Productivity analysis in oil palm plantations using the objective matrix method: case study PT. Dharma Satya Nusantara Tbk.

Mufid Mas'ud[1], Theresia Amelia Pawitra[2] & Lina Dianati Fathimahhayati[3]
[1,2,3]Industrial Engineering Study Program, Faculty of Engineering, Mulawarman University, East Kalimantan, Indonesia

[*] Corresponding author: mufidmasudd@gmail.com

ARTICLE INFO

Article history
Submission: 16th June, 2023
Revised: 17th November, 2023
Accepted: 29th November, 2024

Keywords
Productivity
Objective matrix
Fishbone diagram

https://doi.org/10.22219/oe.2024.v16.i2.118

ABSTRACT

PT. DSN Group Tbk, a company operating in palm oil plantations, wood products, and renewable energy, manages a 112,450-hectare palm oil plantation, including 84,566 hectares of core plantation and 27,884 hectares of plasma plantation. This research aims to identify and measure productivity criteria in the palm oil plantation and suggest improvements. The Objective Matrix (OMAX) method was used to evaluate productivity, revealing that the highest productivity index in 2021 was 136.67% in March, while the lowest was -36.67% in September. In 2022, the highest index was 101.67% in August, with the lowest at -35% in May. The Fishbone Diagram identified causes for productivity declines: in 2021, human-related issues were the primary factor, while in 2022, failure to meet production targets was the main concern. Proposed improvements include redesigning harvesting tools to reduce worker fatigue, remapping the plantation, conducting regular checks for fruit quality, maintaining farm equipment, and training workers to prevent over-fertilization.

1. Introduction

According to Martono (2019), productivity is the ratio between the volume of output and the amount of input used. Another definition states a similar concept, which is the ratio between the output of work and the input of resources used in the process of creating prosperity. According to Mahawati et al., (2021), one of the main challenges faced by many organizations today is the need to enhance employee performance. Employee performance is an assessment of the efficiency of individuals or groups in their work. In reality, this performance has a direct impact on the company's profits. Performance can be evaluated by looking at the results achieved by an employee over a specific period of time. Typically, an employee's performance is assessed relative to the average performance of other employees who perform similar tasks. Evaluation can also be based on the quantity of products or services managed by employees within a specific timeframe. Because the success of an organization heavily relies on employee performance, enhancing employee performance becomes a crucial goal for businesses. If the production productivity of a company is high, it can be concluded that the company has successfully maximized the utilization of available resources (Rahmatullah et al., 2017). According to Hamdani & Syairudin, (2016) to improve productivity, it is necessary to conduct productivity measurements that will provide an evaluation of productivity. To perform an evaluation, reports are needed that can provide information about productivity, enabling the company to create strategic plans for units that can be improved in terms of their productivity.

Please cite this article as: Mas'ud, M., Pawitra, T., & Fathimahhayati, L. (2024). Productivity analysis in oil palm plantations using the objective matrix method: case study PT. Dharma Satya Nusantara Tbk.. Operations Excellence: Journal of Applied Industrial Engineering, 16(2), 204-215. doi:http://dx.doi.org/10.22441/oe.2023.v16.i2.118

Fig. 1 Harvesting oil palm fruits.

Productivity is an important aspect for a company to determine whether it is progressing or regressing. If a company's productivity decreases, the necessary steps to be taken are identifying the causes of the decline in productivity and implementing improvements to enhance the company's productivity. When a company's productivity improves, the profits generated by the company also increase, leading to improved well-being and quality of the company. Therefore, it is essential to measure productivity at PT. DSN Group Tbk. The failure to achieve production targets can be influenced by several factors, such as human factors, for example, workers experiencing fatigue; method factors, for example, non-ergonomic methods such as using short harvest tools causing workers to easily get tired, and non-ergonomic transportation tools for palm fruit resulting in worker fatigue; machine factors, for example, issues or malfunctions in the farm tractors; environmental/weather factors, for example, rain or storms; road factors, for example, damaged roads hindering the delivery of palm fruit to the Palm Oil Mill (POM) using trucks; and employee absenteeism. Maintenance factors for palm oil trees, such as failure to regularly clean weeds/pests and fertilize, can also affect the productivity of PT. DSN Group Tbk.

Currently, PT. DSN Group Tbk only calculates productivity based on the quantity of palm oil targets delivered to the factory, without considering other criteria or factors that contribute to the decline in productivity. Therefore, this research aims to measure productivity and identify the causes of decreased productivity in the oil palm plantation at PT. DSN Group Tbk. The measurement of oil palm plantation productivity will utilize the Objective Matrix (OMAX) method. According to Setiowati (2017), the objective matrix (OMAX) measurement method offers several advantages, including the ability to measure all performance aspects or productivity criteria considered within the relevant work unit. Clear indicators for each input and output can be defined. The model's format is flexible, allowing the criteria to be determined based on the environment in which it is implemented, considering management considerations in assigning weights and performing relatively simple performance indicator calculations. Additionally, this means that the required data for this model can be easily obtained within the company's environment where the model is utilized. This research also aims to determine the company's productivity using the objective matrix (OMAX) method, identifying the criteria causing the decline in productivity within the company, and utilizing the Fishbone Diagram to understand the areas of poor or declining productivity in the oil palm plantation. Furthermore, it seeks to propose recommendations for improvement to minimize productivity issues in the oil palm plantation at PT. DSN Group Tbk in Muara Wahau. According to Singgih & Gunarta (2021), productivity improvement can be achieved by improving the inputs and outputs used. Productivity improvement is closely related to efforts to achieve effectiveness and efficiency. The produced output must be effective first. Once the output is effective, the next step is to optimize the resources used as inputs. The produced output should meet consumer preferences and expectations.

