

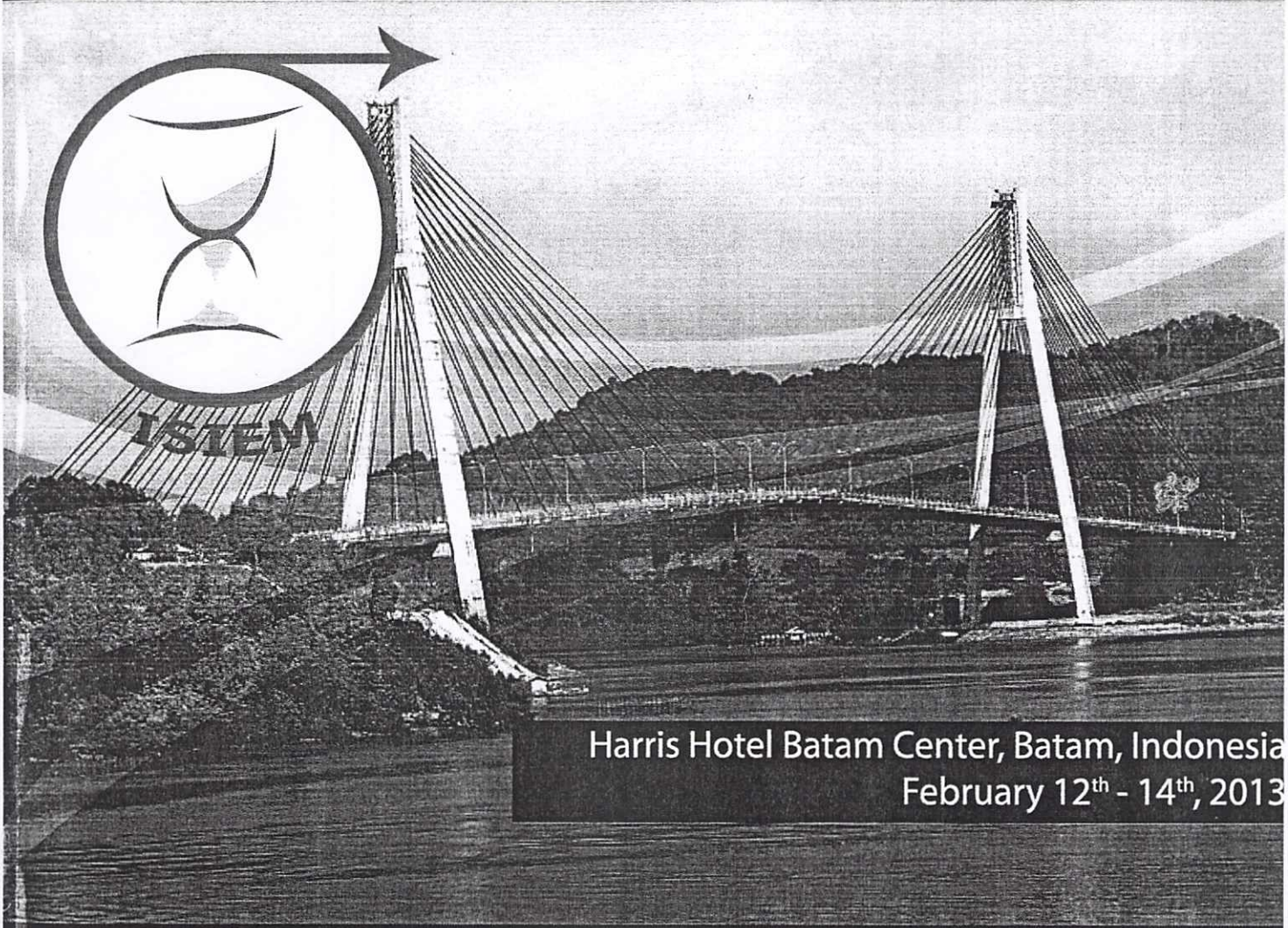
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# Proceeding

