

Contribution of Activities of Al-Irsyad Al-Mubarak Islamic Boarding School *Santri* in Efforts to Reduce Greenhouse Gas (GHG) Emissions

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Abstract: Islamic Boarding School or *Pondok Pesantren* (PONPES) is a traditional Islamic education institution applying a learning model by requiring students to live and study together (live-in) under the guidance of a teacher, *ustadz*, or *kyai* and have a hostel for students to stay at. In addition to efficiency in learning, these live-in activities also result in efficiency in the use of energy, for example in the use of fossil fuel for transportation and electrical energy from the use of electronics, both televisions and cell phones. This efficiency also contributes to the reduction of Green House Gas (GHG) emissions as one that causing global warming and triggers climate change which resulting in the emergence of disease bacteria and viruses. To find out this issue, a quantitative study was carried out by calculating the energy conversion of fuel and electricity from Islamic boarding schools using the principle of carbon conversion based on the Intergovernmental Panel Climate Change (IPCC) formula and comparing it with activities outside Islamic boarding schools. Based on the results, it is known that there is efficiency in carbon release as much as 8.71 kg CO₂/ day in fuel and electricity energy consumption from live-in activities at Islamic boarding schools which also affect the potential for reducing GHG emissions.

Keywords: *carbon emission, climate change, GHG, IPCC, Islamic Boarding School*

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1. Introduction

Energy resources such as electrical energy and fossil fuel produce exhaust gases or pollutants, such as hydrocarbons (HC), nitrogen oxides (NO_x), carbon dioxide (CO₂) and carbon monoxide (CO) (Astra, 2010). These gas, particularly of CO₂, is accumulatively known as greenhouse gas (GHG) emissions which causes global warming and trigger climate change and all its environmental problems. The greenhouse gases gradually fill the Earth's atmosphere and form the ozone layer, which can retain heat from the atmosphere. The accumulated heat then accumulates and raises the earth's temperature, which is known as global warming. This global warming has gradually caused various complex problems, which also underlie various environmental disasters, such as the rise of sea levels due to the melting of glaciers (permanent ice) at the poles, expansion of deserts, weather disturbances that cause various hydrological issues, natural disasters, mass extinction of flora and certain fauna (Surtani, 2015). Climate change can also cause virus mutations to become more virulent and potential to emerge the spread of diseases globally. The situation is exacerbated by global destruction of forest, which in fact, plays important role in converting carbon into oxygen (Ismail, 2020)

The Indonesia Government have been taking actions to mitigate the effect of climate change in Indonesia. In the Greenhouse Gas Emission Reduction Program, the Government of the Republic of Indonesia through the Ministry of Environment appreciates the active participation of the community who have implemented climate change mitigation and adaptation measures in an integrated manner that they can support the national goal of reducing and increasing greenhouse gas emissions and increasing the community's adaptive capacity. Mitigation aims to reduce the input of greenhouse gas concentrations into emission sources and carbon sinks and adapt to the negative effects of climate change due to excess greenhouse gas concentrations (Kustiasih et al., 2017)). This understanding of GHG emission mitigation is important, and it is intended that all parties have an understanding and willingness to participate in efforts to mitigate climate change, including schools or other educational institution.

Islamic boarding schools or known as *Pondok Pesantren* (Ponpes) is a traditional Islamic educational institution implementing a learning model by involving students to live and study together (Live-in) under the guidance of a teacher, *ustadz*, or *kyai* and has a dormitory for students to stay (Ferdinan, 2018). The Islamic boarding schools are one of the Islamic-based educational institutions in Indonesia, which teach various kinds of religious lessons about Islam and are one of the institutions that play a big role in moral education and noble morals for the students there (Fitri & Ondeng, 2022). In order to achieve this goal, life in Islamic boarding schools is carried out with various rules and there are quite strict restrictions, such as restricting the use of electronic facilities and motorcycle.

The *Pondok Pesantren* are growing rapidly and have strong roots in Indonesia, as a country based on Pancasila which guarantees the life of religious people, with Islam as the religion of the majority of the population. Therefore, Islamic boarding schools become one of the educational institutions with hundreds or thousands of students (*santri*). By limiting the use of existing facilities, the life of every student at the Islamic boarding school will of course also result in saving and efficient use of energy resources.