2. Methods

In this research, data collection was conducted by interviewing Mr. Novri Ardiyanto, the Estate Head of LJ2, and Mr. Andrea M.S.T, the Askep Head of LJ2, regarding the criteria that determine productivity in the LJ2 oil palm plantation. After the interviews were conducted, the criteria for

Please cite this article as: Mas'ud, M., Pawitra, T., & Fathimahhayati, L. (2024). Productivity analysis in oil palm plantations using the objective matrix method: case study PT. Dharma Satya Nusantara Tbk.. Operations Excellence: Journal of Applied Industrial Engineering, 16(2), 204-215. doi:http://dx.doi.org/10.22441/oe.2023.v16.i2.118

productivity ratios in the oil palm plantation were identified, which include total production data, workforce size, worker attendance, normal working days for employees, quantity of good and bad fruit, production targets, machine downtime hours, normal working hours for farm tractors, weather conditions (rainfall), and fertilization of the oil palm plantation. The data used in this research are the production data for the periods of 2021 and 2022.

Objective Matrix (OMAX)

According to Waluyo (2008), Prof. James L. Riggs, a productivity expert from the United States, is the creator of this model. The current OMAX model was formed in 1980 when managers were asked to evaluate the relative importance levels of each productivity criterion unit using a weighting system. According to Panjaitan (2018), productivity refers to the relationship between the quantity of goods and services produced and the amount of resources utilized, such as labor, capital, and land. The concept of productivity involves how effectively a process can generate output using specific inputs. Productivity can be calculated as a ratio between input and output, with a focus on the level of output generated by a process that utilizes a combination of resources to achieve a specific output level. According to Siswadi (2017), the overall production and operations of a company will benefit positively if employees exhibit high levels of work productivity, both currently and in the future. Several factors influence the level of employee work productivity, including job training and work discipline. By implementing appropriate training and maintaining good discipline levels, a company can achieve optimal work productivity. According to Wibisono (2019), one suitable and applicable method for analyzing productivity is the Objective Matrix (OMAX). The OMAX method is a form of partial productivity analysis designed to monitor productivity across various sections of a company. This method involves the use of productivity criteria that are appropriate for the characteristics of each respective section of the company. According to Ismail et al., (2022), to achieve good productivity, a company needs to measure and analyze a well-designed productivity system, one of which is analyzing productivity using the Objective Matrix Method that can be implemented by the company for partial productivity measurement. Therefore, analysis and measurement of productivity in the production division need to be conducted to improve the effectiveness and efficiency of the company. According to Hardiantara et al., (2019), by using OMAX, a company can systematically analyze various criteria and their relationships to understand the underlying issues affecting productivity. This method assists in developing targeted strategies and interventions to overcome productivity barriers and improve overall performance. Productivity measurement is carried out by comparing the output produced with the inputs used to produce goods and services. Input factors in the production process can include raw materials, labor, machinery, methods, and capital (Kemenaker Republik, 2019).

According to Waluyo (2008), based on the data that has been obtained through observations and interviews, the next stage is to process the data based on the data obtained from data collection will be processed with the *Objective Matrix* (OMAX) method following the following stages

a. Defining Block
   1) Productivity Criteria refer to the parameters used to measure productivity in the department you want to measure. For example, in the plantation department, the parameters used may include output per hour, output per 100 units, and so on. It is recommended that there be more than one parameter to measure productivity.
   2) Current Performance is the current productivity value, obtained from the last measurement. Each factor that affects productivity will be measured based on the parameters that have been set for each factor.
      a) Human Criteria
         Total Production:

$$\text{Ratio 1} = \frac{\text{Total production output (tons)}}{\text{The number employeers (people)}} = \quad (1)$$

         Employee Attendance:

$$\text{Ratio 2} = \frac{\text{Total employee absenteeism (days)}}{\text{Total Workforce (people)}} \text{x} 100\% = \quad (2)$$

      b) Palm Fruit Criteria
         Palm Fruit:

Please cite this article as: Mas'ud, M., Pawitra, T., & Fathimahhayati, L. (2024). Productivity analysis in oil palm plantations using the objective matrix method: case study PT. Dharma Satya Nusantara Tbk.. Operations Excellence: Journal of Applied Industrial Engineering, 16(2), 204-215. doi:http://dx.doi.org/10.22441/oe.2023.v16.i2.118

$$\text{Ratio 3} = \frac{\text{Total quantity of bad fruit (tons)}}{\text{Total quantity of fruit produced (tons)}} \text{x100\% =} \quad (3)$$

$$\text{Ratio 4} = \frac{\text{Total quantity of bad fruit (tons)}}{\text{Total quantity of good fruit (tons)}} \text{x100\% =} \quad (4)$$

Production Target:

$$\text{Ratio 5} = \frac{\text{Actual production (tons)}}{\text{Target production (tons)}} \text{x100\% =} \quad (5)$$

c) Machine Criteria

Farm Tractor machine:

$$\text{Ratio 6} = \frac{\text{Total hours of Farm Tractor downtime (hours)}}{\text{Total hours of normal Farm Tractor operation (hours)}} \text{x100\% =} \quad (6)$$

d) Environment Criteria

Rainfall:

$$\text{Ratio 7} = \frac{\text{Number of good weather (days)}}{\text{Number of bad weather (days)}} \text{x100\% =} \quad (7)$$

e) Maintenance Criteria

Fertilization of Oil Palm Trees by Area (Hectares)

$$\text{Ratio 8} = \frac{\text{Actual area of fertilization (hectares)}}{\text{Recommended area of fertilization (hectares)}} \text{x100\% =} \quad (8)$$

b. Quantification Block

The quantification block is about the body of the matrix that consists of scales or numbers that indicate the level of performance of each productivity criterion measurement. There are eleven levels or sections in the scale, ranging from 0 to 10. The larger the scale, the better the productivity. This scale consists of three parts, namely:

