Conference Paper

Implementation of Life Cycle Assessment on Green Tea Process at Pt Pagilaran - Factory Samigaluh

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Abstract

Life Cycle Assesment is a method to assess environmental aspects and potential effects which are connected with product, process or service. This method is conducted by using compilation and data analysis on input and output of production system, evaluation of environmental potential effects, intrepretating on data compilation and analysis, and assessment results on effects due to the goal of LCA. The research was conducted at PT. Pagilaran – Samigaluh and aimed to implement LCA on tea product. It was done by direct observation on all process steps, from harvesting tea leaves until tranportation to final storage at manufacturing. The results showed that for producing one kilogram green tea at this factory it was needed energy 68,534.14KJ and released emmissions from fuel were 56.53 g CO2; 7,07 g HC; 2,12 g NOx, and 0.053 g Pb. Emmission from processing steps were 18.37 ppm CO2; 321.31 ppm CO; 22.75 ppm HC; 93.08 ppm NOx; 15.17 ppm SOx and 0.12 g ash. Furthermore for transporting tea leaves some gases were released as follow 15.36 g CO; 9.66 g HC; 65.46 g; NOx; 5.20 g SOx and 2.198 g ash.

Keywords: Green Tea; Energy; LCA; Emissions

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Received: 25 December 2017
Accepted: 5 February 2018
Published: 1 March 2018

Publishing services provided by Knowledge E

Selection and Peer-review under the responsibility of the ICoA Conference Committee.

INTRODUCTION

Currently Indonesia is facing global trade areas, such as ASEAN Economic Society, European Union and North America Free Trade Area. A lot of Indonesian products are exported to foreign countries especially estate crop products for example coffee, tea, rubber, cacao, etc. Some new standard such ISO 9001:2008 (Quality Management System); ISO 14001:2005 (Environment Management System), ISO 22000 and HACCP are implemented in the free trade areas to protect consumers and to make the production sustain.

ISO 14000 focuses on environmental management system and one of these points is ISO 14040 on Life Cycle Assessment (LCA), which deals with macro scale approach for identifying possibilities to prevent pollution based on individual product and also to trace energy balance, raw material and waste [1]

The main purposes of LCA is the assessment to technological implementation, economic and environmental factor for raw material, processing and product, which started from creating until final product and producing waste

Indonesian tea is very popular in domestic and international market, it is consumed by mostly Indonesian people and many countries where they have tea- time habit.

In Indonesia the people know only two kind of tea, namely black tea, which is processed with fermentation, and green tea, without fermentation respectively [2]. Both have certain consumers, who normally enjoy their teas with jasmine aroma, which is prepared and produced by tea manufacturer.

One of the manufacturer/producer is PT. Pagilaran, which has several plantation and production units and factory in Samigaluh is one of tea producer. This production unit is located at Samigaluh District – Yogyakarta Special Province and has 200 ha plantation area and can produce 5,000 kg green tea per day.

This research aimed to propose the implementation of LCA on green tea production at PT. Pagilaran – Factory Samigaluh. Based on this, it should be known how much energy was used for producing 1 kg green tea and how much pollution and emission were produced during the process.

MATERIALS AND METHODS

The research was conducted at Production Unit PT. Pagilaran at Samigaluh – Yogyakarta – Indonesia, which produced green tea. Research materials were tea leaves after harvesting and then processed to green tea product. Some devices were used to measure time, temperature, heartbeat of worker, and distance.

The research was started from tea plantation (harvesting tea leaves) to finished products (green tea) at consumers. The basic calculation for LCA used energy and mass balances from providing fresh tea leaves to storage of green tea. Some steps were conducted for determining LCA, emission, and wastes, which were: a) defining goals and scoping LCA; b) Life Cycle Inventory; c) Impact analysis and assessment; d) Interpretation of results and giving recommendations for improvement [3]

The energy measurement was taken place at all energy used during the production, such as human energy, energy from wood, fuel, gasoline and electricity.

The released emissions were measured in CO2, SO2, and NOx (equivalent).

