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Global and local sustainable certification systems: Factors influencing RSPO and Thai-GAP adoption by oil palm smallholder farmers in Thailand

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Abstract
This paper investigates the factors that influence the adoption of RSPO and Thai-GAP certification by oil palm smallholder farmers in Thailand. A random sample of 77 RSPO certified, 108 non-certified RSPO, 87 Thai-GAP certified, and 67 non-certified Thai-GAP smallholder farmers were interviewed to investigate the factors explaining the RSPO and Thai-GAP scheme adoption, respectively. The logit model was used to analyse the relationships between the adoption and the decision-making factors of the farmers. The results show that membership of farmer groups, the goal of the scheme, and trust in the scheme are the most significant factors affecting the adoption of RSPO certification. Scheme payments have a negative influence on adoption. In case of Thai-GAP, the results show the scheme payment, the image, concerns about the quality of land and water, and trust in the scheme are the most significant factors affecting the adoption. Finally, these findings suggest new factors may be attributed to several issues, including trust in the scheme, membership of farmer groups, the scheme's goal, and trust in the scheme are the most significant. Designing and extension in influencing factors may play multiple roles in driving smallholder farmers to adopt sustainable certification schemes. This finding repeats that the usability of sustainable certification schemes in developing countries needs to be mobilised around a particular socio-cultural context. Including, understanding the factors affecting smallholder farmers' intention to adopt Thai-GAP or RSPO certification is very important to plan and promote these schemes among other farmers and transform the current cultivation practices into more sustainable palm oil production.

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1 Introduction

Sustainable production and productivity issues have become critical concerns for agriculture in recent years, and these aspects are variously referred to as economic viability, environmental conservation, and social responsibility (Giovannucci et al., 2005; Erbaugh et al., 2019; Li et al., 2020). At the same time as plants encourage the production of both main and secondary products that are economically important (Sevik et al., 2021). Cultivation and sustainability have emerged as important in developing the tools for growers that can ultimately lead to sustainability. When discussing oil palm cultivation and palm oil production management, sustainability has become a dominant paradigm regarding economic, social, and environmental components (Glasbergen, 2018; Majid et al., 2021; Tan et al., 2009).

Certification is a new means for environmental protection and sustainable management in the palm oil supply chain. Certification has rather rapidly developed as private voluntary initiative as a market-based measure to entail sustainability in global supply chains (Mihajlovich, 2001; Raynolds et al., 2007). Several certification systems have spread in the agricultural sector to guarantee the environmentally friendliness of sustainable agricultural production (Scarlat et al., 2011). In case of palm oil, the Roundtable on Sustainable Palm Oil (RSPO) certification is the main global certification scheme that links sustainability through its economic, social and environmental dimensions, to support the production of certified sustainable palm oil. The RSPO intends to decrease the negative environmental and social impact from palm oil cultivation (Majid et al., 2021; Saswattecha et al., 2015). Access to the certification scheme for oil palm smallholder farmers is still difficult (Saadun et al., 2018). Therefore, encouraging greater use of RSPO certification of palm oil may be an attractive strategy to promote sustainability and efficiency of oil palm production. RSPO certified can access to the global market especially the demand from the countries of European Union (Saadun et al., 2018). In Thailand, there is another instrument to promote sustainability is GAP (Good Agricultural Practices), a national Thai certification scheme to promote sustainability and safety in food production, including in palm oil supply. The certification process of both Thai-GAP and RSPO certification could drive sustainable production of oil palm cultivation and serve as a starting point towards more efficiency in production. In recent studies, the factors influencing on-farm adoption have been analysed, especially in the agricultural sector (Bunclark et al., 2018; Nguyen-Van et al., 2017; Sanou et al., 2019). Therefore, the factors influencing the adoption of both RSPO and Thai-GAP of palm oil certification scheme need to explore further to understand the potential development of suitable certification schemes for oil palm farmers.

In this research, we focused on Thai GAP which is a national certification scheme, initiated by the Ministry of Agriculture and Cooperatives. Compliance by farmers is controlled by the Department of Agriculture, and issues addressed in the scheme include the safe use of pesticides, water, and fertilizer application. Thai-GAP for oil palm is the certification to be used as guidance to oil palm growers by the Ministry of Agriculture and Cooperatives in 2010 (Ministry of Agriculture & Cooperatives, 2008). Therefore, the GAP in this paper is Thai-GAP which was developed by Thai government by Ministry of Agriculture and Cooperatives in 2008 (Ministry of Agriculture & Cooperatives, 2008). RSPO certification is also included, and this is a global certification scheme supported by private actors.

Seeking the factors that contribute to the adoption of sustainable certification is an importance task for improving agricultural practices especially for oil palm which cultivation has important environmental impact.

This study aims to explore what are the factors influencing the adoption of sustainable oil palm practices certified through RSPO and Thai-GAP certifications by smallholders in Thailand. The rest of this article has five sections. It starts by introducing the certification of smallholder oil palm growers in Thailand, then present the methodology, the results from the research, discusses the reliability of the model, and the final section presents the conclusion of the research.

Certification of smallholder palm oil growers in Thailand

In recent years, the worldwide market has been focused on RSPO certification as an instrument for global sustainable oil palm production (Hutabarat et al., 2019; Kannan et al., 2021; Watts et al., 2021). In the ASEAN region of palm oil production, Indonesia and Malaysia, the world's two largest palm oil producers, founded Indonesia Sustainable Palm Oil (ISPO) in 2011 and Malaysia Sustainable Palm Oil (MSPO) in 2015 (Majid et al., 2021). These are domestic certification schemes that contribute to improving the economic performance and better management practices of oil palm smallholder farmers (De Vos et al., 2021), to support the participation of farmer groups and their access to knowledge and training accessing, to health safety of smallholders, and to environmental conservation (Hidayat et al., 2016). However, in developing countries where smallholder farmers are an important part of the oil palm sectors (Abazue et al., 2019), there are still major problems with the process of certification due to a low understanding of certification, high costs for certified farmers, and the absence of farmer groups that are to be certified. In addition, RSPO certification focuses on environmental impacts and deforestation rather than farmers' immediate needs such as farm income and living conditions (Glasbergen, 2018). These barriers are causing many oil palm smallholders not to have viable RSPO certification processes. In addition, the structure of the oil palm value chain makes smallholder upgrading difficult (Schoneveld et al., 2019). At present, there are global concerns about the palm oil sector's long-term sustainability and these problems of smallholders in certification are part of that.

