Aceh Int. J. Sci. Technol., 12(3) 368-377
December 2023
doi: 10.13170/aijst.12.3.30411

Aceh International Journal of Science and Technology
ISSN: p-2088-9860; e-2503-2398
Journal homepage: http://jurnal.usk.ac.id/aijst

Determination of FFB Raw Material Needs for CPO Production by Forecasting Method at PT. Socfindo Kebun Mata Pao

Mahrani Arfah[1,*], Vivi Anggraini[1]

[1] Department of Industrial Engineering, Faculty of Engineering, Universitas Islam Sumatera Utara Sisingamangaraja Street, Teladan Barat, Medan City, North Sumatera – 20217, Indonesia
*Corresponding author: mahrani.arfah@ft.uisu.ac.id; vivianggrainisurbakti@gmail.com

Received : January1, 2023
Received in revised from: August 7, 2023
Accepted : September 22, 2023
Online : December 15, 2023

Abstract – This research was conducted at PT. Socfindo Kebun Mata Pao is one of the industrial companies engaged in palm oil processing. The main raw material used in processing Crude Palm Oil (CPO) is Fresh Fruit Bunches (FFB), where the FFB used must be based on good characteristics to get quality CPO. PT. Socfindo Kebun Mata Pao needs to pay attention to the adequacy of raw materials or the shortage of FFB raw materials. If the FFB inventory exceeds the amount of production needed, it will certainly cause additional storage costs and a decrease in the quality of CPO. Meanwhile, if the FFB supply is too small, it will increase procurement costs and interfere with the smooth running of products, resulting in inefficient production activities. Therefore, companies need to forecast the need for FFB raw materials, to minimize the occurrence of excess or shortage of FFB. The methods used in forecasting the needs of FFB raw materials are the Linear Regression method and the Quadratic method. The purpose of this study is to obtain forecasting results with the best accuracy between the Linear Regression and Quadratic methods to be able to predict the need for FFB raw materials in the 2022 period and so that companies can manage FFB raw material inventory by production needs. The data collection method was used from the observations and study documents results. The forecasting results from the calculation of the error rate in the Linear Regression method obtained a Standard Error of Estimate (SEE) of 317.16 and a Mean Absolute Percentage Error (MAPE) of 0.58%, while the error rate in the Quadratic method obtained a Standard Error of Estimate (SEE) of 323.55 and a Mean Absolute Percentage Error (MAPE) of 4.75%. From the calculation of the *error* rate in both methods, the smallest error rate is obtained in the Linear Regression method.

Keywords: Fresh fruit bunches; Crude palm oil; Forecasting; Linear regression; Quadratics.

Introduction

The potential of the palm oil business in Indonesia is considered very good because Indonesia has advantages that can make the palm oil commodity industry become one of the competitive industries in world trade. This is because Indonesia has a wet tropical climate, large islands and small islands that stretch around the Indonesian equator provide a large enough area for oil palm development (Anugrah & Wachjar, 2018).

In raw material inventory (FFB) planning, several aspects that need to be considered involve determining the quantities that must be available, the quality standards required for raw materials, as well as relevant prices. Lack of effective control in managing raw material supplies can result in financial losses or even operational failure for the company. In essence, the purpose of having raw material inventory (FFB) is to facilitate and carry out company operations in a sustainable and efficient manner in the production of goods. Therefore, it cannot be ignored that the role of raw material inventory is very important in the company's development efforts.

One of the stages of oil palm cultivation is harvesting, which is one of the key factors in oil palm productivity. Management in harvesting is closely related to the timing of harvesting. The timing of harvesting palm fruit greatly affects the quantity and quality of oil produced (Junaedi et al., 2019).

Aceh Int. J. Sci. Technol., 12(3) 368-377
December 2023
doi: 10.13170/aijst.12.3.30411

The main harvest of oil palm is oil palm fruit in the form of FFB. FFB is processed in palm oil mills to obtain vegetable oil. Harvesting activities consist of pre-harvest preparation, harvesting, harvest evaluation, and fruit transportation. Good preparation for the harvest will facilitate the implementation of the harvest. Successful harvest will support the achievement of oil palm crop productivity because high production potential is also meaningless if yield management is not carried out optimally (Kurniawan & Lontoh, 2018).

