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The effect of just in time and total quality management on environmental performance mediated by green supply chain management (empirical studies on small and medium industries in Banda Aceh and Aceh Besar cities)

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ABSTRACT

This study aims to determine the effect of Just In Time and Total Quality Management on Environmental Performance with Green Supply Chain Management as a mediator in Small and Medium Industries in Banda Aceh and Aceh Besar. The sample used in this study was the IKM in the cities of Banda Aceh and Aceh Besar, amounting to 357 respondents. This research method uses a questionnaire as the research instrument. The sampling technique used is purposive sampling. Linear Hierarchical Regression is used as an analytical method to determine the effect of all the variables involved. This study shows that Just In Time and Total Quality Management have an effect on Environmental Performance and Green Supply Chain Management, Green Supply Chain Management has an effect on Environmental Performance and mediates the relationship between Just In Time, Total Quality Management, and Environmental Performance.

Keyword: Just In Time; Total Quality Management; Green Supply Chain Management; Environmental Performance

INTRODUCTION

Every country has environmental issues and problems that cannot be avoided. Indonesia has jobs around environmental issues that need to be addressed and resolved. Environmental issues are multidimensional problems and involve many stakeholders. We need to look at the environmental problems that occur around us, because the quality of the environment will greatly affect the quality of our lives directly.

Environmental issues are not simple problems, the damage that continues to occur due to human activities in meeting the needs and desires that cannot be fulfilled causes damage to the environment, ranging from air pollution, waste disposal, plastic waste pollution, and even the disposal of excessive greenhouse gas emissions. Currently, environmental pollution is a major problem that has the potential to cause the extinction of mankind if not addressed immediately.

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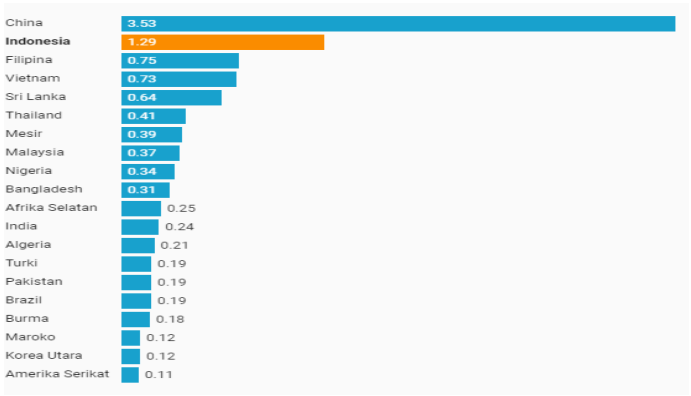
Pollution is also considered as pollution. Pollution occurs due to the presence of pollutants in the environment. Where pollutants are substances that cause pollution. Environmental pollution can also be divided into four conditions, namely; air pollution, water pollution, soil pollution, and noise pollution. In many cases, air pollution requires immediate attention. Global warming which results in an increase in the number of greenhouse gases in the air is the most serious problem facing humanity today.

In addition, water pollution is also very worrying, at least Indonesia produces 3.22 million tons of plastic waste that is not managed properly which pollutes rivers and oceans. Around 0.48-1.29 million tons of plastic waste is suspected to pollute the oceans (cnbcindonesia.com).

Figure 1. **Amount of Plastic Waste (million tons/year)**



Source: cnbcindonesia.com (2019)

Based on these data, we can see that Indonesia is a country with the second-largest amount of water pollution caused by plastic waste in the world after China. It is not enough to stop there, plastic waste pollution in Indonesia is expected to continue to increase. The beverage industry contributes the largest plastic waste after the apparel industry (cnbcindonesia.com).

In Aceh, especially in Banda Aceh, it cannot be separated from pollution by plastic waste. Reporting from (Merdeka.com) In 2021 the City Cleanliness and Beauty Environment Service (DLHK3) of Banda Aceh explained that residents in the capital city of Aceh province produce 230 tons of waste every day. Some of the waste is not even accommodated in the Gampong Jawa Final Disposal Site (TPA), Banda Aceh.

