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RESEARCH PAPER

Analysis of Green Supply Chain Management Factors for Improving Firm Performance in Food Industry

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ABSTRACT

The food industry's supply chain primarily relies on materials that are not environmentally friendly. To address this issue and improve overall performance, the implementation of Green Supply Chain Management (GSCM) becomes crucial. The objective of this research is to analyze the factors influencing the adoption of GSCM and its impact on the performance of the food industry, particularly in Indonesia where there is a high potential for waste production and environmental impact. The study targeted 83 food industry companies as respondents, achieving a response rate of 76.82%. The research employed a Partial Least Squares (PLS) and statistical analysis approach to test hypotheses regarding food industry performance. The findings indicate that GSCM does not directly affect food industry performance. However, GSCM has a positive influence on Green Innovation, which in turn has a positive impact on Company Performance. Green Innovation acts as a mediator between GSCM and Corporate Performance. The implementation of a GSCM at the food industry not only enhances environmental performance but also to improved economic performance. It is emphasized that renewable company innovations should be integrated alongside the adoption of green supply chains. The study highlights that the positive effects of the GSCM are more significant when mediated by green innovation.

KEYWORDS: *Firm performance; Food industry; Green supply chain; SEM-PLS; Supply chain strategy.*

1. Introduction

The food sector possesses the capacity to enhance the economy and is experiencing rapid global development. Indonesia, being an agricultural nation, boasts substantial potential in this regard. As a significant food producer, Indonesia's Food Industry has expanded from local to global proportions, attracting numerous foreign food companies to establish their factories within the country.

The Food Industry exerts a substantial environmental influence, with waste generated from various sources—liquid, solid, and gaseous—inevitably affecting the environment [1]. Within the food industry's supply chain, solid waste is generated during procurement, production, and distribution, often originating from non-environmentally friendly materials. The global food supply chain, involving producers, processors, and consumers, operates within a complex system that generates significant waste. Unfortunately, in current production and distribution practices, the impacts of climate change and population growth tend to be overlooked [2].

The manufacturing and food Industry places a growing emphasis on supply chain management (SCM), as companies depend on robust supply chains to navigate intricate technologies [3]. Consequently, incorporating environmental considerations into the supply chain is becoming increasingly crucial for manufacturers seeking a competitive edge. In recent years, the concept of green supply chain management (GSCM) has

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gained significant traction worldwide, particularly in the United States, European Union, and Japan. GSCM has emerged as an environmental-oriented approach within the realm of SCM [4].

During the 1990s, Supply Chain Management (SCM) underwent a transformation, giving rise to Green Supply Chain Management (GSCM). This shift occurred as companies increasingly competed to adopt environmentally responsible practices within their supply chains. The fundamental idea behind GSCM is to integrate environmental considerations into SCM practices, thereby exerting influence on the environmental impacts of all parties involved in the supply chain [5]. As outlined in [6], GSCM is evaluated using five variables: green manufacturing, green purchasing, green information systems, cooperation with customers, and environmentally friendly designs. Four out of the five variables exhibited statistical significance in measuring company performance within the context of GSCM.

To attain green objectives, companies must establish a connection between their environmental strategy and every functional strategy within the organization, thereby eliminating barriers to environmental integration. To align with evolving business dynamics, decision-makers must adapt the content and objectives of environmental practices accordingly. It is worth noting that numerous companies have recently embarked on initiatives to promote environmental stewardship and implement environmentally friendly activities, resulting in the need to identify various factors associated with the environment that may impact their operations [7].

Despite employing advanced techniques, the Food Industry continues to have a negative environmental footprint. Changing times have resulted in increased energy and material consumption, further exacerbating the industry's environmental impact. Consequently, companies must revise regulations and practices to strike a balance between economic performance and environmental sustainability. One approach that addresses this challenge is the Green Concept, which aims to design more sustainable work processes. This concept can also be applied to supply chains, giving rise to Green Supply Chain Management, which focuses on integrating environmentally friendly practices throughout the supply chain.

This research provide factors that influence the operations of green supply chains in the food industry, considering its proximity to environmental impact and emissions that require mitigation. The study provides a comprehensive formulation of strategies to enhance supply chain performance through the implementation of green supply chain practices. The identified factors are derived from relevant articles that have explored the adoption of green supply chain operations in industrial processes.

