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Factors Affecting Oil Palm Productivity in Surat Thani Province

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Received: *11 November 2022* / **Revised***: 7 March 2023* / **Accepted:** *21 April 2023*

Abstract

This paper was a study of factors affecting oil palm productivity in Surat Thani Province. The objectives were to study the relationship between factors including oil palm prices in Surat Thani Province, the average number of hours of sunshine in Surat Thani, average temperatures in Surat Thani Province, the relative humidity in Surat Thani Province, oil palm productivity in Surat Thani Province, rainfall, fertilizer price and plantation area, as well as the factors affecting oil palm productivity in Surat Thani Province. Collected secondary data for the study from 1996 to 2022, a total of 30 years, and used multiple regression analysis. The results showed that two independent variables related to fertilizer price (X_6) and plantation area (X_7) were in a positive direction, affecting oil palm productivity in Surat Thani Province, which increased with statistical significance at the 0.05 level and had the following form of the multiple regression equation:

$$\hat{Y} = 14337.399 + 58.943(X_6) + 0.000253\ (X_7)$$

Keywords: Oil palm, Productivity, Fertilizer price, Plantation area, Surat Thani Province

1. Introduction

Oil palm originated in West Africa. Oil palm was introduced to Asia by the Portuguese. It was planted in the Botanical Garden of Bogor, Indonesia, around 1848, and then spread to Sumatra between 1853 and 1857, when it became a serious trade. In 1911 and 1918, there were 22,500 rai of palm oil plantations in Sumatra. Around 1870, the Singapore Botanic Gardens were the first place to plant oil palms. Later, it received attention, and the first research was conducted in Selangor State. It began to grow as a trade for the first time in the year 2460 and continues to do so till now. Oil palm plantations have covered approximately 34.04 million hectares in Indonesia and Malaysia since 1929. Oil palm was brought to Thailand for planting at the Kho Hong Rubber Testing Station in Songkhla Province (Krovis & Srikul, n.d.). The palm family is the second-largest plant family known and used by humans after the grass family. It must be seasonal if it does not rain throughout the year. Asia has made the most use of the palm's multiple parts, from food to shelter as well as clothing and medicine. Palms are monocotyledons that are mostly found in the tropics. There are many types of palms; some are bushes, and some are ivy. When seeds germinate, there is only one cotyledon, and the trunk has only one shoot and no branching. It has large, palmate, or feathery leaflets with distinct bracts and petioles, and leaves often form new clusters at the tip of the stem. The young leaves in the first stage combine to form a long stick that resembles a sword. Inflorescences are sheathed. The first flowering is called Tangjan. In the germination stage, the part of the sapling inside the seed expands and grows, known as the "jaw" (Pinkham, 2017).

The southern region has the most oil palm plantations, followed by the central region, the northeastern region, and the northern region. The efficiency of oil palm productivity shows that the productivity per unit of production is uncertain. The important and urgent production problem is the price and low quality of fertilizer. Surat Thani's oil palm had a perennial area of 915,255 rai and a productivity of 2.42 million tons in 2018, rainfall was about 135.4 millimeters, GPP was about 133,415 million baht, and the average oil palm price was 4.32 baht per kilogram. In 2019, the perennial area was approximately 1.34 million rai, the productivity was approximately 3.84 million tons,

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the rainfall was approximately 132 millimeters, the GPP was approximately 210,396 million baht, and the average price of oil palm was 2.82 baht per kilogram (Office of Agricultural Economics 8 Surat Thani, 2019).

