generally implies that benefits are, or income is, higher than the costs. Following earlier research revealing financial benefits as the most important motivation for smallholders to participate in certification (Hidayat et al., 2015; Ibnu, Glasbergen, Offermans, & Arifin, 2015; Ibnu, Offermans, Glasbergen, & Hismono, forthcoming), we have an additional requirement to speak of profitability as certified smallholders need to earn more profit than non-certified smallholders. To decompose all costs and benefits of palm oil

certification we developed a conceptual framework (see Figure 1), which adopts four starting points:

First, the profitability of certified and non-certified oil palm plantations depends on: (1) investment costs, such as the cost of establishing the plantation and purchasing agricultural equipment, (2) operating costs, like the costs for fertilizer and labour, and (3) benefits resulting from the revenues of selling Fresh Fruit Bunch (FFB). Certified farmers have additional costs related to certification, but also additional benefits in the form of a premium fee (resulting from the certificate) and, for the certified independent smallholders, a premium price (resulting from higher quality FFB).

Second, we assume that profitability may be influenced by governmental policies or programs such as fertilizer subsidies, and relationships between farmers and market chains, for example in the form of contract farming (Simmons, Winters, & Patrick, 2005) or, specifically for Indonesia, Nucleus Estate Smallholder schemes (NES).

Third, we also assume that social economic characteristics, such as relatively high education, long experience, good access to agricultural extension programs, tenancy, and the presence of non-farm income may contribute to smallholder's profit (Rahman, 2003).

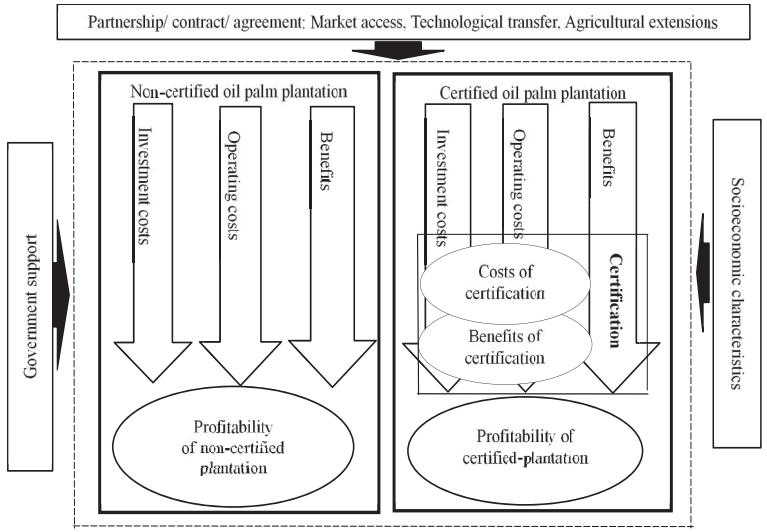
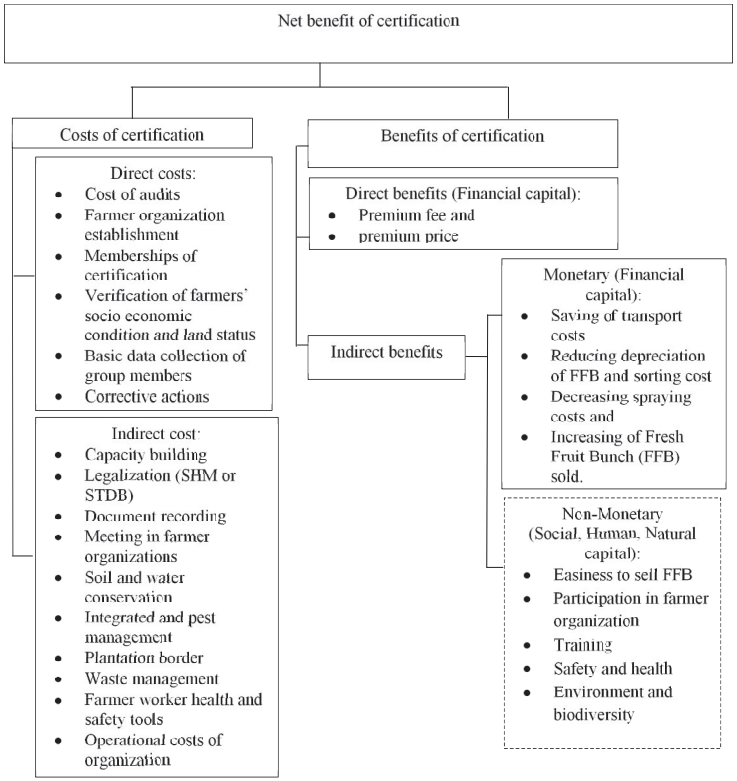


Figure 1. Conceptual framework to assess profitability of certification adoption

Fourth, following Simula et al. (2004), we distinguish between direct costs and benefits and indirect costs and benefits of certification (see Figure 2). The direct costs refer to all costs associated with the certification process, such as the auditing costs and costs to prepare for the certification process. Indirect costs result from activities that are required as part of the certification, such as document recording, and the costs for soil and water conservation.

Direct benefits are monetary benefits directly resulting from certification (premium fee and premium price). The indirect benefits consist of monetary benefits (e.g. cost reductions resulting from economies of scale, higher revenues following better FFB quality, and reductions in FFB depreciation resulting from better harvesting practices and post harvesting treatments) and non-monetary benefits. The latter relate to human capital (for example, better knowledge), social capital (e.g. participation in farmer organizations) and natural capital (e.g. better environmental quality) (see Hidayat et al., 2015 for more information).