In Indonesia, there are several national certification schemes for independent oil palm smallholder farmers who wish to become sustainable, including the Rainforest Alliance Sustainable Agriculture Standard, the Palm Oil Innovation Group (POIG), and the Indonesian Sustainable Palm Oil (ISPO) scheme, (Watts et al., 2021). In Malaysia, the Malaysian Sustainable Palm Oil (MSPO) standard is the country's primary national certification scheme for promoting the oil palm industry's long-term sustainability (Senawi et al., 2019).

Thailand is the third-largest producer of crude palm oil (CPO) in the world, but it does not have a specific national sustainable palm oil certification scheme as in Indonesia and Malaysia. At present, Thai-GAP certification of oil palm plantation is the only one that comes close to it, with its stimulation of sustainable agricultural practices. Currently, the total oil palm planted area in Thailand is 0.65 million hectares mostly in the south of the country and more than 70% of this area is held by independent smallholders (Dallinger, 2011). However, the present area under oil palm cultivation may not be sufficient to cope with the increasing demand for palm oil in the future. Therefore, the Ministry of Agriculture and Cooperatives of Thailand plans to increase the plantation area to 1.6 million hectares in 2029 (Dallinger, 2011).

In Thailand, the main certification schemes applied for sustainable oil palm production are the Good Agricultural Practices (GAP) and the Roundtable on Sustainable Palm Oil (RSPO).

The Thai-GAP scheme was introduced and implemented by the Thai Department of Agriculture (DOA) and introduced the first time in 2003 as a voluntary standard in the country for several agricultural products (Salakpetch, 2007) such as vegetables and fruit. The measures included in Thai-GAP are based on international standards, and these are issued to ensure that all produced food is safe and more sustainable. The Thai government has encouraged all relevant organizations to promote food safety and sustainability to secure its prominent position as an important exporter of agri-food products. For instance, the Ministry of Agriculture and Cooperatives also encourages growers to comply with the guidelines of the Thai-GAP scheme (Ministry of Agriculture & Cooperatives, 2007; Salakpetch, 2007). The Thai-GAP standards are specific for each crop and with respect to palm oil, the Principles and Criteria of the Roundtable on Sustainable Palm Oil (RSPO) were used as a reference. The Thai-GAP scheme for oil palm in Thailand started in 2010 and provides detailed guidance for producers covering field operations at the plantation and transportation of the Fresh Fruit Bunches (FFBs) to the collection points (ramps or mills) in order to increase production efficiency and to ensure good quality and safe raw material as well as taking into account the environmental impact and the workers' health and safety (Thai Ministry of Agriculture & Cooperatives, 2008). From interview, there are, at present, approximately 879 Thai-GAP certified farmers in Krabi and Surat Thani provinces where most oil palm growing takes place. There are several advantages for Thai-GAP certified smallholders especially by improving their agricultural practices the efficiency of oil palm management will increase, they have more knowledge about recording farm data, how to use appropriate fertilizers, how to harvest for the good quality FFBs, and they are proud to receive a certification. In long term, certified farmers will have more income, as they can develop a better farm management plan from the data they have been recording; in particularly, by improving the quality of the soil and protecting the environment.

The RSPO is the first global standard-setting initiative for palm oil. It is a multi-stakeholder initiative dedicated to promote the sustainable production of palm oil worldwide. The objectives of the scheme are promotion of sustainable palm oil production through stakeholder engagement and promotion of credible global standards through the formulation of different criteria and principles which include transparency, legal compliance, environmental, agricultural, labour and social best practices (Nagiah and et al., 2013). The RSPO is successful in linking the concept of sustainability with palm oil by covering the three pillars of sustainable development: environmental, social, and economic concerns (Nikoloyuk et al., 2010; Primadona, 2011). The RSPO specifically addresses the sustainability challenges resulting from the increasing global market demand for palm oil (Von Geibler, 2013). By April 2016, worldwide approximately 2.72 million hectares of oil palm plantations were certified by RSPO, this equals 21% of the global oil palm plantation area (RSPO, 2018) and the total production capacity of CSPO (Certified Sustainable Palm Oil) was 12.90 million tonnes. The development and promotion of RSPO certified sustainable palm oil fit closely with the requirement of the European Union (EU) to purchase only biofuels produced from certified sustainable palm oil (Primadona, 2011) and with different national commitments to only import sustainable palm oil.

Thailand has been an active member of the RSPO since the beginning through the participation of government agencies and private companies. In 2005, the RSPO established a project called the Task Force on Smallholders (TFS) to support smallholders in the process of RSPO certification (Thongrak & Kiatpathomchai, 2012). According to the existing RSPO framework, smallholders have to form groups if they want to remain independent from a processing company while at the same time being able to obtain RSPO certification. Groups of independent smallholder oil palm farmers have to abide by the RSPO standard

for group certification as well as by the RSPO Principle and Criteria to get their FFBs certified.

A project supporting the certification of independent smallholders in Thailand was initiated by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and processing mills. The project provided training services on the best management practices to smallholder palm oil farmers in the South of Thailand. This project was successful, and Thailand became the first country in the world to have independent smallholders as RSPO-certified in 2012 (RSPO, 2012). The group comprised 412 smallholders with over 2,767.33 hectares of palm oil plantations (RSPO, 2012a, 2012b). In 2012, the certification enabled these farmers to annually trade approximately 52,000 tonnes of certified sustainable FFBs, generating an estimated 10,000 tonnes of certified sustainable palm oil (CSPO) or approximately 0.47% of the total CPO production of Thailand (Kasikorn Research Center, 2012).

There are different benefits that certified independent farmers receive from the RSPO scheme. They can improve their knowledge about oil palm growing and harvesting through the training imparted by the processing mill or the promoter of the certification. Moreover, they profit through a supplement of 50 Thai Baht (THB) per ton of FFBs on top of the normal price they receive from the mill, a lower price for the input they buy from the mill and they can deliver their FFBs to the mill directly without any intermediaries which reduces the time needed for transport. In addition, they have the opportunity to access the attractive market for certified palm oil in the future, especially the export market. The benefits of certification may lead to increased efficiency in the production, higher incomes, and more sustainability in the long term.

The Thai government intends to promote sustainability in the palm oil sector through both Thai-GAP and RSPO certification. In order to supply the future market with certified sustainable palm oil, commitment from the farmers is important. Motivating farmers is, however, a challenge because there does not seem to be much of a price difference between certified sustainable palm oil (CSPO) and non-certified palm oil (NCPO) while the production process of CSPO is more complex and involves a commitment to follow the regulations. RSPO certification means adopting an international standard (Corley, 2009), and Thai-GAP certification is a national palm oil standard. It is important to better understand the factors that influence the decision making by farmers for either adopting a certification system or not, especially when considering the promotion of the RSPO and Thai-GAP certification schemes.