**6<sup>th</sup> INTERNATIONAL SEMINAR ON INDUSTRIAL ENGINEERING AND MANAGEMENT (6<sup>th</sup> ISIEM)**

*"Sustainable innovation on enhancing industrial management, technology, and information"*



Harris Hotel Batam Center, Batam, Indonesia  
February 12<sup>th</sup> - 14<sup>th</sup>, 2013

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# FOREWORD

In this 6<sup>th</sup> International Seminar on Industrial Engineering and Management (ISIEM) Seminar issues is **Sustainable on Enhancing Industrial Management, Technology, and Information**, and wide area of Industrial Engineering including Quality Engineering, Supply Chain Management, Production System, Operation Research, Decision Support System, Ergonomics, Artificial Intelligent, Industrial Management, and Entrepreneurship.

All of papers received were review by a peer of reviewers and published for 55 papers from various Indonesian University and abroad, and be presented by 52 presenters.

Historical, the ISIEM is an annual seminar event organized by 6 universities that run Industrial Engineering Department, which are Triskati University Jakarta, Atmajaya Catholic University Jakarta, Tarumanagara University Jakarta, Esa Unggul University Jakarta, Al-Azhar Indonesia University Jakarta, and Pasundan University Bandung. The seminar took different places annually in all over Indonesia.

I would like to thank you to all committees for the efforts, all Reviewers, Mr. Predeep Nair from Schneider Manufacture Batam, Prof. Dr. Rosnah Mohd. Yusuff from Department of Mechanical and Manufacturing Engineering Universiti Putra Malaysia, Prof. Frits Blessing from Rotterdam University/Rotterdam Business School, for the Keynote Speeches, all Participants to join the Seminar, and everybody who helped us to make this seminar happen.

At last, enjoy your stay in Batam and have a good Seminar.

Ir. Wahyukaton, MT.  
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**QM**  
**Quality Engineering &**  
**Management**

## DESIGNING GREEN SUPPLY CHAIN MANAGEMENT IN COCOA AGROINDUSTRY : PROBLEM IDENTIFICATION AND PROFILING

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### ABSTRACT

*Cocoa agroindustry supply chain in Indonesia has many problems such as the complexity of the cocoa supply chain, relying on many discrete actors before the finished product is complete and there are amount of waste produced from the cacao plant, distribution and processing of cocoa beans. So it is necessary to make a green supply chain for minimization transportation costs, maximizing profits, minimization waste and just in time.*

*The purpose of this study is identifying problems and profiling of cocoa green supply chain in Indonesia using Multi Objective Genetic Algorithm and based on problem identification, there are three points that inhibits the implementation of Cacao Green Supply Chain in Indonesia, which is social, environmental and economic sustainability*

**Key words:** Green Supply Chain Management

### 1. INTRODUCTION

Indonesia is the second largest cocoa producer in the world and Indonesia produce 18 percent of the market globalization. Some of the process cocoa beans are cocoa butter and cocoa powder. That product are needed by the people of the world, especially in America and Europe, where the demand for cocoa reached 2.5 million tons every year. (Coordinating Ministry for Economic Affairs, 2011).

Cocoa is one of the prospective plantation commodities and have great opportunities to improve the welfare of society as most are grown by smallholders ( $\pm$  94,01%). Until 2010, extensive cocoa plantations are 1.650.621 Ha, produce 837.918 ton of cocoa beans and scattered in 32 provinces (Director General of Plantation, 2012)

Cocoa beans is sourced from plantations. Cocoa beans needed by the food and beverage industry that is growing due to population growth and people's welfare. So it must be made supply chain to make the synchronization between the need and availability of cocoa beans.