Source: adopted from Simula et al. (2004)

Figure 2. Monetary costs and benefits of the certification adoption

4. Research Methods

In order to assess the profitability of certification adoption, we interviewed five groups of smallholders: (1) certified scheme smallholders, (2) non-certified scheme smallholders, (3) certified independent smallholders, (4) non-certified independent smallholders and (5) prospective independent smallholders. Prospective smallholders are non-certified independent smallholders who are in the preparation phase to become certified. Although they do not comply to all standards yet, they can be considered to be organized around a miller company already, and therefore generally receive higher prices for their products compared to non-certified independent smallholders. The surveyed smallholder groups were selected using cluster sampling techniques. We interviewed 214 smallholders, 50 being drawn from each of the certified and noncertified groups (both scheme and independent) and 14 from the prospective smallholders. To guarantee data reliability we conducted interviews aimed at verification of the data with 7 informants: the head of a farmer association (N=1) and cooperative (N=1), plantation workers (N=2), experienced smallholders (N=2), and a Nucleus Company representative (N=1).

To analyse whether certified smallholders gain more profit than non-certified smallholders, we calculated and compared the Net Present Value (NPV) of all smallholder groups[1] through a two-step approach.

[1] Alternative methods to measure the profitability of certification exist, for example, modelling the same smallholders with and without certification based on data about what changes as a result of certification. Although also offering relevant results, it may neglect profit-related factors that only apply to one specific group of smallholders (independent, scheme or prospective). Therefore we decided to follow the approach as suggested in this article.

In the first step we calculated the present nominal values of costs and benefits based on interviews with farmers. In these interviews we asked the farmers about the quantity of their FFB production/ *kapling* = 2ha/ year, the latest price received for their FFB, and the latest input costs.

To estimate past and future costs and benefits, we asked the farmers to specify quantities of products used and sold in the past[1] and we approached quantities of products in the future by interviewing farmers and agronomist palm oil experts. These quantities are multiplied with current prices to specify past and future costs and benefits in cash flow.

Directly summing up these values to calculate the overall NPV of a plantation for its entire lifetime would neglect the influence of time preference. Therefore, in the second step we corrected all costs and benefits resulting from the first step- for time preference. We multiplied the numbers for costs and benefits that resulted from the first step by the compounded interest factor for the years in the past till the present time. We multiplied values in the future by the discount factor for the years between the current plantation's age and 25 years. The used formula of NPV equals:

$$NPV = \sum_{t=0}^{n} PVB_t - \sum_{t=0}^{n} PVC_t \quad (1)$$

$$NPV = (\sum_{t=0}^{z} PVB_t + \sum_{t=z}^{n} PVB_t) - (\sum_{t=0}^{z} PVC_t + \sum_{t=z}^{n} PVC_t) \quad (2)$$

$$NPV = \sum_{t=0}^{z} (PVB_t - PVC_t) + \sum_{t=z}^{n} (PVB_t - PVC_t) \quad (3)$$

Where,

PVB_t = Present value benefit year-t; where compounding[2] is used if 0≤t≤z (for the past, and discounting[3] is used if z≤t≤n (for the future)

PVC_t = Present value cost year-t; where compounding[4] is used if 0≤t≤z (for the past), and discounting[5] is used if z≤t≤n (for the future)

t = year-t

z = age of the plantation (representing the present point of time)

n = project life time (25 years, based on the economic life-time of oil palm trees)

r = real discount rate (5.58 %)[6]

Following our earlier mentioned interpretation of profitability we consider certification profitable if the NPV of certified farmers is higher than the NPV of non-certified farmers (see Figure 3). However, to be sure that differences in NPV can be attributed to certification, we included three control variables that are largely believed to influence profit in our analysis:

Socio-economic characteristics to control for the potential effects of education, experience and the receipt of governmental support on profits. These characteristics were included in a regression analysis7. We define the average of last year's monthly profit (B-C) as dependent variable whereas the independent variable of certification refers to the level of compliance with the certification standard (1=non-compliance/ uncertified, 2=in the process to certification, but not fully certified yet and 3=full compliance/ certified) (CERT). Subsequent independent variables include: government support (GOV_USED), education (EDU), experience (EXP), income from other activities than oil palm plantation (OTH_I), status of smallholders/scheme or independent smallholders (STATUS), ownership of other oil palm plantations (OTH_LAND), and productivity per kapling (PROD). The equation of the regression analysis equals:

INCOM_MON = f (CERT, GOV_USED, EDU, EXP, OTH_I, STATUS, OTH_LAND, PROD)

[2] $PV = PastValue * Compound\ interest\ factor$; where $Compound\ interest\ factor = (1+r)^{t-z}$ if z≤t≤n; FT = future value, PV=Present Value, t=year-t, z=age of plantation (in the year of observation), n=project life time of the plantation

[3] $PV = FV * Discount\ factor$; where $Discount\ factor = 1/(1+r)^{z-t}$ if 0≤t≤z; PastV = Past value, PV=Present Value, t=year-t, z=age of plantation (in the year of observation)

[4] See footnote 8

[5] See footnote 9

[6] We use real interest rates (real discount rate) because we also used constant or current prices to estimate past and future benefits and costs in step 1 (instead of nominal prices). The real interest rate is calculated by subtracting inflation rates from nominal interest rates: 12% (based on the average (nominal) commercial credit interest in Indonesia in 2014) - 6.42% (based on average of inflation rate in 2014) = 5.58%

[7] Although we see that it may be reasonable to include the age of a plantation as independent variable, it could not be done for this case, as we have already included the experience of farmers (in years) as an independent variable. The majority of farmers are under their first plantation cycle. Therefore, the plantation's age and the farmers' experience are –in almost all cases- similar. Including both would result in severe multicollinearity problems. The selection of variables results from the literature overview provided in section on the conceptual framework and relies on Rahman (2003); Simmons et al. (2005)

If the variable certification (CERT) significantly influences last year's monthly profit (B-C), we can conclude that certification explains variation in profitability.