1) *Level* 0, which indicates the worst possible productivity value.
2) *Level* 3, indicating the average productivity value of current performance
3) *Level* 10, indicates the productivity value that is expected to be achieved in a given period. If there is an increase in the productivity value, it will be adjusted by means of a certain, namely by doing the following calculation:

$$\text{Scale level 1 and 2} = \frac{\text{level 3 - level 0}}{\text{3 - 0}} \quad (9)$$

$$\text{Scale level 4 to 9} = \frac{\text{level 10 - level 3}}{\text{10 - 3}} \quad (10)$$

c. Productivity Assessment Block

The productivity assessment block consists of:

1) Score
   This is a value that indicates the level at which the productivity measurement is located. For example, if output per hour = 100 is located at level 4, then the score for that measurementis 4. If any measurement does not exactly match the number on the matrix, it will be rounded down for internal measurements and rounded up for external measurements.
2) Weight
   This is the effect of each productivity criterion on total productivity. Each criterion that has been determined has a different influence on the unit being measured. Therefore, it is necessary to include a weight that shows the relative influence of the criteria on the productivity of the work unit measured in the form of a percentage. The sum of all criteria weights is 100.
3) Value
   This is the result of multiplying each score by its weight.
4) Productivity Indicator
   It is the sum of each Productivity Index (IP) value. It is calculated as a percentage increase or decrease over the current performance. The current performance is 300 because all indicators scored three when the matrix was put into operation. The score of three refers to

Please cite this article as: Mas'ud, M., Pawitra, T., & Fathimahhayati, L. (2024). Productivity analysis in oil palm plantations using the objective matrix method: case study PT. Dharma Satya Nusantara Tbk.. Operations Excellence: Journal of Applied Industrial Engineering, 16(2), 204-215. doi:http://dx.doi.org/10.22441/oe.2023.v16.i2.118

the third *level of* the 0-10 scale used in the *Objective Matrix* (OMAX). This third level is the average value of the current performance measured against the predetermined productivity criteria. Therefore, if all indicators get a score of three, the current performance will have a value of 300, because the value is obtained from the total number of indicators which is 100 multiplied by the third *level which is* 3. So the Productivity Index is:

$$IP = \frac{\text{Productivity Index - 300}}{300} \text{x100\%} \quad (11)$$

After measuring productivity, the next step is to identify the causes of the decline in company productivity using *Cause and* Effect *Diagrams*. Cause and Effect Diagram is a tool that helps identify, sort, and display the various possible causes of a particular quality problem or characteristic. This diagram illustrates the relationship between the problem and all the causal factors that affect the problem. This diagramming is done with the aim of identifying factors that may be the cause of a problem or deviation (as a result of causes). By knowing the relationship between the cause and effect of a problem, the steps to solve it can be determined more easily (Kurniasih et al., 2021). The data processing stage is carried out after obtaining data from the previous stage. At this stage consists of several tests and calculations including.

Analysis and discussion stage, at this stage the researcher will analyse the results of the previous data processing stage including the following.

a. Productivity Analysis of PT DSN Group Tbk.
   At this stage, researchers analysed productivity measurements at PT DSN Group Tbk using the Objective Matrix (OMAX) method. This method includes analysing productivity criteria, giving weights and values to each criterion and performing matrix operations.
b. Analyze the Causes of Productivity Decline.
   In this analysis, the productivity of PT DSN Group Tbk will be measured and identify the causes of the decline in productivity using the Fishbone Diagram. The use of Fishbone Diagram is because this diagram is able to identify any problems that occur and is able to provide suggestions for improvements that may be the cause of the problem.
c. Provision of Improvement Proposal
   At this stage, we will look for the root causes of factors that can reduce productivity and design improvements to the company.

3. Results and Discussion

After collecting data, the next step is to process the data. Data processing in this study, namely; determining productivity criteria, determining *performance*, determining the highest productivity value (*level* 10), determining the average value (*level* 3), determining the lowest productivity value (*level* 0), determining realistic productivity values (*level* 1-2 and *level* 4-9), determining (weights, scores and values), calculating the productivity index, determining performance indicators, determining the productivity index against standard performance, determining productivity indicators against previous performance and achieving scores on each criterion. The following is data processing on the productivity of oil palm plantations using the *Objective Matrix* (OMAX) method for the 2021 and 2022 periods as shown in Table 3 and Table 1.

3.1 Determine the Highest Ratio (Level 10), Average Ratio (Level 3) and Lowest Ratio (Level 0) values

The results of ratio value level 10 (highest ratio), level 3 (average ratio) and level 0 (lowest ratio ratio) are obtained through the calculation of performance in each month of the ratio.

Table 1 Calculation results of productivity ratio 2021

Criteria / Month	Ratio 1 (tons/person)	Ratio 2 (%)	Ratio 3 (%)	Ratio 4 (%)	Ratio 5 (%)	Ratio 6 (%)	Ratio 7 (%)	Ratio 8 (%)
January	22,081	7,988	0,325	0,326	98,528	14,958	63,158	96,792
February	21,086	6,954	0,340	0,341	92,960	7,708	106,667	64,384
March	26,268	7,365	0,175	0,175	109,744	2,000	106,250	125,354
April	24,350	7,870	0,055	0,055	105,655	6,333	63,158	115,722
May	21,305	17,133	0,103	0,104	85,317	11,250	55,000	61,896
June	20,119	9,666	0,264	0,265	91,642	24,125	287,500	126,881

Please cite this article as: Mas'ud, M., Pawitra, T., & Fathimahhayati, L. (2024). Productivity analysis in oil palm plantations using the objective matrix method: case study PT. Dharma Satya Nusantara Tbk.. Operations Excellence: Journal of Applied Industrial Engineering, 16(2), 204-215. doi:http://dx.doi.org/10.22441/oe.2023.v16.i2.118

