

# Tangible Financial Benefits of Palm Oil Plantations with and without Roundtable on Sustainable Palm Oil Certification in Thailand

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**Abstract** – Thailand has attempted to produce sustainable palm oil by encouraging grower-developed Roundtable on Sustainable Palm Oil (RSPO) criteria with many campaigns, but the target has still not been achieved. Here, we determined the tangible financial benefits of certified and noncertified farmers of 3 groups, namely, those with a large planting area, cooperative members, and small growers supported by palm oil mills, to illustrate the advantage of RSPO certification. The results showed that all certified groups received greater net returns than the noncertified groups, with net return differences of 0.34 baht per kilogram for large planting areas, 0.70 baht per kilogram within the cooperative group and 0.13-1.10 baht per kilogram under the group supported by palm oil mills. However, the increasingly important RSPO certification should provide knowledge to improve agricultural practices because they are affected by increasing net returns and reducing variable costs.

The government should provide financial loans for growers who want RSPO certification because of the high costs of certification and develop criteria, and grower integration can increase negotiation power to decrease the cost of production.

**Keywords** – Tangible financial benefit, palm oil, RSPO, smallholder grower, investment analysis.

## 1. Introduction

Palm oil has become the world's most produced and traded source of vegetable oil over the past 30 years [1]. Its global production increased from 120.79 million tons in 2000 to 317.57 million tons in 2017 [2], and ASEAN countries, including Indonesia, Malaysia, and Thailand, are the main areas of expansion [3]; however, there are issues concerning this rapidly growing industry, such as food security, land use change, deforestation, biodiversity loss and GHG emissions and social conflict [3], [4], [5], [6]. Many countries, including Indonesia, Malaysia, and Thailand, have looked to the Roundtable on Sustainable Palm Oil (RSPO) to develop and implement global standards for sustainable palm oil by developing a set of environmental and social criteria that companies must comply with to produce Certified Sustainable Palm Oil (CSPO) [7]. The important motivations for farmers to join RSPO projects are price premiums, improved agricultural practices, increased production, and environmental conservation [8], [9], [10], [11].

The private sector, especially palm oil mills, committees of smallholder groups, RSPO agencies in Thailand and international organizations such as Shell and GIZ, has launched many campaigns to encourage smallholders to join RSPO projects.

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The reasons for joining include 1) improved agricultural practices leading to increased palm oil production [12]; 2) obtaining premium prices for fresh fruit from palm oil mills, approximately 0.05-0.30 baht per kg (36 baht are equal to 1 US dollar) [13]; 3) palm oil mills providing financial support for RSPO certification and training courses to achieve the RSPO requirements [14], [15]; 4) much lower material prices such as for fertilizers, injection tanks, and water pumps through the bargaining power from sellers through the integration of smallholder member groups [14], [15]; and 5) obtaining extra services/benefits such as free soil and leaf analyses, free empty bunches, savings on chemical costs, and being able to sell Fresh Fruit Branch (FFB) during peak production through a fast track [15]. However, many growers have still not been convinced to join RSPO projects due to many reasons, such as the following: 1) inability of growers in Thailand to meet all of the RSPO criteria due to their age and education (near retirement and not well educated); 2) unclear government policies for CSPO production, especially subsidy policies [14]; 3) insufficient increased revenue from the premium price to incentivize growers to join RSPO compared with the growers' economic losses when implementing RSPO projects [14], [16], [17]; and 4) the lack of knowledge and, most importantly, financial support, among growers [12], [15], [18].

Tangible financial benefits are a very important indicator incentivizing growers to join RSPO projects; however, only a few studies have clarified the financial benefits of RSPO certification in Thailand to obtain indicators of tangible financial benefit and advance the production, procurement, finance and use of sustainable palm oil products to encourage growers to join RSPO projects [15], [19], [20], [21]. Meanwhile, comparing tangible financial benefits between CSPO growers and non-CSPO growers in Thailand [15], [19]. However, previous studies of tangible financial benefits are still limited in terms of the tangible financial benefit of the differences in management patterns of small grower member groups, areas of study, and sampling populations (mostly studying only growers). This study attempted to complement the previous studies to determine tangible financial benefits of CSPO versus noncertified palm oil in Thailand by classifying the management patterns of the growers into 3 groups: those with a large planting area, small growers operating through cooperative concepts and regulation, and small growers who are supported by palm oil mills; furthermore, CSPO groups were compared with the respective non-CSPO groups. Moreover, this study tried to expand sampling to focus not only on growers but also on government agencies, RSPO agencies, palm oil mills and leaders

of palm oil associations. This study employed a traditional indicator, namely, total cost, including fixed costs and variable costs, total revenue including palm fruit and palm branch income but excluding certification fees and net returns to estimate the financial benefit [15], [19], [20] [22], [23] in Thai measurement units (baht per rai by exchange rate, where 1 USD is approximately 35 baht and 1 Ha is approximately 6.25 rai) [15], [19], [20] [23]

Moreover, this paper focuses on Surat Thani and Krabi provinces, which have the largest palm oil plantation areas and CSPO areas in Thailand, with 60% of the total CSPO in Thailand and 75% of the total number of CSPO palm oil growers in Thailand [24] to obtain financial indicators and advance the production, procurement, finance, and use of sustainable palm oil products to encourage growers to join RSPO projects.

This paper is arranged into five sections. Section two presents the current situation and government regulations on CSPO in Thailand. Section three explains the study area, data collection, and methodology. Section four discusses the key findings and discussion, while the last section provides a few key policy implications.

## 2. Literature Review

Thailand started producing Certified Sustainable Palm Oil (CSPO) commercially in 2008 through Univanich Palm Oil Public Company, Limited, followed by United Palm Oil Industry Public Company, Limited, as the first CSPO growers [25]. Currently, 4,624 oil palm growers are RSPO certified with approximately 38,188 Ha certified under 19 member groups; meanwhile, 6 member groups representing approximately 462 oil palm growers have joined the RSPO project and are still in the certification process, and these growers include Palmtongkum RSPO Community Enterprise and Aoluek Land Settlement Cooperative, Limited [25]. A previous study found that the most successful management model for receiving RSPO certification for the smallholder oil palm grower member group was support by palm oil mills (approximately 72% of the total certified groups) (Table 1). Moreover, internal success factors for RSPO include the vision and knowledge of the president and the board of directors, grower integration and the sharing of management information, grower assistance with solving management problems for new members, and the management of group benefits, such as concrete interests and financial viability [14]. External factors affecting the success rate of the RSPO application are financial and technical support from oil palm mills, using mill territory as a group meeting point, and hiring a group administrator.