The decision made by the farmer to aim for certification depends on the characteristics of the farmer him/herself, the decision-making process and the conditions of the farm. The possibly relevant farmer characteristics include household characteristics, farm structure, the wider social environment, and the innovation-called the ‘certification scheme’. The scheme could offer farmers the motivation to adopt more sustainable agricultural practices through financial support from scheme promotors during the certification process (Edwards, 2006). The decision by farmers to adopt a voluntary certification scheme is influenced by the payments related to the scheme, the duration of the scheme, the length of the interruption between the renewal of schemes, the scheme logistics and importance of the changes in farm management required by the scheme or the flexibility of the scheme (Wilson, 1997). Participation of farmers in a certification scheme can lead to improvement in their farm management and livelihood. However, an increasing number of scholars also highlights the role of non-economic concerns such as moral and social factors in farmers’ decision making (Mzoughi, 2011). Understanding this decision-making process can allow research, development, and extension activities to become more effective and accelerate and improve adoption decisions (D’Emden et al., 2008). Saadun et al. (2018) confirmed

that the main factors to boost oil palm farmers in participation the schemes are a premium price for oil palm yield, a desired environmentally friendly palm oil certification scheme for oil palm smallholders, certification cost, financial supporting, knowledge accessing, and technology in production. In study of the determinants and extent of participation in UTZ-RA (UTZ–Rainforest Alliance), certification program of cocoa, the household size, education level, off-farm income, gender, hours of labour in production are all influencing participation (Iddrisu et al., 2020). It is important to identify the factors that influence the level of sustainable certification practices in Thailand, where there is currently no national specific palm oil certification such as ISPO or MSPO. This paper, therefore, explores the factors influencing the adoption of sustainable oil palm practices certified through Thai-GAP and RSPO by smallholders in Thailand. An important additional goal of the study is to develop a decision-making model for certified smallholder farmers to acquire further insights into how the certification system can be improved and how sustainability among smallholder oil palm farmers can be promoted.

2 Research methodology

Phase I, qualitative in-depth interviews were conducted with 29 key informants to identify the factors that are relevant in the decision-making process on the adoption of the RSPO and Thai-GAP certification schemes. The results from Phase I were used to developing a questionnaire. Interviews were held with 3 community leaders, 17 certified and non-certified farmers, 5 government staff and politicians, 2 mill owners, and 2 middlemen. The key informants were randomly selected from involved actors on the palm oil supply chain that related on RSPO and Thai-GAP certification schemes.

Furthermore, these interviews were supplemented with information generated from a literature review. The identified factors were translated into statements on which the respondents could answer by indicating one of the five options of a Likert-scale ranging from 5 (=strongly agree) to 1 (=strongly disagree) in the interview form. The statements for which the weighted mean value was more than 3.50 point were selected to create a questionnaire. The Cronbach's alpha was used to measure the reliability of the statements in the questionnaire. Nunnally (1978) suggested that a Cronbach's alpha larger than 0.70 demonstrates high reliability. Robinson (1991) suggested that a cut-off point of 0.60 should be used as the minimum. The results of the reliability testing are presented below together with the research findings. The Cronbach's alpha for these eight statements was 0.91, representing a high reliability. Therefore, all these eight statements were used for the Logit regression analysis.

Phase II, a quantitative follow-up from a created questionnaire in phase I was developed with the help of the Logistic Regression Model. This model consists of five categories of independent variables: (i) economic factors (oil palm plantation size, income from oil palm cultivation and distance from plantation to mill); (ii) social factors (image of scheme promoter, membership of farmer groups, scheme introduction through community leader and involvement of neighbours in the scheme); (iii) environmental factors (concerns about the environmental impact from oil palm cultivation, concerns about the quality of land and water, and the personal health of the farmer and of the employees on the farm); (iv) scheme factors (target of the scheme, scheme payment, trust in the scheme and severity of changes in farm management required by the scheme) and (v) farmers' characteristics (age, education level, experience in oil palm cultivation, number of members of the household,

number of family members working on the oil palm plantation). There are two options for the farmers: certified and non-certified. In the case of certified farmers, the questionnaire also contained questions related to the factors that affect their decision as a result from phase I and questions about the obstacles and problems in the practice of sustainable oil palm certification schemes. Detailed questions related to the planting and maintenance of oil palms trees and to the harvesting, transporting and sale of FFBs were added.

The survey included 77 RSPO-certified and 108 non-RSPO-certified smallholder farmers and also 87 Thai-GAP-certified and 67 non-Thai-GAP-certified smallholder farmers. The justification for selecting the respondents depends on the majority of the oil palm population. Therefore, respondents were selected through purposive sampling. The selected farmers cultivate oil palm trees of an age between 4 and 20 years on a plantation smaller than 50 hectares in Surat Thani and Krabi provinces. The RSPO definition of smallholders states that "Farmers growing oil palm, sometimes along with subsistence production of other crops, where the family provides the majority of labour and the farm provides the principal source of income, and where the planted area of oil palm is usually below 50 hectares in size" (RSPO, 2009). The sampling was controlled on the basis of area. Certified and non-certified farmers living in the same area were selected for each scheme. One scheme was promoted in the area, and some of the farmers accepted to be part of the certification project, whereas others did not accept this. The selected farmers were between 45 and 55 years old because they are the majority among the Thai-GAP and RSPO oil palm farmers in Surat Thani and Krabi provinces. The survey was conducted between December 2013 and May 2014.

Surat Thani and Krabi provinces, located in southern Thailand (Fig. 1), were selected as the case study areas for this survey for three different reasons. Firstly, they form the largest