Criteria / Month	Ratio 1 (tons/person)	Ratio 2 (%)	Ratio 3 (%)	Ratio 4 (%)	Ratio 5 (%)	Ratio 6 (%)	Ratio 7 (%)	Ratio 8 (%)
July	20,251	13,178	0,233	0,234	86,539	19,458	138,462	130,252
August	22,704	9,831	0,383	0,384	93,294	16,667	57,895	114,932
September	22,644	8,893	0,447	0,449	83,691	27,625	158,333	45,170
October	19,915	6,363	0,303	0,304	70,808	6,000	158,333	157,143
November	24,953	7,254	0,200	0,200	88,909	24,125	106,250	235,917
December	22,291	7,536	0,244	0,245	82,784	27,667	72,222	151,827
Highest Ratio	**26,268**	**6,363**	**0,055**	**0,055**	**109,744**	**2,000**	**287,500**	**235,917**
Average Ratio	**22,331**	**9,169**	**0,256**	**0,257**	**90,823**	**15,660**	**114,436**	**118,856**
Lowest Ratio	**19,915**	**17,133**	**0,447**	**0,449**	**70,808**	**27,667**	**55,000**	**45,170**

Table 2 Calculation results of productivity ratio 2022

Criteria / Month	Ratio 1 (tons/person)	Ratio 2 (%)	Ratio 3 (%)	Ratio 4 (%)	Ratio 5 (%)	Ratio 6 (%)	Ratio 7 (%)	Ratio 8 (%)
January	18,802	7,358	0,362	0,363	97,771	14,000	72,222	183,733
February	14,109	7,380	0,637	0,641	85,520	22,417	121,429	78,825
March	15,742	9,975	0,502	0,504	75,037	36,708	120,000	374,289
April	17,966	8,187	0,455	0,457	77,250	34,500	93,750	124,171
May	18,447	15,210	0,449	0,451	83,909	35,625	72,222	124,171
June	23,764	7,035	0,469	0,471	101,072	44,375	181,818	100,000
July	26,020	8,982	0,278	0,278	121,532	31,667	93,750	100,000
August	29,755	7,822	0,170	0,170	127,321	38,125	172,727	100,000
September	25,418	7,281	0,257	0,258	103,774	47,833	210,000	91,025
October	24,694	6,524	0,167	0,168	82,805	56,875	40,909	45,806
November	24,791	6,633	0,093	0,093	86,419	37,833	72,222	114,277
December	23,798	6,123	0,134	0,134	98,693	19,375	72,222	114,277
Highest Ratio	**29,755**	**6,123**	**0,093**	**0,093**	**127,321**	**14,000**	**210,000**	**374,289**
Average Ratio	**21,942**	**8,209**	**0,331**	**0,332**	**95,092**	**34,944**	**110,273**	**129,214**
Lowest Ratio	**14,109**	**15,210**	**0,637**	**0,641**	**75,037**	**56,875**	**40,909**	**45,806**

3.2 Determining Realistic Productivity Values (*Level* 1-2 and *Level* 4-9)

The realistic productivity value is the value of the range of achievements from the lowest to the highest value, which will be known as the score to be achieved during the measurement period.

3.3 Determine Weight, Score, Value

The determination of the score is obtained by looking at the performance that is close to the performance ratio for that period on the lowest to highest performance indicators (*level* 1 - *level* 10). Determination of the weight of each criterion is done by comparing which priority scale is more important between one criterion and another. The value is obtained by multiplying the score and weight that has been determined. The determination of this weight was carried out by Mr. Novri Ardiyanto as *Estate Head* LJ2 which can be seen in Table 3.

3.4 Determine Current, Productivity Index and Previous values

Before calculating the productivity index, it is necessary to calculate the productivity level (*current*) first, this calculation is done by adding up the values of all productivity ratios.Then after calculating the *current for* each productivity period, the next step is to calculate the productivity index for each period.

Table 3 Weight value in 2021 and 2022 period

No	Productivity Criteria	Ratio 2021 & 2022	Weight (%)
1	Human	Ratio 1 (tons/person)	20
		Ratio 2 (%)	10
		Ratio 3 (%)	10
2	Oil Palm Fruit	Ratio 4 (%)	5
		Ratio 5 (%)	10
3	Machine	Ratio 6 (%)	15
4	Environment	Ratio 7 (%)	10
5	Care	Ratio 8 (%)	20

Please cite this article as: Mas'ud, M., Pawitra, T., & Fathimahhayati, L. (2024). Productivity analysis in oil palm plantations using the objective matrix method: case study PT. Dharma Satya Nusantara Tbk.. Operations Excellence: Journal of Applied Industrial Engineering, 16(2), 204-215. doi:http://dx.doi.org/10.22441/oe.2023.v16.i2.118

The calculation of the productivity index against the previous period (*previous*) is carried out to determine the increase or decrease in productivity in a certain period against the productivity of the previous period. The calculation of the productivity index is used as a tool to analyze changes in the value of the productivity index for the purpose of controlling the production system within the respective company (Komariah, 2019).

According Agustina & Riana (2011), in productivity measurement using OMAX model, there is a body of matrix divided into ten levels that have corresponding value levels. Meanwhile, the performance indicators consist of: current (the value obtained during the measurement), previous (the value from the previous period), and productivity index (PI). The results of the performance indicator matrix calculation for the 2021 and 2022 periods can be seen in Table 4 and Table 5.

Table 4 Performance Indicator Matrix January 2021 Period

Criteria		Ratio 1 (tons/person)	Ratio 2 (%)	Ratio 3 (%)	Ratio 4 (%)	Ratio 5 (%)	Ratio 6 (%)	Ratio 7 (%)	Ratio 8 (%)
Performance		22,081	7,988	0,325	0,326	98,528	14,958	63,158	96,792
Target	10	**26,268**	**6,363**	**0,055**	**0,055**	**109,744**	**2,000**	**287,500**	**235,917**
	9	25,706	6,764	0,084	0,084	107,041	3,951	262,777	219,194
	8	25,143	7,165	0,112	0,113	104,338	5,903	238,053	202,471
	7	24,581	7,566	0,141	0,142	101,635	7,854	213,330	185,748
	6	24,018	7,966	0,170	0,170	98,932	9,806	188,606	169,025
Standardized	5	23,456	8,367	0,199	0,199	96,229	11,757	163,883	152,302
Performance	4	22,893	8,768	0,227	0,228	93,526	13,709	139,159	135,579
	3	**22,331**	**9,169**	**0,256**	**0,257**	**90,823**	**15,660**	**114,436**	**118,856**
	2	21,526	11,824	0,320	0,321	84,151	19,662	94,624	94,294
	1	20,720	14,478	0,383	0,385	77,480	23,665	74,812	69,732
	0	**19,915**	**17,133**	**0,447**	**0,449**	**70,808**	**27,667**	**55,000**	**45,170**
Score		3	6	2	2	6	3	0	2
Weight %		20	10	10	5	10	15	10	20
Value		60	60	20	10	60	45	0	40
								Current	**295**
					Performance Indicator			**Index**	**-1,67**
								Previous	**0**

