



## **A Future Scenario of Oil Palm throughout Thailand and Adjustment Management Guidelines for Oil Palm Farmers:**

### **A Case Study of Global Warming**

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#### **Abstract**

The research on the Future Scenario of Oil Palm in Thailand and Adjustment Management Guidelines of Oil Palm Farmers: A Case of Global Warming was studied by utilizing mixed methods. The first is the qualitative research emphasizing content analysis by using in-depth interview, focus group and the foresight research to create scenario planning. The other is the qualitative research using the survey method. Results of the study were revealed as follows:

1) There are four scenarios likely to occur in the next five years (2015–2019): (1) Previous Good Deeds, representing farmers who suffered from droughts and floods; (2) One Hardship Piling on Another, representing farmers who take a risk as they sell oil palm as primary goods to the palm yard and use the same variety of oil palm that affect their subsistence in terms of changing their occupation or growing other plants to replace oil palm; (3) Fight until Getting Rich, showing farmers who are willing to grow oil palm with standard production following the Roundtable on Sustainable Palm Oil (RSPO) standards for Bio-energy controlled by good plantation management and environmental preservation; and (4) Bright and Sustainable Future, describing farmers who grew oil palm following RSPO standards, including applying a suitable variety that has high yield per rai. The support system could be technology in oil palm planting and other processing products.

2) Adjustment Management Guidelines were given for the appropriate fertilizing and growing method in a friendly environment, including gaining RSPO standards which help restore soil in a long term. Eventually, it will help farmers be able to sell carbon credit in the future.

**Keywords:** Scenario of Oil Palm, Adjustment Management Guidelines, Global Warming

#### **Introduction**

Climate change is a consequential phenomenon from global warming as a result of abnormal greenhouse effect by continuous greenhouse gas emission (Chinwanno, 2012). All regions worldwide have encountered natural disasters such as droughts, floods, and storms, which have been continuously increased in terms of the intensity and frequency. Their effects have been widespread worldwide and in all sectors and become a serious global environmental issues and involving everyone in the society.

Such issues have raised attention from global and Thai societies and for the global warming and climate change (Office of Agricultural Economics Region 1–11, Office of Agricultural Economics, 2013). These inevitably cause direct and indirect effect against Thai agricultural sector, as it has suffered from drought and floods, causing damages to agricultural products and quality of the environment (Ministry of Natural Resources and Environment, 2010). There is an anticipation about the greenhouse gas emission in Thailand that it will increase from 2000 (equivalent to 2.29 billion tons of carbon dioxide) to be double in 2020, which is approximately equivalent to 4.89–5.58 billion tons of carbon dioxide, and will be 3 times in 2030, around equivalent to 7.15–7.64 billion tons of carbon dioxide (Working Group 1: Scientific Basic of Climate Change, The Thailand Research Fund, 2011).



In consideration to the agricultural sector in Thailand, it was found that oil palm has been a Thai industrial crop; in 2013 there are 4.5 million rai of palm cultivated areas, with yielding areas of 3.9 million rai and products of 12.8 million tons. The biggest palm cultivated areas are in the south of Thailand, namely Krabi, Surat Thani, Chumphon, Satun, and Trang provinces (Office of Agricultural Economics, 2014a). Since oil palm grows well in tropical weather, good quality of soil and with rainfall more than 2,000 millimeter/year and high dispersion, the south of Thailand suits this with good soil and all year rainfall (Srisuwan, 2011).

According to the research by the Office of Agricultural Economics Region 1-11, Office of Agricultural Economics (2013), it was found that one kilogram of oil palm products can cause greenhouse gas emission through palm cultivation in Thailand, equivalent to 0.044443 kilogram of carbon dioxide (kg CO<sub>2</sub> eq). It can be identified as the value of greenhouse gas emission from cultivation equals to 0.042564 kg CO<sub>2</sub> eq., accounted for 95.77% of greenhouse gas emission in Thailand. The value of greenhouse gas emission from production factor transportation equals to 0.001879 kg CO<sub>2</sub> eq., accounted for 4.23% of the whole greenhouse gas emission in Thailand.

The selective alternative for the preparation of effects from climate change needs to be based on multi disciplines in comprehensive dimensions and levels, knowledge and reliable information in order to set policy to cope with, enhance ability of adjustment, and reduce loss towards practical implementation (Working Group 1: Scientific Basic of Climate Change, The Thailand Research Fund, 2011). As determining an alternative is significant for the future, the concept of future scenario was used as a tool for determining perception concerning the future environmental alternative, no matter what kinds of future will be generated as part of planning. It concerns strategies related to tools and technologies for coping with uncertainty of the future by foresight for possible future as future scenarios or probable futures, which involve forecasting and desired futures (Thieanphut, 2008). The outstanding part of the future scenario techniques is not the forecasting but an out of the box thinking through considering matters related to interesting issues.