Primary data which was taken at location, such as how they produced green tea and parameters of production steps, how many workers and how long they worked, and secondary data from literatures, emission standard, references on energy and environmental effect analysis were used for calculating, analysis and interpretation of LCA for green tea.

RESULTS AND DISCUSSION

The Production Unit PT. Pagilaran at Samigaluh focused on production of green tea, because the tea plantation was 200 ha and produced 5000 kg tea leaves per day. The plantation mostly belonged to local farmers, but PT. Pagilaran already implemented Industry National Standard on Green Tea so the quality of tea leaves should be fulfilled the standard so that the produced green tea could be met the requirements.

PT. Pagilaran at Samigaluh produced 6 quality grade of green tea: Green Powder, CM 2, Peko Super, Jikeng, BT and Dust. Actually its production capacity was 5 tons/day, but actually it could only produce 1.5 – 2 ton/day.

The green tea processing was as follow:

1. Harvesting at plantation
2. Transporting to factory
3. Withering at withering trough
4. Rolling tea leaves
5. Drying rolled tea leaves
6. Sorting dried green tea based on grades
7. Temporary storage
8. Blending green tea upon request
9. Packing
10. Storage

Table 1: Usage of fuel in production cycle.

Activities	Fuel/ kg tea	Energy (MJ/kg tea)
Transportation	0.0589	2.014
Vehicles	1.0276	39.152
Processing	0.6894	26.27
Delivery	0.009	0.355
Sum		67.79

Table 2: Energy use at all steps per 1 kg produced green tea.

Activities	Fuel (J)	Electricity (J)	Human (J)
Maintenance	2014162	-	381.99
Harvesting	-	-	1389.49
Transportation	39152361	-	256.81
Processing	26212390	691970	4366.279
Sorting & Packing	-	4366.279	513.328
Delivery	355233	-	2.1
SUM	67734146	793081	6909.7

Normally after the green tea was in the storage, it waited for delivery to consumers. The storage time depended on the teas were needed. The storage condition was maintained for keeping the tea quality in best level.

Results of Life Cycle Assessment of Green Tea were depicted in the following tables. Table 1 showed the usage of fuel during the production cycle from harvesting to consumers.

It is shown that most gasoline or fuel was used for vehicles for transporting tea leaves from plantation to factory, then for processing at withering trough, rolling, drying equipment. Table 2 depicted all kind of energy use at whole steps.

Most energy use came from fuel that contributed more than 80% to all activities. Human energy was used in smallest amount, because it contributed usually as operator in the processing or leaves picker during the harvesting.

During the process from plantation to consumer, some energy sources were utilized although the highest amount was reached by using of fuel for transportation and processing. Due to the use of fuel, table 3 showed emissions and pollutant yielded from

Table 3: Pollutant and emission from all steps per 1 kg green tea.

Items	Transport	Electricity/Genset	Truck
CO2	56.64 g	18.37 g	-
CO	-	321 ppm	15.36 g
HC	7.08g	22 ppm	9.66 g
NOx	2.124 g	93.08 ppm	65.46 g
SOx	-		5.20 g
Pb	0.053 g		
Ash	-	0.124 g	2.198 g

combustion of fuel. Calculation of pollutant was based on data from EPA – Compilation of Air Pollutant Emission Factors [4]

In table 3, it was clear that fuel produced emission and pollutant during its combustion. Transportation and truck were separated, since it pointed out the emission yielded from truck for delivering green tea to consumers while the transportation was only in the plantation. In the processing electricity was used for operating all equipment from withering trough to packaging devices for closing the sack.

CONCLUSION

Based on the discussion, it was concluded:

1. The implementation of LCA on green tea production could be done properly and showed energy usage and yielded emission and pollutants.

2. The LCA Value for producing 1 kg green tea production unit at PT. Pagilaran – Samigaluh was 68,534.404.7 J or 68.5 MJ that contributed from fuel, electricity and human.

3. The emission and pollutants produced from these activities were CO2, CO, HC, NOx, SOx, Pb and ash.

ACKNOWLEDGEMENT

We would like to thank PT. Pagilaran and specially Production Unit Samigaluh for giving us opportunity to conduct this research.

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