Table 5 Performance Indicator Matrix for the period January 2022

Criteria		Ratio 1 (tons/person)	Ratio 2 (%)	Ratio 3 (%)	Ratio 4 (%)	Ratio 5 (%)	Ratio 6 (%)	Ratio 7 (%)	Ratio 8 (%)
Performance		18,802	7,358	0,362	0,363	97,771	14,000	72,222	183,733
Target	10	**29,755**	**6,123**	**0,093**	**0,093**	**127,321**	**14,000**	**210,000**	**374,289**
	9	28,639	6,421	0,127	0,127	122,717	16,992	195,753	339,278
	8	27,523	6,719	0,161	0,161	118,113	19,984	181,507	304,268
	7	26,407	7,017	0,195	0,195	113,509	22,976	167,260	269,257
	6	25,290	7,315	0,229	0,230	108,904	25,968	153,013	234,246
Standardized	5	24,174	7,613	0,263	0,264	104,300	28,96	138,766	199,235
Performance	4	23,058	7,911	0,297	0,298	99,696	31,952	124,520	164,225
	3	**21,942**	**8,209**	**0,331**	**0,332**	**95,092**	**34,944**	**110,27**	**129,214**
	2	19,331	10,543	0,433	0,435	88,407	42,254	87,152	101,411
	1	16,720	12,876	0,535	0,538	81,722	49,565	64,030	73,609
	0	**14,109**	**15,21**	**0,637**	**0,641**	**75,037**	**56,875**	**40,909**	**45,806**
Score		2	6	3	3	4	10	2	5
Weight %		20	10	10	5	10	15	10	20
Value		40	60	30	15	40	150	20	100
								Current	**455**
					Performance Indicator			**Index**	**51,67**
								Previous	**49,18**

3.5 Graph Analysis of Standard Productivity Index and Previous Productivity Index

Determination of the productivity index (IP) is carried out to determine the decrease or increase that occurs in each period. The Productivity Index for the 2021 and 2022 periods can be seen in Fig. 2. The highest productivity index occurred in March, amounting to 136.67%, the productivity index is

Please cite this article as: Mas'ud, M., Pawitra, T., & Fathimahhayati, L. (2024). Productivity analysis in oil palm plantations using the objective matrix method: case study PT. Dharma Satya Nusantara Tbk.. Operations Excellence: Journal of Applied Industrial Engineering, 16(2), 204-215. doi:http://dx.doi.org/10.22441/oe.2023.v16.i2.118

due to the fact that in this period the score of the human criteria ratio 1, the oil palm fruit criteria ratio 5 and the machine criteria ratio 6 is above average/reaches the desired target, which is at *level* 10. The lowest productivity index during the 2021 period occurred in the September period, amounting to -36.67, this is because the score of the oil palm fruit criteria in ratio 3 and ratio 4, the farm tractor machine criteria in ratio 6 and the oil palm tree care criteria in ratio 8 are at the lowest *level,* namely *level* 0.

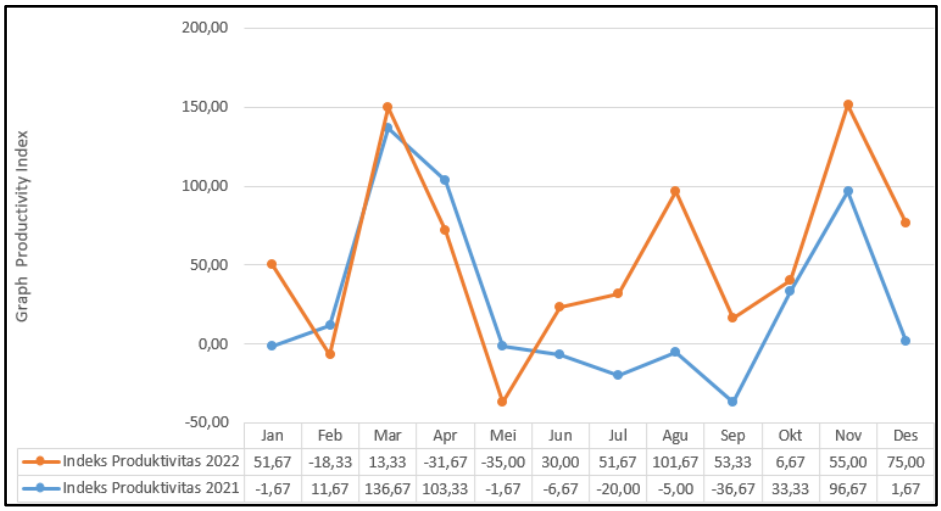

Fig. 2 Index productivity 2021 & 2022.

Fig. 2 of the 2022 productivity index graph above shows that the highest productivity is in the August period, with a productivity index of 101.67%, the high productivity is because in this month the value of the ratio 1 and ratio 5 criteria is above average/achieving the target, which is at *level* 10, while the lowest productivity during the 2022 period is in the May period with a productivity level of -35%, this is because the ratio 2 criteria is at the lowest *level* or below the average, which is *level* 0.