Farmers receive the income difference, amounting to 0.05-0.30 baht per kilogram, between selling the product directly to the factory and selling to the nonparticipants [14]. The CSPO grower community increased from approximately 423 persons in 2014 to 1,151 persons in 2015, increasing by 172.10%, whereas the total certified area in 2015 increased by 321 Ha, approximately 1.90%. In 2018, the total certified sustainable palm oil (MT) was

approximately 45,667 (MT), increasing by 142% from the previous year through a cultivation area of approximately 90% of the total certified area. In the case of certified fresh fruit branch (FFB), the total certified FFB was approximately 18-20% of the total domestic FFB, with a total certified FFB of 29,245 MT, 19,838 MT and 45,667 MT during 2016-2018, respectively. (Table 2)

Table 1. Information on CSPO smallholder oil palm growers, including member group, certified area, number of palm oil growers and type of group

No Group Type	Certified Area	Grower of Palm Oil	
	(Ha)	(Persons)	
1 UPOIC Nuakhlong-Khaopanom	1,871	236	1
2 Univanich Palm Oil Public Company, Limited	5,955.60	1	2
3 United Palm Oil Industry Public Company, Limited	4,158.95	1	2
4 Trang Sustainable Palm Oil Grower Community Enterprise Network	1,544.09	156	1
5 The Sustainable Oil Palm Smallholders Production (Univanich-Plaipraya) Community Enterprise Group	1,343.94	170	1
6 Tapi-Ipun Sustainable Oil Palm Community Enterprise Group	1,425.57	190	1
7 Sustainable Krabi Oil-Palm Farmers Cooperative Federation	1,164	212	3
8 Srijaroen Sustainable Oil Palm Production Community Enterprise Group	1,772.62	336	1
9 Sichon Palm Yangyuen Community Enterprise Group	539.01	175	1
10 Saikueng Bansawan Community Enterprise	2,663.81	378	1
11 Phanom Land Settlement Cooperative, Limited	1,629.60	1,214	3
12 Lumnam Kadae Pattana Oil Palm Community Enterprise Group	766.08	74	1
13 CPI RSPO Enterprise Network	2,314.08	335	1
14 Community Enterprise Growers Palm Oil and Palm Oil Sustainability Sikao-Wangwiset	976.08	119	1
15 Community Enterprise Group – Suratthani	2,211.19	74	1
16 Thappitak Community Enterprise Group	1,236.94	175	1
17 Chumporn Palm Oil Industry Public Company, Limited	3,034.48	1	2
18 Aoluek Land Settlement Cooperative, Limited	-	261	3
19 Langsuan Oil Palm Smallholders Community Enterprise	-	-	1
20 Nuakhlong-Khaopanom Community Enterprise	2,236.90	342	1
21 Smothong Sustainable Oil Palm Production Community Enterprise Group	-	51	1
22 Tha Chang Oil Palm Industries Co., Ltd.	-	1	2
23 Univanich-Plaipraya Community Enterprise Group	1,343.94	435	1
24 Sustainable Palm oil Production (Thachana-Chaiya) Community Enterprise	-	61	1
25 Palmtongkum RSPO Community Enterprise	-	88	1
<b>Total Certified</b>	<b>38,188</b>	<b>4,624</b>	
<b>Total palm oil growers waiting for certification</b>		<b>462</b>	
<b>Total palm oil growers participating in RSPO project</b>		<b>5,086</b>	

Remark: 1 = Supported by palm oil mills, 2=Large planting area and 3= Cooperative; all data collected in June 2018

Source: [26], [27], [28], [29], [30]

Table 2. Total production area, total certified area, and number of independent smallholders under group certification in Thailand, 2014-2018

Indicator/Year	2014	2015	% Δ	2016	% Δ	2017	% Δ	2018	% Δ
Total Certified Area (Ha)	16,882	17,203	1.90	12,903	-24.99	5,662	-56.11	13,973	146.78
Total Production Area (Ha)	15,301	15,607	1.99	12,311	-21.11	5,247	-57.37	12,641	140.91
% Total Certified Area of Total Production Area	90.63	90.72	Na	95.41	Na	92.67	Na	90.46	Na
Total Certified Sustainable Palm Oil (MT)	43,541	44,764	2.80	29,245	-34.66	19,838	-32.16	45,667	130.19
Total Fresh Fruit Branch (MT)	Na	Na	Na	162,492	Na	96,772	-40.44	234,286	142.10
% Total Certified Sustainable Palm Oil of Total Fresh Fruit Branch	Na	Na	Na	18.00	Na	20.50	Na	19.50	Na
Number of Independent Smallholders under Group Certification	423	1151	172.10	1336	16.07	1001	-25.07	1,669	66.73

Source: [26], [27], [28], [29], [30]

### **2.1. Background on Government Regulations for CSPO in Thailand**

Although palm oil growers in Thailand have received RSPO certification since 2008, the government still has not formulated policy to support this project, and the key main driver of success in encouraging smallholder palm oil growers to obtain RSPO certification is palm oil mills, which are directly affected by the RSPO norm [14]. The main mission of RSPO organizations is to promote the expansion and consumption of sustainable palm oil products through collaboration within the supply chain and open dialogue between stakeholders [26].

The important strategies are paying the premium price for certified fresh fruit palm oil at approximately 0.1-0.3 baht per kilogram, financial support certification in the first year, supporting a group location in the factory area, organizing the training under RSPO criteria, and organizing supply chain sales coordinators among oil palm members and potential buyers through the green palm market [14]. However, the government has launched strategies with the same RSPO mission to develop palm oil in Thailand through integrating small oil palm growers into a large plot of crops in accordance with the policy of the Ministry of Agriculture and Cooperatives to provide opportunities to access information, resources, and marketing. Oil palm growers can efficiently manage their product quantity and quality in accordance with market demand. The area manager can manage production planning throughout the supply chain [31]. According to the Oil Palm and Palm Oil Reform Strategic Plan (2017-2036), the priorities are 1) increasing the percent of oil from 17% in 2016 to 22% during 2017-2026 and 23% during 2027-2036; 2) increasing yield from 2.5 tons/rai in 2016 to 3.5 tons/rai in 2036 and increasing production areas from 5.23 million rais in 2016 to 7.23 million rais in 2036 using AGRI-Map for adaptive management; 3) creating a compulsory cultivation and harvest standard by reviewing and revising the existing standard to be more practical with the increasing the number of GAP farms; (4)

establishing a provincial mechanism and developing a distribution-contribution standard as well as implementing an oil-measuring tool at the oil palm before cutting the palm tree; (5) refining a plant standard to transform the industry to be effective, green and sustainable; and (6) setting a supply chain standard by adopting global standards [32].

### **2.2. Background on Costs, Revenue, and Tangible Financial Indicators for CSPO Smallholders**

This section attempts to clarify the cost of CSPO smallholder production, the revenue of CSPO smallholder production, and tangible financial indicators for CSPO smallholders. The significant costs of CSPO include fixed costs such as land (value of land or rental land), building construction, and VAT (paid to the government) and variable costs such as for fertilizers, labor, cultivation, pesticides and herbicides, fuel, transportation, and other costs. The main income of CSPO smallholders is fresh fruit branch income and premium prices obtained through the green palm market (Table 3).