In addition, the COVID-19 situation affects the economy, causing farmers in Surat Thani Province to have the most difficult time regarding the volatility of oil palm prices, followed by no set selling price based on palm quality. Furthermore, there is a lack of aid from government organizations as well as manufacturing issues (Coronavirus Disease 2019 News Operation Center, 2019). As a result, the government should assist farmers by assuring the price of fresh palm fruit so that it can be sold at a fixed price. Farmers requested that fertilizer costs and the supply of high-quality fertilizers be controlled. Furthermore, they need financial help to extend planting areas and the provision of planting areas for farmers who want to grow the oil palm. Many farmers wish to extend their growing area but there is a lack of funds and land. a palm quality criterion for use in palm trading based on the quality class of The Palm Farmers Fund and the Rubber Plantation Aid Fund were established to provide farmers with systematic assistance. Additionally, organizing training classes on production and marketing for farmers, such as analyzing palm planting areas, the effective use of fertilizers and soil, and maintaining and improving palm plantation quality can be considered as another kind of aid that they received . Increasing productivity, lowering costs, and ensuring proper harvesting are the reasons that make researchers interested in researching the factors influencing the price of oil palm in Surat Thani Province. The information here can be useful in agriculture as well as solving production problems and providing guidelines for future development.

Research objectives

The research objective was to study the factors affecting oil palm productivity in Surat Thani Province.

2. Materials and Methods

2.1 Researched data

Secondary data were collected yearly from 1996 to 2022 for a total period of 30 years, and multiple regression equations were used to estimate the coefficients of the independent variables on the dependent variables. The dependent variable was the oil palm productivity data (unit: kilogram per rai), and seven independent variables were as follows:

X_1	the oil palm price in Surat Thani Province	(Unit : kilogram per rai)
X_2	average number of hours of sunshine in Surat Thani	(Unit : hour)
X_3	average temperatures	(Unit: Celsius)
X_4	relative humidity in Surat Thani Province	(Unit : Percent)
X_5	rainfall in Surat Thani Province	(Unit : millimeter)
X_6	fertilizer price in Surat Thani Province	(Unit : baht per kilogram)
X_7	plantation area in Surat Thani Province	(Unit : rai)

2.2 Data collection

Factors Affecting Oil Palm Prices in Surat Thani Province Data is collected from studies and research papers, related articles, and websites as secondary information. Data on dependent variables (Y) and independent variables (X) were collected for research purposes by collecting the following data:

Table 1. Contains statistical data for dependent and independent variables.

Variables	Items	Source
Y	oil palm productivity (Unit: kilogram per rai)	Office of Agricultural Economics 8 Surat Thani (2019)
X_1	oil palm price in Surat Thani Province (Unit : baht per kilogram)	
X_2	average number of hours of sunshine in Surat Thani province (Unit : hour)	Office of Agriculture and Cooperatives, Surat Thani Province (2020)
X_3	average temperatures (Unit: Celsius)	
X_4	relative humidity in Surat Thani Province (Unit : Percent)	
X_5	rainfall in Surat Thani Province (Unit : millimeter)	
X_6	fertilizer price in Surat Thani Province (Unit : baht per kilogram)	
X_7	plantation area in Surat Thani Province (Unit : rai)	

2.3 Data Analysis

Forecasting equations for palm oil prices were constructed with seven independent variables by multiple linear regression analysis. Creating a forecast equation involves the following steps (Wanichbancha, 2008):

2.3.1 Verify the distribution of the dependent variable (Y) to see if there is a normal distribution or not. By plotting the histogram for skewness and using the Lilliefors test, if the dependent does not have a normal distribution, the dependent variable (Y) must be converted to have a normal distribution.

1) If the distribution of the dependent variable (Y) was positively skewed, it would be converted to log Y.

2) If the distribution of the dependent variable (Y) was negatively skewed, it would be converted to Y^2.

2.3.2 The following was the multiple regression analysis assumption:

1) All independent variables were independent of each other. Determine the tolerance of every independent variable in the equation. The value was close to 1, and the value of VIF (Variance Inflation Factor) was not more than 10, indicating that the independent variables in each equation were independent.

2) Tolerance values must have a normal distribution as determined by plotting the NPP (Normal Probability Plot) and Lilliefors's test of residual values. If the NPP (Normal Probability Plot) curve tends to a straight line and Lilliefors's test cannot reject the main hypothesis (H_0), this indicates that the discrepancy is a normal distribution.

