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GREENHOUSE GAS EMISSIONS IN AL AMIN LIVING LAB AND INDUSTRIAL PARK PLANNING

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Abstract*. The impact of carbon emissions as a major cause of climate change has raised concerns and become a challenge for the international community. To reduce emissions, it is necessary to study the carbon footprint of activities in Al-Amin. The planning of Al Amin Living lab and Industrial Park along with the administration in which various activities 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 minimized. Opportunities for PSE-GR Development Areas with the concept of Eco-Tech-Edu Tourism which has an understanding of Circular Economy Education (CED) is still very minimal in North Sumatra, PSE-GR can be a pioneer in spreading this understanding of CED where the integration of economic and educational activities occurs which at the same time helps maintain the preservation of nature. Encouraged by the development of the Independent Learning Curriculum (ILC), 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 the integration of fields of science that become 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 not expected to be as exclusive as 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 the surrounding community. Carbon footprint studies are carried out in 3 scopes according to The Greenhouse Gas Protocol (GHG Protocol), namely emissions from sources owned or directly controlled by the faculty, 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 the national greenhouse gas (GHG) inventory.*

Keywords*: Industrial Park; Planning of Al Amin Living Lab; PSE-GR Development*

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INTRODUCTION

The Indonesian government continues to strive to reduce greenhouse gas (GHG) emissions by the targets listed in the Nationally Determined Contribution (NDC). In the NDC, the target of reducing emissions by 29% by 2030 translates to a figure of 834 million tons of CO2e for all sectors. The energy sector received a share of emission reductions of 314 million tons of CO2e. Two ways can be done to find out the emission reductions that have been achieved. First, by looking for the difference between the baseline of GHG emissions under Business as Usual (BaU) conditions and the results of the emission inventory under actual conditions. This difference is considered a decrease in emissions and can be calculated historically. Second, by calculating the emission reductions from each mitigation action that has been carried out.

To find out the emission reduction in a first way, a complete and accurate inventory of emission data is needed so that the decrease is measured. Complete emission data is obtained by regularly inventorying all the data needed to calculate emissions. Accurate emission data is obtained through the use of appropriate methodologies by international guidelines.

Presidential Regulation (Perpres) No. 61/2011 mandates Ministries/Institutions at the central and provincial levels to prepare an Action Plan for Reducing Greenhouse Gas Emissions (RAN-GRK), as well as develop reference data on GHG emission estimates in the Business as usual (BAU) scenario. Emissions in the BAU scenario will be an important part of determining the current status of GHG emissions and their future progression, which is further important in determining the calculation of emission reductions/absorption levels 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.

The impact of carbon emissions as a major cause of climate change has raised concerns and become a challenge for the international community. To reduce emissions, it is necessary to study the carbon footprint of activities in Al-Amin. Carbon footprint is a measure of the total amount of carbon dioxide emissions that are directly or indirectly

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caused by activity (Wiedman and Minx, 2008). The planning of Al-Amin Living lab and Industrial Park along with the administration in which various activities 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 minimized.

Carbon footprint studies are carried out in 3 scopes according to The Greenhouse Gas Protocol (GHG Protocol), namely emissions from sources owned or directly controlled by the faculty, 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 the national greenhouse gas (GHG) inventory.

LITERATURE REVIEW

Understanding 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 the 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 greenhouse gas emissions, such as carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluorides in the atmosphere. These emissions mainly result from the combustion of fossil fuels (petroleum and coal) as well as from deforestation and forest burning. Global warming is thought to have caused system changes to the earth's ecosystems, including; extreme climate change, melting ice so that sea levels rise, as well as changes in the number and pattern of precipitation. The existence of system changes in this ecosystem has had an impact on life on earth such as the impact of agricultural products, the loss of glaciers, and the extinction of various types of animals. The greenhouse as a system on earth is needed by living things on earth. The temperature of the earth's atmosphere will become colder without the greenhouse effect. However, if the greenhouse effect is excessive compared to its normal conditions then the system will be destructive. Seeing that most of the greenhouse gas emissions come from human life activities, global warming must be solved by changing people's lifestyles and behaviors in everyday life. Global