In the case of tangible financial indicators, the net return or profit (the difference in total income and cost of CSPO smallholder production) per unit of land is widely used for analysis, and some previous studies use the internal rate of return (IRR) and return on investment (ROI). On the one hand, Indonesia, Malaysia, and Thailand are widely used for studies on CSPO smallholders focusing on certification area and the number of smallholders with RSPO certification through two main objectives: 1) finding the net return of CSPO smallholder production and 2) comparing the net return between CSPO smallholder production and non-CSPO smallholder production (Table 3). However, previous studies of tangible financial benefits are still limited in terms of comparing the net return of CSPO and non-CSPO smallholders and focusing on different management patterns of CSPO smallholder groups, namely, support by palm oil mills, large planting areas, and cooperatives (Table 3).

Table 3. Literature review on cost, revenue, area, sampling group and tangible financial indicators for palm oil plantations

Authors	[33]	[34]	[35]	[36]	[37]	[19]	[23]	[20]	[15]	[21]	[38]
<b>Revenue</b>											
Fresh fruit branch income	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Premium prices through the green palm market	✓		✓	✓	✓						
<b>Costs</b>											
<b>Fixed Costs</b>											
Land	✓	✓	✓	✓			✓				
Building Construction				✓							
Machinery				✓							
VAT							✓				
<b>Variable Costs</b>											
Fertilizer cost	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Labor cost	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Cultivation cost	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Pesticide and herbicide cost	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Fuel cost	✓					✓	✓	✓			
Transportation Cost	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
<b>Tangible financial indicators</b>											
Net present value (NPV)				✓							
Internal rate of return (IRR)			✓	✓							
Benefit-cost ratio (BCR)				✓							
Net return	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Return on investment (ROI)			✓	✓							
Payback period				✓							

Remark \* LAPS=Large Agricultural Plot Scheme

### 3. Methodology

This research aimed to compare the tangible costs and return of palm oil plantation area growers with and without roundtable on sustainable palm oil certification in Thailand in smallholder grower member groups with different management patterns.

#### 3.1. Research Case

The data were collected from Surat Thani and Krabi provinces during December 2016-November 2017, which are the two largest areas of CSPO in Thailand (the total area certified was 9,920 Ha) with 3,208.96 Ha and 2,195.68 Ha of certified land in 2015, respectively [24]. Moreover, of the 13 certified palm oil member groups and 1,165 agriculturalists in Thailand, 5 groups with a certified area of 3,208.96 Ha and 540 certified palm oil growers are distributed in Surat Thani province, and 5 groups with a certified area of 2,195.68 Ha through 336 agriculturalists are distributed in Krabi province; thus, these two provinces comprise approximately 60% of the total area certified in 75% of the total certified palm oil growers in Thailand [24]. This research tries to classify the management pattern of certified grower member groups into three groups through the planting area certified per grower and the management pattern of the certified grower group.

The 10 certified palm oil grower member groups in the sampling area were classified into three groups as follows: 1) the group comprising growers with a large planting area was representative of the planting area of palm oil mills, which is the pioneer RSPO certified in Thailand located in Krabi, namely, the Univanich Palm Oil Public Company, Limited, and United Palm Oil Industry Public Company, Limited (UPOIC). 2) The group of small growers operating through cooperatives in concept and regulation to achieve targets includes the Sustainable Krabi Oil-Palm Farmers' Cooperative Federation in Krabi Province. 3) The last group consists of small growers supported by palm oil mills, with 5 groups in Surat Thani and 2 groups in Krabi. The palm oil mills supporting the member groups started by establishing the group and recruiting members, disseminating RSPO information and regulations, offering training courses on RSPO criteria, and providing financial support for RSPO certification in the first year (the RSPO organization provides the financial support for the first year of RSPO certification, but the member group of small growers must submit a proposal to the RSPO organization). Moreover, they also encourage certification by offering premium prices for certified palm oil (approximately 0.10-0.30 baht per kg for FFB) to growers, but it cannot predispose the growers to be certified RSPO members.

### 3.2. Data Collection

This research attempted to compare tangible costs and revenue among CSPO and non-CSPO grower member groups by focusing on three groups as follows: 1) growers with a large planting area (collecting data from CSPO certified and non-CSPO growers), 2) small growers operating through cooperatives (concentrating on CSPO and non-CSPO growers who are cooperative members), and 3) small growers supported by palm oil mills (focusing on CSPO growers in 7 groups and non-CSPO palm oil growers located in the same area as the 7 certified groups). This study also collected data from stakeholders related to the cost effectiveness of palm oil, namely, 1) certified palm oil mills operating in Surat Thani and Krabi provinces, 2) government agencies collecting palm oil databases in Surat Thani and Krabi provinces and 3) leaders of palm oil associations in Krabi and Surat Thani provinces and RSPO officers in Thailand.

Mixed methods were selected to achieve the research objective through many mechanisms (Figure 1).

1) In the first step, tangible cost and revenue data were collected on the three groups above through 122 in-depth interviews with certified growers, including 2 CSPO growers with large planting areas, committee members of approximately 15 CSPO growers in the cooperative group, and committee members of approximately 15 CSPO growers for each of 7 groups among the small growers supported by palm oil mills. Moreover, this study also collected data from 9 stakeholders relating to the cost effectiveness of palm oil, namely, 1) 2 certified palm oil mills that operate in Surat Thani and Krabi provinces, 2) 4 government agencies that collect palm oil data in Surat Thani and Krabi provinces, 3) 2 leaders of palm oil associations in Krabi and Surat Thani provinces and 1 RSPO officer in Thailand. The number of interviewees and their backgrounds and timing of the interviews are shown in Table 4, and the questions and purpose of the questions are shown in Table 5. The aim of the first step was to build a database of palm oil plantations, including details such as the cost of production before yield, the cost

of production and the revenue of the palm oil yield, through the created questionnaires.

2) In the second step, the focus group, 40 certified palm oil growers and representative stakeholders of certified palm oil plantations were included to validate the data from the semi structured questionnaire before the questionnaires were completed. Moreover, this research attempted to test the consistency and validity of questionnaires by examining the Index of Consistency or I.O.C. by using 3 experts and examined the reliability of the questionnaire using Cronbach's alpha value to test the questionnaires from 57 CSPO and non-CSPO growers, which were excluded in this sampling.