Organization. To see whether differences in NPV mainly result from certification or from a better organizational structure in which the certified farmers are embedded, we included the NPV of prospective independent farmers (who are organized already, but not certified yet) in our analysis. We calculated the NPV values for this group and performed an independent T-test to statistically compare the differences in profit between the different smallholder groups.

Pre-condition before certification. Hidayat et al. (2015) observed that certified smallholders may have been better off in terms of productivity before they became certified compared to non-certified farmers. In a first step, we therefore used the independent T-test to compare the productivity of certified smallholders before and after certification adoption. If this test indeed reveals no significant differences between the productivity before and after certification adoption, we can conclude that the certified smallholders have been better off, and continue to control for the influence of productivity on profitability by defining the NPV of a so-called preliminary group. This group comprises certified smallholders that are treated as non-certified by leaving out all costs and benefits directly related to certification. In Figure 3, the criteria for profitability that are adopted in this study are summarized.

The second research question considers the profitability of certification in the case that smallholders have to pay the costs of certification themselves. Although external stakeholders, i.e. companies, NGOs, and other donors, currently pay certification costs for the farmers, the long-term continuation of this support is uncertain (Hidayat et al., 2015). This issue was addressed by complementing the NPV with a sensitivity analysis (Campbell & Brown, 2003, p. 195) in which we included certification costs and premiums as critical variables. We performed the sensitivity analysis under a so-called self-funded scenario, which is the scenario wherein certified smallholders pay all certification costs themselves (while maintaining the premium prices and fee). For the certified scheme smallholders we consider it likely that they will receive the premium fee themselves in the self-funded scenario; i.e. if they have to pay the costs themselves, they will also receive the benefits themselves. Other institutional arrangements between smallholders and their nucleus company do not change in the self-funded scenario. This implies that the nucleus company remains responsible for providing agricultural assistance (training), monitoring and paying the RSPO membership fee (as in the RSPO, the out-grower smallholders are part of the company and registered under the company's name). Compared to the procedure followed to answer the first research question, we included the certification costs in the calculation of the NPV for the certified farmers. Next, we also included the benefits from receiving premium fees in the calculation of the NPV of certified scheme smallholders.

	NPV non certified within the same category (a=scheme/	NPV prospective independent c	NPV without within the same category (d=scheme/ e=independent)
NPV certified scheme (A)	Profitability of certification for scheme smallholders (O) = (A-a)	NA	Profitability of certification for scheme smallholders corrected by all factors that might influence yield and profit such as age of plantation, agricultural practices used; only consider direct costs and benefits of certification (R) = (A-d)
NPV certified independent (B)	Profitability of certification for independent smallholders (P) = (B-b)	Profitability of certification for independent smallholders corrected by influence of organization on profit	Profitability of certification for independent smallholders corrected by all factors that might influence yield and profit such as age of plantation, agricultural practices used; only consider direct costs and benefits of certification (S) = (B-e)
The adoption of certification is profitable for the smallholders if O, P, Q, R and S are positive.			

Figure 3. Criteria for profitability: Certification is profitable if the certified NPVs are higher than the NPVs of the controlling groups (i.e. non-certified smallholders, prospective smallholders and preliminary smallholders (those who were better off already before joining certification))

If the results of the sensitivity analysis show that certification is not profitable under the self-funded condition, we employ a switching value analysis to determine the size of a minimum premium fee to make certification profitable. To also consider uncertainties regarding the provision of premium prices, that heavily

depend on company policies, we calculate the size of the premium fee in two situations: (1) premium prices are available and (2) premium prices are not available. Premium prices are paid per ton CPO or Palm Kernel Oil (PKO). Based on interviews with employees from the nucleus companies and heads of independent smallholder associations we equal 1 ton of the scheme smallholders' FFB to 21% CPO and 5% PKO, and 1 ton of the independent smallholders' FFB to 19.4% CPO and 2% PKO.

5. Study Sites and Characteristics of the Smallholder Respondents

If the results of the sensitivity analysis show that certification is not profitable under the self-funded condition, we employ a switching value analysis to determine the size of a minimum premium fee to make certification profitable. To also consider uncertainties regarding the provision of premium prices, that heavily depend on company policies, we calculate the size of the premium fee in two situations: (1) premium prices are available and (2) premium prices are not available. Premium prices are paid per ton CPO or Palm Kernel Oil (PKO). Based on interviews with employees from the nucleus companies and heads of independent smallholder associations we equal 1 ton of the scheme smallholders' FFB to 21% CPO and 5% PKO, and 1 ton of the independent smallholders' FFB to 19.4% CPO and 2% PKO.

This study was conducted in two important oil palm producer regions in Indonesia, i.e. Riau and South Sumatra. These study sites were purposely selected as the first certified independent smallholders and the first certified scheme smallholders reside in Riau and South Sumatera respectively. The non-certified and certified smallholders were selected within the same district and therefore located in vicinity of each other. Almost all scheme smallholders and certified independent smallholders are Javanese ex-transmigrants, while the non-certified independent smallholders consisted of Javanese migrants and locals (Melayunese and Bataknese).

Most smallholders are between 41 and 60 years old and have more than 15 years' experience in managing oil palm plantations; 89% of the respondents are men and most smallholders have had a low education. For 96% of the smallholders, palm oil encompasses their main source of income. The average land area owned by the certified scheme smallholders equals 3.90 hectare (ha) and does not differ substantially for the non-certified scheme, certified independent, and non-certified independent smallholders, as their land ownership covers 3.21 ha, 3.87 ha and 3.82 ha respectively. The prospective smallholders own, however, relatively smaller plots: 2.21 ha on average. Approximately 33% of the smallholders own both independent plantations and scheme plantations, while 42% of the respondents solely own independent plantations and 25% only scheme plantations. The smallholders who own both types of plantation are treated either as independent or scheme smallholder, based on the status of their farmer organization.