The purpose of this study is Analyze the factors that influence the implementation of GSCM to improve the performance of the Food Industry. Formulate strategies to improve the performance of the Food Industry through the implementation of GSCM.

2. Literature Review

A. Green supply chain management (GSCM)

Green Supply Chain Management (GSCM) plays a crucial role in the development of Supply Chain Management (SCM) concepts and represents a vital decision within operational management that significantly impacts company performance. GSCM encompasses the integration of environmental considerations into the Supply Chain, particularly in procurement decisions and supplier relationships. By incorporating environmental criteria, GSCM aims to minimize the environmental impact of products or services, prompting companies to strike a better balance between their performance and environmental sustainability [8]. According to [9], GSCM entails the alignment of production, manufacturing, distribution, and transportation activities to enhance company performance within an environmentally conscious framework. Moreover, research conducted by [10] highlights GSCM as one of the most crucial approaches to environmental management.

Green procurement, or an environmentally friendly procurement process, involves selecting materials, and suppliers, purchasing materials, scheduling deliveries, planning, and controlling material supplies. In its task, green procurement must consider the environmental impact by considering environmental factors consisting of the 3Rs (reuse, reduce, recycle). Green manufacturing is a production process whose raw materials do not significantly impact the environment but have high efficiency. Green

manufacturing can affect the cost of raw materials to be cheaper, and does not produce pollution in the surrounding environment so that people judge the company very well [8]. Green distribution in its implementation involves green packaging and green logistics. Packaging or packaging uses environmentally friendly materials, sizes that are not too large, and materials that can be recycled. Green logistics makes deliveries to consumers with alternative fuels and routes that are not too long. Reverse Logistics is a process where consumers return used products to the company to be recycled and produced again.

Green supply chain management concept has been widely applied in Industry. Before its adoption, scholars investigated the effect of GSCM to operations in industry. The effect of GSCM to industrial performance and operations has been largely discussed by [11]–[13] that GSCM lead to improve the environmental, economic and business performance. the GSCM adoption has been applied in many industry, e.g. manufacturing [14], food industry [15], agriculture [16], [17], and automotive [18], [19]. The GSCM application found as a potential approach to improve the industry and supply chain improvement in the future with also considers in minimization the environmental impact and fulfillment of customer demand.

B. Green innovation

According to research [20] Green Innovation is defined as innovation related to green processes, such as energy saving, pollution prevention, waste recycling, product design, and corporate environmental management. Green Innovation is applied to improve environmental performance and reduce environmental costs in resource productivity. Green Innovation is influenced by applicable regulations and the company's internal conditions. This innovation requires continuous investment and persistent efforts to improve economic performance for the company, along with environmental responsibility.

The application of Green Innovation by combining renewable technologies that save energy and prevent pollution and the application of waste recycling and environmentally friendly product design. Green innovation also contributes to the company's economic performance because it positively affects financial, social, and environmental results. Though it will take time as being an innovative green company will initially improve the company's financial performance [21]. In its application, green innovation can achieve a sustainable competitive advantage, showing that companies must be in line with economic trends. Although its implementation is risky at the beginning, the implementation of green innovation must be addressed. Effectively, applying green innovation will increase the value of a product, the effect on corporate image, and increase customer acceptance [22]. There are alignment mechanisms that influence green innovation, including increasing efficiency by reducing key variables (time, labor requirements, and noise levels), optimizing logistics, creating new types of buildings, and improving service levels [23].

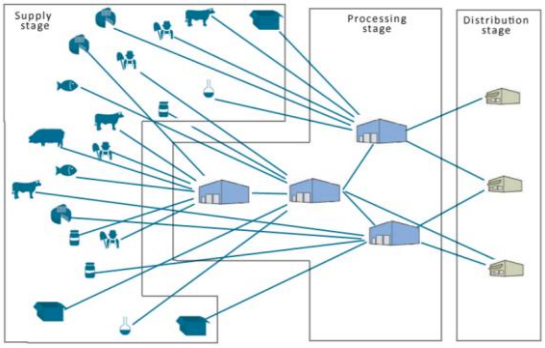

Fig. 1. Food suppy chain [24]

C. Food supply chain

The food supply chain is a dynamic network encompassing financial flows, goods flow, and information flows. It involves multiple interconnected organizations, including producers, distributors, suppliers of raw materials, and consumers [25]. Food products traverse through various stages and distribution channels,

originating from raw material suppliers. Within this supply chain, supplies can be categorized into critical and non-critical components. Critical supplies pertain to primary raw materials that are vital for the production process, while non-critical supplies encompass smaller raw materials or services that have a relatively minor impact on the overall process.