3) In the third step, an in-depth interview questionnaire attempted to compare the cost competitiveness between the CSPO and non-CSPO grower groups using a quota sampling technique through Taro Yamane to calculate the sampling. This study focused on comparing three groups as follows: 1) growers with a large planting area group (data collected from 2 CSPO and 2 non-CSPO growers), 2) cooperatives (concentrating on 30 certified agriculturalists and 30 non-certified agriculturalists who are members of a cooperative), and 3) the small growers supported by palm oil mills (242 certified palm oil growers from 7 groups and 242 non-certified palm oil growers located in the same area as the certified groups) (Table 6). This study also collected data from 13 stakeholders related to the cost effectiveness of palm oil, namely, 1) 4 certified palm oil mills operating in Surat Thani and Krabi provinces, 2) 4 government agencies collecting palm oil data in Surat Thani and Krabi provinces and 3) 2 leaders of palm oil associations in Krabi Province, 1 leader of palm oil associations in Surat Thani Province and RSPO officers in Thailand. The main objective was to illustrate the cost and revenue of CSPO and non-CSPO plantations.

4) The last step was a focus group of 40 certified palm oil grower's representative of stakeholders of CSPO plantations to validate the data based on the questionnaires in terms of the costs and revenue of palm oil plantations for both CSPO and non-CSPO growers.

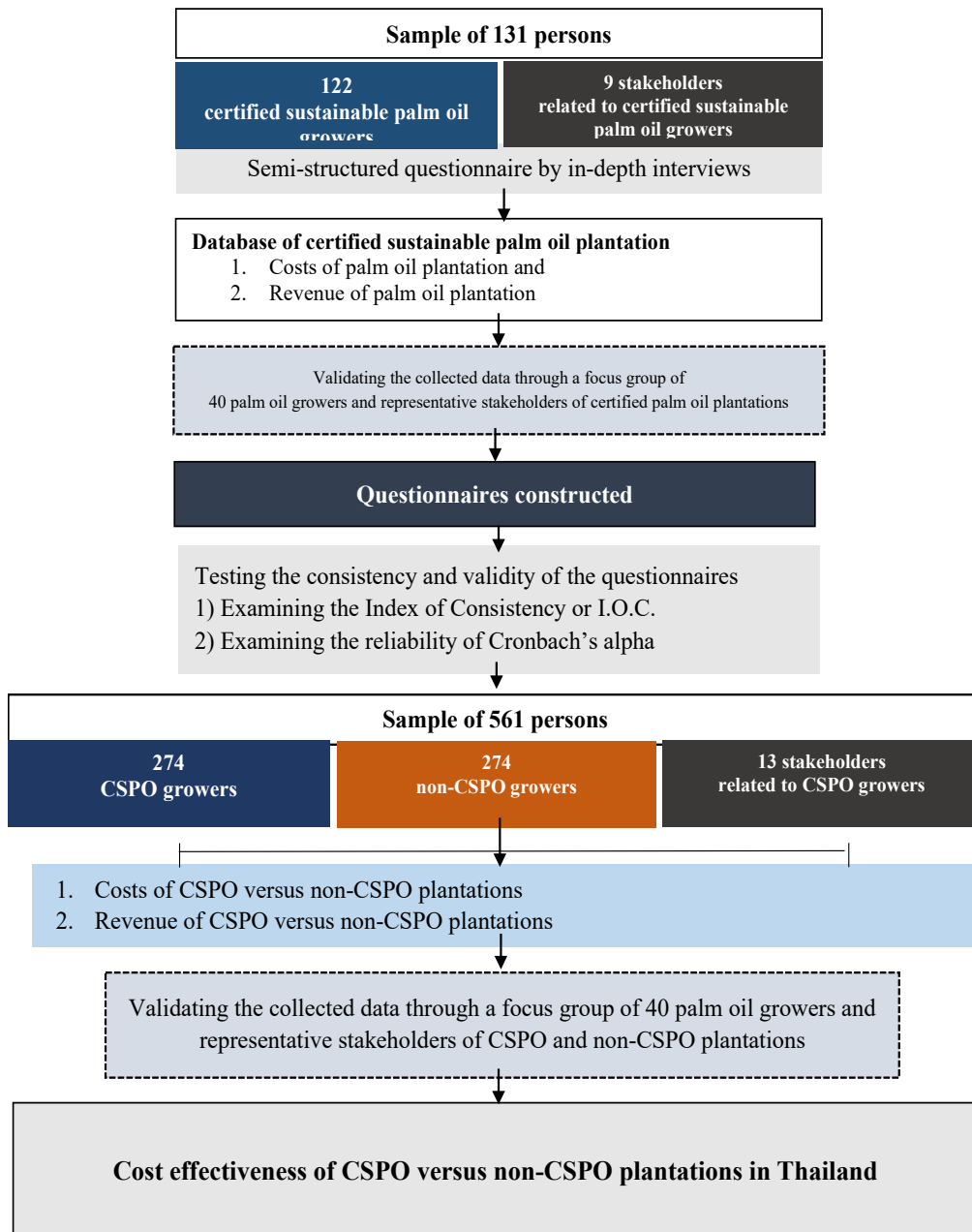


Figure 1. The methodology and process of the study

Table 4. Interviewees and their backgrounds

No	Type	Position	Frequency	
G1	Government agencies	Promoting and developing products	4	4
R1	RSPO agencies	Manager	1	1
LA	Leader of palm oil association	President	2	2
PM1	Palm oil mill	RSPO project co-coordinator	2	2
OM1	Big plantation oil palm grower	Manager or project coordinator	2	2
OM2	Oil palm grower supported by palm oil mill	President or vice president	7	7
OM3	Cooperative palm oil grower	President	1	1
OG1	Oil palm grower supported by palm oil mill	Committee member	98	98
OG2	Cooperative palm oil grower	Committee member	14	14

Table 5. Interview questions

Questions	Purpose
1. How is palm oil planted in Thailand before the harvest?	Gather data regarding the RSPO planting process before harvest
2. What are the costs of palm oil plantations for each process above?	Gather data regarding the cost of planting before harvest
3. How is palm oil planted in Thailand during the harvest?	Gather data regarding the RSPO planting process during yield
4. What are the costs of the palm oil plantation for each process above?	Gather data regarding cost of planting during harvesting periods
5. What are the revenue of the palm oil plantation?	Gather data regarding revenue of planting during harvesting periods