In addition, the production of waste in Aceh Besar Regency is also very large where the waste production reaches 50 tons per day. The high production of this waste generally comes from household waste (aceh.tribunnews.com). If it continues, then this of course has a bad impact on the environment and becomes a health threat in the future.

Environmental issues have become public awareness. This is evidenced by the many public discussions related to the environment. Countries are also increasingly active in making agreements and regulations between countries to overcome various existing problems.

Manufacturing companies should respond to changes desired by consumers directly. As desired by consumers so that products and services that are produced and processed do not endanger environmental sustainability, manufacturing companies must change production patterns to create environmentally friendly products based on consumer demand (Green et al, 2015 in Green et al, 2018).

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The implementation of Just In Time (JIT), Total Quality Management (TQM), and Green Supply Chain Management (GSCM) can be used to support the reduction of excess waste disposal. As stated by Green et al (2018) in their research stating that the application of JIT, TQM, and GSCM is the right combination to support environmental sustainability. This is evidenced by the positive results of JIT and TQM.

JIT variable serves to eliminate all forms of waste, minimize costs associated with the production and delivery of goods and services, thereby increasing profits. The TQM variable supports the emphasis on customers who make goods and services that meet the requirements according to what customers want which leads to increased sales and market share which also means increased profits. Environmental sustainability has been established as a new strategic imperative. Customers want goods and services that are environmentally friendly and produced and delivered through processes that do not harm the environment. The results of this study indicate that manufacturing managers ensure that JIT and TQM programs exist and function properly before attempting to adopt GSCM practices. The impact of implementing GSCM will not materialize unless combined with JIT and TQM. Finally, Ho (2010) in Green *et al* (2018) said, JIT and TQM practices are the main driving force and driving force for preserving the environment

This study examines the more significant effect of Just In Time, Total Quality Management, and Green Supply Chain Management on Environmental Sustainability in Small and Medium Industries in Banda Aceh and Aceh Besar. With the aim of 1) To find out whether the developed model can explain well Environmental Performance, 2) To find out how the involvement of Green Supply Chain Management as a mediating variable and 3) To find out how the effect of Just In Time and Total Quality Management on Environmental Performance Living through Green Supply Chain Management.

LITERATURE REVIEW

Environmental Performance

Environmental performance is the organization's ability to reduce air emissions, liquid and solid waste, and reduce the use of hazardous materials so as not to cause environmental damage (According to Younis *et al*, 2016).

It can be said that Environmental Performance is a company's action in maintaining environmental balance by respecting nature as part of the company's level of environmental awareness (Pranoto and Yusuf, 2014 in Supadi and Sudana 2018). Concern for the environment must be the most important aspect in building a better environmental management system in the form of a company that truly and specifically participates in environmental protection. (Andriana and Panggabean 2017).

The indicators for achieving Environmental Performance according to several experts include: according to Younis *et al* (2016) environmental performance indicators are:

1. minimize air emissions
2. reduction of liquid waste
3. solid waste reduction
4. reduce the use of toxic and hazardous materials
5. reduce the causes of environmental damage.

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Green Supply Chain Managemen

Green supply chain management is a policy that manages the supply chain during the design, distribution, use, recycling, and disposal of a company's products and services with due regard to the environment (Zsidisin & Siferd, 2001).

GSCM not only aims to reduce the environmental impact of the product life cycle but also aims to reduce the environmental impact caused by the activities of stakeholders involved in the supply chain. (Akkucuk, 2017:94).

The five dimensions of implementing GSCM practices that underlie the research include *Internal Environment Management* (IEM), *Green Purchasing* (GP), cooperation with customers including environmental requirements (CC), Eco-Design (ECO), and *Investment Recovery* (IR) (Zhu *et al*, 2008).

Total Quality Management

TQM is an organization-wide set of management practices that ensure that the organization consistently meets or exceeds customer requirements. Based on the ideas of Deming and Duran in their book explaining how an organization can be successful, it can be concluded that the key to quality management is measuring success. through continuous improvement efforts, changing traditional thinking by implementing outdated quality control by changing methods according to the times, and training effective employees. process innovation, think outside the box and seek improvement not after the final product but at every stage of production (Merih, 2016:4).