The food supply chain can be divided into three key stages: the Supply Stage, which involves all suppliers providing raw materials; the Processing Stage, which comprises processing plants and activities related to transforming raw materials into food products; and the Food Distribution Stage [24]. One of the challenges within the food supply chain is the presence of food products with limited brand differentiation. This lack of differentiation makes it easier for products to be substituted by alternatives. Additionally, food processors often lack decision-making authority in downstream activities. The flow of products from producers to consumers presents challenges for all partners in the food supply chain, with a primary concern being compliance with regulations to ensure product quality and safety [26].

The practical adoption of GSCM in food industry has been widely discussed in previous research. The sustainable and green supply chain approach was found significantly impact the companies financial performance in Bangkok [27]. An empirical proof was provided by [28] that the green supply chain impacting supply chain main operations: transportation, warehousing, distribution and order picking. In other research, [29] formulates the critical success factors in adopting green supply chain management in the food industry by surveying practitioners.

3. Hypothesis Development

A. Green supply chain management and firm performance

Literature studies show a perceived positive relationship between GSCM practices and firm performance. In research conducted[4], [10], [30], GSCM practices positively affect company performance. The Company's performance in question is Environmental Performance, Economic Performance, and Social Performance. Research (Ahmed et al., 2019) shows that GSCM practices have a positive effect on environmental and economic performance as well as customer effectiveness. GSCM positively impacts company performance, indicating that GSCM can improve company performance in the long term both from an environmental and economic perspective. So in this study, the researchers proposed a hypothesis:

H1: *The implementation of GSCM in the Food Industry has a relationship positive to improve Firm Performance*

B. Green innovation and firm performance

In addition to GSCM practices, the implementation of Green Innovation affects the company's performance. Green innovations include green product innovation and green process innovation. Both green product innovation and green process innovation have a positive relationship with the company's competitive advantage. [20]. The application of Green Innovation by combining renewable technologies that save energy and prevent pollution and the application of waste recycling and environmentally friendly product design. Green innovation also contributes to the company's economic performance because it positively affects financial, social, and environmental results. However, it will take time because becoming an innovative green company will initially improve its financial performance [21]. In this study, the researcher proposes a hypothesis:

H2: *Green Innovation has a positive relationship to increase firm performance.*

C. Green supply chain management and green innovation

Research (Abu Seman et al., 2019) revealed that there is a positive relationship between GSCM and Green innovation and a positive relationship between green innovation and environmental performance. Research [31] explains that environmental management in businesses such as GSCM has a positive relationship with green products and processes. The concept of green innovation can implement GSCM by approaching and offering new ideas and technologies [32]. In this study, the researcher proposes a hypothesis:

H3: *Implementation of GSCM in the Food Industry has a positive relationship with Green Innovation*

D. Green innovation mediates green supply management and firm performance

Several previous studies have shown that the implementation of Green Supply Chain Management affects the company's performance. If the two are directly related, it will affect the company's cost performance because it is

necessary to add another variable as a mediation. The mediating variable that will be used in this research is green innovation. Green innovation can improve the company's image, improve the company's financial performance, and optimize logistics[21], [23]. The relationship between Green Supply Chain Management and green innovation is between supply chain stakeholders of companies that can implement green innovation to deal with external pressures [33]. In this study, the researcher proposes a hypothesis:

H4: Green Innovation Mediates GSCM Implementation in Food Industry to improve Firm performance.

