SITEKIN: Jurnal Sains, Teknologi dan Industri, Vol. 21, No. 2, June 2024, pp.335 - 343
ISSN 2407-0939 print/ISSN 2721-2041 online

MEASUREMENT AND STRATEGY TO IMPROVE THE PRODUCTIVITY OF MADURA'S PEOPLE'S SALT BUSINESS WITH OBJECTIVE MATRIX (OMAX) AND TRAFFIC LIGHT SYSTEM (CASE STUDY: PEOPLE SALT SUMENEP)

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ABSTRACT

Sumenep Regency is the largest salt producing district on the island of Madura. However, the productivity of salt produced is still low. Therefore, this study aims to measure the salt productivity of the people of Sumenep, find out the factors that affect salt productivity, and provide recommendations for improvements to increase the salt productivity of the people of Sumenep. Productivity measurement uses the Objective Matrix (OMAX) method which uses 5 ratios, namely land area, salt selling price, salt farmer group, quality salt 1 and quality salt 2. The next stage is to measure the value of productivity on each criterion, determine targets and weights using the Analytical Hierarchy Process (AHP) method, determine targets and calculate OMAX levels and analyze the productivity of salt production of the people of Sumenep. The results of productivity calculations using the OMAX method showed that the highest productivity index occurred in September at 572.319%, while the lowest productivity index occurred in August at -66.727%. Based on the traffic light system method, recommendations for improvement to increase ratio 4 (quality 1) and ratio 5 (quality 2) are by making tunnels or prism houses and the use of geomembranes that can increase salt production in quantity and quality.

Keywords: *Sumenep People's Salt, Productivity, Objective Matrix, Analytical Hierarchy Process*

Introduction

Indonesia is an archipelagic country that has 17,508 islands and a coastline of about 81,000 Km which has the potential to develop aquaculture related to the sea [1]. One area that has potential in developing marine resources is the island of Madura. Madura Island is one of the famous islands that is quite advanced in terms of fisheries and marine [2]. The utilization of seawater can later be used to produce salt, so that many Madurese people work as salt farmers [3]. The utilization of seawater can later be used to produce salt, so that many Madurese people work as salt farmers [4]. Unfortunately, this potential still cannot be developed optimally so that salt import activities carried out are still relatively high [5].

Salt is a solid object that has a white color in the form of crystals in which there are NaCl compounds of > 80% and other compounds namely magnesium chloride, magnesium sulfate, calcium chloride, and others [6]. Salt is considered a food commodity whose needs and functions continue to increase every year, both in terms of industrial needs and consumption needs [7]. Industrial salt is salt that is useful for raw materials for production processes in several business sectors such as the chemical industry, various foods, pharmaceuticals, petroleum [8]. Consumption salt is salt used in complementary seasonings [9].

The Sumenep Fisheries Service recorded salt production in 2015 as much as 263,117.96 tons, in 2016 as many as 17,109.20 tons, in 2017 as many as 232,393.29 and in 2020 as many as 236,368 tons [10]. The quality of local salt that has been produced shows that it is not uniform so that the price of the sale of salt farmers is divided into several groups according to their quality [11]. Quality one (KW1) is salt that has a NaCl content between 95 – 98%, quality two (KW2) is salt that has a NaCl content between 90 – 95%, and quality salt three (KW3) has a NaCl content of less than 90% [12].

There are two factors that influence the low productivity of salt in Indonesia, namely physical and non-physical factors. Physical factors include weather, land area, salt table area, production method, duration of salt drying, technology used. While factors that are classified as non-physical include production facilities and skills of salt farmers, age of salt farmers and work experience of salt farmers [13]. Productivity is an important

factor in supporting the sustainability of the company in analyzing and evaluating *output* based on the performance of a certain period [14].

