

Environmental Performance Analysis Using the Green Productivity Method on Convection Waste Baper Shop Surabaya

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ABSTRACT

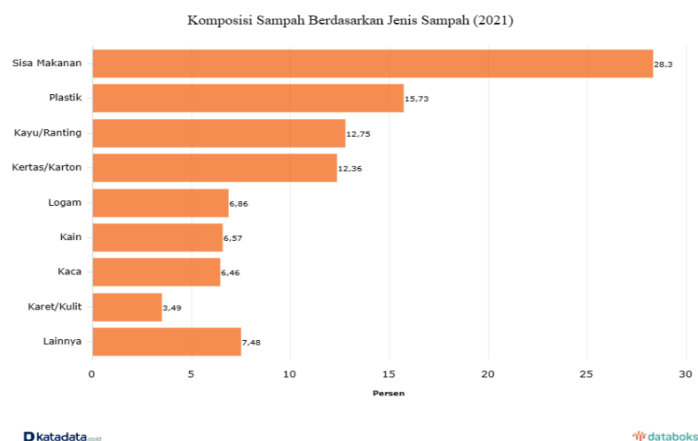
The aim of this research is to analyze the environmental performance of solid waste and liquid waste using the Green Productivity (GP) method. Konveksi Baper Shop is a micro business that operates in the field of making women's clothes. This research method uses a quantitative descriptive approach aimed at providing suggestions for improvements to increase company productivity. The results of the research showed that the company had an initial Environmental Performance Index (EPI) of 23,076. Meanwhile, the initial Green Productivity Index (GPI) at the Baper Shop convection had a value of 0.076 and solid waste GP was 0, 048 and liquid waste GP of 1.01. There are 2 There are two alternative solutions planned with the first alternative in the form of using liquid waste to become liquid organic fertilizer and the second alternative in the form of using solid waste to make patchwork mats. It can be concluded that by improving environmental performance in the form of using liquid and solid waste it can increase the company's income.

INTRODUCTION

Productivity is very important for companies as a way to monitor their production performance. In line with the increase in production, it turns out that many environmental problems arise around it. The problem is caused because the production process often results in the waste of materials and energy which will burden the environment, even though a good production process not only pays attention to safety and side effects from production waste, but also tries to reduce the waste produced. It is very important for companies to pay attention to environmental aspects in the production operations they carry out in order to create harmony with the surrounding environment.

The right approach to help companies increase their productivity and environmental performance is to apply the green productivity method. The implementation of Green Production is able to improve customer service and response rates to customers, reduce environmental impact by reducing waste and increase overall corporate social responsibility.

Refocusing on businesses that are currently being carried out in Indonesia, clothing convection is one of the places to support people's clothing needs that provide t-shirts to shirts. Starting a textile business can be said to be making the right choice in doing business because what is provided in the clothing collection can be said to have become one of the basic needs of society. The textile industry is usually synonymous with traditional processing systems. Therefore, it is not surprising that industry players are very dependent on national economic conditions. Moreover, most of the raw materials in the form of cotton are still imported from several countries. While currently the national demand for cotton is in the range of 700 thousand tons per year, national cotton production is only able to reach below 100 thousand tons per year. (www.kemenperin.go.id)



Picture 1. Waste Composition Based on Waste Type in 2021
Source: Ministry of Environment and Forestry in 2021

Based on data from the Ministry of Environment and Forestry (KLHK), as much as 28.3% of the total waste was food waste in 2021. Food waste constituted the largest composition of waste in Indonesia not only in 2021, but

also in previous years. Plastic waste is in second place with a proportion of 15.73%. As much as 12.75% of waste is in the form of wood/rating. Then as much as 12.36% of waste is paper/cardboard. Then, metal waste reached 6.86%. Furthermore, there is 6.57% in the form of cloth waste. There are also types of waste in the form of glass and rubber/leather with a proportion of 6.46% and 3.49% respectively. Meanwhile, 7.48% of waste is in the form of other types. (<https://www.menlhk.go.id/>)

The data shows how serious the problems faced by society and the government are, which have an impact on the sustainability of the natural environment. The low level of degradation of fabric waste can affect soil fertility, and the liquid waste resulting from washing screen printing tools that is thrown into the sea will damage marine ecosystems and threaten the life of marine biota.