Educational institutions are central to the gathering of many students who of course also use various facilities with energy as a resource, so that educational institutions directly contribute to greenhouse gas emissions which have an impact on climate change, so that significant energy saving measures are needed (Vina, 2023). The problem that occurs is that it is difficult for educational institutions to carry out energy efficiency efforts. The practice carried out by *Pondok Pesantren* as one of the Islamic educational institutions which applies regulations limiting the use of electronic facilities and motorcycle for its students is an interesting thing to be studied, because this regulation could lead to increase energy efficiency. Therefore, this research aims to calculate energy efficiency in the form of carbon (CO₂) conversion based on the limited use of electronic facilities and motorcycle of Al Irsyad Almubarak Islamic boarding school's students.

GHG carbon emissions are released substances or pollutants consisting of a collection of hydrocarbons (HC), nitrogen oxides (NO_x), and carbon monoxide (CO) (Astra, 2010) cumulatively, these substances will become a layer of gas that covers the ozone layer and covers the heat from the earth so that it affects the temperature on the earth's surface. This is exacerbated by the destruction of the forest environment in various parts of the world which in fact is the main bio-engineer in converting carbon into oxygen (Ismail, 2020)

In the Greenhouse Gas Emission Reduction Program, the Government of the Republic of Indonesia through the Ministry of Environment appreciates the active participation of the community who have implemented climate change mitigation and adaptation measures in an integrated manner that they can support the national goal of reducing and increasing greenhouse gas emissions and increasing the community's adaptive capacity. Mitigation aims to reduce the input of greenhouse gas concentrations into emission sources and carbon sinks and adapt to the negative effects of climate change due to excess greenhouse gas concentrations (Kustiasih et al., 2017)). This understanding of GHG emission mitigation is important, it is intended that all parties have an understanding and willingness to participate in efforts to mitigate climate change.

2. Materials and Method

This research was conducted by quantitative research method. It is a research method that uses statistical analysis that leads to a meaningful data interpretation process (Creswell, 2014). In this study, the carbon footprint approach was used to calculate the amount of carbon dioxide (CO₂) produced by human activities related to energy consumption.

The research was conducted at Al-Irsyad Al Mubarak Islamic Boarding Schools located at Gajah District, Demak Regency. This Islamic boarding school received 70 students of Al Irsyad Islamic Senior High School (Madrasah Aliyah Al Irsyad) from its total 603 students to live-in the Islamic Boarding School (Maiga, 2022). Based on the information from the teachers and administrators of the Islamic boarding school, it is known that the 70 students are of men and women, who study, carry out activities and live in the boarding school dormitory separately. As students, they are bound by various regulations limiting the use of facilities that use electricity and fossil fuel.

By an assumption the 70 students follow the regulations in reducing the frequent use of motorcycle and choose to go to school every day for 1.5 km by walk, as well as reducing the access to electronic devices for six days a week, it can be simulated that students have the potential to reduce the GHG emissions. The research was conducted

by calculating the electrical energy (KWh) saved if the use of smartphone devices and television sets was reduced (by an assumption there are seven rooms equipped by a television per room). Calculation was also conducted for possible fossil fuel consumed by 70 motorcycles (by an assumption that each students ride a motorcycle). The Excel-data calculation on energy saving was then converted as CO₂ based on Carbon Footprint calculation formula according to IPCC standards as the following.

1. Carbon Conversion Formula from electrical energy

$$CO_2 = EC \times EF$$

EC : Energy Consumption for electricity (KWh)

EF : Emission Factor (equal to 0.84 for Java, Madura, and Bali islands' electricity) (Direktorat Jenderal Ketenagalistrikan Kementerian ESDM & Energi, 2018)

2. Carbon Conversion Formula from fossil fuel usage

$$CO_2 = FC \times EF$$

FC : Fuel Consumption (Liters/hour)

EF : Emission Factor (equal to 0.6 for Premium type of fuel sold all over Indonesia)

3. Result and Discussion

Madrasah Aliyah Al Irsyad is an upper secondary Islamic education institution under the Ministry of Religion of Indonesia managed by the "Islamic Foundation Al Irsyad Al Mubarak" Gajah sub-district, Demak Regency since January 10. 1982 by dr. H. Abdul Choliq MT, M. Ag by the help of several local figures. At the beginning of its establishment, Madrasah Aliyah Al Irsyad was a private Madrasah by a "registered" status based on the Decree of the Minister of Religion of the Republic of Indonesia Wk/5. d/90/Pgm/MA/1984 dated January 17, 1984.