The measurement method presented by Gultom, et al [15] uses OMAX (Objective Matrix) and FTA (Fault Tree Analysis) methods applied to research at PT. Berlian Eka Sakti Tangguh is engaged in palm oil processing. The research variables used are production results, good products, defective products, the number of workers, the use of kwh electricity, available hours / hours, work attendance, overtime / hours, machine damage, the number of normal hours. The problem that occurs is that it has not been maximized in input control due to erratic demand from consumers. Based on productivity results from January-December 2021, where there was the worst decline in March with a value of 121.42. The measurement method described by Wibiosono [16] uses the OMAX (Objective Matrix) method applied to PT XYZ in the field of flour-based preparations in the form of white bread and sweet bread. The research variables used are defective products, available working hours, energy consumption (Kwh), raw materials, production capacity, production plans, production results. The problem faced is that the company still never knows the productivity that has been achieved because it still has not conducted productivity analysis on some resources. The calculation of the ratio value shows that ratios 1, 2, and 5 have a less significant contribution to increasing production line productivity, so they need to be improved because their performance is below standard. Meanwhile, the ratio values of 3, 4, and 6 show good results.

The method of measuring productivity in this study is the Objective Matrix (OMAX) method. The objective matrix (OMAX) method is a method used to measure performance using achievement indicators in the weighting procedure to obtain the total productivity index [15]. This research was conducted on the productivity of salt farmers of the people of Sumenep. The research variables used were pond land area, salt farmer group data, salt selling price data, quality salt production data one, and salt production data quality two, and the amount of salt production. The OMAX method is also applied in identifying which ratio causes the decline in salt productivity of the people of Sumenep. Furthermore, it is analyzed using the traffic light system to determine the ratio that has the lowest level value, then recommendations for improvements will be made to increase the salt productivity of the people of Sumenep.

Research Methods

This study was carried out in the salt ponds of the people of Madura located in Sumenep Regency. Data retrieval and calculation of salt productivity were carried out in two periods: July - October 2022 and May - November 2023. Productivity input data uses data on salt pond land area, salt farmer groups, salt selling price, quality one, and quality two. As for the output data using data on the amount of salt production. Secondary data for productivity calculations are obtained from the service of the Marine and fisheries of the east Java province while the primary data is analyzed and intersecting to people's salt farmers in Sumenep district. The calculation of salt productivity with the OMAX method begins with determining criteria, calculating ratios, determining goals and calculating OMAX levels, setting weights and values. Determination of the weight of the criteria is carried out by the AHP method. The next step is to calculate scores and performance indicators, determine productivity indices, and operate matrices. Analysis *Traffic Light System* used to indicate ratios that require improvement.

Results and Discussion

1. Determining Criteria

The criteria used to calculate productivity include 5 ratios. Criteria total salt production is the amount of salt production produced by Sumenep people's salt farmers in one month. The amount of salt production produced includes the amount of salt production KW1, KW2, KW3. Criteria land area is the amount of land used by salt farmers of the people of Sumenep in one month. Criteria selling price of salt is total selling price of salt produced by Sumenep salt farmers in one month. Criteria salt farmer group is total of salt farmer groups, a group of salt farmers consisting of several salt farmer members for one month. This salt farmer group is usually called the People's Salt Business Group (KUGAR). Criteria quality salt 1 is the amount of people's salt production classified as quality salt 1 for one month. Criteria quality salt 2 is the amount of people's salt production classified as quality salt 2 for one month. The formula used to calculate productivity from the comparison of criteria can be seen in Table 1.

