PERFORMANCE EVALUATION OF GREEN SUPPLY CHAIN MANAGEMENT IN EFFORTS TO IMPROVE PERFORMANCE IN THE QUAIL FARMING INDUSTRY

UNDERGRADUATE THESIS

Submitted to International Undergraduate Program
Department of Industrial Engineering
The Requirement for the Degree of
Sarjana Teknik Industri
at
Universitas Islam Indonesia

By
Rafly Galih Saputra (18522067)

INTERNATIONAL PROGRAM
DEPARTMENT OF INDUSTRIAL ENGINEERING
UNIVERSITAS ISLAM INDONESIA
YOGYAKARTA
2023

AUTHENTICITY STATEMENT

I hereby certify that this work represents solely my work, that no one has written it for me, that I have not copied another individual's work, and that all sources that I have used have been properly cited and documented. I understand that any investigation of misconduct concerning any aspect of my work may lead to my disqualification as an undergraduate candidate in Universitas Islam Indonesia.

Yogyakarta, November 2022

(Rafly Galih Saputra)

i

UNDERGRADUATE THESIS APPROVAL OF SUPERVISOR

PERFORMANCE EVALUATION OF GREEN SUPPLY CHAIN MANAGEMENT IN EFFORTS TO IMPROVE PERFORMANCE IN THE QUAIL FARMING INDUSTRY

UNDERGRADUATE THESIS

By

Name : Rafly Galih Saputra

Student Number : 18522067

Yogyakarta, November 2022

Supervisor,

(Dr. Ir. Elisa Kusrini, M.T.)

UNDERGRADUATE THESIS APPROVAL OF EXAMINATION COMMITTEE

PERFORMANCE EVALUATION OF GREEN SUPPLY CHAIN MANAGEMENT IN EFFORTS TO IMPROVE PERFORMANCE IN THE QUAIL FARMING INDUSTRY

UNDERGRADUATE THESIS

By

Name : Rafly Galih Saputra

Student Number : 18522067

Has been defended in front of the Examination Committee in Partial Fulfillment of the Requirement for Bachelor Degree of Industrial Engineering Department Universitas Islam Indonesia

Examination Committee

Dr. Ir Elisa Kusrini, M.T. ____________________

Examination Committee Chair

Bambang Suratno, S.T., M.T., Ph.D. ____________________

Member I

Muhammad Ridwan Andi Purnomo, S.T., M.Sc., Ph.D ____________________

Member II

Acknowledged by
Head of Undergraduate Program
in Industrial Engineering
Faculty of Industrial Technology
Universitas Islam Indonesia

UNIVERSITAS ISLAM INDONESIA
YOGYAKARTA
FAKULTAS TEKNOLOGI INDUSTRI

(Ir. Muhammad Ridwan Andi Purnomo, S.T., M.Sc., Ph.D., IPM.)

DEDICATION PAGE

I sincerely say thank you to my parent who is always there to aid me in my time of need anytime anywhere whether they are busy or not by providing me with moral, spiritual, and financial support for me to be able to continue living my life by giving me the essential needs for me to survive in this world and also my caring younger and older sister to aid by giving your moral support.

I am very proud of myself to be able to fight all of the obstacles that are coming to me and withstand the physical and mental strain to reach this point. After finishing my study at this university, I have to be much more ready for afterward, as I will be going to the world of work where I have to endure much more than what I have gone through.

For all the lecturers in the Department of Industrial Engineering, particularly at the International Undergraduate Program of, Universitas Islam Indonesia, I am grateful for the knowledge and practical skill being taught here, which will be useful later down the road.

And lastly, I want to thank all my friends in my class for helping me throughout this university chapter; I am very grateful for that.

ACKNOWLEDGEMENT

With praise and gratitude, the writer conveys the presence of Allah SWT, who has bestowed his grace and guidance so that the author can complete the undergraduate thesis at CV. Vigaza and complete the report without any problem. Salawat and greetings, may it always be devoted to our lord the Great Prophet Muhammad, who brought and illuminated our conscience and became a light for all noble deeds. And God willing, we all include the people of Prophet Muhammad SAW until the end of time.

This undergraduate thesis is evidence of the implementation of the company workflow and fulfilling one of the requirements to achieve a bachelor's degree in the Department of Industrial Engineering, Universitas Islam Indonesia

The author is fully aware that in the preparation of this undergraduate thesis report, there are not a few difficulties and obstacles experienced by the author, both in terms of content, writing, and words that are not well structured, but thanks to the help and guidance of various parties, finally this undergraduate thesis can be completed. With a sincere and sincere heart, the author would like to express his gratitude and gratitude and appreciation to:

1. Prof. Dr. Ir. Hari Purnomo, M.T., as Dean of the Faculty of Industrial Technology, Universitas Islam Indonesia.
2. Dr. Drs Imam Djati Widodo, M.Eng.Sc., as the Faculty Chairman of Industrial Technology, Universitas Islam Indonesia.
3. Muhammad Ridwan Andi Purnomo, S.T., M.SC, Ph.D., as the Chairman of the Industrial Engineering Program, Faculty of Industrial Technology, Universitas Islam Indonesia.
4. Ir. Ira Promasanti Rachmadewi, M.Eng., as the Secretary of the International Undergraduate Program in Industrial Engineering, Faculty of Industrial Technology, Universitas Islam Indonesia.
5. Dr. Ir. Elisa Kusrini, M.T., as the undergraduate thesis supervisor, has guided me in completing the author’s undergraduate thesis.

6. The author's parent has provided moral, spiritual, and financial support to be able to finish this undergraduate thesis.

Finally, the author says Alhamdulillah, may Allah SWT always accompany the steps of the writer Amin. And hopefully, this undergraduate thesis can be useful and can add insight into thinking as well as reference material and information that is useful for knowledge, especially in the field of industry.

Yogyakarta, November 2022

(Rafly Galih Saputra)

MOTTO

"Allah will exalt those who believe among you and those who are given knowledge by several degrees."
-Q.S. Mujadalah [58]: 11

"Do not be weak and do not be heartless, even though you are the most high-ranking person if you believe."
-Q.S. Imran [3]: 139

"And be patient. Verily Allah is with those who are patient."
-Q.S. Anfaal [8]: 46

"We may be disappointed by what has happened, but never lose hope for a better future."
-Bambang Ultimate

"You Shouldn't give up on everything that happens in the sky, you should use whatever happens as a tool to go up, not down."
-Bob Marley

"I can accept failure, but I can't accept anything that hasn't been tried"
-Michael Jordan

ABSTRACT

Quail farming is the act of commercially raising quails to farm the quail egg and its meat. Currently, only 11.4 million quail are being farmed for their egg, and only 11 million quail eggs are produced in Indonesia. Considering this, many quail farms are established due to lots of demand. The increased numbers of quail farms lead to an increase in competition in the quail farm industry. On the other hand, it also increases the amount of waste produced that can harm the environment. Because of these, quail farmers need to establish a sustainable concept to have a competitive advantage and help to reduce waste harm the environment. CV. Vigaza is one of many company that run in the quail farming business that is located in Ngaglik, Sleman, Yogyakarta which sell quail egg. Supply chain in CV. Vigaza never have implement the idea of sustainable which because of that CV. Vigaza still have various problem regarding the environment. Therefore, it is needed that CV. Vigaza to be studied regarding their sustainable performance score. These studies aim to determine the performance score of the Green Supply Chain Management and be given recommendation on the problem that have been identified. Sustainable Supply Chain Operations are used to identify the Key Performance Indicator and measure the performance score of the indicator. It is found out that 10 indicators are present and found out that 4 indicators have reach the target value and the other 6 have not reach the target. Using Analytical Hierarchy Process to determine the weight, it is found out that the Green Supply Chain Management performance score is 65,83% which is in the average level.

Keywords: Green Supply Chain Management, Sustainable Supply Chain Operations Reference, Analytical Hierarchy Process, Performance Score, Key Performance Indicator

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER I

INTRODUCTION

1.1 Study Background

Quail farming is the act of commercially raising quails to farm the quail egg and its meat (Amit, 2019). In Indonesia itself, quail farming is a relatively small industry but has been seen booming, in accordance to the data from Data Statistik Peternakan Kementrian Indonesia (2019), where there are around 14.1 million quails that it is currently being farmed and producing 11 million eggs in 2019. Amit (2019) said that the quail farming industry is currently very lucrative because of the low cost of maintaining a quail farm, and Ikhwan (2019) said that because there were only 11 million eggs produced in 2019 based on Data Statistik Peternakan Kementrian Indonesia data and while there are 265 million people in Indonesia, it can be said that there is still a lot of potential demand to be fulfilled in Indonesia.

Even though the quail farm industry in Indonesia is very lucrative, it can affect the environment if they are not careful in running a quail farm. Amit (2020) said that the poultry industry in common produces an adverse effect on the environment due to its waste. This type of farm is expected to produce waste such as manure, hatchery waste, and dead bird. If this kind of waste is not managed properly, it will eventually be hazardous, and in turn, negatively affect the farm itself. So, for a farm to stay in business and still make a profit and compete with other competitors, they need to be aware of the environment, one of which is by managing its farm supply chain.

A supply Chain is a network of people, activities, information, and resource involved in making a product or service to a customer (Kozlenkova et al., 2015). Supply chain activities involve receiving resources, processing them, and delivering them to the customer (Kozlenkova et al., 2015). The field of supply chain management itself has many scopes; one of them is Green Supply Chain Management which tackles the problem of environmental issues in a supply chain. Green Supply Chain Management, or GSCM is the practice of encouraging improvements in the environmental practices of a supply chain (Vachon & Klassen, 2006). GSCM scopes range from the monitoring of environmental management to practice implementing Reduce, Reuse, Rework, Refurbish, Reclaim, Recycle, Remanufacture, and Reverse Logistics (Srivastava, 2007). To find out the greenness of a certain supply chain, we need to use performance measurement using a key performance indicator which is the Green SCOR indicator.

Performance Measurement is the process in analyzing information of a certain system (Behn, 2003). By doing performance measurement, we are then able to define what is happening in a system. One of the methods of performance measurement is the key performance indicator. A key Performance Indicator in short KPI is one of two performance measurement methods where it evaluates an activity success (Weilkiens et al., 2016). The success of a KPI is determined if an activity has reached its strategic goals (Reh, 2020). In this case, KPI success is determined if one of the Green SCOR indicators, when evaluated, has achieved a certain goal in the Green SCOR model. Green SCOR or Green Supply Chain Operations Reference is a way to measure a supply chain performance by using five performance attribute which includes reliability, responsiveness, flexibility, costs, and asset management (UNEP, 2003). In a Green SCOR, we try to identify the certain process that can affect the environment, which is the process of plan, sourcing, making, delivering, and returning (UNEP, 2003). By using a Green SCOR model, we can then create a measurable indicator of environmental performance that can be further developed for a better model.

After making a model of the indicator of a certain supply chain and calculating its performance, we can then use the AHP method to choose what indicator needs to be fixed. Analytical Hierarchy Process, in short AHP, is a structured method for analyzing complex decisions (Forman & Saul, 2001). It is used for represents an accurate approach used to quantifys the weight of decision criteria. Through pair-wise comparison, we can compare the importance of a certain pair by using a specific questionnaire (Forman & Saul, 2001). AHP is also a method to prioritize what need to be fixed based on the weight of each criterion (Arjuna, 2022). By using AHP, we can analyze criteria's weight and prioritize which indicator needs to be fixed first.

This research will be conducted at a quail farm named CV. Vigaza located in Palgading, Sinduharjo, Ngaglik, Sleman. The selection of the object of this research is based on the data described earlier (Indonesian Ministry of Animal Husbandry Statistical Data, 2019; Amit, 2019; Ikhwan, 2019) where there is a massive production of quails that farmed in 2019 totaling around 14,1 million quails. On the other hand, this type of farm has generated waste which includes manure, hatchery waste, and dead bird. In CV. Vigaza, there are 3 types of waste produced, namely defect quail egg, quail excrement, and dead quail; if this kind of waste is not managed properly, it will eventually be hazardous that negatively affect the farm itself. Therefore analysis and handling are needed on how to manage the waste produced so that it is not harmful to the environment or can be reused by the company. In addition, there are rules made by the Indonesian government regarding environmental conservation that must be obeyed by businesses in Indonesia, and many of these rules regulate businesses waste management in which business are required to manage the waste produced before discharged into the environment or it can also be reprocessed to be reused into another product.

The object of this research is to conduct a Green Supply Chain Management analysis. Green Supply Chain Management (GSCM) tackles the problem of environmental aspects in a supply chain. This method uses several indicators that are adjusted to the conditions of the company at the time this research was conducted; the indicators used are referred from the SCOR guidebook version 12, especially in the special application of SCOR, which is Sustainable SCOR which aims to analyze supply chain performance with environmental aspects. The output of this research can help farmers to be able to apply an appropriate approach based on the results of data processing using GSCM method with the aim of increasing the effectiveness of their supply chain and in order to carry out environmental conservation, which is not only regulated by the rules made by the Indonesian government, it is also a consumer demand that is increasingly aware of the environmental conservation aspect.

1.2 Problem Formulation

The problem formulation, according to the study background of this research, is as follows:

1. What are the key performance indicators referring to sustainable SCOR version 12 that can be used to calculate the green supply chain management performance score in CV. Vigaza quail farm?
2. How is the performance of each key performance indicators, based on sustainable SCOR version 12 has been measured in CV. Vigaza quail farm?
3. Based on the key performance indicator performance, what is the total performance of green supply chain management for CV. Vigaza quail farm supply chain?
4. Based on the green supply chain management score of CV. Vigaza quail farm, what are the recommendations that can be suggested to improve their green supply chain management performance score?

1.3 Research Objective

The objectives of this research, according to the study background of this research are as the following:

1. To identify CV. Vigaza quail farm key performance indicator and its performance score by using Sustainable SCOR version 12.
2. To determine CV. Vigaza quail farm key performance indicator performance score by using Sustainable SCOR version 12.
3. To determine CV. Vigaza quail farm green supply chain management performance score by using Sustainable SCOR version 12.
4. To find recommendations using Sustainable SCOR version 12 based on CV. Vigaza quail farm green supply chain management performance score.

1.4 Research Benefit

The benefit of this research for other people are as the following:

1. Creating a recommended performance evaluation model of a quail farm that other quail farm owners can use this model on their farms to evaluate their green supply chain management performance.
2. Creating a recommended performance evaluation model of a quail farm that can be used as a foundation for the researcher to improve on.
3. To give knowledge to the reader of this report on how to evaluate the green supply chain management performance of a quail farm.

1.5 Systematics Writing

The systematics writing of this report is needed for more structured writing for the benefit of the author as well as the reader of this report, as the following:

CHAPTER I INTRODUCTION

This chapter contains the study background of this research based on the researcher's observation of the topic situation and addresses the problem formulation that the researcher found as well as the objective and benefit of this research.

CHAPTER II LITERATURE REVIEW

This chapter contains the inductive study that the researcher used to gain more knowledge of the problem and find the tool to solve the problem and the deductive study that the researcher used as a theoretical foundation to write this report.

CHAPTER III RESEARCH METHODOLOGY

This chapter contains the research object of this report, what data are being used, the tools to process those data, and a detailed flowchart that explains the flow of this research.

CHAPTER IV DATA COLLECTION AND PROCESSING

This chapter contains the collected data that the research has collected, which is displayed using figures and tables and the detailed processing of the data to get the output.

CHAPTER V DISCUSSION

This chapter contains the result from the data processing of the previous chapter and the discussion of that result to find the conclusion as well as the suggestion.

CHAPTER VI **CONCLUSION AND SUGGESTION**

This chapter contains the conclusion that has been discussed as well as the suggestion of recommendations from the data that have been analyzed that can be implemented in the research object.

REFERENCE This chapter contains the reference used for this research to help the researcher expand their research knowledge by quoting other people's quotes that can be used in this research.

APPENDIX This chapter contains the attachment that is used for this research, either diagram or table attachment.

CHAPTER II

LITERATURE REVIEW

2.1 Inductive Study

Inductive study is used as the base theory of this research from someone else perspective. Inductive study is used to see other researchers problems and how they solve them, which can be compared with my own research. This inductive study covers the research topic of Green Supply Chain Management.