To build a match between TQM elements, these elements can be divided into three dimensions: (1) *Statistical Process Control* (2) *Product Design* (3) *Customer Focus* (Flynn, 1995).

Just In Time

According to that, the *Just In Time* system is a system where goods will be delivered or assembled when there is a demand not because of anticipating demand (Haizer, 2010 in Aprilianti & Hidayat, 2019)

This study will use the JIT elements proposed by Flynn and Sakakibara (1995) *Kanban, Lot Size Reduction, JIT Scheduling, and Setup Time Reductions* as dimensions.

Based on the results of the research that the *Just In Time* aspect can help improve environmental performance, but in the study, it was stated that environmentally friendly practices and environmental performance became weaker in companies that implemented more *Just In Time* practices. (Zhu and Sarkis, 2004)

H_1: Just In Time has a positive effect on Environmental Performance.

Minimize redundant and unnecessary materials, introduce reusable and reproducible parts, reduce refill frequency, integrate returned materials and information flow in supply chain response, share environmental risks, minimize waste, reduce transportation time and resource consumption Efficient power is a part of green supply chain activities (Carvalho et al, 2011).

Just In Time is an innovative program to eliminate waste from purchasing, manufacturing, and shipping, and to promote optimal use of resources. (Inman et al., 2011 in Wu et al., 2012).

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The results show that there are companies in Australia that rely on the ability of *Just In Time* to support environmental sustainability efforts with good results (Young, 2009).

H $_2$: Just In Time has a positive effect on the practice of Green Supply Chain Management.

Companies that seek to respond to markets and customers can also improve environmental performance. Therefore, when customers begin to want products and services that are environmentally friendly, Components total quality management based on customers who must support the production of goods and services that are environmentally friendly through a process that is not harmful to the environment (Green et al., 2012).

In addition, better environmental performance must be supported by optimal use of resources through waste treatment. TQM efforts in overcoming environmental problems yield positive results (Golicic and Smith, 2013).

H $_3$: Total Quality Management has a positive effect on Environmental Performance.

Quality management is an important prerequisite for the successful implementation of many green supply chain management practices (Zhu and Sarkis, 2004: 283). Based on the results of related research (TQEM) which focused on the ability of TQM in eliminating environmental waste, it showed positive results in supporting environmental sustainability (Garza-Reyes et al, 2018).

H $_4$: Total Quality Management has a positive effect on the practice of Green Supply Chain Management.

Zhu and Sarkis (2004) in their research found positive results in their hypothesis, where companies that implement green supply practices experience better performance improvements.

H $_5$: Green Supply Chain Management has a positive effect on Environmental Performance.

The JIT program is designed to eliminate all forms of waste. JIT practices have an indirect impact on environmental performance through GSCM practices. Green et al. (2018).

H $_6$: Effect of JIT on Environmental Performance mediated by Green Supply Chain Management.

Either directly or indirectly, the implementation of TQM has had an impact on environmental performance. The results show that producers who have implemented TQM practices are more likely to succeed in implementing GSCM practices. Where TQM focuses on improving high-quality products and customer service. So that environmental sustainability and performance will increase (Green et al., 2018).

H $_7$: Effect of TQM on Environmental Performance Mediated by Green Supply Chain Management.

RESEARCH METHODS

Population and Sample

The population in this study is Small and Medium Industries (IKM) in the cities of Banda Aceh and Aceh Besar. The sampling technique of this research is non-probability sampling. The sampling method used is the purposive sampling method. The number of samples in this study was 357 respondents.

Data collection technique

In obtaining data and information from this study, the researcher used a questionnaire (questionnaire) given personally by telephone and email to the respondent as a tool to collect related data and information.