3) Verify the mean of the error E(e) because, in calculating the regression, the relationship between the independent set of variables and the dependent variable must be a linear relationship. The project developer uses the least squares error method to minimize the sum of squares of error values, which makes the sum. As a result, the total mean of error E(e) is zero, as well, or $\sum e_i$ = 0. For that reason, there is no need to check this requirement.

4) Examination of the variability of static displacement for all independent variables (X_i) or check the difference between actual Y_i and $\hat{Y}$ from the forecasts based on the generated multiple regression equations $e_i = Y_i - \hat{Y}$. Or is it a check to determine if e_i is spread around that is equal to 0? When X or Y change, or changes or does not change. If e_i does not change, then the variance of the fixed error satisfies the condition. However, if e_i changes with the change in the value of X or Y, heteroscedasticity can be solved by using the weighted least squares method when estimating the regression using the ordinary least squares method.

5) Based on the Durbin-Watson statistic, an autocorrelation-independent test that can be checked from independent variables with no intrinsic correlation, known as "non-problem." Autocorrelation. Using the Durbin-Watson value to test whether the independent variables are correlated or not with the Durbin-Watson measurement criteria, as follows:-

The values are in the range of 0–1.4, indicating that there is a positive correlation.

The values are in the range of 1.5–2.5, indicating that they are independent of each other.

The values are in the range of 2.6–4.0, indicating that there is a negative correlation.

However, if the value of Durbin-Watson is less than 1.5 and greater than 2.5 indicates that autocorrelation, or independent variables with self-correlation, makes the calculation of multiple regression equations problematic.

2.4 Interpreting the results of multiple regression analysis

When the assumption in the multiple regression analysis passed, the order of interpretation of the analysis results was as follows (Wanichbancha, 2008):

1. Examination of dependent variables and independent variables for a linear relationship. Therefore, the overall regression coefficient is tested using the F-test statistic from the ANOVA table. The assumptions will be set as follows:

H_0 : factors unrelated to palm oil prices in Surat Thani Province.

H_1 : Factors related to palm oil prices in Surat Thani Province

2. Checking the significance of the individual constants and coefficients in the equations and tables Coefficients. Each regression coefficient was tested using a statistical value of t-test significance at the 0.05 level. The assumptions were made as follows:

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H_0 : The regression coefficient is zero.

H_1 : The regression coefficient is not equal to zero.

3. To create the form of the regression equation from the coefficients obtained from the coefficients table, the data from the β (the regression coefficient of the independent variable in the raw score form equation) would be written in the form of an equation prediction.

4. Summarizing the regression equations obtained from the Model Summary table by combining the multiple correlation coefficients, forecast coefficients, and standard error values together with the regression equations obtained as follows:

4.1 The multiple correlation coefficients (R) indicate the relationship between all independent variables and dependent variables.

4.2 The forecast coefficient (R^2) is an index that tells the percentage change of variables as a result of all independent variables.

4.3 The standard error of the estimate in the forecast of the resulting forecast equation.

2.5 Create multiple regression equations

According to the following model (Meejang, 2014)

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + \dots b_nX_n \quad (1)$$

Where

Y	mean	dependent variable
a	mean	Constant-coefficient or vertical-axis intercept coefficient.
b	mean	The coefficient of the independent variable, which represents the percentage of change when the change in the independent variable affects the change, is also known as the class coefficient.
X_i	mean	independent variables i = 1,2,…,n

3. Results and Discussion

Descriptive statistics analysis results

In this study, data on palm oil prices in Surat Thani province were collected for 30 years, from 1996 to 2022. Seven variables and related factors were collected as follows:

1. Oil palm price in Surat Thani Province (X_1)
2. Average number of hours of sunshine (X_2)
3. Average temperatures (X_3)
4. Average relative humidity (X_4)
5. Rainfall (X_5)
6. Fertilizer price (X_6)
7. Plantation area (X_7)

The results of the descriptive statistical analysis of the variables consisting of mean, minimum, maximum, and standard deviation are shown in Table 2.