Cocoa supply chain is complex, relying on many discrete actors before the finished product is complete. This makes communication up and down the length of the chain challenging; producers may be unaware of cocoa characteristics that buyers are willing to pay a premium for, while marketers often find it onerous to locate a source for the high value differentiated product demanded by consumers (Haynes et al. 2012)

Cocoa plants produce a lot of waste. The wastes include pulp, rind and flesh. There are pre-harvest waste leaves and tree litter and waste treatment is very necessary because cocoa plantation are only used cacao beans (Kristanto, 2004). Otherwise, at present there are about 10 million tons of solid waste annual in the world, and packaging waste accounts for about the total 1/3. Waste packaging materials include paper, plastic, metal, glass and other ingredients (Zhang et al. 2012). Therefore, Indonesia should be able to implement the green of cocoa supply chain

The purpose of this study is identifying problems and profiling of cocoa green supply chain in Indonesia.

## 2. GREEN SUPPLY CHAIN MANAGEMENT

Green Supply Chain Management (GSCM) is a supply chain management related to environmental aspects.. However, the implementation of GSCM is not easy. Here are the results of a review of several studies that have been conducted regarding the GSCM.

Greening the supply chain (GSC) refers to buyer companies requiring a certain level of environmental responsibility in the core business practices of their suppliers and vendors (APO, 2008).

Sheu et al. 2005, classify chain members into two groups: (1) manufacturing supply chain (mc for short) members, and (2) used-product reverse logistics chain (rc for short) members. Here a typical 5-layer manufacturing supply chain is proposed to characterize 5 respective ILM functions in

corresponding layers, including raw material supply, manufacturing, wholesaling, retailing, and end-customers, which are coded as mc-layers 1–5, respectively. Similarly, a 5-layer used-product reverse logistics chain is specified, which includes collecting points, recycling plants, disassembly plants, secondary material markets, and final disposal locations of wastes; coded as rc-layers 1–5, respectively. Furthermore, considering the potential effects oriented from corresponding governmental regulations, the environmental protection administration (EPA) of the government is included as an actor. Accordingly, these members are linked with solid and dashed lines, representing corresponding directional relationships in terms of logistics flows and induced monetary flows, respectively, in the ILM process and a comprehensive conceptual framework as shown in Figure 1.