It is known that to get good (optimal) CPO quality requires certain conditions including the distance of FFB picking time until it is processed at the processing unit only has a maximum grace time of 12 hours. The allowable period from the time the FFB is harvested to the processing process at the palm oil mill should not exceed 12 hours. If the period is more than 12 hours, the quality of the CPO produced decreases, which ultimately has an impact on reducing the value/selling price of FFB ((Dirjen Bina Pengolahan dan Pemasaran Hasil Pertanian), 2017)

Fresh fruit bunches (FFB), which are used as raw material for processing Crude Palm Oil (CPO) have the characteristic of being easily damaged if handled too late or if there are errors, which can result in increased levels of free fatty acids (ALB). Excess raw material inventory will cause additional storage costs and a decrease in product quality, while too little inventory will result in additional procurement costs, disruption in smooth production, and inefficiencies in production activities (Amalia & Hairiyah, 2018).

The raw material used for the production of CPO oil is fresh fruit bunches (FFB) from oil palm trees which must meet certain requirements before being converted into CPO oil (Tanjung & Azmiati, 2015). In this research, we will predict the amount of oil palm FFB that needs to be prepared by the plantation department so that it can be processed into Crude Palm Oil (CPO) by the production team. The researcher chose the linear regression forecasting method and the quadratic method because it is in accordance with the data used so that it has a high degree of accuracy to overcome existing problems.

The aim of this research is to predict the need for FFB raw materials for CPO (Crude Palm Oil) production in the coming year, namely 2022 and to determine the best forecasting method between the linear regression method and the quadratic method by looking for the smallest error rate in each method.

Materials and Methods

Materials

Forecasting is a quantitative method used to predict events that will occur in the future by relying on historical data or past information as a reference basis. Forecasting is carried out in order to reduce the risk in conditions of uncertainty regarding something that may happen in the future. Minimizing this uncertainty can be done by using a forecasting method approach (Wardah & Iskandar, 2017).

In this study, the discovery of existing problems was carried out through observation or direct observation at PT. Socfindo Kebun Mata Pao with a focus on the supply of raw materials. Data collection in this study was carried out with a study of documents whose documents or data were directly requested to the PT. Socfindo Kebun Mata Pao. The required data is data on the use of Fresh Fruit Bunches (FFB) in PT. Socfindo Kebun Mata Pao for the period of January-December 2021.

Methods

This study used the Linear Regression method and the Quadratic method to estimate the need for FFB in PT. Socfindo Kebun Mata Pao in the period January-December 2022.

Linear regression method

Linear regression as a prediction method has been used to predict book sales and inventory for future periods (Ayuni & Fitrianah, 2019). The general form of the equation is:

$$Dt' = a + b.t \quad (1)$$

Using the *Least Square Method* then the price constants a and b are obtained from the equation below:

$$b = \frac{n\sum(t.Dt) - (\sum t)(\sum Dt)}{n(\sum t^2) - (\sum t)^2}$$

Aceh Int. J. Sci. Technol., 12(3) 368-377
December 2023
doi: 10.13170/aijst.12.3.30411

$$a = \frac{\sum Dt}{n} - \frac{b\sum t}{n}$$

Quadratic method

The quadratic method is the value of the dependent variable with a linear increase or decrease (happens in a parabola), if the data is made into a scatter plot (the relationship between the independent variable and the dependent variable is quadratic) and is a non-linear regression method (Utami et al., 2021). It has a forecasting function, namely:

$$Dt' = a + b.t + c.t^2 \quad (2)$$

To perform forecasting by the quadratic method, then we must first find the values of the constants a, b, and c using the formula:

$$a = \frac{\sum Dt - (b.\sum t) - (c.\sum t^2)}{n} \;, b = \frac{\gamma.\delta - \theta.\alpha}{\gamma.\beta - \alpha^2} \;, c = \frac{\theta - (b.\alpha)}{\gamma}$$