Different probable or even improbable trends are gathered and presented in overall for what is most likely to happen (Sae-Jiu, 2000; Best, 2013). It is a proposal of alternatives for preparation to cope with uncertainty (Fuller-Love, Midmore, Thomas, and Henley, 2006). Therefore, future scenario is deemed as one out of 25 most popular for management tools and is used as a tools for strategies determiner to better foresee future probability (Decharin, 2003).

Previously, it was found that there have been a certain number of researches concerning climate change and global warming which are only in the initial phase research, especially the use of future scenario concept towards preparation to cope with the mentioned effects. Therefore, this research applies the concept of future scenarios as research tools to foresee the future and to plan for scenarios of oil palm in different probable scenarios; namely one positive or desirable future scenario (scenario +, +), two potential scenario (scenario +, -), and one negative or undesirable future scenario (scenario -, -). Then a questionnaire was created, based on such information to collect data from oil palm cultivating farmers to see backward or back cast and verify the probable alternatives of future scenarios and the Adjustment Management Guidelines for oil palm farmers before implementation. This will provide information for adjustment planning to prepare for climate change, which will eventually reduce risks of agricultural profession, lead to a more stable living in the future and bring about stable and sustainable development for prosperity of the nation.



## Research Objectives

1. To present the future scenarios of oil palm in Thailand in the next five years (2015–2019)
2. To study management guideline for oil palm farmers' adjustment

## Research Method and Materials

### Research Methodology and Scope of the Research

This research was a mixed method research, conducting qualitative research through the content analysis, in-depth interview and focus group discussion. The research results were presented through expository description to respond to objective no.1. The quantitative research was conducted through the survey. A questionnaire was designed. The data was statistically analyzed in order to respond to the objective no.2.

### Scope of the Research

**Scope of Research Population:** **Group 1** were experts and qualified persons in global warming and climate change as well as in agricultural sectors from government and private agencies to collect data through in-depth interviews on Future scenarios of oil palm in Thailand in the next five years (from 2015–2019). It was done by foreseeing the future and creating four different probable future scenarios concerning oil palm namely; one positive future scenario or desirable scenario, two potential scenarios and one negative future scenario or undesirable scenario. **Group 2** were oil palm farmers who experienced floods and droughts. Data was collected through focus group discussion among farmers. Then the questionnaire was created to collect data concerning the adjustment management guidelines for oil palm farmers. **Group 3** were executives from private sectors in oil palm businesses. The data was collected through in-depth interview to gather information for the adjustment management guidelines for oil palm farmers as well as suggestions on operational guidelines for government agencies to support potentiality development of future oil palm **Group 4** were oil palm farmers from the southern part of Thailand. Data was collected through the questionnaires concerning the future scenario of oil palm in Thailand in the next five years (from 2015–2019) and the adjustment management guidelines for oil palm farmers in order to back casting verify before implementation.

**Scope of the Content** consists of topics on global warming, states of climate change affecting the agricultural sector and oil palm crop in Thailand, Future research techniques, and content analysis.

### Research Tools

1. The in-depth interview form for the future scenarios of oil palm in Thailand in the next five years (from 2015–2019) through the foresight, creating four different probable future scenario concerning oil palm: one positive future scenario or desirable scenario; two potential scenario; and one negative future scenario or undesirable scenario, including the adjustment management guidelines for oil palm farmers as well as suggestions on operational guidelines for government agencies to support potentiality development of future oil palm
2. The questionnaires concerning the future scenario of oil palm and the adjustment management guidelines for oil palm farmers

### Data Collection Method

1. To created the future scenario of oil palm in Thailand in the next five years (from 2015–2019), the data was collected by using the in-depth interview form with experts and qualified persons in global warming and climate change as well as in agricultural sector from government and private agencies. The qualifications of experts



and qualified persons were: 1) being knowledgeable and having experience in doing oil palm researches; 2) having experience in future scenario analysis; and 3) being a scholar or faculty in government or private academic institute.

2. Regarding the adjustment management guidelines for oil palm farmers, the data was collected by using the focus group discussion form with: 1) oil palm farmers who experienced floods and droughts; 2) in-depth interview with private sector executives involving in oil palm businesses. The topics were about buying fresh palm and educating oil palm farmers, as well as participating with community in environmental preservation for and the adjustment management guidelines for oil palm farmers and the suggestions on operational guidelines for government agencies to support potentiality development of future oil palm.

