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Application of Goal Programming Method in Production Optimization of Crude Palm Oil and Crude Palm Karnel Oil (Case Study: Pt. Barumunagro Sentosa)

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ABSTRACT

Planning in production is an action from a company that can determine the success of a company. PT. BarumunAgro Sentosa is a company that owns palm oil plantations and mills. This study aims to analyze the method*Goal Programming* and its completion in production planning*Crude Palm Oil*and*Crude Palm Kernel Oil* in the period January – December 2022 Completion of the method*Goal Programming* in optimizing the production of CPO and CPKO in this study using the help of LINDO software (*Linear Interactive Discrete Optimizer*). Completion of this method first performs a projection or forecast of the number of requests obtained from the previous period's demand data with Minitab software. The results obtained from this study are that the optimal amount of CPO production for the period January - December 2022 is 74,803,459 kg from the initial target of 73,420,955 kg and for the optimal amount of CPKO production for the period January - December 2022 is 7,058,777 kg from the initial target of 5,937. 531 kg.. The total production of CPO and CPKO has no deviation so that the production of CPO and CPKO can be said to be optimal.

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INTRODUCTION

In the industrial world, companies must pay attention to many things, one of which is production results or commonly referred to as products. Starting from the quantity of production, quality, and the quality of the products produced. In order to maximize profits, companies must make a structured and optimal production plan. Thus, the company can generate production assumptions that will be obtained to be precise and optimal using minimum costs (Hajiyanto, 2014)

Production planning is a determinant of the success of a company. The number of products produced is determined from the production planning process and considers previous documents so that it is balanced with market demand (Ginting, 2007). In preparing a structured production plan, companies must consider all constraints, so that the level of costs required will be even lower. Thus, optimizing production planning actions allows more than one company to achieve goals (Anis, 2007).

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Oil palm is a plant classification from the Arcaceae family that can produce edible oil. In the Indonesian economy, palm oil has a high selling value and is the biggest contributor to the country's deviation compared to other plantation commodities (Baroto, 2002). The community believes that palm oil remains a source of vegetable oil and is the most important ingredient for the agricultural industry. The process of processing oil palm fruit, namely Fresh Fruit Bunches (FFB) into palm oil, namely Crude Palm Oil (CPO) and palm kernel oil, namely Crude Karnel Palm Oil (CKPO) must be carried out with optimal planning so that the maximum production produced is in accordance with the availability of resources as well. remain profitable and still have a high resale value (Armindo, 2006).

According to Sukamto (2008), a palm oil mill (PKS) processes palm fruit into palm oil, namely crude palm oil (CPO) and crude palm kernel oil (CPKO). The processing of fresh fruit is quite long and requires careful monitoring. Each step in fresh fruit (FFB) processing influences the next step in the process. The following is the flow of FFB production into CPO and CPKO:

Researchers consider it important to examine the production process of Crude Palm Oil and Crude Palm Kernel Oil from palm oil mills, especially PT. BarumunAgro Sentosa (PT. BAS). In its operations, PT. BarumunAgro Sentosa obtains raw materials from plantations owned by the company. With the processing time capacity of the CPO machinefor 60,000 kg/hour and CPKO machine 5,000 kg/hour.

One of the problems that is often faced and must be considered in maximizing production results is the provision of optimal raw materials. Excessive and sub-optimal yields can cause the factory to be in idle capacity. Idle capacity conditions can reduce the quality of CPO and also harm the company. There are several methods in mathematics that can be applied in solving production planning optimization problems. One of the many methods is the Goal Programming method (Lestari, 2021).

Forecasting is a process to estimate future needs include size requirementstime, quantity, quality, and location needed into meet demand for goods or services. Forecastingmuch needed for complex market demandsand dynamic (Makridatis dan Steven, 1999).

Main thoughts in using linear programmingis to formulate the problem clearly usingnumber of available sources of information. After troublewell formulated, namely translating the problem intoin the form of a mathematical model so that the optimal decisioncan be got. (Siagian, 2006).