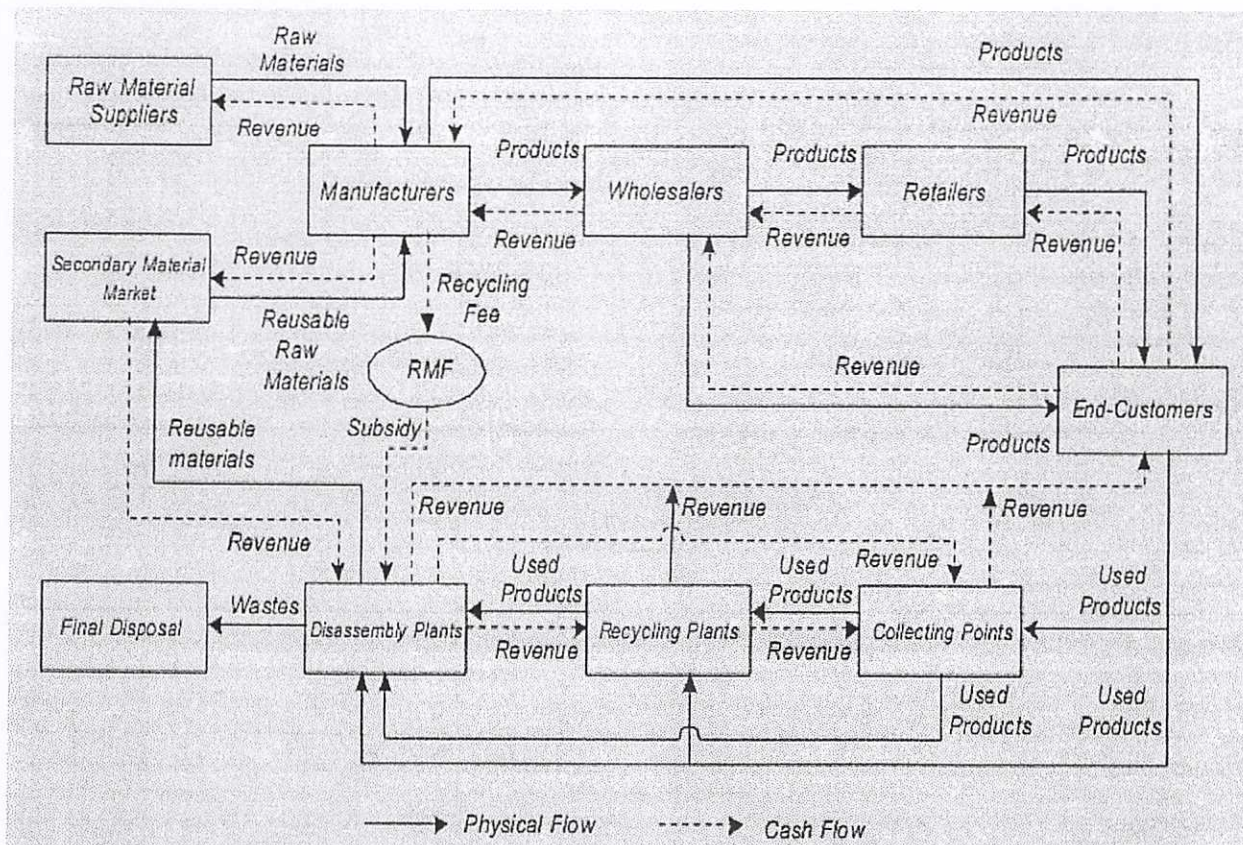


Figure 1. Conceptual framework for integrated logistics control across a green SCM

Table 1. Summary of Green Supply Chain Literature Study

No	Author	Title	Proposed	Method	Result
1	Sheu, 2005	Integrated logistics operational model for green-supply chain management	Presented an integrated logistics operational model to coordinate the cross-functional product logistics flows and used-product reverse logistics flows in a given GSCM.	<i>Multi Objective Linear Programming</i>	Numerical studies have indicated that using the proposed integrated logistics operational model, the chain-based aggregate net profits of a selected notebook computer manufacturer can be improved by 21.1%,
2	Vachon et al, 2006	Green project partnership in the SC: The case of the package printing Industry	Interaction between suppliers and customers in the supply chain	Theoretical	Knowing the criteria of green supply chain, : cost, time, quality and environment
3	Hammond et al, 2007	Closed-loop SC network equilibrium under legislation	Discussing about reverse logistics	Theoretical	There are two things that cause loss of production : lost in the process and lost in the source
4	Yongsheng et al, 2008	Generic Model of Reverse Logistics Network Design	Doing a reverse distribution network design	<i>Mixed Integer (Branch and Bound)</i>	to improvement of the logistics system, must do remanufaktur because it can affect the structure of the system and reduce the cost of network
5	Farahani et al, 2008	A GA to Optimize the total cost and service level for Just In Time distribution in a supply chain	To develop and solve a model for just-in-time (JIT) distribution in the context of supply-chain management	GA, Mixed Integer Linear Programming	developed a new model for a distribution network in a three-echelon supply chain, which minimizes the TC and JIT distribution
6	Evangelista et al, 2010	GSC Initiatives in Transport and Logistics Service Industry: an Exploratory Case Study analysis	To explore the range of initiatives that 3PLs are implementing to reduce the environmental impact of transport and logistics activities	Theoretical	Described in this paper an exploratory in nature as a result of the dearth of literature in this specific area
7	Ninlawan et al, 2010	The Implementation of Green Supply Chain Management Practices in Electronics Industry	To survey current green activities in computer parts' manufacturers in Thailand and to evaluate green supply chain management.	Theoretical	Evaluated GSCM, the questionnaire related to investigate GSCM practices, measure GSCM performance, and explore GSCM pressure/ driver within Thai electronics Industry

Table 1. Summary of Green Supply Chain Literature Study (cont.)