The development of the convection industry is usually not accompanied by environmental awareness of the waste it produces. The convection industry generally produces more than 2000 kg per month, while the amount for processing is 1 roll of cloth or 25 kg. As happened in the Baper Shop Surabaya convection industry.

Baper Shop is an online shop that has been established in the city of Surabaya since 2020. Baper Shop is a brand of online shop that focuses on selling women's fashion which offers trendy and fashionable styles. Baper Shop Convection is a convection that focuses on making women's clothing. The company is located in the Sidotopo Wetan Village, Kenjeran sub-district, Surabaya City, East Java.

During the observation on convection, one main problem was found, namely environmental performance. The environmental performance problems that occurred at this location were thought to be caused by the Baper Shop convection not carrying out optimal processing of the waste produced. Facts in the field state that fabric waste and water waste from washing screen printing equipment produced by the convection industry can cause waste if it is not managed properly. As in the following data which describes the amount of production and waste in the Baper Shop Surabaya convection.

Table 1. Total Production and Waste

Month	Total Production (Kg)	Total Solid Waste (%)	Amount of Liquid Waste (Liters)
November	2750	5%	2250
December	3490	5.2%	2530
January	3985	4.5%	2675
February	4263	4.7%	2786
March	6401	4.8%	2910
April	5460	5.1%	2887

Source: Baper shop convection data for 2022-2023

This is what underlies the researchers in this study to focus more on fabric waste (solid) and waste from washing screen printing equipment (liquid). It is estimated that if the company handles solid and liquid waste it will have a good effect on its business. This good effect can be in the form of an increase in the company's good name and is also expected to be able to increase revenue for the company. The additional income is only to support income because it is suspected that the nominal value is not as big as the main product in the form of finished products.

Green Productivity (GP) is a strategy to increase business productivity and environmental performance at the same time in overall socio-economic development. This method applies techniques, technology and management systems to produce goods and services that are environmentally friendly or environmentally friendly (Asian Productivity Organization, 2006). It is hoped that with this method, researchers can provide alternative solutions for improving productivity and environmental performance in the Baper Shop Surabaya convection industry.

By implementing Green Productivity (GP), it is hoped that it can increase productivity and produce environmental achievements by using fewer resources and energy so that it will have an impact on reducing waste so that it will be more effective in the work processes carried out. The implementation of Green Productivity (GP) also allows for eco-efficiency which in the future will lead to sustainable development. So that it can identify aspects of problems that influence productivity and environmental performance and provide solutions to problems to increase productivity and environmental performance by considering the Green Productivity Index in the Baper Shop Surabaya Convection industry.

Based on this description, the researcher is interested in conducting a study entitled Environmental Performance Analysis Using the Green Productivity Method on Baper Shop Surabaya Convection Waste.

LITERATURE REVIEW

Productivity

Productivity is defined as a concept that describes the influence of the relationship between the amount and an item or service produced with the resources absorbed to obtain results (Wali & Handayani, 2022). Productivity can also be expressed as a result obtained from the division of output with one of the factors of production (Ismail & Hamroh, 2021; Hidayat & Mualim, 2019). Thus, productivity is an important activity to determine the effectiveness of production performance, where productivity can be used to measure the effectiveness and efficiency of a company's production process.