4. Methods

A. Research framework

The implementation of GSCM aims to improve company performance, optimize supply chain performance, and still pay attention to environmental impacts that prioritize customer satisfaction. To implement GSCM, there are several variables or activities, including green purchasing/procurement, green manufacturing, green distribution, and reverse logistics. The supply chain in the Food Industry is a complex network of interactions involving farmers, processors, distributors, retailers, and consumers. A challenge for the Food Industry in planning new strategies that are effective and efficient in the supply chain but still pay attention to environmental impacts. To answer the problems and research objectives, a research framework is designed, which is described in Fig. 2.

The research framework begins with problem indicators. From the indicators of the problem, the objectives are formulated, namely, knowing the factors that influence GSCM and formulating strategies to improve performance through the implementation of GSCM. The method to be used is quantitative. Data is collected through questionnaires from industry.

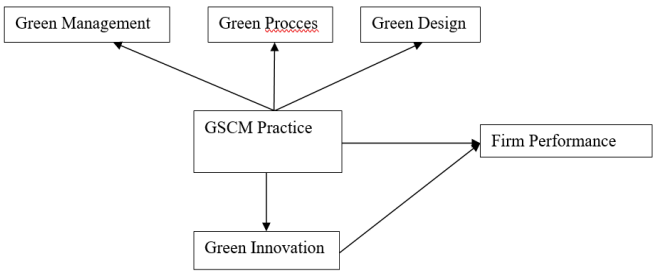

Fig 2. Framework and Hypotheses

B. Sample

The research population are extracted from the number of food industry in Indonesia. The number of samples and respondents are decomposed by Slovin formula. Questionnaires were distributed to a total of 82 respondents, and as many as 63 questionnaires were successfully filled in completely so that they represented a respondent level of 76.82%. Table 1 displays the characteristics of the respondents who filled out the questionnaire.

Tab. 1. Demographic of respondents

	Total	Percentage
Position		
Above Manager	3	4.76%
Engineering Manager	6	9.52%
Supply Chain Manager	8	12.69%
Supply Chain Supervisor	13	20.63%
Others (Staff SC, Staff Operations and production)	33	52.38%
Experience		
< 5 years	21	33.33 %
5 – 10 years	31	49.20%
10 – 15 years	8	12.69%
>15 years	3	4.76%

Education Background		
Highschool	3	4.76%
S1	51	80.95%
S2	8	12.69%
S3	1	1.58%
Sales /year		
<$10 M	19	30.15%
$10 jt - $50 M	24	38.09%
$50 jt - $100 M	8	12.69%
>$100 M	12	19.04%
Location		
West Java	32	50.79%
Central Java	2	3.17%
East Java	4	6.34%
Jakarta	13	20.63%
Others	12	19.04%

The results of the questionnaire show that the position of respondents in a company with a top-level position in the company is 4.76%, managerial and supervisory levels include Engineering Manager as much as 9.52%, Supply Chain Manager 12.69%, Supply Chain Supervisor 20.63%. The respondents under managerial and supervisory were 52.38%.

Work experience in their field is mostly in the range of 5-10 years of experience as much as 49.20%. The educational background of the respondents was dominated by S1 graduates, 80.95%. The scale of the company as seen from the estimated total sales per year is quite diverse, including <$10 million as much as 30.15%, $10 million - $50 million as much as 38.09%, $50 million - $100 million as much as 12.69%, and > $100 million as 19.04%. The locations of the companies were dominated in West Java and DKI Jakarta, each with a percentage of 50.79% and 20.63%.

5. Data Analysis

The software used for data analysis Partial least square structural equation modelling (PLS-SEM) is SmartPLS 3.3.7 after screening the data. According to (Hair et al., 2019) PLS-SEM is recommended for testing complex model hypotheses with a small sample. Several studies on Green Supply Chain Management also apply PLS-SEM [32], [34]–[39]. PLS-SEM in this study is used to analyse the influence of Green Management (GM), Green Process (GP), Green Design (GD), Green Innovation (GI), on company performance (CP). Below are described the result of the analysis.

A. Statistical test using reliability and validity

Validity and Reliability Tests are used to assess whether or not the questionnaire is valid. To test the validity and reliability by calculating the outer model. The components of the outer model include Convergent validity and discriminant validity. In this study, convergent validity was assessed based on the Average Variance Extract (AVE) value, and the outer loading value. The Outer Loading value is said to be valid if it is greater than 0.7. The SmartPLS Outer Loading software can be obtained from the PLS Algorithm.