3.6 Determining the Score Value of Each Ratio

The score achievement of each ratio criterion is used to determine the worst ratio to be used in the proposed improvement, the score achievement of each ratio for the 2021 period can be seen in Table 6. The results of Table 6 show that during the 2021 period the environmental criteria (weather) at ratio 7 was the lowest ratio (*level* 0) in January, April, May and August. The cause of the decline in productivity in the 2021 period is due to bad weather so that harvest workers/employees cannot work or are late in coming to work.

If harvest workers are late or do not go to work, the company's production target will not be achieved. Environmental criteria in ratio 7 (weather) for the 2021 period are difficult to make improvement proposals because weather or rainfall cannot be controlled.

Table 6 Achievement score for each criterion in 2021 period

Period	Score Achievement							
	Ratio 1	Ratio 2	Ratio 3	Ratio 4	Ratio 5	Ratio 6	Ratio 7	Ratio 8
January	3	6	2	2	6	3	0	2
February	1	9	2	2	4	7	3	1
March	10	8	6	6	10	10	3	3
April	7	6	10	10	8	8	0	3
May	2	0	8	8	2	5	0	2
June	0	3	3	3	3	1	10	3
July	0	1	4	4	2	2	4	4
August	4	3	1	1	4	3	0	3
September	4	4	0	0	2	0	5	0
October	0	10	2	2	0	8	5	5
November	8	8	5	5	3	1	3	10
December	3	7	3	3	2	0	1	5

Please cite this article as: Mas'ud, M., Pawitra, T., & Fathimahhayati, L. (2024). Productivity analysis in oil palm plantations using the objective matrix method: case study PT. Dharma Satya Nusantara Tbk.. Operations Excellence: Journal of Applied Industrial Engineering, 16(2), 204-215. doi:http://dx.doi.org/10.22441/oe.2023.v16.i2.118

Therefore, for the 2021 period, the problem taken is in ratio 1 of the total production criteria based on the number of workers because ratio 1 is the second lowest ratio besides the environmental criteria (weather). In Table 7, the ratio 1 criterion has several months with the lowest productivity (*level* 0), namely in June, July and October so that this criterion needs to be proposed for improvement.

Table 7 Achievement of each ratio score in 2022

Period	Score Achievement							
	Ratio 1	Ratio 2	Ratio 3	Ratio 4	Ratio 5	Ratio 6	Ratio 7	Ratio 8
January	2	6	3	3	4	10	2	5
February	0	6	0	0	2	7	4	1
March	1	2	1	1	0	3	4	10
April	1	3	2	2	0	3	2	3
May	2	0	2	2	1	3	1	3
June	5	7	2	2	4	2	8	2
July	7	3	5	5	9	4	2	2
August	10	4	8	8	10	3	6	2
September	6	6	5	5	5	1	10	2
October	5	9	8	8	1	0	0	0
November	6	8	10	10	2	3	1	2
December	5	10	9	9	4	8	1	2

The results of Table 7 above show that during the 2022 period the lowest ratio criteria are in the production target criteria at ratio 5, namely in March and April with a score of 0 or at *level* 0, this will cause a decrease in productivity in that period and ratio. In the 2022 period, the cause of the decline in productivity is due to the ratio of unachieved production targets, unachieved production targets can be influenced by many factors ranging from bad weather, *farm tractor* machines that occur damage, fertilization that does not reach the company's target, the factor of workers who do not come in and the number of workers who are less.

3.7 Fishbone Diagram/Cause and Effect Diagram

The Cause and Effect Diagram is used to find the root cause of the decline in productivity for the 2021 and 2022 periods. The following is a problem identification using a cause and effect diagram can be seen in Fig. 3. Productivity for the 2022 period, in Figure 4 below, the cause and effect diagram above the ratio of 5 criteria for production targets not being achieved is influenced by several factors on oil palm plantations, namely, human factors, materials, environment, methods, machines and tools.

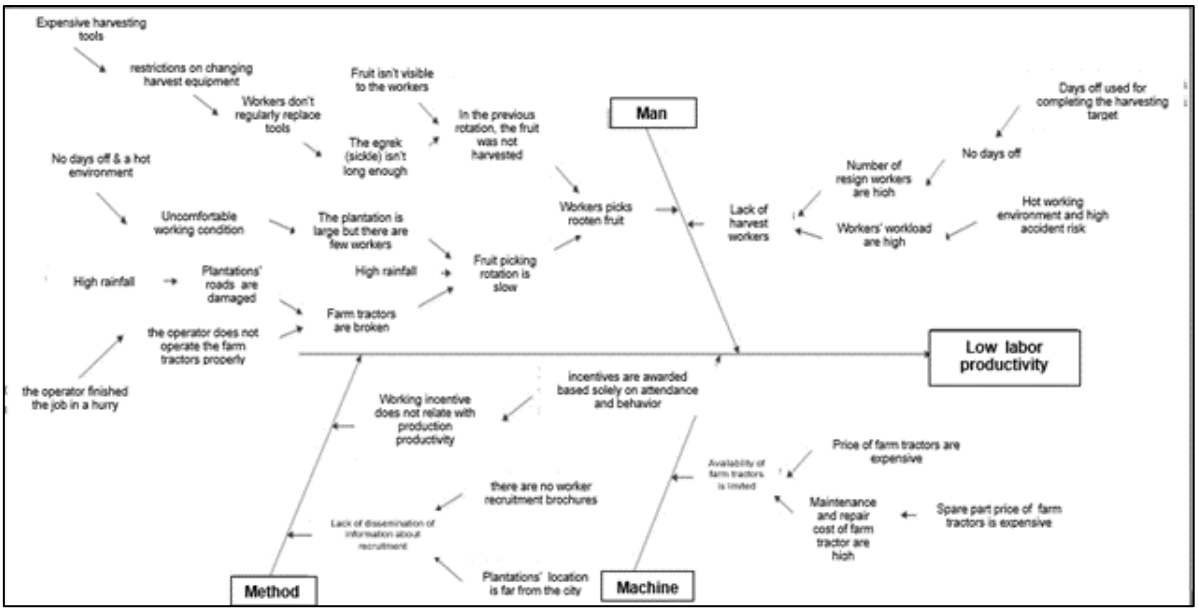

Fig. 3 Fishbone diagram of lack of labor productivity.