To achieve maximum productivity, companies or organizations can use effectiveness and efficiency as measurement indicators. This is based on the concept of effectiveness which is a measure that gives an idea of how far the target has been achieved both in quantity and quality, as well as on efficiency which is a comparison of the use of input or input that has been planned with the realization of the resulting expenditure (output) (Wali & Handayani, 2022)

Environmental Performance

Environmental performance is defined as a company's efforts or performance in creating environmental sustainability (Ningtyas & Triyanto, 2019). Environmental performance is an activity that describes good or bad conditions for the relationship between the resources used and those produced in the company's production and service activities (Chanifah, 2019).

Based on this explanation, it can be concluded by researchers that environmental performance is an activity that needs to be carried out by companies as a form of awareness of what the company produces (input materials) and the results provided are in the form of waste or product designs that are capable of polluting the environment. If the level of environmental performance can be increased within the company, it will help the company create competitiveness in conditions of increased environmental performance as well (Wali, GZ, & Handayani, W. 2022).

Environmental Performance Index (EPI)

Environmental Performance Index (EPI) is the company's effort to create a good production environment (Adhiwangsa et al 2022). The EPI measurement is used to find out how dangerous it is if liquid waste is discharged into the surrounding environment. According to East Java Governor Regulation No. 72 of 2013 there are indicator parameters regarding textile waste quality standards to regulate the amount of textile waste disposal in each parameter. The parameters are set as follows:

Table 2. Textile Industry Liquid Waste Quality Standards

No.	Parameter	Quality standards
1.	BOD5	60 Mg/L
2.	COD	150 Mg/L
3.	TSS	50 Mg/L
4.	Total Phenol	0.5 Mg/L
5.	Chrome (Cr) Total	1.0 Mg/L
6.	pH	6-9

Source: East Java Governor Regulation No. 72 of 2013 (data processed)

There are six parameters that must be tested to determine the quality of the liquid waste produced are as follows, BOD5 is a parameter measuring the amount of oxygen needed by bacteria to decompose almost all organic matter dissolved and suspended in wastewater. COD is the amount of oxygen needed to oxidize organic substances contained in liquid waste. Total Suspended Solids (TSS) is the residue of the total suspended solids. Total Phenol is a chemical compound that can accumulate in the body tissues of living creatures. Chromium (Cr) Total is a metal that is chronic and can cause the death of aquatic organisms. PH is the degree of acidity used to express the level of acidity or alkalinity possessed by a solution.

METHODOLOGY

This study uses a quantitative descriptive approach aimed at explaining a phenomenon using numbers that describe the characteristics of the subjects studied (Wali & Handayani, 2022). This study uses the stages of an environmentally friendly productivity method as an analytical technique referring to Hidayat & Mualim's research (2019), where the method basically goes through four steps, namely analysis and identification of sources of problems, setting goals and targets, discussing problems, and setting alternatives to green productivity solutions.

In the first stage, the researcher describes the material balance table which is used to identify the inputs and outputs produced in the production process. After that, productivity calculations are used as a tool to determine the level of productivity that has been achieved by the company. The next stage is distributing questionnaires to determine the weight of the hazard level of each substance contained in the waste according to the parameters specified and addressed to employees in the production section, as well as Baper Shop convection stakeholders with a total of 10 respondents.

The next stage is to identify waste to find out what and how much waste is produced, then calculate environmental performance or EPI to determine the level of environmental performance in the company and calculate the percentage of deviation. After knowing the level of environmental performance, the cause of the problem is identified based on the results of the calculation of environmental performance or EPI using a fishbone diagram. Calculation of the environmental friendly productivity index is then carried out to determine the comparison between productivity levels and environmental performance. The last step of this research analysis method is to determine alternative solutions and calculate profitability to solve problems and maximize environmental performance and productivity.

RESEARCH RESULT

Material Balance

Material balance is used to identify inputs and outputs produced in the production process. At this stage it is described in the form of a table containing the inputs and outputs and their amounts.