Measuring the Average Variance Extracted (AVE) value is used for the Reliability test. The AVE value is used to measure the level of variance of a construct component that adjusts the error rate. Reliability test can also be with Cronbach's Alpha. This value reflects the reliability of all indicators in the model. The minimum value is 0.7 (Hidayat, 2018). Table 2 presents Construct Reliability and Validity, showing the value of composite reliability which must be higher than 0.7, the Cronbach's Alpha value which must be higher than 0.7 to strengthen the composite reliability test, and the average variance extracted which must be more than 0.5.

Discriminant validity testing can be assessed from the Fornell-Larcker criterion, heterotrait–monotrait ratio, and cross loading. The discriminant validity value is said to have met the validity if the roots of the AVE in the construct are higher than the construct's correlation with other variables [32].

Tab. 2. Average variance extracted

	Cronbach's Alpha	Composite Reliability	Average Variance Extracted
GM	0.824	0.884	0.655
GP	0.849	0.909	0.768
GD	0.871	0.907	0.663

GI	0.850	0.893	0.627
FP	0.850	0.899	0.692

Tab. 3. Fornell-larcker criterion

	GD	GI	GM	PP	GP
GD	0.814				
GI	0.756	0.792			
GM	0.668	0.495	0.809		
PP	0.637	0.693	0.321	0.832	
GP	0.722	0.756	0.559	0.548	0.877

Table 3 displays discriminant validity based on the Fornell-Larcker criterion. The Fornell-Larcker critetion is used to ensure discriminant validity, the AVE value for each variable must be higher than the R-square with all other variables [40].
Table 4 displays discriminant validity based on cross loading. Discriminant validity values indicate that all variables have met validity because each item measures its latent variable higher than the value of other items. Cross Loading and comparison of variance extracted from constructs with shared variance. Each item must load higher on the intended construct than the other constructs [4]. Cross-loadings are used to check discriminant validity in addition to the criteria above. A model fit must be reconsidered if the indicator has a higher correlation with other latent variables. Table 4 finds that all items meet the discriminant validity requirements. Table 5 displays discriminant validity values based on the heterotrait–monotrait ratio. The construct value must be less than 0.9 [41]. In this study, all constructs have fulfilled discriminant validity with all values less than 0.9.

Tab. 4. Cross loading

	GM	GP	GD	GI	FP
GM.1	0.798	0.441	0.479	0.346	0.217
GM.2	0.831	0.402	0.582	0.390	0.275
GM.3	0.848	0.609	0.607	0.524	0.345
GM.5	0.758	0.330	0.481	0.319	0.183
GP.2	0.520	0.839	0.610	0.620	0.347
GP.3	0.345	0.827	0.613	0.712	0.599
GP.4	0.588	0.864	0.674	0.662	0.501
GD.1	0.620	0.528	0.802	0.551	0.504
GD.2	0.665	0.498	0.900	0.676	0.646
GD.3	0.451	0.583	0.806	0.699	0.673
GD.4	0.503	0.500	0.829	0.595	0.588
GD.5	0.463	0.489	0.724	0.550	0.523
GI.1	0.060	0.669	0.690	0.808	0.552
GI.2	0.622	0.675	0.578	0.867	0.622
GI.3	0.589	0.539	0.573	0.834	0.583
GI.4	0.422	0.434	0.410	0.737	0.554
GI.5	0. 576	0.641	0.706	0.707	0.434
PP.2	0.225	0.441	0.529	0.498	0.774
PP.3	0.304	0.499	0.506	0.621	0.840
PP.4	0.274	0.553	0.569	0.657	0.879
PP.5	0.261	0.303	0.516	0.512	0.776

Tab. 5. heterotrait–monotrait ratio

	GD	GI	GM	PE	GP
GD					
GI	0.870				
GM	0.780	0.579			
FP	0.746	0.812	0.321		
GP	0.839	0.885	0.559	0.640	

B. Statistical analysis using partial least square

PLS analysis was performed to test the efficiency of the model. The results of the PLS estimation are shown in Figure 3. This analysis was carried out using SmartPLS 3.3.7 software with input

information Green Management (GM), Green Process (GP), Green Design (GD), Green Innovation (GI). This study applies the bootstrap method to SmartPLS to determine path significance. The data obtained comes from the

answers to the questionnaire as many as 63 respondents.