According to Bu'lolo (2016) Goal Programming is an extension of the liner programming model. Linear Programming is a method for solving problems that allocates limited resources such as labor, raw materials (FFB), machinery and other supporting equipment in the best way so that maximization can be obtained which can be in the form of maximizing profits or maximizing in the form of minimizing production costs. Method*Goal Programming* is a method that is able to make solutions to problems with cases that have more than one goal.*Goal Programming* has a variable called the deviation variable or deviation. Where, the deviation variable shows positive deviation and negative deviation.

LINDO is a software that was created to solve problems in solving cases that exist in linear programming. LINDO can solve linear programming cases by converting cases into mathematical models with a certain format (Siswanto, 1993).

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RESEARCH METHOD

In this study, the data was obtained by the author from company data in 2021. The research location is PT. BarumunAgro Sentosa whose address is in JambuTonang Village, Simangambat District, North Padang Lawas Regency, North Sumatra Province.

This research was conducted with the following steps:

1. Make projections or forecasts (*forecasting*) on FFB yields and demand for CPO and CPKO for 2022 which will be used as the target for CPO and CPKO production in 2022. The data used to make forecasts or projections are FFB yield data and demand for CPO and CPKO in 2021. The data which has been obtained is calculated using the exponential smoothing method by comparing the error value on the forecast. The best forecast is the one with the smallest error.
2. Function Formulation
   a. Determine decision variables,
      namely the results to be optimized so that they meet the target criteria and constraints which will become the decision variables for optimizing production at PT. BarumunAgro Sentosa.
      i. The quantity of CPO to be produced monthly by 2022.
         x_{1i}= Total production of CPO (Kg); i = January – December.
      ii. CPKO quantity to be produced monthly by 2022.
         x_{2i}= Amount of CPKO production (Kg); i = January – December.
   b. Constraint Function
      1. Availability of Fresh Fruit Bunches (FFB)

$$A_{jan}X_{jan} + d_1^- - d_1^+ = C_{jan}$$
$$A_{feb}X_{feb} + d_2^- - d_2^+ = C_{feb}$$
$$\vdots \quad \vdots \quad \vdots \quad \vdots$$
$$A_{des}X_{des} + d_{12}^- - d_{12}^+ = C_{des}$$

where:

$A_{jan},\cdots,A_{des}$	: Availability value of FFB in January – December 2021
$X_{jan},\cdots,X_{des}$	: Decision variable for the target availability of FFB January - December 2022
$C_{jan},\cdots,C_{des}$	: Target value of FFB availability January – December 2022
$d_1^-,\cdots,d_{12}^-$	: Negative deviation of the FFB availability target
$d_1^+,\cdots,d_{12}^+$	: Positive deviation of the FFB availability target

      2. Obstacles in the production of FFB into CPO

$$M_{jan}X_{1jan} + d_{12}^- - d_{13}^+ = a_{1jan}$$
$$M_{feb}X_{1feb} + d_{14}^- - d_{14}^+ = a_{1feb}$$
$$\vdots \quad \vdots \quad \vdots$$
$$M_{des}X_{1des} + d_{24}^- - d_{24}^+ = a_{1des}$$

where:

$M_{jan},\cdots,M_{des}$	: CPO production value January – December 2021
$X_{1jan},\cdots,X_{1des}$	: Decision variable for January CPO production –December 2022
$a_{1jan},\cdots,a_{1des}$	: CPO production target January – December 2022
$d_{13}^-,\cdots,d_{24}^-$	: Negative deviation of the CPO production target
$d_{13}^+,\cdots,d_{24}^+$	: Positive deviation of the CPO production target

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3. Obstacles in processing FFB to CPKO

$N_{jan}\,X_{2jan} + d_{25}^{-} - d_{25}^{+} = b_{2jan}$
$N_{feb}\,X_{2feb} + d_{26}^{-} - d_{26}^{+} = b_{2feb}$
$\vdots \quad \vdots \quad \vdots \quad \vdots$
$N_{des}\,X_{2des} + d_{36}^{-} - d_{36}^{+} = b_{2des}$

where :