Table 3. Material Balance for November 2022

No	Process	Inputs		Outputs	
		Material	Amount (Kg)	Material	Amount (Kg)
1.	Screen printing	Color Paste	9	Liquid waste	2250
		Color Pigments	3		
		Sarestrip	3		
		Water	2235		
Total Liquid		2250 Kgs		2250 Kgs	

2.	Tailoring	Cloth	2750	Finished product	2624
		Sewing thread	12	Solid waste	138
Total Solid		2762 Kgs		2762 Kgs	

Source: Data processing

Table 4. December 2022 Material Balance

No	Process	Inputs		Outputs	
		Material	Amount (Kg)	Material	Amount (Kg)
1.	Screen printing	Color Paste	12	Liquid waste	2530
		Color Pigments	3		
		Sarestrip	4		
		Water	2511		
Total Liquid		2530 Kg		2530 Kg	
2.	Tailoring	Cloth	3490	Finished product	3323
		Sewing thread	15	Solid waste	182
Total Solid		3505 Kgs		3505 Kgs	

Source: Data processing

Table 5. Material Balance for January 2023

No	Process	Inputs		Outputs	
		Material	Amount (Kg)	Material	Amount (Kg)
1.	Screen printing	Color Paste	15	Liquid waste	2675
		Color Pigments	6		
		Sarestrip	6		
		Water	2648		
Total Liquid		2675 Kgs		2675 Kgs	
2.	Tailoring	Cloth	3985	Finished product	3826
		Sewing thread	21	Solid waste	180
Total Solid		4006 Kg		4006 Kg	

Source: Data processing

Table 6. Material Balance for February 2023

No	Process	Inputs		Outputs	
		Material	Amount (Kg)	Material	Amount (Kg)
1.	Screen printing	Color Paste	18	Liquid waste	2786
		Color Pigments	6		
		Sarestrip	8		
		Water	2754		
Total Liquid		2786 Kg		2786 Kg	

2.	Tailoring	Cloth	4263	Finished product	4086
		Sewing thread	24	Solid waste	201
Total Solid			4287 Kg		4287 Kg

Source: Data processing

Table 7. Material Balance for March 2023

No	Process	Inputs		Outputs	
		Material	Amount (Kg)	Material	Amount (Kg)
1.	Screen printing	Color Paste	20	Liquid waste	2910
		Color Pigments	8		
		Sarestrip	10		
		Water	2872		
Total Liquid			2910 Kg		2910 Kg
2.	Tailoring	Cloth	6401	Finished product	6125
		Sewing thread	32	Solid waste	308
Total Solid			6433 Kg		6433 Kg

Source: Data processing

Table 8. Material Balance for April 2023

No	Process	Inputs		Outputs	
		Material	Amount (Kg)	Material	Amount (Kg)
1.	Screen printing	Color Paste	20	Liquid waste	2887
		Color Pigments	7		
		Sarestrip	8		
		Water	2854		
Total Liquid			2887 Kg		2887 Kg
2.	Tailoring	Cloth	5460	Finished product	5210
		Sewing thread	29	Solid waste	279
Total Solid			5489 Kg		5489 Kg

Source: Data processing

Productivity Calculations

Productivity calculations are used to determine the level of productivity that the company has achieved. Before calculating productivity, first find out the amount of input and output in the company's production process. Next, productivity analysis is used by dividing the output value by the input, and multiplying by 100 percent.

Table 9. Productivity Data

No.	Month	Productivity
1.	November	244.3%
2.	December	217%
3.	January	141.9%
4.	February	145.5%
5.	March	132.8%
6.	April	178.6%
	Average	176.6%

Source: Data processing

Based on Table 9, it was found that there was a decline in productivity values from November 2022 to April 2023. Even so, the percentage of productivity is still said to be very good because the value achieved is above 100% percent, so if taken on an average basis, Baper Shop Convection has a productivity value by 176.6 percent in the six-month period. The Baper Shop Convection was identified as experiencing a decline in productivity due to decreased sales and increased production, so a solution was needed for the Baper Shop Convection to be able to increase its productivity again.