Using the formula of a normal equation:

$$\alpha = \left(\sum t \,.\sum t^2\right) - \left(n\sum t^3\right)$$
$$\beta = \left(\sum t\right)^2 - \left(n\sum t^2\right)$$
$$\gamma = \left(\sum t^2\right)^2 - \left(n\sum t^4\right)$$
$$\delta = \left(\sum t \,.\sum Dt\right) - \left(n\sum t.Dt\right)$$
$$\theta = \left(\sum t^2 \sum Dt\right) - \left(n\sum t^2.Dt\right)$$

The troubleshooting steps in this study can be seen in Figure 1.

Aceh Int. J. Sci. Technol., 12(3) 368-377
December 2023
doi: 10.13170/aijst.12.3.30411

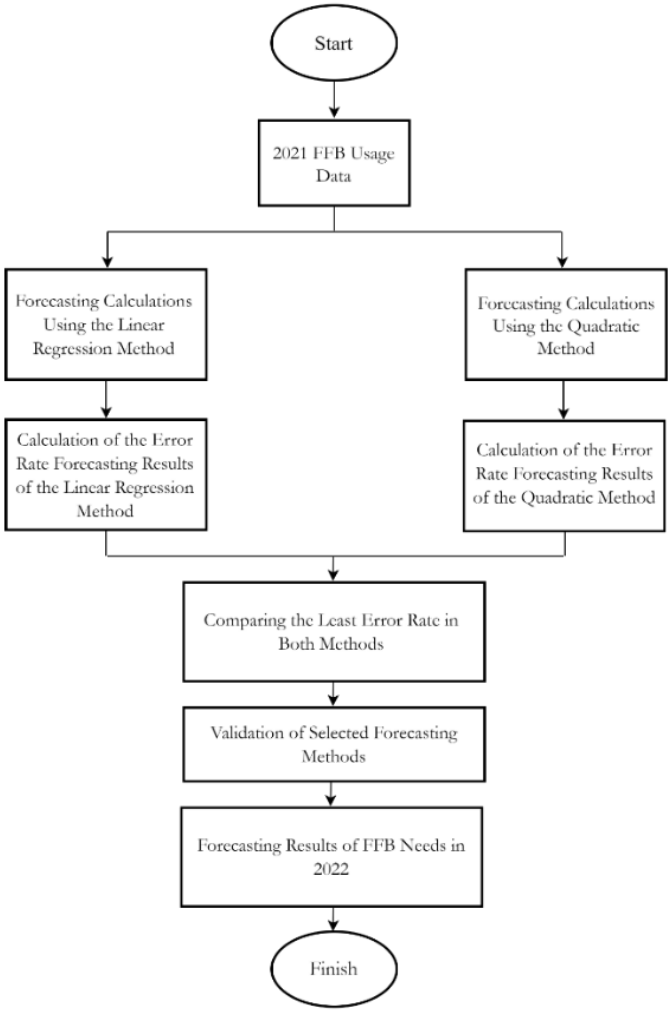

Figure 1. Problem-Solving Steps.

Results

Based on FFB usage data for the January-December 2021 period that has been obtained from PT. Socfindo Kebun Mata Pao can then be done forecasting using the Linear Regression method and the Quadratic method.

Calculation of Forecasting and Error Rate with Linear Regression Method

The calculation of dt' from January-December 2021 using the Linear Regression method using the equation (1) is:

$$Dt' = a + b.t$$

So, to find the value of a and b, the formula is used below :

$$b = \frac{n\sum(t.Dt) - (\sum t)(\sum Dt)}{n(\sum t^2) - (\sum t)^2}, \quad a = \frac{\sum Dt}{n} - \frac{b\sum t}{n}$$

