

# **Performance Improvement of Shrimp Feed Raw Materials in Green Supply Chain**

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## **Abstract**

Activities in supply chain may affect the environment and changes environmental performance. Thus, audit supply chains is needed based on environmental sustainability. One of the most effective things to improve environmental sustainability is integrating traditional supply chain practices into an environmental friendly concept. Efforts to improve the performance of the company's traditional supply chain into an environmental friendly supply chain requires obtaining the company's supply chain performance to reach the export requirements and improve the produced quality by the company. In an effort to improve traditional supply chain performance into an environmental friendly supply chain, the Analytic Network Process (ANP) used as a performance measurement method that takes into account interrelationships between objective strategies one another in achieving the intended goals according to the provisions of the analysis that is processed, there are 4 criterias and 16 most dominant indicators that can improve the quality of shrimp feed companies. The percentage of weighting results on the four performance criteria are the criteria for green manufacturing with a weight of 33.2 percent, followed by the criteria for green procurement of 27.3 percent, green distribution of 23.4 percent and the lowest weight is the reverse logistic criterion of 15.9 percent.

## **Keywords**

Green supply chain, shrimp feed, traditional supply chain, environmental sustainability, life cycle

## **1. Introduction**

Environmental damage and global warming have encouraged the public to focus on continuous improvement of environmental problems [1]. Continuous protection and improvement of environmental issues have attracted global attention in the past two decades. Many companies and governments in various countries have begun to realize the importance of environmentally friendly supply chains [2]. Although company regulations on the environment have not been too serious to consider, the issue of "green" is a new thing that always develops every day and requires continuous research in the field to get a complete understanding of environmental problems [3].

There are four main components for environmentally friendly practices namely analyzing life cycle, environmentally friendly quality management, ISO 1400 certification for environmentally friendly supply chains and ISO 1400 certification for environmentally friendly designs [4]. In today's competitive market, the scope of environmental activities exceeds the limitations of the company and involves the entire supply chain from the supply of raw materials for product use and further to reverse logistics processes including product recycling [5]. Supply chains involve activities that can affect the natural environment and also produce changes in environmental performance. So this is why there is a need to audit supply chains based on environmental sustainability. Every organization must know the status and purpose of developing or enhancing an environmentally friendly supply chain [6]. One of the best and most effective ways to improve environmental sustainability by integrating traditional supply chain practices with environmental friendliness in the concept of "green supply chain" [7].

Supply Chain is a network of entire organizations (from suppliers to end users) and activities related to flow and transformation of goods, information and money. From the concept stage to the destruction of products, there is always excessive use of resources (wasteful) which results in a total cost of logistics becoming more expensive and impacting on environmental sustainability [8]. Green supply chain generally refers to suppliers of raw materials and management related to the environment or to incorporate environmentally friendly principles into the supply chain system whose purpose is to improve market competency by adding the concept of 'green' [9]. The research objective is to improve the performance of the supply chain of shrimp feed raw materials into a green supply chain in order to meet one of the requirements for shrimp exports.

## **2. Research Methodology**

Analytic Network Process (ANP) focuses on influence by using a network, while Analytic Hierarchy Process (AHP) focuses on preference by setting the level of the hierarchy. In previous study, ANP was used to find the effect of dependency relationships between factors or criteria with the knowledge of the experts in order to produce an objective opinion and relevant to the actual situation [10]. This research was carried out from the month of August 2016 until March 2017. The type of research design used was descriptive research which was carried out to describe systematically, factually and accurately the facts and characteristics of a particular object or population. Descriptive research is also in the form of survey research, namely research that aims to obtain facts from the symptoms that exist directly from certain people who are used as objects of research and find a solution that will be applied. This study uses a questionnaire filled by respondents in accordance with the object of the research that is determined. The data used is assessment data on green supply chain criteria obtained from questionnaires.

## **3. Result**

### **3.1. Determination Analysis of Respondents**

Compilation of the inter-criteria and sub-criteria is done by interviewing the experts. Determination of the relationship between criteria is done by using ANP questionnaires to three respondents. The selection of these three respondents is based on total sampling because all members of the population are sampled. The three respondents are general manager of production companies, purchasing managers of companies and a manager in one of the private companies engaged in the manufacture of animal feed.