Table 1. Past Research

No	Title	Researcher (Year)	Method	Result
1	Barriers Analysis for Green Supply Chain Management Implementation in Indian Industries Using Analytical Hierarchy Process	Govindan et al. (2013)	Green Supply Chain Management, Analytical Hierarchy Process, Sensitivity Analysis	Many manufacturing industries try to adopt the concept of green in their supply chain management to focus on environmental issues. Many still struggle to identify the barriers to be implemented into their supply chain. The researcher finds there are a total of 47 barriers were found and only 26 barriers used to use the analytical hierarchy process and sensitivity analysis that are a

				major obstacle in the implementation of GSCM. They found out the next best to be focused on are outsourcing, financial concerns, and knowledge of the environment.
2	Pressure Analysis for Green Supply Chain Management Implementation in Indian Industries Using Analytical Hierarchy Process	Mathiyazhagan et al. (2014)	Green Supply Chain Management, Pressure Analysis, Analytical Hierarchy Process	Environment awareness has been growing recently. Firms need to do something regarding their environmental practices. There are pressures on the ecological impact and are growing issues. But industries are still struggling to identify this environmental pressure. The researcher focuses on identifying these pressures and found out that there are 6 categories of pressure and there are 65 pressures and found out but only 35 is a

				major problem by using a questionnaire survey and found out that most of the pressures are originated from production and operational factors
3	*Penerapan Model Green SCOR untuk Pengukuran Kinerja Green Supply Cain*	Natlia & Astuario (2015)	Green Supply Chain Management, Green Schain Operation Reference, Key Performance Indicator, Analytical Hierarchy Process	Increasing human awareness of the environment makes businesses need to apply environmental concepts to their supply chain. The researcher measures the performance of the company's green supply chain management by using the design performance measurement model and weighting scoring performance. It is identified 16 key performance indicators identified and found out that the plan has 68, source 66.54, make 58.89,

				delivery 32.80, and return 56.85 with an overall score of 60.13 which is sufficient, but delivery needs to be improved on.
4	Performance Evaluation and Measurement of SMEs King of Honey Using the Green SCOR Method	Fitriana et al. (2022)	Green Supply Chain Management, Green Supply Chain Operation Reference, Analytical Hierarchy Process, Importance Performance Analysis, Snorm de Bour	It is important to assess the application of green supply chain management in business because of the current environmental issues. The researcher focuses on the assessment of green supply chain management performance with the help of green supply chain operation reference in 6 processes which are plan, source, make, delivery, return and waste. Using many methods, the researcher found out that the performance value of GSCM in September was 86.03 and in November was

				86.48. 3 indicators still need to be improved, which are defective products recyclable, percentage of solid waste recycling, and percentage of wastewater.
5	Green Supply Chain Performance Measurement Using Green SCOR Model in Agriculture Industry: A Case Study	Arjuna et al. (2022)	Green Supply Chain Management, Green Supply Chain Operation, Performance Measurement, Key Performance Indicator, Objective Matrix	The agriculture industry has been increasing its environment footprint. Many concepts have been developed to be integrated with the ecological aspect of the supply chain. The researcher uses a green supply chain operation reference to measure the environment aspect of the supply chain. The researcher found out there are 15 key performance indicators in the agriculture industry and found out in the objective matrix, there are 6 green, 7 yellow, and 3 red key

				performance indicators with an average green SCOR value of 63.57. Plan and Source have been deemed to be bad and need to be improved.
6	*Penerapan Model Green SCOR Untuk Pengukuran Kinerja Green Supply Chain Management Pada PT. XYZ*	Febrianti et al. (2018)	Green Supply Chain Operation Reference, Analytical Hierarchy Process, Green Supply Chain Management, Supply Chain Performance, Snorm de Bour	Currently, businesses have been competing more and more. To be more distinguished from others is by increasing their product quality. One of the improved aspects is in their greenness of the supply chain. To do this the researcher use Green SCOR to found out indicator that need to be improved on garment company. The researcher found out there are 31 key performance indicators that are in the garment company. By using the analytical hierarchy process method, the researcher

				found that the performance score of PT. XYZ is 67,69 which is average.
7	Green Supply Chain Operations Reference (G-SCOR): An Application for Small Garment Manufacturer in the Philippines	Cruz et al. (2021)	Green Supply Chain Management, Green SCOR	In the Philippines, the common supply chain design has not incorporated the practice of green to resolve the environmental issues even though green supply chain management of companies around the world have appealed GSCM to reduce environment issue. The researcher evaluates a supply chain on a small garment manufacturing using Green SCOR Model and found, based on 15 indicators with 6 attributes that among the indicators CO2 emission are a strong influence on GSCM on a garment industry.

				To improve their supply chain, it is recommended to start managing their waste and implement green practice to reduce harm on the environment.
8	A SCOR Perspective on Green SCM	Schrodl & Simkin (2013)	Green SCOR, SCOR	Supply chain management is an area that scholars have much attention with the reason of it consider the relation between economic and ecological issue and goals. Green IT and IS have been widely discussed with the concept of Green SCM, which extends the concept of resource optimization and recycling. The researcher shows that Green SCM is a first step that responsible to the supply chain. By applying Green SCOR on SCM, it shows comprehensive

				contrasts between isolated concepts. So, Green SCOR can be used to analyse supply chain on their long-term sustainability and create a model for development in supply chain management systems.
9	Analysis of Green Supply Chain Management Practices in Automotive Industry Based on Green SCOR Model	Imane & Fouad (2021)	Green SCOR, Green Supply Chain Management	The automotive industry has been highly competitive because of the changing nature of products and demands. Environmental challenge has been intertwined with all area of economic productivity and environment protection which have been receiving many attentions. Incorporating green practices is a must to achieve economic, environment, and social performance.

				The researcher tries to study green supply chain management practices to automotive industries using green SCOR model. They find that there are three level which include 9 GSCM practices and 5 process are proposed. By applying those proposed model, the companies can accomplish profit and market share goals by decreasing environmental harm and increase green efficiency.
10	*Model Green SCOR Untuk Pengukuran Kinerja Green Supply Chain Management (GSCM) Industri Kelapa Sawit di Indonesia*	Primadasa & Sokhibi (2020)	Green Supply Chain Management, Key Performance Indicator, Green SCOR	The palm oil industry is an important industry in Indonesia. They are an important factor in the economy of the people of Indonesia. The environmental aspect is an important aspect of the palm oil industry because they

				always been linked with pollution and the increase of greenhouse gasses. The researcher tries to create a KPI based on the industry to evaluate GSCM in Indonesia palm oil industry. By using GSCM they can integrate environmental aspects into their supply chain. They found out there is 23 KPIs from 9 target for GSCM in palm oil industry in Indonesia. AHP is used to measure the KPI level and it is found that managing plantations using ISPO and RSPO is the dominant green objectives with 29.7% followed by minimizing emission at 15.9% and manage waste 11.8%.

2.2 Deductive Study

2.2.1 Supply Chain Management (SCM)

Supply Chain Management, or SCM, is the practice of managing the flow of goods and services (Harland, 1996). This process includes the movement, storing, working, finishing, and fulfillment of raw materials until finished goods. It is an interconnected network of channels that combine the provision of products or services that are required for the end customers in a supply chain (Slack, n.d.). Supply Chain Management is defined as the design, planning, execution, control, and monitoring of activities in the supply chain to create net value, create a competitive infrastructure, leverage logistics, synchronize supply and demand, and measure performance (APICS, 2016). The practice of supply chain management has been drawly to industrial engineering, systems engineering, operation management, logistics, procurement, information technology, and marketing (Kozlenkova et al., 2015). It strives for an integrated, multidisciplinary, multimethod approach (Sanders & Wagner, 2011).

The mission of supply chain management is aiming to coordinate the supply chain, from supplying raw materials to delivering products and minimizing costs (Sadeghi et al., 2016). The function of supply chain management is to manage the movement of raw materials into an organization, the processing of materials to finished goods, the movement of finished goods, and delivery to end consumers. This function affects to improve the fulfillment of customer demand while reducing the control of logistics operations. Supply chain management aims to improve the relationship among supply chain partners to improve inventory visibility and movement (Hemold, 2016).

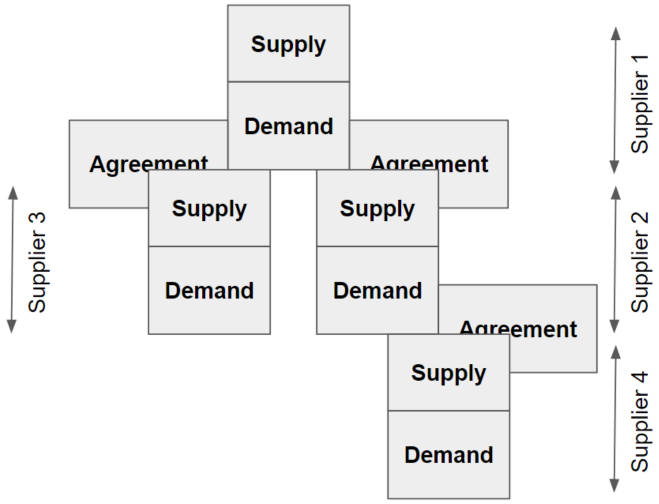

Figure 1. Flink (2020) In an Efficient Supply Chain Agreements are Aligned

The importance of supply chain management in an organization is that it must rely on an effective supply chain to compete with the market and networked economy (Baziotopoulos, 2004). The business environment is also important that it contributed to the development of supply chain networks because of globalization; multinational companies and many others have a significant success factor by practicing lean manufacturing and agile manufacturing (MacDuffie & Helper, 1997). Technologies play an important part, particularly the fall in communications costs that has led to the change of coordination among members of the supply chain network.

2.2.2 Green Supply Chain Management (GSCM)

Green Supply Chain Management, or GSCM, is the practice of integrating environmental processes into the supply chain. This includes the process of selection of suppliers, material purchasing, product designing, manufacturing products, assembling the product, distributing the product, and product end-of-life management (Khan, 2018).

The main target of a green supply chain is to mitigate harmful impacts on the environment by reducing air, water, and waste pollution. The other is to improve performance in terms of lessening manufacturing waste, reusing, recycling, cost reduction, asset efficiency, and image building (Khan, 2018). Green supply chains emphasize by Khan et al. (2017) that practicing green needs to be adopted by firms to mitigate the risk of environmental degradation and increase operational and economic performance.

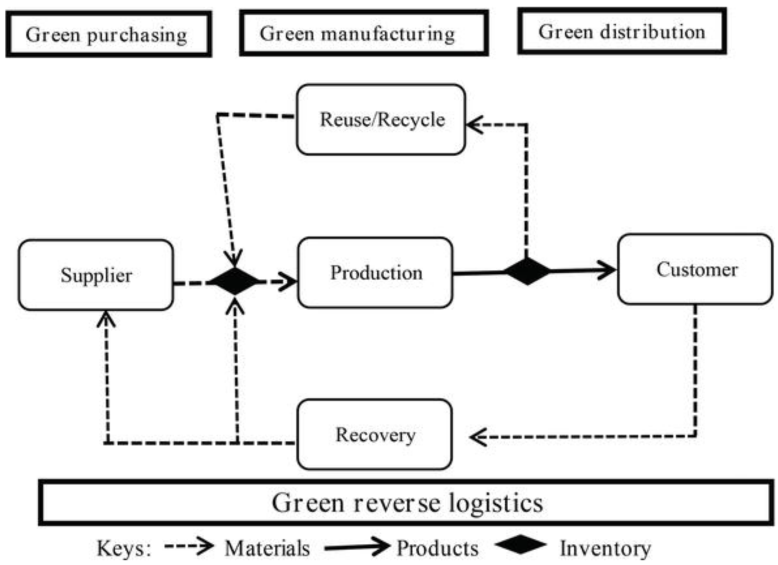

Figure 2. Khan et al. (2017) Simple Model of GSCM

The world has changed, and environmental awareness has increased significantly, which cause many firms to face heavy pressure from customer, stakeholders, and the government to mitigate harmful environmental effect (Luthra et al., 2016). Now corporation needs to reconsider integrating business practice with sustainability and reduce supply chain costs to have an advantage over other competitors (Gunasekaran & Spalanzani, 2012). The growing impact on the environment has risen, such as global warming issues now have wide attention and make people think of a solution towards green (Rostamzadeh et al., 2015). Green Supply Chain Management motivates organizational sustainability and recently woke up many nations to the green movement (Kumar et al., 2014).

Because Green Supply Chain is a relatively new idea (Sarkis et al., 2011), it is gaining popularity in improving environmental performance in a supply chain (Madaan & Mangla, 2015). Khan (2018) identifies six key critical success factors in how green supply chain management practice can attain better environmental sustainability, which are:

- Ethical Leadership and encouragement from the manager regarding environmental management are keys to adopting green practices by pressuring employees, encouraging, and motivating seniors will bring positive change in green practices adoption (Luthra et al., 2016).
- Customer Management, firms are now facing heavy pressure to adopt green practices in their supply chain for their customers to be competitive (Omkarehwar, 2013).
- Supplier Management and collaboration with the supplier are needed to boost the adoption of eco-friendly ideas to implement innovative green practices to achieve a common economic goal (Kaushik et al. 2014).
- Competitiveness, green practices have been important factors in competitiveness. Implementing green practice have been long used for competitive factors (Luthra et al., 2016).
- Social, regulatory bodies have been growing the attention of customers awareness of the environment, and because of it, firms needed to exchange information regarding their supply chain effects on the surrounding people (Shen et al., 2015).
- Regulatory, regulatory authorities have increasing prominence on environmental concerns to control climate change which firms are required to reduce their supply chain effect on the environment (Mangla et al., 2014).

2.2.3 Performance Measurement

Performance Measurement is a compilation of the process of collecting, analyzing, and reporting information about the performance of a group, organization, individual, or system (Behn, 2003). Performance measurement is the process of evaluating an organization on how well they manage their value of delivery to a customer or stakeholders (Moullin, 2002). Performance measurement is the process of quantifying the efficiency or the effectiveness of certain past actions (Neely et al., 2002). Agreement regarding measurement performance is still a little consensus. The two most common frameworks used for performance measurement are:

- Balance Scorecard, used for managing the implementation of strategies.

- Key Performance Indicator for choosing important performance measures.

The additional procedural framework of performance measurement by Kaplan & Norton (1996) said it could be applied to a system in which there is 4 stage which includes:

1. Translating Vision, clarifying a vision of the firm strategic vision that is operational at all levels.
2. Communicating and linking, the process of managers communicating strategy in the organization and linking an individual objective.
3. Business Planning, is the process of companies integrating their business and financial plans.
4. Feedback and learning, give the ability for the company's capacity for strategic learning, review the process of an individual or department's goals are achieved, and enable the company to monitor results.

Medori and Steeple (2000) proposed a framework that designs and audits performance measurement systems. This framework operates as a system by replacing a requirement of a performance measurement structural framework that is related to quality, cost, flexibility, time, delivery, and growth. They also design a procedural framework for a performance measurement system in six stages, which are:

1. Defining manufacturing strategy and the strategy that is required.
2. The strategy that is required is prioritized.
3. Measures in the strategy are selected from a list of performance measurements with full descriptions and calculation methods.
4. Auditing the existing measurement list and comparing it with the new measurement.
5. Implementing measurement.
6. Reviewing periodic maintenance of the company performance measurement system.

2.2.4 Key Performance Indicator (KPI)

Key Performance Indicator or KPI is one of the types of performance measurement (Fitz-Gibbon, 1990). Key performance indicators are used for the evaluation of the success of an activity it engages in (Weilkiens, 2016). It is a repeated process of periodic achievement to achieve operational goals in terms of progressing toward strategic goals (Reh, 2020). Key performance indicator relies on the individual good understanding of what is important for the organization (White Paper, 2015). The importance of performance indicators is needed in a decision-making process where when decision-makers have many options, they need to use proper analysis to predict the outcome of their actions. If they use incomplete data to predict something, the decision will have unexpected results; that is why performance indicators need proper preparation to minimize mistakes (Dolence & Norris, 1994).

