ICEAT

**2019 3RD INTERNATIONAL CONFERENCE ON
ENGINEERING AND APPLIED TECHNOLOGY**

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Certified that

Ahmad Mubin

(Universitas Muhammadiyah Malang)

has presented a paper entitled

**"Green Productivity Application for Improving Productivity and Environmental Performance
through The Selection of the Best Solution Scenario in The Agroindustry"**

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Preface

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Preface

The International Conference on Engineering and Applied Technology (ICEAT) was first launched in 2017 at Mataram hosted by Universitas Muhammdiyah Mataram. The second conference was in 2018 at Banda Aceh hosted by Universitas Muhammdiyah Aceh. The third ICEAT present is hosted by Faculty of Industrial Technology, Universitas Muhammadiyah Sorong, West Papua, Indonesia. The 3rd ICEAT is organized by Science and Technology Association of Muhammadiyah Higher Education (AST-PTM) as well as jointly with Universitas Ahmad Dahlan, Universitas Muhammadiyah Magelang, Universitas Muhammadiyah Malang, Universitas Muhammadiyah Surakarta, Universitas Muhammadiyah Purwokerto, Universitas Muhammadiyah Makassar, Universitas Muhammadiyah Gresik, Universitas Muhammadiyah Jakarta, Universitas Muhammadiyah Yogyakarta, Universitas Muhammadiyah Jember, Universitas Muhammadiyah Surabaya, Universitas Muhammadiyah Sidoarjo, Universitas Muhammadiyah Banjarmasin, and Universitas Muhammadiyah Prof Dr Hamka (UHAMKA). On behalf of the organizing committee, I cordially welcome to all the delegates of the 3rd ICEAT 2019.

Being in the third event, the 3rd ICEAT 2019 is aimed at keeping abreast of the current development and innovation in the advanced of research area on Engineering and Applied Technology as well as providing an engage forum for participants to share knowledge and expertise in related issues. In this conference, submitted papers were limited in five conference tracks. The committee member blindly reviewed as well as provided the technical comments to all the submitted paper before ensuring that submitted paper is qualified. Finally we are accepting 52 papers to be presented in the conference. The accepting papers are covering the scope include: Electronics Engineering, Electrical Engineering, Informatics Engineering, Computer Engineering, Industrial Engineering, Mechanical Engineering, Civil Engineering, Architecture, Chemical Engineering, Applied Science, and Agrotechnology as well.

Last but not least, I do hope through this conference will convey a good opportunity for sharing at the forefront of the field and an informal exchange of ideas, knowledge and friendship in a relaxing environment. Then, our academic and social atmosphere will become more active year to year.

Warm Regards,
General Chair
Aster Rahayu, S.Si., M.Si., Ph.D

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Green productivity application for improving productivity and environmental performance through the selection of the best solution scenario in the agroindustry

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Green productivity application for improving productivity and environmental performance through the selection of the best solution scenario in the agroindustry

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Abstract. Improving productivity and environmental performance is very important for agroindustry to improve performance and competitiveness .The application of the green productivity (GP) can help the company to be able to increase productivity and environmental performance in the same time. The purpose of this research is to improve the productivity and the environmental performance through improvement in the system of production by selecting alternative scenario as the best solution from some of alternative solution scenarios. The method of the research is conducted in several stages that are measuring process productivity and early environmental performance, arrangement of the improvement scenario system that can increase productivity and environmental performance simultaneously and provide suggestions for refurbishing and improving productivity and environmental performance. The result of the calculation from early productivity level is obtained the average of the past 7 period is 139.4%. While the value of early environmental performance is 0.69 which means that the quality of waste has met the standard of regulations, although they are still relatively small so they still needs to do restitution and improvement. The measurement value of green productivity index (GPI) is obtained that the existing condition, the scenario 1, the scenario 2 and scenario 3 are 1.39, 1.43, 1.45 and 1.41. Thus, then the selected best scenario is scenario 2, it is expected that the productivity and the environmental performance, as well as the competitiveness of companies can improve.