### **3.2. Analytical Network Process : Network Structure Analysis**

Determining the relationship between subcriteria and criteria from the expert side is the basis for the formation of the network structure, which is the main and important part of the ANP. Network structure creation is a very important stage in the process of Analytic Network Proces in an effort to improve the quality of shrimp feed through improving the performance of conventional supply chains into green supply chains in companies. The following shows the description of the criteria and sub-criteria that are compared.

Table 1. Selected Criteria and Sub-Criteria

<b>Criteria</b>	<b>Notation</b>	<b>Sub - criteria</b>	<b>Notation</b>
Green Procurement	P	Supplier selection is ISO standardized	P-1
		Efficient use of raw materials	P-2
		Use of recycled content products	P-3
		The ability of human resources in managing the procurement of environmentally friendly raw materials	P-4
Green Manufacturing	M	Control of chemical use	M-1
		Technology for energy use efficiency	M-2
		Green competencies (Understanding and ability of human resources in green production)	M-3
		Utilization of waste and pollution reduction	M-4

Table 1. Selected Criteria and Sub-Criteria

Criteria	Notation	Sub - criteria	Notation
Green Distribution	D	Use of environmentally friendly packaging	D-1
		Transportation tools that are environmentally friendly (can keep the quality of raw materials in a state of freshness)	D-2
		Storage utilization	D-3
		Energy use in the distribution process	D-4
		Selection of location routes to delivery time	D-5
Reverse Logistic	RL	The process of grouping the level of product redistribution	RL-1
		Green competencies Company competencies in observing product policies on the environment on the use of existing resources)	RL-2
		Use of returned products	RL-3

These criterias is obtained from the results of interviews and filling out questionnaires by respondents, namely general manager of production companies, purchasing managers of companies and a manager in one of the private companies engaged in manufacturing of animal feeds. These four criterias will be used as an improvement to the green supply chain performance criteria.

Those criterias were developed into 16 sub-criterias which aimed to facilitate the improvement of the green supply chain performance aspects, in addition to the sixteen sub-criteria in accordance with the conditions of the company so that it can be used in this study. The following is the network structure arrangement (network) formed after the analysis of the data from the ANP questionnaire is shown in Figure 1.

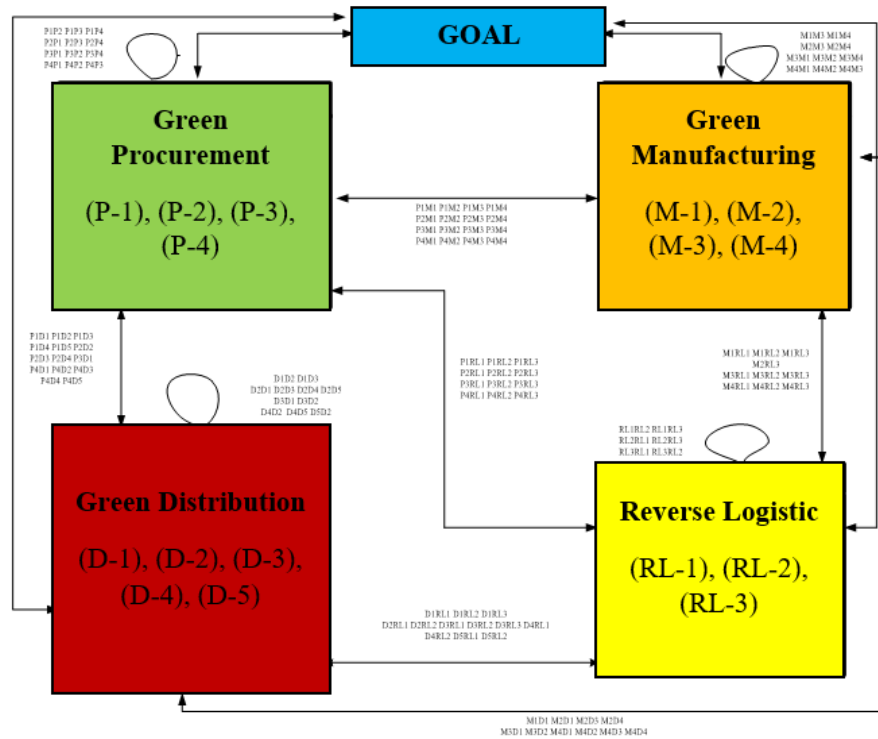


Figure 1. Network Structure

Through Table 2 below explained the goal of the reciprocal relationship generated in order to improve the quality of shrimp feed through improving the performance of the traditional supply chain to become a green supply chain by the company.