The company's performance should be enhanced if it intends to survive the much more intense competition in its sector (Dipura, 2020). Because of that, the development of company performance also has to be measured and evaluated (Bayhaqi, 2020). According to Hidayat (2017), there are objectives regarding performance measurement, namely the level of achievement of organizational goals, improved performance in the next period, and employee motivation. A key performance Indicator (KPI) is an assessment analysis based on providing for the monitoring, control, and validation of an occurrence to achieve the required company performance (Putri et al., 2012). Then, the determination of KPI is based on SMART (Specific, Measurable, Achievable, Reasonable, Time-bound) rules (Rokhim, 2017). In key performance indicator, there is 6 point of measure which are an element of an activity which are:

- Input, the required input of an activity to produce an output.
- Output, the results of an activity.
- Activity, the transformation of producing.
- Mechanism, is the activity of a work by a human or system.
- Control, the object that controls an activity.
- Time, is a temporary element of an activity.

2.2.5 Sustainable Supply Chain Operation References (Sustainable SCOR)

By the requirements, the Sustainable Supply chain Operations Reference or the old name Green Supply Chain Operation References (GSCOR) process is utilized to measure the environmental effect (Arjuna, 2020). The concept "green supply chain management" refers to the integration of environmental considerations into all aspects of supply chain management, including product design, raw material procurement and selection, manufacturing procedures, final product delivery to consumers, and even product flow management following consumer use (Natalia & Astuario, 2015). Environmentally responsible supply chain management aims to protect the environment by taking into account the past and present environmental effects of all products and activities (Febrianti et al., 2018).

In a Green SCOR model, according to UNEP (2003). There is 5 environmental indicator that needs to be identified that impacts a supply chain, which are:

- Plan, such as energy consumption, hazardous materials, and waste.
- Source, such as supplier environmental records, materials environmental content, packaging, and transportation.
- Make, such as producing energy consumption, waste generated, and emissions produced.
- Delivery, such as packaging materials and shipment of fuel consumption.
- Return, such as transportation fuel consumption, hazardous materials spills, and damaged products.

UNEP (2003) defines to measure a supply chain performance, it uses the five performance attributes from the SCOR mode, to create a Green SCOR model from the SCOR model, the performance attributes framework needs to be recreated into performance attributes for environmental impacts.

Performance attribute	SCOR definition	Environmental definition
Reliability	The performance of the supply chain in delivering: the correct product, to the correct place, at the correct time, in the correct condition and packaging, in the correct quantity, with the correct documentation, to the correct customer	The ability to deliver the correct product reduces waste from product discards; reduces air emissions and fuel use from extra transportation for returned products. Proper documentation enables all plays of the supply chain to keep better track of hazardous materials or toxins that are embedded in certain products; thus allow them to arrange for proper storage, handling and disposal
Responsiveness	The velocity at which a supply chain provides products to the customer	The environmental impacts that affect the speed of material movement, including regulatory or pollution control steps within a process
Flexibility	The agility of a supply chain in responding to marketplace changes to gain or maintain competitive advantage	The degree to which a firm can meet the environmental demands of its customers. This pertains to the products, their production, transportation and recyclability etc.
Costs	The costs associated with operating the supply chain	The costs of environmental compliance and cleanup as well as the energy costs
Asset management efficiency	The effectiveness of an organisation in managing assets to support demand satisfaction. This includes the management of all assets: fixed and working capital	Managing assets in a manner that reduces environmental impacts and reduces internal costs

Figure 3. UNEP (2003) Linking SCOR Performance Attributes with Environmental Performance

2.2.6 Analytical Hierarchy Process (AHP)

Analytic Hierarchy Process or AHP is a simplification of a complex problem that is not organized, strategic, or dynamic that is arranged in a hierarchy, then each variable's significance is subjectively evaluated (Putri et al., 2012). The analytical hierarchy process is usually used for group decision-making (Saaty, 2008), and it is used for different situations, such as for the government, business, healthcare, education, and industry (Saracoglu, 2013). The analytical hierarchy process helps decision-makers to find the best choice for their goals and better understand the problem. A hierarchy is built for decision-makers to analyze different elements to be compared to each other. It uses various data regarding the elements and is judged by the importance of the element. Because of that analytical hierarchy process use human to judge the information that can be used to perform evaluations (Saaty, 2008). Analytical hierarchy processes are useful when working on a complex problem that needs human perspective and judgment for long-term repercussions (Bhushan, 2004). According to Forman (2001), a decision situation where it can use an analytical hierarchy process are:

- Choices, selection of alternative where multiple decision is involved.
- Ranking, order of alternatives.
- Resource Allocation, apportioning of resources of set alternatives.
- Benchmarking, comparing processes in an organization.
- Quality Management, dealing with quality multidimensional aspects and improvement.
- Conflict Resolution, settling disputes of an individual or group for different goals.

The Analytic Hierarchy Process, according to Suryadi and Ramdhani (1998), is as follows:

1. Hierarchy Problem

   In this hierarchy, there are several level structures called multi-level; the first level is the target of a problem to be answered, the second level is the criteria in the problem that must be answered, and the third level is an alternative that can answer the criteria of the target problem

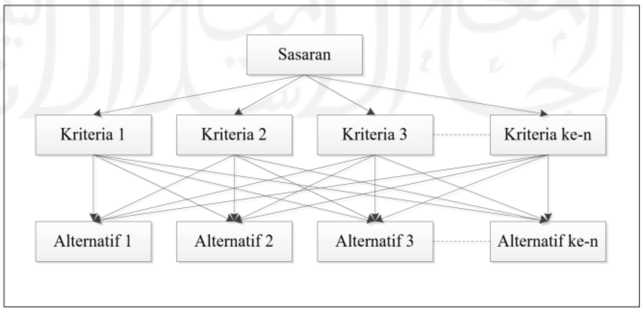

Figure Structure of Analytical Hierarchy Process (Darmanto et al., 2014)

2. Criteria and alternative assessment

This assessment is carried out by comparison between criteria or alternatives to find their respective values. Using a comparison scale from 1 to 9, we can judge a criterion and an alternative according to our own goal desirability (Saaty, 1983). The scale table that Saaty proposed for comparison is as follows:

Table 2. Pairwise Comparison Importance Description

Importance	**Importance Description**
1	Both indicators are equally important
3	Indicators are less important than others
5	Indicators are more important than others
7	Indicators are clearly more important than others
9	One indicator is clearly more important than another
2, 4, 6, 8	The value between two adjacent indicators

After determining the importance and description of the criteria or alternatives, you can start by making a matrix model like the example below.

Table 3. Pairwise Comparison Example

	A1	**A2**	**A3**
A1	1	1/6	
A2	6	1	
A3			1

Saaty (1983) explains that for the matrix table, if an indicator crosses with its own components, it will produce a value of 1, but if it crosses with other indicators, one must choose one indicator (A) to be given a high score and one indicator (B) to be rated low with using the formula B = (1/A).

3. Priority

   After naming each criterion and alternative value, a ranking arrangement is carried out to find priorities between indicators in the following way:

   a. Doing matrix squares

b. Doing the sum of values per row

c. Normalization of the matrix by dividing the indicator by the total number of indicators

$$N = \begin{bmatrix} n1 = \frac{s1}{\sum_{i=1}^{n} si} \\ n2 = \frac{s2}{\sum_{i=1}^{n} si} \\ n3 = \frac{s3}{\sum_{i=1}^{n} si} \end{bmatrix}$$

4. Logical consistency

Logical consistency can be calculated in the following way:

a. The matrix is multiplied by the priority weight.

b. Divide the calculation results by priority weights.

c. Do the max calculation with the previous value and divide by the number of indicators

d. Calculation of Consistency Index (CI)

$$CI = \frac{\lambda maks - N}{N - 1}$$

e. Calculation of Consistency Ratio (CR)

$$CR = \frac{CI}{RI}$$

If the calculation of the CR value is below 0.1 then the calculation is correct. According to Saaty (1983), the consistent value of the ratio is as in the following table.

Table 4. Consistency Ratio Value

Consistency Ratio Value											
n	1	2	3	4	5	6	7	8	9	10	11
R1	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49	1.51

Compared to other methods, AHP is frequently used as a problem-solving tool for the following reasons (Pebakirang et al., 2017); Hierarchical structure, as a consequence of the selected criteria, down to the deepest sub-criteria, measures the validity up to the tolerance limit for the inconsistency of various criteria and alternatives chosen by decision-makers and measures the durability of the decision-making sensitivity analysis output. The ratio scale also can be determined from both discrete and continuous pairwise comparisons using the broad theory of measurement known as the AHP (Darmanto et al., 2014).

2.2.7 Quail Farming

According to Singh, 2022, the term "quail farming" means the commercial rearing of quails for the purpose of profitable meat and egg production. Raising quails is easy, lucrative, and entertaining. It is very easy to maintain a quail farm, as quails are one of the smallest poultry species. Raising quail is highly profitable, just like other agribusinesses, such as raising chickens, turkeys, or ducks, and can give poor farmers high returns with low investment. Almost all kinds of weather conditions are suitable for starting a quail farming business. Quail meat and eggs are very tasty and nutritious than other poultry meat and eggs. Because quail eggs contain relatively high amounts of protein, phosphorus, iron, vitamins A, B1 and B2. Raising quails can play an important role in meeting food and nutritional needs. Quail farming businesses require small capital and labor and can even be raised alongside your other poultry to produce meat or eggs.

(Singh, 2022) Quail is a very small bird. An adult quail weighs from 150 to 200 grams, and an egg from 7 to 15 grams. Female quails begin to lay eggs at 6 to 7 weeks of age and continuously lay one egg per day. Quails usually live for 3 to 4 years. An adult quail weighs from 150 to 200 grams. Female quails begin to lay eggs at 6-7 weeks of age. Each egg weighs between 7 and 15 grams. A newborn quail weighs about 6-7 grams.

Quails are smaller birds and are easy to handle. The main advantages of starting a quail farming business are listed below.

- They lay about 230 to 300 eggs in their first year of life. They then produce about 150-175 eggs in the second year.

- Quail eggs are very good for human health. It contains 2.47% less fat than chicken eggs.
- Many people believe that quail eggs help prevent blood pressure, and diabetes.
- Quail meat is very tasty and nutritious. Their meat is very low in fat. Therefore, quail meat is very suitable for hypertensive patients.
- Quails are smaller birds, so they can be kept in a small space.
- The cost of quail feed is relatively lower than that of chicken or other poultry.
- Diseases rarely occur in quail, and they have very high resistance.
- Quails grow very quickly and mature faster than any other bird species. They start laying eggs when they are 6 to 7 weeks old. It takes about 16 to 18 days for the eggs to hatch.
- Raising quail requires little capital, labour, and very low cost. Housing is very important for quail farming.

Generally, there are two types of housing in the case of quail farming:

1. Floor rearing

   Quail can be reared directly on the floor in an upgraded housing (at least 2 m high, with good ventilation and a large solid door to facilitate cleaning and prevent theft), made of bamboo or cement, and covered with straw or corrugated iron depending on the farmer's resources and the availability of materi3als. They can be reared with or without bedding (5-10 cm thickness of wood shavings, moss or sawdust). A housing measuring 2 m x 1 m x 2 m can hold 160 birds for brooding for up to 4 weeks or 80 adults (preferably by dividing the building in two).
2. Cage rearing

   Cage rearing is often chosen in urban or peri-urban areas, as it requires little space. The cages are often made with several floors. Generally, 6 to 7 quails can be kept in a cage in the same place that is required for one chicken.

For keeping quails healthy, properly growing, and highly productive, it is essential to provide them with balanced feed regularly. An adult quail consumes about 20 to 25 grams of food daily. Chick feed should contain 27%, and adult feed

22-24% of protein. To increase the protein and energy levels of the feed, add insects such as termites, fly larvae or pupae, or mealworms.

Diseases are less in quails compared to other poultry birds. But you have to take good care and manage them properly, to keep them free from all types of diseases or illnesses. Good care and management are a must for a profitable quail farming business. Generally, they are not provided any preventive diseases vaccines. Quail chicks cannot tolerate weather changes, and sudden temperature changes. So, they get affected by the disease, if they experience sudden temperature or weather changes. The following measurements are very useful for keeping quails healthy and free from diseases

- Always try to keep their house dry and clean.
- Ensure proper movement of light and air inside their house.
- Keep different aged quails separated from each other.
- Separate the disease-affected quails from the healthy ones.
- Burn the dead bird or put it under the soil.
- Don’t allow other birds, animals, or unknown persons to enter the quail house.
- Ensure a hygienic and balanced feed supply.
- Provide adequate fresh and clean water according to their demand.

Quail meat and eggs are very tasty and highly enriched with nutrient elements. So, there is already an established market for quail products. As quail birds and their eggs are small in size, it is cheap in price, and all types of people can purchase them. So, it is easy to sell quail meat and eggs in the local market.

CHAPTER III

RESEARCH METHODOLOGY

3.1 Research Object

The research object of this research is a quail farm that is owned by CV. Vigaza is located at Dusun Palgading, Sinduharjo, Ngaglik, Sleman, Daerah Istimewa Yogyakarta. CV. Vigaza quail farm focuses on the production of a quail egg. This research itself focuses on the evaluation of CV. Vigaza Green Supply Chain Management performance score and also to find a recommendation to improve its performance by using Sustainable SCOR.

3.2 Data Collection

The scope of research is made for the purpose of not deviating when conducting research from a predetermined subject and object. Therefore, the scope of this research is:

1. Research data are taken from the quail industry company CV. Vigaza, Sleman, Special Region of Yogyakarta.
2. The data that is focused on is quail.
3. Measurement of data is internal supply chain management.
4. The Sustainable SCOR model used is the model issued by The Supply Chain Council, which is version 12.0.
5. The data variables used in this process are plan, source, make, deliver, and return.

3.3 Data Processing

Data processing is carried out after all data is collected. The steps for data processing are as follows:

1. Calculation of key performance indicator

   Performance scores will be calculated using data collected during field observations and interviews with company workers.

2. Calculate gap the between the actual and target value of the key performance indicator

   Calculating the gap between the actual and target value of an indicator to determine if the indicator needs to be fixed or not.
3. Calculation of Analytical Hierarchy Process

   Prioritizing each key performance indicator using the analytical hierarchy process.
4. Normalization of Snorm de Boer

   Perform the size scale equation for each indicator value.
5. Calculation of the performance value of green supply chain management

   Perform a calculation of the performance value generated by snorm de boer with an analytical hierarchy process to find the total value.
6. Selection of performance indicators to improve

   The selection is made to improve performance indicators that are still poor and what causes the problem indicators to solve the problem.
7. Provide performance proposals

   After finding the answers to these problems, suggestions are made to improve the indicator problems that exist in the company CV. Vigaza at that time and for the future.