Table 2. Descriptive statistical analysis results

Variables	Mean	Minimum	Maximum	Std. dev.
Y	2765.90	1891.00	3536.00	410.48
X_1	3.50	1.15	7.80	1.53
X_2	151.71	52.90	202.70	26.83
X_3	27.16	26.50	27.60	0.25
X_4	81.12	75.00	86.00	3.54
x_5	1626.93	1227.10	2060.20	196.80
x_6	14.19	7.57	25.80	4.99
x_7	2014664.00	240212.00	4066640.00	1243043.34

Table 2: Summary of preliminary data from data collection on oil palm productivity in Surat Thani province by yearly data collection from 1996 to 2022, totaling a period of 30 years. The preliminary results were summarized as follows:

The average oil palm productivity (Y) was 2765.90 kilogram per rai; the lowest was 1891 tons, the highest was 3536 kilogram per rai, and the standard deviation was 410.48.

The average oil palm price (X_1) was 3.50 baht per kilogram, the lowest price was 1.15 baht per kilogram, the highest price was 7.80 baht per kilogram, and the standard deviation was 1.53.

The average number of hours of sunshine (X_2) was 151.71 hours, the lowest average was 52.90 hours, the highest average was 202.70 hours, and the standard deviation was 26.83.

The average temperature (X_3) was 27.16°C, the lowest average was 26.50°C, the highest average was 27.60°C, and the standard deviation was 0.25.

The average relative humidity (X_4) was 81.12 percent; the lowest average was 75 percent; the highest average was 86 percent; and the standard deviation was 3.54.

The rainfall (X_5) was 1626.93 millimeter; the lowest average was 1227.10 millimeter; the highest average was 2060.20 millimeter; and the standard deviation was 196.80.

The fertilizer price (X_6) was 14.19 baht per kilogram; the lowest average was 7.57 baht per kilogram; the highest average was 25.80 baht per kilogram; and the standard deviation was 4.99.

The plantation area (X_7) was 2014664 rai; the lowest average was 240212 rai; the highest average was 4066640 rai; and the standard deviation was 1243043.34.

Assumption Test for Multiple Linear Regressions

1. Tests for independent and dependent variables

Variables must have an interval scale or above, data on independent and dependent variables were collected on a yearly basis from 1996 to 2022, a period of 30 years. The data used on the interval scale is a measure that can divide the variables into groups and arrange them in order, and the measuring range will have the same distance.

2. Test data for independent and dependent variables

Variables must be randomized from a normal distribution population that can be tested using the Lilliefors method based on statistical testing. The Shapiro-Wilk test statistic was used to test the normal distribution data (Meejang, 2014).

Table 3. Tests of normality for independent and dependent variables.

Variables	Kolmogorov-Smirnov			Shapiro-Wilk		
	statistic	df	Sig.	statistic	df	Sig.
Y	.140	30	.137	.960	30	.317
X_1	.105	30	.200	.932	30	.056
X_2	.149	30	.089	.933	30	.059
X_3	.132	30	.193	.950	30	.165
X_4	.136	30	.167	.943	30	.110
x_5	.090	30	.200	.973	30	.621
x_6	.148	30	.092	.937	30	.074
x_7	.132	30	.195	.936	30	.070

The results from Table 3 showed that there were 8 normal distributions as follows:

1. The fact that the oil palm productivity (Y) has a sig = 0.317, which is greater than α=0.05, shows that the main hypothesis was accepted. As a result, the oil palm productivity variables (Y) had a normal distribution.

2. The fact that the oil palm price (X_1) has a sig = 0.056, which is greater than α=0.05, shows that the main hypothesis was accepted. As a result, the oil palm price (X_1) had a normal distribution.

3. The average number of hours of sunshine (X_2) has a sig = 0.059, which is greater than α=0.05, shows that the main hypothesis was accepted. As a result, the average number of hours of sunshine (X_2) had a normal distribution.