$M_{jan\,,\cdots,}M_{des}$	: CPKO production value January – December 2021
$X_{2jan\,,\cdots,}X_{2des}$	: Decision variables for January CPKO production - December 2022
$X_{2jan\,,\cdots,}X_{2des}$	: CPO production target January – December 2022
$d_{25}^{-}, \cdots, d_{36}^{-}$	: Negative deviation of CPKO production target
$d_{25}^{+}, \cdots, d_{36}^{+}$	: Positive deviation of CPKO production target

4. Constraints to the availability of CPO processing time

$t_{jan}\,X_{1jan} + d_{37}^{-} - d_{37}^{+} = T$
$t_{feb}\,X_{1feb} + d_{38}^{-} - d_{38}^{+} = T$
$\vdots \quad \vdots \quad \vdots \quad \vdots$
$t_{des}\,X_{1des} + d_{48}^{-} - d_{48}^{+} = T$

where :

t	: Time needed to produce CPO each month
$X_{1jan}\,, \ldots, X_{1des}$	: CPO produced from January to December 2022
$d_{37}^{-}, \ldots, d_{48}^{-}$	: Negative deviation of processing time availabilityCPO
$d_{37}^{+}, \ldots, d_{48}^{+}$	: Positive deviation of processing time availabilityCPO
T	: The maximum processing time availableavailable (hours)

5. CPKO processing time availability constraints.

$t_{jan}\,X_{2jan} + d_{49}^{-} - d_{49}^{+} = T$
$t_{feb}\,X_{2feb} + d_{50}^{-} - d_{50}^{+} = T$
$\vdots \quad \vdots \quad \vdots \quad \vdots$
$t_{des}\,X_{2des} + d_{60}^{-} - d_{60}^{+} = T$

where :

t	: Time required to generate each CPKO month
$X_{2jan}\,, \ldots, X_{2des}$	: CPKO produced from January to December2022
$d_{49}^{-}, \ldots, d_{60}^{-}$	: Negative deviation of time availabilityCPKO processing
$d_{49}^{+}, \ldots, d_{60}^{+}$	: Positive deviation of processing time availabilityCPKO
T	: The maximum processing time availableavailable (hours)

6. Constraints on the target of processing FFB into CPO

$P_{1jan}\,X_{jan} + d_{61}^{-} + d_{61}^{+} = 0$
$P_{1feb}\,X_{feb} + d_{62}^{-} + d_{62}^{+} = 0$
$\vdots \quad \vdots \quad \vdots$
$P_{1des}\,X_{des} + d_{72}^{-} + d_{72}^{+} = 0$

where :

$P_{1jan}\,, \cdots, P_{1des}$	: Yield of CPO January – December
$X_{jan\,,\cdots,}X_{des}$	: FFB availability decision variable in January- December

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$d_{61}^{-}, \cdots, d_{72}^{-}$: Negative deviation of FFB processing target
$d_{61}^{+}, \cdots, d_{72}^{+}$: Positive deviation of FFB processing targets