No	Author	Title	Proposed	Method	Result
8	Priyono, 2011	Faktor pendorong dan penghambat rantai pasok ramah lingkungan: literatur review	Analysis of reverse logistics	Theoretical	Reverse logistics is a key to the success of the green supply chain
9	Rahmayanti et al, 2011	Perancangan model peng. kinerja lean & green rantai pasok semen secara terintegrasi	Designing assessment integration of lean and green supply chain	Balance ScoreCard and AHP	Obtained 25 KPIs that can be generated from the integration of cement lean and green supply chain application packaging
10	Yeh et al, 2011	Using Multi Objective Genetic Algorithm for Partner Selection in Green Supply Chain Problems	To develop an optimum mathematical planning model for green partner selection, which involved four objectives such as cost, time, product quality and green appraisal score	MOGA	Developed multi objective genetic algorithms for solving green supplier selection and production volumes transportation problems
11	Zhang et al, 2011	Green Packaging Management of Logistics Enterprises	To development of green packaging	Theoretical	Suggest to development of green packaging
12	Xuezhong et al, 2011	Business Process Analysis and Implementation Strategies of Greening Logistics in Appliances Retail Industry	Proposed the strategies and measures of greening logistics in the electrical appliances retail industry	Theoretical	The structure system of green logistics in the appliances retail industry
13	Saridogan, 2012	The Impact of Green Supply Chain Management on Transportation Cost Reduction in Turkey	To reduce the cost of green supply chain	Regresion Analisys	Calculated reduce cost of green supply chain
14	Seman et al. 2012	Green Supply Chain Management : A review and Reseach Direction	To discuss an overview of the development of GSCM literature	Theoretical	Green supply chain should refer into ISO 14001

Table 1. Summary of Green Supply Chain Literature Study (cont.)

No	Author	Title	Proposed	Method	Result
15	Wu et al, 2012	A Study on Green Supply Chain Management Practices Among Large Global Corporation	To report the status of sustainable SCM practices among the world's largest corporations.	Theoretical	Provides some insights as to what extent do large companies engage in sustainable SCM practices and what specific activities they are doing
16	Lu, 2012	Research on Green Logistics Service Providers Selection Based on Intuitionistic Language Fuzzy Entropy	Proposes the criteria for evaluating providers of green logistics service by combining the traditional evaluation index system	MCDM, berdasarkan pada penilaian fuzzy,	All the solutions, including logistics management, for managing the overall lifecycle of products should be integrated in a more comprehensive supply chain procedure
17	Cojocariu, 2012	A Sustainable Food Supply Chain: Green Logistics. Metalurgia International	Discussing the patterns of green logistics in food supply chains in the framework of sustainable development	Theoretical	Each and every participant in the food supply chain must undertake not only its commitment but also the related costs
18	Vahdani, 2012	Reliable design of a forward/reverse logistics network under uncertainty	Presents a novel model for designing a reliable network of facilities in closed-loop supply chain under uncertainty	Fuzzy multi-objective programming	Designing and modeling a novel reliable network for the facility location to integrate both strategic and tactical decisions in the CLSC
19	Akdoğan, 2012	Drivers of Reverse Logistics Activities: An Empirical Investigation. Procedia	To examine the main drivers of reverse logistics (RL) activities which is a fairly new concept that emphasizes the environmental perspective of logistics	AHP and MCDM	Provide an insight of the importance levels of drivers to the decision makers of other companies in the industry
20	Sbihi, 2012	Combinatorial optimization and Green Logistics	To introduce the area of Green Logistics and to describe some of the problems that arise in this subject which can be formulated as combinatorial optimization problems.	Theoretical	Described the field covered by Green Logistics and described some of the new problems that arise when the objectives considered are not simply economic, but involve wider environmental and social considerations too