Table 2. Relationship of Criterias

No	Reciprocal Relationship of Criteria with Other Criteria		Goals Generated from Reciprocal Relations
1.	<i>Green procurement</i>	<i>Green manufacturing</i>	Green procurement criteria have a reciprocal relationship with green manufacturing criteria that can improve shrimp feed quality.
2.	<i>Green procurement</i>	<i>Green distribution</i>	Green procurement criteria have a reciprocal relationship with green distribution criteria that can improve the quality of shrimp feed.
3.	<i>Green procurement</i>	<i>Reverse logistic</i>	Green procurement criteria have reciprocal relationships with reverse logistic criteria that can improve the quality of shrimp feed.
4.	<i>Green manufacturing</i>	<i>Green distribution</i>	Green manufacturing criteria have a reciprocal relationship with green distribution criteria that can improve the quality of shrimp feed.
5.	<i>Green manufacturing</i>	<i>Reverse logistic</i>	Green manufacturing criteria have a reciprocal relationship with reverse logistic criteria that can improve shrimp feed quality.
6.	<i>Green distribution</i>	<i>Reverse logistic</i>	Green distribution criteria have reciprocal relationships with reverse logistic criteria that can improve shrimp feed quality.

### 3.3. Calculation of Green Supply Chain Criteria and Sub-Criteria Weight with ANP Method

Efforts to improve the quality of shrimp feed through improving the performance of conventional supply chains become the green supply chain conducted in this study using the ANP method. In processing data using ANP obtained the consistency value of each criterion and alternative is smaller than 0.1 which shows the respondents are consistent in answering the questions on the questionnaire. ANP processing results give the total global weight for each subcriteria. The ranking of the green supply chain subcriteria can be seen in the following Table 3 and the assessment of the green supply chain criteria can be seen in Figure 2.

Table 3. Results of Green Supply Chain Sub-Criteria Assessment

NO.	Sub – criteria	Weight	%
1.	Chemical use control (M-1)	0.0977	9,79%
2	Use of environmentally friendly packaging (D-1)	0.0926	9,26%
3.	Supplier selection is ISO standard (P-1)	0.0887	8,87%
4.	Waste utilization and pollution reduction (M-4)	0.0804	8,05%
5.	Green competencies (Understanding and ability of human resources in green production) (M-3)	0.0795	7,95%
6.	Technology for energy use efficiency (M-2)	0.0745	7,45%
7.	Use of recycled content products (P-3)	0.0629	6,37%
8.	The process of grouping the level of product redistribution (RL-1)	0.0626	6,29%
9.	Human resource capability in managing the procurement of environmentally friendly raw materials (P-4)	0.0613	6,23%
10.	Efficient use of raw materials (P-2)	0.0585	5,85%
11.	Transportation tools that are environmentally friendly (can keep the quality of raw materials in a state of freshness) (D-2)	0.057	5,60%
12.	Green competencies (company competence in observing product policies on the environment on the use of existing resources) (RL-2)	0.0542	5,46%
13.	Use of returned products (RL-3)	0.0427	4,22%
14.	Storage utilization (D-3)	0.0409	4,09%
15.	Energy use in the distribution process (D-4)	0.0241	2,47%
16	Selection of location routes to delivery time (D-5)	0.0205	2,05%
<b>Total</b>			<b>100,00%</b>

From Table 3, the results of ANP processing also give a total global weight for each criterion. The criteria with the highest weight are the criteria for green manufacturing with a weight of 0.3324 and the percentage of the total weight of 33.24% of the total weighting criteria.