Waste Identification

After knowing the level of productivity and the flow of input and output in the production process, the next step is to identify the various types of waste generated by the production process. Waste identification is carried out to see how much waste is produced.

Table 10. Waste Identification

Waste Type	Form	Source	Waste Impact
Fabric Waste	Congested	Cutting	Generates trash
Liquid waste	Liquid	Screen printing tools	Degrades the quality of groundwater

Source: Data processing

Calculation of Environmental Performance Index (EPI)

After knowing the type of waste produced, then an analysis of the environment performance index (EPI) is carried out which aims to determine the environmental performance of the Baper Shop Convection.

Table 11. EPI Calculation Results

No	Parameter	Weight (Wi)	Quality Standards	Analysis Results	Deviation (Pi)	EPI Index (Wi*Pi)
1.	BOD5	8,4	60 Mg/L	9,24	84.6%	6.88
2.	Chemical Oxygen Demand (COD)	8,6	150 Mg/L	29,8	80.1%	7.92

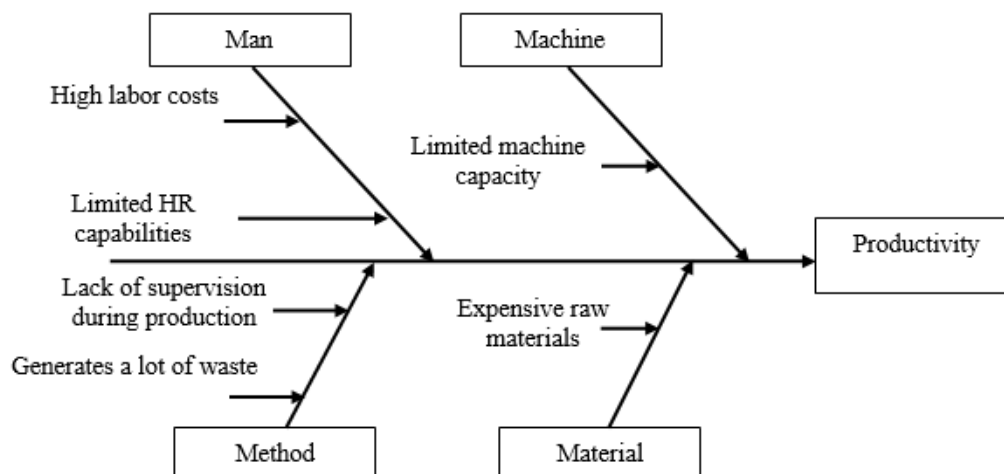
3.	Suspended Solids (TSS)	8,8	50 Mg/L	5	90%	- 6,688
4.	Phenol	8,8	0.5 Mg/L	0.88	-76%	7,708
5.	Total Chrome (Cr)	8,2	1.0 Mg/L	<0.051	94.9%	0.376
6.	pH	8,8	6-9	6,7	4.28%	6.88
Total EPI Index						23,076

Source: Data processing

Table 11. Shows that the EPI index for BOD5 parameters is 6.88, COD is 7.92, TSS is -6.688, Phenol is 7.708, total chromium is 0.376 and PH is 6.88. The results of the following analysis show that TSS and total chrome experienced low EPI levels, therefore identification of the causes and determination of objectives for this level of decline was carried out.

Identifying the Causes of Problems and Determining Goals

Identifying the causes of problems in production productivity at the Basper Shop convection also uses a fishbone diagram. In the fishbone diagram of productivity there are also four categories, namely humans, machines, methods and materials. In humans, there are causes in the form of labor costs and limited human resource capabilities. In the engine category, the cause of the problem was detected in the form of limited engine capacity. In the method category there are two causes, namely lack of supervision and producing a lot of waste. Meanwhile, the material category causes problems in the form of expensive raw materials.



Picture 2. Fishbone Diagram
Source: Data Processing

From the identification results, the goals and targets to be achieved in handling the identified problems are determined. Goals and targets can be seen in the following table.

