Measurement of company productivity which experiencing material supply shortage

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Abstract. This research was conducted at a palm oil producing company in North Sumatra known as Sumatera Utara Province, Indonesia. This company has oil palm plantations, some of which have been converted to other businesses. This causes the production capacity that has been previously designed to be less effective in its use. This can be seen from the achievement of the target level of productivity. This research measured the level of productivity the company has achieved in the last two years using the Kendrick-Creamer Total Productivity Index Approach. The measurement results obtained over the past two years indicate that an increase in the total productivity index from 1.47 to 1.53. However, the increase has not been able to reach the productivity index target of 1.66. That was caused mainly by material, organizational, and installed capacity factors. The results obtained are selected alternatives for improvements to the sorting of materials, optimizing the production of his own garden, and maintaining screw press pressure with a total productivity index of 1.7.

1. Introduction
Productivity is the ratio between output and input used [1]. The level of productivity achieved by a company will determine the company's success in winning market competition [2]. Efforts to increase the productivity of a company are carried out with various strategies and policies in the management and operations of the company [3].

Research to increase productivity with the Productivity Evaluation Tree (PET) model has been conducted by Anis et al (2007) in a furniture company showing that the best productivity increases with the use of higher raw material standards and continuous workforce motivation [4]. The research variables used are materials, labor, and overhead costs so that an increase in productivity is obtained by +0.39 to 1.58.

Another study was conducted by Iqbal (2016) on the productivity of CNC Milling Machine operators with PET models [5]. The variables used are the number of production, number of operators, number of machines, and production targets. This study resulted in an increase in total productivity of +4.1 to 7.87 by using alternative processes and machine standardization tools.

This research was conducted in Indonesian Palm Oil Mill in North Sumatra, known as Sumatera Utara Province. At present, the level of productivity of the company is still at 1.40, while the productivity ever achieved by the company reaches 1.66. Research conducted by Bakhtiar at PKS Pabatu, productivity levels above two are achieved over 2 years of historical data [6]. Therefore, this research aims to evaluate and obtain a draft proposal that can increase company productivity in the future using Total Productivity Index.
2. Method and equipment
In this study, the input variables assessed are materials, labor, capital, energy, and organization. The five variables are used to assess the achievement of productivity in actual and proposed conditions. The steps of the research can be seen in the Block Diagram in the following Figure 1 [1].

Research was conducted using several steps as below:

- Productivity measurement
  Productivity measurement is the first step in conducting productivity research. At this stage, a total constant price will be measured for the company's output. Output is measured based on prices in 2018. At this stage, total constant prices will also be measured for inputs consisting of materials, labor, energy, capital, and organization. Total Constant Prices are measured for 2018 and 2019. The calculation formula for measuring the productivity index with the Kendrick-Creamer model is as follows:

\[
Productivity\ Index = \frac{Total\ Output\ (on\ constant\ price)}{Total\ Input\ (on\ constant\ price)}
\]

- Productivity evaluation
  At this stage, things identified that caused productivity were not achieved. Then the competitiveness of existing companies was analyzed as input for the productivity planning stage.

- Productivity planning
  At this stage an adequate alternative arrangement is made based on the company's competitiveness. The path chosen using the Productivity Evaluation Tree is arranged in alternatives.

- Productivity improvement
  At this stage, steps are taken to implement selected alternatives for a year before re-measuring productivity again. This stage is outside the study in this study and needs to be carried out by the company.

3. Results and Discussions

3.1. Productivity measurement
Measurement of Total Productivity Index is carried out using the approach of the Kendrick-Creamer Model. The calculation is done by dividing the total constant price for output to the total constant price for input.
### Table 1. Output and Input Data for 2018 and 2019

|                  | 2018          | 2019          | Basis          |
|------------------|---------------|---------------|----------------|
| **Output**       |               |               |                |
| CPO              | 41,047        | 48,601        | 8,450,000      |
| Kernel Oil       | 8,132         | 9,078         | 10,250,000     |
| Kernel           | 246           | 288           | 1,106,000      |
| **Labor**        |               |               |                |
| Factory Manager  | 1             | 1             | 480,827,476    |
| Production Assistant | 4     | 4             | 141,636,948    |
| Maintenance/ Utility Asst, Laboratory and Scale Asst, Analyst | 12 | 12 | 54,184,326 |
| Administration   | 14            | 12            | 56,083,557     |
| Security         | 12            | 12            | 51,166,670     |
| Driver           | 3             | 3             | 71,400,678     |
| Office Assistant | 1             | 1             | 54,123,033     |
| Production and Maintenance Foreman | 4         | 4             | 66,176,760     |
| Production Labor | 101           | 99            | 49,591,796     |
| Maintenance Labor | 40   | 36            | 58,671,054     |
| **Energy**       |               |               |                |
| Electricity      | 2,608,604     | 1,545,413     | 6,787          |
| **Capital (Fixed Asset)** |       |               |                |
| Building         | 32,161,586,800| 31,674,979,580| 0.05           |
| Machine and Tools Investation | 123,461,426,360 | 152,657,200,150 | 0.10          |
| Land preparation | 15,060,207,450| 5,550,728,550 | 0.10           |
| Investment of Office Inventory | 963,050,000 | 83,310,260 | 0.20          |
| **Capital (Current Asset)** | | | |
| Cash             | 1,276,000     | 7,888,000     | 1.08           |
Based on the data obtained, then processed with the Kendrick-Creamer model. Recapitulation of calculation results as shown in Table 2.