warming is the cause of climate change. Global warming is an event where the earth's temperature increases continuously from year to year due to the increase in greenhouse effect emission gases. The Greenhouse Effect is formed due to the warming of the earth released into the atmosphere. Gas emissions that cause greenhouse effects include CO2, N2O, CFCs, and CH4. The increase in the concentration of greenhouse gases in the atmosphere can be caused by the combustion of fuel, coal, and other organic fuels. In essence, the combustion products can be absorbed by plants and the sea. However, not all combustion results can be absorbed, increasing GHG concentrations. The more GHG trapped in the atmosphere, the more infrared radiation waves reflected by the earth will be absorbed by the atmosphere, causing the earth's temperature to be higher. The increase in the earth's temperature can be caused by radiation from solar waves that reach the earth's surface and then turn into heat. Part of this heat is again reflected into outer space by the earth's surface in the form of long-wave infrared radiation. However, more or less the heat is reabsorbed by gases in the atmosphere that envelops the earth so that the heat of the rays cannot return to outer space.

The World Meteorological Organization (WMO) reported that the initial 6 months in 2016 broke the previous global warming record. the global average temperature in 2016, 0.07o C higher than in 2015. Global warming has fatal consequences for the biogeophysical environment such as melting polar ice caps, extreme climate change, and many flora and fauna experiencing extinction. Not only that, but global warming also results in activities in daily life, for example in the field of social and economic activities of the community, for example, such as disruptions in 1 function of coastal areas and coastal cities, disruptions to the function of port and airport infrastructure, increased risk of disease, and others.

Causes of Global Warming

One of the causes of global warming comes from greenhouse gases created by daily human activities. The characteristics of this gas can absorb heat thereby increasing the temperature of the air on the earth. The following are the factors that cause the onset of greenhouse gases:

a. Motor Vehicle Smoke One of the symptoms of global warming can be detected from the unpredictable change of seasons. Currently, there are

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frequent rains, storms, and tornadoes in various regions. Floods that occur along with droughts trigger disease outbreaks. The cause is none other than various activities that trigger global warming, such as incomplete combustion of fuel and pollution caused by motor vehicles. CO gas, resulting from such activity can be a barrier to geothermal reflection. It is estimated that air pollution due to industrial activities and motor vehicle pollution will increase in 2020. Such pollution can reduce air quality to a degree that is harmful to health. Generally, the diseases caused are in the form of respiratory disorders such as ARI, asthma, and pneumonia. Therefore, effective measures are needed to reduce the increase in air pollutants. One of them is the use of environmentally friendly alternative fuels.

b. Land Conversion Excessive felling of trees by illegal logging actors also adds to environmental problems. The reason is, trees that play a role in absorbing CO gas, and maintaining the cleanliness of the air are getting thinner. In addition, forest areas have now also changed their functions to become plantations, industries, and settlements.

c. Livestock Waste That Is Not Managed Properly Livestock activities also trigger the creation of greenhouse gases. Based on an FAO report in 2006, one of the largest emitters of greenhouse gases comes from the livestock sector, which is 18%. The resulting gas consists of carbon dioxide (9%), methane (37%), nitrous oxide (65%), and ammonia (64%). These gases are the result of livestock waste. Among the gases produced, methane (CH) has a higher heating potential compared to carbon dioxide. In fact, on the one hand, the thermal energy produced from methane is the potential that can be used as a renewable energy source. However, because it has not been processed properly, the potential is wasted.

d. Excess Carbon dioxide Emissions Carbon dioxide (CO) is one of the factors causing global warming. CO emissions, at the global, regional, national, and local levels continue to increase every year. CO gas production is inseparable from human activities, such as the use of fossil fuels, land use changes, industrial waste, and forest fires.

Global Warming Potential

Global Warming Potential (GWP) is a measure to compare the potential of greenhouse gases in heating the earth at a certain period, and equated with the value of potential CO2 gas. The GWP value for carbon dioxide gas as a reference is worth 1 regardless of the period, while for other gases the value depends on the type of gas and the period. Then the carbon dioxide equivalent (CO2e) is calculated from GWP. For all gases, the mass of CO2 produced heats the earth just as much as the mass of that gas. Thus, a scale can be formed to measure the climate change effect of various gases calculated by multiplying the GWP value by the mass of the gas. For example: if a gas has a GWP of 100, then 2 tons of gas has a CO2e of 200 tons. Global warming poses a serious threat to humanity. The process of increasing the average temperature of the earth's atmosphere, land, and waters. Changes that occur due to global warming include sea level rise, and increasing extreme weather. Melting glaciers, and the extinction of various types of animals, are some of the consequences of global warming.