All plantations covered by this research are matured, although the average age of the plantations differs between the smallholder groups. The scheme smallholder's plantations are relatively old (22 years in the case of the certified scheme smallholders, and 25 years for non-certified scheme smallholders), which implies that their productivity will steadily decrease. The plantations of the independent smallholders are younger: 15 years on average in the case of the certified independent smallholders and 13 year for the non-certified smallholders. This means that these plantations are currently on, or just before, the top of their productivity. As we consider and calculate the profitability of the entire palm oil plantation life-span (t=25, see section 4 on research methods) these differences in the plantations' age will be considered in our study and therefore not bias our results.

6. Profitability of Palm Oil Certification under Actual Conditions

Our profitability analysis suggests that oil palm certification is currently profitable for scheme and independent smallholders. The NPV of certified scheme smallholders is 35% or $48,919.72 higher than the NPV of the non-certified scheme smallholders. For independent smallholders, certification is even more profitable as the NPV of certified independent smallholders is 89% or $39,279.38 higher than for the non-certified independent smallholders (Table 1). Although the certified scheme smallholders can be considered the most profitable palm oil farmer group, the independent smallholders relatively gain most when they become certified (e.g. a 89% increase in profit).

Table 1. Net Present Values of smallholders' oil palm plantations

No.	Type of smallholder	Certification	NPV ($)
1	Scheme	Certified	187,854.23
2	Scheme	Non-certified	138,934.52
3	Independent	Certified	83,603.19
4	Independent	Non-certified	44,323.81
5	Independent	Prospective non-certified	62,368.45

The certified scheme smallholders have a higher NPV than the non-certified scheme smallholders because they have higher benefits (32%) and lower operating costs (9%) (See Table 2 and Table 3). The higher benefits result from higher productivity, and following from this, higher FFB sales. The productivity of the certified scheme smallholders reaches on average 25 ton/year/ha, whereas the non-certified scheme smallholders

produce around 19 ton/year/ha. The certified scheme smallholder's premium fee is received and managed by the farmer organizations that also pay the certification costs. In terms of operating and investment costs, the certified scheme smallholders pay relatively lower costs than the non-certified scheme smallholders (see Table 3). This results from the lower costs for the plantation's establishment and lower costs for spraying. The latter can be explained by referring to their centralized plantation management system that allows benefiting from purchasing large quantities for lower prices and changing agricultural practices that require less chemical usage.

Table 2. Benefits of the oil palm smallholders, average value per year[1,2]

Smallholder group	FFB selling ($/year/kapling)	Premium price ($/year)	Premium fee ($/year)	Total benefit
Certified scheme	6,492.39	-	-	6,492.39
Non-certified scheme	4,900.45	-	-	4,900.45
Certified independent	4,950.64	197.14*)	60.00*)	5,207.78
Non-certified independent	3,037.33	-	-	3,037.33
Prospective independent	4,280.38	177.02*)	-	4,457.40

*Note:**) The average is counted by considering the period in which the smallholders have adopted the certification: for the scheme smallholders this equals 6 years and for the independent smallholders 13 years.

The difference between the NPV of the certified and non-certified independent smallholders' results from higher benefits, and not from lower costs as was the case for the scheme smallholders. A higher productivity, resulting from changing practices, again explains why certified independent smallholders have higher benefits than the non-certified independent smallholders. (On average, the productivity of the non-certified smallholders equals 12 ton/year/ha, compared to 15 ton/year/ha for the prospective smallholders and 17 ton/year/ha for the certified independent smallholders). Moreover, a stronger organization opens opportunities for the certified independent smallholders to bypass middlemen through directly selling their FFB to a Miller Company. This results in higher selling prices that lie around $17 (per ton FFB) higher than the prices for FFB received by the non-certified smallholders. Additionally, the certified independent smallholders receive a premium price of about $5/ton FFB (average premium price of the last year) or $197.14/year/*kapling* from the Affiliated Miller Company. The sale of Green Palm certificates (i.e. premium fees) offers another $60.00/year/*kapling* to the certified independent smallholders. The prospective independent smallholders do not receive premium fees from the Green Palm certificate sales yet, but they do benefit from higher FFB prices as they are already affiliated to a miller company (see Table 2).

Table 3. Costs for Indonesian oil palm smallholders, average value per year[3]

Costs structure	Certified scheme	Non-certified scheme	Certified independent	Non-certified independent	Prospective independent
Investment costs	**351.27**	**389.37**	**388.85**	**293.26**	**271.47**
Land	-	-	226.04	197.10	164.03
Agricultural Equipment	74.78	79.18	85.64	51.96	51.96
Plantation establishment	276.49	290.53	47.37	32.88	39.10
Land clearing	-	-	22.02	9.68	9.94
Rehabilitation of Plantation	-	7.93	-	-	-
FFB collecting place	-	11.73	7.78	1.63	6.44
Contribution of farmers to association /costs of certification	**-**	**-**	**30.75**	**-**	**31.78**
Operating costs	**1,390.34**	**1,529.85**	**1,439.04**	**1,020.78**	**1,341.39**
Plantation maintenance	-	-	-	-	-
Spraying	76.12	176.51	102.45	138.46	158.54
Irrigation and *tapak kuda*[4] maintenance	7.97	22.62	5.26	39.75	-
Fertilizer application	442.14	469.04	744.05	629.38	665.94
Pruning	88.66	103.01	73.24	70.14	36.42
Management Fee	16.08	112.49	80.68	-	71.11
Road maintenance	45.77	16.08	54.80	-	77.74
Harvesting	385.85	358.59	192.59	143.05	125.93
Weighing	-	59.99	40.34	-	35.56
Transportation costs	327.76	211.52	145.63	-	170.16

The cost structure also differs between scheme and independent certified farmers (see Table 3).