Table 12. Goals and Targets

Objective	Target
Waste management and reducing environmental impact	Utilization of production waste
Increase Productivity	Increased company income

Source: Data processing

Calculation of Green Productivity Index (GPI)

The Green Productivity Index is present in a strategy that aims to find out and solve problems that occur. Calculation of Green Productivity is used to determine the balance between economic performance/productivity and environmental performance.

Initial GPI Calculation

$$\text{GPIs} = \frac{\text{Tingkat Produktivitas}}{\text{Dampak Lingkungan}}$$

$$\text{GPIs} = \frac{1,766}{23,076}$$

$$\text{GPI} = 0.076$$

Calculation of the Green Productivity Index can be determined by dividing the level of productivity and environmental impact. By knowing the GPI, we can know the balance between productivity performance and environmental performance. In this study it is known that the GPI index on the Baper Shop convection is still low at 0.076.

$$\begin{aligned} \text{GP Solid Waste} &= \frac{\text{Waste Padat}}{\text{Input Material}} \\ &= \frac{1288}{26349} \\ &= 0.048 \end{aligned}$$

$$\begin{aligned} \text{Liquid Waste GP} &= \frac{\text{Waste Cair}}{\text{Input Material}} \\ &= \frac{16038}{15874} \\ &= 1.01 \end{aligned}$$

The GP waste calculation is still in the Green Productivity index series. So by calculating GP waste it will increase the amount of waste produced. In Green Productivity calculations, waste is divided into two, namely solid and liquid. The solid waste GP result is known to be 0.048, while the liquid waste GP result is known to be 1.01.

Preparation of Alternative Solutions

Utilization of liquid waste into organic liquid fertilizer

Utilization of waste from washing screen printing equipment is the main part of liquid waste. The utilization can be from the simplest things, such as making organic fertilizer from waste from washing screen printing equipment.

Table 13. Economic Value of Organic Liquid Fertilizer

Variable	Information	units	Expenditures for 1 Month		
			Amount	Price (IDR)	Total Price (Rp)
Material	Liquid waste	Liter	2887	-	-
	EM4	Liter	15	19,000	285,000
Tool	Water drums	Pcs	8	180,000	1,440,000
Total Inputs					1,725,000
Production	Product results	Liter		2000	5,774,000
Outputs					
Total Outputs					5,774,000
Profit					4,049,000

Source: Data Processing

Utilization of Waste into Patchwork Mats

Table 14. Economic Value of Patchwork Doormats

Variable	Information	units	Expenditures for 1 Month		
			Amount	Price (IDR)	Total Price (Rp)
Material	Fabric waste	Kg	279	3000	837,000
	Sewing thread	Pcs	9	13,500	121,500
Energy	Electricity	Watt	-	70,000	70,000
Labor	Labor Salaries	Person	2	900,000	1,800,000
Etc	Tool maintenance	-	2	50,000	100,000
Total Inputs					2,858,500
Production	Doormat	Pcs	488	10,000	4,880,000
Outputs					(60*40)
Total Outputs					4,880,000
Profit					2,021,500

Source: Data processing

Calculation of Final Productivity

Table 15. Increased Productivity after Utilizing Liquid and Solid Waste

Variable	Information	units	April 2023 Release		
			Amount	Price (IDR)	Total Price (Rp)
Material	Fabric Raw Materials	Kg	5460	59,000	322,140,000
	Sewing thread	Pcs	174	13,500	2,349,000
	Button	Gross	31	16,000	496,000
	Product Labels	Pcs	7200	150	1,080,000
	Color Paste	Kg	20	40,000	800,000
	Color Pigments	Kg	7	110,000	770,000
	Sarestrip	Kg	8	65,500	524,000
	Water	Liter	2854	-	29,000
Energy	Electricity	Watt	-	884,000	884,000
Labor	Labor Salaries	Perso	8	2,000,000	16,000,000

		n			
Etc	Tool	-	-	50,000	500,000
	Depreciation				
	Advertising	-	-	-	385,000
	Costs				
Total Inputs					345,957,000
Outputs	Product sale	Pcs	6450	-	617,296,796
	Fabric Waste	Kg	279	3000	837,000
Total Outputs					618,133,796
total profit					272,156,796
Utilization of liquid waste					4,049,000
Utilization of solid waste					2,021,500
Total profit per month					278,227,296