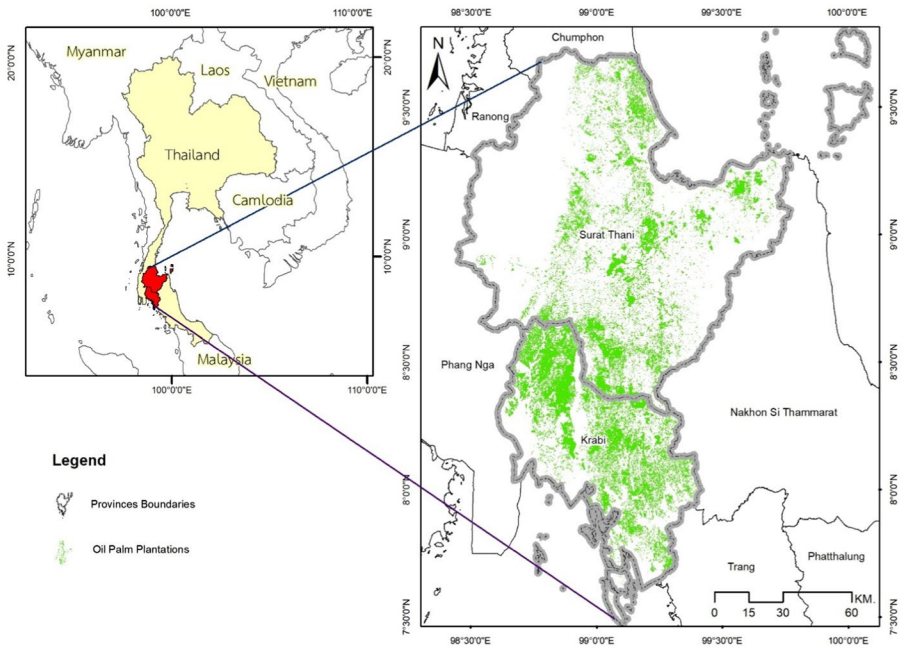

Figure1 Research Area

oil palm production region in Thailand with an area of 367,916.16 hectares in 2012. This is over 50% of all oil palm plantations in Thailand (Office of Agricultural Economics, 2015). The majority of the income of inhabitants in this area comes from oil palm cultivation. Over ten years, the income has increased more than fourfold as a result of the growth in oil palm cultivation (Chao et al., 2009). Secondly, the RSPO and Thai-GAP schemes for sustainable oil palm growing practices have been promoted first in this region. Thirdly, smallholder farmer groups from this region were the first smallholder groups in the world to have received RSPO certification (RSPO, 2012a, 2012b). Therefore, farmers' participation in both schemes could be examined in Surat Thani and Krabi provinces.

3 Data analysis

The Logistic regression model is a popular statistical technique that is used to analyse the probability of an event dependent on the values of independent variables, either categorical or numerical (Neupane et al., 2002). The factors influencing farmers' adoption of agricultural practices or new technology have been studied in a wide range of studies (e.g. Daxini et al., 2018; Liu et al., 2018; Mariano et al., 2012; Qi et al., 2021). This study applies the binary logit regression model in two distinct cases. It is used to analyse, firstly, the relationship between the adoption/non-adoption of RSPO practices and several explanatory variables. And secondly, the binary logit regression model is used to analyse the case of adoption and non-adoption of the Thai-GAP practices.

Data were analysed with SPSS (version 15.0), using the following techniques:

1. Developing descriptive statistics of the key social, environmental and certification scheme factors using at Likert Scale (Emory et al., 1991). The distribution in the Likert Scale followed the one set by Daxini and colleagues (2018): Strongly Agree/Very Important (4.51–5.00), Agree/Important (3.51–4.50), Undecided/Moderately Important (2.51–3.50), Disagree/Unimportant (1.51–2.50), Strongly Disagree/Very Unimportant (1.00–1.50).
2. Analysing correlation coefficients between the different variables by using the Pearson–Product Moment of Correlation:

   Where: r = Pearson correlation coefficient between x and y. x = Independent variable, y = Dependent variable, n = Sample size

$$r = \frac{n\sum xy - \left(\sum x\right)\left(\sum y\right)}{\sqrt{\left[n\sum x^2 - \left(\sum x\right)^2\right]\left[n\sum y^2 - \left(\sum y\right)^2\right]^2}}$$

   To select the independent variables, a Binary Logit Model was used while the variables with correlation coefficients below 0.70 were eliminated.

3. Analysing the factors influencing the adoption of the Thai-GAP and RSPO certification scheme by using Binary Logit Analysis.

A Logistic Regression Model was used to identify the factors influencing the adoption of the Thai-GAP and RSPO certification scheme by the farmers. The dependent variable

was dichotomous, coded as 0 *(*non-certified farmers*)* or 1 *(*certified farmers*)*. A Logit Regression Model using maximum-likelihood procedures was applied to estimate the probability of adoption. The model is specified as follows*:*

$$P(\text{Prob} : Y = 1) = \frac{e^{\beta_0+\beta_1 X_1+\ldots+\beta_i X_i}}{1 + e^{-(\beta_0+\beta_1 X_1+\ldots+\beta_i X_i)}} \tag{1}$$

$$P(\text{Prob} : Y = 0) = 1 - P(\text{Prob}\ Y = 1) = \frac{1}{1 + e^{(\beta_0+\beta_1 X_1+\ldots+\beta_i X_i)}} \tag{2}$$

where, P is the probability that a farmer decides to adopt the Thai-GAP or RSPO practices under the given X_i (X_i is the set of explanatory variables influencing the adoption decision).

$Y = 1$ if the choice is yes.

$Y = 0$ if the choice is no.

β_0, β_1, …, β_i are regression beta coefficients of explanatory variables to be estimated, and e is the base of natural logarithms.

The model predicts the response variable (adoption) from the independent variables. The logarithm of the odds ratio is given by:

Dividing (1)/(2) = Odds Ratio

$$\text{OddsRatio} = (P(\text{Prob} : Y = 1))/(P(\text{Prob} : Y = 0)) = e^{(\beta_0+\beta_1 X_1+\ldots+\beta_i X_i)}$$

Logistic Regression Model is

$$\text{Logit}(Y) = \ln\left(\frac{P}{1-P}\right) = \beta_0 + \beta_1 X_1 + \ldots + \beta_i X_i$$

4 The independent variables

As per knowledge of the authors, there is no previous study identifying the factors influencing the probability of the oil palm farmers joining a sustainable palm oil scheme that provides international certification. In this research, the conceptual model of factors influencing oil palm farmer's adoption though a voluntary certification scheme incorporates twenty independent variables, combined in five groups of variables*:* farmer's characteristics, economics factors, social factors, environmental factors, and scheme factors. The description of variables specified in the model is presented in (Tables 1).

5 Research results

5.1 Reliability of the model

According to Hair et al. (2006), the predictive ability of the binary logistic regression can be assessed by forecasting the adoption of a scheme. Table 2 presents this classification matrix, in case of Thai-GAP, shows that 65.6% of the non-adopting farmers were correctly predicted and 72% of the adopting farmers. On average, 69.1% of the original cases were correctly predicted. Consequently, the model is shown to have a high predictive ability.

