

Analysis of Greenhouse Gas Emissions as an Effort to Reduce the Impact of Climate Change

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ABSTRACT

The planning of Al Amin Living lab and Industrial Park along with the administration in which there are various activities that produce carbon emissions, these activities need to be calculated to find out how much the activity contributes to the emissions produced so that negative impacts on the environment can be assimilated. This research is a descriptive research. Calculation of carbon footprint from combustion results for four-wheeled vehicles as many as 156 units of 356.757 Kg CO₂-eq and 4.757 Kg CH₄-eq; 155 Two-wheeled Vehicles amounting to 354,470 Kg CO₂-eq and 4,726 Kg CH₄-eq; 5 units of buses amounted to 13.338 Kg CO₂-eq and 0.020 Kg CH₄-eq. Calculation of carbon footprint from waste disposal activities from Ecotourism activities with a capacity of 500 people amounting to 31.85 Kg CO₂-eq; Agriculture with a working capacity of 20 people of 1,274 Kg CO₂-eq; Farm with a working capacity of 5 people of 0.382 Kg CO₂-eq; Mosque with a capacity of 2,000 people of 127.4 Kg CO₂-eq; Café and Plaza Utama with a capacity of 2,500 people of 159.25 Kg CO₂-eq; Ceremony ha; with a capacity of 1,000 people of 63.7 Kg CO₂-eq; Sport center with a capacity of 300 people of 19.11 Kg CO₂-eq. The calculation of the carbon footprint of waste disposal activities is calculated only based on the number of people or users in the activity area.

Keywords: Capacity of Al Amin Living Laboratory Activities, Carbon Footprint, Garbage disposal activities, Greenhouse Gas Emissions.

INTRODUCTION

Presidential Regulation (Perpres) No. 61/2011 mandates Ministries/Agencies at the central and provincial levels to prepare Action Plans for Greenhouse Gas Emission Reduction (RAN-GRK), as well as develop reference data for GHG emission estimates in Business as usual (BAU) scenarios. Emissions in the BAU scenario will be an important part in determining the current GHG emission status and their future projections, which is further important in determining emission reduction/absorption rate calculations and formulating GHG emission reduction actions and monitoring the successful implementation of these actions. The BAU projection is an estimate of future GHG emissions (in this case 2011-2021) with the current development rate scenario, without policy interventions specifically aimed at mitigation actions, or development policies that cause a significant increase in emissions. To be recognized nationally and internationally, then BAU must consider technical aspects (scientific foundations) while taking into account aspects of land-based development policies. The methodology chosen must also be in accordance with national and international standards by referring to scientific methods, social, economic and cultural conditions, as well as applicable laws and regulations.

Carbon footprint assessment is carried out in 3 scopes according to The Greenhouse Gas Protocol (GHG Protocol), namely emissions

from sources owned or controlled directly, indirect emissions from electricity consumption, and other indirect emissions (WRI and WBSCD, 2004). Carbon footprint emissions from all three scopes are calculated based on methods from the International Panel on Climate Change (IPCC) for national greenhouse gas (GHG) inventories. The calculated emission is carbon dioxide (CO₂), expressed in kgCO₂-eq. CO₂ is included in long-lived greenhouse gases which are the main contributors to climate change (WMO, 2014).

The impact of carbon emissions as the main cause of climate change has raised concerns and become a challenge for the international community. In order to reduce emissions, carbon footprint studies from activities in Al-Amin need to be carried out. Carbon footprint is a measure of the total amount of carbon dioxide emissions directly or indirectly caused by an activity (Wiedman and Minx, 2008).

The planning of Al Amin Living lab and Industrial Park along with the administration in which there are various activities that produce carbon emissions, these activities need to be calculated to find out how much the activity contributes to the emissions produced so that negative impacts on the environment can be assimilated. Carbon footprint assessment is carried out in 3 scopes according to The Greenhouse Gas Protocol (GHG Protocol), namely emissions from sources owned or controlled directly, indirect emissions from electricity consumption, and other indirect emissions (WRI and WBSCD, 2004).