[1] The average is counted by considering the period in which the smallholders have adopted the certification: for the scheme smallholders this equals 6 years and for the independent smallholders 13 years.
[2] Standard deviation: overall=28%; certified scheme=14%; non-certified scheme=20%; certified independent=17%; prospective independent=29%; non-certified independent=34%
[3] Coefficient of variation (CV): overall=28%; certified scheme=11%; non-certified scheme=22%; certified independent=15%; prospective independent=24%; non-certified independent=42%. The CV for non-certified independent is relatively high due to variation in input use, as a consequence of differences in capital ownership. It further implies higher CV of profit gained by non-certified independent smallholders.
[4] *Tapak kuda* (horseshoe) is a technique of soil and water conservation in oil palm plantation which located on sloped areas (3◦-28◦)

Whereas the certification costs of the scheme smallholders are paid by the affiliated Miller Companies, the certified independent smallholders pay the certification costs themselves. The results furthermore indicate that certified independent smallholders have higher investment- and operating costs compared to their non-certified counterparts. This can be explained by the fact that non-certified independent smallholders generally have a lack of capital (Molenaar, Persch-Orth, Lord, & Harms, 2013), therefore, they often used low quality of seedlings, limited agricultural equipment e.g. manual weeding tools, no adequate safety tools, and they apply land clearance with slash and burning, which is commonly done by family labor. Moreover, non-certified independent smallholders are not organized, and therefore do not have to pay management fees. Next, although bypassing middlemen may result in higher FFB prices, it may also reduce income for the independent smallholders, as the middlemen pay for the post-harvesting expenses of non-certified independent smallholders (e.g. transportation costs). In addition, due to the lack of capital the non-certified independent (Molenaar et al., 2013), smallholders generally use lower amounts of fertilizers and commonly use family labour for pruning and harvesting, which further reduces their monetary costs. Only some operating costs (e.g. spraying and irrigation) are higher for the non-certified independent smallholders than for the certified independent smallholders as the former generally apply blanket spraying (or total spraying), which is banned by the RSPO, and involves higher costs. Irrigation costs only play a minor role in explaining differences in profit as it is only applicable to young plantations; maintenance is however applicable for the entire plantation life time.

7. Controlling the Relation between Certification and Profitability for Organization, Socio-Demographic Characteristics, Governmental Support and Pre-Conditions

Although the results in section 6 seem to indicate a positive relationship between certification and profit, we want to verify this relation through a regression analysis wherein we also include other variables (see the section 4, on research methods). First, the regression analysis (see Table 4) shows that certification significantly and positively contributes to smallholder's profit (P=0.001). Second, the inclusion of an organization variable in the profit analysis for the independent smallholders indicates that the organized (non-certified) independent smallholders obtain significantly more profit than the non-certified smallholders (P=0.011, see Table 5). The profit may further increase if the smallholders fully comply with the certification (P=0.013, see Table 5). Certification therefore seems to be an important vehicle to increase profit in the sense that it opens opportunities for better organization in relation to the Miller Companies, and for better access to training. Better organization ultimately leads to benefits in terms of higher FFB prices and improved productivity.

Table 4. The results of the regression analysis: we observe significant effects of certification, status and productivity on profit.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	-956.833	174.651		-5.479	0.000		
Certification[1]	113.19	33.034	0.08	3.426	0.001	0.624	1.603
Other income	-34.908	140.793	-0.005	-0.248	0.804	0.892	1.121
Other land outside current land	29.493	61.158	0.01	0.482	0.63	0.773	1.294
Experience	-6.773	3.93	-0.034	-1.724	0.086	0.845	1.184
Education	7.079	8.951	0.015	0.791	0.43	0.977	1.024
Productivity per kavling	126.738	3.326	0.899	38.107	0.000	0.607	1.647
Dummy Government support[2]	33.682	63.884	0.012	0.527	0.599	0.628	1.592
Status[3]	183.258	68.683	0.067	2.668	0.008	0.542	1.845
F-test=344.377; R2=0.931; Prob-F=0.000							

[1]The scores describe the level of compliance with the certification standard (1=non-compliance/ uncertified, 2=in the process to certification, but not fully certified yet and 3=full compliance/ certified)
[2] Dummy government support: 1=receive government support; 0=do not receive government support
[3] Status: 1=scheme smallholders; 0=independent smallholders

Table 5. The results of the T-test analysis for fertilizer expenses, productivity, price, and profit among smallholder groups

	certified vs non-certified Independent smallholders		Prospective vs certified independent smallholders		prospective vs non-certified independent smallholders		non-certified vs certified scheme smallholders	
	Sig. (2-tailed)	Mean Difference	Sig. (2-tailed)	Mean Difference	Sig. (2-tailed)	Mean Difference	Sig. (2-tailed)	Mean Difference
Fertilizers expenses ($)	0.002	194.6123	0.383	-57.7739	0.06	136.8384	0.281	-55.5086
Productivity (ton/kavling/year)	0.000	13.0732	0.003	-7.3866	0.055	5.6866	0.000	-6.89
Price ($/ton)	0.000	17.84	0.601	-0.14	0.000	17.7	0.866	0.167
Profit ($/kavling/year)	0.000	1799.282	0.013	-882.924	0.011	916.3584	0.000	-1223.4

Third, Table 4 shows that smallholders' profit is not influenced by governmental support and socio-economic variables such as education, experience, ownership of other plantations, or having alternative sources of income. Certification, status and pre-condition before certification productivity, however, significantly influence smallholder's profit. The significant and positive relation between certification and profit validates our argumentation in section 6. The significant effect of status refers to the fact that scheme smallholders (both certified and non-certified) gain significantly more profit than the independent smallholders. This can be explained by referring to the scheme smallholders' higher productivity, the higher prices for their FFB, and the technological support they receive from their NES Company. Further, Table 4 shows that productivity is the most important variable explaining variation in the smallholders' profit. The higher the productivity of the smallholders, the higher their profit.