Table 1 Description of variables specified in the model

	Description	Type of measure	
Dependent variable			
	Dichotomous response (Y)	0 = Non certified farmer 1 = Certified farmer	
Independent variable			
Farmer's characteristics			
X_1	Age		Age of farmers (years)
X_2	Oil palm farming experience (years)		Number of oil palm farming experience (years)
X_3	Household members		Number of family members in the household
X_4	Household farm labour		Number of household members working on the oil palm plantation
X_5	Education level of farmers		0 = No education 6 = Primary school 12 = Secondary school 16 = Post-secondary education
Economics factors			
X_6	Oil palm plantation size	Number of hectares oil palm plantation	
X_7	Oil palm income	Income from oil palm (THB/Hectares)	
X_8	Distance	Distance from plantation to promotor mill (km)	
Social factors			
X_9	The positive image of the scheme	**Rating Scale	
X_{10}	Membership of farmer groups	0 = No, 1 = Yes	

Table 1 (continued)

	Description	Type of measure
X_{11}	Introduced scheme by community leader	0 = No, 1 = Yes
X_{12}	Introduced through neighbours	0 = No, 1 = Yes
Environmental factors**		
X_{13}	Oil palm cultivation has environmental impacts	0 = No, 1 = Yes
X_{14}	Concerns about the quality of land	** Rating scale
X_{15}	Concerns about the quality of water	** Rating scale
X_{16}	Concerns personal health of farmer and employees	** Rating scale
Scheme factors **		
X_{17}	The target of the scheme	** Rating scale
X_{18}	Scheme payment	** Rating scale
X_{19}	Trust in the scheme	** Rating scale
X_{20}	The severity of change in farm management required by the scheme	** Rating scale

**Rating Scale with Likert Scaling Technique which assigns one scale value of each of the different responses: Strongly Agree = 5, Agree = 4, Undecided = 3, Disagree = 2, and Strongly Disagree = 1

Table 2 Classification matrix in Thai-GAP and RSPO adoption correctly predicted

	Non-adoption	Adoption	Percentage correct
Item	Forecasting Value Thai-GAP certification scheme adoption		
Non-adoption	42	22	65.6
Adoption	21	54	72
Overall percentage predicted	69.1		
Item	Forecasting Value RSPO certification scheme adoption		
Non-adoption	95	13	88
Adoption	20	57	74
Overall percentage predicted	82.2		

Including, in the classification matrix shows that 88% of non-adopting farmers were correctly predicted and 74% of the farmers that did adopt the RSPO scheme. On average, 82.2% of the original cases were correctly predicted. Consequently, the model can be considered to have a high predictive ability. In we assessed whether or not the model fits the data by calculating Nagelkerke's R^2 of the model. In this study, Nagelkerke's R^2 (the fraction of explained variation) was 0.351 (Table 3). This means that 35.1% of the probability of adopting Thai-GAP could be explained through all independent variables included in this model. In the case of adopting the RSPO scheme, Nagelkerke's R^2 was 0.622 (Table 4), so 62.2% of the probability of the RSPO adoption could be explained through all independent variables included in this model.

5.2 Logistic regression analysis results

The logit analysis was used to estimate the extent to which characteristics of the selected oil palm farmers influenced their participation in a certification scheme. The dependent variable has a dichotomous character as farmers can be Thai-GAP/RSPO certified or non-certified. The calculated factor scores were used in a binary logit analysis along with selected demographic characteristics, economic, social, environmental, and scheme factors (see Tables 3 and 4 for the details).

From the logit analysis in Table 3, the factor scores regarding the adoption of the Thai-GAP scheme were calculated. A positive sign for a coefficient indicates that the probability of farmers to adopt the Thai-GAP scheme was affected positively by the independent variables. On the other hand, a negative sign indicates that a high value of the variables tends to decrease the probability of adopting a Thai-GAP scheme. The following variables were statistically significant at the 5% level: a good image, concerns about the quality of the land, concerns about the quality of water, the costs involved in participating in the scheme and the trust vested in the scheme. The variables related to the introduction of the scheme by a community leader were statistically significant at the 10% level. On the other hand, there were a number of variables that were not statistically significant. These include age, years of oil palm farming experience, number of household members, number of household members working on the farm, the education level of the farmer, oil palm plantation size, income from oil palm plantation, distance from the plantation to the promoter's mill, membership of farmer groups, introduction of the scheme by neighbours, concerns about

Table 3 Logistic Regression estimates of Thai-GAP adoption in Thailand

	Variable	B	S.E	Wald	Sig	Exp (B)
	Demographic characteristics					
X_1	Age	0.005	0.023	0.041	0.840	1.005
X_2	Oil palm farming experience	0.040	0.027	2.106	0.147	1.040
X_3	Household members	−0.222	0.153	2.104	0.147	0.801
X_4	Household farm labour	0.039	0.098	0.162	0.687	1.040
X_5	Education level of farmers	−0.135	−0.135	0.334	0.686	0.874
	Economics factors					
X_6	Oil palm plantation size	0.009	0.012	0.562	0.453	1.009
X_7	Oil palm income	0.000	0.000	0.342	0.559	1.000
X_8	Distance	0.044	0.053	0.694	0.405	1.045
	Social factors					
X_9	Good image	0.469	0.176	7.093	***0.008	1.598
X_{10}	Membership in farmer groups	−0.549	0.489	1.263	0.261	0.577
X_{11}	Introduced scheme from a community leader	−0.798	0.477	2.802	*0.094	0.450
X_{12}	Introduced neighbours	0.013	0.061	0.047	0.828	1.013
	Environmental factors					
X_{13}	Concerns about environmental impacts from oil palm cultivation	−0.287	0.478	0.362	0.548	0.750
X_{14}	Concerns about the quality of land	0.679	0.314	4.663	**0.031	0.507
X_{15}	Concerns about the quality of water	0.580	0.297	3.829	**0.050	1.787
X_{16}	Concerns about personal health of farmer and employees	−0.171	0.204	0.704	0.402	0.843
	Scheme factors					
X_{17}	Scheme payment	0.503	0.170	8.793	***0.003	0.605
X_{18}	Goal of the scheme	0.306	0.188	2.647	0.104	1.358
X_{19}	Severity of change in farm management required by scheme	0.225	0.196	1.313	0.252	1.252
X_{20}	Trust of the scheme	0.385	0.192	4.031	**0.045	1.469
	Constant	1.150	1.822	0.398	0.528	3.158
	-2loglikelihood (-2LL)	149.457				

Table 3 (continued)

Variable	B	S.E	Wald	Sig	Exp (B)
Nagelkerke's R^2	0.351				

*, **, and *** represent $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively

Table 4 Logistic Regression estimates of RSPO adoption in Thailand

	Variable	B	S.E	Wald	Sig	Exp (B)
	Demographic characteristics					
X_1	Age	0.000	0.029	0.000	0.989	1.000
X_2	Oil palm farming experience	0.059	0.031	3.489	*0.062	1.061
X_3	Household members	0.221	0.173	1.632	0.201	1.247
X_4	Household farm labour	0.072	0.125	0.329	0.566	1.074
X_5	Education level of farmers	− 0.045	0.070	0.400	0.527	.956
	Economics factors					
X_6	Oil palm plantation size	− 0.004	0.012	0.082	0.774	.996
X_7	Oil palm income	0.000	0.000	2.837	*0.092	1.000
X_8	Distance	− 0.106	0.060	3.124	*0.077	0.899
	Social factors					
X_9	The positive image of the scheme	− 0.291	0.193	2.278	0.131	0.748
X_{10}	Membership in farmer groups	1.150	0.482	5.696	**0.017	3.158
X_{11}	Introduced scheme from the community leader	− 0.648	0.584	1.230	0.267	0.523
X_{12}	Introduced neighbours	0.929	0.588	2.496	0.114	2.533
	Environmental factors					
X_{13}	Concern about the environmental impacts from oil palm cultivation	− 0.843	0.481	3.069	*0.080	0.430
X_{14}	Concerns about the quality of land	0.410	0.349	1.383	0.240	1.508
X_{15}	Concerns about the quality of water	− 0.265	0.279	0.903	0.342	0.767
X_{16}	Concerns about the personal health of farmers and employees	0.110	0.238	0.215	0.643	1.117
	Scheme factors					
X_{17}	Scheme payment	− 1.080	0.222	23.730	***0.000	0.339
X_{18}	The goal of the scheme	0.453	0.236	3.692	**0.050	1.573
X_{19}	The severity of the changes in farm management required by the scheme	− 0.309	0.232	1.768	0.184	0.734
X_{20}	Trust in the scheme	0.805	0.303	7.076	***0.008	2.237
	Constant	− 2.322	2.322	1.000	0.317	0.098
	-2loglikelihood (-2LL)	136.565				

Table 4 (continued)

Variable	B	S.E	Wald	Sig	Exp (B)
Nagelkerke's R^2	0.622				

*, **, and *** represent $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively

the environmental impact from oil palm cultivation, concerns about the personal health of the farmer and the employees, the target of the scheme, the severity of changes in the farm management that were required by the scheme.

A good image of the scheme had a positive influence on the probability of adopting Thai-GAP, as well as concerns about the quality of land and water and farmers' perception about the payments when participating in the scheme.

Trust in the scheme had a positive contribution to the probability of adopting Thai-GAP. A relevant factor with respect to the Thai-GAP scheme includes its voluntary nature (Baldock et al., 1990). Although this voluntary character allows for non-participation, farmers consider this a positive factor because it allows the farmers to enter and to adapt the scheme based on their personal choice (Wilson, 1997). Also, the target of the scheme and trust in the scheme was considered important almost all of the farmers have trust in the scheme because it is promoted by Thai government agencies.

The results from the Logit analysis as presented in Table 4 show the calculated factor scores with regard to the adoption of the RSPO scheme. Significant at 5% ($p < 0.05$) were the following variables: membership of farmer groups, the payments involved in scheme participation, the target of the scheme, and trust in the scheme. Significant at 10% ($p < 0.10$) were the variables: income from oil palm (THB/hectare), years of experience in oil palm farming, the distance between the oil palm plantation and the promoter's mill (km), and concerns about the environmental impact from oil palm cultivation. The other factors, age, level of education, number of household members, number of family member engaged in the oil palm plantation, farm size, good image, introduction of the scheme through a community leader, introduction of the scheme through a neighbour, concerns about the quality of land and water and about the personal health of the farmer and the employees on the farm and the severity of the changes in farm management that are required by the scheme are not statistically significant.

Membership of farmer groups had a positive influence on the likelihood of RSPO scheme adoption. This observation confirms the findings from Nnadi and Nnadi (2009) who found that a significant positive relationship exists between membership of farmer groups and the adoption of sustainable methods for maize–cassava intercropping. Membership of farmer groups has been found to play an important role in enabling farmers to access information, knowledge, credit, markets, and agricultural technologies (Aliguma et al., 2007; Gibson et al., 2008; Mathenge et al., 2010). It may be expected that information about the RSPO scheme was more easily accessible for farmers who were members of a group. The RSPO scheme is developed and implemented as a group scheme and therefore, farmers who have already participated in other groups have greater chances of participating in the RSPO scheme.

Farmers' perceptions about the costs involved in the scheme had a negative influence on the probability of adopting RSPO. Adopting RSPO does not have significant effects on-farm investments, as production of FFBs before the adoption was similar to production after certification. Adopting RSPO by farmers has been done primarily after the introduction to the scheme by promoters who showed how to produce palm oil following the RSPO principles and criteria. Therefore, support to cover the higher costs does not increase the probability of participating in the RSPO certification scheme. This finding confirms Wilson (1997), who showed that financial support was not the main factor influencing farmers' adoption of the Environmentally Sensitive Area (ESA) scheme.

Trust in the scheme as well as in the objectives of the scheme had a positive influence on the probability of adopting RSPO certification. Another important factor in relation to the adoption of the RSPO scheme is its voluntary nature because this has positive

implications for participation (Baldock et al., 1990). The voluntary approach taken in the scheme, although it may enable non-participation, has also positive influence because it allows the farmers to enter the scheme and to adapt to the scheme (Wilson, 1997).

Given these coefficients, the logistic regression equation for the probability of targeted farmers to join the schemes was developed**.** These factors have been decomposed into the explanatory variables as shown in the empirical model below. In the case of Thai-GAP, the model is specified as follows:

$$\begin{aligned}\text{Logit}(Z);\text{GAP} = {} & 1.150 + 0.005X_1 + 0.040X_2 - 0.222X_3 + 0.039X_4 \\ & - 0.135X_5 + 0.009X_6 + 0.000X_7 + 0.044X_8 \\ & + 0.469X_9 - 0.549X_{10} - 0.798X_{11} - 0.013X_{12} \\ & - 0.287X_{13} + 0.679X_{14} + 0.580X_{15} - 0.171X_{16} \\ & + 0.503X_{17} + 0.306X_{18} - 0.225X_{19} + 0.385X_{20}\end{aligned}$$