LITERATURE REVIEW

Greenhouse Gases

Increased concentrations of Greenhouse Gases (GHG) such as Carbon dioxide (CO₂), Methane (CH₄), and N₂O, resulting from various human activities cause an increase in sunlight radiation trapped in the atmosphere and have an impact on increasing the earth's temperature resulting in global warming. Without efforts to

control GHG emissions, by the end of 2100 global temperatures are expected to be 1.8 – 4.0 °C higher than the average temperature in 1980-1999 (Directorate General. PPI, 2016). Based on existing data, it is noted that the global temperature of the earth has increased between 0.8 - 1.2 °C (IPCC, 2018) since the end of the 19th century. Global warming triggers climate change which has a significant influence on human life on earth, including in Indonesia. Climate change has caused changes in rain patterns, rising sea levels, storms and high waves, and other adverse impacts that threaten people's lives. Climate change can increase the risk of climate-related disasters such as droughts, floods, landslides, crop failures, tidal floods, as well as increasing outbreaks of climate-related diseases such as malaria, dengue fever and diarrhea. In facing climate change, all parties, including the community, need to take adaptation actions to adapt to the impacts that occur and mitigation to reduce GHG emissions through the application of a low-emission lifestyle in carrying out daily activities such as saving electricity usage, maximizing the use of renewable energy.

Global Warming

Global warming is a form of ecosystem imbalance on earth due to the process of increasing the average temperature of the atmosphere, sea, and land on earth. Over the past hundred years or so, the average temperature on Earth's surface has increased by 0.74 ± 0.18 °C. The increase in the average temperature of the earth's surface that occurs is due to increased emissions of greenhouse gases, such as: carbon dioxide, methane, dinitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride in the atmosphere. These emissions mainly result from the burning process of fossil fuels (petroleum and coal) as well as due to deforestation and burning of forests. Global warming is thought to have caused system changes to ecosystems on earth, including; Extreme climate change, melting ice so that sea levels rise,

and changes in the amount and pattern of precipitation.

Causes of Global Warming

The following are the factors that cause greenhouse gases:

- a. Motor Vehicle Smoke One of the symptoms of global warming can be detected from unpredictable seasonal changes.
- b. Land Conversion Excessive felling of trees by illegal logging actors also adds to environmental problems.
- c. Poorly Managed Livestock Waste Livestock activities also contribute to the creation of greenhouse gases.
- d. Excess Carbon dioxide Emissions Carbon dioxide (CO) is one of the factors causing global warming.

Global Warming Potential

Global Warming Potential (GWP) is a measure to compare the potential of greenhouse gases in warming the earth in a certain period, and is equivalent to the potential value of CO₂ gas. The GWP value

for carbon dioxide gas as a reference is 1 regardless of the time period, while for other gases the value depends on the type of gas and the time period. Then carbon dioxide equivalent (CO₂e) is calculated from GWP. For all gases, the mass of CO₂ produced heats the earth as well as the mass of that gas.

Impact of Global Warming

Global warming causes an increase in temperature on the earth's surface. Rising earth temperatures can cause various adverse impacts on the environment and other ecosystems due to world climate change. One example of the impact of global warming is the melting of glaciers and polar ice caps. This can result in rising sea levels and make part of the area submerged in sea water.

MATERIALS & METHODS

The research material comes from the design and planning of Al Amin Living Lab and Industrial Park. With rosedur carried out is as follows

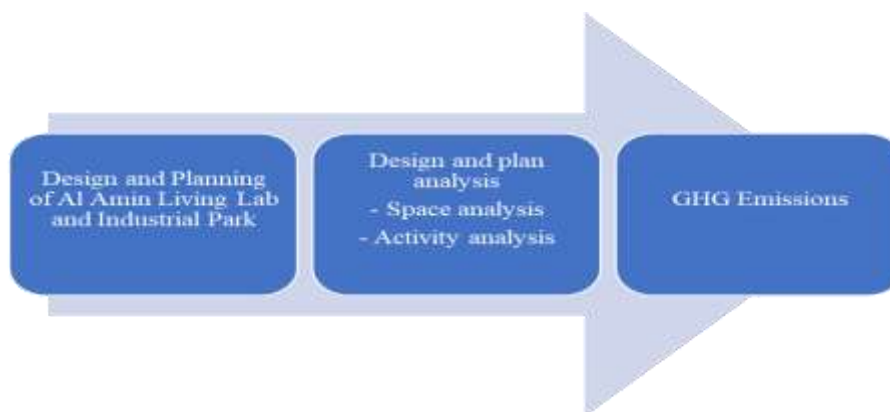


Figure1. Research Plan

Glugur Research Place is Lush. Research Time for 1 (one) year. This research is a descriptive research. Collection techniques based on qualitative analysis.