And obtained the results of the values of a and b, namely :

$$b = \frac{n\sum(t.Dt) - (\sum t)(\sum Dt)}{n(\sum t^2) - (\sum t)^2} = \frac{(12 \times 186.405{,}77) - (78 \times 27.605{,}95)}{(12 \times 650) - (78)^2} = \mathbf{48{,}72}$$

$$a = \frac{\sum Dt}{n} - \frac{b\sum t}{n} = \frac{27.605{,}95}{12} - \frac{(48{,}72)(78)}{12} = \mathbf{1.983{,}81}$$

Aceh Int. J. Sci. Technol., 12(3) 368-377
December 2023
doi: 10.13170/aijst.12.3.30411

So that the function of forecasting FFB needs with the Linear Regression method is:

$$Dt' = a + b.t = 1.983,81 + (48,72).t$$

The results of the calculation of FFB need forecasting in the January-December 2021 period using the Linear Regression method, which can be seen in Table 1. The error rate in this method can then be calculated.

Table 1. Calculation of linear regression method.

No.	Month	FFB Needs (Tons)/Dt	Dt' (*Forecast*)	Dt-Dt'	(Dt-Dt')²
1	January	1.680,50	2.032,53	-352,03	123.925,12
2	February	2.362,65	2.081,25	281,4	79.185,96
3	March	2.087,58	2.129,97	-42,39	1.796,91
4	April	2.068,72	2.178,69	-109,97	12.093,40
5	May	2.202,18	2.227,41	-25,23	636,55
6	June	2.700,20	2.276,13	424,07	179.835,36
7	July	2.539,10	2.324,85	214,25	45.903,06
8	August	2.393,87	2.373,57	20,3	412,09
9	September	2.060,52	2.422,29	-361,77	130.877,53
10	October	2.154,40	2.471,01	-316,61	100.241,89
11	November	3.037,85	2.519,73	518,12	268.448,33
12	December	2.318,38	2.568,45	-250,07	62.535

(Source: Processed data)

It can be seen from the results of forecasting using the linear regression method, the historical data used in forecasting the monthly demand for FFB raw materials for 2022 forms an upward linear trend according to the resulting linear equation. The forecasting results using this method have increased the number of requests. The thing that causes an increase in forecasting results is the trend of past data (Tiranda et al., 2022).
Forecasting *error* rate using linear regression method:

$$\text{SEE Linear Regression} = \sqrt{\frac{\sum(Dt - Dt')^2}{n - f}} = \sqrt{\frac{1.005.891,23}{12 - 2}} = \mathbf{317,16}$$

$$\text{MAPE Linear Regression} = \frac{\sum|Dt - Dt'|}{n} \times 100\% = \frac{0,07}{12} \times 100\% = \mathbf{0,58\%}$$

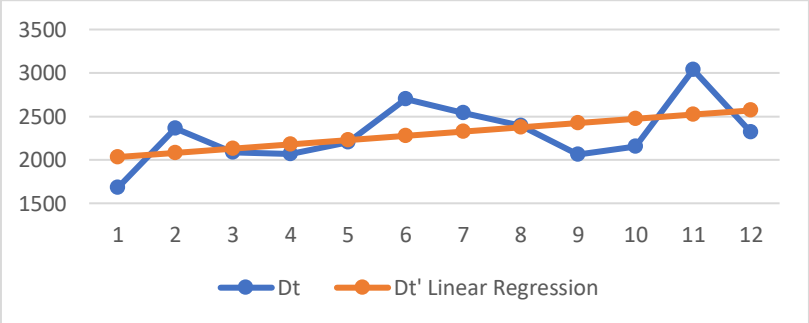

Figure 2. Linear regression forecasting calculation results graph.