The model for Thai-GAP adoption specified on the basis of a 5% statistical significance ($p < 0.05$) is as follows:

$$\text{Logit}(Z \ast\ast \text{Thai} - \text{GAP}) = 1.150 + 0.469X_9 + 0.679X_{14} + 0.580X_{15} + 0.385X_{20}$$

In the case of RSPO, the model is specified as follows:

$$\begin{aligned}\text{Logit}(Z);\text{RSPO} = {} & -2.322 + 0.000X_1 + 0.059X_2 + 0.221X_3 + 0.072X_4 \\ & - 0.045X_5 - 0.004X_6 + X_7 - 0.106X_8 - 0.291X_9 \\ & + 1.150X_{10\text{-}} - 0.648X_{11} + 0.929X_{12} - 0.843X_{13} \\ & + 0.410X_{14} - 0.265X_{15} + 0.110X_{16} - 1.080X_{17} \\ & + 0.453X_{18} - 0.309X_{19} + 0.850X_{20}\end{aligned}$$

The model for RSPO adoption specified on the basis of a 5% statistical significance ($p < 0.05$) is as follows:

$$\text{Logit}(Z \ \ast\ast \text{RSPO}) = -2.322 + 1.150X_{10} - 1.080X_{17} + 0.453X_{18} + 0.805X_{20}$$

The probability of adoption in the case of the RSPO scheme $= \frac{1}{1+e^{-(Z\ast\ast)}}$

Remark; Logit (Z**) = Logistic Regression Equation significant at 5% ($p < 0.05$).

5.3 Demographic characteristics of the farmers included in the GAP-certification sample

Table 5 shows the demographic characteristics of farmers, including gender, age, education level, marital status, oil palm farming experience, number of household members, family labour on oil palm plantation, distance between plantation and mill, farm size, and income from oil palm cultivation. This Table shows that 154 oil palm farmers were included in the Thai-GAP sample, of which 87 were Thai-GAP-certified and 67 non-Thai-GAP-certified.

On average, the farmers were just over 49 years of age with nearly 16 years of experience in growing oil palm. They included, on average, 4.89 members in their household, and 1.98 family members worked on the oil palm plantation. The average size of the oil palm plantation was 3.91 hectares, and the income they received from its cultivation was 2,660.27 THB per hectare. The distance from the plantation to the mill was 5.17 km. on average. The education level of the majority of the farmers was primary school (45.5%) followed by secondary school (37.7%). Nearly all farmers (98.1%) were married.

When comparing the Thai-GAP-certified farmers with the non-Thai-GAP-certified farmers, there are only few differences while in many aspects they are similar. However,

Table 5 Characteristics of the Thai-GAP sampled oil palm farmers

Characteristic	Thai-GAP certified farmers	Non-Thai-GAP certified farmers	Total
Sample size	87	67	154
Percent male	64.4	71.6	67.5
Age of farmers (years)	49.08	49.49	49.26
Oil palm farming experience (years)	16.31	15.53	15.97
Household members	4.65	5.12	4.89
Family labour on oil palm plantation	1.89	2.07	1.98
Area of oil palm plantation (hectares)	4.8	3.02	3.91
Oil palm income (THB/hectare/year)	2,837.6	2,430.39	2,660.27
Farmers participating in groups apart from Thai-GAP (%)	61.2	25.35	40.92
Distance from plantation to mill (km)	5.26	5.06	5.17
Education level of farmers	%		%
No education	0	1.5	0.6
Primary school	46	44.8	45.5
Secondary school	36.8	38.8	37.7
Post-secondary Education	17.2	14.9	16.2
Marital status	%		%
Married	100	95.5	98.1
Otherwise	0	4.5	1.9

the area of their oil palm plantation is larger for Thai-GAP-certified farmers compared with non-Thai-GAP-certified farmers (4.8 ha versus 3.02 ha), their average income per hectare higher (2837.6 THB versus 2430.27 THB hectare) and their participation in groups other than GAP is much higher (61.2% versus 25.35%).

5.4 Demographic characteristics of the farmers included in the RSPO certification sample

Table 6 shows the demographic characteristics of the farmers included in the RSPO certification sample. These characteristics are similar to those included in the Thai-GAP-certification sample. This table shows that out of the 185 oil palm farmers selected in the sample 77 were RSPO-certified and 108 were non-RSPO-certified.

The average age of the farmers was over 49 years, and, on average, they had more than 18 years of experience in oil palm growing. There had 4.21 household members and 2.14 of their family members worked on the oil palm plantation. The average oil palm plantation size was 3.44 hectares, and their income from oil palm cultivation was 2,664.75 THB per hectare. The distance from the plantation to the mill was 4.87 km. Nearly, 40% of all farmers participated in other groups than Thai-GAP/RSPO. The majority (50.27%) had only primary school level of education, and 32.97% had secondary school level. Almost all farmers (91.4%) were married.

In the case of RSPO, there are even fewer differences between certified and non-certified farmers compared with the Thai-GAP-sample. An important difference was found in the average income from oil palm, as certified farmers earn 2900.16 THB per hectare,

Table 6 Characteristics of RSPO sampled oil palm farmers

Characteristic	RSPO certified farmers	Non- RSPO certified farmers	Total
Sample size	77	108	185
Percent male	74.03	63.94	68.1
Age of farmers (years)	51.19	48.16	49.42
Oil palm farming experience (years)	20.26	16.44	18.23
Household members	4.44	4.04	4.21
Family labour on oil palm plantation	2.11	2.16	2.14
Area of oil palm plantation (hectares)	3.28	3.55	3.44
Oil palm Income (THB/ hectare/year)	2,900.16	2,334.53	2,664.75
Percent farmers participated groups apart from Thai-GAP/RSPO	55.84	26.85	38.92
Distance from plantation to mill (km)	4.7	4.98	4.87
Education level of farmers	%	%	%
No education	1.3	0.93	1.08
Primary school	55.84	46.30	50.27
Secondary school	35.06	31.48	32.97
Post-secondary Education	7.79	21.3	15.68
Marital status	%	%	%
Married	97.4	90.19	91.4
Otherwise	2.6	9.81	8.6

while non-certified farmers receive 2334.53 THB per hectare because the RSPO certified scheme has more price and yield than the Thai-GAP certification scheme. Another striking difference was found in social networking where 55.84% of the RSPO-certified farmers participated in groups other than the Thai-GAP/RSPO and only 26.85% of the non-RSPO-certified farmers.

Results indicate that among those farmers participating in the study, certified farmers receive more oil palm income than non-certified farmers. Certified farmers seem to participate more in groups (apart from Thai-GAP and RSPO), which means that it is easier to let them participate in a certified program. The distance of oil palm plantations of certified farmers (especially RSPO certified ones) to the mill is less than that of non-certified farmers, which means that it is easier for the former to deliver the yield to the mills, as the results are shown in Tables 5 and 6.