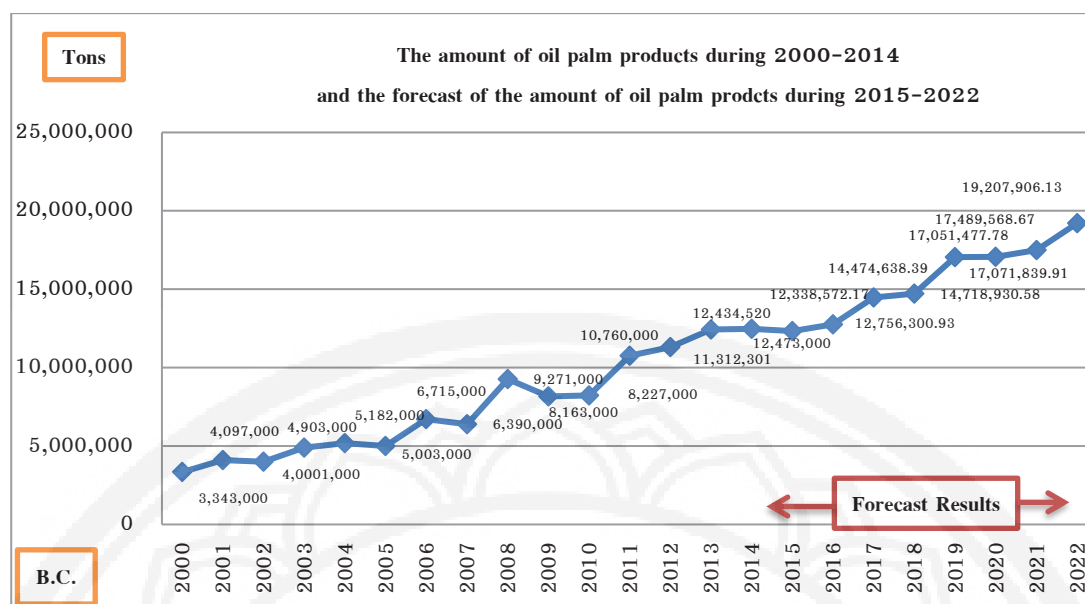
3. On the future scenario of oil palm in Thailand in the next five years (from 2015–2019) and the adjustment management guidelines for oil palm farmers. The data was collected through questionnaires with oil palm farmers from the southern part of Thailand, since it accounts to 86% of the whole oil palm plantation areas. Thus, it was determined to collect data from oil palm farmers in the southern part of Thailand by using Proportional Stratified Sampling according to the proportion of population in each province in the south of Thailand. The proper number of sample was 394 and the researcher added up for 25% equals to 99, so the total sample were 493 persons in order that the research results would provide more validity and less chance of deviation. The questionnaires consist of two parts: Part 1 Personal Information; namely gender, age, education, and the areas of oil palm plantation; and Part 2 the adjustment management guidelines in case of encountering global warming to determine the level of implementation.

#### **Data Analysis Method**

The qualitative data was analyzed by the content analysis and presented in expository style whereas the quantitative data was analyzed using descriptive statistics; namely percentage, mean, and Standard Deviation.

### **Research Results**

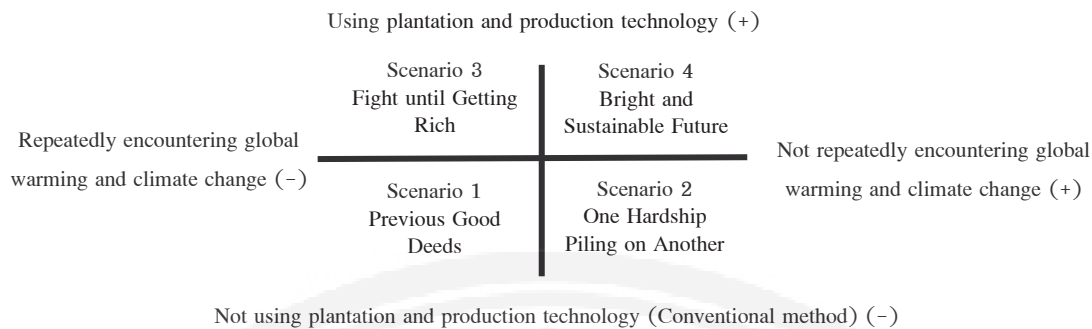
**In Responding to the Objective 1** The data was analyzed from research documentations and in-depth interview with experts and qualified persons in global warming and climate change. It was found in the research of the Office of Agricultural Economics Region 1–11, Office of Agricultural Economics (2013) that production of one kilogram of fresh oil palm causes greenhouse gas emission equals to 0.044443 kg CO<sub>2</sub> eq. This was divided into the value of greenhouse gas emission by plantation equals to 0.042564 kg CO<sub>2</sub> eq., which accounts to 95.77% of the whole greenhouse gas emission in Thailand. According to the analysis of the forecast trend for the amount of oil palm product, it was likely to be continuously increased (Figure 1). This reflected that the greenhouse gas emission by the oil palm plantation in Thailand also had the trend of continuous increase in the same direction.