Calculation of forecasting and error rate with quadratic method

The calculation of dt' from January-December 2021 using the Quadratic method using the following equation (2) is:

$$Dt' = a + b.t + c.t^2$$

So, to find the values of a, b and c, the formula is used below:

Aceh Int. J. Sci. Technol., 12(3) 368-377
December 2023
doi: 10.13170/aijst.12.3.30411

$$a = \frac{\sum Dt-(b.\sum t)-(c.\sum t^2)}{n} \;, b = \frac{\gamma.\delta-\theta.\alpha}{\gamma.\beta-\alpha^2} \;, c = \frac{\theta-(b.\alpha)}{\gamma}$$

And obtained the results of the values of a, b and c, namely:

$$b = \frac{\gamma.\delta-\theta.\alpha}{\gamma.\beta-\alpha^2} = \frac{\big((-306.020)(-83.605{,}1)\big)-((-976.206)(-22.308))}{\big((-306.020)(-1716)\big)-(-22.308)^2} = \mathbf{138,5}$$

$$c = \frac{\theta-(b.\alpha)}{\gamma} = \frac{(-976.206)-(138{,}54\times(-22.308))}{-306.020} = \mathbf{-6,9}$$

$$a = \frac{\sum Dt-b(\sum t)-c\,(\sum t^2)}{n} = \frac{(27.605{,}95)-(138{,}54\times 78)-((-6{,}91)\times 650)}{12} = \mathbf{1.774,23}$$

So that the function of forecasting FFB needs using the Quadratic method is:

$$Dt' = a + b.t + c.t^2 = 1.774{,}23 + (138{,}54).t - (6{,}91).t^2$$

A quadratic trend is a time series with data in the form of a parabolic line (Rifa'i, 2019). The results of the calculation of FFB needs forecasting in the January-December 2021 period using the Quadratic method can be seen in table 2 and can then be calculated the error rate in this method.

Table 2. Calculation of the quadratic method.

No.	Month	FFB Needs (Tons)/Dt	Dt' (*Forecast*)	Dt-Dt'	$(Dt-Dt')^2$
1	January	1.680,50	1.905,86	-225,36	50.787,13
2	February	2.362,65	2.023,67	338,98	114.907,44
3	March	2.087,58	2.127,66	-40,08	1.606,41
4	April	2.068,72	2.217,83	-149,11	22.233,79
5	May	2.202,18	2.294,18	-92	8.464,00
6	June	2.700,20	2.356,71	343,49	117.985,38
7	July	2.539,10	2.405,42	133,68	17.870,34
8	August	2.393,87	2.440,31	-46,44	2.156,67
9	September	2.060,52	2.461,38	-400,86	160.688,74
10	October	2.154,40	2.468,63	-314,23	98.740,49
11	November	3.037,85	2.462,06	575,79	331.534,12
12	December	2.318,38	2.441,67	-123,29	15.200,42

(Source: Processed data)

A quadratic trend is a time series with data in the form of a parabolic line. A parabolic (quadratic) trend is a trend in which the value of the dependent variable increases or decreases linearly or becomes parabolic when the data is made into a scatter plot (Rifa'i, 2019).

Aceh Int. J. Sci. Technol., 12(3) 368-377
December 2023
doi: 10.13170/aijst.12.3.30411

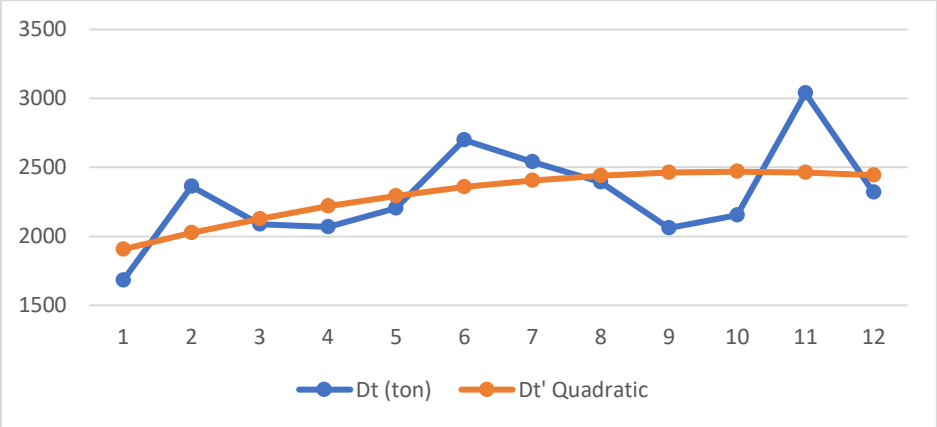

Figure 3. Quadratic forecasting calculation results graph.