Table 6. The number of growers sampled in this study

NO	Name	Type	Certified area (Ha)	Growers of palm oil (person)	Sampled CSPO growers (person)	Sampled Non-CSPO growers (person)
<b>Krabi Province</b>			<b>13,723.23</b>	<b>336</b>	<b>107</b>	<b>107</b>
1	United Palm Oil Industry Public Company, Limited (UPOIC)	Large planting area	5,215.61	1	1	1
2	Univanich Palm Oil Public Company, Limited	Large planting area	5,708.60	1	1	1
3	UPOIC Nuakhlong-Khaopanom	Supported by a palm oil mill	1,697.12	159	49	49
4	The Sustainable Oil Palm Smallholders Production (Univanich-Plaipraya) Community Enterprise Group	Supported by a palm oil mill	317.00	86	26	26
5	Sustainable Krabi Oil-Palm Farmers Cooperative Federation	Cooperative	784.90	89	30	30
<b>Surat Thani Province</b>			<b>3,209.07</b>	<b>540</b>	<b>167</b>	<b>167</b>
6	Community Enterprise Group – Suratthani	Supported by a palm oil mill	449.91	75	23	23
7	Lumnarn Kadae Pattana Oil Palm Community Enterprise Group	Supported by a palm oil mill	416.35	90	30	30
8	Saikueng Bansawan Community Enterprise	Supported by a palm oil mill	1,415.22	244	72	72
9	Srijaroen Sustainable Oil Palm Production Community Enterprise Group	Supported by a palm oil mill	434.25	78	25	25
10	Tapi-Ipun Sustainable Oil Palm community Enterprise Group	Supported by a palm oil mill	493.34	53	17	17
<b>Total</b>			<b>16,932.3</b>	<b>876</b>	<b>274</b>	<b>274</b>

Source: [24]

#### 4. Results

This study examined the tangible financial benefits of CSPO versus non-CSPO growers through the following three aspects: 1) comparing the costs of CSPO versus non-CSPO plantations with large areas, 2) comparing the costs of CSPO versus non-CSPO plantations supported by a palm oil mill, and 3) comparing the costs of CSPO versus non-CSPO cooperative plantations.

##### 4.1. Tangible Costs and Revenue of CSPO Versus non-CSPO Plantations with Large Areas

For the growers with a large palm oil planting area, data were collected from 4 palm oil growers, including 2 CSPO growers (Univanich Palm Oil Public Company Limited and United Palm Oil Industry Public Company Limited (UPOIC)) and 2 non-CSPO growers. The results showed that the total variable cost of the CSPO planting area per rai (6.25 rai is equal to 1 Ha) is approximately 22 baht per rai lower than that of the non-CSPO planting area (36 baht is equal to 1 US dollar) [13] because of RSPO regulations requiring the certified growers to undergo training for palm oil planting systems on topics

including the selection of oil palm tree species, fertilizer application, irrigation, occupational health and safety by avoiding pesticides and herbicides and using natural products that are environmentally friendly substances or integrated pest management (for example, using owls to control rats in plantation areas) and fresh fruit branch quality. This leads to significantly lower pesticide and herbicide expenditures and costs of cultivation compared with those of non-CSPO growers (Table 7).

The revenue and net return of growers with large palm oil plantations showed that the total revenue and net return on large palm oil plantation area per rai for both CSPO and non-CSPO growers were positive, but the total revenue and net return of CSPO growers is approximately 2,000 baht per rai higher than those of non-CSPO growers due to the yield per rai and incentive prices for CSPO (approximately 0.30 baht per kg of fresh fruit branch) according to the certified palm oil mill policy. This study also attempted to analyze the net return, total revenue and total costs per kg, which were 3.09 baht, 5.71 baht and 2.62 baht for CSPO growers and 2.75 baht, 5.62 baht and 2.87 baht for non-CSPO growers, respectively (Table 7).



Table 7. Comparison of the total costs, total revenue, and net return of CSPO versus non-CSPO growers with a large palm oil planting area

Source	CSPO growers n=2	Non- CSPO growers n=2
<b>Variable costs</b>		
1. Labor costs excluding cultivation costs	5,617.00	4,289.00
2. Cultivation costs	500.00	700.00
3. Fertilizer costs	2,614.00	2,173.00
4. Pesticide and herbicide costs	700.00	1,018.00
5. Fuel costs	0.00*	1,273.00
<b>Total variable costs (baht per rai)</b>	<b>9,431.00</b>	<b>9,453.00</b>
Total palm fresh fruit branch (kg per rai)		
1. Palm fruit	0.00	280.00
2. Palm branch	3,600.00	3,019.00
Price of palm fresh fruit branch (baht per kg)		
1. Palm fruit	0.00	7.91
2. Palm branch	5.71	5.41
<b>Total revenue (baht per rai)</b>	<b>20,556.00</b>	<b>18,548.00</b>
<b>Net return (baht per rai)</b>	<b>11,125.00</b>	<b>9,095.00</b>
<b>Total revenue (baht per kg)</b>	<b>5.71</b>	<b>5.62</b>
<b>Total variable costs (baht per kg)</b>	<b>2.62</b>	<b>2.87</b>
<b>Net return (baht per kg)</b>	<b>3.09</b>	<b>2.75</b>

Remark: \* the fuel cost is calculated in the cultivation cost.

#### 4.2. Tangible Costs and Return of Small CSPO Versus non-CSPO Growers Supported by Palm Oil Mills

According to our study, the revenue of CSPO farmers is higher than that of non-CSPO farmers. The results indicate that Sustainable Oil Palm Smallholders Production (Univanich-Plaipraya) has the highest revenue of 22,123.60 baht/rai. The second highest revenue belongs to the Srijaroen Sustainable Oil Palm Production Community Enterprise Group with 21,661.28 baht/rai. Regarding non-CSPO farmers, Saikueng Bansawan Community Enterprise has the highest income of 17,598.00 baht/rai, followed by Community Enterprise Group – Suratthani with 17,227.21 baht/rai (Table 8).

With respect to the certified member groups, the Suratthani Sustainable Palm-Oil Grower Community Enterprise and Naam Ka-Dae Palm-Oil Developer Community Enterprise are the groups with the lowest income, 20,537.00 baht/rai and 20,280.87 baht/rai, respectively. For the noncertified member groups, the farmers with plantation areas in UPOIC - Neua Klong-Khao Phra Nom and Ying-Yeun Sri Chareon Community Enterprise have the lowest revenue, 16,451.44 baht/rai and 16,617.47 bath/rai, respectively (Table 8).

In the comparison of the net revenue per rai, the CSPO farmer groups had higher revenue per rai than the non-CSPO farmer groups, i.e., Saikueng Bansawan Community Enterprise had the peak revenue of 4.35 baht/kg, followed by Community Enterprise Group – Suratthani with 4.19 baht/kg. Community Enterprise Group – Suratthani and Saikueng Bansawan Community Enterprise are the top two noncertified farmer groups, having the highest net revenue per rai of 4.3 and 3.59 baht/kg, respectively.

The results showed that the CSPO group received a net return greater than that of the non-CSPO group, with a difference of approximately 0.05-1.10 baht per kilogram. The lowest higher net return among CSPO versus non-CSPO groups is Saikueng Bansawan Community Enterprise, approximately 0.05 baht per rai (CSPO groups with a net return of 4.35 baht per rai and non-CSPO groups with a net return of 4.30 baht per rai); meanwhile, Tapi-Ipun Sustainable Oil Palm Community Enterprise Group had the highest net return of 1.10 baht per kilogram (CSPO groups with a net return of 4.29 baht per rai and non-CSPO groups with a net return of 3.19 baht per rai) (Table 8).