Source: Data Processing

New Productivity Calculations

$$\text{Productivity} = x \ 100\% \frac{\text{Output}}{\text{Input}}$$

$$\text{Productivity} = x \ 100\% \frac{624.204.296}{402.728.000}$$

$$\text{Productivity} = 154.49\%$$

After adding the additional results from engineering planning for the utilization of waste into liquid organic fertilizer, it was found that productivity increased from 132.8% in April to 154.49% in the following month assuming the amount of production was the same as April.

DISCUSSION

Productivity

Based on the research results, it is known that productivity at the Baper Shop Convection has decreased in December-February and tends to increase in March to April. The decline occurred by 45%, where in November productivity reached 244% and in December to March it fell to 132%. Identification of the cause of the problem is done using a fishbone diagram. From the identification results, it is known that there are several causes. The cause is the high price of raw materials. The difficulty in raw materials is influenced by the fact that raw materials for making cloth are still imported from several countries. In addition, the use of methods that are still traditional makes the production process less than optimal, traditional methods also cause a lot of waste to be generated.

Environmental Performance

Based on research, it was found that the company has actually made efforts to protect the environment by not throwing production waste into the surrounding area. However, these efforts are only limited to making storage tanks for liquid waste from washing screen printing equipment and also the solid waste produced is usually limited to selling rags. To see how dangerous the resulting liquid waste is to the environment, researchers calculated the

Environment Performance Index using quality standards in accordance with government policy. The results obtained from these calculations show that one of the six parameters is negative and based on the overall Environment Performance Index having a positive value, the total EPI value is 23.076. The low environmental performance at Konveksi Baper Shop is known because of the large amount of waste produced. Therefore, researchers identify the cause of the problem using a fishbone diagram. Based on the identification results, several causes of large waste production were found. These results are a lack of knowledge for workers and owners about the dangers of waste produced, as well as inefficient use of raw materials.

Green Productivity

Green Productivity as an effort to increase productivity and environmental performance simultaneously. This effort is by utilizing liquid waste which has the largest volume and if it is not utilized it will have a negative impact on the surrounding environment. In this study it was found that the Green Productivity Index only had a value of 0.076. This value is a very small value for the balance between the environment and productivity. Researchers also calculated the Green Productivity Waste to determine the ratio of raw material use and the resulting waste. The GP waste is divided into two, namely solid and liquid, solid GP waste produces 0.048 and liquid GP waste is 1.01. This means that the GP waste is very low and tends to have a large waste ratio.

CONCLUSIONS AND RECOMMENDATIONS

Based on the analysis and discussion, it can be concluded as follows:

1. Initial productivity at Baper Shop Convection was 244.3% in November and continued to decline to 132.8% in March 2023, and had an initial total productivity of 176%. Meanwhile, the company has an environmental performance on the initial EPI index of 23,076.
2. The initial GPI at the Baper Shop Convection has a value of 0.076 and GP waste has two values, namely 0.048 for GP solid waste and 1.01 for GP liquid waste.
3. There are two alternative solutions planned with the first alternative being the use of liquid waste into liquid organic fertilizer which can increase the economic value to IDR 4,049,000 and increase productivity to 334%. And the second alternative is the use of solid waste into patchwork mats which can increase the economic value to IDR 2,021,500 and increase productivity to 170.7%.

Researchers have a suggestion given to companies that need to do efficiency in each process of tofu production stages instruments such as water use efficiency etc. So that companies can be more competitive and develop faster. As well as material for consideration for subsequent research.

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