**Figure 1** The amount of oil palm products during 2000-2014 and the forecast of the amount of oil palm products in the future  
**Source:** Information of the Office of Agricultural Economics (2014b), analyzed by the researcher

Furthermore, the trend analysis for the reduction of greenhouse gas emission by oil palm plantation was able to conduct through the findings of the research of Office of Agricultural Economics Region 1-11, Office of Agricultural Economics (2013). According to the simulation model in case of using the amount of chemical fertilizer adhering to suggestions and using good species of oil palm to increase crop products per rai, it could maximize the reduction of greenhouse gas emission to 69.03%. Meanwhile, in the existing oil palm plantation areas with the simulation model in case of using chemical fertilizer adhering to suggestion in the handbook for oil palm farmers of Department of Agriculture, it was found that the greenhouse gas emission could reduce for 66.68%. It could be concluded that the more usage of technology for plantation and production by farmers, the less greenhouse gas emission from oil palm plantation will be. This could be done by using good oil palm species to increase crop per rai, using chemical fertilizer adhering to suggestions or the production of oil palm and palm oil as bio fuel and adhering to the Roundtable on Sustainable Palm Oil (RSPO) standards. The monitoring of good plantation management and environmental preservation, together with the more reduction of waste through recycle process and residue disposal of palm oil factories, is suggested. According to such information, as well as the interview of experts and qualified persons in global warming and climate change brought about the future scenario of oil palm in Thailand using future scenario creating techniques, the scope of the time period for future foresight in the next five years (2015-2019) was set by the analyzed data. It set the vertical axis as plantation and production technology and horizontal axis as global warming and climate change consisting of four scenarios (Figure 2).





**Figure 2** Future scenario creating of oil palm in Thailand in the next five years (2015–2019)

## 1. Future Scenario of Oil Palm in Thailand in the Next Five Years (B.E.2558–2562)

### 1.1 Scenario 1 Previous Good Deeds [negative or undesirable future scenario (scenario -, -)]

Oil palm farmers have repeatedly encountered both droughts and floods and they produce oil palm as primary products (selling in palm bunches) to the palm yard as well as using conventional palm species and methods.

### 1.2 Scenario 2 One Hardship Piling on Another [Potential scenario (scenario +, -)]

Even though oil palm farmers do not repeatedly encounter both droughts and floods, small farmers take much risks since there are no risk distributions like large companies, since they produce oil palm as primary products (selling in palm bunches) to the palm yard as well as using conventional palm species and methods. In the future, they may not compete with farmers in Indonesia and eventually may need to sell their lands and change to other careers or cultivate other plants to replace oil palm.

### 1.3 Scenario 3 Fight until Getting Rich [Potential scenario (scenario -, +)]

Even though oil palm farmers repeatedly encounter both droughts and floods, they can adjust by accepting oil palm and palm oil productions for Bio- energy and adhering to the Roundtable on Sustainable Palm Oil (RSPO) standards with the monitoring of good plantation management and environmental preservation. Moreover, palm oil factories reduce wastes by conducting recycle process and residues disposal as the expression of social and environmental responsibility.

### 1.4 Scenario 4 Bright and Sustainable Future [positive or desirable future scenario (scenario +, +)]

Even though oil palm farmers do not repeatedly encounter both droughts and floods, they accept oil palm and palm oil productions for bio fuel and adhering to the Roundtable on Sustainable Palm Oil (RSPO) standards with the monitoring of good plantation management and environmental preservation. Moreover, palm oil factories in the communities reduce wastes by conducting recycle process and residues disposal as the expression of social and environmental responsibility. Farmers also use oil palm species that yield high amount of crop per rai and are supported to use oil palm plantation technology as well as oil palm product processing technology.