3.4 Research Flowchart

The research flowchart below shows the working steps visually of this research as well the detailed explanations of the flowchart, below is the following research flowchart:

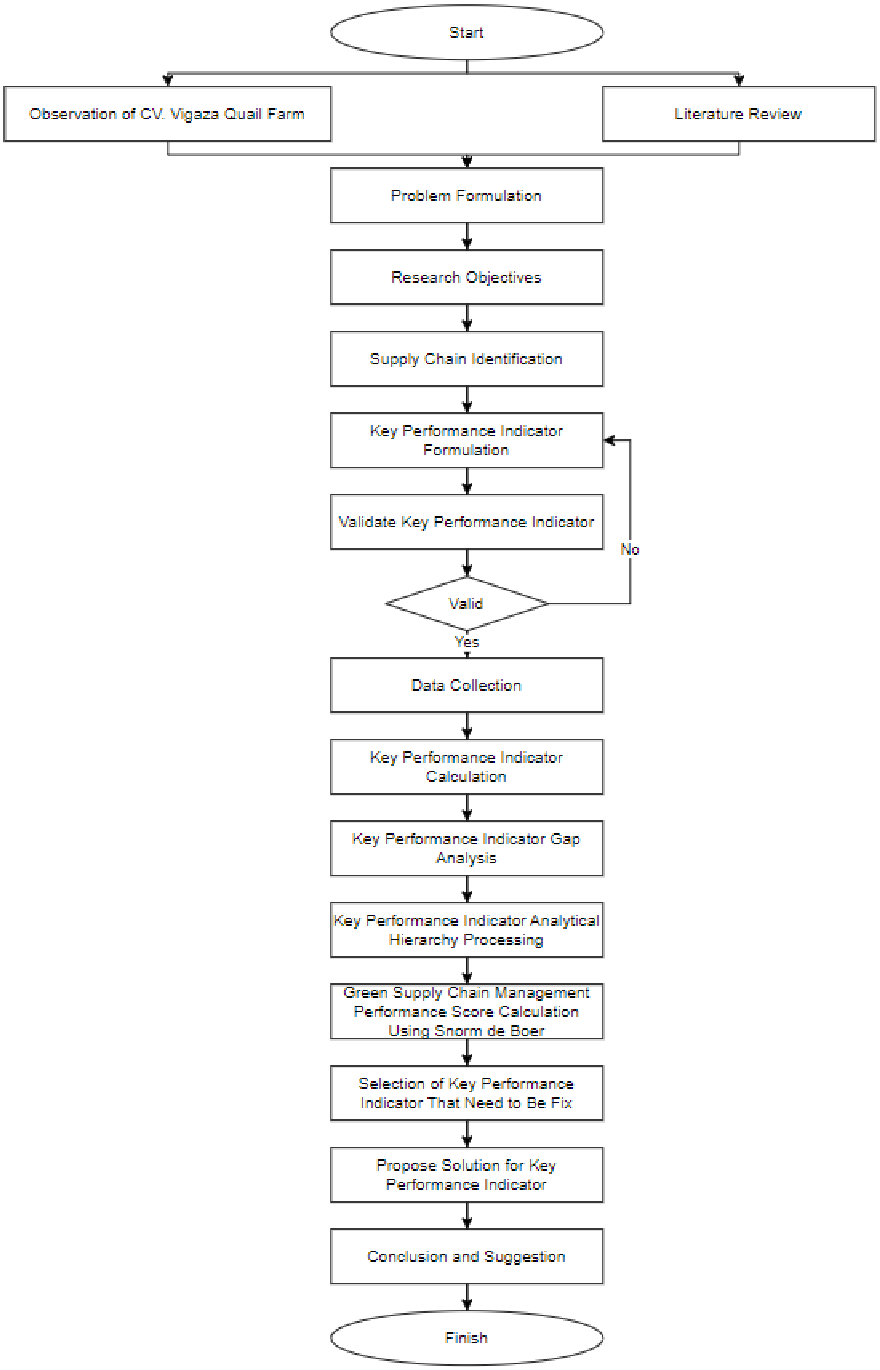

Figure 4. Research Flowchart

1. Observation of CV. Vigaza Quail Farm and Literature Review

   The researcher goes to the location of CV. Vigaza quail farm to observe the condition of the supply chain on how it operates and study literature review regarding past research and theory to better know the scope of the research.

2. Problem Formulation

   The researcher formulates the problem regarding CV. Vigaza quail farm supply chain condition based on the observation has have been done and reviewing the literature.

3. Research Objectives

   The researcher determines the objective of the research after formulating the problem as a milestone of the research.

4. Supply Chain Identification

   The researcher identifies parts of CV. Vigaza supply chain and its activities will be used later to determine the key performance indicator of CV. Vigaza supply chain.

5. Key Performance Indicator Formulation

   The researcher formulates the key performance indicator based on CV. Vigaza supply chain, which is the key performance indicator, is based on Sustainable SCOR version 12 from APICS 2017.

6. Validate Key Performance Indicator

   After the researcher formulates the key performance indicator, the researcher validates each key performance indicator with the owner of CV. Vigaza to determine if it is suitable to be used by considering if the key performance indicator data are available. If the key performance indicator is valid, I can then go to the next step; if it is not, the key performance indicator needs to be assessed.

7. Data Collection

   The researcher collects data on each key performance indicator by asking the data from the owner of CV. Vigaza.

8. Key Performance Indicator Calculation

   The researcher calculates the data of each key performance indicator using a formula that I based on Sustainable SCOR version 12 from APICS 2017, which will determine the 6-month worth of actual value and target value.

9. Key Performance Indicator Gap Analysis

The researcher calculates and analyzes the gap between the actual value and target value of each key performance indicator and determines which key performance indicator need to be fixed and which not needed to be fixed.

10. Key Performance Indicator Analytical Hierarchy Processing

    The researcher uses an analytical hierarchy process to determine the weight of each key performance indicator by discussing each weight with the owner of CV. Vigaza.

11. Green Supply Chain Management, Performance Score Calculation, Using Snorm de Boer

    The researcher uses snorm de boer to calculate the green supply chain management performance score to determine the overall performance score of the company.

12. Selection of the Key Performance Indicators That Need to Be Fix

    The researcher 1selects key performance indicator that needs to be fixed based on the result of gap analysis and green supply chain management performance score.

13. Propose Solutions for Key Performance Indicators

    The researcher proposes solutions by proposing appropriate method that can be used to fix the problem of the key performance indicator.

14. Conclusion and Suggestion

    The researcher writes the solutions and suggestions based on the research report that has been written.

CHAPTER IV

DATA COLLECTION AND PROCESSING

4.1 Data Collection

4.1.1 Business Process

Figure 5. Inside CV. Vigaza Quail Farm with the Owner Sir Aris Anggara

CV. Vigaza is one of many UMKM (*Usaha Mikro, Kecil, dan Menengah*) with the scale of CV (*Perseroan Komanditer*) that strive in the quail farming industry. Located in Palgading, Sinduharjo, Ngaglik, Sleman, CV. Vigaza was established by a retired worker name Sir Aris Anggara on the year 2018, and he started to engage in the quail farming industry because of the recent trend of selling quail eggs. Mr. Aris Anggara has started this quail farm as a side business with his other animal farms such as sheep, fish, birds, and guinea pigs, but since he found success in the quail business, he started to sell all the assets of the other animal to focus on only the quail farm. First, he started only with 5000 quail to farm by himself, and only 4 years later, it develops into a much larger scale with now farming 15000 quail and having 5 other employees to run the business. CV. Vigaza sells one product, which is the quail egg from the quail bird with the side product that are fertilizer that are produced from the quail farm waste.

On CV. Vigaza work time started at 07:00 in the morning and finished at 10:00 PM every day. Resting time is not determined by the owner, which means that they rest only when all activities at a certain time have been accomplished. Because of this work culture, it can be said that the place still does not have a proper pre-determined work culture. Work accidents rarely happen in CV. Vigaza because employees have been trained on how to handle certain work activities properly and have their own proper checklist.

Supply chain in CV. Vigaza starts with "Planning" where there are planning activities carried out in 3 main activities; the first is material planning needed (for example, food); this activity begins with a request order made by CV. Vigaza to the supplier and from the request, CV. Vigaza is waiting for confirmation of the availability of suppliers. After being confirmed with, the next step is to make a payment and then the supplier will send a request for the order needed by CV. Vigaza. After the order is received by CV. Vigaza, the next step is to carry out the storage of materials sent by the supplier and continue with the processing of quail food, which is adjusted to the concoction that has been made by CV. Vigaza, where the finished food is given to the quail. Apart from planning for the materials needed, other planning is related to the need for water to be used for giving to quails and for cage maintenance activities (for example, cage cleaning). The third plan is related to harvesting quail eggs, where this planning is very important to be able to match customer demand with the capacity owned by CV. Vigaza to provide quail eggs. After planning, the next step is to carry out the storage of quail eggs that have been harvested, followed by the packaging process, which will be sent to the customer according to the quantity they ordered. After the product arrives at the customer, the customer will check the product condition to meet the conditions the customer wants; if the product is not meet the customer’s orders, the customer can return the product and later CV. Vigaza will send the product back according to the customer's needs.

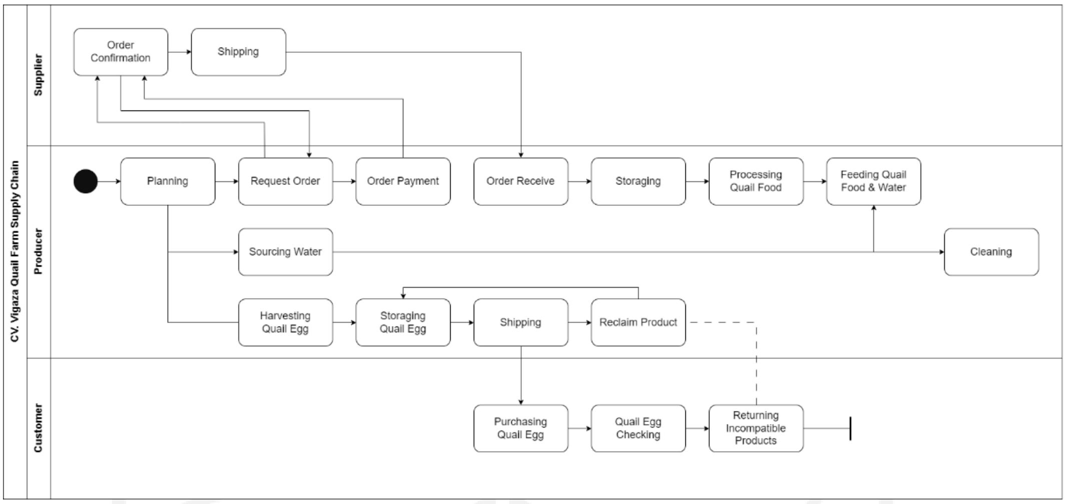

Figure 6. CV. Vigaza Supply Chain

4.1.2 Identifying and Validating Key Performance Indicators

From Figure 1, several key performance indicators can be identified from these activities. Key performance indicators are based on APICS 2017 books regarding SCOR 12 version for Sustainable SCOR. Chosen key performance indicators are needed to have data and are validated by CV. Vigaza quail farm owner to be picked for this research and have a targeted value based on the company's key performance indicator standard. Below shows the key performance indicator metric level 1 and level 2 that is chosen for this research that is according to APICS (2017).

Table 5. Key Performance Indicator of Metric Level 1 & 2

Metric Level 1	**Metric Level 2**	**Definition**	**Characteristic**	**Formula**
SS.1.001 Total Supply Chain Materials Used	SS.2.003 Make Materials Used	The total amount of materials used in Make process	Lower is better	$Make\ Materials\ Used = Sum\ of\ Plan\ Materials\ Used$
	SS.2.004 Deliver	The total amount	Lower is better	$Deliver\ Materials\ Used = Sum\ of\ Deliver$

	Materials Used	of materials used in Deliver process		Materials Used
SS.1.005 Total Supply Chain % of Recycled Input Materials Used	SS.2.009 Make % of Recycled Input Materials Used	The total percentage of recycled input materials used in Make process	Higher is better	$\text{Make \% of Recycled Input Materials Used} = \text{Sum of Make Percentage o Recycled Input Materials Use}$
SS.1.006 Total Supply Chain % of Reclaimed Products and Their Packaging Materials	SS.2.017 Return % of Reclaimed Products and Their Packaging Materials	The total percentage of products and their packaging materials that are reclaimed in Return process	Lower is better	Return % of Products and their Packaging Materials Reclaimed within the reporting period $= \text{Sum of Return Percentage Products and Their Packagin Materials Reclaimed Within the Reporting Period}$
SS.1.007 Total	SS.2.020 Make	The total energy	Lower is better	$\text{Make Energy Consumed} = \text{Sum of Energy Consumed}$

Supply Chain Energy Consumed	Energy Consumed	consumed in Make process		
SS.1.008 Total Supply Chain Non-Renewable Energy Consumed	SS.2.026 Deliver Non-Renewable Energy Consumed	The total non-renewable energy consumed in Deliver process	Lower is better	$Deliver\ Non\ Renewable\ Energy\ Consumed = Sum\ of\ Deliver\ Non\ Renewable\ Energy\ Consumed$
	SS.2.027 Return Non-Renewable Energy Consumed	The total non-renewable energy consumed in Return process	Lower is better	$Return\ Non\ Renewable\ Energy\ Consumed = Sum\ of\ Return\ Non\ Renewable\ Energy\ Consumed$
SS.1.012 Total Supply Chain Water Withdrawn	SS.2.035 Make Water Withdrawn	The total water withdrawn in Make process	Lower is better	$Make\ Water\ Withdrawn = Sum\ of\ Make\ Water\ Withd$

SS.1.025 Total Supply Chain Non-Hazardous Waste	SS.2.075 Make Non-Hazardous Waste	The total non-hazardous waste produced in Make process	Lower is better	$Make\ Non\ Hazardous\ Waste = Sum\ of\ Deliver\ Make\ Non\ Hazardous\ Waste$
SS.1.026 Total Supply Chain Hazardous Waste	SS.2.080 Make Hazardous Waste	The total hazardous waste produced in Make process	Lower is better	$Make\ Hazardous\ Waste = Sum\ of\ Make\ Hazardous\ Waste$

From the above table 1 & 2, it can be seen that there are 8 metric level 1 indicator and 11 metric level 2 indicators. Those chosen indicators are obtained by observing the supply chain of the quail farm and validating if it is possible to be measured and approved by CV. Vigaza quail farm owner for this research.

4.2 Data Processing

4.2.1 Measuring Key Performance Indicator

Measuring the key performance indicator, in this case, is based on data that are obtained by interviewing the owner of the CV. Vigaza quail farm. Data that are used are 6-month data, spanned from January to June. Key performance indicator measurement results will then be compared with the actual company standard of the key performance indicators. The target value of max and min are according to the owner's perspective, which is the target max performance score is 100%, and the target of min performance score is the minimum score in the previous 6 months of data that have been reached.

4.2.1.1 SS.1.001 Total Supply Chain Materials Used

This indicator discusses the total amount of materials used in the supply chain. There are 2 level of 2 metric key performance indicators which are Make and Deliver process. This indicator is the total sum of all materials in the level 2 metric indicators and will be compared with the company-targeted key performance indicator value. This indicator will use the 6-month worth of data. Below shows the formula used for this indicator that is referred from APICS (2017).

$$Total\ Supply\ Chain\ Materials\ Used$$
$$= Make\ Materials\ Used + Deliver\ Materials\ Used$$

In Make materials used indicator, this indicator discusses the total amount of materials used in Make process. Materials, in this case, is the amount of quail food that is measured in Kg. The company has determined the targeted materials used in Make process is 7.000 Kg per month. Below shows the formula used for this indicator that is referred from APICS (2017).

$$Make\ Materials\ Used = Sum\ of\ Plan\ Materials\ Used$$

Table 6. SS.2.003 Make Materials Used

Month	Actual Make Materials Used (Kg)	Target Make Materials Used (Kg)
1	7.000	7.000
2	7.000	7.000
3	7.000	7.000
4	7.000	7.000
5	7.000	7.000
6	7.000	7.000
Total	42.000	42.000

From the above table, it can be seen that for the 6-month worth of data, the total materials used in Make process is 42.000 Kg, and the company key performance indicators target materials used in Make process is 42.000 Kg.

In Deliver materials used, this indicator discusses the total amount of materials used in Deliver process. Materials, in this case, is the amount of quail egg tray that is measured in Kg. The company has determined the targeted materials used in Deliver process is 457 Kg per month. Below shows the formula used for this indicator that are referred from APICS (2017).

$$Deliver\ Materials\ Used = Sum\ of\ Deliver\ Materials\ Used$$

Table 7. SS.2.004 Deliver Materials Used

Month	Actual Deliver Materials Used (Kg)	Target Deliver Materials Used (Kg)
1	442,06	457
2	465,14	457
3	459,89	457
4	425,14	457
5	462,49	457
6	444,11	457
Total	2.698,83	2.742

From the above table, it can be seen that for the 6-month worth of data, the total materials used in Deliver process is 2.698,83 Kg, and the company key performance indicators target material used in Deliver process is 2.742 Kg.

After measuring all required processes for Total Supply Chain Materials Used, we are now able to determine the total supply chain materials used. It is found that the actual materials used are a are combined sum of Make and Deliver process is 44.698,83 Kg and the target materials used is a combined sum of Make and Deliver process is 44.742 Kg.

4.2.1.2 SS.1.005 Total Supply Chain % of Recycled Input Materials Used

This indicator discusses the total % of recycled input materials used in the supply chain. There are 1 level 2 metric key performance indicators that are in this indicator which are Make process. This indicator are the total percentage of recycled input materials that is used in the level 2 metric indicators and will be compared with the company targeted key performance indicator value. This indicator will use the 6-month worth of data. Below shows the formula used for this indicator that is referred from APICS (2017).

$$Total\ Supply\ Chain\ \%\ of\ Recycled\ Input\ Materials\ Used$$
$$= \frac{Total\ Supply\ Chain\ Recycled\ Input\ Materials\ Used}{Total\ Supply\ Chain\ Input\ Materials\ Used}\ x\ 100\%$$

In Make % of recycled input materials used, this indicator discusses the total percentage of recycled input materials used in Make process. Recycled input materials, in this case, are the total amount of recycled input materials that are used in Make process measured in Kg. The company has determined the targeted recycled materials for input in Make process is 100% of the total materials input per month. Below shows the formula used for this indicator that is referred from APICS (2017).

$$Make\ \%\ of\ Recycled\ Input\ Materials\ Used$$
$$= Sum\ of\ Make\ Percentage\ of\ Recycled\ Input\ Materials\ Used$$

Table 8. SS.2.009 Make % of Recycled Input Materials Used

Month	Make Recycled Input Materials Used (Kg)	Input Materials Used (Kg)	Recycled Input Materials Used (%)
1	1.002	1.275	
2	1.134	1.301	
3	998	1.267	
4	1.079	1.275	
5	1.153	1.307	
6	1.094	1.279	
Total	6.460	7.704	83,85%

From the above table, it can be seen that for the 6-month worth of data, the total weight of recycled input materials used in Make process is 6.460 Kg, and the company's total input materials used is 7.704 Kg.