To check the overall strength of the model structure and variance using the R^2 value. to meet the requirements for the strength of the variation must be more than 0.1 or 10%. In this study there are two dependent variables, namely Green Innovation and Company Performance. The value of green innovation is 0.606, this shows that Green Supply Chain Management provides 60% of the total variance in green innovation.

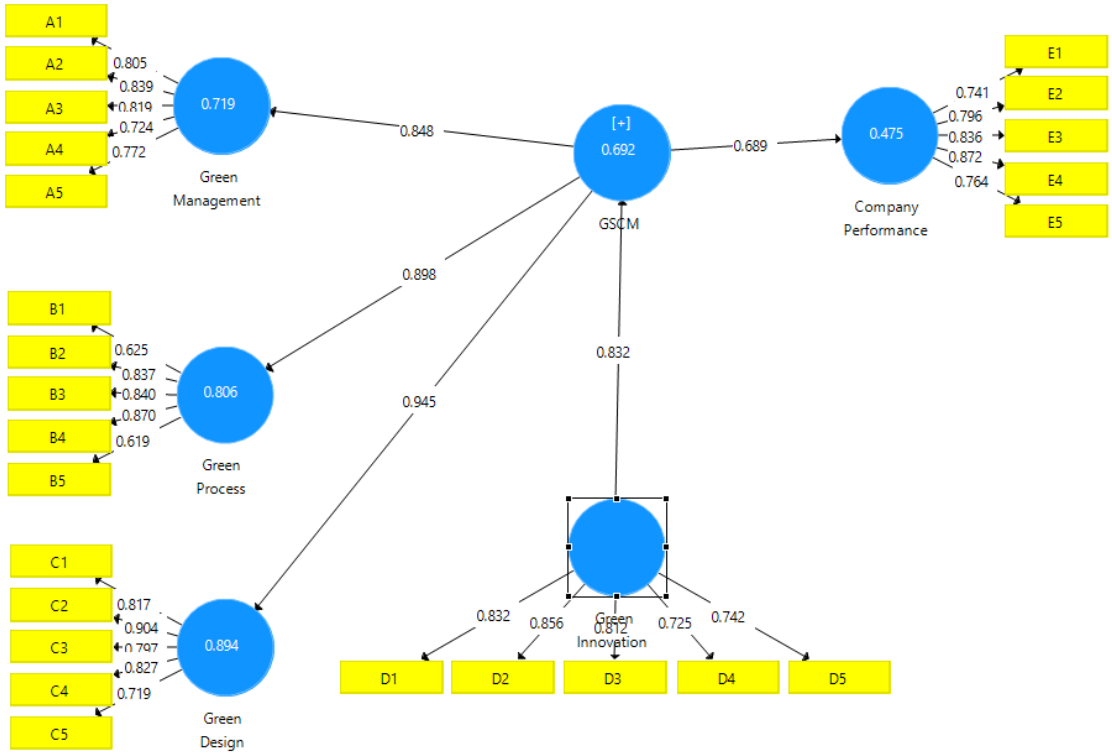

Fig 3. Construct model

Tab. 6. Hypothesis

	Original	Mean	STDEV	t-Statistic	p-Values	
GSCM -> PP	0.223	0.204	0.168	1.324	0.186	Not Significant
IH -> PP	0.519	0.535	0.417	3.538	0.000	Significant
GSCM-> IH	0.779	0.776	0.065	12.038	0.000	Significant
GSCM->IH->PP	0.405	0.409	0.117	3.457	0.001	Significant

C. Hypotheses testing

For the hypothesis in this study, it was carried out by testing the statistical *t* values, *P* values, and Multiple Linear Regression. This hypothesis test can be accepted and has a significant effect if the *t* statistic > *t* table, and *P* Values < 0.05. On the SmartPLS software the hypothesis test was obtained by means of Bootstrapping. The results of testing the hypothesis in this study are shown in Table 6.