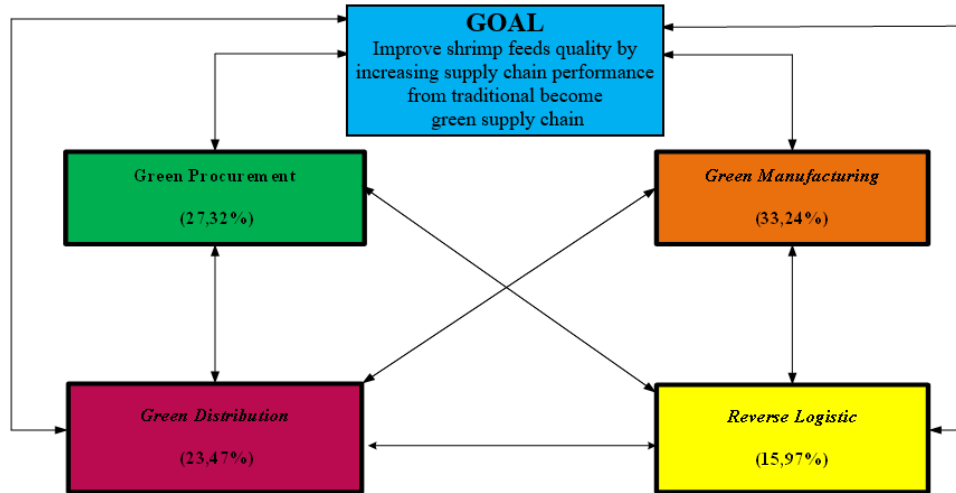


Figure 2. Green Supply Chain Criteria Percentage

From Figure 2 it can be seen that the percentage of sub-criteria of the criteria for green manufacturing is 33.24% having a strong relationship from the other three criteria to efforts to improve the quality of shrimp feed through improving the performance of conventional supply chains into a green supply chain, which is then followed by the subcriteria of the criteria Green procurement is 27.32%, green distribution is 23.47% and reverse logistic is 15.97%.

From the above it can be seen that the percentage of sub-criteria of the criteria for green manufacturing is 33.24% having a strong relationship from the other three criteria towards improving the quality of shrimp feed through improving the performance of conventional supply chains into a green supply chain, followed by sub-criteria from the green criteria. procurement is 27.32%, green distribution is 23.47% and reverse logistic is 15.97%. Figure 3. shows the pareto diagram of the subcriteria.

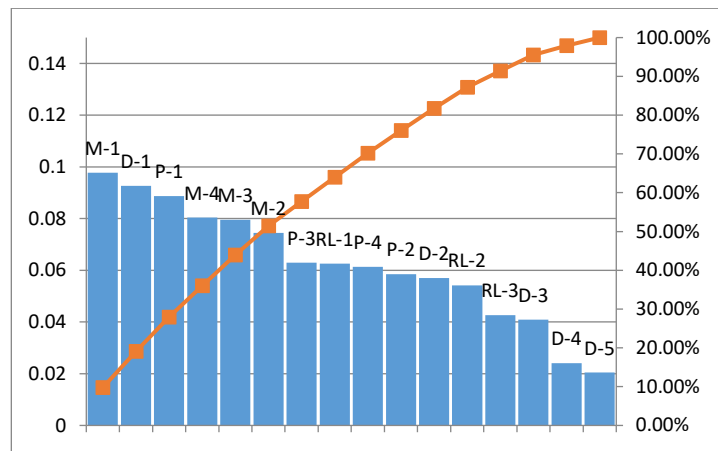


Figure 3. Pareto diagram

In the Pareto diagram above can be seen sub-criteria that have a huge influence on efforts to improve the quality of shrimp feed through improving the performance of traditional supply chains into a green supply chain, this is seen from the global weight of each subcriteria obtained.

#### **4. Conclusion**

Based on the results of data processing and analysis that have been carried out, some conclusions can be drawn as follows:

1. Measurement of the performance of the green supply chain at PT. X which influences efforts to improve the quality of shrimp feed through improving the performance of traditional supply chains into green supply chains using 4 criteria, namely green procurement, green manufacturing, green distribution and reverse logistics.
2. The most dominant criteria that influence efforts to improve the quality of shrimp feed through improving the performance of traditional supply chains to become a green supply chain by companies based on the ANP method are the criteria for green manufacturing (0.3324), followed by the criteria of green procurement (0.2732), green distribution (0.2347) and the lowest weight is the reverse logistic criterion (0.1597).
3. Things that can improve the quality of shrimp feed in accordance with export requirements for performance improvement can be done with environmentally friendly manufacturing activities (green manufacturing).
4. Green Manufacturing is the main criterion with the highest percentage of 33.24% by controlling the use of chemicals that influence technology on energy use efficiency, green competencies that is training in understanding and capability of human resources in green production and on waste utilization and pollution reduction on the company.
5. Green procurement becomes the second criterion with a percentage of 27.32% by selecting a green supplier that implements ISO standards, paying attention to the efficiency of the use of raw materials, using products that can be recycled and improving the ability of human resources in managing the procurement of friendly raw materials environment in the company.
6. Green distribution becomes the third criterion with a percentage of 23.47% by doing and improving the use of environmentally friendly packaging for the company.
7. Reverse Logistics becomes the fourth criterion with a percentage of 15.97% by doing and improving the process of grouping the level of product redistribution to the company.

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