Forecasting *error* rate using the quadratic method:

$$\text{SEE Quadratic} = \sqrt{\frac{\sum(Dt - Dt')^2}{n - f}} = \sqrt{\frac{942.174{,}95}{12 - 3}} = \mathbf{323,55}$$

$$\text{MAPE Quadratic} = \frac{\sum|Dt - Dt'|}{n} \times 100\% = \frac{0{,}57}{12} \times 100\% = \mathbf{4,75\%}$$

In all forecasting situations, there is a degree of uncertainty. We recognize this fact by including an element of error in the formulation of a time series forecast. The sources of discrepancies in forecasting results are not only related to errors but also depend on the ability of the forecasting model to recognize other elements in the data set. Therefore, large deviations in forecasting can be caused by unexpected factors (outliers) that are difficult to predict by any forecasting method. In addition, deviations can also be caused by the inability of the forecasting method to accurately model the trend component, seasonal component, or cyclical component that may be present in the data, indicating the inappropriateness of the method used (in Sungkawa & Megasari, 2011).

In this study using the linear regression forecasting method and the quadratic forecasting method to determine the need for FFB raw materials for the production of CPO (Crude Palm Oil) at PT. Socfindo Kebun Mata Pao. Selection of the best forecasting method is based on the level of prediction error, where the smaller the resulting error rate, the more precise a method is in predicting (in Yanti et al., 2016). The accuracy measures used in this research are SEE and MAPE.

Table 3. Comparison of SEE and MAPE error rate values.

Accuracy Size	Forecasting Methods	
	Linear Regression	Quadratic
SEE	317,16	323,55
MAPE	0,58%	4,75%

From the table above, it can be seen that each method has a different accuracy measure value. Where the Standard Error of Estimate (SEE) value in the linear regression method is 317.16, smaller than the SEE value in the quadratic method which is 323.55. For the MAPE value in the linear regression method of 0.58%, it is smaller than the MAPE value in the quadratic method which is 4.75%. Of the two forecasting precision measurement values used to compare linear and quadratic regression methods, it turns out that all the smallest precision values are found in the linear regression method. This proves that the linear regression method is the best in forecasting FFB needs for CPO production in PT. Socfindo Kebun Mata Pao.

Aceh Int. J. Sci. Technol., 12(3) 368-377
December 2023
doi: 10.13170/aijst.12.3.30411

Discussion

After obtaining the best forecasting method (SEE and the smallest MAPE), the next step is to verify forecasting. The purpose of forecasting verification is to check whether the forecasting function has represented the existing data. To check the forecasting that has been done, you can use the Moving Range Chart.

After verification, it is known and $\overline{MR} = 362{,}98$ can be seen in the graph above that no data is outside the upper and lower control limits, with the upper limit values obtained, namely UCL = 965.53 and the lower limit obtained by LCL = -965.53. For this reason, there is no need to verify by eliminating *out-of-control* data.

From the smallest SEE and MAPE error rates found in the linear regression method. This means that the linear regression method is the best method to forecast the need for FFB for CPO production in PT. Socfindo Kebun Mata Pao. This is known from the smallest error value by the SEE and MAPE accuracy measurement methods. To calculate the results of forecasting FFB needs for the coming year period, namely January – December 2022, the equation Dt' = a + b.t, with the function of the equation Dt' = 1,983.81 + 48.72(t). So that it can be known the forecasting of FFB needs for the January-December 2022 period as in table 5.

The Linear Regression Method is a method that is suitable for making predictions or forecasting, by looking at the influence between two or many variables. Meanwhile, the relationship between these variables is functional in nature which is realized in a process or mathematical model (Ababil et al., 2022).

Table 4. Verification of FFB needs data forecasting results.