After measuring all required processes for the Total % of Recycled Input Materials Used, we are now able to determine the total supply chain % of recycled input materials used. It is found out the percentage of recycled input materials used score is 83,85% out of 100%.

4.2.1.3 SS.1.006 Total Supply Chain % of Reclaimed Products and Their Packaging Materials

This indicator discusses the total amount of products and their packaging materials that are able to be reclaimed in the supply chain. There are 1 level 2 metric key performance indicators that are in this indicator which are Return process. This indicator is the total percentage of all products and packaging reclaimed at the level 2 metric indicators will be compared with the company-targeted key performance indicator value. This indicator will use the 6-month worth of data. Below shows the formula used for this indicator that is referred from APICS (2017).

$$Total\ Supply\ Chain\ \%\ of\ Reclaimed\ Products\ and\ Their\ Packaging\ Materials = \left(\frac{\text{Total Supply Chain Products and Their Packaging Materials Reclaimed within the reporting period}}{\text{Total Supply Chain Products Sold within the reporting period}}\right) x\ 100\%$$

In Return % of reclaimed products and their packaging materials, this indicator discusses the total amount of products and their packaging that are able to be reclaimed back in Return process. Products, in this case, is the amount of quail egg sold that is measured in Kg, and packaging, in this case, is the amount of quail egg trays measured in Kg. The amount of product and packaging that are reclaimed will be compared to the amount of product and packaging sold. The company has determined that they will have 0% reclaimed products and packaging, or in other words, every product sold without being returned. Below shows the formula used for this indicator that is referred from APICS (2017).

$$Return\ \%\ \text{of Products and their Packaging Materials Reclaimed within the reporting period} = Sum\ of\ Return\ Percentage\ of\ Products\ and\ Their\ Packaging\ Materials\ Reclaimed\ Within\ the\ Reporting\ Period$$

Table 9. SS.2.017 Return % of Reclaimed Products and Their Packaging Materials

Month	Actual Return Products and Their Packaging Reclaimed (Kg)	Target Return Products and Their Packaging Reclaimed (Kg)	Products and Their Packaging Sold (Kg)	Product and Their Packaging Reclaimed (%)

1	0	0	1.705	
2	0	0	1.624	
3	0	0	1.911	
4	0	0	1.738	
5	0	0	1.895	
6	0	0	1.650	
Total	0	0	10.523	0%

From the above table, it can be seen that for the 6-month worth of data, the total weight of reclaimed products and their packaging materials in Return process is 0 Kg, and the company products and their packaging sold is 10.523 Kg.

After measuring all required processes for the Total % of Reclaimed Products and Their Packaging Materials, we are now able to determine the total supply chain % of products and their packaging materials. It is found out the total percentage of products and their packaging materials reclaimed is 0% out of 0%.

4.2.1.4 SS.1.007 Total Supply Chain Energy Consumed

This indicator discusses the total amount of energy consumed in the supply chain. There are 1 level 2 metric key performance indicators that are in this indicator which are Make process. This indicator is the total sum of all energy consumed at the level 2 metric indicators will be compared with the company-targeted key performance indicator value. This indicator will use the 6-month worth of data. Below shows the formula used for this indicator that is referred from APICS (2017).

$$Total\ Supply\ Chain\ Energy\ Consumed = Make\ Energy\ Consumed$$

In Make energy consumed, this indicator discusses the total amount of energy consumed in Make process. Energy, in this case, is the amount of electricity that is measured in kWh. The company has determined the targeted energy consumed in Make process is 370 kWh per month. Below shows the formula used for this indicator that is referred from APICS (2017).

$$Make\ Energy\ Consumed = Sum\ of\ Energy\ Consumed$$

Table 10. SS.2.020 Make Energy Consumed

Month	Actual Make Energy Consumed (kWh)	Target Make Energy Consumed (kWh)
1	453	370
2	394	370
3	419	370
4	444	370
5	425	370
6	429	370
Total	2.564	2.220

From the above table, it can be seen that for the 6-month worth of data, the total energy consumed in Make process is 2.564 kWh, and the company key performance indicators target material used in Make process is 2.220 kWh.

After measuring all required processes for Total Supply Chain Energy Consumed, we are now able to determine the total supply chain energy consumed. It is found that the actual energy consumed is a sum of Make process is 2.564 kWh, and the target energy consumed is a sum of Make process is 2.220 kWh.

4.2.1.5 SS.1.008 Total Supply Chain Non-Renewable Energy Consumed

This indicator discusses the total amount of non-renewable energy consumed in the supply chain. There are 2 level 2 metric key performance indicator that are in this indicator which are Deliver and Return process. This indicator is the total sum of all non-renewable energy consumed in the level 2 metric indicators and will be compared with the company targeted key performance indicator value. This indicator will use 6-month worth of data. Below shows the formula used for this indicator that is referred from APICS (2017).

$$Total\ Supply\ Chain\ Non\ Renewable\ Energy\ Consumed$$
$$= Deliver\ Non\ Renewable\ Energy\ Consumed$$
$$+\ Return\ Non\ Renewable\ Energy\ Consumed$$

In Deliver non-renewable energy consumed indicator, this indicator discusses the total amount of non-renewable energy consumed in Deliver process.

Non-renewable energy in this case is the amount of vehicle fuel used that is measured in Liter. The company have determined the targeted non-renewable energy consumed in Deliver process is 20 Liter per month. Below shows the formula used for this indicator that is referred from APICS (2017).

$$Deliver\ Non\ Renewable\ Energy\ Consumed$$
$$= Sum\ of\ Deliver\ Non\ Renewable\ Energy\ Consumed$$

Table 11. SS.2.026 Deliver Non-Renewable Energy Consumed

Month	**Actual Deliver Non-Renewable Energy Consumed (Liter)**	**Target Deliver Non-Renewable Energy Consumed (Liter)**
1	22,5	20
2	21,5	20
3	25	20
4	23	20
5	24	20
6	22,5	20
Total	138,5	120

From the above table it can be seen that for 6-month worth of data, the total non-renewable energy consumed in Deliver process is 138,5 Liter and the company key performance indicators target non-renewable energy consumed in Deliver process is 120 Liter.

In Return non-renewable energy consumed indicator, this indicator discusses the total amount of non-renewable energy consumed in Return process. Non-renewable energy in this case is the amount of vehicle fuel used that is measured in Liter. The company have determined the targeted non-renewable energy consumed in Return process is 20 Liter per month. Below shows the formula used for this indicator that is referred from APICS (2017).

$$Return\ Non\ Renewable\ Energy\ Consumed$$
$$= Sum\ of\ Return\ Non\ Renewable\ Energy\ Consumed$$

Table 12. SS.2.027 Return Non-Renewable Energy Consumed

Month	Actual Return Non-Renewable Energy Consumed (Liter)	Target Return Non-Renewable Energy Consumed (Liter)
1	22,5	20
2	21,5	20
3	25	20
4	23	20
5	24	20
6	22,5	20
Total	138,5	120

From the above table it can be seen that for 6-month worth of data, the total non-renewable energy consumed in Return process is 138,5 Liter and the company key performance indicators target non-renewable energy consumed in Deliver process is 120 Liter.

After measuring all required process for Total Supply Chain Non-Renewable Energy Consumed, we are now able to determine the total supply chain non-renewable energy consumed. It is found out that the actual non-renewable energy consumed is a combined sum of Deliver and Return process is 277 Liter and the target non-renewable energy consumed is 240 Liter.

4.2.1.6 SS.1.012 Total Supply Chain Water Withdrawn

This indicator discusses the total amount of water withdrawn in the supply chain. There are 1 level 2 metric key performance indicator that are in this indicator which are Make process. This indicator is the total sum of all water withdrawn in the level 2 metric indicators and will be compared with the company targeted key performance indicator value. This indicator will use 6-month worth of data. Below shows the formula used for this indicator that is referred from APICS (2017).

$$Total\ Supply\ Chain\ Water\ Withdrawn = Make\ Water\ Withdrawn$$

In Make water withdrawn, this indicator discusses the total amount of water withdrawn for Make process. Water withdrawn in this case is the amount of water withdrawn for various activity in Make process measured in Liter. The company have determined the targeted water withdrawn in Make process is 15.000 Liter per month. Below shows the formula used for this indicator that is referred from APICS (2017).

$$Make\ Water\ Withdrawn = Sum\ of\ Make\ Water\ Withdrawn$$

Table 13. SS.2.035 Make Water Withdrawn

Month	Actual Make Water Withdrawn (Liter)	Target Make Water Withdrawn (Liter)
1	16.749	15.000
2	15.319	15.000
3	16.384	15.000
4	17.185	15.000
5	16.631	15.000
6	15.240	15.000
Total	97.508	90.000

From the above table it can be seen that for 6-month worth of data, the total water withdrawn in Make process is 97.508 Liter and the company key performance indicators target material used in Make process is 90.000 Liter.

After measuring all required process for Total Supply Chain Water Withdrawn, we are now able to determine the total supply water withdrawn. It is found out that the actual water withdrawn is a sum of Make process is 97.508 Liter and the water withdrawn is a sum of Make process is 90.000 Liter.

4.2.1.7 SS.1.025 Total Supply Chain Non-Hazardous Waste

This indicator discusses the total amount of non-hazardous waste produced in the supply chain. There are 2 level 2 metric key performance indicator that are in this indicator which are Make and Deliver process. This indicator is the total sum of all non-hazardous waste produced in the level 2 metric indicators and will be compared with the company targeted key performance indicator value. This indicator will use 6-month worth of data. Below shows the formula used for this indicator that is referred from APICS (2017).

$$Total\ Supply\ Chain\ Non\ Hazardous\ Waste$$
$$= Make\ Non\ Hazardous\ Waste$$

In Make non-hazardous waste indicator, this indicator discusses the total amount non-hazardous waste produced in Make process. Non-hazardous waste in this refer to leftover quail food, broken quail egg, and quail excrement that is measured in Kg. The company have determined the targeted non-hazardous waste produced in Make process is 20.000 Kg per month. Below shows the formula used for this indicator that is referred from APICS (2017).

$$Make\ Non\ Hazardous\ Waste$$
$$= Sum\ of\ Deliver\ Make\ Non\ Hazardous\ Waste$$

Table 14. SS.2.075 Make Non-Hazardous Waste

Month	**Actual Make Non-Hazardous Waste (Kg)**	**Target Make Non-Hazardous Waste (Kg)**
1	19.372	20.000
2	18.634	20.000
3	19.640	20.000
4	20.294	20.000
5	19.555	20.000
6	17.570	20.000
Total	115.065	120.000

From the above table it can be seen that for 6-month worth of data, the total non-hazardous waste produced in Make process is 115.065 Kg and the company key performance indicators target non-hazardous waste produced in Make process is 120.000 Kg.

After measuring all required process for Total Supply Chain Non-Hazardous Waste, we are now able to determine the total supply chain non-hazardous waste produced. It is found out that the actual non-hazardous waste produced is a sum of Make process is 115.065 Kg and the target non-hazardous waste is 120.000 Kg.

4.2.1.8 SS.1.026 Total Supply Chain Hazardous Waste

This indicator discusses the total amount of hazardous waste produced in the supply chain. There are 1 level 2 metric key performance indicator that are in this indicator which are Make process. This indicator is the total sum of all hazardous waste produced in the level 2 metric indicators and will be compared with the company targeted key performance indicator value. This indicator will use 6-month worth of data. Below shows the formula used for this indicator that is referred from APICS (2017).

$$Total\ Supply\ Chain\ Hazardous\ Waste = Make\ Hazardous\ Waste$$

In Make hazardous waste, this indicator discusses the total amount of hazardous waste produced in Make process. Hazardous waste in this case is referred to a disease infected dead quail bird that is measured in Kg. The company have determined the targeted hazardous waste in Make process is 0.5 Kg per month. Below shows the formula used for this indicator that is referred from APICS (2017).

$$Make\ Hazardous\ Waste = Sum\ of\ Make\ Hazardous\ Waste$$

Table 15. SS.2.080 Make Hazardous Waste

Month	Actual Make Hazardous Waste (Kg)	Target Make Hazardous Waste (Kg)
1	0.8	0.5
2	1.1	0.5
3	0.6	0.5
4	0.5	0.5
5	1	0.5
6	1	0.5
Total	5	3

From the above table it can be seen that for 6-month worth of data, the total hazardous waste produced in Make process is 5 Kg and the company key performance indicators target hazardous waste produced in Make process is 3 Kg.

After measuring all required process for Total Supply Chain Hazardous Waste, we are now able to determine the total supply hazardous waste produced. It is found out that the actual hazardous waste produced is a sum of Make process is 5 Kg and the target hazardous waste is a sum of Make process is 3 Kg.

4.2.2 Key Performance Indicator Gap Calculation

After measurement is done on the metric level 1 key performance indicator, now we are able to perform gap analysis on the measurement result of the indicators and the company targeted value of each key performance indicators to find the gap of the actual data and the targeted one. For this case both actual and target data will use 6-month of data. Below shows the gap analysis formula for of each key performance indicators.

$$Gap = Target\ Score - Actual\ Score$$

Table 16. Key Performance Indicators Gap Calculation

Level 1 Metric	Level 2 Metric	Actual Score	Target Score	Gap
SS.1.001 Total Supply Chain Materials Used	SS.2.003 Make Materials Used	42.000 Kg	42.000 Kg	0 Kg
	SS.2.004 Deliver Materials Used	2.689,83 Kg	2.742 Kg	52,17 Kg
SS.1.005 Total Supply Chain % of Recycled Input Materials Used	SS.2.009 Make % of Recycled Input Materials Used	83,85%	100%	16,15 %
SS.1.006 Total Supply Chain % of Reclaimed Products and Their Packaging Materials	SS.2.017 Return % of Reclaimed Products and Their Packaging Materials	0%	0%	0%
SS.1.007 Total Supply Chain Energy Consumed	SS.2.020 Make Energy Consumed	2.564 kWh	2.220 kWh	344 kWh
SS.1.008 Total Supply Chain Non-Renewable Energy Consumed	SS.2.026 Deliver Non-Renewable Energy Consumed	138,5 Liter	120 Liter	18,5 Liter

	SS.2.027 Return Non-Renewable Energy Consumed	138,5 Liter	120 Liter	18,5 Liter
SS.1.012 Total Supply Chain Water Withdrawn	SS.2.035 Make Water Withdrawn	97.508 Liter	90.000 Liter	7.508 Liter
SS.1.025 Total Supply Chain Non-Hazardous Waste	SS.2.075 Make Non-Hazardous Waste	115.065 Kg	120.000 Kg	4.935 Kg
SS.1.026 Total Supply Chain Hazardous Waste	SS.2.080 Make Hazardous Waste	5 Kg	3 Kg	2 Kg

After calculating the gap analysis, it can be seen that some indicators cannot meet the expected KPI, and some are exceeding it. The indicators that have not met the target of the KPI are highlighted with red color and need to be fixed, but those that have already met or exceeded the target are highlighted with green and will not be necessary to be fixed.