Table 1. Number of students and classes of MA Al-Irsyad Gajah for the last 4 years

| School Year | Grade 10 | | | Grade 11 | | | Grade 12 | | | Total | | | | | | | |
|-------------|----------|-----|----|------------|----------------|------|----------|----|------------|----------------|------------|----------------|----|-----|---|-----|----|
| | MIPA | IPS | BB | Num Of Std | Num Of Classes | MIPA | IPS | BB | Num Of Std | Num Of Classes | Num Of Std | Num Of Classes | | | | | |
| 2018/2019 | 101 | 64 | 31 | 196 | 6 | 80 | 77 | 39 | 196 | 5 | 76 | 74 | 31 | 181 | 5 | 573 | 16 |
| 2019/2020 | 69 | 60 | 29 | 158 | 5 | 100 | 60 | 31 | 191 | 6 | 80 | 77 | 38 | 195 | 5 | 544 | 16 |
| 2020/2021 | 74 | 69 | 32 | 175 | 5 | 69 | 60 | 29 | 158 | 5 | 100 | 60 | 31 | 191 | 6 | 524 | 16 |
| 2021/2022 | 97 | 78 | 38 | 211 | 6 | 70 | 69 | 33 | 172 | 5 | 67 | 59 | 28 | 154 | 5 | 540 | 16 |

Since its establishment in 2007/2008 academic year until present, it has been opening three majors, namely the Natural Sciences, Social Sciences, and Language programs, equipped with laboratories, i.e., Physics laboratory, Chemistry laboratory, Biology laboratory, Language Learning laboratory, and Computer laboratory. The

program is expected to meet the demands which in line to the needs of an increasingly complex society. Equipped by the complete facilities to support its educational program, MA Al-Irsyad has succeeded in becoming a favorite high school (Maiga, 2022). This is indicated by the large number of students who study here (Table 1).

The Table 1 presents the number of MA Al-Irsyad students from the 2018/2019 school year to 2021/2022 which shows a high number of specializations, and it accepted more than 500 students. This is ensured by the latest data on the number of students of the academic year 2022/ 2023 which reached 603 students. In addition, MA Al-Irsyad also has a boarding school program (*Pondok Pesantren*) to further intensify religious education programs carried out in a dormitory or live-in system. Until the 2022/2023 academic year, including the Al-Irsyad Al-Mubarak Islamic Boarding School, it has had as many as 70 students who live and settle from the time they enter until they are declared to have passed MA-Al Irsyad. Al Mubarak Islamic Boarding School being a comfortable place for students of Madrasah Tsanawiyah (equal to junior high school) and MA Al Irsyad to study and deepen religious knowledge as well as learn to live in society to practice their knowledge. The school management was conducted in one integrated management (MA Al-Irsyad, 2020).

As with religion-based educational institutions, Al-Irsyad Al-Mubarak Islamic Boarding School applies a high discipline pattern for students with an intensive religious study schedule reinforced by regulations limiting the use of electronic facilities, motorcycle, to other facilities that generally can distract their time and attention to study. the students. With restrictions on the use of these facilities, it means that there will be savings in the use of energy needed to operate these facilities. The amount of the savings can be seen from the table of results of energy calculations and GHG carbon conversion as follows

Table 2. Carbon Conversion from Electrical Energy Consumption

| Unit | Volt | Ampere | Operating hours (Hours/day) | Number Of Units | WH | KWH | Emission Factor | CO2 emission kg/day |
|------------|------|--------|-----------------------------|-----------------|------|-------|-----------------|---------------------|
| Smartphone | 5 | 2.4 | 8 | 70 | 6720 | 6.72 | 0.726 | 4.87872 |
| TV | 12 | 5 | 8 | 7 | 3360 | 3.36 | 0.726 | 2.43936 |
| Total | | | | | | 10.08 | | 7.31808 |

The Table 2 presents the calculation of electrical energy consumption from electronic facilities in the form of smartphones and television sets which incidentally are one of the facilities that are restricted to be used at Al-Irsyad Al-Mubarak Islamic Boarding School and their conversion in the form of GHG emission carbon. The data shows that by not using smartphones and televisions, from the electricity consumption sector, live-in life at Al-Irsyad Al-Mubarak Islamic Boarding School has the potential to save electricity energy of 10.08 Kwh/Day, with the potential to withstand carbon wastage of 7.31808 CO₂ Kg/day.