7. Constraints on the target of processing FFB into CPKO.

$$P_{2jan}\, X_{jan} + d_{73}^{-} + d_{73}^{+} = 0$$

$$P_{2feb}\, X_{feb} + d_{74}^{-} + d_{74}^{+} = 0$$

$$\vdots \quad \vdots \quad \vdots \quad \vdots$$

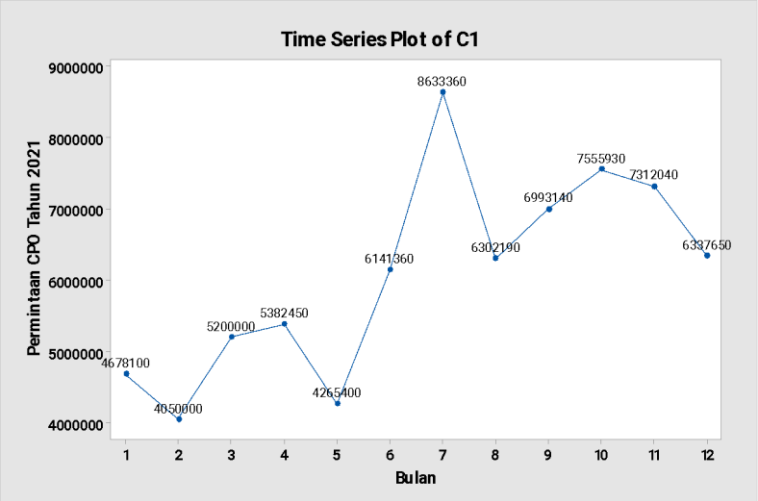
$$P_{2des}\, X_{des} + d_{84}^{-} + d_{84}^{+} = 0$$

where :
$P_{2jan}, \cdots, P_{2des}$: Yield of CPKO January – December
$X_{jan,\cdots,}X_{des}$: FFB availability decision variable in January –December
$d_{73}^{-}, \cdots, d_{84}^{-}$:Negative deviation of FFB processing target
$d_{73}^{+}, \cdots, d_{84}^{+}$: Positive deviation of FFB processing targets

3. Precalculation solutions with*software*Minitab and optimal solution problems with methods*GoalProgramming* with*software*PRETTY.
4. Analyze the results and draw conclusions.

RESULTS AND DISCUSSION

1. Forecast (Projection)
   Projected demand for CPO and CPKO at PT. BarumunAgro Sentosa in 2022 (January - December) aims to reduce the high value of deviations that may occur when forecasting. Data can be seen in the table on the average percentage of requests per month in 2021.
   a. Creating Data Patterns
      In determining the data pattern, the author will plot the CPO and CPKO demand data for 2021 in the form of a time graph. This step aims to see the pattern of data formed in order to determine the most appropriate forecasting method. The author will plot the data using Minitab software.



Graph 1. Graph of January – December 2021 CPO demand

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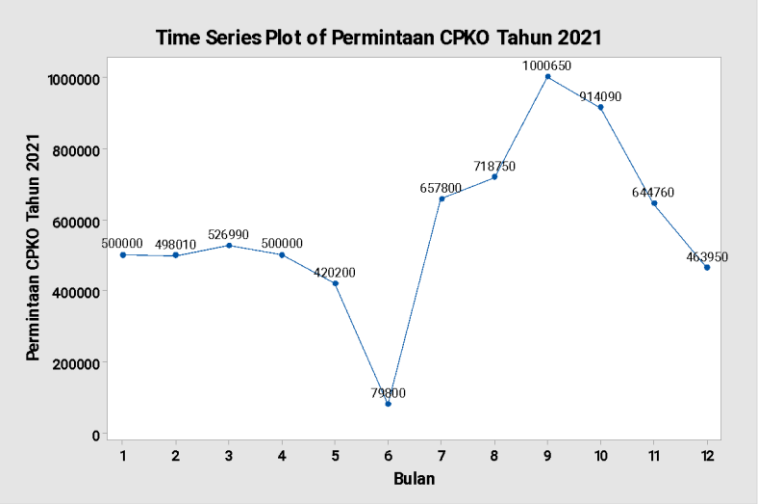

Graph 2. CPKO Demand Graph January – December 2021.

b. Choosing a Forecast Method (Projection)
The author will choose the best projection method that will be adjusted to the acquisition of data patterns. The author will analyze the single exponential smoothing, double exponential smoothing, and seasonal exponential smoothing methods to find out the lowest accuracy value. The author will determine the parameter values of α, β, γ each is 0.2. The selection of this value will be done with*software*Minitab and based on the smallest MAPE value (Juliana, 2017).

c. Forecast Results (Projections)
Based on the forecast projection graph on FFB yields and demand for CPO and CPKO respectively with*Double Exponential Smoothing*, *Double Exponential Smoothingdan Single Exponential Smoothing*, then the projection results for the period January - December for 2022 are as follows:

Table 1. FFB Harvest Projection Results and Demand for CPO and CPKO in 2022

Moon	FFB Projection (kg)	CPO Demand Projection (kg)	CPKO Demand Projection (kg)
January	22.733.588	4.517.877	420.833
February	23.827.866	4.838.711	436.667
March	23.758.088	4.938.209	448.935
April	25.514.849	5.258.280	464.546
May	26.860.533	5.555.793	471.637
June	28.390.249	5.518.778	461.350
July	30.481.592	5.889.261	385.040
August	33.551.224	6.793.811	439.592
September	36.891.006	7.031.553	495.423
October	38.893.280	7.358.400	596.469
November	40.166.971	7.740.336	659.993
December	40.519.618	7.979.976	656.946
Amount	371.558.864	73.420.985	5.937.431

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2. Sorting Data into Functions*Goal Programming*

a. Decision Variables

The decision variables in this study are as follows:

$X_{1januari} - X_{1desember}$: Amount of CPO Production January – December.

$X_{2januari} - X_{2desember}$: Number of CPKO Production January – December.

With the following deviation variables:

$d_1^- - d_{12}^-$: the target number of FFB availability that is below the target.
$d_1^+ - d_{12}^+$: the target number of FFB availability that is above the target.
$d_{13}^- - d_{24}^-$: the number of CPO production targets that are below the target.
$d_{13}^+ - d_{24}^+$: the number of CPO production targets that are above the target.
$d_{25}^- - d_{36}^-$: the number of CPKO production targets that are below the target.
$d_{25}^+ - d_{36}^+$: the number of CPKO production targets that are above the target.
$d_{37}^- - d_{48}^-$: the number of target CPO processing times that are below target.
$d_{37}^+ - d_{48}^+$: total target CPO processing time above target.
$d_{49}^- - d_{60}^-$: number of CPKO processing time targets that are inunder target.
$d_{49}^+ - d_{60}^+$: number of CPKO processing time targets that are in under target.
$d_{61}^- - d_{72}^-$: the target number of FFB processing into CPO located in under target.
$d_{61}^+ - d_{72}^+$: number of targets for processing FFB into existing CPOover the mark.
$d_{73}^- - d_{84}^-$: the target number of FFB processing into existing CPKO under target.
$d_{84}^+ - d_{84}^+$: the target number of FFB processing into existing CPKOover the mark.

b. Formulation and target constraints

1. Constraints on target availability of Raw Materials or FFB

$21.404.560X_{januari} + d_1^- - d_1^+ = 22.733.588$
$17.870.110X_{februari} + d_2^- - d_2^+ = 23.837.866$
$26.403.870X_{maret} + d_3^- - d_3^+ = 23.758.088$
$26.006.850X_{april} + d_4^- - d_4^+ = 25.514.849$
$28.037.330X_{mei} + d_5^- - d_5^+ = 26.860.533$
$31.711.030X_{juni} + d_6^- - d_6^+ = 28.390.249$
$37.325.110X_{juli} + d_7^- - d_7^+ = 30.481.592$
$40.379.780X_{agustus} + d_8^- - d_8^+ = 33.551.224$
$37.008.520X_{september} + d_9^- - d_9^+ = 36.891.006$
$35.955.450X_{oktober} + d_{10}^- - d_{10}^+ = 38.893.280$
$33.881.090X_{november} + d_{11}^- - d_{11}^+ = 40.166.971$
$30.093.490X_{desember} + d_{12}^- - d_{12}^+ = 40.519.618$

2. CPO production target target constraints

$4.310.526X_{1januari} + d_{13}^- - d_{13}^+ = 4.517.877$
$3.582.070X_{1februari} + d_{14}^- - d_{14}^+ = 4.838.711$
$5.221.617X_{1maret} + d_{15}^- - d_{15}^+ = 4.938.209$
$4.986.458X_{1april} + d_{16}^- - d_{16}^+ = 5.258.280$
$5.417.253X_{1mei} + d_{17}^- - d_{17}^+ = 5.555.793$
$6.250.318X_{1juni} + d_{18}^- - d_{18}^+ = 5.518.778$
$7.164.551X_{1juli} + d_{19}^- - d_{19}^+ = 5.889.261$
$7.583.007X_{1agustus} + d_{20}^- - d_{20}^+ = 6.793.811$