Table 2. Recapitulation of Constant Prices for Output and Input in Indonesian Rupiah

| Element            | 2018                  | 2019                  |
|--------------------|-----------------------|-----------------------|
| Output             |                       |                       |
| , Product          | 430,465,197,834       | 504,049,227,785       |
| Total Output       | 430,465,197,834       | 504,049,227,785       |
| Input              |                       |                       |
| , Labor            |                       |                       |
| - Staff            | 1,494,790,527         | 1,494,790,527         |
| - Office Labor     | 2,317,706,817         | 2,205,539,703         |
| - Direct Labor     | 7,620,320,596         | 7,286,452,788         |
| , Energy           | 17,705,392,284        | 10,489,190,159        |
| , Capital          | 15,654,128,721        | 17,297,518,628        |
| - Fixed Asset      | 15,652,852,721        | 17,290,214,925        |
| - Current Asset    | 1,276,000             | 7,303,704             |
| , Material         | 257,733,944,000       | 300,308,411,000       |
| , Organization     | 5,426,793,206         | 5,162,092,968         |
| Total Input        | 307,953,076,151       | 344,243,995,773       |
| Total Productivity | 1.40                  | 1.46                  |

3.2. Productivity Evaluation
Productivity measurement results will provide benefits if followed by an evaluation of the results obtained. What is seen is what factors support and the problems experienced in implementing productivity improvements.
Figure 2. Total Productivity Index and Target set for 2018 and 2019

Based on the results obtained for 2018 and 2019 as seen in Figure 2, it appears that the achievements have not yet reached the expected target. Therefore, a competitiveness analysis of the company is also carried out so that alternative improvements can be arranged as can be seen in Figure 3 [7].

Figure 3. Porter’s Diamond for Company Competitiveness
Based on Porter's diamond, it is seen that the company's opportunities are influenced by internal and external factors.

3.3. Productivity Planning

Based on Porter's diamond, an alternative settlement is arranged as follows: [8]

- Alternative 1, contains improvements to the sorting of materials, optimizing the production of his own garden, and maintaining screw press pressure.
- Alternative 2, contains improvements in terms of capital and energy, namely the optimization of the production of his own garden and the use of dried screw press material.

Based on these alternatives, the estimated changes in input and output, as well as the results of their productivity can be seen in the following Table 3.

| Table 3. Recapitulation of Alternatives Result (in Indonesian Rupiah) |
|---------------------------------------------------------------|
| **Element**          | **Alternative 1** | **Alternative 2** |
|----------------------|-------------------|-------------------|
| Output              | 627,682,205,684   | 558,639,371,835   |
| Total Output        | 627,682,205,684   | 558,639,371,835   |
| Input               |                   |                   |
| Labor               | 10,986,783,018    | 10,986,783,018    |
| - Staff             | 1,494,790,527     | 1,494,790,527     |
| - Office Labor      | 2,205,539,703     | 2,205,539,703     |
| - Direct Labor      | 7,286,452,788     | 7,286,452,788     |
| Energy              | 10,489,190,159    | 10,557,063,214    |
| Capital             | 17,429,091,901    | 17,424,591,901    |
| - Fixed Asset       | 17,421,203,901    | 17,416,703,901    |
| - Current Asset     | 7,888,000         | 7,888,000         |
| Material            | 324,333,083,880   | 300,308,411,000   |
| Organization        | 5,575,060,405     | 5,575,060,405     |
| Total Input         | 368,813,209,363   | 344,851,909,538   |
| Total Productivity  | 1.70              | 1.62              |

3.4. Productivity Improvement

Productivity improvements need to be done by the company and need to be carried out for a year. The steps that can be taken to implement productivity improvements are as follows:

1. Drafting opportunities for improving productivity
2. Obtain output and inform participants
3. Compilation of technical details of the implementation of productivity improvements
4. Communication on top management
5. Formation of small groups
6. Application of the strategies that have been prepared
7. Compilation of final recommendations
8. Determination of implementation management responsibilities by Top Management
9. Implementation of overall implementation
10. Monitor the results obtained from time to time, related to the targeted indicators

4. Conclusion
The conclusions obtained from this study are improvements to the sorting of materials, optimizing the production of his own garden, and maintaining screw press pressure with a total productivity index of 1.7.

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