After that, the alternative future scenarios for oil palm were presented in the focus group discussion among farmers who experienced droughts and floods. Then the data was collected from oil palm farmers who were samples in the southern part of Thailand; namely in Krabi, Chumphon, Trang, Nakorn Sri Thammarat, Prajuaap Khirikhun and Surat Thani, totally 493 persons to get information through back casting before implementation. The data collection was conducted during 7–13 November 2014 with 477 sample, accounted for 96.8%; with



16 missing samples due to engaging in some important businesses so they could not provide information. However, the participated samples had already exceeded the acceptable minimum at the statistically significant at 0.05 level of 394 samples. Thus, the derived data could be used for an analysis and presentation for the population (as shown in table 1-2). It was found that:

**Table 1** Attributes of Questionnaire Respondent Samples (N = 477)

Attributes of Respondents	Number (Persons)	Percentage
<b>Gender</b>		
Male	261	54.7
Female	216	45.3
<b>Total</b>	<b>477</b>	<b>100.0</b>
<b>Age</b>		
below 40 years old	67	14.0
between 41 – 55 years old	212	44.4
between 56 – 70 years old	170	35.7
From 71 years old and over	28	5.9
<b>Total</b>	<b>477</b>	<b>100.0</b>
<b>Education</b>		
Primary School	300	62.9
Junior High School	71	14.9
Senior High School / Vocational Certificate	66	13.8
Vocational Higher Certificate / Diploma	11	2.3
Bachelor Degree	28	5.9
Others	1	0.2
<b>Total</b>	<b>477</b>	<b>100.0</b>
<b>Oil Palm Plantation Areas</b>		
Not exceed 30 rai	394	82.6
Between 31 – 60 rai	65	13.6
between 61 – 90 rai	7	1.5
from 91 rai and over	11	2.3
<b>Total</b>	<b>477</b>	<b>100.0</b>

From Table 1, it was found that males were more than females, males accounted for 54.7% while female account for 45.3%. Most were between 41–55 years old, accounted for 44.4%. Most of them graduated in primary school level (62.9%) and had oil palm plantation areas not exceeding 30 rai (82.6%).

**Table 2** The future scenario of oil palm in Thailand in the next five years (from 2015–2019)

The Future Scenario of Oil Palm in Thailand in the Next 5 Years (from 2015–2019)	Number (Persons)	Percentage
1. Previous Good Deeds	60	12.6
2. One Hardship Piling on Another	139	29.1
3. Fight until Getting Rich	211	44.2
4. Bright and Sustainable Future	67	14.1
<b>Total</b>	<b>477</b>	<b>100.0</b>



In Table 2, it was found that samples who are oil palm farmers mostly viewed that the future scenario of oil palm in Thailand in the next five years (from 2015–2019) was the scenario of Bright and Sustainable Future (44.2%), the scenario of “One Hardship Piling on Another” (29.1%) and the scenario of “Bright and Sustainable Future” (14.1%), respectively.

## 2. Adjustment Management Guidelines for Oil Palm Farmers

**To Respond to Objective 2**, the data was analyzed from the focus group discussion with oil palm farmers who experienced floods and droughts, the in-depth interview with private sector executives in oil palm businesses, and the questionnaire replied by oil palm farmers in the southern part of Thailand as shown in Table 3.

**Table 3** Adjustment Management Guidelines of oil palm farmers towards implementation

Adjustment Management Guidelines	Mean	S.D.	Evaluation Results
1. Oil palm Plantation should be cleared to prevent mice destroying the plantation	5.49	0.989	The Highest
2. Adhere to correct method of adding fertilizer	5.28	1.138	The Highest
3. When encountering drought, palm leaves should be used to cover land surface to keep the plantation moistured.	5.05	1.335	High
4. Apply Philosophy of Economic Sufficiency in agriculture such as reduction of production cost by using compost and manure/increase income	5.01	1.388	High
5. Follow suggestions of successful people in oil palm production	5.00	1.352	High
6. Intercrop in oil palm plantation should be done only in the first year, growing plants like water melon, papaya, banana and mushroom	4.80	1.621	High
7. In raining season or when there is much rainfall, put in fertilizer in January	4.54	1.818	High
8. The ridge should be at least 50 centimeters high to prevent flood	4.12	1.819	Quite High
<b>Total</b>	<b>4.91</b>	<b>0.8087</b>	<b>High</b>

**Note:** The rating criteria are 6 summated rating scale (6, 5, 4, 3, 2, and 1 score).

The total scores was summed for the whole questionnaire. The respondents could select from 1 score to 6 scores, from “the lowest” to “the highest”.

The interpretation of mean for opinions of respondents bases on the following criteria

Scores lower than 1.83	equals to level 1	means	the respondents agree with the expression in the lowest level
Scores between 1.84 – 2.66	equals to level 2	means	the respondents agree with the expression in low level
Scores between 2.67 – 3.49	equals to level 3	means	the respondents agree with the expression in quite low level
Scores between 3.50 – 4.32	equals to level 4	means	the respondents agree with the expression in quite high level
Scores between 4.33 – 5.15	equals to level 5	means	the respondents agree with the expression in high level
Scores between 5.16 – 6.00	equals to level 6	means	the respondents agree with the expression in the highest level

In Table 3, it was found that in overall the adjustment management guidelines for oil palm farmers for implementation was at the high level (mean = 4.9 out of total 6 scores). The results were as follows:

Item 1. Oil palm plantation should be barely cleared, not in a mess, to prevent mice destroying the plantation was at the highest level (Mean = 5.49).