1. Introduction
Sustainable industry is the industry that has the sustainability economically, environmentally and socially. One indicator of the economic aspect can be shown through level of productivity that is the ratio between output and input in production process in the industry. While the environment aspect can be measured through environmental performance or environmental performance indicator index (EPI). Improving green productivity is an important way to achieve sustainable development [1].

Improving productivity and environmental performance is quite important for agroindustry to improve of performance and competitiveness. The application of green productivity method (GP) may help the company to be able to improve productivity and environmental performance in the same time [2]. GP is a broad strategy for enhancing productivity and environmental performance. Green Productivity's greatest attribute is its potential for integrating environmental protection into the operations of a business as a mean of improving productivity. Towards GP measurement and improvement, Hur et al. [3] developed a measurement tool that indices economic and environmental

performance in one index called GP index that is defined as the ratio of productivity of a system to its environmental impacts. This index is intended for estimating the GP performance of an existing product or process and comparing it with other equivalents. Gandhi et al. [4] developed indicators and Green Productivity Index (GPI). A casting case indicates that the GPI can be used as an actionable feedback for leadership to make effective decision. Green Productivity Indicator as a measure the level of Green Productivity companies [5]. Green productivity (GP) index is a measurement tool developed to analyze economic performance and environmental performance in one index [6].

Moharamnejad, et al. [7] did a research regarding to management of GP in Iran Aseman Airline Company current situation are analyzed such as the consumption of energy, water, airplanes fuel and evaluating environmental pollutants. The research result from Marimin, et al. [8] concluded that the best scenario is suggested to improve the productivity of motorcycle tires was a combined treatment of controlling raw material characteristics and reusing water and materials. The research result from Ghahremani, et al. [9] showed that Green Productivity Index depends on factors such as manpower, materials, energy and machinery and environmental factors. Mubin et al. [10] has conducted a study on the application of GP to improve productivity and environmental performance in the leather tanning industry. Liu et al. [11] introduces energy consumption and carbon emission into the analysis framework of the green productivity of tourism.

The purpose of this research is to improve productivity and environmental performance through the improvement of production system in agroindustry by selecting the best alternative solution scenario from some alternative solution scenarios. Improving productivity and environmental performance is expected could increase efficiency in the use of the resources and could reduce the environmental impact, thus it can increase competitiveness and sustainability of the agroindustry.

2. Methods

The GP assessment methodology works within the framework of an Environmental Management Systems (EMS) to help a company concentrate on opportunities to prevent pollution and improve material productivity [12]. The research was conducted in several phases that are the measuring process productivity and early environmental performance, the arrangement of scenario improvement system which is able to increase productivity and environmental performance simultaneously and provide suggestion for refurbishing and increasing productivity and sustainable environmental performance [13].

On the measuring process that is to measure level of productivity and environmental performance has achieved by this company. The result productivity and environmental performance measurement has been done and it will be referred to estimation of increasing productivity and environmental performance. The measurement of productivity is calculated by dividing total output with total input.

Case study research was conducted in an agro industry sugar A. The output is the total income and input is the material cost, labors cost, energy consumption, water cost, and the waste processing cost. The total calculation of level of productivity in company uses this following equation:

$$\text{Productivity} = \frac{Total\ Output}{Total\ Input} \qquad (1)$$

The next stage is arranging improvement scenario systems based on the identification result of factor that can increase productivity and environmental performance. The final stage is providing suggestion for improvement and enhancement of productivity and environmental performance based on the selection result of best scenario.