Please cite this article as: Mas'ud, M., Pawitra, T., & Fathimahhayati, L. (2024). Productivity analysis in oil palm plantations using the objective matrix method: case study PT. Dharma Satya Nusantara Tbk.. Operations Excellence: Journal of Applied Industrial Engineering, 16(2), 204-215. doi:http://dx.doi.org/10.22441/oe.2023.v16.i2.118

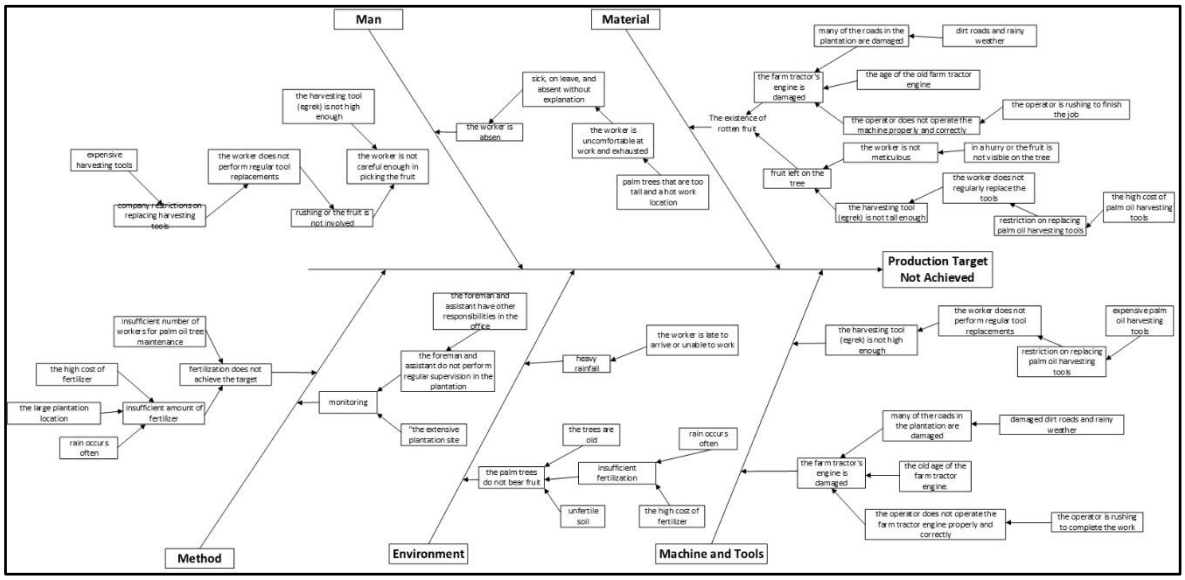

Fig. 4 Fishbone diagram of unachieved production target.

3.8 Determining Improvement Proposals

Based on the results of the identification of the causes of declining productivity in the company using the cause and effect diagram, it is necessary to propose improvements/improvement solutions. Proposed improvements that need to be made can be seen in Table 8.

Table 8 Provision of improvement proposals

Causes	Proposed Improvements
Human	
Workers leave fruit on an oil palm tree	It is necessary to check regularly and if possible, consider additional labor to assist in checking the harvesting of oil palm fruit.
Worker Attendance	It is necessary to set limits on worker absences and permits, unless the worker is experiencing illness.
Materials	
There is rotten fruit	It is necessary to provide workers whose job is to check each plantation location for any fruit left on the oil palm trees and harvest workers then pick back the oil palm fruit that is left behind.
There are trees that do not bear fruit	It is necessary to take extra care of trees that do not bear fruit by pruning and routine maintenance such as fertilization and weed/pest removal. Good pruning can help improve air and light circulation, and stimulate fruit production.
Environment	
Rainy Weather	The company can provide raincoats to workers, so that when it rains workers can use the raincoats.
Old age of oil palm trees	Pruning of old oil palm trees is necessary to stimulate the growth of new shoots. Routine fertilization and cleaning of mill waste streams to the plantation to meet the water needs of oil palm trees.

Please cite this article as: Mas'ud, M., Pawitra, T., & Fathimahhayati, L. (2024). Productivity analysis in oil palm plantations using the objective matrix method: case study PT. Dharma Satya Nusantara Tbk.. Operations Excellence: Journal of Applied Industrial Engineering, 16(2), 204-215. doi:http://dx.doi.org/10.22441/oe.2023.v16.i2.118

Causes	Proposed Improvements
Methods	
Oil palm fruit harvesting method	It is necessary to map in detail the location of oil palm plantations. The purpose of this mapping is to find out the location of plantations that can be passed by *farm tractor* machines or not.
Machinery and Tools	
Farm tractor engine breakdown	It is necessary to maintain the *farm tractor* machine regularly. Scheduling of checking, maintenance and repair of *farm tractor* machinery needs to be done so that the machine can be in good condition.
Non-ergonomic oil palm harvesting tools	The egrek harvesting tool has two knives of different lengths. The longer blade is used for harvesting fruit that is not pinched and cutting bunches, while the shorter blade is used for pinched fruit or bunches. Oil palm fruits that are pinched on oil palm trees make it difficult for harvest workers to pick oil palm fruits and cause workers to get tired easily. Therefore, it is necessary to redesign the palm fruit picking tool in order to facilitate workers in picking palm fruit.