Item 2. Adhere to correct method of putting fertilizer in was at the highest level (Mean = 5.28).

Item 3. When oil palm plantations encounter drought, palm leaves should be used to cover land surface to keep moisture was at high level (Mean = 5.05).

Item 4. Apply Philosophy of Economic Sufficiency in agriculture such as reduction of production cost by using compost and manure/increase income was at high level (Mean = 5.01).

Item 5. Follow suggestions of successful people in oil palm production was at high level (Mean = 5.00).





Item 6. Intercrop in oil palm plantation should be done only in the first year, growing plants like water melon, papaya, banana and mushroom was at high level (Mean = 4.80).

Item 7. In raining season and when it is anticipated for much rainfall, the fertilizer should be put in during January was at high level (Mean = 4.54).

Item 8. The ridge should be made at least 50 centimeters high to prevent flood was at quite high level (Mean = 4.12).

Moreover, according to the questionnaires, the adjustment management guideline for oil palm farmers was divided into two cases. First, in case of flood, the adjustment management guideline of oil palm farmers should be: 1) Let water to naturally drain (gradually recover oil palm plantation after water level is low and stab the bunches of flooded palm to prevent rotten); 2) Dig drain ditch or water way about two meters deep to let water flow well; 3) Make soil ridge to prevent flood (to prevent water flowing into the plantation) with water closing and opening system; 4) Stop fertilize two months in advance before flooding season. Second, in case of drought, the adjustment management guideline should be: 1) Pump water from ponds (using ground water). Water pumps may be adapted from lawn mowers. Use water from nearby brooks or water sources to water oil palm trees; 2) Cover the bases of palm trees with palm leaves and cover the land surface with oil palm bunches (around or at the bases of palm trees). Use straw to cover land surface. Cultivate straw mushroom to make extra income and close the drain ditch to keep moisture; 3) During dry season, grass should not be cut; let it grow high to cover land surface (no herbicide spray); 4) Apply less fertilizer by using urea fertilizer to maintain plantation or stop fertilizing/spraying bio fertilizer on the top of palm trees; 5) Use water sprinkle system or dripping system for efficient water management or put fertilizer in water; and 6) Pump water from pig farms to water palm trees.

## Discussion

**1. The Four Future Scenarios of Oil Palm in Thailand in the Next Five Years (2015–2019): Scenario 1** Previous Good Deeds, Scenario 2 One Hardship Piling on Another, Scenario 3 Fight until Getting Rich, and Scenario 4 Bright and Sustainable Future. The oil palm farmers viewed that the future scenario of oil palm in Thailand in the next five years (2015–2019) should be “Fight until Getting Rich” (44.2%). For the Fight until Getting Rich scenario, oil palm farmers could accept oil palm and palm oil productions for Bio-energy and adhering to the RSPO standards by monitoring good plantation management and environmental preservation. Palm oil factories could reduce wastes by conducting recycle process and residues disposal as the expression of social and environmental responsibility. This reflects that oil palm farmers want to continuously sell their products in good price so they adjust themselves by adhering to RSPO standards to yield more palm products and sell them for higher price. As a result, farmers gained more returns than those who conduct general palm production and not adhere to RSPO standards. The findings correspond to the research by Jaismut, Benchasri, Pruthikanee, Sanputawong, & Simla (2015); farmers approved for RSPO standards used average production factors for 5,559.58 baht per rai and gained average net returns for 8,734.90 baht per rai. On the contrary, oil palm farmers who conducted general palm production and not adhere to RSPO, used average net production factors for 5,344.54 baht per rai but gained average net returns for 4,536.94 baht per rai, lower than farmers who adhere to the RSPO standards for 4,197.96 baht per rai. This corresponds to the researches of Office of Agricultural Economics Region 8, Office of Agricultural Economics (2014), which found that farmers should adjust their behaviors on choosing the proper type of fertilizer and chemical according to needs of plants in each phase.



They should also conduct proper oil palm plantation management which will reduce effects of greenhouse gas emission. Related authorities should encourage farmers to have good awareness and understanding to global warming that affects the agricultural sector. This also corresponds to the researches of National Center for Genetic Engineering and Biotechnology, National Science and Technology Development Agency (2012) which studied the effect assessment of flood/disasters and the guideline for food stability in Thailand. It was found that the adjustment guideline for changes was the application of technologies to support wisdom or conventional practice and develop product quality and environmental friendly manufacture.