No.	Month	Dt	Dt' (*Forecast*)	Et=Dt'-Dt	MR= $\lvert E_t - E_{t-1} \rvert$
1	January	1.680,50	2.032,53	-352,03	
2	February	2.362,65	2.081,25	281,4	633,43
3	March	2.087,58	2.129,97	-42,39	323,79
4	April	2.068,72	2.178,69	-109,97	67,58
5	May	2.202,18	2.227,41	-25,23	84,74
6	June	2.700,20	2.276,13	424,07	449,30
7	July	2.539,10	2.324,85	214,25	209,82
8	August	2.393,87	2.373,57	20,3	193,95
9	September	2.060,52	2.422,29	-361,77	382,07
10	October	2.154,40	2.471,01	-316,61	45,16
11	November	3.037,85	2.519,73	518,12	834,73
12	December	2.318,38	2.568,45	-250,07	768,19
Total		**27.605,95**	**27.605,88**	**0,07**	**3.992,76**

(Source: Processed data)

$$\overline{MR} = \frac{\sum MR}{n-1} = \frac{3.992{,}76}{12-1} = 362{,}98$$

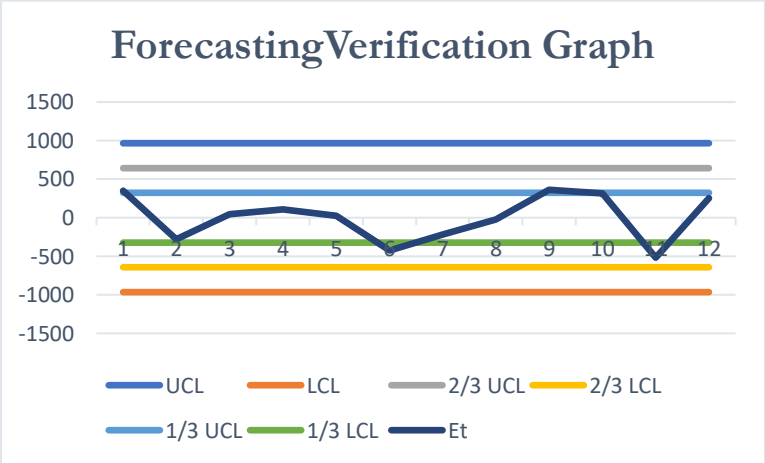

Figure 4. Forecasting results verification chart.

Table 5. FFB needs forecasting data January – December 2022.

Month	t	Dt'= a+b.t (Tons)
January	13	2.617,17
February	14	2.665,89
March	15	2.714,61
April	16	2.763,33
May	17	2.812,05
June	18	2.860,77
July	19	2.909,49
August	20	2.958,21
September	21	3.006,93
October	22	3.055,65
November	23	3.104,37
December	24	3.153,09

Conclusion

The best forecasting method for determining the raw material requirement for FFB (Fresh Fruit Bunches) for CPO production in 2022 is the linear regression method. This is because by forecasting with the linear regression method it is known that the SEE and MAPE values in these methods are in the smallest value so that the risk of errors in production forecasting and losses caused by forecasting method errors can be minimized or avoided. In the experiments that have been carried out, the results from the linear regression method are better than those from the quadratic method. The error results in the linear regression method are smaller, namely SEE of 317.16 and MAPE of 0.58% compared to the error results in the quadratic method, namely SEE of 323.55 and MAPE of 4.75%. The results of these errors can be taken into consideration in choosing the right method in making decisions about the need for FFB for CPO production in order to get even better results. Using this forecasting method can help companies order FFB according to their needs so that there is no excess or shortage of raw materials in the coming year.

References

Dirjen Bina Pengolahan dan Pemasaran Hasil Pertanian. 2017. Kebijakan pengembangan pengolahan kelapa sawit skala kecil (Mini Plant). *Analisis Kebijakan Pertanian*, *1*(1): 57–65.