Table 1. Productivity ratio

No	Ratio	Information
1	Ratio 1 (Land Area Ratio)	$\frac{Total\ salt\ production}{Large\ amount\ of\ land}$
2	Ratio 2 (Salt Selling Price Ratio)	$\frac{Total\ salt\ \ production}{Salt\ selling\ price}$
3	Ratio 3 (Salt Farmer Group Ratio)	$\frac{Total\ salt\ production}{Total\ salt\ farmergroup}$
4	Ratio 4 (Quality Salt 1)	$\frac{Total\ salt\ production}{Total\ \ quality\ salt\ 1}$
5	Ratio 5 (Quality Salt 2)	$\frac{Total\ salt\ production}{Total\ quality\ salt\ 2}$

2. Calculation of Ratio

Determining the ratio calculation for Madurese people's salt is as follows.

$$ratio\ of\ land\ area = \frac{Total\ production\ (ton)}{Large\ amount\ of\ land\ (ha)} \quad (1)$$

$$= \frac{141,100}{1595,910}$$

$$= 0,088$$

Table 2. Ratio calculation 1

Year	Month	Ratio 1	Ratio 2	Ratio 3	Ratio 4	Ratio 5
2022	July	0,088	$6,719.10^{-7}$	0,860	1,041	25,655
	August	2,678	$3,191.10^{-7}$	32,065	1,104	10,594
	September	18,566	$6,750.10^{-7}$	222,203	1,066	16,108
	October	2,858	$6,821.10^{-7}$	33,515	1,128	8,841
2023	May	0,133	$8,287.10^{-7}$	1,201	44,773	1,023
	June	5,998	$6,760.10^{-7}$	61,374	1,074	14,478
	July	20,898	$6,970.10^{-7}$	227,709	1,278	4,593
	August	23,870	$6,944.10^{-7}$	259,984	1,250	5,007
	September	23,928	$6,957.10^{-7}$	260,614	1,264	4,788
	October	24,922	$6,962.10^{-7}$	271,448	1,270	4,711
	November	18,214	$6,945.10^{-7}$	198,384	1,251	4,987

Table 2 is a table of calculation recaps for each ratio. The calculation of the ratio is carried out during the period July 2022 to October 2022 and May 2023 to November 2023. The calculation results in July 2022 include ratio 1 of 0,088, ratio 2 of $6,7190.10^{-7}$, ratio 3 of 0,860, ratio 4 of 1,041, ratio 5 of 25,655.

3. Goal Setting and OMAX Level Calculation

The following is the determination of the lowest value (level 0), the value at the initial standard (level 3), and the final goal (level 10).

Table 3. Recap determination of the level 0, level 3 and level 10

Ratio	Level 0	Level 3	Level 10
Ratio 1	0,088	12,923	24,922
Ratio 2	$3,19065.10^{-7}$	$6,66429.10^{-7}$	$8,28706.10^{-7}$
Ratio 3	0,860	142,669	271,448
Ratio 4	1,041	5,136	44,773
Ratio 5	1,023	9,162	25,655

Table 3 is a recap of the results of determining level 0 based on the lowest value of the ratio, level 3 based on the average value of the ratio, and level 10 based on the highest value of the ratio. The determination of the level is based on five ratios. The result of the ratio 1 at level 0 is 0.088, level 3 is 12.923, level 10 is 24.922.

The following is a calculation of the level in the objective matrix.

1. Level 1 – 2 Calculation
   Calculates the value of the interval between level 1 and level 2.
   Interval Formula $_{(1\text{-}2)}$ $= \frac{Level\ 3 - Level\ 0}{3-0}$ (2)
2. Level 4 – 9 Calculation (Example calculation at ratio 1):
   Calculates the value of the interval between level 4 and level 9.
   Interval Formula $_{(4\text{-}9)}$ $= \frac{Level\ 10 - Level\ 3}{10-3}$ (3)