4. Conclusion

The criteria that affect productivity on oil palm plantations are the number of workers, worker absenteeism, the number of rotten fruits, production targets, tree care (fertilization and weed removal) and weather (rainfall). The highest productivity index during the 2021 period was in March, which amounted to 136.67%, the high productivity was due to the fact that in this month the criteria values for ratio 1 and ratio 5 were above average/achieved the target. The lowest productivity index decline during the 2021 period occurred in September with a value of -36.67%, this is because the score of the oil palm fruit criteria in ratio 3 and ratio 4, the farm tractor machine criteria in ratio 6 and the oil palm tree maintenance criteria in ratio 8 are at the lowest *level,* namely *level* 0. In the 2022 period, the highest productivity index is in August with a productivity index of 101.67%, the high productivity is because in this month the value of the criteria for ratio 1 and ratio 5 is above average/achieve the target, which is at *level* 10. The lowest productivity index is in May with a value of -35%, this is because the ratio 2 criterion is at the lowest *level* or below the average, namely *level* 0. Proposed improvements that need to be made are, it is necessary to check regularly and if possible can consider additional labor to assist in checking the harvesting of oil palm fruit, provide limits on worker absence and permission, except if the worker is sick, need to provide workers whose job is to check each plantation location if there is fruit left on the oil palm tree and harvest workers then pick back the oil palm fruit that is left behind, it is necessary to do a detailed map of the location of the oil palm plantation. The purpose of this mapping is to find out the location of the plantation that can be passed by the *farm tractor* machine or not. It is necessary to maintain the *farm tractor* machine regularly. Scheduling checking, maintenance and repair of *farm tractor machines* needs to be done so that the machine can be in good condition. Improvements to the egrek harvesting tool are two knives with different lengths.

Acknowledgments

The author wishes to express sincere gratitude to the individuals and institutions who have contributed to the success of this research. Special thanks are extended to the company and the supervising professor for their support and guidance throughout the research. Additionally, the author is grateful to PT. DSN Group Tbk for allowing the author to conduct research at their company and for their valuable input.

Please cite this article as: Mas'ud, M., Pawitra, T., & Fathimahhayati, L. (2024). Productivity analysis in oil palm plantations using the objective matrix method: case study PT. Dharma Satya Nusantara Tbk.. Operations Excellence: Journal of Applied Industrial Engineering, 16(2), 204-215. doi:http://dx.doi.org/10.22441/oe.2023.v16.i2.118

References

Agustina, F., & Riana, N. A. (2011). *Productivity Analysis with Objective Matrix (OMAX) Method at PT. X. Analisis Produktivitas Dengan Metode Objective Matrix (OMAX) Di PT. X*, 6(2), 150–158.

Hamdani, M., & Syairudin, B. (2016). *Productivity Analysis Using Objective Matrix Method (Case Study at Auto2000 Kenjeran)*. Jurnal Studi Manajemen Dan Bisnis, 3(2), 157–172. http://repository.its.ac.id/2733/

Hardiantara, Y., Kusmindari, C. D., & Zahri, A. (2019). *Analysis Of Gas Power Plant Productivity Using Objective Matrix (Omax) Method (Case Study: Pt Sa Ary Indoraya).* Jurnal Tekno, 16(1), 17–37. https://doi.org/10.33557/jtekno.v16i1.357

Ismail, Marwan, Mayandra, A., & Indrawan, S. (2022). *Production Division Productivity Analysis at PT Jaya Tech Palmindo Using Objective Matrix (OMAX) Method.* Jurnal ARTI: Aplikasi Rancangan Teknik Industri, 17(2), 127–135.

Ministry of Manpower of the Republic of Indonesia. (2019). *Labor Productivity Measurement. In Ministry of Manpower of the Republic of Indonesia (Issue 021).* Directorate of Productivity Development, Directorate General of Training and Productivity, Ministry of Manpower of the Republic of Indonesia.

Komariah, I. (2019). *Production Floor Productivity Measurement Using Objective Matrix (Omax) Method at PT. Xyz.* Jurnal Industrial Galuh, 1(1), 16–21. https://doi.org/10.25157/jig.v1i1.2984

Mahawati, E., Yunita, I., Ferinia, R., Rahayu, P. P., Fani, T., Sari, A. P., Setijaningsih, R. A., Fitriyatinur, Q., Sesilia, A. P., Mayasari, I., Dewi, I. K., & Bahri, S. (2021). *Workload and Work Productivity Analysis.* Yayasan Kita Menulis.

Martono, R. V. (2019). *Productivity and Efficiency Analysis*. PT Gramedia Pustaka Utama.

Panjaitan, M. (2018). *The Effect of Work Environment on Employee Productivity.* Jurnal Manajemen, 3(2), 1–5.

Rahmatullah, S., Wahyuni, N., & Katili, P. B. (2017). *Productivity Analysis in the Production Division of PT. XYZ Using Objective Matrix (OMAX) Method.* Jurnal Teknik Industri, 5(1), 1–6. https://doi.org/10.51999/jpti.v1i1.1

Rini Setiowati. (2017). *Analysis of Production Department Productivity Using Objective Matrix (Omax) Method at CV. Jaya Mandiri.* Faktor Exacta, 10(3), 199–209. https://journal.lppmunindra.ac.id/index.php/Faktor_Exacta/article/view/1321

Singgih, L. M., & Gunarta, I. K. (2021). *Company Productivity Management.* Tekno Sains Publisher.

Siswadi, Y. (2017). *The Influence of Training and Discipline on Employee Work Productivity at PT. Jasa Marga Branch (Belmera) Medan.* Jurnal Ilmiah Manajemen Dan Bisnis, 17(01), 124–137.

Waluyo, M. (2008). *Productivity for industrial engineering*. Dian Samudra.

Wibisono, D. (2019). *Productivity Analysis Using Objective Matrix (OMAX) Method: A Case Study at PT. XYZ*. Jurnal Optimasi Teknik Industri (JOTI), 1(1), 7. https://doi.org/10.30998/joti.v1i1.3423

Please cite this article as: Mas'ud, M., Pawitra, T., & Fathimahhayati, L. (2024). Productivity analysis in oil palm plantations using the objective matrix method: case study PT. Dharma Satya Nusantara Tbk.. Operations Excellence: Journal of Applied Industrial Engineering, 16(2), 204-215. doi:http://dx.doi.org/10.22441/oe.2023.v16.i2.118