3. Analysis and discussion

3.1. Productivity calculation

The result of company productivity in period 1 – 7 can be observed in Figure 1. From the data below, it can be recognized that company productivity is above 100%. In other words, the productivity is good enough and it has increasing trend pattern. The average productivity is 139,4%.
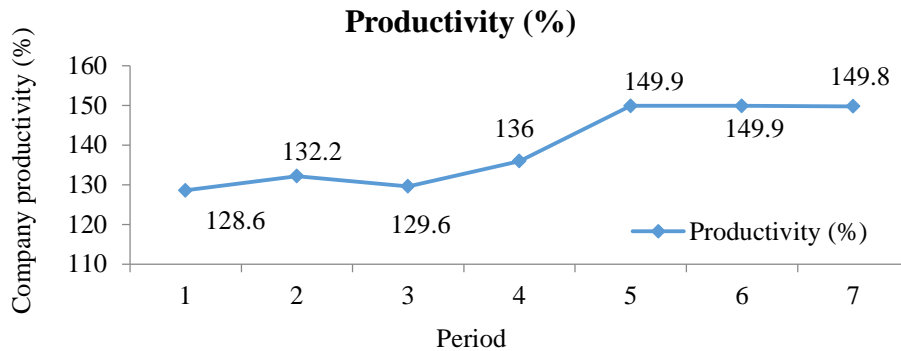
Figure 1. Productivity value period 1 - 7 [14, 15].

3.2. Calculation of environmental performance

The measurement of environmental performance is an important part of environmental management system. A study in environmental performance based on the environmental policy, and environmental target (ISO 14004, ISO 14001). Environmental performance indicator (EPI) can be defined as parameter or the number of measurement based on the number of subjects that are observed or counted. An environment indicator is a thing that is expected to be described various impacts of environment activity and efforts to reduce it. EPI described environment efficiency from the process production by involving numbers input and output. EPI that is used in this study includes: (1) BOD, (2) COD, (3) pH, (4) TSS, (5) sulphide, (6) oil and fat, and (7) the volume of waste.

EPI index can be calculated by using this formula: $\text{EPI Index} = \sum_{i-1}^{k} W_i P_i$ (2)

K is the number of waste criteria that are lodged and Wi is weights of each criteria. This weight is obtained through the questionnaire to the experts. The value of Pi is deviation percentage between standard quality with the analysis result of company. The measurement result of EPI total index is obtained a positive value that is 0.69 which means that in general the quality of waste has met the standards as specified, although it is still relatively small so that it is still needed refurbishing and improvement.

3.3. Selecting the best scenario

Alternative solution scenario are: (1) scenario 1: Biotray installation, (2) scenario 2: adding outlet capacity from the result of waste water processing, and (3) scenario 3: DAF (*Dissoveled Air Flotation*) installation. Selecting the alternative solution has been done based on calculation of GPI (*Green Productivity Index*) estimation towards the selected alternative solution. The calculation result and comparative GPI value can be observed in Table 1.

Table 1. Ratio of productivity level and environmental impact

No.	Description	Productivity Level (%)	Environmental Impact (EPI Index)	Percentage (%)	GPI
1	Early	139.04	0.69	100.00	1.39
2	Scenario 1	139.05	0.71	97.10	1.43
3	Scenario 2	139.07	0.72	95.65	1.45
4	Scenario 3	139.19	0.70	98.55	1.41

From Table 1, it can be identified that scenario 2 has higher GPI value than scenario 1, 3 and early GPI. Therefore, Scenario 2 is defined as the best scenario and it is suggested as the suggestion to refurbish productivity and environmental performance.

4. Conclusions

The calculation result of the early productivity level is obtained the average over 7 periods that is 139.4 %. While early environmental performance value with the parameters of EPI, BOD, COD, pH, TSS, sulphide, oils and fats, and the volume of the waste is obtained 0.69 which means that the quality of waste has met the regulation standard although it is still relatively small so it is still needed an improvement and enhancement.

The measurement result of green productivity index (GPI) value that is obtained for the existing condition is 1.39, scenario 1 is 1.43, scenario 2 is 1.45 and scenario 3 is 1.41. Thus, the best scenario that is selected is scenario 2, it is expected that productivity and environmental performance, and the competitiveness of companies can increase.

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