Table 17. Key Performance Indicators Money Analysis

Level 1 Metric	**Level 2 Metric**	**Money Saved**	**Money Losses**
SS.1.001 Total Supply Chain Materials Used	SS.2.003 Make Materials Used	Rp. 0	Rp. 0
	SS.2.004 Deliver Materials Used	Rp. 580.000	Rp. 0
SS.1.005 Total Supply Chain % of Recycled Input Materials Used	SS.2.009 Make % of Recycled Input Materials Used	Rp. 0	Rp. 9.454.000
SS.1.006 Total Supply Chain % of Reclaimed	SS.2.017 Return % of Reclaimed Products	Rp. 0	Rp. 0

Products and Their Packaging Materials	and Their Packaging Materials		
SS.1.007 Total Supply Chain Energy Consumed	SS.2.020 Make Energy Consumed	Rp. 0	Rp. 496.976,8
SS.1.008 Total Supply Chain Non-Renewable Energy Consumed	SS.2.026 Deliver Non-Renewable Energy Consumed	Rp. 0	Rp. 129.000
	SS.2.027 Return Non-Renewable Energy Consumed	Rp.0	Rp. 129.000
SS.1.012 Total Supply Chain Water Withdrawn	SS.2.035 Make Water Withdrawn	Rp. 0	Rp. 0
SS.1.025 Total Supply Chain Non-Hazardous Waste	SS.2.075 Make Non-Hazardous Waste	Rp. 0	Rp. 0
SS.1.026 Total Supply Chain Hazardous Waste	SS.2.080 Make Hazardous Waste	Rp. 0	Rp. 165.000
Total		Rp. 580.000	Rp. 10.373.976,8

By finding the gap between actual and target value, we can also determine the amount of money that is lost and gained, which can be seen in the 6-month period between January to June; the total money saved is Rp. 580.000, but the total money spent for extra is Rp. 10.373.976,8.

4.2.3 Analytical Hierarchy Process Data Processing

The analytical hierarchy process is done to normalize weight between key performance indicator so that each key performance indicator has an assigned weight and have the same output if combined to 100%. Below shows the hierarchy model of CV. Vigaza green supply chain performance measurement.

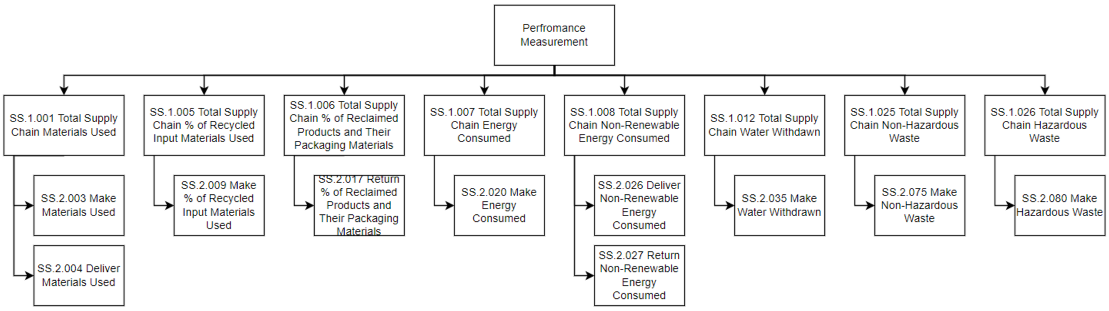

Figure 7. Analytical Hierarchy Process Model of CV. Vigaza Key Performance Indicators Performance Measurement

4.2.3.1 Analytical Hierarchy Process Weighting

After key performance indicator weight have been normalized, a consistency check is performed to find out the consistency ratio of all indicator to determine if each indicator have a consistent pairwise comparison. The consistency ratio needs to be below 0.1 or 10%, for the indicator can be consistent. Below shows the calculation of consistency in level 1 and 2 metrics.

Table 18. Pairwise Comparison Weighting Level 1 Metrics

Indicator	**SS.1.001**	**SS.1.005**	**SS.1.006**	**SS.1.007**	**SS.1.008**	**SS.1.012**	**SS.1.025**	**SS.1.026**
SS.1.001	1,00	4,00	5,00	2,00	2,00	3,00	0,50	0,33
SS.1.005	0,25	1,00	2,00	0,25	0,33	0,50	0,20	0,20
SS.1.006	0,20	0,50	1,00	0,20	0,25	0,33	0,20	0,20
SS.1.007	0,50	4,00	5,00	1,00	2,00	3,00	0,50	0,33
SS.1.008	0,50	3,00	4,00	0,50	1,00	2,00	0,33	0,25
SS.1.012	0,33	2,00	3,00	0,33	0,50	1,00	0,25	0,20
SS.1.025	2,00	5,00	5,00	2,00	3,00	4,00	1,00	0,50
SS.1.026	3,00	5,00	5,00	3,00	4,00	5,00	2,00	1,00
Total	7,78	24,50	30,00	9,28	13,08	18,83	4,98	3,02

4.2.3.2 Analytical Hierarchy Process Normalizing Weight

After key performance indicator have an assigned weight. It is able now to do normalization on weight of each key performance indicator. This is important to find the balanced weight between indicator so it can be used to calculate the green supply chain management performance score. Below shows the normalized weight of the analytical hierarchy process key performance indicator.

Table 19. Pairwise Comparison Weight Normalization Level 1 Metrics

Indicator	SS.1.001	SS.1.005	SS.1.006	SS.1.007	SS.1.008	SS.1.012	SS.1.025	SS.1.026
SS.1.001	0,13	0,16	0,17	0,22	0,15	0,16	0,10	0,11
SS.1.005	0,03	0,04	0,07	0,03	0,03	0,03	0,04	0,07
SS.1.006	0,03	0,02	0,03	0,02	0,02	0,02	0,04	0,07
SS.1.007	0,06	0,16	0,17	0,11	0,15	0,16	0,10	0,11
SS.1.008	0,06	0,12	0,13	0,05	0,08	0,11	0,07	0,08
SS.1.012	0,04	0,08	0,10	0,04	0,04	0,05	0,05	0,07
SS.1.025	0,26	0,20	0,17	0,22	0,23	0,21	0,20	0,17
SS.1.026	0,39	0,20	0,17	0,32	0,31	0,27	0,40	0,33
Total	1	1	1	1	1	1	1	1

4.2.3.3 Analytical Hierarchy Process Consistency Check

After key performance indicator weight have been normalize, consistency check is done to find out the consistency ratio of all indicator to determine if each indicators have consistent pairwise comparison. Consistency ratio need to be below 0.1 or 10% for the indicator can be say consistent. Below shows the calculation of consistency in level 1 and 2 metrics.

Table 20. Pairwise Comparison Consistency Check Level 1 Metrics

Indicator	1	2	3	4 = 3/2	5 = Sum 4/Sum 1	6 = (5 – Sum 1)/ (Sum 1-1)	7	8 = 6/7
	Total Weight Matrix	Eugen Vector	Multiplication Matrix	Eugen Value	λ Max	Consistency Index	Index Ratio	Consistency Ratio
SS.1.001	1,20	0,15	1,28	8,53	8,35	0,05	1,40	0,04
SS.1.005	0,32	0,04	0,33	8,14				
SS.1.006	0,24	0,03	0,25	8,15				
SS.1.007	1,02	0,13	1,07	8,37				
SS.1.008	0,71	0,09	0,73	8,29				
SS.1.012	0,47	0,06	0,48	8,19				
SS.1.025	1,65	0,21	1,77	8,55				
SS.1.026	2,38	0,30	2,55	8,54				

Total	8,00	1,00	8,45	66,76				

From the above table 18, it can be seen for level 1 metrics key performance indicators; the weighting has been consistent because the consistency ratio shows the value of 0,04 consistency ratio which is below 0,1, meaning that the weight for level 1 metrics has a consistency which means the weight of level 1 and 2 metrics can be used for later green supply chain management performance score calculation.

4.2.4 Analytical Hierarchy Process Final Weight

Based on the calculation from before, the final analytical hierarchy process model for level 1 is based on the normalized weight, and for level 2 is based on the discussion with the owner. Below is the final model of the analytical hierarchy process for CV. Vigaza quail farm.

Table 21. Final Analytical Hierarchy Process Model

Level 1 Metrics Indicator	Level 1 Metrics Indicator Weight	Level 2 Metrics Indicator	Level 2 Metrics Indicator Weight
SS.1.001	0,15	**SS.2.003**	0,75
		SS.2.004	0,25
SS.1.005	0,04	**SS.2.009**	1
SS.1.006	0,03	**SS.2.017**	1
SS.1.007	0,13	**SS.2.020**	1
SS.1.008	0,09	**SS.2.026**	0,67
		SS.2.027	0,33
SS.1.012	0,06	**SS.2.035**	1
SS.1.025	0,21	**SS.2.075**	1
SS.1.026	0,30	**SS.2.080**	1

4.2.4 Green Supply Chain Management Performance Score Calculation

To find the green supply chain management performance score, it is needed to use Snorm de Boer normalization with the objective of balancing the value parameter of each indicator because each indicator has a different weight and parameter. Below shows the snorm de boer normalization to find out the green supply chain performance score.

Table 22. Green Supply Chain Management Performance Score

No	1	2 = Eugen Vector	3	4 = Eugen Vector	5	6	7	8 = (5/6)/(7/6)	9 = 4*8	10 = 2*9
	Level 1 Metrics	**Level 1 Normalize Weight**	**Level 2 Metrics**	**Level 2 Normalize Weight**	**Actual (Si)**	**Min (Smin)**	**Max (Smax)**	**Snorm de Boer**	**Level 2 Normalize Weigting**	**Level 1 Normalize Weighting**
1	SS.1.001	0,15	SS.2.003	0,13	42.000	54.600	42.000	100%	75,00%	11,25%
2			SS.2.004	0,13	2.689,83	2.965	2.742	98%	24,52%	3,68%
3	SS.1.005	0,04	SS.2.009	0,03	83,85%	72%	100%	84%	83,85%	3,35%
4	SS.1.006	0,03	SS.2.017	0,02	0%	5%	0%	100%	100,00%	3,00%
5	SS.1.007	0,13	SS.2.020	0,09	2.564	2.886	2.220	89%	88,84%	11,55%
6	SS.1.008	0,09	SS.2.026	0,06	138,5	156	120	89%	59,48%	5,35%
7			SS.2.027	0,06	138,5	156	120	89%	29,30%	2,64%
8	SS.1.012	0,06	SS.2.035	0,04	97.508	127.468	90.000	76%	76,50%	4,59%
9	SS.1.025	0,21	SS.2.075	0,19	115.065	156.000	150.000	96%	95,89%	20,14%
10	SS.1.026	0,3	SS.2.080	0,23	5	8	3	63%	62,50%	18,75%
Final Green Supply Chain Management Performance Score										**84,30%**

From the above table, it is revealed that CV. Vigaza quail farm has a total green supply chain management performance score of 84,30% which is above the 80 range, so it can be said that CV. Vigaza green supply chain performance score is good. Because their performance score is good, they need improvement but not in a short time, in order to fix some key performance indicators to improve their performance score.

CHAPTER V

RESULT AND DISCUSSION

5.1 Result

After data processing is done using Sustainable SCOR to find out the green supply chain management performance score, it is found that the green supply chain management performance score is 84,30% which, according to Trienekens & Hvolby (2000), 84,30% performance score is considered in the above 80 range which is categorized as good. Because green supply chain management is categorized as average, it is recommended for CV. Vigaza to start improving its supply chain to improve its performance score and reduce environmental impact by fixing the key performance indicator.

To easily identify and choose which key performance indicator needs to be fixed, this research will use the traffic light system. The traffic light system will use 2 different color indicators, which are green and red, which are based if the indicator has reached the target KPI or not. The green indicator is given to the key performance indicator with the performance score that has no gap of value and target KPI or has exceeded the target value. The red indicator is given to the key performance indicator with a lower score than the target value. This indicator has been given the respective color and can be seen in Table 13.

In table 13, it can be seen that each indicator has been given a color based on its achievement of the KPI target. Out of 10 indicators, 4 indicators are labeled with green color because they have reached or exceeded the KPI target, based on the characteristics of the indicator. On the contrary, there are 6 indicators that have been given red color because they cannot meet the target of KPI, based on the characteristics of the indicator. Also, by finding the gap between actual and target value, we can also determine the amount of money that is lost and gained, which can be seen in the span of the 6-month period between January to June, with the total money saved is Rp. 580.000, but the total money spent for extra is Rp. 10.373.976,8. For those indicators with green color, it is recommended to maintain that performance or even improve it and those indicators with red color require solution to improve it to reach the target set in the KPI. By proposing a solution to the indicators with problem, it will help to improve the KPI to reach the its target value and help improve the overall score of the green supply chain management.

Choosing what indicator to start to be fixed is based on how much weight is given to the indicator. It is based on the discussion between the researcher and the owner of CV. Vigaza. This allows us to know which indicators are more important to identify the importance of the indicator for prioritization. After prioritizing and finding which indicator is needed to be fixed, the solution is proposed based on the cause of the problem by suggesting multiple journal-based solutions.

Table 23. Solution Based on Indicators Problem

Indicator	**Solution**
SS.1.005 Total Supply Chain % of Recycled Input Materials Used	Feed Preservation, using BASF technique on feed preservation on quail food to reduce the probability of feed spoiled by drying out the feed BASF (2016).
SS.1.007 Total Supply Chain Energy Consumed	Visual Number Feedback, bring awareness to worker on how much electricity is consumed per day by visually giving feedback to them how much electricity has been used Peterson et al. (2007). Off On Automation, installing an automated sensor electronic such as a light bulb to automatically turn off light if there is no one present.

SS.1.008 Total Supply Chain Non-Renewable Energy Consumed	Downsizing, downsizing by reconfiguring electronic control unit to consume less fuel Silva et al. (2009). Stop-Start, a technique of shutting off a vehicle when not moving, like an idle stop Silva et al. (2009). Fuel Cut, installing a custom mechanism to automatically reduce or add fuel base on the vehicle speed Silva et al. (2009).
SS.1.012 Total Supply Chain Water Withdrawn	Visual Number Feedback, bring awareness to worker on how much water they consume per day by visually giving feedback to them on how much water has been used Schultz et al. (2014).
SS.1.026 Total Supply Chain Hazardous Waste	Reduce the number of poultry in the cage, by reducing the number of quail in the cage based on how much big the cage is using a proposed size of quail per cm to reduce stress and increase ventilation Kunz (1999). Adding polyene on feed reduces the mortality rate that is caused by ascites disease, which causes bloating of quail Kunz (1999).

5.1.1 SS.1.001 Total Supply Chain Materials Used Discussion

This indicator can be seen in Table 13, that shows the absence of gap between the actual and target value in Make with 0 Kg and above the target value in Deliver business process with 52.17 Kg. This means that this indicator has fully reached the targeted KPI. This indicator discusses the materials used in both Make and Deliver business processes, in this case, in Make process is about the quail food materials, and in Deliver process is about the quail tray used in delivering quail eggs. Because both of these KPIs have fully reached the targeted KPI, it is recommended for them to maintain that performance or even get more better by trying to do forecasting in the materials to ensure that the materials used for the present and future have a rough idea of how much it will be used.

5.1.2 SS.1.005 Total Supply Chain % of Recycled Input Materials Used Discussion

This indicator can be seen in Table 13 that this indicator has a gap between the actual value and the target value of about 16,15%. This means that this indicator still is not able to fully reach the target KPI. This indicator discusses the recycled input materials that are used for the operation, which in this case is the quail food. It is found that the leftover food that has been used for other days can still be used for another time, but some cannot be used because some quail foods have gone spoiled due to a complex process of microbial spoilage (Gram et al., 2002). To solve this problem, we need to control a few parameters for preservation, such as the temperature, atmosphere, and pH level (Gram et al., 2002). We can use BASF (2016) guide to feeding preservation. In accordance with this guide, a recommended way to preserve animal feed to prevent spoil is below:

1. Pick a place that is inside a building and place a layer of plastic sheet on the floor and apply an acid-resistant coating.
2. Place the leftover feed on top of the sheet and let it dry with some help of a fan to reduce moisture in the feed so that bacteria and other microorganisms perish.
3. After the feed is dry, place it inside an enclosed box (recommended to use an acid-resistant coating box such as glass, enamel, or plastic) and close the lid.
4. Place the box in a storage place.

By following this guide, it can be ensured that leftover of quail food will not spoiled in such a fast pace and can be used again to feed the quail and in turn will reduce cost for buying more quail feed in the future.

5.1.3 SS.1.006 Total Supply Chain % of Reclaimed Products and Their Packaging Materials

For this indicator, it can be seen in table 13 that this indicator does not have a gap between the actual and target value of 0 %. This means that this indicator has fully reach the target KPI. This indicator discusses how much products and their packaging are reclaimed. The product, in this case, the quail egg, and the packaging, which is the quail tray. Because this KPI has fully reached the targeted KPI, it is recommended to maintain that performance or even improving it by forecasting products will be sold and the packaging used for the present and future time in order to have a rough idea on how much the products will be sold.