RESULT

Al Amin Living Lab and Industrial Park

There is non-productive land owned by the Prof. Dr. H Kadirun Yahya Foundation in the Glugur Rimbun area of 20 ha, in order to

change the land to be more productive, UNPAB is currently building a use plan for 10 ha and is expected to cultivate all 20 ha of the land. In this planning, UNPAB involves all study programs (study programs) in its nature. Basic Concepts The land development meets the needs of UNPAB's learning, practicum, research and innovation center which can become an income generator. Living Lab or Panca Budi

Science EcoPark Glugur Rimbun (PSE-GR) has 4 main themes: 1. Tri Dharma of Higher Education UNPAB 2. Eco-Tech-Edu Tours 3. Fitrah (Islamic) based education 4. Economic mutualism symbiosis Therefore, PSE-GR has rooms and activities that are mutually sustainable internally and externally. Tri Dharma of Higher Education UNPAB Tri Dharma PT has 3 points, namely Education and Teaching, Research and Development, and Community Service. PSE-GR was developed as a land for educational and learning applications, research and trials of the UNPAB academic community, therefore there are facilities such as workshops, research land provided and can be seen by visitors as UNPAB educational show cases. It is also hoped that with the cooperation of villages and the surrounding community, Community Service can be carried out in the form of cooperation, counseling, and even services so that surrounding villages can become part of PT UNPAB's Tri Dharma application. Eco-Tech-Edu Tourism The combination and integration of learning across programs that are applicative is expected to be part of PSE-GR educational tours for general visitors. Apart from being a place of entertainment, visitors will be shown and can interact with learning objects so as to understand that technological, educational, and economic developments can take place without leaving religious, spiritual, cultural, and natural sustainability values. Education based on Fitrah (Islam) UNPAB with its pearls of wisdom which aims as a place for human spiritual training will include religious values in all its activities. The concept of halal and tayyib in education, animal husbandry, agriculture, to the creation of a reflection of an independent civilizational ecosystem. Economic Symbiosis Mutualism Economic Symbiosis Mutualism in this case is the participation of the role of the surrounding community in

UNPAB Tri Dharma activities through cooperation with villages and surrounding communities. This is aligned with the understanding of UNPAB Living Lab which adheres to the concept of circular economy education based on Islamic and humanitarian values. PSE-GR Development Opportunities Areas with the Eco-Tech-Edu Tourism concept that has an understanding of circular economy education (CED) are still very minimal in SUMUT, PSE-GR can be a pioneer in spreading this CED understanding where there is an integration of economic and educational activities that at the same time help preserve nature. Encouraged by the development of the Independent Learning Curriculum (KMB), it is hoped that PSE-GR can become a place for research, service and practicum of the UNPAB academic community that increases awareness of the need for nature conservation. Because Green Technology from across fields of science is still very minimally discussed and is still often partially researched, UNPAB can be an example of integration of fields of science into practical, dynamic, educational and economic value innovations.

The existence of 20 ha of land owned by the Prof. DR H Kadirun Yahya Foundation, it is hoped that UNPAB can develop a Living lab ecosystem at least on 10 ha of land. PSE-GR is expected not to be exclusive like tourist areas in general, with the concept of CED, PSE-GR will not only help become an income generator & source of educational land for the academic community, but also help the welfare of the village and surrounding communities.

Greenhouse Gas Analysis

Based on the planning and site plan of al Amin Living lab, the capacity of activities can be known as the following table.

- a. Carbon footprint of combustion

Table 1. Capacity of Al Amin Living Laboratory Activities

No	Activity	Land Area	Visitor Activities	Capacity	Garbage Generation	The Composition of the litter
1	Parking	6,778 m ²	Vehicle parking	156 private vehicles (4 wheels) 155 wheels 2 5 big buses		
2	<u>Eco Tourism</u>	69,002.8 m ²	Nature tourism, camping, outbound, staying at cottages	500 people	300 Kg	Organic 210 kg
3	Agriculture	77,933 m ²	Agricultural production, agricultural tourism	Workers 20 people		
4	Animal husbandry	24,818 m ²	Livestock production, livestock tours	Worker 5 people		
5	Mosques	7.277,5 m ²	Worship	2.000 people	1.200 Kg	Organic 840 kg
6	Café and Main Plaza	5.127,6 m ²	Eat, drink, gathering	2.500 people	1.500 Kg	Organic 1050 kg
7	Ceremony Hall	1.830 m ²	Gathering, incidental events	1.000 people	600 Kg	Organic 420 kg
8	Sport Center	6.015 m ²	Basketball, futsal, and swimming.	2 multipurpose courts,	180 Kg	Organic 126 kg