4. The average temperatures (X_3) have a sig = 0.165, which is greater than α= 0.05, shows that the main hypothesis was accepted. As a result, the average temperature (X_3) had a normal distribution.

5. The average relative humidity (X_4) has a sig = 0.110, which is greater than α=0.05, shows that the main hypothesis was accepted. As a result, the average relative humidity (X_4) had a normal distribution.

6. The Rainfall (X_5) has a sig = 0.621, which is greater than α=0.05, shows that the main hypothesis was accepted. As a result, the Rainfall (X_5) had a normal distribution.

7. The Fertilizer price (X_6) has a sig = 0.074, which is greater than α=0.05, shows that the main hypothesis was accepted. As a result, the Fertilizer price (X_6) had a normal distribution.

8. The Plantation area (X_7) has a sig = 0.070, which is greater than α=0.05, shows that the main hypothesis was accepted. As a result, the Plantation area (X_7) had a normal distribution.

3. Test of multicollinearity

If the independent variables are not independent, multicollinearity will occur. The method used for verification of the multicollinearity correlation coefficient between the independent variables can be determined by the tolerance of all independent variables in the equation approaching 1 and the VIF (Variance Inflation Factor) being less than 10, showing that the independent variable in the equation is independent and the Pearson correlation being more than 0.8. Using the Stevens criterion, it may be assumed that the pair of independent variables' many correlations should be addressed (Meejang, 2014).

Table 4. Relationship between independent variables with Pearson Correlation.

Variables	Y	X_1	X_2	X_3	X_4	X_5	X_6	X_7
Y	1	0.591**	0.108	.626	-0.056	-0.115	0.785**	0.791**
X_1		1	0.168	.0900	0.006	0.078	0.093	0.068
X_2			1	-0.015	0.304	0.143	0.238	0.226
X_3				1	-0.259	-0.201	0.021	0.640
X_4					1	0.095	0.024	0.144
X_5						1	-0.050	-0.191
X_6							1	0.089
X_7								1

**** P < 0.01**

Table 4 shows that all independent variables were uncorrelated and that we can take into account each independent variable's tolerance in the equation. A value closest to one, and VIF (Variance Inflation Factor) is less than 10. Therefore, the independent variables in the equation are independent of each other.

4. Relationship between independent variables coefficients

Table 5 shows that all independent variables are independent and can be determined by the tolerance of the independent variables in the equation with values approaching 0, where the calculated variable is the minimum at 0.218 and maximum 0.851. As a result, because the values of all independent variables in the equation are close to zero, it can be concluded that each independent variable is independent of the other. The value of the VIF (Variance Inflation Factor) must not be exceeded 10 (Kleinbaum, 1998), where all the variables obtained from the calculation are not more than 10. It can be concluded that each independent variable is independent of the others.

Table 5. Relationship between independent variables coefficients.

Variables	Tolerance	VIF
X_1	0.341	2.935
X_2	0.711	1.407
X_3	0.635	1.576
X_4	0.316	3.166
X_5	0.851	1.176
X_6	0.218	4.587
X_7	0.262	3.822

5. Assumption of normality

Figure 1 shows that the normal probability plot graph represents the normal distribution of the error values. Therefore, if the points are aligned along a straight line, the error is assumed to have a normal distribution. From the analysis of the data, the points in the normal probability plot graph are aligned close to the straight line. Concluded that the error has a normal distribution.

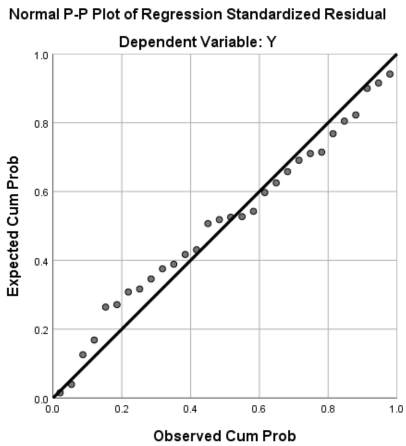

Figure 1. Normal probability plot graph.