Fourth, and following from the important role of productivity in explaining profit, we analysed the potential influence of pre-condition before certification productivity on profit. Table 6 indicates a significant difference in productivity before and after independent smallholders become certified. We can say that, for the independent smallholders, their productivity and therefore also their profit goes up as a result of certification. For the scheme smallholders, however, we could not identify significant differences in productivity before and after the adoption of certification. This result indicates that the certified scheme smallholders may have been better off already before they joined the certification.

Table 6. The result of T-test analysis of the certified smallholders before and after the certification adoption

	Scheme smallholders		Independent smallholders	
	t-test for Equality of Means		t-test for Equality of Means	
	t	Sig. (2-tailed)	t	Sig. (2-tailed)
Productivity	1.271	0.219	3.966	0.002
FFB sale*) (Revenues)	1.096	0.287	4.221	0.001

Note: *) It is analysed based on price in 2014

Figure 4 (last column) subsequently shows the effects of certification on NPV corrected for the fact that (scheme) smallholders were already better off in terms of productivity before they adopted certification (see previous paragraph). The results show that the certified scheme smallholders still increase their profit by adopting certification, although the additional profit is relatively low (0.06%).

	NPV non certified within the same category (a=scheme/ b=independent)	NPV prospective independent c	NPV without within the same category (d=scheme/ e=independent)
NPV certified scheme (A= $187,854.23)	(a= $138,934.52) Profitability of certification for scheme smallholders	NA	(d= $187,742.55) Profitability of certification for scheme smallholders corrected by all factors that might influence yield and profit such as age of plantation, agricultural practices used; only consider direct costs and benefits of certification
	(O)=(A-a)= $48,919.72		(R)=(A-d) = $111.68
NPV certified independent (B= $83,603.19)	(b=$44,323.81) Profitability of certification for independent smallholders	(c= $62,368.45) Profitability of certification for independent smallholders corrected by influence of organization on profit	(e= $81,320.65) Profitability of certification for independent smallholders corrected by all factors that might influence yield and profit such as age of plantation, agricultural practices used; only consider direct costs and benefits of certification
	(P) = (B-b)= $39,279.38	(Q)=(B-c)= $21,234.73	(S)=(B-e)= $2,282.54
The adoption of certification is profitable for the smallholders if O, P, Q, R and S are positive.			

Figure 4. Summary of profitability of the certification adoption under actual condition

Figure 4 shows that under the actual condition, where smallholders do not (fully) pay the costs of certification, certification adoption is profitable for all types of smallholders. Certified actors have a higher NPV than the uncertified actors. Although productivity and organization play a role in explaining differences in profit as well, certification still contributes positively to the smallholder's profit, also for well-organized non-certified smallholders with a relatively high productivity. To what extent the certification can be considered profitable depends on the initial performance of the smallholders as adopters e.g. productivity, and their status (scheme or independent).

8. On the Self-Funded Condition: Profitability of the Certification Adoption

Under the self-funded scenario, in which the smallholders pay all certification costs themselves, certification adoption will still be profitable for the independent smallholders, but not for the scheme smallholders who were already better off at the moment they become involved in certification (see Figure 5). The NPV of certified independent smallholders in this scenario is still much higher (e.i. 84%) than for the non-certified independent smallholders. The well-organized independent smallholders also still receive 31% higher profits (about $19,308.82 in terms of NPV) if they fully adopt certification. Scheme smallholders with a low initial productivity improve their profitability by 35% in the self-funded scenario. However, for the scheme smallholders who have been better off (e.i. who had a high initial productivity), certification will not be economically appealing if they have to pay all certification costs themselves. Even if they receive the present premium fees, certification adoption will not be profitable as the scheme smallholders' NPV decreases by 0.14% (equal to $259.65).

	NPV non certified within the same category (a=scheme/ b=independent)	NPV prospective independent c	NPV without within the same category (d=scheme/ e=independent)
NPV certified scheme (A= $ 187,482.91)	(a= $138,934.52) Profitability of certification for scheme smallholders	NA	(d= $187,742.55) Profitability of certification for scheme smallholders corrected by all factors that might influence yield and profit such as age of plantation, agricultural practices used; only consider direct costs and benefits of certification
	(O)=(A-a)=$ 48,584.39		(R)=(A-d) = $ (-259.65)
NPV certified independent (B= $ 81,677.28)	(b=$44,323.81) Profitability of certification for independent smallholders	(c= $62,368.45) Profitability of certification for independent smallholders corrected by influence of organization on profit	(e= $81,320.65) Profitability of certification for independent smallholders corrected by all factors that might influence yield and profit such as age of plantation, agricultural practices used; only consider direct costs and benefits of certification
	(P) = (B-b) =$37,353.47	(Q) = (B-c) = $19,308.82	(S) = (B-e) = $356.63
The adoption of certification is profitable for the smallholders if O, P, Q, R and S are positive.			

Figure 5. Profitability of certification adoption in the self-funded scenario

Table 7 further specifies the certification costs for scheme and independent smallholders in the self-funded scenario. These costs are much lower for the scheme smallholders (56%) than for the independent smallholders. This results from the fact that some costs are necessary to be paid by independent smallholders but not by the scheme smallholders (for example data verification costs, certification group establishment (Association), RSPO membership costs, compliance to legal aspects (Cultivation Registration Certificate/*Surat Tanda Daftar Budidaya*/STDB) and the operating costs of farmer associations). Moreover, due to the connectedness of scheme smallholders with their Nucleus Company, some certification costs, like the costs of training and internal audits, can be saved as they are taken up by the Nucleus Company.