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Operational Variables

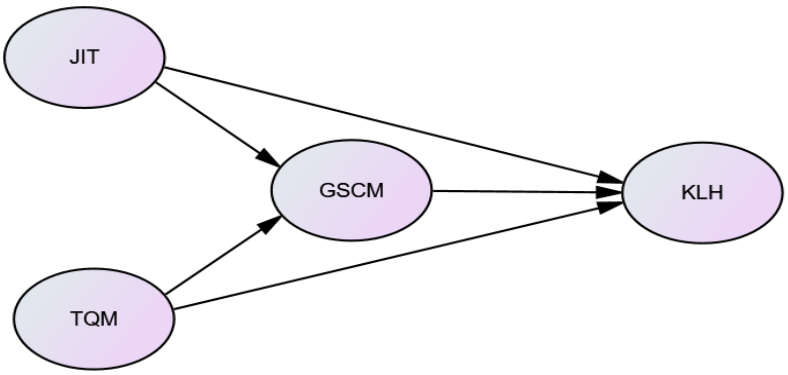
The operational variables of this study are as follows:

1. Dependent Variable (Y)
   - Environmental Performance
2. Mediation Variable (Z)
   - Green Supply Chain Management.
3. Independent Variable (X)
   - Total Quality Management (X_1)
   - Just In Time (X_2)

Data Analysis Tools

The data analysis equipment used in this study was to determine the effect of Just In Time and Total Quality Management on Environmental Performance through Green Supply Chain Management using the Hierarchical Linear Modeling (HLM) method (Baron and Kenny, 1986). Hierarchical regression was used to test the relationship is not directly between the variables, test the effect of mediation in this study using the approach of Baron and Kenny.

Figure 2. **Framework**



RESULTS

Industry Characteristics

Based on the number of workers less than 5 by 7%, 6 to 10 workers by 36.1%, 11 to 15 workers by 50.1%, 16 to 20 workers by 6.2%, and more than 20 workers by 0.6%.

Based on the average engine life of fewer than 5 years by 11.2%, 6 to 10 years by 31.1%, 11 to 15 years by 51%, 16 to 20 years by 6.2%, and more than 20 years by 6.2%.

Based on the type of handicraft industry 27.2%, Metal and Electronics 23.0%, Food and Beverage 24.9%, and textiles 24.9%.

Characteristics of Respondents

Based on gender, there were 159 respondents (44.5%), while there were 198 female respondents (55.5%) of the total respondents.

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Based on age, respondents aged 30 years were 59 people (16.5%), 31 to 35 years were 65 people (18.2%), 36-40 years old were 68 people (19.0%), 41-45 years were 86 people (24.1 %), and 45 years of 79 people (22.1%).

Based on the position, respondents were Financial Managers of 88 people (24.6%), Operations Managers were 91 people (25.5%), Factory Managers were 83 people (23.2%), and Quality Control Managers were 95 people (26.6%).

Based on the length of work, respondents who have worked 1 to 5 years are 84 people (23.5%), 6 to 10 years are 102 people (28.6%), 11 to 15 years are 82 people (23.0%) and the length of work is more than 15 years 89 people (24.9%).

Table 1. **Validity and Reliability Test Results**

No	Statement	Variable	Correlation coefficient	Cronbach Alpha
1	JIT1	Just In Time	0.835	0.962
2	JIT2		0.870	
3	JIT3		0.803	
4	JIT4		0.848	
5	JIT5		0.834	
6	JIT6		0.868	
7	JIT7		0.803	
8	JIT8		0.849	
9	JIT9		0.850	
10	JIT10		0.840	
11	JIT11		0.875	
12	JIT12		0.803	
13	JIT13		0.849	
1	TQM1	Total Quality Management	0.892	0.984
2	TQM2		0.911	
3	TQM3		0.763	
4	TQM4		0.893	
5	TQM5		0.915	
6	TQM6		0.775	
7	TQM7		0.894	
8	TQM8		0.916	
9	TQM9		0.768	
10	TQM10		0.896	
11	TQM11		0.918	
12	TQM12		0.773	
13	TQM13		0.763	
14	TQM14		0.893	
15	TQM15		0.915	
16	TQM16		0.775	
17	TQM17		0.894	
18	TQM18		0.916	
19	TQM19		0.768	
20	TQM20		0.896	
21	TQM21		0.918	
22	TQM22		0.773	
23	TQM23		0.905	
24	TQM24		0.767	
1	GSCM1	Green Supply Chain Management	0.909	0.991
2	GSCM2		0.956	
3	GSCM3		0.948	
4	GSCM4		0.846	