The results showed that chemical fertilizers are the main variable cost of palm oil production, similar to the findings of Thongrak and Kiatpathomchai [15] and Jaisamut *et al.* [19].

Table 8. Comparison of the costs and revenue of palm oil production per rai among the CSPO and non-CSPO groups

Variables	Tapi-Ipun Sustainable Oil Palm Community Enterprise Group		Srijaroen Sustainable Oil Palm Production Community Enterprise Group		Saikueng Bansawan Community Enterprise		Community Enterprise Group – Suratthani	
	CSPO n=17	Non-CSPO n=17	CSPO n=25	Non-CSPO n=25	CSPO n=72	Non-CSPO n=72	CSPO n=23	Non-CSPO n=23
<b>Variable Costs</b>								
1. Labor costs	2,145.00	3,024.00	2,517.00	2,636.00	1,772.00	1,872.00	2,224.00	1,174.00
2. Cultivation costs	1,094.00	1,238.00	987.00	1,030.00	1,216.00	988.00	1,668.00	1,578.00
3. Fertilizer costs	1,726.00	1,951.00	1,691.00	1,972.00	1,338.00	2,598.00	512.00	439.00
4. Pesticide and herbicide costs	0.00	153.00	50.00	75.00	0.00	121.00	-	65.00
5. Fuel costs	200.00	550.00	420.00	200.00	302.00	440.00	195.00	320.00
<b>Total variable costs (baht per rai)</b>	<b>5,165.00</b>	<b>6,916.00</b>	<b>5,665.00</b>	<b>5,913.00</b>	<b>4,628.00</b>	<b>6,019.00</b>	<b>4,599.00</b>	<b>3,576.00</b>
Total palm fresh fruit branch (kg per rai)								
1. Palm fruit	0.00	15.00	4.00	10.00	0.00	21.00	38.00	9.00
2. Palm branch	3,689.00	3,061.00	3,768.00	3,057.00	3,811.00	3,224.00	3,662.00	3,172.00
Price of fresh fruit branch (baht per kg)					7.64	7.41		
1. Palm fruit	8.19	7.91	8.24	7.91	5.67	5.41	7.53	7.41
2. Palm branch	5.69	5.41	5.74	5.41			5.53	5.41
<b>Total revenue (baht per rai)</b>	<b>20,990.41</b>	<b>16,678.66</b>	<b>21,661.28</b>	<b>16,617.47</b>	<b>21,494.00</b>	<b>17,598.00</b>	<b>20,537.00</b>	<b>17,227.21</b>
<b>Net return (baht per rai)</b>	<b>15,825.41</b>	<b>9,762.66</b>	<b>15,996.28</b>	<b>10,704.47</b>	<b>16,866.00</b>	<b>11,579.00</b>	<b>15,938.00</b>	<b>13,651.21</b>
<b>Total revenue (baht per kg)</b>	<b>5.69</b>	<b>5.45</b>	<b>5.75</b>	<b>5.44</b>	<b>5.64</b>	<b>5.46</b>	<b>5.61</b>	<b>5.43</b>
<b>Total variable cost (baht per kg)</b>	<b>1.40</b>	<b>2.26</b>	<b>1.50</b>	<b>1.93</b>	<b>1.21</b>	<b>1.87</b>	<b>1.26</b>	<b>1.13</b>
<b>Net return (baht per kg)</b>	<b>4.29</b>	<b>3.19</b>	<b>4.25</b>	<b>3.50</b>	<b>4.43</b>	<b>3.59</b>	<b>4.35</b>	<b>4.30</b>
Variable	Lumnam Kadae Pattana Oil Palm Community Enterprise Group		UPOIC Nuakhlong-Khaopanom		The Sustainable Oil Palm Smallholders Production (Univanich-Plaipraya)		Sustainable Krabi Oil-Palm Farmers Cooperative Federation	
	CSPO n=30	Non-CSPO n=30	CSPO n=49	Non-CSPO n=49	CSPO n=26	Non-CSPO n=26	CSPO n=30	Non-CSPO n=30
<b>Variable costs</b>								
1. Labor costs	2,637.00	2,028.00	2,391.00	2,825.00	2,117.00	2,411.00	2,225.00	2,657.00
2. Cultivation costs	978.00	1,098.00	1,300.00	1,097.00	1,612.00	2,015.00	1,091.00	1,220.00
3. Fertilizer costs	2,379.00	2,394.00	2,452.00	2,471.00	1,952.00	1,837.00	1,804.00	1,871.00
4. Pesticide and herbicide costs	113.00	98.00	271.00	519.00	108.00	134.00	124.00	203.00
5. Fuel costs	458.00	600.00	459.00	570.00	591.00	393.00	387.00	400.00
<b>Total variable costs (baht per rai)</b>	<b>6,565.00</b>	<b>6,218.00</b>	<b>6,873.00</b>	<b>7,482.00</b>	<b>6,380.00</b>	<b>6,790.00</b>	<b>5,631.00</b>	<b>6,351.00</b>
Total palm fresh fruit branch (kg per rai)								
1. Palm fruit	144.00	32.00	0.00	15.00	0.00	14.00	30.00	9.00
2. Palm branch	3,309.00	3,075.00	3,721.00	3,019.00	3,895.00	3,177.00	3,707.00	3,272.00
Price of fresh fruit branch (baht per kg)								
1. Palm fruit	7.79	7.41	7.69	7.91	8.18	7.91	7.65	7.91
2. Palm branch	5.79	5.41	5.69	5.41	5.68	5.41	5.65	5.41
<b>Total revenue (baht per rai)</b>	<b>20,280.87</b>	<b>16,872.87</b>	<b>21,172.49</b>	<b>16,451.44</b>	<b>22,123.60</b>	<b>17,298.31</b>	<b>21,174.05</b>	<b>17,772.71</b>
<b>Net return (baht per rai)</b>	<b>13,715.87</b>	<b>10,654.87</b>	<b>14,299.49</b>	<b>8,969.44</b>	<b>15,743.60</b>	<b>10,508.31</b>	<b>15,543.05</b>	<b>11,421.71</b>
<b>Total revenue (baht per kg)</b>	<b>5.87</b>	<b>5.43</b>	<b>5.69</b>	<b>5.45</b>	<b>5.68</b>	<b>5.44</b>	<b>5.71</b>	<b>5.43</b>
<b>Total variable cost (baht per kg)</b>	<b>1.90</b>	<b>2.02</b>	<b>1.85</b>	<b>2.48</b>	<b>1.64</b>	<b>2.14</b>	<b>1.52</b>	<b>1.94</b>
<b>Net return (baht per kg)</b>	<b>3.97</b>	<b>3.41</b>	<b>3.84</b>	<b>2.97</b>	<b>4.04</b>	<b>3.31</b>	<b>4.19</b>	<b>3.49</b>

Remark: The labor costs exclude the cultivation costs

**4.3. Costs and Revenue of the Cooperative Farmers – The Comparison Between CSPO and non-CSPO Farmers**

The CSPO farmer cooperatives have a variable cost of 5,631 baht/rai, total revenue of 21,174.05 baht/rai, and 15,543 baht per rai of net revenue, or 5.71 baht/kg. These CSPO farmers also have a cost of 1.52 baht/kg and yield net revenue of 4.19 baht/kg. Meanwhile, the non-CSPO farmers have variable

costs of 6,351 baht/rai, a total income of 17,772.712 baht/rai and a net income of 11,421.72 baht/rai, or 5.43 baht/kg. The total cost of non-CSPO farmers is equal to 1.94 baht/kg, and the net revenue is 3.49 baht/kg.