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$6.827.639X_{1september} + d_{21}^{-} - d_{21}^{+}$ = 7.031.553
$7.026.411X_{1oktober} + d_{22}^{-} - d_{22}^{+}$ = 7.358.400
$6.825.916X_{1november} + d_{23}^{-} - d_{23}^{+}$ = 7.740.336
$6.112.357X_{1desember} + d_{24}^{-} - d_{24}^{+}$ = 7.979.976

3. Constraints on CPKO production targets

$439.330X_{2januari} + d_{25}^{-} - d_{25}^{+}$ = 420.833
$405.035X_{2februari} + d_{26}^{-} - d_{26}^{+}$ = 436.667
$550.500X_{2maret} + d_{27}^{-} - d_{27}^{+}$ = 448.935
$515.251X_{2april} + d_{28}^{-} - d_{28}^{+}$ = 464.546
$513.568X_{2mei} + d_{29}^{-} - d_{29}^{+}$ = 471.637
$657.447X_{2juni} + d_{30}^{-} - d_{30}^{+}$ = 461.350
$498.168X_{2juli} + d_{31}^{-} - d_{31}^{+}$ = 385.040
$724.735X_{2agustus} + d_{32}^{-} - d_{32}^{+}$ = 439.592
$680.624X_{2september} + d_{33}^{-} - d_{33}^{+}$ = 495.423
$654.763X_{2oktober} + d_{34}^{-} - d_{34}^{+}$ = 596.469
$636.021X_{2november} + d_{35}^{-} - d_{35}^{+}$ = 659.993
$625.292X_{2desember} + d_{36}^{-} - d_{36}^{+}$ = 656.946

4. Constraints target availability of CPO processing time

$357X_{1jan} + d_{37}^{-} - d_{37}^{+}$ = 379
$298X_{1feb} + d_{38}^{-} - d_{38}^{+}$ = 397
$440X_{1mar} + d_{39}^{-} - d_{39}^{+}$ = 396
$433X_{1apr} + d_{40}^{-} - d_{40}^{+}$ = 425
$467X_{1mei} + d_{41}^{-} - d_{41}^{+}$ = 448
$529X_{1jun} + d_{42}^{-} - d_{42}^{+}$ = 473
$622X_{1jul} + d_{43}^{-} - d_{43}^{+}$ = 508
$673X_{1agst} + d_{44}^{-} - d_{44}^{+}$ = 559
$617X_{1sep} + d_{45}^{-} - d_{45}^{+}$ = 615
$599X_{1okt} + d_{46}^{-} - d_{46}^{+}$ = 648
$565X_{1nov} + d_{47}^{-} - d_{47}^{+}$ = 669
$502X_{1des} + d_{48}^{-} - d_{48}^{+}$ = 675

5. Obstacles to target availability of CPKO processing time

$214X_{2jan} + d_{49}^{-} - d_{49}^{+}$ = 227
$179X_{2feb} + d_{50}^{-} - d_{50}^{+}$ = 238
$264X_{2mar} + d_{51}^{-} - d_{51}^{+}$ = 238
$260X_{2apr} + d_{52}^{-} - d_{52}^{+}$ = 255
$280X_{2mei} + d_{53}^{-} - d_{53}^{+}$ = 269

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$317X_{2jun} + d_{54}^{-} - d_{54}^{+} = 284$
$373X_{2jul} + d_{55}^{-} - d_{55}^{+} = 305$
$404X_{2agst} + d_{56}^{-} - d_{56}^{+} = 336$
$370X_{2sep} + d_{57}^{-} - d_{57}^{+} = 369$
$360X_{2okt} + d_{58}^{-} - d_{58}^{+} = 389$
$339X_{2nov} + d_{59}^{-} - d_{59}^{+} = 402$
$301X_{2des} + d_{60}^{-} - d_{60}^{+} = 405$