5.1.4 SS.1.007 Total Supply Chain Energy Consumed Discussion

For this indicator, it can be seen in table 13 that this indicator has a gap between the actual value and the target value of about 344 kWh. This means that this indicator still is not able to fully reach the target KPI. This indicator discusses the electricity usage of the quail farm, and it is found that the consumption of electricity usage is over the target KPI because of a lack of awareness. In the study of Peterson et al. (2007), electricity overconsumption is only due to human lack of awareness, and to reduce electricity consumption is through behavior changes. One of the ways to change behavior is by giving real-time feedback on the data. This real-time feedback also needs to be combined with education and incentives interest to empower the owner to reduce the usage of electricity consumption (Peterson et al., 2007). By implementing digital real-time feedback on the facility, the owner will likely reduce the consumption of electricity by turning off the light or other unused electronic devices, which will lead to lower energy consumption, lower electricity fee, and indirectly help lower carbon emissions to products and the electricity that is used.

5.1.5 SS.1.008 Total Supply Chain Non-Renewable Energy Consumed Discussion

This indicator can be seen in Table 13 that there is 2 level 2 indicators, which are in the Deliver and Return process. Both of them have gap between the actual value and the target value of about 18.5 Liter, respectively. This means that this indicator is still unable to fully reach the targeted KPI. This indicator discusses the fuel consumption of transportation that is used by the company to deliver and return their product from their customer. And it is found that the fuel consumption has exceeded the target fuel consumption per month. The main problem that causes this problem is the driver usage of the vehicle, which the vehicle in question is a light-duty vehicle called Mitsubishi L300, a diesel-based engine that uses solar fuel. Silva et al. (2009) discussed the strategies to lower fuel consumption; there are several strategies to be used, but only the strategies that are suitable for a diesel-based engine vehicle are chosen, which are fuel cut, stop-start, and downsizing. Silva et al. (2009) explained that the fuel-cut strategy adds a system that automatically cuts fuel injection, which in return lower the fuel consumption of the vehicle. The stop-start strategy is generated by adding a mechanism that can be an idle stop or a manual stop-start where the driver manually shut down the engine where the vehicle is not moving such situation can be when in a traffic stop or if there is a traffic jam which in return the vehicle will not unnecessarily consume fuel when the vehicle is not moving, and for the last strategy is by downsizing where the car downsizes the use of fuel by either downsizing the engine or the cheaper way is by remapping the engine control unit or ECU which will lower the fuel consumption. By using this strategy that Silva et al. (2009) have created the lower fuel consumption and will lower the bill of fuel. It eventually will help the environment by lowering the carbon pollution.

5.1.6 SS.1.012 Total Supply Chain Water Withdrawn Discussion

For this indicator, it can be seen in table 13 that this indicator has a gap between the actual value and the target value of about 7.508 Liter. This means that this indicator still is not able to fully reach the target KPI. This indicator discusses the water consumption of the quail farm. Water consumption is mainly used for quail consumption, food processing, and facility cleaning. It is found that the water consumption of this company, based on the data collected, uses excessive water for many things, which exceeded the target consumption per month. The study of Schultz et al. (2014) about the social norm of water conservation explained that to reduce water consumption, he tries a field experiment in which the residents are provided with personalized feedback with information about how much water that is used personally. The result shows that after the resident are shown the number of water consumption that they use will consume less water. By using this study, I can apply the same to the quail farm with the added visual feedback on how much water is consumed per month. By doing this feedback method, it should bring more awareness and thus reduce water consumption, which will conserve , the environment's water.

5.1.7 SS.1.025 Total Supply Chain Non-Hazardous Waste

For this indicator, it can be seen in table 13 that this indicator is above the target value of 4.935 Kg. This means that this indicator has fully reached the target KPI. This indicator discusses how much non-hazardous waste is produced in the quail farm; this can include quail eggs, quail eggshell, leftover material, and other waste products. Because this KPI has fully reached the target KPI it is recommended for them to maintain that performance or even get more better by trying to be not wasteful on the materials used, be more careful on handling the egg to not get it broken.

5.1.8 SS.1.026 Total Supply Chain Hazardous Waste Discussion

For this indicator, it can be seen in table 13 that this indicator has a gap between the actual value and the target value of about 2 Kg. This means that this indicator still is not able to fully reach the target KPI. This indicator discusses the amount of hazardous waste that is produced by the quail farm, which this hazardous waste is mainly quail birds. Dead quail birds needed to be disposed of immediately because of the presence of harmful microorganisms. When the bird dies, the microorganisms can spread to other animals, which is why it is considered hazardous to the surrounding bird and the facility. According to Kunz (1999), the main factor for commercial poultry death is stress that is caused by the density of the poultry in the enclosure, insufficient ventilation, and disease such as ascites. Kunz (1999) gave a solution to this problem which first reducing the stress of poultry by expanding its cage. Therefore, it is recommended a size of 0.6 square feet, around 557.4 square centimeters per poultry animal such as chicken, quail, and any other bird that have around the same size as a chicken; which this will help the poultry to have more space in the enclosure and get sufficient ventilation because of the amount of quail in the same cage. Therefore, to tackle the disease problem, Kunz (1999) explains that one of the diseases that commonly infect the commercial poultry industry is a disease called ascites. Ascites is a condition where fluids collect in the abdomen, causing swelling, nausea, vomiting, and other difficulties. To prevent poultry from getting this disease Kunz (1999) recommended using a polyene material such as natamycin in a regular basis when feeding with a recommended size of 10 grams of natamycin per pound or around 453.5 grams of feed to the poultry to reduce the overall mortality rate. So, reducing the stress of the poultry and preventing disease before it catches up, will help reduce the mortality rate of the quail bird, which in turn helps lower hazardous waste.

5.1.9 Cost of Solution Discussion

Based on the solution that I have suggested, below shows the cost needed to implement the farming in CV. Vigaza quail farm. Some of the solutions that have been suggested are one-time installation, and some are daily or monthly costs. Below shows the table regarding the cost of each solution.

Table 24. Cost of Solution for Each Key Performance Indicator

Indicator	Solution	Needed	Cost	Description
SS.1.005 Total Supply Chain % of	Feed Preservation, using BASF technique on	Aluminum foil (120cm x 120cm)	Rp. 3.700/day Rp. 114.700/month	120 x 120 cm aluminum foil will be used daily as a base

Recycled Input Materials Used	feed preservation on quail food to reduce the probability of feed spoiled by drying out the feed BASF (2016).			to dry up the quail feed, which will be put outside on the sun to remove moisture from the quail feed. This will help reduce the cost of buying new quail feed and reduce waste.
SS.1.007 Total Supply Chain Energy Consumed	Visual Number Feedback, bring awareness to worker on how much electricity have been consume per day by visually giving feedback to them on how much electricity has been used Peterson et al.	LED bulb motion proforce moving sensor 11W (14 pieces)	Rp. 35.000/pcs	14 lightbulbs will be installed, which will automatically turn off on its own, which help reducing the consumption of electricity, which will reduce cost.

	(2007). Off On Automation, installing an automated sensor electronic such as a light bulb to automatically turn off the light if there is no one present.	Electricity Monitor (1 piece)	Rp. 195.000/pcs	Electricity monitor will be installed once, which will help workers to identify how much electricity is used daily.
SS.1.008 Total Supply Chain Non-Renewable Energy Consumed	Downsizing, downsizing by reconfiguring electronic control unit to consume less fuel Silva et al. (2009). Stop-Start, a technique of shutting off vehicle when not moving like an idle stop Silva et al. (2009). Fuel Cut, installing a custom mechanism to automatically	Remapping Downsize Electrical Component Unit GrandMax Pickup (1 piece)	Rp. 2.850.000/pcs	Remapping of ECU is done once which will help reduce the use of fuel on the vehicle, thus reducing the cost of buying more fuel.
		Fuel Cut Grand Max Pickup (1 piece)	Rp. 900.000/pcs	Fuel cut will be installed to help the driver to automatically turn off and on quickly to reduce fuel consumption

	reduce or add fuel base on the vehicle speed Silva et al. (2009).			when standby which will help reduce cost.
SS.1.012 Total Supply Chain Water Withdrawn	Visual Number Feedback, bring awareness of worker on how much water they consume per day by visually giving feedback to them on how much water has been used Schultz et al. (2014).	Flowmeter (1 piece)	Rp. 3.500.000/pcs	Flowmeter will be installed once which will help monitor how much water has been consumed daily.
SS.1.026 Total Supply Chain Hazardous Waste	Adding polyene to feed, reduce the mortality rate that is caused by ascites disease, which caused	Polyene Medicine (2 bottles)	Rp. 295.000/pcs Rp. 590.000/month	Polyene will be bought 2 times per month which will help with the disease of ascites that can kill the quail

	bloating of quail Kunz (1999).			and prevent the spread of the disease to other quail bird.

CHAPTER VI

CONCLUSION AND SUGGESTION

6.1 Conclusion

Based on the research that has been done, the conclusion can be drawn as follows:

1. Based on the supply chain of CV. Vigaza quail farm, the indicators that are used for this research in order to find the performance score of green supply chain management which the indicator are referred to the APICS (2017) books about supply chain management sustainable SCOR are:
   - Total Supply Chain Materials Used in the Make and Deliver business process which discusses how many materials are used, which in this case, quail feed and quail egg tray in the supply chain.
   - Total Supply Chain % of Recycled Input Materials Used in the Make business process, which discusses how many the recycled materials are used, which in this case, quail feed in the supply chain.
   - Total Supply Chain % of Reclaimed Products and Their Packaging Materials in the Return business process, which discusses how many products and their packaging are reclaimed, which in this case, quail egg and quail egg tray in the supply chain.
   - Total Supply Chain Energy Consumed in the Make business process, which discusses how much energy is consumed, which in this case is electricity in the supply chain.
   - Total Supply Chain Non-Renewable Energy Consumed in the Deliver and Return business process, which discussed how much non-renewable energy is consumed, which in this case, vehicle fuel in the supply chain.
   - Total Supply Chain Water Withdrawn in Make business process, which discusses how much water is taken from the environment and used in the supply chain.
   - Total Supply Chain Non-Hazardous Waste in Make business process which discusses on how much non-hazardous waste is

produced, such as quail eggshell, quail waste, plastic, and others in the supply chain.

- Total Supply Chain Hazardous Waste in Make business process which discusses how much hazardous waste is produced, such as dead quail in the supply chain.

2. Based on the gap analysis of the indicators, it is found that out of 10 level 2 indicators is that 4 indicators have reached or exceeded the targeted KPIs, which include:
   - Total Supply Chain Materials Used in Make business process.
   - Total Supply Chain Materials Used in Deliver business process.
   - Total Chain % of Reclaimed Products and Their Packaging Materials in Return business process.
   - Total Supply Chain Non-Hazardous Waste in Make business process.

   The other 6 out of 10 indicators have not reached the targeted KPIs, which include:
   - Total Supply Chain % of Recycled Input Materials Used in Make business process.
   - Total Supply Chain Energy Consumed in Make business process.
   - Total Supply Chain Non-Renewable Energy Consumed in Deliver business process.
   - Total Supply Chain Non-Renewable Energy Consumed in Return business process.
   - Total Supply Chain Water Withdrawn in Make business process.
   - Total Supply Chain Hazardous Waste in Make business process.
3. Based on the calculation of the analytical hierarchy process and snorm de boer. The total green supply chain management performance score is 84,30% which is in the above 80 performance score range is categorized as good, this means the improvement is necessary but not in a short time.

4. Based on the discussion, it is found 5 level 1 metric indicators that have not met the targeted KPI. The proposed solutions for those indicators are:
   - For the indicator of Total Supply Chain Material % of Recycled Input Materials Used, it is proposed to use the guide from BASF (2016) about animal feed preservation by drying out the moisture so that microbial do not spoil the animal feed.
   - In Total Supply Chain Energy Consumed indicator proposed solutions is to install a digital feedback mechanism to deal with the worker lack of awareness on the usage of the electricity.
   - In Total Supply Chain Non-Renewable Energy Consumed proposed solutions is to use three techniques that Silva et al. (2009) proposed, which are fuel cut, stop-start, and downsizing to lower fuel consumption.
   - In Total Supply Chain Water Withdrawn indicator proposed solutions is to install a digital feedback mechanism to deal with the worker's lack of awareness of the usage of water.
   - In Total Supply Chain Hazardous Waste indicator proposed solutions is to deal with the quail stress by expanding the cage of the quail bird and disease by adding a polyene such as natamycin to reduce the mortality rate.

6.2 Suggestions

Suggestions that the researcher give for other researcher and the company are:

1. For other researchers who want to do similar research, it is suggested to be carried out in a PT-scale company (Persearoan Terbatas) to have many and more accurate data, which will generate a more accurate output. Later, all indicators on APICS (2017) Sustainable SCOR indicators can be employed.
2. For company, to make improvements based on the performance of each indicator in the supply chain for the development of the company.

REFERENCES

Amit, S. (2019, July 22). *Quail Farming Business is a profitable business for small and landless farmers*. Poultry Punch English Monthly Magazine. https://www.thepoultrypunch.com/2019/07/quail-farming-business-is-the-profitable-business-for-small-and-landless-farmers/

Amit, S. (2020, September 14). *Poultry Farm Waste Disposal Management*. Poultry Punch English Monthly Magazine. https://www.thepoultrypunch.com/2020/09/poultry-farm-waste-disposal-management/

Arjuna, et al. (2022). Green Supply Chain Performance Measurement using Green SCOR Model in Agriculture Industry: A Case Study. *Jurnal Teknik Industri Jurnal Keilmuan Dan Terapan Teknik Industri*, *24*(1), 53-60. https://doi.org/10.9744/jti.24.1.53-60

APICS. (2017). *APICS Supply Chain Operations Reference Model SCOR Version 12.0*.

BASF. (2016). *Guide to Feed Preservation Solutions for Agricultural Operations.* BASF SE.

Bayhaqi, I. (2020). Perancangan Key Performance Indicators Sebagai Sistem Penilaian Kinerja di PT. Inti Isawit Subur. *Journal of Industrial View, 2*(2), 1-11. https://doi.org/10.26905/4826

Baziotopoulos, et al. (2004). Overseas Assembly Production Choices. *Contemporary Economic Policy*, *23*(3), 394-403. https://doi.org/10.1093/cep/byi029

Behn, R. D. (2003). Why Measure Performance? Different Purposes Require Different Measures. *Public Administration Review*, *63*(5), 586-606. https://doi.org/10.111/1540-6210.00322

Bhushan, N., & Kanwal, R. (2004). *Strategic Decision Making: Applying the Analytical Hierarchy Process*. Springer Science & Business Media.

Cruz, V. D., et al. (2021). Green Supply Chain Operations Reference (G-SCOR): An Application for Small Garment Manufacturers in the Philippines. *IEOM Society International*. 4187-4198

Darmanto, E., et al. (2014). Penerapan Metode AHP (Analytical Hierarchy Process) Untuk Menentukan Kualitas Gula Tumbu. *Jurnal Teknik Industri, Mesin, Elektro Dan Ilmu Komputer, 5*(1), 75-82. https://doi.org/10.24176/simet.v5i1.139

Dipura, S., & Soediantono, D. (2022). Benefit of Key Performance Indicators (KPI) and Proposed Applications in the Defense Industry: A Literature Review. *International Journal of Social and Management Studies, 3*(4), 23-33. https://doi.org/10.5555/ijomas.v3i4.146

Dolence, M. G., & Norris, D. M. (1994). Using Key Performance Indicators to Drive Strategic Decision Making. *New Directions for Institutional Research, 1994*(82), 63-80. https://10.1002/ir.37019948207.

Febrianti, F. F., et al. (2018). Penerapan Model Green SCOR untuk Pengukuran Kinerja Green Supply Chain Management pada PT. XYZ. *Jurnal Informatika Merdeka Pasuruan, 3*(3), 39-44. https://dx.doi.org/10.37438/jimp.v3i3.164

Fitriani R. N., et al. (2022). Performance Evaluation and Measurement of SMEs King of Honey Using the Green SCOR Method. *Journal of Soft Computing Exploration, 3*(1), 12-18. https://doi.org/10.52465/joscex.v3il.63.