**2. Adjustment Management Guideline for Oil Palm Farmers:** It was found that the overall of the adjustment management guideline of oil palm farmers towards implementation was at the high level (mean = 4.91 out of the total scores of 6) and the Standard Deviation = 0.8087. This reveals that in overall the samples had the adjustment management at the high level and had corresponding opinions or had quite similar or identical views, since there was narrow distribution of information shown by the Standard Deviation lower than 1. This revealed that farmers had some aspect of false knowledge about oil palm cultivation namely, fertilizing disaccording to suggestions of Department of Agriculture, lack of knowledge concerning fertilizer formula for oil palm, cultivating period, suitability of cultivating land and cultivation land planning. Therefore, related authorities should emphasize on potentiality development for oil palm plantation of farmers through planning or supporting and developing oil palm production to be more efficient in order that the farmers are able to adjust properly based on knowledge and standard on oil palm management system. This will lead to good plantation monitoring and environmental preservation in Thailand and eventually resulting in one way or another the reduction of greenhouse gas emission. The finding of this research corresponds to the research of Wongwai et al. (2017) which found that farmers used fertilizer different from suggestions. They also used less fertilizer than the amount suggested by Department of Agriculture and lacked of knowledge about fertilizer formula for oil palm. The result corresponds to the research of Satsue and Phitthayaphianant (2015) which found that most farmers had some aspect of false knowledge about oil palm cultivation namely, fertilizing, oil palm species, cultivating period, suitability of cultivating land and cultivation land planning. This is similar to the research of Office of Agricultural Economics Region 1-11, Office of Agricultural Economics (2013) which found that the stimulation model, in case of using chemical fertilizer adhering to suggestions and using good oil palm species to increase crop yields per rai, will be able to reduce the maximum of greenhouse gas emission to 69.03%. This is also in accordance with the oil palm plantation promotion policy in new lands or in substitute of conventional species. Whereas existing oil palm plantation land with the use of the stimulation model, in case of using chemical fertilizer adhering to suggestions in the farmer handbook for oil palm cultivation of Department of Agriculture, it was found that this would reduce the greenhouse gas emission to 66.68%. It also corresponds to the research of Office of Agricultural Economics Region 8, Office of Agricultural Economics (2014) which found that farmers should adjust their behavior in choosing proper fertilizer and chemical in accordance to the needs of plants in each stage or should manage oil palm plantation properly on academic basis to lessen the effects of greenhouse gas emission.

### Conclusions and Recommendations

This research can be concluded as follows:

**1. The Future Scenario of Oil Palm in the Next Five Years (2015-2019)** consists of four scenarios. Scenario 1 Previous Good Deeds is the scenario that farmers produce oil palm at the head water level for primary

product selling to palm ramps as well as use conventional palm species. **Scenario 2** One Hardship Piling on Another was the scenario the farmer at high risks due to oil palm production at the upstream for primary product selling to palm yard as well as using conventional palm species. Eventually, farmers are likely to sell their land and change their occupations or cultivate other kinds of crops in substituting oil palm. **Scenario 3** Fight until Getting Rich was the scenario that farmers accept the production according to the RSPO standards and oil palm for the scenario that bio fuel under the monitoring for proper plantation management and environmental preservation. **Scenario 4** Bright and Sustainable Future was the scenario of farmers produce oil palm adhering to the RSPO standards. It used oil palm species that yield high amount of crop per rai, supported for using oil palm plantation technology as well as oil palm product processing technology. The oil palm farmers viewed that the future scenario of oil palm in Thailand in the next five years (2015–2019) was the “Fight until Getting Rich” Scenario at the highest level (44.2%).

**2. The Adjustment Management Guideline of Farmers:** They should be educated for proper methods of fertilizing and environmental friendly cultivation in order to get the certificate for sustainable oil palm productions. This can help recover soil condition in long term, and farmers are also able to sell the carbon credit in the future.

**3. Research Recommendations:** The following recommendations are based on the findings of this research for applying in the future development. The researcher identified into aspects as follows:

**3.1 Development of Oil Palm Farmers:** In this research, it was found that the future scenarios of oil palm in the next four years (2015–2019) consist of four scenarios: Scenario 1 Previous Good Deeds, Scenario 2 One Hardship Piling on Another, Scenario 3 Fight until Getting Rich, and Scenario 4 Bright and Sustainable Future. Most of the samples viewed that the future scenario would be the “Fight until Getting Rich” scenario (44.2%). To prepare oil palm farmers, farmers should be educated through a tour of investigation with successful people as models in agriculture occupation in accordance with the RSPO standards. The models should be the change agents or lectures who convey and motivate the successful method they have used such as how to proper fertilizing, oil palm management and adjustment management guideline to lesson effects incurred by flood and drought, including oil palm cultivation in accordance to the RSPO standards which is environmental friendly and spontaneously helps soil condition recovery in the long term. The carbon credit can also be sold in the future.