Ababil, O. J., Wibowo, S. A. and Zulfia Zahro', H. 2022. Penerapan metode regresi linier dalam prediksi penjualan liquid vape di toko vapor pandaan berbasis website. *Jurnal Mahasiswa Teknik Informatika*, *6*(1): 186–195. https://doi.org/10.36040/jati.v6i1.4537

Amalia, R. R. and Hairiyah, N. 2018. Peramalan kebutuhan bahan baku tandan buah segar (TBS) menggunakan metode exponential smoothing dan linier regresion di PT. Pola Kahuripan Intisawit. *Jurnal Teknologi Agro-Industri*, *5*(2): 101–109. https://doi.org/10.34128/jtai.v5i2.75

Anugrah, P. T. and Wachjar, A. 2018. Pengelolaan pemanenan dan transportasi kelapa sawit (*Elaeis guineensis* Jacq.) di Bangun Bandar Estate, Sumatera Utara. *Buletin Agrohorti*, *6*(2): 213–220. https://doi.org/10.29244/agrob.v6i2.18810

Ayuni, G. N. and Fitrianah, D. 2019. Penerapan metode regresi linear untuk prediksi penjualan properti pada PT XYZ. *Jurnal Telematika*, *14*(2): 79–86. https://journal.ithb.ac.id/telematika/article/view/321

Ginting and Rosnani. 2019. *Sistem Produksi*. Yogyakarta : Graha Ilmu

Junaedi, A., Matra, D., Agronomi, D., Pertanian, F. and Bogor, I. P. 2019. *No Title*. *7*(3), 319–328.

Kurniawan, I. and Lontoh, A. P. 2018. Manajemen Pemanenan Kelapa Sawit (*Elaeis guineensis* Jacq.) di Divisi 2 Bangun Koling Estate, Kotawaringin Timur, Kalimantan Tengah. *Buletin Agrohorti*, *6*(1): 151–161.

https://doi.org/10.29244/agrob.v6i1.22528

Rifa'i, A. 2019. The statistical parabolic projection method untuk forecasting dalam penerimaan mahasiswa baru universitas islam indragiri di masa mendatang. *Jurnal Manajemen Dan Bisnis*, *8*(2): 354–365. https://doi.org/10.34006/jmbi.v8i2.137

Sungkawa, I. and Megasari, R. T. 2011. Penerapan ukuran ketepatan nilai ramalan data deret waktu dalam seleksi model peramalan volume penjualan PT. Satriamandiri Citramulia. *ComTech: Computer, Mathematics and Engineering Applications*, *2*(2): 636. https://doi.org/10.21512/comtech.v2i2.2813

Tanjung, W. N. and Azmiati, S. 2015. *Peramalan Jumlah Tanda Buah Segar (TBS) Kepala Sawit Dengan Metode Fuzzy Time Series Chen dan Algoritma Ruey Chyn Tsur (Studi kasus : Pada PT. XYZ)*. *VIII*(1): 36–48.

Tiranda, M. F., Utomo, T. P., Anungputri, S. and Al Rasyid, H. 2022. Analisis peramalan kebutuhan bahan baku pada PT Alta Kencana Raya. *Jurnal Agroindustri Berkelanjutan*, *1*(2): 262–270.

Utami, G. F., Suhaedi, D. and Kurniati, E. 2021. Perbandingan metode regresi linier dan non-linier kuadratik pada peramalan penjualan air minum. *Jurnal Matematika*, *20*(2): 33–40.

Wardah, S. and Iskandar, I. 2017. Analisis peramalan penjualan produk keripik pisang kemasan bungkus (Studi kasus : Home industry arwana food tembilahan). *J@ti Undip : Jurnal Teknik Industri*, *11*(3): 135. https://doi.org/10.14710/jati.11.3.135-142

Yanti, N. P. L. P., Tuningrat, I. M. and Wiranatha, A. A. P. A. S. 2016. Analisis peramalan penjualan produk kecap pada perusahaan kecap manalagi Denpasar Bali. *Jurnal Rekayasa Dan Manajemen Agroindustri*, *4*(1): 271–276.