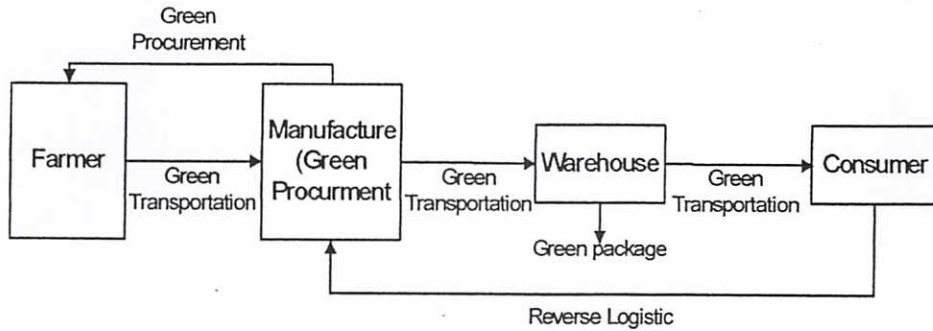


Figure 2. Cocoa Supply Chain Management

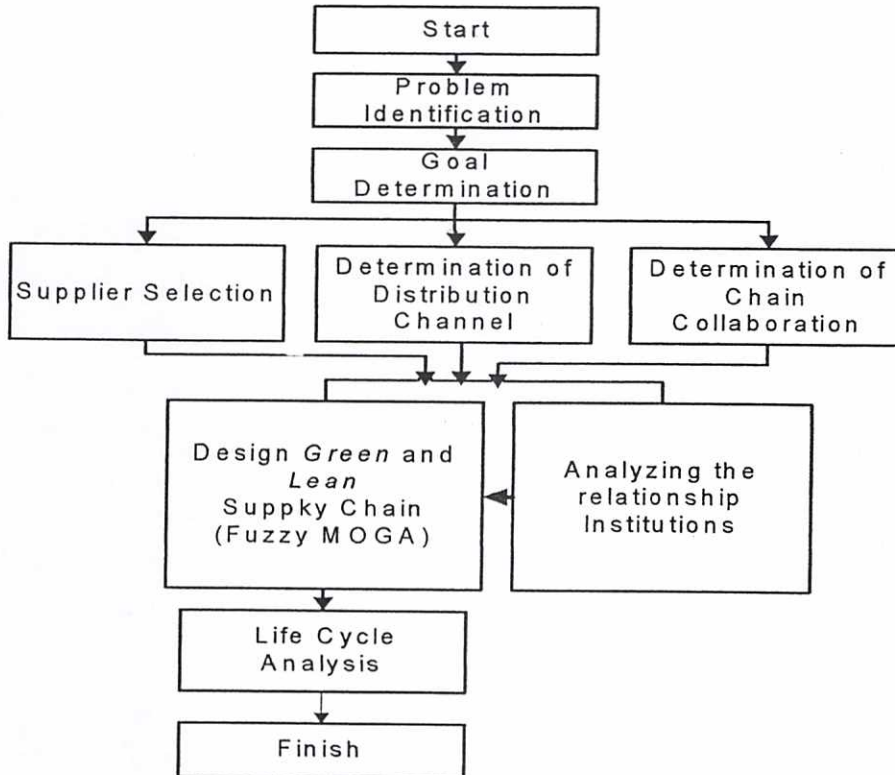


Figure 3. The research method

### 3. GREEN SUPPLY CHAIN TO ENHANCE CACAO INDUSTRY

Cocoa supply chain in Indonesia has a very long chain. If the chain is shorter, it will generate benefits for the many actors involved in the supply chain and provides a balanced gains between farmers and companies.

Currently, in addition to pay attention to cacao supply chain problems, it should be followed by a reduction in environmental waste. In order to reduce environmental waste of cocoa agro-industry supply chain, it must be implemented of green cacao supply chain.

To implement green supply chain, there are several steps that must be done, begins at the root source or the green supplier of raw materials (cacao beans). After cacao beans have been assessed, it's up to the manufacturer and consumer. supplier to determine what improvements can be made. Internally, suppliers can do anything from creating a green purchasing plan to improving the manufacturing process in order to reduce emissions or conserve energy as figure 2.