Hypothesis I (t statistic = 1.324, P Value = 0.186) obtained a significance value of 0.186 (sig <5%), hypothesis I is not accepted and is not significant, this shows green supply chain management has no effect on company performance. The company considers that the implementation of Green Supply Chain Management currently has no significant effect on the company's performance, especially in terms of the economy.

Hypothesis II Green innovation has a significant positive effect on company performance (t statistic = 3.538, P value = 0.000) a significance value of 0.000 (sig <5%) this shows that green innovation has a positive effect on company performance.

Hypothesis III Green Supply Chain Management has a significant positive effect on Green Innovation (t statistic = 12.038, P Value = 0.000) a significance value of 0.000 (sig <5%) this shows Green Supply Chain Management has a positive effect on Green Innovation.

Hypothesis IV Green Innovation mediates green Supply Chain Management and company performance (t statistic = 3.467, P Value = 0.001)

a significance value of 0.000 (sig <5%) indicates that Green Innovation can mediate Green Supply Chain Management and Firm Performance.

6. Discussion

The hypotheses testing emphasize factors that influence the supply chain performance through green supply chain management. Based on the data analysis, this research provided practical recommendation to enhance the food industry performance. First, companies are required to develop proactive initiatives like corporate social responsibility (CSR) to safeguard and enhance the environment. Customers who purchase or utilize eco-friendly products are often referred to as Green Customers. Therefore, secondly, customer of the food industry must be massively campaigned. Environmental concerns serve as a motivation for customers to prioritize the environment and reduce pollution. Third, as green supply chain mediates green innovation to supply chain performance, the green approach in managing food industry supply chains may improve the performance. The innovation to support the green approach must be deliver along supply chain management. Employee must be supported by the industry to enhancing green activity. Implementing Green Supply Chain Management (GSCM) in the food industry offers additional benefits, such as creating new branding opportunities for companies to earn environmental care certifications. Therefore, fourth recommendation is it encourages the production of more environmentally friendly food products and encourages factories to perceive innovation as a valuable asset for the company.

This study found that Green Supply Chain Management practices affect the performance of companies engaged in the food industry when mediated by green innovation first. Companies must start making the latest innovations that have a positive impact on nature and pay attention to the company's economic performance. Green supply chain strategy formulation by integrating green innovation, inter-departmental communication, supportive management.

The formulation of strategies to improve company performance by implementing green supply chain management in the food industry must be accompanied by the latest innovations with a green orientation, communication from upstream to the end. In previous research, [42] argues that to reduce waste in the food industry supply chain, the solution is sharing responsibilities throughout the supply chain where all stakeholder behaviour is connected in such a way that each activity impacts all other actors in the chain, regionally and globally. Food industry companies must start by cooperating with companies that comply and are environmentally oriented.

Innovation that can be applied directly to the Food Industry is Reverse Logistics. This innovation is carried out by utilizing waste generated from consumers to be returned to Food Processing Manufacturers to dispose of it properly and reuse it into useful goods, for example for environmentally friendly packaging which has been widely applied. In this competitive era, multinational food companies in Indonesia have paid attention to reverse logistics management as a strategy to increase the company's competitive advantage.

7. Conclusion and Future Research

Implementing a Green Supply Chain in the food industry not only has an impact on environmental performance but also improves economic performance. The successful implementation of a Green Supply Chain requires the integration of innovative practices within the company. Research suggests that the positive effects of a Green Supply Chain can be realized through the mediation of green innovation. To implement a Green Supply Chain strategy in the food industry, it is essential to have management support, effective interdepartmental communication, the development of renewable technologies, and a corporate design that is based on sustainability principles. Reverse logistics, which involves the return of products from consumers, is particularly relevant in the Food Industry as it reduces environmental impact by minimizing waste and enhances the company's reputation as an environmentally conscious organization. There are several potential benefits that can be derived from this approach, including branding opportunities, improved supply chain performance through green innovation, enhanced customer satisfaction, and the ability to manage the supply chain in alignment with green and sustainable objectives.

For further research, including companies engaged in helping the food industry, such as shipping and packaging manufacturing companies. This study has not included factors that hinder the implementation of GSCM for further research to include obstacles that may affect the implementation of GSCM.

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