According to our study, the revenue of CSPO farmers is 3,400 baht/rai greater than that of non-CSPO farmers. Considering net revenue, the net revenue of CSPO farmers is 0.7 baht/kg higher than that of non-CSPO farmers (Table 9).

Table 9. Comparison of the total costs, total revenue and net return of CSPO versus non-CSPO cooperative growers

Sustainable Krabi Oil-Palm Farmers Cooperative Federation		
Variable	CSPO n=30	Non-CSPO n=30
<b>Variable costs</b>		
1.Labor costs	2,225.00	2,657.00
2.Cultivation costs	1,091.00	1,220.00
3.Fertilizer costs	1,804.00	1,871.00
4.Pesticide and herbicide costs	124.00	203.00
5.Fuel costs	387.00	400.00
<b>Total variable costs (baht per rai)</b>	<b>5,631.00</b>	<b>6,351.00</b>
Total palm fresh fruit branch (kg per rai)		
1. Palm fruit	30.00	9.00
2. Palm branch	3707.00	3272.00
Price of fresh fruit branch (baht per kg)		
1. Palm fruit	7.65	7.91
2. Palm branch	5.65	5.41
<b>Total revenue (baht per rai)</b>	<b>21,174.05</b>	<b>17,772.71</b>
<b>Net return (baht per rai)</b>	<b>15,543.05</b>	<b>11,421.71</b>
<b>Total revenue (baht per kg)</b>	<b>5.71</b>	<b>5.43</b>
<b>Total variable cost (baht per kg)</b>	<b>1.52</b>	<b>1.94</b>
<b>Net return (baht per kg)</b>	<b>4.19</b>	<b>3.49</b>

**5. Discussion**

1) The results of the study suggest that CSPO farmers have lower costs of production due to the supporting policies from palm oil mills. Moreover, those farmers can have bargaining power when purchasing production equipment such as injection tanks, spades, water pumps, scythes, and carts. Notably, CSPO farmers use fewer chemical products.

To reduce the costs of production, they formulated their own fertilizers. These findings are in good agreement with those of a previous study, i.e., [15], except that this study found higher labor costs for certified farmers, which corresponds to the RSPO standard, and the result agrees with [19] (Table 10).

2) Regarding palm oil revenue, the benefits per rai were larger for CSPO farmers than for non-CSPO farmers. The reason could be that they have both a higher FFB per rai and a higher FFB sale price (premium price between 0.05- 0.30 baht per kg),

leading to a higher income [15], [19] (Table 9). However, the revenue from selling CSPO through the Green Palm market via the Book & Claim (B&C) option by each certificate represents a ton of CSPO.

3) When comparing the returns for all 10 CSPO farmers with the suitable soil layer for the palm oil plantation map suggested by the Land Development Department, the study found that plantations in highly suitable soil yielded lower returns than those in less suitable soil. This result indicates that palm oil production and returns can be affected by other factors, e.g., palm oil plantation management, including adapting the results of soil and leaf analyses to fertilization. Farmers used mixed chemical fertilizers, especially nitrogen, potassium and phosphorus chemical fertilizer substitutes, buying famous standard chemical fertilizer formulas (lower price than standard chemical fertilizer formulas), which can reduce the costs of production and yield more quality palm oil (Figure 2).

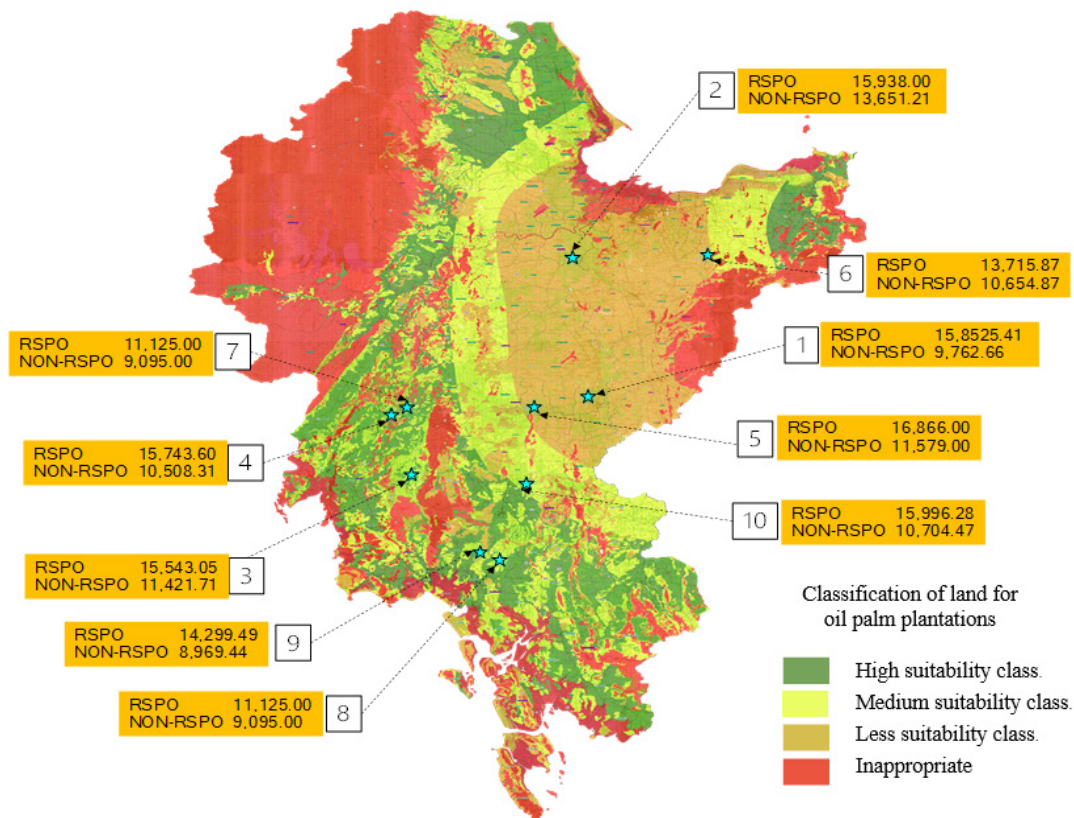


Figure 2. Costs and returns categorized by the suitability of land for palm oil plantations. Source: [39]

4) Regarding net revenue, CSPO farmers are worthy of investment because the net revenue shows a positive trend. The result is consistent with the literature [15], [19], [20], [23]. The same positive trend of net revenue was found in Papua New Guinea, approximately 101,381.39 USD per Ha [22]. In addition, CSPO farmers have higher net revenue than non-CSPO farmers. This finding also agrees with past research [15], [19] (Table 10).