6. Constraints on the target of processing FFB into CPO

$0{,}1969X_{jan} + d_{61}^{-} - d_{61}^{-} = 0$
$0{,}1978X_{feb} + d_{62}^{-} - d_{62}^{-} = 0$
$0{,}1983X_{mar} + d_{63}^{-} - d_{63}^{-} = 0$
$0{,}1982X_{apr} + d_{64}^{-} - d_{64}^{-} = 0$
$0{,}1969X_{mei} + d_{65}^{-} - d_{65}^{-} = 0$
$0{,}1961X_{jun} + d_{66}^{-} - d_{66}^{-} = 0$
$0{,}1963X_{jul} + d_{67}^{-} - d_{67}^{-} = 0$
$0{,}1954X_{agst} + d_{68}^{-} - d_{68}^{-} = 0$
$0{,}2139X_{sep} + d_{69}^{-} - d_{69}^{-} = 0$
$0{,}2080X_{okt} + d_{70}^{-} - d_{70}^{-} = 0$
$0{,}2055X_{nov} + d_{71}^{-} - d_{71}^{-} = 0$
$0{,}2047X_{des} + d_{72}^{-} - d_{72}^{-} = 0$

7. Constraints on the target of processing FFB into CPKO

$0{,}0204X_{jan} + d_{73}^{-} - d_{73}^{-} = 0$
$0{,}0204X_{feb} + d_{74}^{-} - d_{74}^{-} = 0$
$0{,}0208X_{mar} + d_{75}^{-} - d_{75}^{-} = 0$
$0{,}0208X_{apr} + d_{76}^{-} - d_{76}^{-} = 0$
$0{,}0206X_{mei} + d_{77}^{-} - d_{77}^{-} = 0$
$0{,}0201X_{jun} + d_{78}^{-} - d_{78}^{-} = 0$
$0{,}0202X_{jul} + d_{79}^{-} - d_{79}^{-} = 0$
$0{,}0188X_{agst} + d_{80}^{-} - d_{80}^{-} = 0$
$0{,}0186X_{sep} + d_{81}^{-} - d_{81}^{-} = 0$
$0{,}0186X_{okt} + d_{82}^{-} - d_{82}^{-} = 0$
$0{,}0185X_{nov} + d_{83}^{-} - d_{83}^{-} = 0$
$0{,}0185X_{des} + d_{84}^{-} - d_{84}^{-} = 0$

3.The optimal solution with*software*PRETTY

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Based on constraint function*goal programming* which has been formulated with negative deviations, namely DB and positive deviations, namely DA, the results are:

Table 2. Optimal Solution for Availability of FFB

Moon	Target	Optimal Solution for Availability of FFB		Status
		Variable	Weight (kg)	
January	22.733.588	X_{jan}	22.733.591	Achieved
February	23.827.866	X_{feb}	23.837.869	Achieved
March	23.758.088	X_{mar}	23.758.097	Achieved
April	25.514.849	X_{apr}	25.514.852	Achieved
May	26.860.533	X_{mei}	26.860.519	Not achieved
June	28.390.249	X_{juni}	28.390.251	Achieved
July	30.481.592	X_{juli}	30.481.700	Achieved
August	33.551.224	X_{agst}	33.551.236	Achieved
September	36.891.006	X_{sep}	36.891.018	Achieved
October	38.893.280	X_{okt}	38.893.298	Achieved
November	40.166.971	X_{nov}	40.166.981	Achieved
December	40.519.618	X_{des}	40.519.620	Achieved
TOTAL	371.558.864		371.599.032	

Based on Table 2, it can be concluded that the yield of FFB availability in May had a deviation of 14 kg. However, it still met the target set by the company, namely 371,599,032 kg of FFB from the initial target of 371,588,864 kg of FFB.