There are many things that are expected from this research. Expected goals are waste minimization, maximum profit, minimizing cost, can also fulfill consumer demand fluctuates on time.



To develop and solve a model with many desired goal of cocoa agro-industry supply chain, where each goal is not linear, there is a methods that can be used to solve. The method is Fuzzy Multi Objective Genetic Algorithm (FMOGA).

To solve the waste problem, we used analysis of LCA (Life Cycle Assessment) to address the environmental impact of cocoa supply chain and measure the amount of resource consumption and emissions from upstream to downstream.

Stages of LCA to be used in this research are :

- a. Objective Determination and Scoping
- b. Life Cycle Inventory. At this stage, described boundary system, transport and waste.
- c. Life Cycle Impact Assesment. At this stage, an assessment of the impact and then categorized into the determination of the impact of relevant and important. Type of environmental issues is based on the scale
- d. Interpretation. Guide to making decisions about the product or process

Figure 3 is the stages of research to be conducted.

Cocoa plantations in Indonesia, located in 33 provinces, and based on statistical data of cocoa plantation in 2010, South Sulawesi has the largest area about 279.135 ha with a production 171.443 tons.

Various problems concerning the cocoa supply chain that occur on cocoa plantations in Sulawesi such as: (source : <http://id.shvoong.com/society-and-news/opinion/2069160-gernas-kakao-hambatan-dan-harapan/>, 2010)

- a. Social issues, including human resources and Farmers Extension officials, the level of awareness in the farmers manage their Businesses, Farmers ability to invest in the gardens.
- b. Necessary to have adequate infrastructure to support business continuity farmers (eg drainage and road)

- c. The role of government is still lacking, which it can begin to build the infrastructure to support ease of investment, enabling a more competitive market

Three problems, if not corrected it will obstruct the implementation of green Cacao Supply Chain because the logistical activities comprise freight transport.

Based on Vachon et al. 2006, the criteria of green supply chain are cost, time, quality and environment, so in addition to freight transport, it is necessary also handling storage, inventory management, materials handling and all the related information processing.

The improvement of the logistics system, must do remanufaktur because it can affect the structure of the system and reduce the cost of network (Yongsheng et al. 2008. Based on literature about green supply chain, it can be seen that green supply chain design will provide a lot of added value to reduction of environmental waste

From the many literary, reverse logistics is a key to the success of the green supply chain and Green supply chain should refer into ISO 14001 and for managing the overall lifecycle of products should be integrated in a more comprehensive supply chain procedure. Each and every participant in the food supply chain must undertake not only its commitment but also the related costs.

Cocoa agro-industry development should be done in integrated and have designed a green supply chain model by considering various costs ranging from the cost of purchasing and selection of green cocoa beans and cost of green packaging cacao beans, distribution costs and the determination of green transportation, and how do the reverse logistics.

Implementation of green cocoa supply chain is not easy because it is associated with other institutions, such as government. The government can adopt legislation prohibiting certain packaging materials use, establishing of storage refund system, drawing up the recycling or reuse laws, giving a discount or

punishment in tax, limiting over-packaging, founding sundry research institutions to evaluate packing materials, legislation to promote the development of new packaging materials and the use of such measures

## 5. CONCLUSION

Based on the literature study, it can conclude that Green Supply Chain Management is one of the activities that must be performed on cocoa agroindustry supply chain in Indonesia because the chain was too long and there are amount of waste produced from the cacao plant, distribution and processing of cocoa beans.

Issues about social, environmental and economic sustainability are inseparable to achieve green cocoa agroindustry. Meanwhile, the three points is still an issue for the development of green Supply Chain Management in Indonesia, while cocoa plantations spread across 33 provinces, are still far away from the cocoa bean processing industry which will surely hinder the implementation of green scm

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