6. Test of the Residuals Statistics E(e)

Table 6 shows that the mean error E(e) can be determined using the residual statistics, in which the mean is 0.000. It was determined that residual statistics E(e) = 0 and from testing problems with heteroskedasticity with the Breusch-Pagan-Godfrey method. It is a general test for the unstable variance of the residuals obtained from the model estimation by the least-squares method. The test results were found to be statistically insignificant at the 0.05 level (Sig. = 0.2593 > α = 0.05), so the obtained equations were not problematic for heteroskedasticity.

Table 6. Residuals statistics.

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	2220.00	3331.2217	2765.90	366.834	30
Residual	-468.385	338.86746	.00000	184.202	30
Std. Predicted Value	-1.488	1.541	.000	1.000	30
Std. Residual	-2.164	1.565	.000	.851	30

7. Tests for constancy of error variance

Figure 2 shows the scatter of data points. Data from the north and south were both scattered near the 0.0 level. They have similar areas and are rectangular. This indicates that the data discrepancies have constant variance.

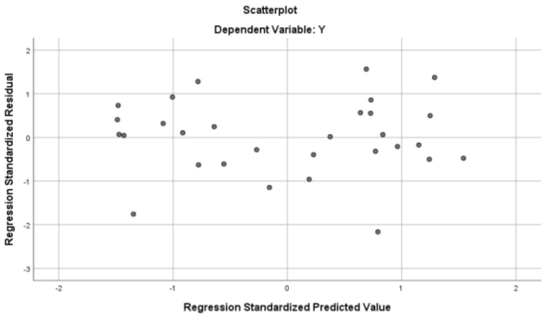

Figure 2. Scatterplot graph.

8. Test of autocorrelation

The Durbin-Watson statistic can be examined for independent variables that have no intrinsic correlation or autocorrelation by using Durbin-Watson values to test whether independent variables have a relationship among themselves or not. The criteria for measuring Durbin-Watson are as follows (Meejang, 2014):

The range 0 – 1.4 Correlated in a positive direction

The range 1.5 – 2.5 Independence

The range 2.6 – 4.0 Correlated in a negative direction

However, if the Durbin-Watson was less than 1.5 and more than 2.5, it was autocorrelation, which means that independent variables are correlated with themselves. This results in the problem of calculating multiple regression equations. In addition, the researcher has also tested autocorrelation using the Breusch–Godfrey serial correlation LM test and found that the value of F-statistics = 0.4048, which is greater than α = 0.05, indicates that the variable does not have autocorrelation problems (Table 7).

Table 7. Test of Autocorrelation with Breusch–Godfrey serial correlation LM test.

F-statistics	0.946562
Prob.F (2,20)	0.4048
Obs*R-squared	2.594136
Prob. Chp-Square (2)	0.2733

Table 8 shows that Durbin-Watson found Durbin-Watson = 1.704 in the range of 1.5 to 2.5, indicating that the independent variables used in the test were not correlated with themselves.

Table 8. Test for independence of error (Model summary).

Model	R	R Square	Adjusted R Square	Std. Error of The Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	Df1	Df2	Sig. F Change	
1	.894	.799	.722	216.46327	.799	10.411	8	21	0.000	1.704

9. Multiple regression analysis results

Table 9 Multiple regression analysis found that F-test = 10.411 (Sig. = 0.000 < α = 0.05) shows some independent variables affecting oil palm productivity in Surat Thani province; details are as follows:

1. The fertilizer price (X_6) in Surat Thani Province has a positive correlation with oil palm productivity in Surat Thani Province, which is statistically significant at 0.05 levels. When all other variables are held constant, the coefficient of 58.943 denotes that if the fertilizer price increases, affecting oil palm productivity in Surat Thani province, it increases by 58.943 baht per kilogram. If the fertilizer price decreases, affecting oil palm productivity in Surat Thani province, it decreases by 58.943 baht per kilogram.