Fitz-Gibbon, C. (1990). *Performance Indicators* (2 ed.). BERA Dialogues

Flink, F. (2020). [In an Efficient Supply Chain Agreements are Aligned]. Wikipedia. https://en.wikipedia.org/wiki/Supply_chain_management#/media/File:Supply_and_demand-stacked4.png

Forman, E. H., & Sail, I. G. (2001). The Analytical Hierarchy Process-An Exposition. *Operations Research, 49*(4), 469-487. https://doi.org/10.1287/opre.49.4.469.11231

Gram, L., et al. (2002). Food Spoilage-Interactions Between Food Spoilage Bacteria. *International Journal of Food Microbiology, 78*(1-2), 79-97. https://doi.org/10.1016/S0168-1605(02)00233-7

Gunasekaran, A., & Splanzani, A. (2012). Sustainability of Manufacturing and Services: Investigations for Research and Applications. *International Journal of Production Economics, 140*(1), 35-47. https://doi.org/10.1016/j.ijpe.2011.05.011

Harland, C. M. (1996). Supply Chain Management, Purchasing and Supply Management, Logistics, Vertical Integration, Material Management, and Supply Chain Dynamics.

Hemold, M., & Terry, B. (2016). *Global Sourcing and Supply Management Excellence in China: Procurement Guide for Supply Experts*. Springer.

Hidayat, S., et al. (2017). Determination of Key Performance Indicator with Balanced Scorecard Approach in Public Sector. *Journal Aplikasi Manajemen, 15*(2), 290-300. https://dx.doi.org/10.21776/ub.jam.2017.015.02.13

Ikhwan. (2019, January 4). *Ternak Puyuh: Peluang Usaha di Masa Pandemi*. DataCore Indonesia. https://datacore.id/2021/01/01/ternak-puyuh-peluang-usaha-di-masa-pandemi/

Imane, T., & Fouad, J. (2021). Analysis of Green Supply Chain Management Pratices in Automotive Industry Based on Green SCOR Model. *IOEM Society International*, 3363-3369.

Jorge-Garcia, D., & Estruch-Guitart, V. (2022). Comparative Analysis Between AHP and ANP in Prioritization of Ecosystem Services – A Case Study in a Rice Field Area Raised in the Guadalquivir Marshes (Spain). *Ecological Informatics, 70*. https://doi.org/10.1016/j.ecoinf.2022.101739.

Kaplan, R. S., & Norton, D. P. (1996). *Using the Balanced Scorecard as a Strategic Management System*. Harvard Business Review. https://hbr.org/2007/07/using-the-balanced-scorecard-as-a-strategic-management-system

Kaushik, A., et al. (2014). Technology Transfer: Enablers and Barriers-A Review. *International Journal of Technology, Policy, and Management, 14*(2), 133-159. https://doi.org/10.1504/IJTPM .2014.060152

Khan, S. A. R. (2018). Introductory Chapter: Introduction of Green Supply Chain Management. *IntechOpen*. https://doi.org/10.5772/intechopen.81088.

Khan, S. A. R., et al. (2017). [Simple Model of GSCM]. IntechOpen. https://www.intechopen.com/chapters/63678

Khan, S. A. R., et al. (2017). Environmental Logistics Performance Indicators Affecting Per capita Income and Sectoral Growth: Evidence from a Panel of Selected Global Ranked Logistics Countries. *Environmental Science and Pollution Research, 24*(2), 1518-1531. https://doi.org/10.1007/s11356-016-7916-2

Kozlenkova, I., et al. (2015). The Role of Marketing Channels in Supply Chain Management. *Journal of Retailing, 91*(4), 586-609. https://doi.org/10.1016/j.jretai.2015.03.003.

Kumar, A., et al. (2014). A Comprehensive Environment Friendly Approach for Supplier Selection. *Omega, 42*(1), 109-123. https://doi.org/j.omega.2013.04.003

Kunz, G. L. (1999). *Methods For Reducing Mortality Rates in Poultry*. (United States Patent No. US 5985845).

Luthra, S., et al. (2016). The Impacts of Critical Success Factors for Implementing Green Supply Chain Management Towards Sustainability: An Empirical Investigation of Indian Automobile Industry. *Journal of Cleaner Production, 121*, 142-158. https://doi.org/10.1016/j.jclepro.2016.01.095

MacDuffie, J., & Helper, S. (1997). Creating Lean Suppliers: Diffusing Lean Production Through the Supply Chain. *California Management Review, 39*(4), 1-37. https://doi.org/10.2307/41165913.

Madaan, J., & Mangla, S. (2015). Decision Modelling Approach for Eco-Driven Flexible Green Supply Chain. *Systematic Flexibility and Business Agility*, 343-364. https://doi.org/10.1007/978-81-322-2151-7_21

Mangla, S. K., et al. (2014). Flexible Decision Approach for Analyzing Performance of Sustainable Supply Chains Under Risks/Uncertainty. *Global Journal of Flexible Systems Management, 15*(2), 113-130. https://doi.org/10.1007/s40171-014-0059-8

Medori, D., & Steeple, D. (2000). A Framework for Auditing and Enhancing Performance Measurement Systems. *International Journal of Operations &*

Production Management, 20(5), 520-533. https://doi.org/10.1108/01443570010318896

Moullin, M. (2002). *Delivering Excellence in Health and Social Care*. Open University Press.

Mustaniroh, S. A., et al. (2019). Evaluasi Kinerja pada Green Supply Chain Management Susu Pasteurisasi di Koperasi Agro Niaga Jabung. *IndustriaL Jurnal Teknologi dan Manajemen Agroindustri, (8)*1, 57-66. https://doi.org/10.21776/ub.industria.2019.008.01.7

Natalia, C., & Astuario, R. (2015). Penerapan Model Green SCOR untuk Pengukuran Kinerja Green Supply Chain. *Jurnal Metris, 16*, 97-106.

Neely, A. D., et al. (2002). *The Performance Prism the Scorecard for Measuring and Managing Stakeholder Relationships*. Financial Times/Prentice Hall.

Omkareshwar, M. (2013). Green Marketing Initiatives by Corporate World: A Study. *Advances in Management 6*(3), 20-26.

Pebakirang S. A. M., et al. (n. d.). Penerapan Metode AHP (Analytical Hierarchy Process) Untuk Pemilihan Supplier Suku Cadang di PLTD Bitung. *Jurnal Online Porso Teknik Mesin, 6*(1), 32-44.

Peterson J. E., et al. (2007). Dormitory Residents Reduce Electricity Consumption When Exposed to Real-Time Visual Feedback and Incentives. *International Journal of Sustainability in Higher Education, 8*(1), 17-32. https://doi.org/10.1108/14676370710717562

Primadasa, R., & Sokhibi, A. (2020). *Model Green SCOR Untuk Pengukuran Kinerja Green Supply Chain Management (GSCM) Industri Kelapa Sawit di Indonesia*. *Quantum Teknika, 1*(2), 55-62. https://doi.org/10.18196/jqt.010209.

Putri, N. T., et al. (2012). Perancangan Standar Penilaian Kinerja Pemeliharaan Lampu Jalan Berdasarkan Key Performance Indicators (KPI'S) (Studi Kasus di Kota Padang). *Jurnal Optimasi Sistem Industri, 11*(2), 225-234. https://doi.org/10.25077/josi.v11.n2.p225-234.2012

Reh, F. J. (2020, March 19). *How key performance indicators work*. The Balance Careers.

Rostamzadeh, R., et al. (2015). Applications of Fuzzy VIKOR for Evaluation of Green Supply Chain Management Practices. *Ecological Indicators, 49*, 188-203. https/doi.org/10.1016/j.ecolind.2014.09.045

Saaty, & Tomas, L. (1983). *Decision Making for Leader: The Analytical Hierarchy Process for Decision in Complex World*. RWS Publication.

Saaty, & Tomas, L. (2008). *Group Decision Making: Drawing out and Reconciling Differences*. RWS Publications.

Sadeghi, J., et al. (2016). Optimizing and Inventory Model with Fuzzy Demand, Backordering, and Discount Using Hybrid Imperialist Competitive Algorithm. *Applied Mathematical Modelling, 40*(15-16), 7318-7335. https://doi.org/10.1016/j.apm.2016.03.013

Sanders, N. R., & Wagner, S. M. (2011). Multidisciplinary and Multimethod Research for Addressing Contemporary Supply Chain Challenges: Multidisciplinary and Multimethod Research. *Journal of Business Logistics, 32*(4), 317-323. https://doi.org/10.1111/j/0000-0000.2011. 01027. x

Saracoglu, B. O. (2013). Selecting Industrial Investment Locations in Master Plans of Countries. *European Journal of Industrial Engineering, 7*(4), 416-441. https://doi.org/10.1504/EJIE.2013.055016

Sarkis, J., et al. (2011). An Organizational Theoretic Review of Green Supply Chain Management Literature. *International Journal of Production Economics, 130*(1), 1-15. https://doi.org/10.1016/j.ijpe.2010.11.010

Schultz P. W., et al. (2014). Personalized Normative Feedback and the Moderating Role of Personal Norms: A Field Experiment to Reduce Residential Water Consumption. *Environment and Behaviour*, 12(5), 1-15. https://doi.org/10.1177/0013916514553835

Schrodl, H., & Simkin, P. (2013). A SCOR Perspective on Green SCM. *International Conference on Information Resources Management (CONF-IRM)*, 1-13.

Shen, L., et al. (2015). Evaluation of Barriers of Corporate Social Responsibility Using an Analytical Hierarchy Process Under a Fuzzy Environment-A

Textile Case. *Sustainability*, *7*(3), 3493-3514. https://doi.org/10.3390/su7033493

Silva, C., et al. (2009). Analysis and Simulation of “Low-Cost” Strategies to Reduce Fuel Consumption and Emissions in Conventional Gasoline Light-Duty Vehicles. *Energy Conversion and Management*, *50*(2), 215-222. https://doi.org/10.1016/j.enconman.2008.09.046

Singh, R. (2022, 2 May). *Quail Farming for Income, Health and Happiness*. Pashuhanpharee. https://www.pashudhanpraharee.com/quail-farming-for-income-health-and-happiness/#:~:text=The%20term%20%27quail%20farming%27%20means,smallest%20species%20of%20poultry%20birds.

Slack, N. (n.d.). *Blackwell Encyclopaedic Dictionary of Operations Management*. Blackwell.

Srivastava, S. K. (2007). Green Supply-Chain Management: A State-of-the-Art Literature Review. *International Journal of Management Review*, *9*(1), 53-80. https://doi.org10.1111/j.1468-2370.2007.00202. x

Suryadi, K. & Ramdhani, M. A. (1998). *Sistem Pendukung Keputusan: Suatu Wacana Struktural Idealisasi dan Implementasi Konsep Pengambilan Keputusan.* Remaja Rosdakarya.

Trienekens, J. H., & Hvolby, H. (2000). *Performance Measurement and Improvement in Supply Chains*. RWS Publications.

UNEP. (2003). *GreenSCOR: Developing a Green Supply Chain Analytical Tool Report (LG101T4)*. United Nations Environment Programme (UNEP).

Vachon, S., & Klassen, R. D. (2006). Extending Green Practices Across the Supply Chain: The Impact of Upstream and Downstream Integration. International *Journal of Operations & Production Management*, *26*(7), 795-821. https://doi.org/10.1108/01443570610672248.

Weilkins, T., et al. (2016). Frameworks. *OCEB 2 Certification Guide*, 149-169. https://doi.org/10.1016/b978-0-12-805352-2.00007-8.

White Paper. (2015). *Key Performance Indicators Establishing the Metrics that Guide Success*. CA Technologies.

APPENDIX

1. Data Total Supply Chain Materials Used

1 response

Dalam proses Make
Target material pakan terpakai per bulan adalah 7000 Kg atau 7 Ton

Januari: 7000 Kg
Februari: 7000 Kg
Maret:7000 Kg
April: 7000 Kg
Mei: 7000 Kg
Juni: 7000 Kg

Dalam proses Deliver
Target material tray telur puyuh terpakai per bulan adalah 4000 tray puyuh atau 457 Kg

Januari: 3868 unit atau 442,06 Kg
Februari: 4070 unit atau 465,14 Kg
Maret: 4024 unit atau 459,89 Kg
April: 3720 unit atau 425,14 Kg
Mei: 4046 unit atau 462,49 Kg
Juni: 3886 unit atau 444,11 Kg

Figure 8. Total Supply Chain Materials Used Questionnaire and Answer

2. Data Total Supply Chain % of Recycled Input Materials Used

1 response

Target pemakaian material yang dapat didaur ulang adalah seluruhnya material yang dipakai

Material sisa pakan

Januari: 1275 Kg
Februari: 1301 Kg
Maret: 1267 Kg
April: 1275 Kg
Mei: 1307 Kg
Juni: 1279 Kg

Material sisa pakan yang didaur ulang lalu dipakai

Januari: 1002 Kg
Februari: 1134 Kg
Maret: 998 Kg
April: 1079 Kg
Mei: 1153 Kg
Juni: 1094 Kg

Figure 9. Total Supply Chain % of Recycled Input Materials Used Questionnaire and Answer

3. Data Total Supply Chain % of Reclaimed Products and Their Packaging Materials

1 response

Target barang yang bisa di ambil balik adalah 0 karena diharapkan seluruh barang terjual tanpa ada pengembalian

Barang yang terjual:

Januari: 1705 Kg
Februari: 1624 Kg
Maret: 1911 Kg
April: 1738 Kg
Mei: 1895 Kg
Juni: 1650 Kg

Barang yang diambil balik:

Januari: 0 Kg
Februari: 0 Kg
Maret: 0 Kg
April: 0 Kg
Mei: 0 Kg
Juni: 0 Kg

Figure 10. Total Supply Chain % of Reclaimed Products and Their Packaging Materials Questionnaire and Answer

4. Data Total Supply Chain Energy Consumed

1 response

Dalam proses Make
Target listrik yang digunakan adalah 370kWh perbulan

Januari: 453kWh
Februari: 394 kWh
Maret: 419 kWh
April: 444 kWh
Mei: 425 kWh
Juni: 429 kWh

Figure 11. Total Supply Chain Energy Consumed Questionnaire and Answer

5. Data Total Supply Chain Non-Renewable Energy Consumed

1 response

Dalam proses Deliver
Target bensin yang digunakan adalah 20 Liter per bulan

Januari: 22,5 Liter
Februari: 21,5 Liter
Maret: 25 Liter
April: 23 Liter
Mei: 24 Liter
Juni: 22,5 Liter

Dalam proses return
Target bensin yang digunakan adalah 20 Liter per bulan

Januari: 22,5 Liter
Februari: 21,5 Liter
Maret: 25 Liter
April: 23 Liter
Mei: 24 Liter
Juni: 22,5 Liter

Figure 12. Total Supply Chain Non-Renewable Energy Consumed Questionnaire and Answer

6. Data Total Supply Chain Water Withdrawn

1 response

Dalam proses Make
Target air yang ditarik dengan pompa air dalam sumur adalah 15000 Liter

Januari: 16749 Liter
Februari: 15319 Liter
Maret: 16384 Liter
April: 17185 Liter
Mei: 16631 Liter
Juni: 15240 Liter

Figure 13. Total Supply Chain Water Withdrawn Questionnaire and Answer

7. Data Total Supply Chain Non-Hazardous Waste

1 response

Dalam proses Make
Target limbah tidak berbahaya yang dihasilkan per bulan adalah 15000 Kg atau 15 Ton

Januari: 15372 Kg
Februari: 16634 Kg
Maret: 14640 Kg
April: 15294 Kg
Mei: 14555 Kg
Juni: 15570 Kg

Figure 14. Total Supply Chain Non-Hazardous Waste Questionnaire and Answer

8. Data Total Supply Chain Hazardous Waste

1 response

Dalam proses Make
Target limbah berbahaya yang dihasilkan per bulan adalah 5 burung puyuh mati karena penyakit atau dibawah 0.5 Kg.

Januari: 8 puyuh atau 0.8 Kg
Februari: 11 puyuh atau 1.1 Kg
Maret: 6 puyuh atau 0.6 Kg
April: 5 puyuh atau 0.5 Kg
Mei: 10 puyuh atau 1 Kg
Juni: 10 puyuh atau 1 Kg

Figure 15. Total Supply Chain Hazardous Waste Questionnaire and Answer