Impact of Global Warming

Global warming causes an increase in temperature on the earth's surface. The earth's rising temperature can cause various adverse impacts on the environment and other ecosystems due to changes in the world's climate. 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 parts of the area submerged by seawater. Other examples of adverse impacts of global warming are the occurrence of high rainfall, crop failure, loss of coral reefs, extinction of various species, and depletion of the ozone layer in the earth's atmosphere. The occurrence of global warming is a warning to all countries around the world to always be vigilant due to the adverse impacts that may occur, for example, the melting of polar ice caps, causing sea level rise. This of course has a very bad impact on developing countries and archipelagic countries such as Indonesia because it can cause small islands to sink. Another consequence of global warming is climate change, or the phenomenon of 5 climate deviations, for example, the occurrence of three hydrometeorological disasters, namely tornadoes, floods, and landslides, maybe even coupled with high sea waves that can cause human casualties. The losses caused by the disaster are not only life losses, but also material losses, for example, there is damage to

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settlements, damage to infrastructure, and much other damages. Other effects of the occurrence of global warming are climate instability such as heat energy and water vapor that are abundant in the atmosphere, much higher rainfall, larger hurricanes, shifts in rainy and dry seasons, and anomalies of weather changes that are difficult to predict, and extreme. Such climate instability can cause storms and high waves, which can disrupt fishermen's activities. The increase in sea level makes the frequency of flooding in cities close to the coast increase. In addition, global warming also disrupts agricultural products because the weather is so extreme that in the dry season in tropical countries, it can cause severe droughts and the drought could cause most farmland to dry out. Global warming results in very extreme weather, which makes viruses and bacteria stronger and faster to multiply, and can cause new types of diseases, Global warming that is getting worse must be overcome immediately, not only by converting bare land into a green land but also by educating the community to carry out a healthy, energy-efficient lifestyle, By getting used to using everything environmentally friendly, for example, reducing the use of plastic is one of the efforts to reduce global warming. If the pollution continues, Indonesia's land area, which is only a few centimeters high from sea level, will sink.

RESEARCH METHOD(S)

The research location is located on Jl. Glugur Rimbun is bordered by the north of the Garden, South of JL. Glugur Rimbu East of the garden, and South of the Garden

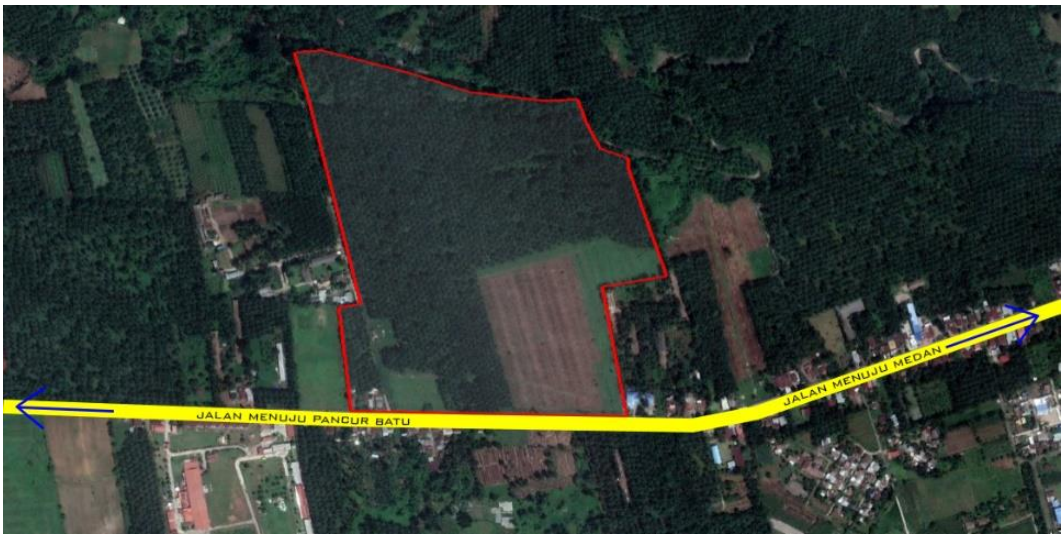

Figure 1. Al Amin Living Lab Research Location

FINDINGS AND DISCUSSION

Al-Amin Living Lab and Industrial Park

There is a non-productive land owned by the Prof. Dr. H Kadirun Yahya Foundation in the Glugur Rimbun area of 20 ha, to change the land to be more productive, the Panca Budi Development University (UNPAB) is currently building a use plan for 10 ha and is expected to cultivate the entire 20 ha of land. In this planning, UNPAB involves all study programs that are in its hands. Basic Concepts The development of the land meets the needs of learning, practicum, research, and innovation centers of UNPAB 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 UNPAB Higher Education