2. The plantation area (X_6) in Surat Thani Province had a positive correlation with oil palm productivity in Surat Thani Province, which was statistically significant at 0.05 levels. When all other variables are held constant, the coefficient of 0.000253 denotes that if the fertilizer price increases, affecting oil palm productivity in Surat Thani province, it increases by 0.000253 rai. If the fertilizer price decreases, affecting oil palm productivity in Surat Thani province, it decreases by 58.943 0.000253 rai.

The results of the multiple regression analysis can be written in the equation as follows:

$$\hat{Y} = 14337.399 + 58.943(X_6) + 0.000253\,(X_7) \quad (2)$$

R-squared and adjusted R-squared can explain the variability of dependent variables. R-squared = 0.799, according to the results of the multiple regression analysis. This equation's independent variables and related factors can explain 79.90 percent of the variation in oil palm productivity in Surat Thani province. The remaining 20.01% was caused by other factors that were not analyzed. Adjusted R-squared = 0.722, which is close to the R-squared value. Most of the variables were able to explain the factors that correlate well with oil palm productivity in Surat Thani province. Therefore, the R-squared and adjusted R-squared obtained from the analysis were acceptable values. From the multiple regression equations using the enter method, it was found that the four factors consisting of oil palm price, average number of hours of sunshine, average temperature, and relative humidity have an influence on oil palm productivity, indicating that if one wants to have more oil palm productivity, all four factors must be controlled to be appropriate.

Table 9. Multiple regression analysis.

Variable	b	Std. Error	Beta	t	Sig.
Constant	14337.399	6216.068	-	2.307	.031
Oil palm prices (X_1)	-25.385	45.109	-.094	-.563	.580
Average number of hours of sunshine (X_2)	-2.607	1.777	-.170	-1.467	.157
Average temperatures (X_3)	-379.065	198.093	-.235	-1.914	.069
Relative humidity (X_4)	-24.474	20.178	-.211	-1.213	.239
Rainfall (X_5)	.098	.221	.047	.444	.661
Fertilizer price (X_6)	58.943	17.258	.716	3.415*	.003
Plantation area (X_7)	.000	.000	.765	3.995*	.001

R-Square = 0.799 Adjusted R-squared = 0.722 S.E. of regression = 216.463
F = 10.411 Sig. = 0.000 Durbin-Watson = 1.704 * $p < 0.05$

Discussion

In this study, factors affecting oil palm productivity in Surat Thani province consisted of fertilizer price (X_6) and plantation area (X_7). The effect of these factors on oil palm productivity in Surat Thani province was 79.90%. Each factor can be discussed as follows:

1. Fertilizer prices affect oil palm productivity in Surat Thani Province. In the first year, the oil palm requires a small amount of nutrients, while in the second and third years, it requires a much higher amount of nutrients. Especially potassium and nitrogen. Because it is a period of rapid growth both above and below ground, the need for fertilizer each year is quite stable after planting for 3 years or more. Oil palm normally requires more potassium than nitrogen and needs a higher amount in the pre-production period. However, nitrogen, potassium, phosphorus, magnesium, and boron are the plant nutrients that oil palm require in large or very large amounts (Suratthani Oil Palm Research Center, 2020). Fertilizer is an important production factor for growing Thai agricultural crops. the demand for fertilizer is mainly based on the quantity of crops, which more than doubled in 2022, had the direct impact on farmers who grow the most oil palm. Compared to other main crops, oil palm has a fertilizer application rate per rai as high as 120 kilograms per rai (Kasikorn Research Information Center, 2022). Therefore, the price of fertilizer directly affects oil palm productivity in Surat Thani Province because fertilizer is one of the production costs for farmers. If fertilizer prices are higher, farmers will have to pay more for fertilizer cost. Or in some cases, there may be a reduction in the quantity of fertilizer orders to meet the cost. However, reducing the amount of fertilizer will affect oil palm productivity and consistent with the research of Klaiyoo et al. (Klaiyoo, Sattayanuwat, & Premashthira, 2018), they studied factors affecting the efficiency of oil palm production. The results showed that factors affecting the efficiency of oil palm production include increasing the efficiency of fertilizer use and improving soil quality. Selection of good palm seedlings, increasing the supply chain in income variables, and training and management of palm plantations are all important factors to increase the efficiency of oil palm production. when they will provide farmers with important knowledge about an analysis of the economic worthiness of investment in production factors and the payment of oil palm production price subsidies based on the net present value of return (NPV), thus it could increase Competition in an investment of different