Table 3. Optimal Solutions for CPO Production

Moon	Target	Optimal Solution for CPKO Production		Status
		Variable	Weight (Kg)	
January	4.517.877	X_{jan}	4.576.162	Achieved
February	4.838.711	X_{feb}	4.838.710	Not achieved
March	4.938.209	X_{mar}	4.938.209	Achieved
April	5.258.280	X_{apr}	5.258.793	Achieved
May	5.555.793	X_{mei}	5.555.794	Achieved
June	5.518.778	X_{juni}	5.588.659	Achieved
July	5.889.261	X_{juli}	6.319.134	Achieved
August	6.793.811	X_{agst}	6.793.813	Achieved
September	7.031.553	X_{sep}	7.031.813	Achieved
October	7.358.400	X_{okt}	7.601.192	Achieved
November	7.740.336	X_{nov}	8.082.369	Achieved
December	7.979.976	X_{des}	8.218.810	Achieved
TOTAL	73.420.955		74.803.459	

Based on Table 3, it can be concluded that in February, the CPO production target experienced a deviation of 1 kg. However, the company was able to meet the production target set based on market

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demand by producing 74,803,459 kg of CPO, of which the target was73.420.955 in the period January – December 2022.

Table 4. Optimal Solutions for CPKO Production

Moon	Target	Optimal Solution for CPKO Production		Status
		Variable	Weight (kg)	
January	420.833	X_{2jan}	466.018	Achieved
February	436.667	X_{2feb}	538.538	Achieved
March	448.935	X_{2mar}	496.284	Achieved
April	464.546	X_{2apr}	505.342	Achieved
May	471.637	X_{2mei}	471.637	Achieved
June	461.350	X_{2juni}	589.006	Achieved
July	385.040	X_{2juli}	407.349	Achieved
August	439.592	X_{2agst}	602.750	Achieved
September	495.423	X_{2sep}	678.784	Achieved
October	596.469	X_{2okt}	707.508	Achieved
November	659.993	X_{2nov}	754.220	Achieved
December	656.946	X_{2des}	841.340	Achieved
TOTAL	5.937.531		7.058.777	

Based on Table 4.it can be concluded that the company is able to meet the production targets set by the company based on market demand by producing as much CPKO7,058,777 kg of the initial target is5,937,531 kg in the period January – December 2022.

Table 5. Optimal Solution Availability of CPO and CPKO Processing Time

Moon	Optimal Solution (hours)	
	CPO	CPKO
January	379	227
February	403	238
March	416	238
April	457	255
May	479	257
June	473	284
July	549	305
August	603	336
September	635	369
October	648	389
November	669	402
December	675	405

Based on the optimal solution obtained using the LINDO software, the availability of CPO and CPKOprocessing times from January to December 2022 can be seen in Table 5.

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Table 6. Optimal Solutions for CPO and CPKO Processing Targets

Moon	Optimal Solution (Hours)	
	CPO	CPKO
January	20,91%	2,16%
February	26,38%	2,72%
March	17,84%	1,87%
April	19,44%	2,04%
May	18,86%	1,97%
June	17,55%	1,79%
July	16,04%	1,64%
August	16,23%	1,56%
September	21,32%	1,85%
October	22,49%	2,01%
November	24,36%	2,19%
December	27,56%	2,49%

Based on the optimal solution obtained using*software*LINDO, CPO and CPKO processing targets based on yield can be seen in Table 6.

CONCLUSION

Based on the processing results obtained from PT. BarumunAgro Sentosa and projected the following data, the following conclusions were obtained:

1. The amount of FFB harvested at PT. BarumunAgro Sentosa in the period January – December is 371,599,032kg from the initial target of 371,588,862kg. This means that the FFB harvest reaches the target set by the company.
2. The amount of CPO production at PT. BarumunAgro Sentosa in the period January - December 2022 can be said to be optimal with a total production of 74,803,459 kg with an initial target of 73,420,955 kg.
3. The amount of CPKO production at PT. BarumunAgro Sentosa in the period January - December 2022 can be said to be optimal with a total production of 7,058,777 kg with an initial target of 5,937,531 kg.

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