5) Based on the costs and revenue of RSPO growers in this study compared with previous studies, the opposite perspective was obtained in terms of variable costs. Previous studies illustrated that chemical fertilizer costs are a key driving cost of production, followed by cultivation costs with 34%-50% and 21%-32% of the total variable cost, respectively. Meanwhile, labor costs excluding cultivation costs and chemical fertilizer costs were the main costs of production in this study, with 39% and 30%-32% of the total variable costs, respectively

The main reasons for the decreased chemical fertilizer costs were as follows: 1) since 2014, the costs of imported chemical fertilizer decreased, with an average growth rate of approximately 1%-5% depending on the type of chemical fertilizer [40] Small growers started mixing chemical fertilizer formula substitutes using standard chemical fertilizer formulas, leading to decreasing costs. 2) Small growers widely used chemical fertilizers as recommended by the palm oil leaf and soil analyses, increasing FFB and decreasing costs.

The national minimum wage rate increased in 2016-2018, with an average growth rate of 6.66%, by increasing approximately 2.66% and 3.89% in 2017 and 2018, respectively [41]. Moreover, over 50% of the smallholder growers older than 50 years old were limited by the few activities in CSPO farm management (i.e., mowing in the field and applying chemical fertilizers to palm plantations) [14], leading to increased labor costs through hiring local labor instead.

Table 10. Comparing the CSPO costs and revenue of this study with those of other previous studies

Variable	Researcher						
	[20]	[19]	[15]	[23]	This study: Growers with a large planting area	This study: Small growers in a cooperative	This study: Small growers supported by palm oil mills
Area of study	Surat Thani Province, Thailand	Krabi Province, Thailand	Thailand	Prachuap Khiri Khan Province, Thailand	Surat Thani Province and Krabi Province, Thailand		
<b>Variable costs:</b>							
Chemical fertilizer costs	1,396.00	2,730.31	2,170.00	-	2,614.00	1,804.00	1,721.00
Organic fertilizer costs	-	-	-	-	-	-	-
Labor costs excluding cultivation costs	550.00	678.85	332.00	-	5,617.00	2,225.00	2,258.00
Pesticide and herbicide costs	-	-	168.50	-	700.00	124.00	77.00
Cultivation costs	1,310.00	1,480.12	901.00	-	500.00	1,091.00	1,265.00
Transportation costs	627.00	670.31	535.90	-	-	-	-
Fuel costs	-	-	147.90	-	-	387.00	375.00
Other costs	139.00	-	-	-	-	-	-
Total cost (baht per rai)	4,022.00	5,559.58	4,255.40	4,028.48	9,431.00	5,631.00	5,696.00
Total FFB (kg per rai)	3,377.00	3461.13	2,843.30	1,107.60	3,600.00	3,737.00	3,771.00
Total revenue (baht per rai)	-	14,294.48	10,538.70	25,873.78	20,556.00	21,174.05	21,332.22
Net return (baht per rai)	-	8,734.90	6,283.30	-	11,125.00	15,543.05	15,636.22

Source: [15], [19], [20], [23]

## 6. Conclusion

This research focused on the costs and return of CSPO versus non-CSPO farmers. The study used semistructured questionnaires and conducted questionnaires with 561 stakeholders of the palm oil industry, including 1) 274 CSPO farmers in Krabi and Surat Thani provinces (including 2 farmers with a large plantation area, 30 certified agriculturalists in the cooperative group, and 242 farmers supported by palm oil mills); 2) 274 non-CSPO farmers in Krabi and Surat Thani provinces with the same proportions of samples as the CSPO group to compare the CSPO and non-CSPO results; and 3) 4 certified palm oil mills operating in Surat Thani and Krabi provinces, 4 government agencies collecting palm oil data in Surat Thani and Krabi provinces, and RSPO-related stakeholders in Surat Thani and Krabi provinces. The findings of this study show higher net returns per rai for CSPO farmers versus non-CSPO farmers. Regarding the costs of production, the farmers who received support from palm oil mills have lower costs of production than non-CSPO farmers.

The study finds that the expenditures of supported farmers are lower than those of unsupported farmers because mills sell palms at a lower price to those farmers. In addition, the plantations costs of supported farmers, e.g., layout design and hole drilling, are lower than those of unsupported farmers because the educational support from mills helps farmers understand palm oil plantations and optimize their plantation management. With respect to the cooperative group, the study indicates that CSPO farmers have lower costs of production than non-CSPO farmers because the latter normally buy noncertified and low-quality palms and also bring palm oil trees that grew from replanting. For plantation preparation, uneducated farmers without academic advice have a higher cost of production, leading to approximately lower net returns of 4,100 baht per rai versus CSPO farmers.

According to our results on the costs of production, the revenue of a rai of palm oil produced by the farmers with a large plantation area farmers, i.e., the CSPO companies, have a higher net return of 11,125.00 baht/rai, total revenue of 20,556.00 baht/rai, and variable costs of 9,431.00 baht/rai.



When considering the baht/kg, the net return of CSPO farmers is approximately 3.09 baht/kg, the total revenue is 5.71 baht/kg, and the total cost is 2.62 baht/kg. Large non-CSPO enterprises have a net return of 9,095.00 baht/rai, total revenue of 18,548.00 baht/rai, and variable costs of 9,453.00 baht/rai, or 2.75 baht/kg net return, 5.62 baht/kg total revenue, and a total cost of 2.87 baht/kg.

Regarding the policy implications, our study of costs and returns found that good management of oil palm plantations results in higher net returns and leads to reductions in variable costs. Therefore, academic advice should be given to farmers regarding good palm oil plantation management, including fertilizer application, soil analyses, leaf analyses, and the use of fertilizer formulas to reduce production costs. Second, the application for RSPO certification takes approximately 2 years to prepare and requires a considerably high budget, and many indicators need to be met (132 indicators of P&C 2016). If farmers do not have sufficient capital, they cannot participate in the project. Therefore, the relevant agencies should contribute some initial financial assistance, which can be in the form of low-interest loans or seeking supporting funds from both domestic and international agencies. Last, farmers will get together to purchase production factors resulting in less expensive costs than the actual market. Therefore, farmers should be grouped to create bargaining power from the seller to reduce production costs.

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