Table 7. Annual costs of certification adoption in the self-funded scenario

Costs of the certification component	Certified scheme*) ($/year)	Certified independent*) ($/year)
Direct costs	**44.75**	**65.94**
Audit implementation	0.23	-
Capacity building and training	-	13.49
Data verification	-	0.22
External audit	44.35	37.03
Follow up audit	0.18	8.02
Internal audit	-	3.25
organization establishment	-	2.86
RSPO membership	-	1.07
Indirect costs	**56.07**	**164.82**
Document recording	36.00	5.89
Environmental and biodiversity standard compliance	6.24	2.60
Farmer organization meeting and for independent smallholders also incentive for ICS	8.10	130.92
Legal aspect compliance (STDB/ Cultivation Registration Certificate)	-	7.76
operational costs of organization	-	5.82
Social standard compliance	5.74	11.84
Total Costs of the certification per year	**100.83**	**230.76**

Note: *) The average is counted by considering the period in which the smallholders have adopted the certification: for the scheme smallholders this equals 6 years and for the independent smallholders 13 years.

In the scenario we assume that not the farmer groups, but the smallholders receive the premium fees and prices (see section 4). This implies that the certified scheme smallholders receive a premium fee in the worth of $37.35/ year, while the certified independent smallholders maintain their $197.14/year premium price and $60.00/year premium fee (Table 8).

Table 8. Benefits of certification in the self-funded scenario

Smallholder group	Premium price ($/year)	Premium fee ($/year)
Certified scheme	-	37.35*)
Certified independent	197.14*)	60.00*)

Note: *) The average is counted by considering the period in which the smallholders have adopted the certification: for the scheme smallholders this equals 6 years and for the independent smallholders 13 years.

To transform certification into a profitable investment project for the scheme smallholders in the self-funded scenario, a minimum premium fee of $8.6/ton CPO, which is roughly twice as much as the fee that is currently received by the scheme smallholders' organization ($4/ton CPO), is necessary. The minimum premium fee decreases if the scheme smallholders adopt certification from the beginning of the plantation period, as this may allow costs to be distributed over a longer period. In the case of early adoption, a minimum premium fee of $8.5/ton CPO is necessary to maintain the same profitability compared to the pre-condition before certification (break-even point). As this is still a significantly higher amount compared to the current fees, it is questionable whether certification will be profitable for scheme smallholders in the self-funded scenario.

In the long-term, the receipt of a premium price is uncertain as it relies on the policies of affiliated companies to provide an incentive for independent smallholders of being certified and applying the best management practices. If the independent smallholders do not receive premium prices anymore, but nonetheless pay all certification costs themselves, certification adoption is no longer profitable for them: the NPV will go down by 5%. In this case, the independent smallholders need to receive a minimum of $29.7/ ton CPO to reach the break-even point. Considering the rate of the actual premium fee for independent smallholders, which reaches $15/ton (Wangrakdiskul & Yodpijit, 2013), the sustainability certification may only be profitable for independent smallholders if they receive a premium fee that is 93% higher than the actual premium fee. However, this seems to be an unrealistic situation, particularly as the supply of Crude Sustainable Palm Oil (CSPO) is already much higher than the demand, leading to an oversupply of 55%1. Given this oversupply, it is unlikely that premium fees will increase dramatically. Therefore, certification will likely not be profitable for independent smallholders in the self-funded scenario wherein premium prices will be cut.

[1] CSPO production in 2014= 11,909,121 tonnes; CSPO uptake in 2014= 5,349,666 tonnes (http://www.rspo.org/about/impacts)

9. Beyond Direct Monetary Benefits

Next to monetary benefits, certification contributed positively to non-monetary aspects. These aspects include ease of selling FFB, participation in farmer organizations, access to knowledge and training, better safety and health, environmental conservation and biodiversity.

After joining the RSPO, the independent smallholders perceive better access to a miller company, which made it easier to sell their FFB. However, for scheme smallholders, certification does not contribute to better market access, because they are already contractually bound to a miller company from the moment they join the Nucleus Estate Smallholder (NES) scheme.

Both independent smallholders and scheme smallholders argue that certification enhances the exchange of knowledge and participation of smallholders in farmer organizations. Farmer organization meetings are attended more frequently by certified scheme smallholders compared to non-certified scheme smallholders. Similarly, the participation of certified independent smallholders in farmer organizations increases after they become certified. Through these regular meetings, members have the opportunity to become informed about activities undertaken by the farmer organization, which contributes to transparency and accountability, and about recent developments in, or affecting, the palm oil sector.

Further, certification is believed to improve the safety and health of farmers, both for the independent and scheme smallholders. The farmers are, for example, required to use safety tools and instructed on how to use safer equipment. The health condition of the farmers is checked regularly and health care expenses are covered by cooperatives or associations. The latter does not only lead to better health, but also to lower expenses (around $11.67 - $ 158.13 for medical expenses and $26 - $120 regarding the redundancy of an income-free recovery period after accidents that may occur without certification).

Certification also creates awareness about the importance of environmental conservation (Brandi et al., 2013). Certified farmers arrange the palm oil midrib in the plantation in a specific way, planting Bamboo or other trees along the river and do not apply chemical substances along the river side to reduce erosion and pollution of waterways. Almost all certified scheme and independent smallholders apply soil and water conservation techniques, which they evaluate as a positive effect of certification.

Protecting biodiversity is one important objective of the RSPO and was –among other causes- threatened by illegal hunting practices. However, we found that most smallholders, also those who are not certified (yet), do not hunt protected animals. The smallholders prefer to use natural predators to get rid of unwanted species, but, in alignment with Brandi et al. (2013), we found that certification increases knowledge about integrated pest management (IPM). Therefore, besides leaving useful animals, such as mice-eating snakes, in their plantation, certified scheme- and independent smallholders tend to plant *Turnera ulmifolia* (yellow alder) as a habitat for natural predators consuming bagworms (moths damaging oil palm trees), and build owl nests as a natural way to contribute to eradicating pests. The protection of biodiversity implies that the smallholders use less chemicals in their plantation. It, therefore, contributes to a better health and prevents soil degradation ultimately contributing to sustained long-term income.