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5	GSCM5		0.906	
6	GSCM6		0.956	
7	GSCM7		0.949	
8	GSCM8		0.857	
9	GSCM9		0.911	
10	GSCM10		0.960	
11	GSCM11		0.954	
12	GSCM12		0.855	
13	GSCM13		0.903	
14	GSCM14		0.961	
15	GSCM15		0.955	
16	GSCM16		0.851	
17	GSCM17		0.903	
18	GSCM18		0.954	
19	GSCM19		0.949	
20	GSCM20		0.853	
21	GSCM21		0.896	
22	GSCM22		0.955	
1	KLH1		0.870	
2	KLH2		0.869	
3	KLH3	Environmental	0.977	0.973
4	KLH4	Performance	0.973	
5	KLH5		0.973	
6	KLH6		0.970	

Validity Test and Reliability Test

The research validity test used in the study is the result of a set of indicators obtained as a result of distributing questionnaires so that the resulting data must be tested for truth or validity. The validation tool that is used includes the use of a torque factor Pearson product test correlation validation test questionnaire is based on a comparison between the value of r count the value of r table.

The reliability test of the wording of the questionnaire using Cronbach's Alpha values was carried out only once on a group of respondents per variable. The reliability measure is considered reliable based on the Cronbach Alpha 0.60 (Malhotra. 2003). If the confidence level data is greater than Cronbach's alpha (α), the measurement results can be considered as a measure of the level of accuracy and consistency ideological that good. Can be seen in Table 1.

Regression Analysis Results

In scaling, the Likert scale is used, so for the regression coefficient, the normalization coefficient is used, where the constant value does not need to be explained (Hair et al., 2010)**.** From the results of the SPSS 25.0 output, a linear equation can be drawn. The results of the analysis of the influence of Just In Time and Total Quality Management on Environmental Performance, the following equation can be made:

$$\mathbf{Y = 0.415\ X_1 + 0.507\ X_2}$$

From these equations, it can be explained that:

1) Just In Time regression coefficient is positive 0.415. The higher the Just In Time, the Environmental Performance will increase. 2) Total Quality Management regression coefficient is positive 0.507. The higher the Total Quality Management, the Environmental Performance will increase. Furthermore, the results of the analysis of the effect of Just In Time and Total Quality Management on Green Supply Chain Management can be made the following equation:

$$\mathbf{Z = 0.324\ X_1 + 0.478\ X_2}$$

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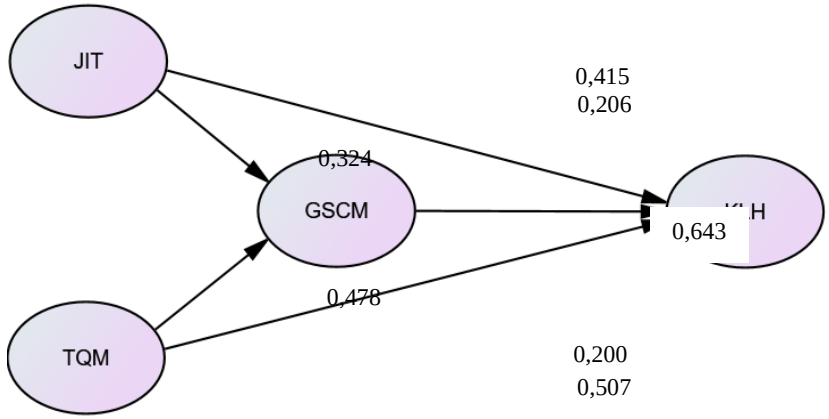
1) Just In Time regression coefficient is positive 0.324. This means that the higher the Just In Time, the Green Supply Chain Management will increase. 2) Total Quality Management regression coefficient is positive 0.478. This means that the higher the Total Quality Management, the Green Supply Chain Management will increase. Furthermore, the results of the analysis of the influence of Green Supply Chain Management on Environmental Performance, the following equation can be made:

Y = 0.914Z

So from this equation, it can be explained that the regression coefficient of Green Supply Chain Management (mediation) is positive 0.914. This means that the higher the Green Supply Chain Management, the higher the Environmental Performance.