**3.2 The Operational Guideline for Government Agencies:** According to the in-depth interview of the director of Trang oil palm co., Ltd. In Trang province, the executive from private sectors involving in oil palm businesses through buying fresh palm, educating palm farmers and preserving environment through the community participation.

According to M. Wongsureerat (interviewed, October 20, 2014), government agencies should take roles to support the development of oil palm potentiality towards oil palm production. This will be in accordance with the RSPO standards by using species that yield high crops per rai and supporting technology for oil palm cultivation as well as technology for manufacture of processed palm oil products. Therefore, government agencies should take actions as follows:

**3.2.1 The Ministry of Energy** should determine an obvious policy for renewable energy and continuously adhere to the renewable and alternative energy development plan to reach 25% in the next 10 years (2012–2021), especially the oil palm alternative energy strategies.

**3.2.2 Ministry of Agricultures and Cooperatives** should select flood and drought resistant species suitable for Thailand to reduce production costs of farmers. Farmers should be educated for the RSPO standards,



since they seem to lack of the knowledge. They should also gather in groups to upgrade oil palm plantation management in accordance with the RSPO standards. The key aims are the emphasis on economic, social and environmental sustainability to prevent forest and land invasion of local people. This will bring about forest and biodiversity preservation for sustainable oil palm production and production competitiveness enhancement (Department of International Trade Promotion, Ministry of Commerce, 2012). The RSPO standards will be an alternative for manufacturers of products with oil palm composition. Brands with signs of the RSPO standards and Green Palm Sustainability will be more and more interesting for production line manufacturers, especially in Europe and U.S.A. However, there are only 30% in the present even though the RSPO standards can increase efficiency and reduce production costs as well as traceable retroactively. Department of Forest, Ministry of Agriculture and Cooperatives should prevent forest invasion to expand oil palm plantation, since the invasion will affect wild life, plant species and soil quality.

3.2.3 Ministry of Science and Technology, together with the Committee of National Policy for Science, Technology and Innovation or academic institutes, should develop and differentiate oil palm species to bring about health care innovation for value added. Aromatic and cholesterol reduction should be studied for development of processed oil palm production technology and investment support and enhancement for private sector.

3.2.4 Ministry of Industry should determine strategies for sustainable oil palm industry development: 1) to promote environmental friendly manufacturing development; 2) to support investment of oil palm product processing factories to add value to palm oil; 3) to develop oil palm product management scheme in thorough connection from upstream-midstream-downstream; and 4) to increase oil palm products through increasing yield crop per rai.

3.2.5 Ministry of Finance such as Department of Revenue, should determine farmers to have duty of tax filing like other professions so that the agricultural profession information of farmers will be included in the taxation database. Such taxation filing information should include aspects, for example, types of agriculture, areas of plantation, status of owners or lease and crop yields, etc. The department should increase the commutation tax rate from 80% to 95%, which will be an incentive for farmers to file tax, since they rarely pay tax. Here, the department will get information from the agricultural sector through the taxation filing of farmers as key facts & figures. It will give farmers self-learning and assessment as business involving loss or profit. This will lead to professional development that farmers are able to live stably instead of only relying on government subsidy. The department then can support information for agricultural sector management to assist farmers in the future systematically and efficiently.

One example is the large area promotion scheme launched through the Next 20 Years Agricultural and Cooperatives Development Strategy (2017-2036) by the Ministry of Agriculture and Cooperatives and crop insurance.

3.2.6 The government should prescribe oil palm in the national agenda through preparing the Master Plan with the concept of Green Niche Market that is to position the oil palm production of Thailand to be the production for environmental friendly and to sell palm oil in Premium markets.

### **3.3 Recommendation for Further Study**

3.3.1 The future research should study farmers' adjustment management guideline for global warming and climate change affecting other crops (such as rice, sugar cane, and maize) and other live stocks (such as pigs and cows) and fishing.



3.3.2 The future research should be a quantitative research studying an independent variable to foresee the acceptance and the implementation of adjustment management guideline of farmers for effects of global warming and climate change in order to get information for planning development of adjustment management properly and efficiently.

3.3.3 The future research should repeat the study on adjustment management guideline of farmers for effects of global warming and climate change within five years period in order to review and examine the academic strength.

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