10. Conclusion

This paper contributes to our understanding of the profitability of palm oil certification for Indonesian smallholders and to methodological and conceptual advancements in the academic field of sustainability certification. Our conceptualization of certification as a profitable investment project is rather novel as it not only considers the profit resulting from certification, but also compares this profit to the profit of non-certified actors. Smallholders will only consider certification adoption if they can increase their profit compared to their current, non-certified situation. Methodologically we presented a procedure to include a more realistic range of costs and benefits for both certified and non-certified farmers. By doing so we also considered direct and indirect costs and benefits of certification, as well as the entire lifespan of a plantation. Neglecting the entire lifespan may lead to misleading conclusions as a plantation's productivity, and therefore profit, strongly depends on its age. Next, some costs that mainly apply to young plantations (e.g. irrigation), may be neglected if the analysis only considers matured plantations. Given these novelties, this research can be considered to offer a clearer and more nuanced picture of the profitability of sustainability certification.

Under the actual condition, in which the smallholders do not pay the certification costs, certification adoption is profitable for all different types of smallholders (scheme smallholders and independent smallholders). To what extent the adoption is profitable depends on the smallholder's conditions before they adopt the certification. In the self-funded scenario wherein smallholders pay all certification costs themselves, certification remains profitable for smallholders except for scheme smallholders who were already better off before certification. Certification might still be profitable for them if they would receive $8.6/ton CPO. However, as this amount is twice as much as what is currently received by their organization, we doubt whether certification will ever be profitable for these smallholders in the self-funded scenario. For independent smallholders, premium prices turned out to be crucial to speak of certification as a profitable investment project

in the self-funded scenario. A collapse of premium prices implies that the independent smallholders would need $29.7/ ton CPO premium fee to reach a breakeven position. This amount of fee is however twice as much as the current premium fee. Considering the current oversupply of sustainable palm oil (SPO), it seems that an 100% increase in premium fee is not realistic. Therefore, it is very unlikely that certification remains profitable for independent smallholders if they do not receive premium prices anymore in the self-funded scenario.

The practical relevance of this study is two-fold. First, it may support the RSPO's intention to bring in more smallholders. The results indicate that in the present situation, certification is financially profitable for all types of smallholders. Given the fact that financial considerations are among the most important drivers for smallholders to join certification, communication of the results may result in higher smallholder adoption rates and make smallholders decide to invest upfront costs with the prospect of higher profits. Although investment costs for independent smallholders can be substantially limited by making use of hand-tools and family labour, the time needed to develop a well running plantation will be relatively high. It may be good to smoothen the access of independent smallholders to credit. We have also seen that certification adoption is not only profitable for farmers with young plantations, but also for farmers with old plantations (20-25 years). This indicates that certification as an investment project already offers tangible benefits in the short term. What we have furthermore seen is that certification (although still being profitable) does not significantly contribute to a better productivity for the scheme smallholders. The explanation is that these smallholders were already better off in terms of productivity before they became involved in the certification process. The question why the certification process with its trainings and focus on Good Agricultural Practices (GAP) does not succeed to increase the productivity of this group of smallholders needs further investigation. Possibly, the plantation's age may play a role in this, or the level and intensity of trainings that are (sometimes) already provided to scheme smallholders by the affiliated companies.

Second, it may contribute to better targeting certification programs (privately e.g. RSPO and publicly e.g. ISPO) for the benefit of the smallholders. We furthermore found that the organization of farmers around a miller company significantly contributes to higher profits. Such an organization assures higher FFB prices, lower costs, and better opportunities to structurally sell FFB. In the current structure, however, it is impossible for independent smallholders to become organized around a miller company without being in the process towards certification. Certification in this scenario will still be profitable, but also implies a rather long and sometimes difficult process to comply with all formal requirements. Organization on the other hand, would be a faster less complicated process if it is focused around an agreement between farmer groups and a miller company. Investing in organization may therefore be an effective form of government involvement, especially as our results indicate that governmental provision of seeds and fertilizer does not contribute to farmer's profits. A further exploration of the ineffectiveness of current governmental programs to increase profits, and the potential role of the government in organizing farmers around miller companies, would be an interesting topic for further research. Furthermore, if certification will turn out to be a self-funded project, it is absolutely crucial that premium prices will be maintained. Otherwise, certified farmers will need unrealistically high amounts of premium fee, which most likely implies that certification adoption will no longer be profitable.

This study reveals the importance of relations between farmer organizations, certification and the ability of farmers to improve their profit. However, the exact interrelations between these components, as well as their effects (individually, but also holistically) on smallholder's livelihoods remain unclear. Particularly the question whether strengthening the organization of farmers, without certification, would contribute significantly and positively to the smallholders' livelihoods, and how and to what extent certification could potentially play an additional role in this, deserves further investigation. An example of such a study applied to coffee certification can be found in Ibnu, Offermans, and Glasbergen (2016).

In next research, it may also be interesting to investigate how profit would change if the institutiona1 arrangements between certified scheme smallholders and their affiliated companies would change (and if smallholders would really pay all costs, including RSPO membership fees themselves). Methodologically, our approach could benefit from a more longitudinal approach in which we do not only calculate real quantities, but also real costs and benefits during the entire life time of a plantation. This approach would then also ask for the inclusion of different scenarios for discount rates as these are inherently uncertain and depend on global and national developments in economy (for example inflation) and politics. Moreover, stricter selection on sampling bias may be applied for example by considering information and knowledge flows about certification, ownership of mixed plantations (scheme and independent smallholders' plantation) to gain better insight in spillover effects. In addition, it might also be important to monetize non-market costs such as opportunity costs of smallholders to actively involve in organization, and non-market benefits of certification such as environmental improvements, and better health and to internalize them in the calculation of economic cost-benefit analysis. By doing so, we approach the potential benefits of certification on a national/public scale instead of solely on an individual scale.

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