Figure 3. **Thinking Framework After Testing**



DISCUSSION

Zhu and Sarkis (2004) in their research found that JIT helps improve environmental performance, but in companies that adopt JIT practices, the relationship between environmental protection practices and environmental performance is higher. This is in line with the results of research conducted by Klassen (2000) that there is a positive relationship between JIT and Environmental Performance

Companies that seek to respond to markets and customers can also improve environmental performance. Therefore, when customers begin to want products and services that are environmentally friendly, Components total quality management based on customers who must support the production of goods and services that are environmentally friendly through a process that is not harmful to the environment (Green et al., 2012).

In addition, better environmental performance must be supported by optimal use of resources through waste treatment. TQM efforts in overcoming environmental problems yield positive results (Golicic and Smith, 2013).

Just In Time is an innovative program to eliminate waste from purchasing, manufacturing, and shipping, and to promote optimal use of resources. (Inman et al., 2011 in Wu et al., 2012). Certain elements of JIT, such as buying and selling require coordination with suppliers and customers to support the implementation of GSCM practices (Freeland, 1991; Germain and DrÃ¶ge, 1997 in Green and Inman, 2005). JIT-buying and JIT-selling should support an expanded focus on environmental

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sustainability through GSCM practices such as eco-friendly purchasing and collaboration with customers. The results show that there are companies in Australia that rely on the ability of *Just In Time* to support environmental sustainability efforts with good results (Young, 2009).

Zhu and Sarkis (2004) in their research found positive results in their hypothesis, where companies that implement green supply practices experience better performance improvements. Based on the results of related research (TQEM) which focused on the ability of TQM in eliminating environmental waste, it showed positive results in supporting environmental sustainability (Garza-Reyes et al, 2018).

Zhu and Sarkis (2004) in their research found that JIT helps improve environmental performance, but in companies that adopt JIT practices, the relationship between environmental protection practices and environmental performance is higher. This is also in line with the results of research conducted by Inman and Green (2018), Green et al. (2012), and Li et al. (2016) that there is a positive relationship between GSCM and Environmental Performance

Based on the results of the study, shows that the combination of JIT and TQM practices supports GSCM practices that lead to an increase in environmental performance. The JIT program is designed to eliminate all forms of waste. JIT practices have an indirect impact on environmental performance through GSCM practices. Green et al. (2018).

Either directly or indirectly, the implementation of TQM has had an impact on environmental performance. The results show that producers who have implemented TQM practices are more likely to succeed in implementing GSCM practices. Where TQM focuses on improving high-quality products and customer service. So that sustainability and environmental performance will be further improved (Green et al., 2018).

CONCLUSION

Based on the discussion of the research results that have been described in the previous section, the following conclusions can be drawn:

1. Just In Time affects Environmental Performance.
2. Total Quality Management affects Environmental Performance.
3. Just In Time affects Green Supply Chain Management.
4. total Quality Management affects Green Supply Chain Management.
5. Green Supply Chain Management affects Environmental Performance
6. Just In Time has an effect on the Environmental Performance of SMEs in Banda Aceh and Aceh Besar through Green Supply Chain Management.
7. Total Quality Management affects the Environmental Performance of SMEs in Banda Aceh and Aceh Besar through Green Supply Chain Management.

Based on the conclusions described above, some suggestions can be summarized as follows:

1. Further research is needed on Just In Time, Green Supply Chain Management, and Environmental Performance as well as other influencing factors such as Stakeholders, Legitimacy, Leverage, and Brand Equity.

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2. Further research methods can be carried out by expanding the description, framework, and indicators for each sub-variable that will be used, as well as in the use of methods and analytical tests that should be to obtain detailed results.
3. Conduct research on Total Quality Management. Just In Time and Green Supply Chain Management in service companies

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