Table 4. Calculation value at level 0 to level 10

Level	Ratio 1		Ratio 2		Ratio 3		Ratio 4		Ratio 5	
Interval	4,278	1,714	$1,158.10^{-7}$	$2,318.10^{-7}$	47,270	18,397	1,365	5,662	2,713	2,356
0	0,088		$3,191.10^{-7}$		0,860		1,041		1,023	
1	4,367		$4,349.10^{-7}$		48,130		2,406		3,736	
2	8,645		$5,506.10^{-7}$		95,399		3,771		6,449	
3	12,923		$6,664.10^{-7}$		142,669		5,136		9,162	
4	14,637		$6,896.10^{-7}$		161,066		10,799		11,518	
5	16,351		$7,128.10^{-7}$		179,463		16,461		13,874	
6	18,066		$7,360.10^{-7}$		197,860		22,123		16,230	
7	19,780		$7,592.10^{-7}$		216,257		27,786		18,586	
8	21,494		$7,823.10^{-7}$		234,654		33,448		20,942	
9	23,208		$8,055.10^{-7}$		253,051		39,110		23,298	
10	24,922		$8,287.10^{-7}$		271,448		44,773		25,655	

Table 4 is a recap table consisting of 5 ratios where the calculation recap starts from level 0 to level 10. The calculation is based on 2 interval values on each ratio. Ratio 1 has intervals of 4,278 and 1,714, and at level 0 has a value of 0,088. Based on the traffic light system, level 0 to level 3 indicates a bad level indicated in red, level 4 to 6 indicates a fairly good level marked in yellow, level 8 to level 10 indicate a very good level indicated in green.

4. Determine Weight and Value

Weight determination is based on the priority of each criterion and makes comparisons between criteria to find out which criteria are more important. Determination of the weight and value of productivity indicators using the Analytical Hierarchy Process (AHP) method. The questionnaire is addressed to people who are experts in the field of salt. The results of the questionnaire will be input for data processing using the Objective Matrix (OMAX) method.

Table 5. Priority weight of each criterion

Criterion	Weight
Land Area	0,41
Salt Farmer Group	0,39
Salt Selling Price	0,10
Quality Salt 1	0,04
Quality Salt 2	0,06

Table 5 is a table of priority weights carried out on five criteria. Criterion 1 (land area) has a weight of 0,41, criterion 2 (salt farmer group) has a weight of 0,39, criterion 3 (salt selling price) has a weight of 0,10, criterion 4 (quality 1) has a weight of 0,04, criterion 5 (quality 2) has a weight of 0,06.

5. Calculating Scores and Performance Indicators

The following is the determination of scores and values in the operation of the objective matrix structure.

1. Score
   The score is obtained by looking at the value at level 0 – level 10 whose value is close to performance.
2. Value
   The value is obtained from the multiplication between the weight and the score in each ratio. Here is an example of calculating the value in July 2022.
   Ratio 1 = 0 x 0,415 = 0,000
   Ratio 2 = 4 x 0,385 = 1,542
   Ratio 3 = 0 x 0,098 = 0,000
   Ratio 4 = 3 x 0,041 = 0,123
   Ratio 5 = 10 x 0,061 = 0,607
3. Performance Indicators
   Performance indicators are obtained from the sum of values in all criteria ratio.

6. Calculating the Productivity Index

The calculation of the productivity index is carried out to determine whether there has been an increase or decrease during the period from July 2022 to October 2022 and from May 2023 to November 2023. The calculation of the productivity index refers to the calculation of the previous month. Below is the formula used in calculating the productivity index.

$$IP = \frac{current\ performance\ indicator - previous\ period's\ performance\ indicator}{previous\ period's\ performance\ indicator} \times 100\% \quad (4)$$

Example of calculating the productivity index for August 2022.

$$IP = \frac{0,746 - 2,291}{2,291} \times 100\%$$

$$= -67,444\%$$

7. Operating the Matrix

The following is the matrix operation that will be performed to measure the level of productivity.