Emission = BB Consumption x Calorific Value x Emission factor x GWP

Table 2. Calorific Value and Combustion Emission Factor

Fuel	Calorific Value	FE CO ₂ (kgCO ₂ / MJ)	FE CH ₄ (kgCH ₄ / MJ)	FE N ₂ O (kgN ₂ O / MJ)
Premium	33 MJ/l	0,0693	0,000033	0,000003 ₂
Fristx	33 MJ/l	0,0693	0,000025	0,000008
Solar	36 MJ/l	0,0741	0,000003 ₉	0,000003 ₉
LPG	47,3 MJ/kg	0,0631	0,000005	0,000000 ₁

Source: KemenLH, 2012

It is assumed to use pertalite gasoline. In accordance with the Ministry of Environment and Forestry 2012 that pertalite has a calorific value of 33 MJ / l with a CO₂ emission factor of 0.0693 kg CO₂ / MJ, 0.000033 FE CH₄ kg CH₄ / MJ. GWP values for CO₂ and CH₄ from IPCC, 2014.

Table 3. Natural Gas Heating Potential Value

No	Greenhouse Gas	GWP values
1	CO ₂	1
2	CH ₄	28

Source: IPCC, 2014

So it can be known greenhouse gas emissions in parking lots according to the following table.

Table 4. Value of Greenhouse Gas Emissions in Parking Lots

Vehicle	Unit	Calorific Value	FE CO2	FE CH4	GWP CO2	GWP CH4	Kg CO2-eq	Kg CH4-eq
4 Wheels	156	33	0.0693	0.000033	1	28	356.756	4.757
2 Wheels	155	33	0.0693	0.000033	1	28	354.470	4.726
Bus	5	36	0.0741	0.0000039	1	28	13.338	0.020

DISCUSSION

The calculation of the carbon footprint of waste disposal activities is carried out by calculating CO₂ emissions in open combustion (KemenLH, 2012)). The carbon footprint is calculated based on the CO₂ Emissions Equation = waste generation x FE x GWP.

The generation of waste comes from user capacity The solid waste generation figure

refers to SNI 19-3964-1994, namely for large cities = 2 – 2.5 L / person / day, or = 0.4 – 0.5 kg / person / day and for organic smapah it is estimated at 70% of waste generation.

So it can be known the carbon footprint of the activities of Al Amin Living lab and Industrial Park which produces waste disposal activities in the following table.

Table 5. Value of Greenhouse Gas Emissions from Waste Disposal Activities

Activities	Capacity	Garbage generation	Organic	FE CH4	GWP CH4	Kg CH4-eq
Eco Tourism	500 people	250 Kg	175	0.0065	28	31.85
Agriculture	Workers 20 people	10 Kg	7	0.0065	28	1.274
Farm	Workers 5 people	3 kg	2.1	0.0065	28	0.382
Mosque	2.000 people	1.000 Kg	700	0.0065	28	127.4
Café and Main Plaza	2.500 people	1.250 Kg	875	0.0065	28	159.25
Ceremony Hall	1.000 people	500 Kg	350	0.0065	28	63.7
Sport Center	300 people	150 Kg	105	0.0065	28	19.11

Source: Calculation analysis

The calculation of the carbon footprint of waste disposal activities is calculated only based on the number of people or users in the activity area. Does not include activities that produce waste from agricultural and livestock activities. Farms and ranches need to calculate emissions back based on the type of crops and farms planned. At this time the planning of Al-Amin Living Lab and Industrial Park is still under regional planning. To minimize Greenhouse Gases, further management strategies and research are needed.

CONCLUSION

1. The calculation of the carbon footprint of combustion results is:

- 156 Units of Four Wheeled Vehicles amounting to 356.757 Kg CO₂-eq and 4.757 Kg CH₄-eq
- 155 Two-wheeled Vehicles amounting to 354,470 Kg CO₂-eq and 4,726 Kg CH₄-eq
- 5 units of buses amounting to 13.338 Kg CO₂-eq and 0.020 Kg CH₄-eq

2. Calculation of carbon footprint of waste disposal activities

- Ecotourism with a capacity of 500 people of 31.85 Kg CO₂-eq
- Agriculture with a working capacity of 20 people of 1,274 Kg CO₂-eq
- Farm with a working capacity of 5 people of 0.382 Kg CO₂-eq
- Mosque with a capacity of 2,000 people amounting to 127.4 Kg CO₂-eq
- Café and Main Plaza with a capacity of 2,500 people of 159.25 Kg CO₂-eq
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Declaration by Authors

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