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production factors. Consistent with Chatsirapop (2017), a study of factors affecting palm oil prices in Thailand in 2017 found that if the price of palm oil quality in the country increases by 17%, it would increase the price of refined palm oil in the country by 0.55 baht. The price of crude palm oil in the country would increase by 1 baht, which could affect the price of refined palm oil in the country, by 0.85 baht. For pure palm wax or stearin, an increase of 1 baht in the country would increase the price of refined palm oil by 2.78 baht. The refined palm oil exported from FOB Malaysia will increase by 1 baht. This would increase the price of refined palm oil in the country by 1.57 baht and create policy issues. The government's domestic refined palm oil stockpile was a direct factor affecting palm oil prices in Thailand in 2017.

2. The plantation area affects oil palm productivity in Surat Thani Province**.** The planting of oil palm is most prevalent in the southern region (Suratthani Oil Palm Research Center, 2020). However, having a large area of oil palm plantations gives the opportunity to increase the yield**.** However, the output of palm oil per ton of production is uncertain due to a variety of factors. So the more palm plantation areas, would obviously bring the more income from palm production**.** In addition, there are farmers who grow other crops but are turning to plant oil palm due to the high price of the product (Surat Thani Provincial Statistical Office, 2017). This is consistent with the research of Sowana (2009), who studied the suitability of peatlands for palm plantations. they presented that most of the peatlands were unsuitable or less suitable for oil palm planting due to the soil conditions being acidic and marshy, and the bottom soil layer being sandy soil with severe acidity. Therefore, in order for oil palms to grow well, good management is required. This leads to the high cost of oil palm plantations. In addition, the current agricultural production behavior has shifted from subsistence production to commercial production that focuses more on the quantity and quality of the product, leading to the selection of crops that provide higher economic value, such as palm oil, rubber, etc and consistent with the research of Thongpradab (2010), who found that oil palm plantations instead of rice in the South. This is because oil palm is an economic crop that is more important economically, while rice is less important because rice production in the south is highly uncertain, resulting in lower yields and poorer quality.

4. Conclusions

Summarizing the results of the correlation analysis, it was found that the only two independent variables related to oil palm productivity in Surat Thani province were fertilizer price (X_6) and plantation area (X_7) they were moving in a positive direction, affecting oil palm productivity in Surat Thani Province, which increased with statistical significance at the 0.05 level. The most influential factor was plantation area (X_7) (Beta = 0.765), followed by fertilizer price (X_6) (Beta = 0.716)

The results of the multiple regression analysis can be written in the equation as follows:

$$\hat{Y} = 14337.399 + 58.943(X_6) + 0.000253\,(X_7) \quad (3)$$

Suggestions for this research; The variables that the researcher brought into the study for the recommendation of this research were those that were directly related to the concepts, theories, and facts arising from the study of relationships, as well as those that were related to the oil palm productivity in Surat Thani Province. However, there may be additional factors influencing the amount of oil palm output in Surat Thani province that should be considered**.** Those interested in undertaking more research may take into account political and policy variables for the growth of the government's agriculture sector as secondary data; this research investigates the relationship and factors associated with the oil palm productivity in Surat Thani province. The whole term is 30 years, beginning in 1996 and ending in 2022. As a result, the amount of data collected in future studies should be increased and may utilize monthly, daily, or weekly data.

Acknowledgements

Thank you to Surat Thani Rajabhat University, which provides funding for research.

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