Table 6. Operating matrix in July 2022

Ratio 1	Ratio 2	Ratio 3	Ratio 4	Ratio 5	Productivity Criteria
0,088	$6,719.10^{-7}$	0,860	1,041	25,655	*Performance*
24,922	$8,287.10^{-7}$	271,448	44,773	25,655	10
23,208	$8,055.10^{-7}$	253,051	39,110	23,298	9
21,494	$7,823.10^{-7}$	234,654	33,448	20,942	8
19,780	$7,592.10^{-7}$	216,257	27,786	18,586	7
18,066	$7,360.10^{-7}$	197,860	22,123	16,230	6
16,351	$7,128.10^{-7}$	179,463	16,461	13,874	5
14,637	$6,896.10^{-7}$	161,066	10,799	11,518	4
12,923	$6,664.10^{-7}$	142,669	5,136	9,162	3
8,645	$5,506.10^{-7}$	95,399	3,771	6,449	2
4,367	$4,349.10^{-7}$	48,130	2,406	3,736	1
0,088	$3,191.10^{-7}$	0,860	1,041	1,023	0
0	4	0	3	10	Score
0,415	0,385	0,098	0,041	0,061	Weight
0,000	1,542	0,000	0,123	0,607	Value
Performance Indicators		Current	Previous	Index	
2,272		227,168	0	0	

Table 6 is a table of matrix operations carried out in July 2022, consisting of five productivity ratios. ratio 1 and ratio 3 have the lowest score of 0. The productivity measurement results in July 2022 have a productivity indicator value of 2,272, a current value of227,168, a previous value of 0, and an index value of 0.

8. Productivity Indicator Analysis

Below is the analysis of productivity indicators for each ratio.

Table 7. Summary of productivity indicators for each ratio

Year	Month	Ratio				
		1	2	3	4	5
2022	July	0,000	1,542	0,000	0,123	0,607
	August	0,415	0,000	0,098	0,000	0,243
	September	2,488	1,542	0,688	0,000	0,364
	October	0,415	1,542	0,098	0,000	0,182
2023	May	0,000	3,854	0,000	0,410	0,000
	June	0,415	1,542	0,098	0,000	0,304
	July	3,317	1,927	0,786	0,000	0,061
	August	3,732	1,927	0,491	0,000	0,061
	September	3,732	1,927	0,885	0,000	0,061
	October	4,146	1,927	0,983	0,000	0,061
	November	2,488	1,927	0,590	0,000	0,061

Table 7 are summaries and graphs of productivity indicators for each ratio, showing that in August 2022, ratios 1, 3, and 5 experienced an increase in performance. In September 2022, only ratios 1, 2, and 5 experienced an increase. In October 2022, all ratios experienced a decrease in performance except for ratio 2. In May 2023, ratios 2 and 4 had the highest values. This was also influenced by the weights, as ratios 2 and 4 had the highest weights compared to the other ratios. In June 2023, ratios 1, 3, and 5 experienced an increase in performance. In July 2023, only ratio 5 experienced a decrease in performance. In August 2023, only ratio 1 experienced an increase. In September 2023, only ratio 3 experienced an increase. In October 2023, many ratios, including ratios 1 and 3, experienced an increase. In November 2023, all indicators experienced a decrease in performance except for ratios 2 and 4, which had constant values.

9. Productivity Index Analysis

Below is the productivity index for the period from July 2022 to October 2022 and from May 2023 to November 2023.

Table 8. Summary of productivity index

No	Year	Month	Index Productivity (%)
1	2022	July	0,000
2		August	-66,727
3		September	572,319
4		October	-55,987
5	2023	May	90,611
6		June	-44,688
7		July	158,306
8		August	1,966
9		September	6,330
10		October	7,767
11		November	-28,829

Table 8 shows the productivity index for the period from July 2022 to October 2022 and from May 2023 to November 2023. In August 2022, the productivity index was -66.727%. In September 2022, there was an increase in the productivity index to 572.319%. This increase was influenced by the performance values of ratios 1, 3, and 5, which achieved good values, and ratio 2, which achieved a fairly good value compared to August 2022. In October 2022, the index decreased to -55.987%, due to the decline in performance values for ratios 1, 3, and 5. In May 2023, the index increased to 90.611%, influenced by the very good performance values for ratios 1 and 4 compared to October 2022. In June 2023, the index decreased to -44.688%, caused by the decline in performance values for ratios 2 and 4, especially ratio 4, which reached a value of 0. In July 2023, the index increased to 158.306%. In August 2023, it decreased to 1.966%. In September 2023, the index increased by 6.330%. In October 2023, there was a slight increase to 7.767%. In November 2023, the index decreased to -28.829%.