6 Discussion

Exploring of the factors influencing the adoption of sustainable oil palm practices certified shows that a global sustainability standard, such as the RSPO, can promote more sustainable palm oil provision in different countries, provided there is more room for translation of the standards and criteria to the specific local context. Different countries have specific local conditions in producing and processing palm oil as well as in consumption and policy making. Through translation to the context of Thailand and other countries, the RSPO could serve as a global resource for developing an effective national framework for

promoting sustainable palm oil provision. However, developing countries have low adoption rates of sustainable agricultural practices as exemplified in a sustainable certification scheme or good agricultural practices (Laosutsan et al., 2019; Liu et al., 2018; Serebrennikov et al., 2020; Tey et al., 2014, 2017). I empirically studied the economic, social, environmental, and scheme factors as well as farmers' characteristics. It became clear that, besides the economic aspects, this result resembles the findings of, for instance, Jin and colleagues (2015) and Glin and colleagues (2012) on cotton certification. This means that the adoption of sustainable practices upstream in the value chain needs to build trust among stakeholders. The research findings revealed that trust is an important factor influencing the adoption of both Thai-GAP and RSPO certification schemes. Scholars such as (Coulibaly et al., 2021; Joffre et al., 2020) argue that it is necessary to build trust in order to enable the adoption of sustainable practices. Higher trust in the scheme leads to increasing adoption of the schemes in developing countries that promote sustainability. It is important to understand how to maintain and further enhance collaborative trust development over time in certification schemes. Preparation for the inclusion of smallholders needs to be done by building trust and relationships among farmers and other stakeholders in the supply chain, establishing coordination, choosing strong leaders, and providing correct information (Coulibaly et al., 2021; Joffre et al., 2020).

The outcomes from this study contribute to expanding the debate on smallholders' decision-making on sustainability schemes in the developing country context. Although their adoption could be strengthened when the economic advantages for smallholders would be more evident, it is important to look beyond this single dimension. In particular, this study confirms Rizal et al. (2021) argument that smallholders' decisions on participation in global and national schemes depend not only on economic factors but also on social structures and social interactions. Degli Innocenti and Oosterveer (2020) found that the relatively higher independence of Thai oil palm growers in farming decision-making, compared with their Indonesian counterparts, means they are more aware of farming and environmental practices, but that their weaker peer-to-peer interactions mean they deviate more from best management practices, with consequences for compliance with RSPO principles and criteria. Adopting a sustainable certification scheme or not is therefore embedded in the broader livelihood of smallholder oil palm growers as well as in their social relations with other farmers and with the public and private actors promoting such schemes.

7 Conclusion

The aim of this study was to explore the factors influencing the decision by smallholder farmers on whether or not to adopt a certification system on producing sustainable palm oil. The study is based on a field study in Surat Thani and Krabi provinces, Southern Thailand among oil palm smallholder farmers who were certified or not certified through the Thai-GAP and RSPO certification schemes. The logit model was used to identify the variables that positively influence the adoption of these schemes by the smallholders, and we found that five variables were statistically significant at 5% ($p < 0.05$) in the case of the Thai-GAP certification scheme.

There are three variables that positively influenced smallholder farmers in adopting the RSPO certification scheme, and these are membership of farmer groups, the target of the scheme and the trust farmers had in the scheme. Only one variable, i.e. the costs involved in participating in the scheme, negatively influenced the adoption of the RSPO certification

scheme among smallholder farmers. It has become clear that group membership enables farmers to share knowledge and information with their fellow farmers and to make them aware that if others can follow the practices required for RSPO, they can also do this as well. It may therefore not be surprising that the first group that was targeted to join the project were farmers who already participated in social groups.

Overall not many differences between both schemes with regard to the farmers adopting them could be observed. The results of the study showed that the adoption of the Thai-GAP and the RSPO certification scheme depends as well on the performance of government agencies and private actors when encouraging the adoption of certification. In the case of Thai-GAP, providing information about the advantages of certification both in the short and the long term is important to convince farmers. It is critical to continue development to improve oil palm cultivation efficiency, and encouraging oil palm farmers to cultivate sustainably through Thai-GAP and the Roundtable on Sustainable Palm Oil (RSPO) (Nupueng et al., 2018).

At the same time, promoting environmental awareness about the need to secure the quality of the soil and water for oil palm cultivation may support the perspectives for oil palm certification schemes. In addition, because Thai-GAP certification is promoted by government agencies, this scheme is seen as trustworthy by the farmers. The results on the farmers adopting the RSPO scheme show that organizing farmers in groups is an important pre-condition for adopting the scheme. It is particularly within groups that farmers get to understand the goals of the RSPO certification scheme and its potential benefits. Also in the case of RSPO, farmers' trust in the scheme and particularly in its promotors is essential because otherwise, farmers have little interest in adopting it.

We conclude that global certification as RSPO has emerged as private governance for sustainable palm oil in developing countries. However, it remains relevant for developing countries to develop national certification schemes in order to achieve international standards and quality requirements (Kannan et al., 2021). RSPO certification alone cannot be a practical solution as it does not effectively increase the number of smallholders adopting the scheme and achieve sustainable practices at the upstream part of the palm oil value chain. In particular, the requirement of being a member of a group before entering the RSPO scheme is a barrier for smallholders. Most oil palm smallholders in Thailand are not members of a group. In that case, a national certification scheme adapted to the specific context of a developing country can be very helpful, particularly for farmers who are far from the principles and criteria of the global certification scheme. In addition, as the study shows the image of a scheme has a significant influence on smallholders' participation. Therefore, a national scheme such as Thai-GAP which is promoted by the government state is better known by the farmers than a global scheme, such as RSPO, and thus, more easily accepted. Therefore, promoting national certification schemes among farmers as a first step before upgrading to global certification is helpful. Include these factors in designing and extension, which may play multiple roles in driving smallholder farmers to prefer adoption in sustainable certification schemes. This finding repeats that the usability of sustainable certification schemes in developing countries needs to be mobilised around a particular socio-cultural context.

Therefore, this research concludes that collaboration between the private and public sectors, including civil society organizations, is essential in promoting sustainable palm oil that confirm the study of Nupueng et al., (2022). Through their collaboration, both global (RSPO) and local (Thai-GAP) voluntary sustainability certification schemes for oil palm cultivation can be adopted by smallholders in Thailand and thereby contribute to more sustainable production practices.

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