   Tri Dharma Perguruan Tinggi 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, and research land provided and can be seen by visitors as a UNPAB educational showcase. It is also hoped that with the cooperation of the village and the surrounding community, service can be carried out in the form of cooperation, counseling, and even services so that the surrounding villages can be part of the PT UNPAB Tri Dharma application.

2. Eco-Tech-Edu Tourism

   Eco-Tech-Edu Combination Tourism and integration of learning across applicable programs is expected to be part of the PSE-GR educational tour for general visitors. Apart from being a place of entertainment, visitors will be shown and can interact with learning objects to understand that technological, educational, and economic developments can take place without leaving religious, spiritual, cultural, and natural values. Fitrah (Islamic) based education UNPAB with its pearls of wisdom which aims as a place for human spiritual training will include religious values in all the implementation of its activities.

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3. Fitrah-based education (Islam)

   The concept of halal and tayyib in education, animal husbandry, and agriculture, to the creation of a reflection of an independent ecosystem. This is aligned with the understanding of the UNPAB Living Lab which adheres to the concept of circular economy education based on Islamic and humanitarian values.

4. Symbiosis of economic mutualism Therefore, PSE-GR has a space and activities that are mutually sustainable internally and externally.

   Economic Symbiosis Mutualism Economic Symbiosis Mutualism in this case is the inclusion of the role of the surrounding community in the activities of the Tri Dharma UNPAB through cooperation with villages and surrounding communities.

Opportunities for PSE-GR Development Areas with the concept of Eco-Tech-Edu Tourism which has an understanding of Circular Economy Education (CED) is still very minimal in SUMUT, PSE-GR can be a pioneer in spreading this understanding of CED where the integration of economic and educational activities occurs which at the same time helps preserve nature. Encouraged by the development of the Independent Learning Curriculum (ILC), 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 the integration of fields of science that become 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 not expected to be as exclusive as 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 the surrounding community.

Source: Al Amin Living lab and Industrial Park

Figure 2. Panca Budi Science EcoPark Glugur Rimbun Site Plan (PSE-GR)

The idea of a room in PSE-GR is divided into several areas according to its activities and functions, namely:

Table 1. Activity Plan and its functions

Area	**Space Requirements**	
Welcome Area	Information Center	Parking
	Gerbang	Landscaping Garden
Rest Area	Café & Restaurant	Marketplace, Product Gallery
	Office	Mosque
	Toilet	Garden
Service Area, Office & Administrative Area	Generator Set	Water Reservoir
	Waste Bank & Hygiene	Control Room & Security
	Boarding House	Amenities
Educational Area Research, Workshop & Production Area	Hall	Museum
	Workshop	Laboratory
	Production & Packaging Space	
Public Recreational Area	Camping Ground & Picnic Area	River Tours
	Outbound & Outdoor Playground	
Agro-Tourism	Agriculture	Farm
	Processing of Production Products	Packaging of Products
	Waste	

Source: Al Amin Living lab and Industrial Park

The planning of Al Amin Living lab and Industrial Park along with the administration in which various activities 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 minimized. Carbon footprint studies are carried out in 3 scopes according to The Greenhouse Gas Protocol

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CONCLUSION AND RECOMMENDATION

Conclusion

1. Opportunities for PSE-GR Development Areas with the concept of Eco-Tech-Edu Tourism which has an understanding of circular economy education (CED) is still very minimal in NORTH SUMATRA, PSE-GR can be a pioneer in spreading this understanding of CED where the integration of economic and educational activities occurs which at the same time helps 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 the integration of fields of science that become practical, dynamic, educational, and economic value innovations.
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Recommendation

Further Research in calculating Global Warming Potential (GWP).

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