10. Traffic Light System Analysis

The traffic light system aims to identify level achievement in a certain period. the traffic light system consists of three colors at each level is level 0 to level 2 indicating a poor productivity level marked in red, level 3 to level 5 indicating a fairly good productivity level marked in yellow, and level 6 to level 8 indicating a good productivity level marked in blue, Levels 9 and 10 indicate excellent productivity levels marked in green. The following are the achievement scores at each ratio.

Table 9. Scoring reaching on every ratio

No	Year	Month	Ratio1	Ratio 2	Ratio 3	Ratio 4	Ratio 5
1	2022	July	0,000	4,000	0,000	3,000	10,000
2		August	1,000	0,000	1,000	0,000	4,000
3		September	6,000	4,000	7,000	0,000	6,000
4		October	1,000	4,000	1,000	0,000	3,000
5	2023	May	0,000	10,000	0,000	10,000	0,000
6		June	1,000	4,000	1,000	0,000	5,000
7		July	8,000	5,000	8,000	0,000	1,000
8		August	9,000	5,000	5,000	0,000	1,000
9		September	9,000	5,000	9,000	0,000	1,000
10		October	10,000	5,000	10,000	0,000	1,000
11		November	6,000	5,000	6,000	0,000	1,000
Total			51,000	51,000	48,000	13,000	33,000
Average			4,636	4,636	4,364	1,182	3,000
Total of Red Colors			5	1	5	9	6
Total of Yellow Colors			0	9	1	1	3
Total of Blue Colors			3	0	3	0	1
Total of Green Colors			3	1	2	1	1

Table 9 shows the level of performance that occurs in each ratio whose assessment is based on the traffic light system in the period July 2022 to October 2022 and May 2023 to November 2023. Based on table 4.40, ratio 4 (quality salt 1) and ratio 5 (quality salt 2) show the worst level of performance indicated by the lowest number and average value compared to other ratios. The average value at a ratio of 4 and is 13,000. The average value at a ratio of 5 and that is 33,000. The values in both ratios occupy a level below level 3, which indicates that ratio 4 and ratio 5 are at that average level of achievement. The ratio of 4 (quality salt 1) has the greatest number of red colors which is 9 periods. The ratio of 4 (quality salt 1) has the number of yellow colors as much as 1 in August 2023 and has the number of green colors as much as 1 in May 2023. Ratio 5 (quality salt 2) has the number of red colors which is as many as 6 periods. The ratio of 5 (quality salt 2) has 3 periods of yellow, 1 period of blue, and 1 of green in July 2022.

Conclusion

The calculation of salt productivity of the people of Sumenep uses 5 ratios: land area, salt selling price, salt farmer group, quality salt 1, and salt quality 2. The results of productivity measurement using the Objective Matrix (OMAX) method had the highest productivity index in September at 572.319%, while the lowest productivity index occurred in August at -66.727%. Based on the results of the analysis of the traffic light system method, a ratio of 4 (quality salt 1) and ratio 5 (quality salt 2) is obtained that requires improvement. The improvement recommendations given are the manufacture of tunnels or prism houses and the use of geomembranes that can increase salt production in quantity and quality. Research related to the salt productivity of the Sumenep people can be developed by adding other ratios, such as sustainability criteria that consider economic, social, and environmental aspects. As well as research related to the design of tunnels or prism houses that are in accordance with the conditions of the salt ponds of the people of Sumenep will be the next interesting research.

Acknowledgement

The authors are grateful to all those who have helped with this research as well as to the reviewers for their excellent suggestions for improving this article. This research was supported by the MBKM research program from the independent research of Trunojoyo Madura University.

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