The Table 3 indicates the calculation of fuel energy consumption from transportation facilities in the form of motorbikes with an average type of engine of 125 cc which incidentally is one of the facilities that are limited in use at Al-Irsyad Al-Mubarak Islamic Boarding School and their conversion in the form of GHG emission carbon. The data shows that by not using motorcycle, live-in at Al-Irsyad Al-Mubarak Islamic

Boarding School has the potential for fuel energy savings of 2.31 Liters/Day, along with the potential to withstand carbon wastage of 1.4 CO₂. Kg/day. From the calculation of the Table 3, it can be seen that the live-in at Al-Irsyad Al-Mubarak Islamic Boarding School, with restrictions on the use of electronic devices and motorcycles, has the potential for efficiency in carbon release as much as 8.71 kg CO₂/ day.

Table 3. Carbon conversion from energy consumption of Fossil fuel (BBM)

| Unit | Distance (Km) | Average Speed (Km/h) | Travel Time (hours) | Gasoline Consumption/hour (Liter/h) | Gasoline Consumption | Number of students/users of motorcycle | Total gasoline consumption/day | Emission Factor | CO ₂ Emissions (Kg/CO ₂) |
|------------|---------------|----------------------|-------------------------|-------------------------------------|----------------------|--|--------------------------------|-----------------|---|
| A | b | c | $[(b \cdot 2) / c] = d$ | e | $d/e = f$ | g | h | i | $h \cdot i = j$ |
| Motorcycle | 1.5 | 60 | 0.05 | 1.5 | 0.0333333 | 70 | 2.31 | 0.6 | 1.4 |
| Total | | | | | | | | | 1.4 |

Only few studies found similarities in terms of location and object in the form of Islamic boarding schools, previously. In addition, studies aiming to explain CO₂ carbon efficiency. Based on the searching process, a final assignment research was obtained entitled Analysis of the Quality of Carbon Monoxide (CO) and CO₂ Emissions Due to the Construction of the Miftahun Najah Islamic Boarding School, Tangkit Village, Sungai Gelam District, Muaro Jambi Regency. The research conducted by Muhamad Fadli from Batanghari University in 2022 explained the amount of Carbon (CO₂) emissions from the construction process of the Miftahun Najah Islamic Boarding School, Tangkit Village, Sungai Gelam District, Muaro Jambi Regency, which reached 593.0547 tons of CO₂-eq/year (Fadli, 2022). This result seems to be far beyond the efficiency of Al-Irsyad Al Mubarak Gajah Islamic Boarding School. However, it needs to be understood that the carbon emissions figure produced by Miftakhun Najah Islamic Boarding School is an unsustainable capture which only accounts for carbon emissions from the development process, while the efficiency of this study seems to be sustainable and indicating an accumulated value which is potential to increase every day and year.

In terms of efficiency comparisons, alternative comparisons are used in other research entitled "Potential for reducing greenhouse gas (GHG) emissions in on-line home learning activities: carbon footprint analysis" conducted by Ismail (2020). The results of the research (by universities as research object) showed that the efficiency of carbon dissipation by learning from home activity is 28.90454 kg CO₂/day (Ismail, 2020). Although the result shown by Islamic boarding schools is lower than that of universities, because the number of facilities used is certainly less than universities, at least the highlight is that there is same pattern in the form of efficiency. The contribution of Islamic boarding schools could show greater results if the research was carried out at large Islamic boarding schools by a larger number of students, even could reach tens of thousands of students.

Based on the explanation above, it can be said that energy savings which can also reduce the rate of GHG, such as those found in Al-Irsyad Al-Mubarak Islamic Boarding School, are proof that live-in-life at Islamic boarding schools also has the potential to make a significant contribution to climate change mitigation. These efforts can also

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